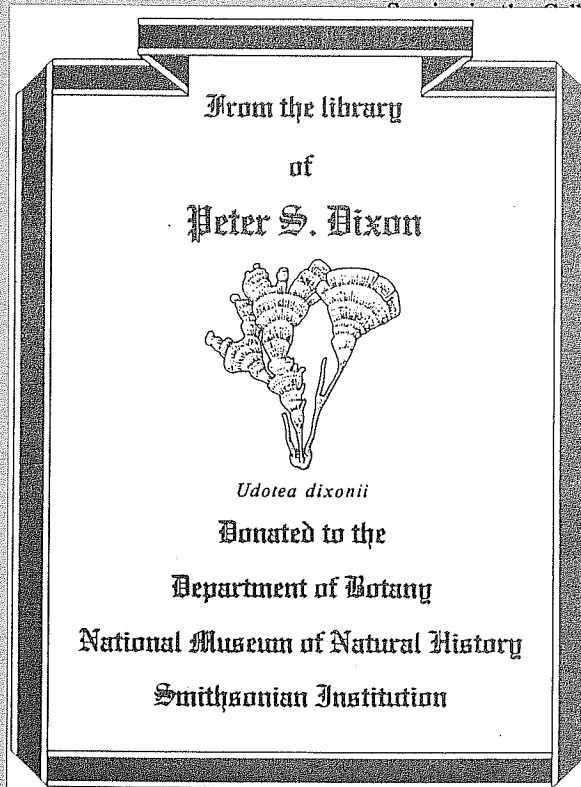


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XXIX

EXPEDITION OF THE CALIFORNIA ACADEMY
 OF SCIENCES TO THE GULF OF
 CALIFORNIA IN 1921*

THE MARINE ALGÆ

BY

WILLIAM ALBERT SETCHELL
 and
 NATHANIEL LYON GARDNER

INTRODUCTION

Very little is known about the marine algæ of the western coast of North America south of the boundary of the United States. These coast lines, viz., of Mexico, Guatemala, Salvador, Nicaragua, Costa Rica and Panama, extend from somewhat above 32° lat. N. down to about 5° lat. N., or about twenty-seven degrees of latitude, while east and west, they extend from 77° long. W. to 118° long. W., or almost forty-one degrees of longitude. Altogether these west coasts of Mexico and the Central American states form a considerable proportion of the coast line of Pacific North America. From this extensive coast line there are at present fewer than sixty

*A general account of the expedition accompanied by a map showing all of the islands, etc., visited by the expedition is to be found in vol. XII, No. 6, of the Proceedings of the California Academy of Sciences for June 2, 1923.
 A reprint of the map showing all of the islands, etc., visited by the expedition next to back cover of this paper.

May 13, 1924

species of marine algæ listed and where we might expect at least several hundred to occur.

Of the coast line of western North America south of the United States, the shores of the Gulf of California represent something more than a thousand miles and somewhere about forty species are listed from them (cf. Hariot, 1895 and M. A. Howe, 1911). From the Mexican coast, southward from the mouth of the Gulf of California, Liebmann, of Copenhagen, collected twelve species of marine algæ (cf. J. G. Agardh, 1847). M. A. Howe (1910) has remarked on the scantiness of the marine flora of the Bay of Panama where he found about fifty inconspicuous, mostly incrusting species and of which, as yet, he has not published any determinations. Of the islands off the coast, a few specimens have been collected on Guadalupe Island by Palmer and Brandegee, of which two species of Sargassaceæ have been described as new (cf. Grunow, 1915, p. 338, Gardner, 1913, p. 325, 1917, p. 386, and 1918, p. 448).

It is with the greatest interest, therefore, that we have undertaken the study of the comparatively large collection made by Mr. Ivan M. Johnston on the expedition of the California Academy of Sciences to the Gulf of California in the summer of 1921. In our study we have also included two other fairly extensive collections from the same region, viz.: one made in 1890 by T. S. Brandegee and Walter E. Bryant on the third expedition sent out by the California Academy of Sciences to explore Lower California, particularly the Cape region, and a collection made by Dr. and Mrs. Marchant in 1917. Among the specimens of these collections, we have detected one hundred and forty-four species and varieties, of which one hundred and eleven are, in our judgment, new to science. The Corallinaceæ and less conspicuous epiphytic forms remain for future study. These results are in line with the experience of Hariot and of Howe, each of whom, however, dealt with much smaller collections. Hariot (1895) describes three new species and lists four as referable to described species. Howe (1911), working over collections made chiefly at La Paz by G. J. Vives, and at San Felipe Bay (about five hundred miles north of La Paz) by D. T. MacDougal, describes seven new species, lists sixteen species as referable to described species,

and notes four species not to be determined beyond the genus. In these two lists of species there is no duplication. Howe, in his list, reports on a few species found in the herbarium of Dr. C. L. Anderson (of Santa Cruz, California) whose collectors were unknown to him. These were undoubtedly collected by the first or second expedition of the California Academy of Sciences and previous to 1890. It seems likely that there will be found to be an exceedingly rich marine flora in the Gulf of California when it shall have been carefully and thoroughly explored.

The subtropical flora of the southern California coast extends down to Magdalena Bay, or possibly somewhat to the south of it, but at San José del Cabo, the water is evidently warm enough (25° C. or over) to be considered tropical and this condition extends up the Gulf. The winter marine flora may be subtropical, however, at least in portions of the Gulf of California. The more exact relations of the algal flora to temperature and to salinity, as well as to substratum cannot be entered into with any certainty at present, since full data are not yet available.

The affinities of the marine flora of the Gulf of California are with that of the Eastern Pacific, i. e., with the subtropical and tropical coasts of Western America, which we know chiefly through Howe's Marine Algæ of Peru (1914) and our own publications (incomplete) for the western coast of North America. There is a wealth of species of *Codium*, of *Sargassum*, of *Laurencia*, of *Grateloupia*, of *Gracilaria* and of *Ceramium*. There is a noticeable, and we may infer, significant lack of species of *Halimeda* and other calcareous Siphonales, of species of *Liagora*, *Galaxaura* and calcareous reds, but the Corallinaceæ of our collections are not, as yet, identified.

We desire to express our indebtedness to Mr. T. S. Brandegee, to Dr. and Mrs. Marchant and to Mr. Ivan M. Johnston for collections of marine algæ, undertaken at request and in addition to other duties, and to Dr. Anna Weber-van Bosse and to Dr. Marshall A. Howe for critical notes. To the California Academy of Sciences, and, in particular, to Dr. Barton W. Evermann and to Miss Alice Eastwood, we are indebted for the privilege of carrying through these studies.

MYXOPHYCEÆ

Family CHROOCOCCACEÆ

CHLOROGLOEA WILLE, Algol. Not. I-VI, 1900, p. 5*Chlorogloea regularis* S. and G. sp. nov.

Plate 12, fig. 1

Plants forming cushions very definitely circular in outline, up to 200 μ in diameter and 30 μ thick in the center; cells in the basal layer spherical to subspherical in the center of the thallus, cylindrical at the ends of the radiating rows, 0.5-1 μ diam., marginal cells 2 times as long as broad; cells in the vertical rows spherical; the radiating basal filaments dichotomously branched; color pale blue-green.

Growing in abundance on *Cladophoropsis robusta*.

Type: No. 1316, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 135a), at Tortuga Island, Gulf of California.

In its method of development this species of *Chlorogloea* resembles the genus *Radaisia*. The colony or plant starts as a single cell, which divides a number of times in different vertical planes, soon establishing a number of growing points around the margin of a circular plate. From this margin radiating rows of cells, or that which amounts to filaments, develop, which by dichotomous branching build up a solid basal layer. The largest plant noticed measured 200 μ in diameter. The cells in the center of the basal disk soon begin to divide in horizontal planes and contiguous rows of cells up to 30 μ long are generated. In the genus *Radaisia* the terminal cells of these vertical rows of cells, or filaments, produce gonidia. The gonidia formation is absent in *Chlorogloea*.

Family CHAMÆSIPHONACEÆ

DERMOCARPA CROUAN, Notes sur Quelques Algues Marines Nouvelles, 1858, p. 70

Dermocarpa fucicola Saunders

A few colonies of a *Dermocarpa* which seem to be of this species have been observed intermixed with other species of Myxophyceæ as epiphytes on other algæ, notably upon *Graci-*

laria pachyderma. The general form and size correspond very well with the description and figures given by Saunders (1901, p. 397, pl. 46, figs. 4, 5). The plants do not form as large colonies as in typical material found along the coast of Washington and California. The length of the cells varies from 50 μ to 60 μ . We place it here pending further investigation of more typical material.

Dermocarpa Reinschii S. and G. sp. nov.

Plate 12, fig. 6

Cells epiphytic, narrowly to broadly pyriform, 18-24 μ long, 15-20 μ wide at the top, few to many forming colonies circular to irregular in outline; color steel blue; contents homogeneous; gonidia formed simultaneously, 1.5 μ diam.

Growing on various species of red algæ.

Type: No. 1317, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 34c), in June, at Tortuga Island, Gulf of California.

Dermocarpa Reinschii approximates very closely to *D. prasina* (Reinsch) Born. & Thur. The shape and size of the colonies do not agree entirely with the description and figures given by Bornet and Thuret (cf. Notes Algol., p. 76, pl. 26, figs. 6-9). This is particularly true of the shapes of the gonidangia and the arrangement of the gonidia. We have examined the material of Howe's *D. prasina* growing on *Chaetomorpha cartilaginea* from Peru (Howe, Mar. Alg. Peru, p. 16). The colonies of this material are thicker and more extensive and there is a much greater polymorphism in the shapes of the cells. The cells in his material are very commonly "trumpet shaped." Ours do not show such variations. The type of *Sphaenosiphon prasinus* Reinsch (Contrib. Alg. et Fung., p. 17, pl. 26, fig. 1) is probably not available and since the interpretations of Reinsch's conception of the species have been so varied and our plant differs so decidedly in dimension from all of them, we hardly feel justified in adopting the name of *D. prasina* for our material from the Gulf of California.

Dermocarpa Marchantæ S. and G. sp. nov.

Plate 12, fig. 12

Cells aggregated into relatively extensive colonies, at times several hundred, densely crowded, cuneate to balloon-shaped, 18-22 μ long, 9-12 μ broad at outer end; gonidia few, 2-2.5 μ in diam.

Growing on various species of algæ. Santa Rosalia, Lower California, opposite Guaymas. Type, Marchant, no. 108, May.

Only a very few specimens of this species of *Dermocarpa* have been observed producing gonidia. The gonidangia of these are no longer than the other larger cells. It is presumed that they are just coming into fruit. Little can be said of the method of formation of the gonidia on account of scarcity of material.

Dermocarpa sp.

Plate 12, fig. 11

There is a species of *Dermocarpa* which seems to be widely distributed along western Mexican borders. It is very generally present on various species of Dictyotaceæ in particular, as well as on a variety of other algæ. Figure 11 represents specimens growing on *Dictyota* sp. (Johnston, no. 5a). The rather uniformly cylindrical character of the cells and their wide expansion in a continuous stratum indicate that it is distinct from any known species, but since no specimens out of the many which we have observed have been found producing gonidia, we feel that it is too immature for us to attempt to diagnose and name it. The cells in the present state are 12-15 μ long. The only described species to which it at all approximates is *D. strangulata* Sauv. (1895, p. 8 (Repr.), pl. 7, fig. 4), which quite likely also represents an immature species. It is possibly only a young state of *D. Marchantæ*.

XENOCOCCUS THURET, Essai Class. Nost., 1875, p. 373 (*Nom. nud.*);
Bornet and Thuret, Notes Alg. 2, 1880, p. 73 (descr. of type).

Xenococcus deformans S. and G. sp. nov.

Plate 12, fig. 2 and plate 40, fig. a

Plants embedded in the cuticle of the host, 75-150 in a colony, dividing in two planes only; cells spherical to slightly pyriform, 10-14 μ long, 9-12 μ broad; contents homogeneous; color bright blue-green.

Growing in *Gelidium Johnstonii*.

Type: No. 1318, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 13a), in June, at San Francisquito Bay, Lower California.

This species of Myxophyceæ is the only representative of the genus *Xenococcus* which has been reported growing endophytically. Our attention was called to it by the peculiar effect it produces on the host. It was noticed that many specimens of the *Gelidium* had branches densely proliferating near or at their outer ends (Plate 40, fig. a). These short, densely crowded outgrowths proved to be infested by this species of Myxophyceæ. No gonidangia are present in our material, hence the generic position will have to stand in doubt for the present. Some of the cells are much larger than others, indicating preparation for gonidia formation. Its division in two planes only, excludes all other Chamæsiphonaceæ. It does not resemble very closely any of the known Coccogonales.

Family OSCILLATORIACEÆ

HYDROCOLEUM KUETZING, Phyc. Gen., 1843, p. 196.

Hydrocoleum codicola S. and G. sp. nov.

Plate 12, fig. 3

Filaments associated more or less into loose rope-like colonies interwoven among the utricleles of the host; sheath very delicate and hyaline, containing few to many trichomes; trichomes cylindrical or at times slightly tapering at the

apices, pale blue-green, $2.75-3.25\ \mu$ diam.; cells not constricted at the dissepiments, 0.5-1.5 times as long as the diameter, the terminal cells somewhat enlarged and rounded with decidedly thickened end walls.

Penetrating among the utricles of *Codium* sp., in the upper sublittoral belt.

Type: No. 1319, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 8a), in June, at **San Marcos Island, Gulf of California.**

The habitat of this species of *Hydrocoleum* is decidedly unusual and the trichomes are the narrowest yet described for the genus. The genus typically has few and relatively large trichomes. It is difficult to distinguish the largest colonies from certain species of *Phormidium* but the smaller colonies are definitely bound together in a single sheath. The trichomes, however, are not densely intertwined like those of *Microcoleus*. It seems generally prevalent on various species of smaller *Codiums* in the Gulf.

Family RIVULARIACEÆ

CALOTHRIX AGARDH, Syst. Alg., 1824, p. XXIV

Calothrix nodulosa S. and G. sp. nov.

Plate 12, figs. 9, 10

Plants gregarious, loosely associated into small, stellate fascicles, $350-450\ \mu$ high; filaments decumbent at the base, the free end soon becoming erect, $28-32\ \mu$ diam., subcylindrical, tapering rather abruptly at the apices to blunt ends, not distinctly bulbous at the bases; sheath $3-4.5\ \mu$ diam., hyaline, homogeneous, closed for some time but later dissolving at the apex, becoming funnel-shaped above the middle where the trichome becomes constricted, eventually dies and the end breaks through to form a false branch; trichome aerugineous, $20-24\ \mu$ diam., very blunt at the apex, not terminating in a hair, cells $2-2.5\ \mu$ long, protoplast homogeneous, cross walls very inconspicuous; heterocysts 1-4, basal, variously shaped.

Forming microscopic fascicles on various species of *Laurencia*.

Type: No. 1320, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 9e), in June at **San Marcos Island, Gulf of California.**

This species appears to be most closely related to *C. consociata* (Kuetz.) Bornet et Flah., in habit and size, of all the described species, but differs in several minor details, particularly in not having the trichomes so long-attenuated and in the character of the sheath, which is much thinner, hyaline, and very delicately striate.

A pronounced character of the species is the constriction of the trichome in advance of the formation of intercalary heterocysts and the resulting hormogonia and false branching. This constricted appearance seems to be formed by the re-establishment of rapid growth at the attenuated apex of the trichome suddenly enlarging it at that point while the attenuated portion remains unchanged and finally dies, separating the trichome at that place. This character is not well shown in the illustration, plate 12, fig. 10.

Calothrix nidulans S. and G. sp. nov.

Plate 12, fig. 7

Plants epiphytic or slightly embedded in the gelatinous covering of the host, procumbent, $40-60\ \mu$ long, $10-12\ \mu$ diam. at the very much swollen base, much diminished above, not branched; sheath very delicate, hyaline and homogeneous; trichome dull æruginous, $9-11\ \mu$ diam. at the enlarged base, constricted at the dissepiments below, cross walls inconspicuous above; heterocysts basal, single, considerably flattened.

Growing on a fragment of a young filamentous brown alga, possibly *Liebmannia*. Locality not noted.

Type: No. 1321, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 162), locality not noted.

This species is very close to *Calothrix parasitica* (Chauv.) Thuret, but differs in being much smaller in all of its dimensions and in not having hairs. The base is very decidedly bulbous and the three or four basal cells are very prominent and constricted at the dissepiments.

CHLOROPHYCEÆ

Family CAULERPACEÆ

CAULERPA LAMOUROUX, Mem. Caulerpes, 1809, p. 141*Caulerpa Vanbosseæ* S. and G. sp. nov.

Plate 13, figs. 13-15

Plants forming dense pulvinate masses 1.5-2 cm. thick, attached by delicate branched hyaline rhizoids; erect fronds irregularly and alternately (occasionally opposite) branched, more or less irregular, cylindrical; terminal ramuli slightly clavate; main fronds and ramuli 400-500 μ diam.; trabeculæ of numerous, delicate, much branched, cylindrical threads intertwined in the center of the filament; reproduction unknown.

Habitat unknown. Vicinity of La Paz. Type, Bryant, no. 1.

The plants on which we base our diagnosis seem most closely related to *Caulerpa fastigiata* Mont., both as regards habit and general structure, but they show, when boiled with potash solution, small papilliform projections from the inner surface of the walls. According to Correns (1894), who discovered such structures among the species of *Caulerpa*, these are wanting in *C. fastigiata* Mont. Through the kindness of Dr. Anna Weber-van Bosse, we have been able to study specimens of *C. fastigiata* sent by Montagne to Kuetzing. These cotypes show low but distinct papillæ and simple trabeculæ as well as more slender (180-220 μ) and less rigid filaments than *C. Vanbosseæ*. Our species, therefore, belongs to the section of *Vaucherioideæ* and is closely related to, but distinct from, *C. fastigiata* Mont.

Family CODIACEÆ

HALIMEDA LAMOUROUX, Class. Polypes, 1812, p. 186*Halimeda discoidea* Decne.

Marchant, no. 7, and Bryant, no. 2, La Paz. This species is apparently rather limited in distribution. Howe (1911, p. 492) reported it collected by Vives in the same locality.

CODIUM STACKHOUSE, Nereis Brit, 1797, p. XVI

In treating the genus *Codium* in this account, we have felt compelled to propose several new species, at the same time feeling that the treatment must be more or less tentative on account of lack of adequate material for comparison and especially on account of the paucity of material and the lack of suitable field notes from the region covered. Observations on the effect of age and habitat upon the structure of the various parts of the plant, especially the size and thickening of the end walls of the utricles, is highly desirable. We have endeavored to give as complete an account in descriptions, photographs, and drawings as the material at hand will warrant, awaiting more abundant material and further investigation to completely establish the validity of the species here proposed.

Codium tomentosum (Huds.) Stackh.

Plate 16, figs. 38, 39

In rendering our account of the Chlorophyceæ in the Marine Algæ of the Pacific Coast of North America (1920), we included *C. tomentosum* from La Paz, Mexico, rather on the authority of Howe (1911, p. 493), at the same time expressing some doubt as to the occurrence of typical material of this species within the range covered by our account. We are not now aware whether the type material of *C. tomentosum* is available to anyone, but during our present study we have examined the material of this species distributed by Le Jolis from Cherbourg in *Algues Marines de Cherbourg*, No. 204, of W. A. Setchell's copy. We are taking the view that this distribution, which was collected across the English Channel from the type locality of the species, viz., Exmouth in Devon, is likely to be as nearly typical as any which has yet been reported under this name. We have figured the utricles of this distribution in plate 16, figs. 38, 39, and with this material as the basis for our judgment we are still more convinced after a careful study of our material that it should not be included in the flora on the Pacific Coast of North America.

Otto C. Schmidt (1923), although excluding the West Indian forms still retains plants from many parts of the world under this species.

***Codium simulans* S. and G. sp. nov.**

Plate 14, figs. 21, 22 and plate 31

Fronds up to 13 cm. high, 3-4 mm. diam., cylindrical, slightly flattened at the forkings and cuneate below; branching dichotomous throughout; utricles subcylindrical to clavate, 600-700 μ long, up to 200 μ diam. at the outer ends, which are rounded and somewhat flattened, never fornicate; terminal wall thickened, up to 50 μ thick, hairs 2 to several in a whorl, attached just below the thickened terminal wall; gametangia blunt, narrowly to broadly conical, tapering abruptly at the base, up to 250 μ long and 100 μ broad.

Growing on rocks in the upper sublittoral belt, San Marcos Island.

Type: No. 1322, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 8), in June, at **San Marcos Island, Gulf of California.**

Codium simulans approximates to *Codium tomentosum* more nearly than any of the other collections from the Gulf, as we interpret that species. The fronds of *C. simulans* are smaller, the dichotomies are slightly flattened and cuneate below, and the utricles have much thicker end walls than in *C. tomentosum*, and the hairs are at the uppermost portions of the lateral wall of the utricle. Howe's specimens of *C. tomentosum* are young, but seem to belong under *C. simulans* (cf. Howe, 1911, p. 493).

***Codium conjunctum* S. and G. sp. nov.**

Plate 15, figs. 32, 33, and plate 32, fig. a

Thallus 2-5 cm. high, 2-2.5 mm. diam., attached by a relatively small holdfast, cylindrical above, somewhat flattened and profusely anastomosing at the base, branching dichotomous to sub-dichotomous above; utricles cylindrical, clavate to pestle-shaped, truncate to slightly round and smooth at the outer end, 400-500 μ long, up to 200 μ wide at the outer

end, terminal wall thickened, up to 20 μ thick; gametangia (?) broadly fusiform, 180-240 μ long, 60-70 μ , up to 100 μ broad, not extending beyond the utricles.

Growing on rocks in the upper sublittoral belt.

Type: No. 1323, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 16), in June, at **Tortuga Island, Gulf of California.**

This species is to be distinguished by its small size, its relatively short utricles and especially by the profuse anastomosing of the fronds at the base. In this way small dense cushions are built up about a centimeter thick in which the fronds extend outwards more or less laterally. It is fruiting profusely and it is assumed to be nearing its maximum development.

***Codium reductum* S. and G. sp. nov.**

Plate 14, figs. 23, 24 and plate 33

Thallus 15 cm. high, decidedly flattened towards the base, nearly cylindrical at the apices, dichotomously branched, gradually reduced in width from the base to the extremities; segments between the forkings cuneate; utricles narrowly to broadly clavate, rounded and smooth or blunt-conical at the apices, sometimes branching, 600-800 μ , up to 1250 μ long, up to 250 μ broad, terminal wall of utricle up to 30 μ thick, finely laminated, frequently umbonate; hairs numerous, attached very close to the ends of the utricles; gametangia (?) narrowly fusiform, 180-210 μ , at times up to 440 μ long, 60-90 μ broad.

Growing on rocks in the lower littoral belt.

Type: No. 1324, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 42), in June, at **Angeles Bay, Lower California.**

In this species of *Codium*, as well as in many others, there is a marked variation in the size and shape of the utricles. A sort of dimorphism seems to exist regarding their size. There is a typical size and form, possessed of a liberal range of variation, and interspersed among these there is a much smaller number of very decidedly large specimens always

having much thinner end walls than the typical forms. The significance of this large type has not been interpreted. They bear gametangia (?) and are present in practically all of the species reported here.

Codium cuneatum S. and G. sp. nov.

Plate 16, figs. 34, 35 and plate 34

Thallus decidedly flabellate, attached by a relatively small spongy disk, 12-16 cm. high, branching very close to the base, regularly dichotomous, distinctly flattened, especially immediately below the forking, angles rounded; segments between the forkings broadly cuneate, up to 2 cm. wide below the forking, terminal branches numerous, much reduced; utricles 0.5-1 mm. long, 200-250 μ diam., large type up to 450 μ diam. at the outer end; side wall 2-3 μ thick, end wall 8-12 μ thick; hairs short, attached near the outer end of the utricles; sporangia sub-fusiform, widest below the center, 200-260 μ long, 90-110 μ wide; often extending beyond the utricle.

Growing on rocks in the upper sublittoral belt.

Type: No. 1325, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 47), in July, at Smith Island, Gulf of California.

The gross morphological features of this species, which distinguish it from all other known species, are the regularly dichotomous branching, the flattened and flabellate character of the frond, and the broadly cuneate segments between the forkings. These combined with the characters of the utricles and the gametangia are decidedly sufficient in our judgment to render this one of the most distinct of all the species of *Codium*.

The fronds are small at the base and the forking begins very close to the base. The specimens at hand are in full fruit and presumably are very near to maturity. They are forked about ten times. At each forking the frond widens rather decidedly and rapidly, reaching its greatest width at about the seventh forking, after which it is reduced very rapidly to the small apices only 2-4 mm. wide.

Its nearest relative would seem to be *C. Lindenbergii* Binder (in Kuetz., Tab. Phyc., vol. 6, pl. 97), but as described and figured, that species has longer and less cuneate segments and decidedly long and attenuated apices. Also the utricles as figured differ in shape from ours and are not represented as having thickened end walls.

Codium amplivesiculatum S. and G. sp. nov.

Plate 15, figs. 28, 29 and plate 35

Thallus cylindrical, somewhat flattened at the forking, 5-6 dm. high, main branches 6-9 mm. diam. in widest part, tapering slightly towards the base, terminal ramuli 1-2 mm. diam.; branching profuse, regularly dichotomous; branches gradually and much reduced in diameter upward; utricles 1.4-1.8 mm. long, of two kinds, the typical, 350-550 μ diam. at the outer ends and the rarer, up to 1 mm. diam. at the outer end, clavate, enlarging gradually upward; walls thin, 1.5-2 μ on the sides, 3-4 times as thick at the ends; hairs inserted near the outer end of the utricle; gametangia (?) fusiform, 350-400 μ long, 90-120 μ broad.

Specimens found floating.

Type: No. 1326, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 74), in July, near south end of Angel de la Guarda, Gulf of California.

This species of *Codium*, according to the report by Mr. Johnston, is quite plentiful in the above mentioned locality. It was found growing in abundance and many specimens were floating in the bay. Only two complete specimens were collected. It seems to be very loosely attached by a small holdfast. A very striking feature of the gross morphology is the very gradual attenuation of the fronds upward, the widest part being at the base.

It is probably to be considered a near relative of *C. decortiatum* (Woodw.) Howe (Phyc. Studies, V., p. 494), who determined a specimen of the Vives Collection from La Paz and sets forth his reasons in full for changing the combination. Our plants are larger and have much larger utricles and

the dichotomies are up to twelve, thus producing a very large number of slender branches.

The characters of the utricles are almost identical with those of *Codium longiramosum* of this paper.

***Codium unilaterale* S. and G. sp. nov.**

Plate 15, figs. 30, 31 and plate 36

Thallus cylindrical to somewhat irregular, 20 cm. high, 3-4 mm. diam. at the base, enlarging slightly upwards, subterminal segments widest, dichotomous to sub-distichous, branching very close to the base, angles narrow; utricles nearly cylindrical to narrowly clavate, smooth and rounded to slightly conical at the outer ends, 700-900 μ long, 200-250 μ , up to 400 μ , broad; hairs sparse, attached very close to the outer end of the utricles; gametangia (?) sub-fusiform, widest below the center, attached above the center of the utricles, often projecting beyond them, 225-270 μ long, 90-120 μ broad.

Growing on rocks in the upper sublittoral belt.

Type: No. 1327, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 74a), in July at Pond Island, near south end of Angel de la Guarda, Gulf of California.

One of the very striking characters of *Codium unilaterale* is the very unequal growth of one of the branches arising at the apex by an apparent equal splitting at the growing region. This method is prevalent throughout the plant and results in several main shoots with the branches all on one side, since with few exceptions it is the branch arising on the same side as the preceding branch which is reduced in growth.

***Codium longiramosum* S. and G. sp. nov.**

Plate 15, fig. 27 and plate 37

Thallus cylindrical throughout, 4 dm. high, 5-8 mm. diam., tapering decidedly towards the base to a small short stipe and only slightly towards the apices; branching dichotomous, mostly near the base, moderately sparse; utricles of two forms, the typical, with smaller dimensions, narrowly clavate to

slightly pestle-shaped, and the larger, fewer, up to 1.2 mm. diam., broadly clavate, interspersed among the typical, 1-1.8 mm. long, convex and smooth at the apices, with apical walls 8-14 μ thick; gametangia and zoosporangia unknown.

Type: No. 1328, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 74b), in July, floating in Rattlesnake Harbor, Pond Island, Gulf of California.

Codium longiramosum is to be distinguished from all other known species by its sparse dichotomous branching, taking place mostly near the base, its long straight cylindrical branches slightly attenuated toward the apices and decidedly so at the base, along with certain microscopic characters. The utricles are relatively very large, especially one type, which is not very abundant. The side walls are very thin and the end walls as compared with the size of the utricles and with most species are likewise thin. Unfortunately we have but a single specimen and it is sterile. The characters of the utricles are almost identical with those of *Codium reductum*, of this paper, with which it was found floating.

***Codium anastomosans* S. and G. sp. nov.**

Plate 16, figs. 36, 37

Thallus about 4 cm. long, 3-5 mm. diam., cylindrical, profusely anastomosing at the base, more or less spread out laterally, attached in the center by a disk-shaped holdfast and more or less by rhizoids along the prostrate fronds; branching sub-dichotomous; typical utricles narrowly clavate, at times branching, 45-70 μ diam., an occasional large thin-walled specimen, reaching 290 μ diam.; apices mostly blunt conical, capped with a thick, hyaline, laminated cell wall, 35-50 μ thick, a few specimens up to 70 μ thick; gametangia unknown.

Growing on rocks.

Type: No. 1329, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 84e), in June, at Angel de la Guarda, Puerto Refugia Rocks, Gulf of California.

This species of *Codium* combines characters of several species apparently, which seem to be very closely related, and

possibly overlap each other. The profuse anastomosing of the fronds, spreading out laterally, forming more or less of a cushion, are characters slightly represented in *Codium cervicorne* and highly developed in *Codium conjunctum*. In thickness of frond and general method of branching it resembles *C. cervicorne*. The small size, the rounded to blunt-conical apices, and the decidedly thick end walls of the utricles are a combination of characters not found in any other species. Unfortunately we have but a single sterile specimen upon which to base the species, but its morphological characters seem too distinct not to warrant its being placed in a separate species, awaiting further investigation to establish well its entity.

Codium Brandegeei S. and G. sp. nov.

Plate 14, figs. 25, 26 and plate 30

Thallus 10-12 cm. high, cylindrical to slightly flattened, tapering gradually from the base upwards, terminal segments 2-3.5mm. diam., branching dichotomous; hairs 2-3 in a whorl near the top of the utricles; utricles 750-850 μ long, variable in diameter, 50-200 μ at widest part, narrowly clavate, apices rounded to subconical, terminal wall 30-45 μ up to 60 μ thick, frequently umbonate; gametangia (?) mostly narrowly fusiform, 240-280 μ long, 70-90 μ broad.

Habitat unknown. La Paz (?). Type, Brandegee, no. 28.

We have but a single specimen upon which to base this species. It was collected by T. S. Brandegee many years ago and probably at La Paz. It seems most closely related to *C. simulans* of this paper.

Codium cervicorne S. and G. sp. nov.

Plate 14, figs. 19, 20 and plate 32 b

Thallus cylindrical throughout, 4-6 cm. high, 3-5 mm. diam., attached by a relatively large spongy holdfast, several erect fronds arising from the same holdfast; branching sub-dichotomous, becoming almost unilateral towards the outer ends, angles wide and rounded; utricles 500-600 μ long,

75-225 μ in widest part, varying from narrowly cylindrical forms with end walls thickened up to 40 μ and more or less conical, to broadly clavate forms with end wall only slightly thickened and convex; gametangia (?) narrow-fusiform, 190-220 μ , at times up to 300 μ , long, 40-60 μ broad.

Cast ashore at Eureka, near La Paz, Lower California. Type, Marchant, no. 8, May.

Among the specimens of our collections of *Codiums* from the Gulf of California appear a few which although resembling *C. conjunctum* very closely as to form, are of a distinct species. It is to be distinguished from *C. conjunctum* in being a larger plant in all measurements, in having fewer branches, which are sub-dichotomous and almost unilateral, in having wider, rounder angles, and in having larger utricles and gametangia. There is a slight anastomosing of the fronds at the base, a character which is very prominent in *C. conjunctum*. The character of the branching reminds one of antlers of an elk.

Family CLADOPHORACEÆ

CHÆTOMORPHA KUETZING, Phyc. Germ., 1845, p. 203

Chætomorpha antennina (Bory) Kuetz.

Collected at Mazatlan, Mexico. Marchant, no. 100.

Kuetzing, sp. Alg. 1849, p. 379; Setchell and Gardner, Chlorophyceæ, 1920, p. 203. *Conferva antennina* Bory, Voy. quatre Îles d'Afr., vol. 2, 1804, p. 161. *Chætomorpha pacifica* Kuetzing, Sp. Alg. 1849, p. 379.

The cell walls of this collection, which seems to be thoroughly mature, are very thick, 60 μ above and up to 100 μ below.

CLADOPHORA KUETZING, Phyc. Gen., 1843, p. 262

Cladophora hesperia S. and G. sp. nov.

Plate 13, fig. 17

Fronds forming dense, thin mats on the substratum, profusely branched; di-trichotomous; main branches nearly uniform in diameter throughout, tapering only at the apices;

ramuli of different orders reduced in diameter at each forking and all tapering gradually to blunt apices; main filaments 190-230 μ diam., ultimate ramuli 25-40 μ diam.; main branches relatively strict, ramuli widely divaricate; segments slightly constricted at the dissepiments, 2-4 times as long as the diameter in the ramuli, up to 1 mm. long in the main filaments.

Growing in a muddy habitat, at the southern extremity of Lower California. Type, Brandegee, no. 21.

No data are available as to the habitat or the exact locality of this species of *Cladophora* nor the time of the year it was collected. The locality is undoubtedly along the coast of the southern extremity of Lower California, where Mr. Brandegee collected many flowering plants. Only a single mount was preserved, consisting of a mat of material about three inches square. There are a few fronds of a small *Enteromorpha* mixed with it, and the mass is quite muddy, indicating that the probable habitat is a mud-flat. There is no indication available as to the nature of attaching portions. The chromatophores, difficult to interpret in old dried material, occupy the periphery of the whole segment, both ends and sides, forming a thin stratum seemingly composed of closely crowded fine disks. The branching is very profuse, especially the ramuli of the fourth to sixth orders which extend in all directions and arise at almost right angles with the parent branch. The species is especially characterized by its profuse, short, divaricate and subulate ramuli.

CLADOPHOROPSIS BÖRGESEN, Cont. Conn. du genre *Siphonocladus*, 1905, p. 259

Cladophoropsis robusta S. and G. sp. nov.

Plate 13, fig. 16

Fronds forming extensive dense tufts, 3-3.5 cm. high, attached by numerous branching rhizoidal filaments; erect filaments nearly cylindrical throughout, up to 1100 μ diam., sparsely forked at the base and bearing a few short lateral branches near the apex; segments very long except in the region of branches.

Growing on rocks in the upper sublittoral belt.

Type: No. 1330, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 135), in June, at Tortuga Island, Gulf of California.

This species may readily be distinguished from all other known species of *Cladophoropsis* by the large diameter and by the great length of the segments between the branches.

Family ULVACEÆ

ENTEROMORPHA LINK, Epistola, 1820, p. 5

Among the collections of *Enteromorpha* from the Gulf of California at our disposal, we have identified four different known species, all of which, as far as we are able to ascertain, are new to the Gulf, and one species new to science. Doubtless others exist but have escaped collectors' notice.

Enteromorpha acanthophora Kuetz.

Plate 16, fig. 43 and plate 38

Cast ashore at Guaymas, Marchant, no. 1, May. On rocks in the lower littoral belt, Johnston, no. 39, June. La Paz (?) Brandegee, No. 29.

These specimens agree very well in habit with Kuetzing's figure of this species, Tab. Phyc., vol. 6, pl. 34. The specimens collected by Brandegee are probably older and do not seem quite typical in this stage of its life history. The plant figured (loc. cit.) is of a specimen of Johnston's collection, no. 39, June.

Enteromorpha prolifera (Muell.) J. Ag.

Cast ashore at Guaymas, Mexico, Marchant No. 4, May.

Marchant's material appears to be quite typical of this species, as understood and figured by Kuetzing, Tab. Phyc., vol. 6, pl. 30, and by J. G. Agardh, Till. Alg. Syst., part 3, p. 129, pl. 4, figs. 103, 104.

Enteromorpha tubulosa Kuetz.

Cast ashore at La Paz, Lower California. Johnston, no. 49, April.

Kuetzing, Tab. Phyc., vol. 6, pl. 32, fig. 2.

The material of this species is rather sparse and seems not to be typical. It is sparingly branched above. The membrane is 34-40 μ thick, and the cells are 14-18 μ diameter, as seen from above. It does not agree completely with either *E. tubulosa* or *E. prolifera*, both of which it resembles, but is seemingly closer to the former, where we are placing it.

Enteromorpha compressa (L.) Grev.

Guaymas, Mexico, Brandegee no. 7, and La Paz, Lower California, Brandegee, no. 17.

Greville, Alg. Brit., 1830, p. 180, pl. 18. *Ulva compressa* Linnæus, Fl. Suec., Ed. II, 1755, p. 433.

As we understand this species (cf. Setchell and Gardner, 1920, p. 251, 252), the material cited here is fairly typical.

Enteromorpha Marchantæ S. and G. sp. nov.

Plate 16, figs. 40-42

Fronds 4-7 cm. high, up to 1 cm. wide in widest parts, tubular, more or less bullate, clavate, tapering below to a delicate stipe, simple or with a few branches like the main frond and with delicate proliferations on the stipe; cells in the smooth parts arranged more or less in longitudinal and in cross rows, mostly square in surface view, 16-22 μ diam., membrane 24-27 μ thick; cell walls 2.5-3.5 μ thick, not thickened on the inside; chromatophore not filling the cell, mostly in the outer end of the cell.

Cast ashore at La Paz, Lower California. Type, Marchant, no. 3, May.

In form this species seems most closely related to forma *clavata* of *E. intestinalis*. It differs from all of the forms of *E. intestinalis* in having a thin wall on all sides of the cell, in having the cells arranged more or less in longitudinal rows, and in having the cells nearly cubical. The specimens are very much smaller than typical *f. clavata*.

ULVA LINNÆUS, Gen. Plant., 1737, p. 326

In this account we have listed three species of *Ulva*, viz., *U. dactylifera* S. and G., *U. lactuca* L., and *U. rigida* Ag. Howe (1911, p. 490) reported *U. fasciata* Delile from La Paz and *U. lactuca rigida* (Ag.) Le Jolis from San Felipe Bay. We have not seen the material of these last two species but raise the question here whether the former may not be our *U. dactylifera* (S. and G., 1920, p. 272) and the latter one of the other species cited above.

Ulva dactylifera S. and G.

Growing on rocks in the upper sublittoral belt, San Marcos Island, Gulf of California, Johnston, no. 11a, June; Tortuga Island, Gulf of California, Johnston, no. 31, June; La Paz, Lower California, Brandegee, nos. 9 and 30; Eureka, near La Paz, Marchant, no. 5, May.

Setchell and Gardner, Phyc. Cont. I, 1920a, p. 285, pl. 26, fig. 1, Chlorophyceæ, 1920, p. 272, pl. 21, fig. 1.

As a rule the specimens from the Gulf have a more ample base and shorter "streamers," otherwise they approximate very closely the California plants.

Ulva rigida Ag.

Cast ashore, La Paz, Lower California. Marchant, no. 6, May.

Agardh, Sp. Alg., vol. 1, part 2, 1822, p. 410; Setchell and Gardner, Chlorophyceæ, 1920, p. 270.

We have three well preserved specimens of this species. All of them are somewhat smaller than the average size for this species. Structurally they seem typical of the species as we understand it.

Ulva lactuca L.

Growing on rocks in the lower littoral belt. Los Angeles Bay, Lower California, Johnston no. 40, June; Guaymas, Mexico, Johnston, no. 63, April.

Linnæus, Sp. Plant., vol. 2, 1753, p. 1163 (in part); Setchell and Gardner, Chlorophyceæ, 1920, p. 265.

Family CHÆTOPHORACEÆ

ENTOCLADIA REINKE, Zwei par. Algen, 1879, p. 476; Setchell and Gardner, Chlorophyceæ, 1920, p. 288

Entocladia condensata S. and G. sp. nov.

Plate 12, figs. 4, 5

Plants forming a disk of compact cells in the center, with a few short filaments extending outwards from the margin; cells in the center of the thallus 12-16 μ in surface view, angular; marginal filaments 7-9 μ diam.

Growing in the terminal membrane of the utricles of various species of *Codium*.

Type: No. 1331, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 26), in June, at San Francisquito Bay, Lower California.

E. condensata is quite similar to *E. codicola* S. and G., growing in the utricles of *C. fragile* (Suring) Hariot, on the coast of California, but the cells are much larger throughout and the whole plant is more condensed. It is apparently quite widely distributed on a number of different species of *Codium* in the gulf.

Entocladia Polysiphoniæ S. and G. sp. nov.

Plate 13, fig. 18

Filaments distinct, very crooked, irregularly and much branched, branches often at right angles, arising from the middle of the cell, not coalescing in the center of the thallus to form a disk; cells very variable in shape and size, 4-9 μ diam., 3-6 times as long as the diameter; chromatophores parietal, pyrenoid single; zoosporangia (?) intercalary; formed from vegetative cells at irregular intervals in the filaments, numerous, up to 24 μ diam.; thallus up to 1 mm. diam.

Growing in the membrane of *Polysiphonia Marchantæ*. Guaymas, Mexico, Marchant, no. 50b, May; La Paz, Lower California, Bryant, no. 7a. *Type*, Marchant, no. 50b.

In a previous work (Chlorophyceæ, 1920, p. 289, 290) we discussed briefly the genus *Entocladia*, setting forth our con-

ceptions of it, and expressed our difficulties in arriving at a complete and satisfactory arrangement of our Pacific Coast forms, owing to incomplete life histories of the organisms. We are compelled to acknowledge that the same difficulties stand in the way of disposing of these Mexican forms. Notwithstanding the presence of well developed sporangia (?) or gametangia (?) with completely formed reproductive cells within them, we are unable to say whether the reproduction is asexual or sexual, or whether the reproductive cells have two or four cilia, important matters in establishing relationships. All of our species thus far located on the Pacific Coast of North America are endophytic. They branch more or less abundantly, have a single parietal chromatophore and one pyrenoid.

We have in the three species, here newly proposed, apparently represented the extremes of variation in the matter of the formation of the thallus. In *E. condensata* the whole plant is practically a solid parenchymatous disk, with only a few peripheral short free filaments. In *E. Polysiphoniæ* there is no indication of a central parenchymatous disk. The filaments are all free, more or less crooked and distorted, and the branching is alternate or at times secund, usually arising from the center of the cells. Between these two extremes we have *E. codicola* S. and G. with a slight central disk, *E. mexicana* of this paper, and *E. cingens* S. and G. In all cases the reproductive cells are merely vegetative cells enlarged and more or less metamorphosed. In *E. Polysiphoniæ* those of the central part of the thallus are enlarged to almost spherical whereas those near the margin may only be slightly swollen. This condition does not seem to be the case in the other species.

Entocladia mexicana S. and G. sp. nov.

Plate 19, fig. 57

Thallus wholly endophytic, 350-450 μ diam., parenchymatous in the center with copious free filaments around the margin; cells in the center nearly equidiametric, 15-18 μ diam., cells of the free filaments 5-7 μ diam., 1.5-2.5 times as long; zoosporangia (?) scattered, numerous, up to 20 μ diam.

Growing within the membrane of *Chaetomorpha antennina*.

Type: No. 1332, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 49b), at La Paz, Lower California.

PRINGSHEIMIA REINKE, Einige neue braune und grüne Algen. 1888, p. 241

Pringsheimia Marchantæ S. and G. sp. nov.

Plate 12, fig. 8

Thallus epiphytic, up to 280 μ diam., often numerous and confluent on the host; cells in the center of the thallus nearly isodiametric, 15-20 μ diam., much reduced and elongated radially towards the margin, 3-4 μ diam., 2-3 times as long; chromatophore parietal; pyrenoid single; reproduction unknown.

Growing on various species of *Laurencia*. La Paz, Lower California. *Type*, Marchant, no. 68x, May.

We have seen neither gametes nor zoospores either in position or free. However, very frequently the cells in the center of the thallus are empty and we are therefore assuming that the plants are mature. If this is the case, *P. Marchantæ* is quite distinct from *P. scutata* Reinke, which has the reproductive cells very much elongated in the center of the host. The shape and size of the cells on the periphery are decidedly different from those of *P. scutata*, being much smaller and longer. It has no resemblance to *P. (?) Udotea* Börgesen, 1913, p. 11. We mark it as a new species pending further investigation.

MELANOPHYCEÆ

Family ECTOCARPACEÆ

ECTOCARPUS LYNGBYE, Hydrophyt. Dan., 1819, p. 130

Ectocarpus Bryantii S. and G. sp. nov.

Plate 17, fig. 45

Fronds intertwined, forming a more or less continuous stratum, 1-2.5 mm. high, attached by relatively short, penetrating, rhizoidal filaments; erect filaments forked more or

less at the surface of the host, with very few short ramuli above, nearly cylindrical, tapering slightly above, uncorticated; terminal cell blunt 28-32 μ diam., cells 1-2 times as long as broad; chromatophores small disks; zoosporangia unknown; gametangia narrowly to broadly fusiform, sessile or on 1-celled pedicels, 70-100 μ , up to 140 μ , long, 25-35 μ broad, scattered promiscuously along the whole length of the erect fronds.

Growing on *Codium Brandegeei*. La Paz, Lower California. *Type*, Bryant, no. 3a.

Ectocarpus Bryantii and *E. gonodioides* are evidently closely related to each other and both have near affinities in the *pusillus* group of Sauvageau (1895). They both differ from all of the forms proposed, in the method of branching and in having no hairs terminating the erect filaments.

Ectocarpus gonodioides S. and G. sp. nov.

Plate 17, fig. 44

Fronds minute, forming small tufts 500-550 μ high, attached by long, more or less hyaline rhizoidal filaments penetrating the host; filaments sparsely branched at the surface of the host, tapering rather abruptly at the base, long attenuated upward to a blunt apex, 18-24 μ diam. at the base, 10-14 μ at the apex; cells 1-2 times as long as broad; zoosporangia unknown; gametangia narrowly fusiform on 1-2 celled pedicels, near the base of the erect filaments, up to 125 μ long, 20-28 μ diam. in widest part.

Growing on *Codium cuneatum*.

Type: No. 1333, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 47e), in July, at Smith Island, Gulf of California.

The small tufts which this species of *Ectocarpus* produces remind one of the genus *Gonodia* (*Myriactis*), but the penetrating part, which extends relatively deep into the host, is composed of slender, almost colorless, slightly branched, closely intertwined filaments, which, however, do not coalesce or form a false parenchyma as in the case of some species of

Gonodia. The plants, though sparse, are in excellent fruiting condition. The chromatophores are too much disorganized for characterization.

Family CORYNOPHLOEACEÆ

GONODIA NIEUWLAND, Critical notes, IX, 1917, p. 30, *Myriactis* auct.

As pointed out by Nieuwland (1917, p. 30), *Myriactis* was applied by Lessing to a still recognized genus of flowering plants belonging to the Compositæ, in 1831. It became necessary, therefore, to adopt another generic name for the algæ which have been listed under this name and Nieuwland has proposed the name *Gonodia*, in honor of Eugene Gonod, and has made the new combination *Gonodia pulvinatum* (Kuetz.) Nieuwland (*loc. cit.*). As far as we know there have been but two other unmistakable species of the genus described. We are here making these new combinations and adding two new species.

Gonodia Sargassi (Yendo) S. and G. comb. nov.

Myriactis sargassi YENDO, Novae Alg. Japon., 1920, p. 3

Gonodia moniliformis (Foslie) S. and G. comb. nov.

Elachista moniliformis FOSLIE. *Myriactis moniliformis* (FOSLIE) KYLIN, Zur Kenntnis der Algenfl., 1910, p. 13, fig. 3

Gonodia Johnstonii S. and G. sp. nov.

Plate 17, figs. 46, 47

Plants forming dense minute tufts in the conceptacles and on other parts of the host, 160-200 μ high, attached by rather deeply penetrating, sparsely branched, rhizoidal filaments; erect fronds forked at the surface of the host, vegetative filaments unbranched above, decidedly clavate and blunt, at times tapering upwards above the center; cells in widest part 10-14 μ diam., 1-1.5 times as long as broad, slightly constricted at the dissepiments; zoosporangia broadly clavate, 65-75 μ long, 18-22 μ broad; gametangia cylindrical, 60-75 μ long, 6-9 μ

broad, densely fasciculate; both sets of reproductive organs borne on the same plant at the surface of the host.

Growing on *Sargassum insulare*.

Type: No. 1334, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 11b), in June, at San Marcos Island, Gulf of California.

Gonodia Marchantæ S. and G. sp. nov.

Plate 17, fig. 48

Fronds forming dense tufts with a pseudoparenchymatous base penetrating the host, the free portion about 200 μ long; filaments unbranched above the host, the lower portion composed of 2-3 long, narrow cells, abruptly changing into 2-3 asymmetrical swollen cells, then gradually attenuated upward to blunt apices; widest cells 18-22 μ , the length of the cells in the upper part equalling the breadth; pseudoparenchymatous cells doliiform to subspherical; zoosporangia broadly clavate, 55-65 μ long, 22-26 μ broad; gametangia cylindrical, densely fasciculate, 55-65 μ long, 6-7 μ broad; both sets of reproductive organs borne on the same plant at the base of the free filaments.

Growing on the fronds of *Sargassum horridum*, La Paz, Lower California. *Type*, Marchant, no. 22a, May.

G. Marchantæ differs from *G. Johnstonii* in the character of the basal penetrating portion, the former having few narrow filaments and the latter having a dense, copious, pseudoparenchymatous base. Two or three cells in the lower part of the free filaments are usually asymmetrical in *G. Marchantæ* and not so in *G. Johnstonii*. Neither species has hairs or any indication of having had them, a prominent character as figured by Thuret and Bornet in *Etudes Phyc.*, pl. 7, figs. 2-6, for *Elachista pulvinata*, and mentioned by Yendo as "paraphysibus paucioribus" in *Myriactis Sargassi* (*loc. cit.*). *G. Marchantæ* is close to *G. pulvinata* in the character of the basal penetrating portion. *G. Johnstonii* in general resembles *G. moniliformis* but is much smaller throughout.

Family MYRIONEMATACEÆ

COMPSONEMA KUCKUCK, Beitr. Kennt. Meeresalgen, 1899, p. 92*Compsonema immixtum* S. and G. sp. nov.

Plate 17, fig. 49

Thallus inconspicuous, the basal filaments creeping among the gametangia of the host; erect filaments very numerous, all bearing gametangia; hairs and zoosporangia unknown; gametangia narrowly ellipsoidal, 24-30 μ long, 6-8 μ broad.

Growing on *Colpomenia sinuosa* f. *deformans*.

Type: No. 1335, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 58b), in July, at Isla Partida, Gulf of California.

This organism is on the border between *Myrionema* and *Compsonema* as we interpret these two genera (S. and G. Phyc. Cont. II-VI, 1920). Under the present conditions of the host it is impossible to learn much of the basal portion. It appears that the basal layer was largely developed before the gametangia of the host started to develop. Later these pushed out among the basal filaments and leaving these behind developed along with the gametangia of the epiphyte. The gametangia project beyond the general surface of the host nearly their entire length. On account of the pluriseriate nature of the gametangia we are placing it in the genus *Compsonema* rather than in *Myrionema*.

Family SPHACELARIACEÆ

SPHACELARIA LYNGBYE, Hydrophyt. Dan., p. 130 (In part)*Sphacelaria furcigera* Kuetz.

Plate 19, fig. 58

Kuetzing, Tab. Phyc., vol. 5, p. 27, pl. 90

A few tufts of a species of *Sphacelaria* which seems to be this species have been noted on different species of *Sargassum* from the Gulf. Marchant, No. 22b is a fruiting specimen, having apparently two forms of gametangia, represented on plate 19, fig. 58.

Sphacelaria brevicorne S. and G. sp. nov.

Plate 19, figs. 59, 60

Fronds 1-1.5 mm. high, attached by small penetrating filaments, branching very sparse and strict, 35 μ diam. below, 22-30 μ near the tip; hairs arising near the tips, composed of 6-8 cells; zoosporangia and gametangia unknown; propagula tricornute, about 120 μ long, about 70 μ wide below the horns, composed of a few large cells, on 2-3 celled pedicels; horns short, blunt, composed of 2-3 cells.

Growing on *Sargassum polyacanthum* f. *americanum*. La Paz, Lower California. Type, Brandegee, no. 59.

S. brevicorne has a very close affinity in *S. cornuta* Sauv. (1901, p. 132, Repr.), the type locality of which is New Caledonia. Unfortunately we have no fruit on ours. We are basing the distinction from *S. cornuta* largely on the differences in the character of the propagula.

Family ENCELIAACEÆ

COLPOMENIA (ENDLICHER) DERBÈS and SOLIER, Mém. phys. Alg., 1856, p. 11, Endlicher, Gen. Plant., Suppl. III, 1843, p. 26, n. 98b

Colpomenia sinuosa f. *tuberculata* (Saunders) S. and G.

San Francisquito Bay, Lower California, Johnston, no. 26, June; Los Angeles Bay, Lower California, Johnston, no. 117, May; La Paz, Lower California, Marchant, no. 13, May, and Brandegee, nos. 15 and 36.

Setchell and Gardner, Alg. N. W. Amer., 1903, p. 242.

C. tuberculata Saunders, Phyc. Mem., 1898, p. 164, pl. 32, figs. 1-3.

The specimens of all of these collections are sterile. They are larger and seem somewhat more membranaceous than any which have been reported from the California coast, the type locality being Monterey, California. Otherwise they seem quite typical.

Colpomenia sinuosa f. *deformans* S. and G.

Plate 19, figs. 61, 62

Isla Partida, Gulf of California, Johnston, no. 58, July.
Setchell and Gardner (*loc. cit.*). *Scytosiphon bullosus*
Saunders, Phyc. Mem., 1898, p. 163, pl. 31, figs. 1-7.

There is an extensive variation in the form. The type locality of Saunders' *Scytosiphon bullosus* is Pacific Grove, California. The character which the plants assume growing along the California coast is about one-half bullose base and the other half consisting of irregular, more or less finger-like projections above. In the region of the San Juan Islands, Washington, the upper free portion is saccate and up to ten inches long. The basal portion of the material from the Gulf, as represented on plate 19, fig. 61, has practically disappeared and only the narrow, finger-like portions remain. The gametangia in this material are longer than in the material found along the California and Washington coasts.

Colpomenia sinuosa f. *expansissima* S. and G. f. nov.

Fronds 3-6 dm. in diam., thin, sinuose, with minute, spine-like projections.

Type: No. 1336, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 24), in June, at San Francisquito Bay, Lower California.

Johnston says in regard to the habitat: "Floating in large billowy masses out in the bay." Structurally the specimens seem very similar to *C. sinuosa* f. *expansa* Saunders (*loc. cit.*).

In his description Saunders does not mention the size of the plants. The specimens distributed in Collins, Holden, and Setchell, Phyc. Bor.-Amer., no. 825, from La Jolla, measure only a few centimeters in diameter. Comparison of the fruits cannot now be made, since our material is all sterile.

HYDROCLATHRUS BORY, in Dict. Class., vol. 8, 1825, p. 419

Hydroclathrus clathratus (Bory) Howe

Cast ashore, La Paz, Lower California. Marchant, no. 12;
Brandege, no. 11.

HOWE, ALGÆ in Britton and Millspaugh, Bahama Flora, 1920, p. 590

Hydroclathrus cancellatus Bory (*loc. cit.*)

Encelium clathratum (BORY) Ag. Sp. Alg. vol. 1, 1822, p. 412

This alga has been known for a century or more and has been collected from a large number of widely separated localities, yet very little seems to be known of its method of development and the characters of its fruit. Harvey (1852, p. 120) expresses doubt as to whether all of the plants referred to this species actually belong to it. We are referring here the collections from La Paz with some hesitation, as we have no fruit to give a clue to its relationship. Statements concerning the fruit have been vague. Harvey (*loc. cit.*, p. 119) quotes Montagne, without citation, thus: "Spores minute, globose, collected into dot-like, scattered innate sori, accompanied by club-shaped, jointed filaments."

Farlow (1881, p. 88) states that *Hydroclathrus* has plurilocular sporangia like *Phyllitis* and *Scytosiphon*, but did not state whether he referred to *Hydroclathrus sinuosus* or to *H. cancellatus*. Mitchell (1893, p. 53), in considering the structure of *Hydroclathrus* Bory, treats *H. sinuosus* Zanard. along with *H. cancellatus*. She states (p. 56), referring to *H. cancellatus*: "While one region of the thallus is fully formed and capable of producing sporangia, another may be still in a state of growth." . . . "On all the branches cryptostomata and sporangia are present in various stages of development." She did not figure the sporangia but we presume she referred to a type similar to that in *H. sinuosus* (*Colpomenia sinuosa*). Aside from these statements, so far as we are aware no one else has described or figured the fruit.

CHNOOSPORA AGARDH, J. Nya Alg., 1847, p. 7

Chnoospora pacifica J. Ag.

Cast ashore, La Paz, Lower California. Marchant, no. 16; Brandegee, no. 39.

J. Agardh, Nya. Alg., 1847, p. 7; Kuetzing, Tab. Phyc., vol. 9, 1859, pl. 86, fig. 1. *Chnoospora fastigiata* = *pacifica* J. Agardh, Sp. Alg., vol. 1, p. 172.

Our material is in fine vegetative condition but has no fruit. It does not perfectly coincide with Kuetzing's figure in its vegetative character. The plants are dichotomously branched and the older parts are at times flattened. The terminal portions are profusely branched, forming short, dense clusters with divaricate branches, while the terminal ramuli, as shown in Kuetzing's figure, are few and erect. Kuetzing's figures were doubtless drawn from material of the type from the type locality, St. Augustine, Mexico.

Family LAMINARIACEÆ

MACROCYSTIS AGARDH, Sp. Alg., vol. 1, part 1, 1821, p. 46

Macrocystis pyrifera (Turner) Ag.

Caught on log line of vessel between Espiritu Santo Island and La Paz, Lower California. Johnston, no. 78, April.

Agardh (*loc. cit.*), *Fucus pyrifera* Turner, Fuci, vol. 2, pl. 110.

A single specimen about three feet long was brought aboard the vessel but no specimens were found growing attached within the Gulf.

Family DICTYOTACEÆ

NEUROCARPUS WEBER and MOHR, Beitr. Naturk., vol. 1, 1805, p. 300 (242-246)

Neurocarpus zonarioides (Farlow) Howe

Growing on rocks in the upper sublittoral belt. Tortuga Island, Johnston, no. 22, June; Isla Partida, Johnston, no. 83, July.

Howe, Mar. Alg. Peru, 1914, pp. 69, 70. *Dictyopteris zonarioides* Farlow in Erythea, vol. 7, no. 8, 1899, p. 73.

The material of these collections seems to be identical with the material of *Dictyopteris zonarioides* Farlow, distributed from southern California in Collins, Holden, and Setchell, Phyc. Bor.-Amer. (Exsic), no. 581.

Howe (1914, p. 69) has brought forward new facts as to the priority of *Neurocarpus*, and it seems best to adopt this generic name rather than *Dictyopteris* or *Haliseris*.

Farlow (*loc. cit.*) compares the California specimen with *D. undulata* Holmes and properly, in our judgment, regards it as distinct.

Our plants are not fruiting and hence they are probably winter fruiting forms in that locality.

PADINA ADANSON, Fam. Pl., vol. 2, 1763, p. 13

Padina Durvillæi Bory

Growing in the lower littoral and upper sublittoral belts. Guaymas, Mexico, Marchant, no. 11a, May; Brandegee, no. 8. Eureka, near La Paz, Lower California, Marchant, no. 32, May. La Paz, Lower California, Marchant, no. 15, May. Bryant, no. 8. San Marcos, Johnston, no. 3, June. Tortuga Island, Johnston, no. 17, June. San Esteban, Johnston, no. 54, April. Georges Island, Johnston, no. 73, April. San Francisquito Bay, Johnston, no. 76, June. San Pedro Martir, Johnston, no. 150, April. Isla Partida, Johnston, no. 154, April.

Bory, Dict. Class., vol. 12, 1827, p. 591; Voy. Coquille, 1828, p. 147, pl. 21, fig. 1.

Among these various collections there is a great variation in the size, thickness, and amount of laceration, as well as the arrangement of the fruit. Without more critical study of the material in its native habitat and histological comparison we are unable to state whether we are dealing with one or more than one species. We are grouping them all under the above name for the present without further comment.

Dictyota LAMOUROUX Nouv. Bull., Sci. Soc. Philom., vol. 1, 1809, p. 331

Dictyota crenulata J. Ag.

Plate 18, figs. 50, 51

Cast ashore, La Paz, Lower California. Brandege, no. 24. J. Agardh, Nya. Alg., 1847, p. 7.

The collection listed above agrees very well with Agardh's brief description. We have not seen the type which is from St. Augustine, Mexico. The illustration (plate 18, fig. 50) is of a typical specimen of our collection in an advanced stage of development. The numerous proliferations represent plantlets developed from spores in situ.

Dictyota Johnstonii S. and G. sp. nov.

Plate 18, figs. 54-56 and plate 39

Fronds 12-16 cm. high, 5-8 mm. wide, 125-135 μ thick, composed of a single layer of large medullary cells surrounded by a single surface layer of small cells except in the lower part along the margin the medullary and surface cells become doubled; slightly stupose at the base, pinnate, dichotomously branched, angles acute to somewhat rounded, branches strict, margins smooth, color dark brown, black on drying; oogonia aggregated into elliptical or elongated areas, 115-125 μ long, 80-90 μ wide; tetrasporangia and antheridia unknown.

Growing on rocks in the upper sublittoral belt, San Marcos Island, Gulf of California, Johnston, no. 4, June.

Type: No. 1337, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 81), in July, at Isla Partida, Gulf of California.

Dictyota Johnstonii appears to belong to the subgenus or section of the genus, *Strigocarpus* J. Ag. (Anal. Algol. cont. 1, 1894, p. 73) and related to *D. pinnatifida* Kuetz., Tab. Phyc., vol. 9, 1859, p. 16, pl. 39, fig. 1, to *D. Pappeana* Kuetz. (loc. cit., pl. 38, fig. 2), and to *D. liturata* Kuetz. (loc. cit., fig. 1). The cross section in the central and lower parts of the frond has a structure similar to that shown by Okamura (1913, p. 33, pl. 109, figs. 3 and 7) for *D. marginata*. In *D. Johnstonii* the margins are thickened by divisions of the

cells of both the medulla and the surface while in *D. marginata* increase in thickness is brought about by division of the medullary cells only.

Dictyota hesperia S. and G. sp. nov.

Plate 18, figs. 52, 53

Fronds linear, repeatedly branched, 8-10 cm. high, 2-4 mm. wide, 80-120 μ thick, more or less finely stupose at the base, dichotomously or at times subdistichously branched, antheridia and oogonia distributed over both surfaces on the same frond, oogonia single and antheridia in small circular groups; tetrasporangia single or in small irregular groups; oospores germinating freely in position.

Growing on rocks in the lower littoral and upper sublittoral belts, San Marcos Island, Gulf of California, Johnston, no. 5, June.

Type: No. 1338, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 32), in June, at Tortuga Island, Gulf of California.

Dictyota hesperia seems to belong to the subgenus or section of the group designated as *Pleiadophora* by J. Agardh (loc. cit., p. 69) with close affinity with *D. sandvicensis* Sond.

New plants may be freely formed by growth of the oospores in position in the fronds. We have not been able to investigate the cytological characters of these spores to ascertain whether growth follows fertilization or whether the spores germinate parthenogenetically.

Family SARGASSACEÆ

SARGASSUM AGARDH, Sp. Alg., vol. 1, part 1, 1820, p. 1

In the posthumous publication of Grunow's work (1915-1916) two hundred and thirty species, besides a large number of varieties and forms of *Sargassum*, are listed. Notwithstanding this large number of published species, we find, in the region covered by our account, a considerable number of *Sargassums* which do not coincide with any of Grunow's

descriptions. We feel compelled, therefore, to propose fifteen additions, leaving several others for future investigation, on account of lack of fruit and herbarium material with which to compare sterile specimens.

Sargassum acinacifolium S. and G. sp. nov.

Plate 21, fig. 82

Basal parts unknown; branches terete, smooth; leaves 12-16 mm. long, asymmetrical, the upper margin concave and smooth, the lower margin and apex coarsely dentate, ecostate, cryptostomata absent; vesicles situated at the base of the receptacles or more rarely among the receptacles, subspherical, smooth, apiculate, 1.5-2.5 mm. diam., on pedicels shorter than the diameter; receptacles 2-3 times forked, nearly cylindrical, not spiny, acuminate, more or less denticulate towards the apices.

Cast ashore. Guaymas (?), Mexico. Type, Brandegee, no. 2.

This species of *Sargassum* is a near relative, apparently, to *S. lapazeanum* and to *S. Bryantii*, both of this paper, but it differs sufficiently in leaf, bladder, and receptacle characters to warrant giving it a separate characterization.

Sargassum guardiense S. and G. sp. nov.

Plate 19, fig. 64

Basal parts unknown; primary branches up to 5 dm. high; secondary branches long and slender; branches and ramuli all smooth, terete; leaves slightly flattened, to filiform, ecostate, margins smooth, cryptostomata absent or rare; vesicles situated at the base of the fructiferous ramuli or among the branches of the receptacles, subspherical to slightly cylindrical, 2-4 mm. long, smooth, tapering at both ends, apiculate, on pedicels shorter than the diameter; receptacles 1-3 times forked, terete, not spinose, 5-8 mm. long, forming with the vesicles short heteroclyte cymes.

Cast ashore at Angel de la Guarda Island, Gulf of California.

Type: No. 1339, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 2), in June, at Angel de la Guarda, Gulf of California.

Unfortunately we have no complete specimens of this seemingly very well defined species of *Sargassum*. The character of the holdfast and of the main stipe, which are in many instances of much value in classification, cannot be stated. We have several clean primary branches which are in good fruiting condition and otherwise seemingly characteristic. The loose, open character of the branching and the shape and size of the vesicles remind one very much of some members of the genus *Cystophyllum* J. Ag. It has perhaps its nearest relative in *S. carpophyllum* but differs in leaf characters and in the vesicles being regularly lateral or terminal to the receptacles.

Sargassum lapazeanum S. and G. sp. nov.

Plate 20, fig. 74

Fronds 4.5-6 dm. high, arising from a solid parenchymatous disk; stipe 1.5 cm. long; primary branches 5-7, terete, smooth, giving rise to numerous long, slender, secondary branches; leaves 0.5-1.5 cm. long, asymmetrical, widest towards the apices, with very short petioles, the basal half of the upper margin smooth and concave, the remainder of the blade sharply dentate, midrib inconspicuous, cryptostomata abundant and conspicuous; vesicles scattered among the receptacles, ellipsoidal, 1-2 mm. long, transformed from the base of a leaf, mostly crowned by the remnants of the blade; receptacles 4-7 mm. long, 2-3 times forked, branches strict, spinulose, intermixed with leaves and receptacles forming a heteroclyte cyme.

Cast ashore, La Paz, Lower California. Type, Marchant, no. 21, May.

Sargassum Bryantii S. and G. sp. nov.

Plate 21, fig. 83

Basal parts unknown; branches terete, more or less contorted; leaves 6-12 mm. long, 0.5 as broad as long, ecostate, asymmetrical, the upper margin concave and smooth, the

lower margin and the end unevenly serrate; cryptostomata few and irregularly placed; vesicles numerous along the ramuli or more rarely intermixed with the receptacles, subspherical, marginate when young, spinose, short-petiolate; receptacles short, 4-8 mm. long, 1.5-3 mm. broad, irregular, cylindrical below, blunt or pointed, at times slightly spinose and crowned with a rudiment of a leaf.

Cast ashore near La Paz, Lower California. Type, Bryant, no. 5.

The characters of the receptacles do not agree in every particular with those given by J. Agardh (Sp. Sargas. Austral.) in his key to *Eusargassum*. They are not regularly two-edged and serrate-dentate along the margins. Many of them are slightly flattened above, somewhat spinose, and crowned with a leaf rudiment. It fits into this section better than into any other.

Sargassum horridum S. and G. sp. nov.

Plate 20, figs. 65, 66

Basal parts unknown; branches and branchlets muricate, leaves linear-lanceolate, acute, midrib percurrent, margins deeply and doubly serrate; cryptostomata numerous and conspicuous on the leaves, stems and vesicles; vesicles sparse, occupying the position of leaves near the base of the ramuli or scattered among the receptacles, spherical, 4-8 mm. diam., short-petiolate; receptacles decompoundly ramose, decidedly spinose.

Cast ashore, La Paz, Lower California. Type, Marchant, no. 22, May.

Like the majority of our specimens from the Gulf of California, the specimens of this species of *Sargassum* have no holdfast or stipe. Presumably many of them grow only in the sublittoral belt and collectors have observed only such specimens as have been cast ashore, and these are usually fragmentary. Otherwise the specimens of *S. horridum* are in excellent condition.

Sargassum Marchantæ S. and G. sp. nov.

Plate 19, fig. 63

Basal parts unknown; primary branches 4.5-6 dm. high, terete, smooth; secondary branches numerous, densely fructiferous; leaves 4-6 cm. long, 3-5 mm. wide, linear-lanceolate, acute, midrib percurrent, margins irregularly serrate-dentate; cryptostomata numerous and conspicuous; vesicles sparse, spherical, on short pedicels near the base of the ramuli or near the base of the branching receptacles, 4-6.5 mm. diameter, smooth; receptacle several times forked, occasionally one fork develops into a leaf or a vesicle forming a "heteroclyte cyme(?)," but all others fructiferous and from a single pedicel, supported near the base of a leaf, cylindrical, blunt, spinulose, the whole cyme 10-15 mm. long.

Cast ashore, Eureka, near La Paz, Lower California. Type, Marchant, no. 17, May.

Sargassum Marchantæ is probably genetically related to *S. Liebmanni* J. Ag.

Sargassum insulare S. and G. sp. nov.

Plate 20, figs. 67, 68 and plate 21, fig. 78

Fronds 7-9 dm. high, arising from a parenchymatous disk; stipe small, 5-10 mm. long; primary branches cylindrical throughout, 1-2 mm. diameter, smooth, moderately and alternately branched; leaves 1-2 cm. long, about half as wide as long, asymmetrical, the upper margin concave and mostly smooth, the lower margin and apex convex and crenate or dentate, ecostate; cryptostomata sparse; vesicles intermingled with the receptacles, spherical or sub-spherical, 1.5-2.5 mm. diameter, short-petiolate, often crowned by the remnant of a leaf; receptacles moderately branched, standing on a single pedicel on the base of a leaf, irregular in shape, clothed with scattered blunt spines, sometimes crowned by a rudiment of a leaf.

Growing on rocks in the upper sublittoral belt.

Type: No. 1340, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 11), in July, at San Marcos Island, Gulf of California.

Sargassum Brandegeei S. and G. sp. nov.

Plate 21, fig. 79

Basal parts unknown; branches and branchlets terete, smooth, without cryptostomata; branching rather dense in the upper parts; leaves 15-25 mm. long, 4-8 mm. wide, apices blunt, base cuneate, margins deeply serrate, cryptostomata absent; vesicles spherical, small, 2-3 mm. diam., smooth, apiculate or crowned by a rudiment of a leaf, supported by pedicels mostly shorter than their diameter, occupying positions of leaves toward the base of the ramuli, or scattered among the receptacles; receptacles in short dense racemes, with short distinct pedicels below but with sessile branches above, mostly blunt.

Cast ashore, Guaymas (?), Mexico. Type, Brandegee, no. 4.

Sargassum sinicola S. and G. sp. nov.

Plate 20, fig. 73

Basal parts unknown; branches and branchlets smooth, terete; leaves linear-lanceolate, acute, margins serrate-dentate, midrib percurrent, cryptostomata sparse, inconspicuous; vesicles numerous, mostly borne near the base of pedicel supporting the receptacles, spherical, smooth, 3-5 mm. diam., pedicels equaling the diameter; receptacles 1-3 times forked, the lower pedicellate, the upper sessile, cylindrical, with acuminate apices, not spinose.

Cast ashore. Eureka, near La Paz, Lower California; Marchant no. 20, May; La Paz, Lower California, Marchant, no. 26, May. Type, Marchant, no. 20.

This species seems nearly related to *S. podacanthum* Sond. and to *S. spinuligerum* Sond. but the leaves are much more "glandular" and the receptacles much more branched.

Sargassum polyacanthum f. *americanum* S. and G. f. nov.

Basal parts unknown; branches and branchlets up to 1.5 mm. diameter, moderately muricate; leaves 3-4 cm. long, narrowly lanceolate, acute, margins serrate-dentate, midrib percurrent, cryptostomata sparse; vesicles spherical, smooth,

up to 8 mm. diameter, occupying positions of leaves along the ramuli or at times supported by a leaf; receptacles 1-2 times forked, 2.5-4 mm. long, obtuse-conical.

Cast ashore, La Paz (?), Lower California. Type, Brandegee, no. 27.

This species stands very close to *S. spinuligerum* Sond. The leaves are longer and narrower than in that species. There are also other specific differences.

Sargassum Johnstonii S. and G. sp. nov.

Plate 20, fig. 72 and plate 21, fig. 80

Basal parts unknown; primary branches relatively robust, terete, smooth, up to 8 dm. long, secondary branches numerous, densely crowded with fructiferous ramuli; leaves narrowly lanceolate, ecostate, margins sparsely denticulate, cryptostomata almost absent, 1.5-2.5 cm. long, 2-4 mm. wide; vesicles smooth, narrowly elliptical, merging gradually below into a short petiole, crowned by a mucron or a remnant of a blade, scattered along the fruiting rhachis among the receptacles, 3-5 mm. long, on pedicels shorter than their length; receptacles single or 2-3 times forked, nearly cylindrical, mostly blunt, with slightly denticulate apices.

Cast ashore.

Type: No. 1341, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 71), in April, at Georges Island, Gulf of California.

Related to *S. galapagense* Grun. but differs in having elongated, long-apiculate vesicles and slightly denticulate receptacles, and in details of leaf characters.

Sargassum Johnstonii f. *laxius* S. and G. f. nov.

Plate 21, figs. 75 and 81

Basal parts unknown; primary branches up to 13.5 dm. long; secondary branches very much less frequent and much longer than in the species; leaves filiform, 1-2 cm. long, cryptostomata sparse, inconspicuous; vesicles subspherical, mostly long-mucronate; receptacles 1-2 times forked, rarely simple, not denticulate.

Cast ashore at Guaymas, Mexico. Type, Marchant, no. 28.

This variety differs from the species in the following particulars: the secondary branches and fructiferous ramuli are very much more widely scattered and several times longer, the leaves are narrower, in fact they are filiform, the vesicles are very much shorter, about one and a half times as long as broad, and the receptacles are less branched and rarely if ever denticulate at the apices.

Sargassum Johnstonii f. *gracile* S. and G. f. nov.

Plate 21, fig. 76

Basal parts unknown; branches of all orders very slender, long, and wide apart, up to 1 mm. diam.; leaves filiform; vesicles narrowly ellipsoidal.

Cast ashore, Guaymas, Mexico. Type, Marchant, no. 28a.

This differs from the species in being decidedly more slender throughout, much less frequently branched, and in having the branches much longer and more delicate, and in having filiform leaves. In these respects they more nearly coincide with f. *laxius* but are much more delicate throughout than that form. The receptacles are young in the specimens at hand. The vesicles are practically the same in form as those of the species.

Sargassum cylindrocarpum S. and G. sp. nov.

Plate 21, fig. 77

Basal parts unknown; primary branches and branchlets smooth, terete; leaves 5-8 cm. long, 3-5 mm. wide, linear-lanceolate, acute, serrate-dentate, midrib percurrent, cryptostomata abundant and conspicuous; vesicles 5-8 mm. diameter, spherical, smooth, on stipes shorter than the diameter, occupying positions of leaves toward the base of the fructiferous ramuli; receptacles several times forked, cylindrical, blunt, 1-2 cm. long.

Cast ashore, La Paz, Lower California. Type, Marchant, no. 11.

Sargassum herporhizum S. and G. sp. nov.

Plate 20, figs. 69-71

Fronds 6-8 dm. high, attached at first by a small parenchymatous disk, later the short stipe giving rise to erect primary branches in part and to horizontal branches which in turn develop attaching branches, hapteres, below and to erect branches above; primary branches slender, terete, smooth, densely clothed with leaves and with scattered secondary branches below and with fructiferous branches above; lower leaves sub-linear, upper linear-lanceolate and acute, lower 3-5 mm. broad, upper 1-2 mm. broad, midrib percurrent, margins sparsely denticulate, cryptostomata absent; vesicles numerous, scattered among the receptacles, spherical to subspherical, smooth, rarely apiculate, 1-2 mm. diam., on pedicels as long as or longer than the diam.; receptacles short, 5-10 mm. long, sub-cylindrical, acuminate, only sparsely branched, tuberculate with conspicuous conceptacles; plants very dark on drying.

Growing in the upper sublittoral belt.

Type: No. 1342, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 72), in April, at Georges Island, Gulf of California.

Arrangement of the species of *Sargassum* found on the Pacific Coast of North America according to the system of Agardh (1889) as revised by Grunow (1915-1916).

Subgenus *Phyllotrichia*

Tribe V. *Dimorphæ*

1. *S. Palmeri* Grunow

Subgenus *Eusargassum*

Series I. *Zygocarpicæ*

Tribe I. *Carpophylleæ*

Receptacles terete, not spiny.

Rachides terete or nearly so.

2. *S. acinacifolium* S. and G. sp. nov.

3. *S. guardiense* S. and G. sp. nov.

4. *S. lapazeanum* S. and G. sp. nov.
 ## Receptacles 2-edged (subangular), apex and margin serrate-dentate.
5. *S. Bryantii* S. and G. sp. nov.
 Series II. Acanthocarpicae
 Tribe II. Glomerulatae
 ## Rhachides terete
 ϕ Cryptostomata conspicuous.
6. *S. horridum* S. and G. sp. nov.
7. *S. Marchantæ* S. and G. sp. nov.
 ϕϕ Cryptostomata of leaves either minute or none
8. *S. Liebmanni* J. Ag.
 Tribe III. Biserrulæ
 ## Illicifolia. Leaves more or less oblique at base
 ϕ Leaves ecostate
9. *S. Agardhianum* J. Ag.
10. *S. insulare* S. and G. sp. nov.
 Series III. Malacocarpicae
 Tribe VI. Racemosæ
 ## Acinariae
 ϕ Cryptostomata almost absent or none
11. *S. Brandegeei* S. and G. sp. nov.
 ϕϕ Cryptostomata more or less conspicuous
 ψψ Vesicles spherical
12. *S. sinicola* S. and G. sp. nov.
13. *S. polyacanthum* f. *americanum* S. and G. f. nov.
 ## Glandularia
 ϕ Vesicles elongated, aristate
14. *S. Johnstonii* S. and G. sp. nov.
15. *S. Johnstonii* f. *laxius* S. and G. f. nov.
16. *S. Johnstonii* f. *gracile* S. and G. f. nov.
 ϕϕ Vesicles spherical
17. *S. cylindrocarpum* S. and G. sp. nov.
 ### Siliquosæ
 ϕ Younger receptacles rather cymose, confluent with the fertile rhachis, etc.
18. *S. herporhizum* S. and G. sp. nov.
 ϕϕ Younger receptacles swollen on a rhachis, etc.
19. *S. paniculatum* J. Ag.

RHODOPHYCEÆ

Family BANGIACEÆ

ERYTHROTRICHIA ARESCHOUG, Phyc. Scand., 1850, p. 209 (435 repr.)

Erythrotrichia polymorpha Howe

We have noticed scattered specimens, on various hosts, of a small, epiphytic red alga forming disks similar to those figured by Howe (1914, p. 77, pl. 29) for *E. polymorpha*. In one instance, Johnston, no. 32a, on *Dictyota hesperia*, they are sufficiently abundant to give the surface of the host a reddish hue. In no instance have we been able to observe the erect filaments from the center of the disks as figured by Howe (*l. c.*, figs. 8, 11-14), but according to Howe's idea the species may even come to complete maturity and reproduce without the development of these erect parts. We are placing our specimen here provisionally, awaiting further knowledge of the life-history of the species.

Howe, Mar. Alg. Peru, 1914, p. 77.

GONIOTRICHUM KUETZING, Phyc. Gen., 1843, p. 244,
 in Linnæa, vol. 17, p. 89

We are not sure as to which one of the above publications may claim the priority in the publication of this genus. In neither work is reference made to the other. In Linnæa the name is a *nomen nudum*. We are considering the appearance in Phycologia Generalis as constituting the original publication.

Goniotrichum Alsidii (Zanard.) Howe

Growing sparsely on various species of algae. Seemingly particularly characteristic in Johnson, no. 167.

Howe, Mar. Alg. Peru, 1914, pp. 75, 76.

For a discussion of the literature and the reasons for the use of the above combination, see Howe (*loc. cit.*) whom we are following in placing this somewhat troublesome alga, troublesome as to its genetic relationship.

Family GELIDIACEÆ

SCINAIA BIVONA-BARNARDI, *Scinaia*, etc., in L'Iride, 1822

For a discussion of the genus see Setchell, The *Scinaia* Assemb., 1914, p. 79 *et seq.*

Scinaia latifrons Howe

Cast ashore at Guaymas, Mexico, Marchant, nos. 53 and 57. Howe, Phyc. studies V, 1911, p. 500; Setchell, *loc. cit.*

Several excellent specimens of this elegant species of *Scinaia* were taken at Guaymas. The only other known locality in the Gulf of California from which it has been reported is the type locality, La Paz.

Scinaia Johnstonæ Setchell

Dredged in 4-9 fathoms, Los Angeles Bay, Lower California. Johnston, no. 46. San Pedro Martir Island, Johnston, no. 106. Esteban Island, Johnston, no. 114.

Setchell, The *Scinaia* Assemb., 1914, p. 97.

The specimens here cited resemble very closely the type of the species as found at San Pedro, California, the type locality.

GELIDIUM LAMOUROUX, Essai, 1813, p. 41 (40 repr.)

Gelidium Johnstonii S. and G. sp. nov.

Plates 72, 73 and 46, a

Fronds flattened throughout, 7-12 cm. high, central axis up to 3 mm. wide, tapering abruptly at the base, and gradually upwards, dividing irregularly and more or less pinnately above into several segments, which in turn are 3-4 times regularly and pinnately divided; the ultimate, tetrasporic ramuli decidedly flattened; the ultimate, cystocarpic ramuli subcylindrical, cystocarps above the center; medulla composed of sparse cells and a few small scattered fibers, inner cortex of larger cells and abundant fibers, outer cortex of anticlinal rows of 3-4 cells.

Growing on rocks in the upper sublittoral belt. San Marcos Island, Gulf of California, Johnston, no. 13, June; San Francisquito Bay, Lower California, Johnston, no. 27, June.

Type: No. 1343, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 27), in June, at San Francisquito Bay, Lower California.

Gelidium Johnstonii seems to be most closely related to *Fucus Amansii* Lamour. (Diss., 1805, p. 48, pl. 26, figs. 2-5) or *Gelidium Amansii* Lamour. (in Kuetzing, Tab. Phyc., vol. 18, 1868, p. 16, pl. 44). The original description and the figure represent a plant cylindrical throughout, with subdichotomous branching and acute ultimate ramuli. Our plant differs from this in being decidedly flattened throughout, and the branching is regularly pinnate. *G. Johnstonii* also resembles *G. Amansii* Okamura (Icon. Jap. Alg., vol. 3, 1913, p. 25, pl. 106). The tetrasporic ramuli in ours are more flattened and spatulate. Okamura does not figure nor describe the structure of the frond. We are thus in considerable doubt as to whether the two collections are identical, and incline to the belief that ours is an entirely distinct and undescribed species.

Gelidium decompositum S. and G. sp. nov.

Plate 71

Fronds flattened throughout, 6-9 cm. high, central axis up to 1.5 mm. wide, dividing irregularly into 4-7 primary branches, these in turn are densely 4-5 pinnately branched, pinnæ of each different order variable in length, nearly perpendicular to the axis of origin, many recurved, those of the third and fourth order often densely matted together; fibers absent in terminal and subterminal ramuli, scattered along the edges of the medulla of medium ramuli, scattered through the medulla in primary axes; cortex of a single row of palisade cells, subcortex of larger thick-walled cells; fruiting conditions unknown.

Growing on rocks in the lower littoral belt.

Type: No. 1344, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 23), in June, at San Francisquito Bay, Lower California.

Gelidium decompositum differs chiefly from *G. Johnstonii*, with which it seems somewhat closely related, in the greater irregularity of the length of the pinnæ which are mostly very decidedly crowded together and stand more nearly perpendi-

cular to the parts from which they arise, and in being smaller in all of their dimensions. The sub-cortex, and especially the cells of the medulla are decidedly larger and thicker walled.

Family GIGARTINACEÆ

GIGARTINA STACKHOUSE, Mém. soc. nat. Mosc., II, 1809

Gigartina Chauvinii (Bory) Mont.

Plate 46b and plate 70

Growing on rocks. San Esteban Island, Gulf of California, Johnston, no. 53, April; Georges Island, Gulf of California, Johnston, no. 101, April.

Montagne, Voyage Bonite, p. 72. *Sphaerococcus Chauvini* Bory, Voyage Coquille, no. 58, p. 165, pl. 26. *Chondroclonium Chauvini* Kuetzing, Tab. Phyc., vol. 17, 1867, pl. 70.

We have a series of plants listed under the above mentioned numbers which seem to be very close to the *Sphaerococcus Chauvini* of Bory, based upon the material collected by Lesson and Durville at Concepcion, Chile. Bory was confronted with the same difficulties, apparently, which have confronted us, viz.—a series of forms without any accompanying data as regards their habitat, variability, etc., and hence he finally grouped them under one species with three forms, α *latissimus*, β *intermedius* and γ *angustus*. Plate 70 may be taken as representing his widest form, and plate 46, figure b, as representing his narrowest form. Critical study of these various forms in their native habitat may reveal them to be distinct entities with wide, though limited, variations. For the present, with the scanty material at hand, we are grouping them all under one species.

Gigartina sp.

Johnston, no. 10a, represents a single small plant which seems to be unlike any known species. The specimen is sterile, and seems to be close to *G. tenella* Harvey. We are not venturing to name it.

GYMNOGONGRUS MARTIUS, Fl. Bras., I, 1833, p. 27

Gymnogongrus carnosus S. and G. sp. nov.

Plate 47, a, and plate 22, fig. 1

Fronds 7-10 cm. high, attached by a small disk-shaped holdfast, irregularly and subdichotomously branched, more or less flattened throughout, somewhat cartilaginous, gelatinizing readily in fresh water after drying; color purplish red; cystocarps relatively small, completely immersed in the tissues of the frond; tetraspores and antheridia unknown; medulla composed of large, rounded, thickwalled cells merging gradually into smaller subspherical cells of the subcortex, merging in turn into anticlinal rows of small, thick-walled cortical cells, 6-9 in a row. Cast ashore.

Type: No. 1345, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 102), in April, at San Pedro Martir Island, Gulf of California.

The combination of characters of this species is not such as to make it unmistakably a member of the genus *Gymnogongrus*. It has a Gigartinaceous cystocarp, and the histological characters are mainly those of *Gymnogongrus*. The very gelatinous nature of the cell-walls, however, is quite different from those of all the known species of the genus.

DICRANEMA SONDER, Nova Algarum, 1845, p. 56

Dicranema rosaliæ S. and G. sp. nov.

Plate 22, fig. 6

Fronds 2-4 cm. high, 350-450 μ diam., sparsely and irregularly branched, cylindrical, tapering upwards to acute apices; medulla composed of a small group of compact, thick-walled, elongated cells, surrounded by about two layers of large, rounded thick-walled cells, with a few small angular cells interspersed just beneath the single layer of cortical cells more or less cubical in form; reproduction unknown.

Cast ashore. Santa Rosalia, across the bay from Guaymas, Mexico. Type, Marchant, no. 103.

Unfortunately all of the specimens of this species are sterile. We are placing them under *Dicranema*, basing our judgment wholly upon the vegetative characters.

CALLOPHYLLIS KUETZING, Phyc. Gen., 1843, p. 400, pl. 69, fig. 2,
in Linnæa, vol. 17, 1843, p. 102 (*nom. nud.*)

Callophyllis Johnstonii S. and G. sp. nov.

Plate 51, a, b

Fronds 6-8 cm. high, 2-4 mm. wide, mostly tapering gradually upwards and more or less acute, consistency mucilaginous, color purplish, branching dichotomous to subdichotomous, angles relatively acute; medulla composed of thick-walled large cells, becoming smaller gradually outwards and interspersed with fine filaments; cortical cells small, easily separating into branched tufts; cystocarps scattered over the "disk" of the frond, numerous and prominent, often elongated lengthwise of the frond, with a single carpostome, not rostrate; antheridial plants thin and delicate; tetraspores unknown.

Growing on rocks in the upper sublittoral belt.

Type: No. 1346, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 118), in June, at Tortuga Island, Gulf of California.

We have but a few specimens of this genus which seems sufficiently amply distinct from all known species to warrant its publication. Some specimens have, in addition to the regular larger branches, rows of short, closely set fimbriæ which bear fruit.

CALLYMENIA AGARDH, J. G., Algæ Med., 1842, p. 98

The original spelling is *Kallymenia*. The genus was founded upon *Rhodomenia Requierii* J. Ag., Symb., 1841, p. 12.

Callymenia pertusa S. and G. sp. nov.

Plate 49, b

Fronds thin and flabby, indefinite in form and size, rose colored, perforations numerous, relatively large, nearly circular, smooth; medulla composed of much branched, intertwined

filaments passing rather abruptly on either side into a few relatively large angular cells in turn merging into short, 2-4 celled anticlinal rows, forming the cortex, the terminal cells in the rows being 4-6 μ diam., and 2-3 times as long; reproduction unknown.

Cast ashore.

Type: No. 1347, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 105), in April, at San Pedro Martir Island, Gulf of California.

Unfortunately the plants of this collection are too fragmentary and sterile to permit a complete diagnosis of the species. The habit is different from *C. perforata* J. Ag. and the perforations are different from those of *C. cribrosa* Harvey, while the structure is different from both.

Family RHODOPHYLLIDACEÆ

ANATHECA SCHMITZ, in Schmitz and Hauptfl., Rhodophyllidaceæ,
in Engler and Prantl, Natürl. Pflanzenfam., 1896, p. 374

Anatheca elongata S. and G. sp. nov.

Plate 22, figs. 4, 5 and plate 69

Frond 15-18 cm. high, 5-8 mm. wide, irregularly branching into several elongated erect segments, and into numerous, short, subulate, perpendicular marginal pinnæ; medulla composed of a few small compact filaments, merging directly into large, rounded thick-walled parenchymatous cells with abundant contents, these becoming smaller, somewhat elongated radially and terminating in 2-3 layers of small, angular cortical cells; tetrasporangia 70-80 μ long, tetraspores zonate, terminal ones more or less conical; cystocarps and antheridia unknown.

Cast ashore.

Type: No. 1348, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 107), in April, at San Pedro Martir Island, Gulf of California.

The structure of this species of *Anatheca* is very similar to that of *A. furcata* S. and G. (1903, p. 310, pls. 23, 24) from Whidbey Island, Washington, but the plants are very much

longer and narrower and the branching distinctly different. It is a much larger and coarser plant in every way than *A. dichotoma* Howe (1911, p. 502, pl. 29) from the Gulf of California.

EUCHEUMA AGARDH, J. G., Nya Alg., 1847, p. 16

Eucheuma uncinatum S. and G. sp. nov.

Plates 67, 68

Fronds cylindrical, cartilaginous, 15-20 cm, up to 33 cm. high, 3-5 mm. diam., attached by a parenchymatous disk, branching freely into numerous long, slender, acute branches beginning near the base, all densely clothed with short, more or less branched, acute, uncinat, spinose, fructiferous ramuli; cystocarps occupying the base of the ramuli; antheridial and tetrasporic ramuli much more branched and uncinat than the cystocarpic; color purplish red.

Growing on rocks. San Francisquito Bay, Lower California, Johnston, no. 28, June; San Esteban Island, Gulf of California, Johnston, no. 54, April; Isla Partida, Gulf of California, Johnston, no. 80, July; Angel de la Guarda Island, Gulf of California, Johnston, no. 84a; North San Lorenzo Island, Gulf of California, Johnston, no. 86, June; San Esteban Island, Gulf of California, Johnston, no. 109, April; and Mazatlan, Mexico, Marchant, nos. 62 and 63, May.

Type: No. 1349, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 86), in May, at **North San Lorenzo Island, Gulf of California.**

The distinguishing characteristic of the species is the numerous branched, acute, uncinat ramuli. The ramuli are rarely branched, however, in the cystocarpic plants, which we have considered to belong to the species.

Eucheuma Johnstonii S. and G. sp. nov.

Plate 25, fig. 42 and plates 65, 66

Fronds cylindrical, cartilaginous, 40-50 cm. high, 3-6 mm. diam., gradually attenuated to acute apices; main frond extending nearly to the apex, profusely and alternately branched, branches of several orders, ultimate ramuli of short, acute

spines, irregularly placed; cystocarps unknown; tetrasporangia 80-100 μ long, 30-40 μ broad; tetraspores zonate, very unequal in size, the two terminal ones apparently abortive.

Growing on rocks.

Type: No. 1350, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (Nos. 84 and 88b, tetrasporic plants), in June and July, at **Angel de la Guarda Island, Gulf of California.**

The plants of this species are apparently the largest that have yet been reported. The largest specimen measured over fifty centimeters and was broken off at the base so that the full length could not be ascertained. The extreme inequality in size of the tetraspores, so far as we are aware, has not before been reported. From the relatively small size of the two terminal ones in the sporangium, it would seem that they must be sterile. They are represented on plate 25, figure 42.

GELIDIOPSIS SCHMITZ, Mar. Florid., 1895, vol. 21, p. 148

Gelidiopsis tenuis S. and G. sp. nov.

Plate 22, fig. 2

Fronds 2-3 cm. high, 0.5-0.8 mm. diam., cylindrical, sparsely and alternately branched, long-attenuated, acute; reproduction unknown.

Cast ashore. Santa Rosalia, near Guaymas, Mexico. Type, Marchant, no. 104.

We have very little data upon which to base this species since all of the scanty material at our disposal is sterile. The structure of the fronds seems clearly that of a *Gelidiopsis*, and the size and method of branching seem to be distinct, differing sufficiently from all the few known species to warrant giving to it specific rank, awaiting further data with which to verify the conclusion. The medullary structure is denser than that of *G. variabilis* Harvey, from Ceylon.

GRACILARIA GREVILLE, Alg. Brit., 1830, p. 121

Gracilaria Vivesii Howe

Plate 64

Cast ashore. Guaymas, Mexico, Marchant, no. 55.

Howe, Phyc. Studies V, 1911, p. 503, pls. 30 and 33.

The type locality of *G. Vivesii* is La Paz, Lower California. Although we have fairly extensive collections by Johnston, Marchant and Brandegee from this locality, nothing among them seems to agree with Howe's description and figures of the species. The specimens which we have here allied with this species seem to agree perfectly so far as color, form and structure are concerned. The plant figured on plate 64 is considerably larger (about twenty-four centimeters high) than the measurements given by Howe for his La Paz plant, but this is the largest of several specimens in the collection, and has a few more dichotomies than the type. We have a single plant with young cystocarps, rather sparsely scattered over the frond. The other specimens are sterile. Howe had only sterile and antheridial plants.

Gracilaria lichenoides (L.) Harv.

Growing in the sublittoral belt. Coyote Bay, or Concepcion Bay, Lower California, Johnston, no. 14, June.

Harvey, Alg. Tasm., 1844, p. 445.

The plants of this collection are sterile. They have the habit of *Fucus lichenoides* of Turner (Fuci, vol. 2, 1809, pl. 118) although they resemble *G. confervoides* as figured by Harvey, in Phyc. Brit., vol. 1, 1846, pl. 65. There is a rather more abrupt transition to two layered cortex than in the plant figured by Kuetzing for *G. lichenoides* in Tab. Phyc., vol. 18, 1858, pl. 81, b, otherwise the structure is practically the same.

Gracilaria vivipara S. and G. sp. nov.

Plate 24, figs. 28, 29 and plate 63

Fronds flat, 15-20 cm. up to 30 cm. high, 1.5-2.5 cm. up to 4 cm. wide, branching sub-dichotomous to flabellate-polytomous, segments decidedly cuneate, apices rounded, more or

less rolled along the margin, with numerous proliferations of various shapes; main fronds up to 600 μ thick in the lower parts, terminal lobes much thinner; medulla composed of 4-5 more or less indefinite layers of thick-walled, subspherical cells, up to 400 μ diam., and with very sparse contents; the medulla merging rather abruptly into the subcortical tissue composed of a few rounded cells abundantly supplied with contents, and these merging into the cortex composed of 2-3 layers of cuboidal cells or at times slightly elongated radially; cuticle up to 10 μ thick; tetrasporangia numerous, distributed over the main parts of the fronds; cystocarps rather sparse, distributed over the frond; antheridia unknown; color dark violet purple.

Dredged from 4-6 fathoms. Smith Island, Gulf of California, Johnston, no. 61, June.

Type: No. 1351, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 36), in June, at Los Angeles Bay, Lower California.

This species of *Gracilaria* resembles in general form no other described species of the genus. It is much larger than *G. Cunninghamii* Farlow, much more proliferous and flabby than either *G. Vivesii* Howe or *G. peruana* Picc. and Grun., and is decidedly different from *G. Johnstonii* of this paper, although it seems to have its nearest relatives in these species.

Gracilaria pinnata S. and G. sp. nov.

Plate 61

Fronds flattened, sub-cartilaginous, 8-10 cm. high, 3-4 mm. wide, pinnately branched, the branches and terminal pinules all tapering gradually to acuminate apices; marginal pinules either alternate or secund; medulla composed of elongated cells in transverse section, decreasing in size toward the margins; cortex composed of 2 layers of small cuboidal cells; reproduction unknown; color purplish red.

Dredged in 4-6 fathoms.

Type: No. 1352, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 44), in June, at Los Angeles Bay, Lower California.

The basal portions of all of the plants in this collection are lacking. The plants, however, have the appearance of being nearly complete. They are all sterile. The method of branching and flatness of fronds allies them with J. G. Agardh's subgenus *Podeum*, but it does not agree with any of the species described under this section of the genus.

Gracilaria sinicola S. and G. sp. nov.

Plate 62

Fronds dark flesh colored, decidedly coriaceous, 15-20 cm. up to 30 cm. high, 2-3 cm. wide, dichotomously branched 4-6 times, segments only slightly cuneate, margins smooth, entire or at times slightly proliferous; terminal segments blunt, rounded, angles rounded; medulla composed of large rounded cells, merging into a few small spherical subcortical cells; cortex composed of 4-6 layers of small cuboidal cells, the surface layer two times as long radially as broad; cuticle 8-10 μ thick; cystocarps and antheridia unknown; tetrasporangia abundant, spread over the whole surface of the upper parts of the frond.

Type: No. 1353, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 108), in April, at San Esteban Island, Gulf of California.

Gracilaria sinicola is closely related to *G. Vivesii* Howe but the fronds are more rigid and coriaceous, are darker colored, have more acute angles, longer segments and a thicker cortex.

Gracilaria Johnstonii S. and G. sp. nov.

Plate 22, figs. 11-14 and plate 60

Fronds coriaceous, flat, 12-18 cm. up to 28 cm. high, 1-1.5 cm. wide, branching mostly poly-chotomous, segments mostly narrowed below, margins smooth, free from proliferations, terminal segments blunt, round, angles mostly rounded, color purplish red; medulla composed of large thick-walled cells merging into smaller, more or less spherical storage cells; cortex composed of 3-5 layers of small cells; cuticle 8-10 μ thick;

tetrasporangia numerous, scattered over the upper parts of the whole frond; cystocarps numerous, large and prominent, somewhat flattened; antheridia unknown.

Growing on rocks in the upper sublittoral belt.

Type: No. 1354, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 62), in July, at Isla Partida, Gulf of California.

Gracilaria Johnstonii resembles in habit some of the wider forms of *G. multipartita* (Clem.) Harv. but the smallest specimens are larger than the widest of that species.

Gracilaria pachydermatica S. and G. sp. nov.

Plate 24, figs. 30, 31

Fronds attached by a small disk, cylindrical to slightly flattened, caespitose, 3-5 cm. high, 1.5-2.5 mm. diam., branching dichotomous, angles acute, color coral red; medulla composed of cells relatively uniform in size, nearly circular in cross section, merging almost directly into the cortex composed of 2-3 layers of cells except towards the base where it becomes 10-20 cells thick, parenchymatous, arranged in radial rows; reproduction unknown.

Growing on rocks in the upper sublittoral belt.

Type: No. 1355, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 122), in June, at Tortuga Island, Gulf of California.

The habit of *Gracilaria pachydermatica* is close to the habit of *Sphaerococcus obtusus* Kuetzing, (Tab. Phyc., vol. 19, 1869, pl. 21) from Ceylon. The fronds are more regularly dichotomous, much more densely caespitose, and has the much thickened cortex on the stipe. Nothing is known of the reproduction in either species.

Gracilaria crispata S. and G. sp. nov.

Plate 22, figs. 7-10 and plate 44, a

Fronds complanate throughout, 4-7 cm. high, 400-600 μ thick, attached by a very small disk; color dark purplish red; branching polytomous into several distinct main branches, each

again dividing into several smaller segments with crisped margins and finally terminating in very numerous fine flattened ramuli; fronds composed of 3-5 layers of medullary cells very variable in size, up to 200 μ diam. and subspherical, merging into 2-3 layers of smaller subcortical cells giving rise to anticlinal rows of 2-4 cells, the outer usually considerably elongated; cuticle 4-6 μ thick; tetrasporangia among the anticlinal cells, 40 μ long, 30 μ broad; antheridia arising from subcortical cells, borne in pockets irregular in shape and size surrounded by elongated cortical cells; mature cystocarps wholly superficial, scattered over the whole frond, mostly apiculate, placenta narrow at base, extending upward and branching in all directions.

Cast ashore. Eureka, near La Paz, Lower California. Type, Marchant, no. 51, May.

Gracilaria crispata has very much the same habit as *G. Millardetii* (Mont.) J. Ag. in the section Podeum of J. Agardh (Epicr., p. 422) but has apparently more of the structure of the members of his section, Pachycladia. Our plants are much smaller and much more profusely branched, especially so at the outer ends of the secondary branches. The placenta of the cystocarp has a structure worthy of note as being quite distinct from any which have been described in the genus. Contrary to the general rule, the base of the placenta is relatively small. The sterile, almost parenchymatous, mass of cell extends upward through the cavity of the cystocarp, branches in all directions, and finally terminates in simple spore bearing threads, giving rise to chains of carpospores.

The antheridia are similar to those described by Howe (Phyc. Studies, 1911, p. 503, pl. 33, figs. 1-5) in *G. Vivesii*, but the crypts are not so extensive as he illustrates for that species. The tetrasporangia are of the characteristic type, and occur in the narrow cortex of the anticlinal cells. The cortex in the cystocarpic plants is composed quite uniformly of two cells in the anticlinal rows except in the wall of the cystocarp which has several cells in a row. There is a much more abrupt change from the subcortical cells to the anticlinal cells than in either the tetrasporic or the antheridial plants. The

antheridial plants are more laciniately divided and are less crisped along the margins than either the tetrasporic or cystocarpic plants.

Gracilaria subsecundata S. and G. sp. nov.

Plate 23, figs. 26, 27 and plate 59

Fronds subcylindrical, attached by a small disk, 10-14 cm. high, 1-2 mm. wide, branching variable, dichotomous, dichotomopalmate, distichous and secund, attenuated upwards and acute; medullary cells more or less angular, irregular in shape and size, merging into smaller parenchymatous cells radially elongated, these terminating in anticlinal rows 3-4 cells long; cystocarps and antheridia unknown; tetrasporangia of the usual *Gracilaria* type.

Cast ashore. Guaymas, Mexico. Type, Marchant, no. 56, May.

This species of *Gracilaria* is decidedly distinct from all of the others collected in the Gulf of California, and indeed seems to have no close relative outside of the Gulf. The relatively delicate acute fronds and the diversity of methods of branching are distinguishing characters.

Gracilaria lacerata S. and G. sp. nov.

Plate 51, C

Frond flattened, 6-8 cm. high, 2-5 cm. wide, color dark coral red, branching more or less irregular, margins somewhat proliferous, serrate, with scattered teeth, lenticular in cross section; medulla composed of thin-walled parenchymatous cells, surrounded by a few small angular cells, the whole clothed in a single layer of small, cuboidal cortical cells; cystocarps and antheridia unknown.

Cast ashore. Santa Rosalia, near Guaymas, Mexico. Type, Marchant, no. 102, May.

The plants of this species apparently have been subjected to abnormal treatment. They are covered with foreign material, and appear to be more or less battered. The tetrasporic plants have the characteristic tetraspores of the genus. It undoubtedly belongs to J. Agardh's section Podeum, and is possibly

near to *G. corticata* J. Ag. and to *G. dentata* J. Ag., but is more lacerate or dentate than the former, and broader, thinner and less acutely dentate than the latter.

Gracilaria sp.

Plate 58

We have a few sterile specimens, Johnston, no. 123, of a species which seems to belong to the genus *Gracilaria*, and is well illustrated as to size and method of branching on plate 58. The structure is somewhat different from typical *Gracilaria* and having no fruit we list it here under this genus without a name.

Gracilaria sp.

We have three fragments of plants under Marchant, no. 64, which have the general appearance of *Gracilaria confervoides* but whose structure is quite different from the structure of that species as represented by Thuret and Bornet in *Etudes Phycologiques*, plate 40. The fronds are cylindrical, slightly branched and long attenuate. The medullary cells are up to 300 μ in diameter and change rather abruptly into two or three layers of smaller cells and finally these into anticlinal rows of four to six cells.

It is possibly near to *Gracilaria dura* (Ag.) J. Ag., but is much less branched than that species. We list it here with the hope that better material may be found, when its correct classification may then be made out.

CORALLOPSIS GREVILLE, Alg. Brit. Syn., 1830, p. LIII

***Corallopsis excavata* S. and G. sp. nov.**

Plate 23, figs. 24, 25 and plates 44, b, and 48

Fronds terete, caespitose, 8-14 cm. high, 1-2 mm. diam., attached at first by a small disk, later by branched, creeping filaments or fronds, giving rise to numerous erect fronds; branching on all sides, alternate or opposite, often becoming fasciculate at the top, at times producing whorls of short,

subulate ramuli mostly at the nodes; young plants and terminal ramuli of mature plants, particularly tetrasporic plants, deeply constricted at regular intervals forming fusiform segments, medulla composed of a loose network of fine filaments in the tetrasporic region, terminating toward the surface in anticlinal rows of cortical cells; in the vegetative region composed of narrow, parenchymatous cells elongated lengthwise of the filaments, merging into large cells, cells of the subcortex and terminating in short anticlinal rows of the cortex; color dark coral red; tetrasporangia numerous in cavities opening at several points in the fusiform segments, or internodes; tetraspores variable, mostly cruciate; cystocarps numerous, very prominent spherical to urn-shaped, placenta large, dense, much elevated, pericarp thick, composed of anticlinal rows of small dense cells, carpostome small, single, carpospores very numerous, 7-10 μ diam., in radiating rows from the large placenta; antheridia unknown.

Growing on rocks in the upper sublittoral belt. San Marcos Island, Johnston, no. 12, June; Tortuga Island, Johnston, no. 21, June; Isla Partida, Johnston, no. 59, July; San Esteban Island, Johnston, no. 116, April; Angel de la Guarda Island, Johnston, nos. 129 and 130, June, all in the Gulf of California.

Type: No. 1356, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 59 with tetraspores, and No. 21 with cystocarps), in June and July, at Tortuga Island and Isla Partida, Gulf of California.

This interesting and apparently unique plant seems to be pretty generously distributed in the Gulf. We are in some doubt as to the genus to which it belongs. Judging from the description only, of the genus *Corallopsis* Grev., it seems best for the present to ally it with that genus. We have no specimens of any species of the genus for comparison. Indeed, most of the species have been imperfectly described. Its internal structure is differentiated into three tissues, whereas the description of the genus calls for only two. The structure of the cystocarp agrees very well with the generic description. Tetraspores have been described in only one species, viz.; *C. aculeata* (Her.) Holmes (New Mar. Alg., 1894, p. 336, pl. 18,

fig. 16-20). The tetraspores in this species are regularly cruciate, but are developed near the surface in the anticlinal rows. The tetraspores of ours are developed in cavities extending to the center of the swollen, almost moniliform, portions of the ramuli. The tetraspores escape through numerous openings on the surface (plate 23, fig 25). We know of no other plant which has tetraspores borne in this way. It may thus become necessary, after a careful study of the species, especially of the antheridial plants, to create a new genus for its reception.

HYPNEA LAMOUROUX, Essai, 1813, p. 43

Hypnea pannosa J. Ag.

A few scattered specimens of a *Hypnea* which seems to belong to this species have been found among the Johnston specimens.

J. G. Agardh, Nya. Alg., 1847, p. 14.

Hypnea Johnstonii S. and G. sp. nov.

Plate 23, fig. 19-21 and plate 57

Fronds densely caespitose, 7-10 cm. high, 1.5-2.5 mm. diam., freely branching near the decumbent base into long, rigid, tapering branches, these in turn producing numerous, aculeate ramuli on all sides, gradually reduced in length towards the apices; apices rounded, not terminated by a single cell; tetrasporangia borne on very short, densely branched, acuminate, fructiferous ramuli not constricted at the base; tetraspores zonate; cystocarps and antheridia unknown; color dark red.

Growing on rocks in the upper sublittoral belt. Tortuga Island, Gulf of California, Johnston, no. 125, May; Angel de la Guarda Island, Gulf of California, Johnston, no. 1, June.

Type: No. 1357, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 1), in June, at Angel de la Guarda Island, Gulf of California.

Hypnea Marchantæ S. and G. sp. nov.

Plate 23, figs. 22, 23 and plates 42, a, and 56

Fronds caespitose, 8-14 cm., up to 20 cm., high, up to 1 mm. diam., branching very irregular, of 5-8 orders, becoming smaller at each successive branching and more or less contorted, clothed throughout with short, relatively simple, perpendicular, sterile branches of varying lengths and in part with densely crowded, subulate, acute, more or less branched, fructiferous ramuli; tetrasporangia in swollen parts of the ramuli, usually some distance from the broad base; antheridia and cystocarps unknown; ramuli terminating in a single growing cell.

Cast ashore. Eureka, near La Paz, Lower California. Type, Marchant, no. 48, May.

This species is to be distinguished from *H. Johnstonii* in being much longer, more delicate, in having more orders of branching, more densely crowded, less branched and more attenuate fructiferous ramuli, and in having a single apical cell instead of a group.

CORDYLECLADIA J. G. AGARDH, Sp. Alg., vol. 2, 1852, p. 702

Cordylecladia lemanæformis (Bory) Howe

"Sublittoral, on sandy beach. Very common." Los Angeles Bay, Lower California, Johnston, no. 35, June; La Paz, Lower California, Johnston, no. 48, April, and Marchant, no. 69, May.

Howe, Mar. Alg. Peru, 1914, p. 128. *Gigartina lemanæformis* Bory, Voy. Coquille, Bot. Crypt., 1828, p. 151. *Cordylecladia Andersonii* Grun. (in part) in Piccone Alg. Vettor Pisani 1886, p. 62.

We have a series of fine specimens of plants which we are referring to this species. They very much resemble some forms of *Gracilaria confervoides*, but they are much more profusely branched, decidedly more delicate, longer attenuate upward and are acute. The medulla is composed of large parenchymatous cells, merging abruptly into a rather thick cortex, composed of very small cells. The cystocarps are external, quite

small, and somewhat flattened, with a broad flattened placenta. The color is light brown to almost black. The plant agrees fairly well with Bory's description (*loc. cit.*) and in part with that of Grunow (*loc. cit.*) who based his description of *C. Andersonii* in part upon plants collected by d'Urville at Paita, Peru, and in part upon plants collected by Anderson on the coast of California, but our knowledge of the species comes through the description and figure of Howe.

Family BONNEMAISONIACEÆ

ASPARAGOPSIS MONTAGNE, Phyt. Canar., 1840, p. XV

Asparagopsis Sanfordiana f. *amplissima* S. and G. f. nov.

Plate 22, fig. 3 and plate 41

Fronds up to 25 cm. high, several arising from creeping filaments attached to rocks at various points; primary branches very densely crowded, plumose, 3-5 cm. long, arising on all sides; antheridia in dense cylindrical clusters at the ends of the ramuli.

Cast ashore. Eureka, near La Paz, Lower California. Type, Marchant, no. 37.

This form differs from the species principally in being much more ample in all of the upper branching portions. Apparently the antheridia have not previously been seen. We are describing and figuring them here.

Family RHODOMELACEÆ

LAURENCIA LAMOUROUX, Essai, 1813, p. 42

Laurencia obtusiuscula S. and G. sp. nov.

Plate 23, fig. 17 and plate 55

Fronds 10-18 cm. high, terete; main axis mostly percurrent, 1-2 mm. diam.; secondary branches distant, alternately branched on all sides, all of the branches being long and slender and more or less crooked; color dark purple. The short lateral branches bearing the fructifications sub-verticillate; fructiferous ramuli several, frequently themselves branched, arising on all sides, forming conical shaped groups; cells of the

main axis 25-35 μ diam., 2.5-3.5 times as long, ellipsoidal; cells of the fructiferous ramuli equilateral or slightly wider than long; cystocarps lateral on the ramuli, occupying the position of ultimate ramuli, flaskshaped with short neck, sessile, 600-700 μ diam.; tetrasporic ramuli cylindrical, up to 500 μ diam., blunt, scarcely constricted at the base; antheridia unknown.

Cast ashore. Eureka, near La Paz, Lower California, Marchant, nos. 40 and 46; La Paz, Lower California, Marchant, no. 67. Type, Marchant, no. 46, May.

Laurencia obtusiuscula seems, from its structure and general habit of growth, to be related rather closely to *L. papillosa* (Forsk.) Grev. but it differs very decidedly from that species as represented by Kuetzing (Tab. Phyc., vol. 15, pl. 62, a, b) in the character of the fructiferous ramuli. Those of *L. obtusiuscula* are cylindrical while those of *L. papillosa* are very short and broadly clavate, the younger ones subspherical. It seems best to coincide with the characters set forth by J. Agardh (Epicr., 1876, p. 653) for his group "Obtusæ," and is probably close to *L. obtusa* (Huds.) Lamour. or some described form.

Laurencia obtusiuscula var. *corymbifera* S. and G. var. nov.

Plate 23, figs. 15, 16 and plate 45, b

Fronds 4-7 mm. high, branching at the base into several main branches, ramuli sub-verticillate, the ultimate fructiferous ramuli crowded on short branches forming dense clusters; cystocarps and antheridia unknown; tetrasporic ramuli cylindrical, slightly constricted at the base.

Growing on rocks in the upper sublittoral belt.

Type: No. 1358, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 18b), in June, at Tortuga Island, Gulf of California.

A few specimens of this plant were separated from a collection from Tortuga Island which resemble those which we have called *L. obtusiuscula*. They differ decidedly in general aspects as comparison of the figures of the two, as here produced, readily show. The plants of var. *corymbifera* are much smaller,

however we are unable to state whether these are typical specimens or otherwise. The tetrasporic plants are all which we have for study and these bear a close resemblance to *L. corymbifera* Kuetz. (Tab. Phyc., vol. 15, pl. 56, a, b) the tetrasporic ramuli are more numerous, however, and are not disposed in quite the same manner, and are more nearly cylindrical. If further discoveries should reveal these to be typical plants, the variety should doubtless be given specific rank.

Laurencia obtusiuscula var. *laxa* S. and G. var. nov.

Plate 29, fig. 67 and plate 52, b

Fronds 5-8 cm. high, up to 1 mm. diam., branching into several main branches, ramuli less numerous and more scattered than in the species; cystocarps and antheridia unknown.

Cast ashore. Guaymas, Mexico. Type, Marchant, no. 41, May.

We have but a few tetrasporic specimens of this plant upon which to base our judgment. They are very much smaller in general stature and much less profusely branched than *L. obtusiuscula*. The characters of the cells and of the tetrasporic ramuli agree very well with *L. obtusiuscula*. Further investigation to determine the typical size, and the discovery of cystocarpic and antheridial plants may reveal characters sufficiently different to warrant specific rank for it.

Laurencia paniculata (Ag.) J. Ag. f.

Growing on rocks in the lower littoral belt. San Francisco Bay, Lower California, Johnston, no. 30b, June; Isla Partida, Gulf of California, Johnston, no. 69, June.

The plants of these collections agree fairly well with the descriptions of *L. paniculata* J. Ag. (not *L. paniculata* Kuetz.) and with Kuetzing's figure of *L. glandulifera* (Tab. Phyc., vol. 15, pl. 59, fig. c). Howe (Phyc. Studies V, p. 508) listed a plant of the Vives collection under *L. paniculata* from La Paz, Lower California. The plants of the Johnston collection are probably of the same species. Howe states that the Vives' plants are more slender and the ultimate branches more elongate than the specimens under that name distributed from

Southern California in Phycotheca Boreali-Americana, no. 1093. Our plants are likewise more slender and smaller and not so regularly branched as are the California specimens. We have not had any authentic specimens of *L. paniculata* J. Ag. for comparison, but judging from the descriptions alone, we feel that our plants are not identical with Agardh's. The surface cells throughout the whole length of the main axis are of about the same dimensions, approximately 20 μ across, and occasionally slightly longer than broad. The semiwhorled arrangement of the ultimate ramuli are the same in the Johnston plants as is figured by Kuetzing for *L. glandulifera*. More critical study will be required to establish definitely the specific rank of these forms.

Laurencia estebaniana S. and G. sp. nov.

Plate 24, fig. 34 and plate 45, a

Fronds more or less compressed, 7-10 cm. high, 2-4 mm. broad, considerably distorted; main stem somewhat percurrent with branches at times nearly as long, branching pinnate to alternate, subdistichous, with branches more or less decurrent, fructiferous ramuli in dense glomerules on short ramuli, the glomerules at times distichous and sub-opposite, at times alternate or more or less verticillate; the antheridial ramuli numerous, short-turbinate; tetrasporic and cystocarpic ramuli nearly cylindrical; surface cells on the main frond 10-14 μ diam., 1.5-2 times as long as broad, on the fructiferous ramuli length less than the diameter; antheridia in dense, much branched pyramidal clusters, the apical cell of each main cluster pedicellate, sub-spherical, 20-25 μ long, 16-20 μ broad; antheridia 2-3 μ diam.

Growing on rocks at San Esteban Island, no. 53c, in April and Smith Island, no. 89, in June.

Type: No. 1359, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 53c), in April, at San Esteban Island, Gulf of California.

Laurencia estebaniana seems to have no close relatives on the Pacific Coast. It clearly belongs to Group IV, Pinnatifidæ, of J. Agardh (Epicr., 1876, p. 655) in which he groups all of

the species with flattened or partially flattened fronds. Most of the fronds of *L. estebaniana* are decidedly flattened, but some of them are more or less terete above, and somewhat angled where the branches are decurrent. It is apparently most closely related to *L. flexuosa* Kuetz. but the tetrasporic ramuli are not arranged in whorls as represented by Kuetzing (Tab. Phyc., vol. 15, pl. 68) for that species.

Laurencia Johnstonii S. and G. sp. nov.

Plates 52, a, and 53

Frond up to 15 cm. high, cylindrical, slender throughout, attached by repeatedly branched rhizoidal filaments; primary axis percurrent, up to 1.5 mm. diam.; virgate, the secondary branches at times as long as the primary axis and clothed with very numerous, densely crowded, tertiary branches and ultimate fructiferous ramuli; color dark purple, black on drying; cells of the main axis equilateral to slightly longer than broad, with rounded angles; cells of the fructiferous ramuli slightly broader than long; fructiferous ramuli cylindrical, considerably constricted at the base, 375-425 μ diam., numerous, arising on all sides, of very numerous, short sub-ultimate ramuli, flask-shaped; antheridia unknown; terminal hairs in dense clusters, profusely branched, up to 130 μ long.

Growing on rocks in the upper sublittoral belt. San Marcos Island, Gulf of California, Johnston, no. 127, June; San Francisco Bay, Lower California, Johnston, No. 30a, June.

Type: No. 1360, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 127), in June, at San Marcos Island, Gulf of California.

Laurencia sinicola S. and G. sp. nov.

Plate 29, figs. 65, 66 and plate 50, a

Frond epiphytic, attached by a creeping thallus, decidedly compressed, 3-6 cm. long, 2-4 mm. broad, sparsely and pinnately branched, with branches at times as long as the main frond; surface cells of the main axis more or less ellipsoidal, 45-55 μ long 25-30 μ broad; fructiferous ramuli pinnately ar-

ranged, not constricted at the base, the antheridial tuberculate, the tetrasporic clavate-tuberculate, surface cells on the main frond 10-14 μ diam., 3-5 times as long; antheridia in loose paniculate clusters, the apical cell of each main cluster being pyriform, 7-9 μ long, 5-7 μ broad.

Growing on *Sargassum* sp. Eureka, near La Paz, Lower California, Marchant, nos. 34 and 47, May; San Marcos Island, Gulf of California, Johnston, no. 126, June. Type, Marchant, no. 47.

Laurencia sinicola is distinct in its gross morphological characters from all of the known species of *Laurencia* in the small size combined with the flattened frond. Its antheridial clusters are loose and composed of very delicate branches. The antheridia are small, 2-3 μ in diameter. It seems to be nearly related to *L. spectabilis* Post. and Rupr. but is very much smaller in all of its parts, less regularly pinnately branched and is epiphytic instead of growing on rocks.

Laurencia papillosa var. *pacifica* S. and G. var. nov.

Plate 23, fig. 18; plate 24, fig. 33; plate 43, a, b, and plate 54

Fronds pyramidal, 9-13 cm. high, main axis percurrent; fructiferous ramuli short, turbinate; antheridial and tetrasporic ramuli with several lobes around the terminal depression; antheridia borne in whorls on an axis terminated by a single large pyriform cell; color dark purple, almost black on drying; cystocarps not observed; cells on the surface of the main axis polygonal, closely appressed, thin, firm walled, 18-22 μ diam.

Growing on rocks in the upper sublittoral belt. San Marcos Island, Gulf of California, Johnston, no. 9, June; Eureka, near La Paz, Lower California, Marchant, no. 38, May. Type, Marchant, no. 38.

We have examined some of the co-type material of *L. papillosa* (Forsk.) Grev. and find that the ultimate fructiferous ramuli are sub-spherical, in this respect agreeing very well with the figures of Kuetzing in Tab. Phyc., vol. 15, pl. 62, figs. a, b. Our plants agree very well in general form and method of branching with the descriptions of *L. papillosa* but the fructif-

erous ramuli in ours are much less numerous and not so densely crowded, are short and much more broadly turbinate than in the co-type material or as shown in Kuetzing's figures.

Comparison with Howe's plant, no. 128, of *L. papillosa* from the Bahamas, shows a considerable difference in the character and size of the surface cells. Ours are about 20 μ in diameter, are thin walled and are densely crowded together, while his are about 40 μ in diameter and are somewhat thicker walled. The antheridial and tetrasporic ramuli of var. *pacifica* are broadly turbinate with several distinct lobes surrounding the terminal depression.

Laurencia sp.

Plate 29, figs. 68, 69

Among the specimens of the Marchant collection a terminal fragment of a branch from a tetrasporic plant was found (Marchant no. 76) which approximates to the description of *L. virgata* (Ag.) J. Ag. The tetrasporic ramuli are about 5 mm. long, and occur in very dense clusters alternately arranged on the stem so that the main stem is almost obscured. These ramuli are cylindrical and about a half millimeter in diameter. It is distinct from any of the other Mexican species but too fragmentary to justify a name.

CHONDRIA AGARDEL, Syn. Alg. Scand., 1817, p. XVIII

Chondria acrorhizophora S. and G. sp. nov.

Plate 40, b

Fronds 4-5 cm. high, 500-700 μ diam., decompositely branched from near the base; main frond at times percurrent, more frequently divided into several secondary branches, the lower branches longest, forming a flat top, more or less resembling an inverted cone; the ultimate, tetrasporic ramuli numerous on all of the branches of different orders, 1-1.5 mm. long, standing at about 45° angle, constricted at the base, curved at times almost cirrhose at the apices; apices of the main branches nude for some distance, acute, usually uncinat; the subterminal ramuli frequently developing dense clusters of rhizoidal cells;

pericentral cells 5, large, surrounded by one layer of smaller, thick walled, angular cells, and the cortex composed of a single layer of cells; cortical cells thick walled, irregular in shape, 2-6 times as long as broad in surface view, decidedly elongated radially in cross section; pericentral cells of the lower parts of the main fronds having parts of the walls very much thickened.

Cast ashore. Eureka, near La Paz, Lower California. Type, Marchant, no. 44, May.

Chondria acrorhizophora resembles in form and size *C. lanceolata* Harv. but our specimens are terete throughout while *C. lanceolata*, as figured by Harvey in Phyc. Austral., plate 239, is flattened. A nearer relative, as it seems to us, may be found in *C. tenuissima* f. *californica* Collins, in Phy. Bor. Amer. (Exsicc.) no. 636, from La Jolla, Calif. These plants are more robust than ours and have a distinctly different cell structure.

POLYSIPHONIA GREVILLE, Fl. Edin., 1824, p. 308

Polysiphonia Johnstonii S. and G. sp. nov.

Fronds ecorticate, relatively rigid, 5-8 cm. high, up to 1 mm. diam. at the base, tapering gradually from the base upwards, branched dendritically near the base into several primary branches moderately wide-spreading, which in turn are repeatedly branched alternately and terminated by dense fascicles of fructiferous ramuli which finally terminate in dense fascicles of long branched hairs; pericentral cells 6, up to 1 mm. long at the base of the fronds, reduced in length above becoming quadrate or less in the ramuli; color dark brownish red, almost black on drying; cystocarps supported on short pedicels, numerous on the terminal ramuli, sub-spherical 450-500 μ diam., clothed with large quadrate cells 60-70 μ diam., antheridia in terminal, pyramidal, dark colored clusters. Tetrasporangia unknown.

Growing on *Gracilaria* sp.

Type: No. 1361, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 110), in April, at San Esteban Island, Gulf of California.

There are no *Polysiphonias* with six pericentral cells which at all approximate to the characters of this Mexican form.

Our plant varies in almost every detail from any of the described species. In some respects it may perhaps be considered close to *P. decipiens* Mont., which has seven pericentral cells, but differs in other respects. As figured by Kuetzing, Tab. Phyc., vol. 13, pl. 65, figs. c-e, the growing apices of *P. decipiens* are much more blunt and lack the fine terminal divisions and fascicles of hairs so characteristic in ours.

Polysiphonia Marchantæ S. and G. sp. nov.

Plate 49, a

Fronds 5-8 cm. high, 450-550 μ diam. at the base, ecorticated, main branching sub-dichotomous, ramuli alternate, distant, divaricate, terminating in a fascicle of long branched hairs; color dark red; pericentral cell 5; 3-4 times as long as broad below, 0.5-1 times above; cystocarps on short pedicels, slightly beaked, 380-420 μ diam.; tetrasporic ramuli relatively short and considerably distorted; tetrasporangia few, near the ends of the ramuli, spherical, prominent, 80-110 μ diam.

Cast ashore at Guaymas, Marchant, no. 50; Eureka, near La Paz, Lower California, Marchant, nos. 52, 83, and 84; La Paz, Marchant, no. 66 and Brandege, no. 12. Type, Marchant, no. 66. The Marchant plants were all collected in May, 1917.

This five-siphoned species seems to be quite generally distributed in the Gulf of California. Having been cast ashore among other algæ, the habitat and the character of the attaching parts will have to remain subjects for future investigation.

The very large and relatively short cells and the size and general appearance of the plant are characters very similar to those of *P. Johnstonii* of this paper. There is a constant difference in the number of pericentral cells, and differences in details of dimensions of parts which, along with differences in the character and method of branching, render the two distinct species.

Polysiphonia forcipata Harvey (Mar. Bot. of West Australia) seems to be a near relative of *P. Marchantæ*, as far as we may judge from the description. The figures of Kuetzing

in Tab. Phyc., vol. XIV, pl. 44, figs. a-d, represent a plant of *P. forcipata* much more blunt, lacking the numerous small terminal divisions and fascicles of branched hairs which are prominent in ours. *P. forfex* Harvey, Phyc. Austr., pl. 96, considered by De Toni, Syll. Alg., vol. IV, p. 921, as a synonym of *P. forcipata*, has six pericentral cells and the forcipate ramuli much more blunt than ours.

Polysiphonia sinicola S. and G. sp. nov.

Fronds ecorticate, 7-10 cm. high, 250-350 μ diam. at the base, tapering only in the upper parts, branching alternate on all sides; ramuli strict, substance soft and flabby, color flesh red, pericentral cells 6; reproduction unknown.

Growing on rocks in the lower littoral belt.

Type: No. 1362, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 41), in June, at Los Angeles Bay, Lower California.

It may seem presumptuous to describe another *Polysiphonia* from the small amount of material at our disposal and particularly so when the same is completely sterile. The six siphoned species appear to be rather scarce and the morphological characters of this one seem sufficiently different from any known form to warrant giving this one a name, awaiting further investigation to establish its independence.

DIGENEÆ AGARDH, Sp. Alg., vol. 1, part 2, 1822, p. 388

Digenea simplex (Wulf.) Ag.

Cast ashore. La Paz, Lower California, Brandege, no. 33.

Agardh, Sp. Alg., vol. 1, part 2, p. 389. *Conferva simplex* Wulfen, Crypt. Aquat., 1803, p. 17, n. 16.

The specimens of this collection are all sterile. Structurally they appear to be very similar to the specimens distributed in Collins, Holden and Setchell, Phyc. Bor. Amer., nos. 143 from Florida and 1939 from Bermuda.

HETEROSIPHONIA MONTAGNE, Prod. Phyc. Pol. Antarct., 1842, p. 4

Heterosiphonia sinicola S. and G. sp. nov.

Plate 28, figs. 59, 60 and plate 47, b

Fronds erect, 6-8 cm. high, terete; main frond usually percurrent, dendroidally branched, up to 1 mm. diam.; branches terminated by small dense fascicles of much branched acute filaments with cells about twice as long as broad; medulla with 5 large pericentral cells surrounded by a single layer of smaller irregular cells; cortex composed of a single layer of cells, very thick-walled and very irregular in size and form, 2-5 times as long as broad, thicker radially in cross section; cystocarps and antheridia unknown.

Cast ashore. Eureka, near La Paz, Lower California, Marchant, no. 49, May; La Paz, Marchant, no. 65, May; Marchant, no. 86a. Type, Marchant no. 65.

The nearest described relative of this species seems to be *H. coccinea* (Huds.) Falkenb.

COLACODASYA SCHMITZ, in Engler and Prantl., Natürl. Pflanzenfam., 1897, p. 473

Colacodasya sinicola S. and G. sp. nov.

Plate 28, fig. 63

Fronds very variable in size, up to 900 μ diam., solid, somatic portion spherical, attached by a broad base; cystocarpic fronds with ample somatic portion, covered with sessile or short stalked cystocarps; cystocarps spherical to slightly elongated, 160-180 μ diam.; antheridial fronds with smaller somatic portion giving rise to numerous antheridial branches, 400-500 μ long and sympodially branched; antheridia in dense fusiform clusters; tetrasporic fronds producing sparse short stichidial branches with short, slightly curved tips and tripartite tetraspores.

Growing on *Chondria acrorhizophora* S. and G. Eureka, near La Paz, Lower California. Type, Marchant, no. 43a, May.

Colacodasya sinicola is closely related to *C. verruciformis* Setchell and McFadden, in McFadden, 1911, p. 149, pl. 19,

growing on *Mychodea episcopalis* J. Ag. The material at hand, although having representatives of all three forms of fruit, is too sparse to admit of detailed study as to histological characters. The plants in general are smaller, the cystocarps are mostly sessile and more nearly spherical, not urceolate, and the tetrasporic ramuli, stichidia, are smaller, so far as the material at hand shows. These differences, coupled with having a different host and growing in a different temperature-region, seem to us sufficient to warrant keeping it separate for the present.

Family CERAMIACEÆ

CALLITHAMNION LYNGBYE, Hydr. Dan., 1819, p. 123

Callithamnion endovagum S. and G. sp. nov.

Plate 28, fig. 62

Plants parasitic (?), the endophytic portion extending completely through the frond of host, and composed of much branched, slender filaments, 5-7 μ diam., with cells very variable in length, giving rise to erect vegetative and reproductive filaments on both sides of the host; erect fronds blunt, up to 200 μ high, 8-10 μ diam., 2-5 times forked; cystocarps small, apparently with but a single lobe; tetrasporic and antheridial plants unknown.

Growing in the fronds of *Grateloupia prolongata* J. Ag.

Type: No. 1363, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 53b), in April, at San Esteban Island, Gulf of California.

Only cystocarpic plants of this species have been observed, and these are young. There are but two cells in the carpogonial branch and the carpogonium surmounting these is about 50 μ long. There are no known species closely related to it.

CERAMIUM AGARDH, Syn. Alg. Scand., 1817, pp. XXVI and 60

The genus *Ceramium* seems to be well represented in the Gulf of California, but, as is usual in the warmer waters, most of the species are very diminutive, indeed some are microscopic, and their discovery has been more or less accidental or inci-

dental in the study of the structure of their hosts, as has been our experience on several occasions. The amount of material has thus, in several instances, been very scanty and further study is highly desirable to clear up doubtful points and make known their complete history.

Ceramium procumbens S. and G. sp. nov.

Plate 27, figs. 51-54

Fronds microscopic, wholly prostrate, attached to the host by very short rhizoidal filaments, 0.5-1 mm. long, 45-55 μ diam., corticated only at the nodes, branching distichous, the ramuli parallel with the host, often opposite; tetrasporic ramuli short, clavate; tetrasporangia completely immersed, sparse, irregularly placed, 50 μ long, 40 μ broad; cystocarps single, or rarely 2-3 together, short-pedicellate, spherical, 50-60 μ diam., arising near the ends of ramuli, the main ramulus being pushed aside, 1-3 very short ramuli developing up around them; cystocarps few, 8-12, 20-25 μ diam.; antheridia on short specialized ramuli.

Growing on *Gelidium* sp., San Francisquito Bay, Lower California, Johnston, no. 27a, June, and on *Grateloupia prolougata*, Isla Partida, Gulf of California.

Type: No. 1364, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 27a), in July, at Isla Partida, Gulf of California.

The cystocarps are borne on short one-celled pedicels, and are most frequently single, but as many as three have been observed developing from the same node. The node becomes considerably enlarged, the main ramulus is turned to one side and a few very short ramuli arise from the node and develop around the cystocarp which appears now to sit upon the end of the frond.

This species seems very closely related to *Hormoceras pygmaeum* Kuetzing (Tab. Phyc., vol. 12, pl. 75, figs. a-c) as regards branching and general structure. The magnification as given by Kuetzing (*loc. cit.*) makes our plant somewhat

smaller. Kuetzing's plant seems less frequently branched and has no opposite branching, a character very prominent in ours. His plant apparently is erect, while ours is wholly prostrate.

Ceramium bicornis S. and G. sp. nov.

Plate 28, fig. 64 and plate 74

Fronds 5-8 mm. high, profusely and dichotomously branched, attached by a creeping, prostrate portion with rhizoids; main fronds up to 200 μ diam., completely corticated above, the internodes naked below but shorter than the corticated zones at the nodes; corticating cells not arranged in longitudinal rows, rounded to slightly angular; tetrasporangia completely immersed, irregularly placed in the much swollen terminal ramuli; antheridia on ramuli similar to the tetrasporic ramuli; cystocarps sessile, usually double, surrounded by 6-8 ramuli, some or all of which may develop farther and produce other cystocarps; carpospores numerous, irregular in form, up to 60 μ long.

Growing on *Grateloupia* sp., upper sublittoral belt.

Type: No. 1365, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 62a), in July, at Isla Partida, Gulf of California.

The combination of creeping habit with erect fronds, the small size, dense dichotomous branching, almost complete cortication, immersed scattered tetrasporangia and the final development of two sharp points after the last division of the apical cell on the forcipate branches, distinguish this species from all other known species. The sharp points found on this species are not unique, as they are present in other species, notably *C. Johnstonii* of this paper.

Ceramium sinicola S. and G. sp. nov.

Plate 25, figs. 40, 41 and plate 75

Fronds 1-2 cm. high, dichotomously branched, the forcipate apices long and blunt, completely corticated above, internodes below partially naked; corticating cells not arranged in any definite order, 8-11 μ diam. in surface view, 3-5 sided, with

rounded angles; tetrasporangia completely immersed, in a single whorl at the nodes, occupying several forks of the terminal ramuli; cystocarps and antheridia unknown.

Found unattached among the fronds of *Laurencia* sp.

Type: No. 1366, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 67b), in April, at Ensenada Bay, Lower California.

The basal portions of this species of *Ceramium* were not present, thus leaving some doubt as to the size of the plant. The largest filaments below the tetrasporic ramuli are 140 μ in diameter, and it seems quite probable that the portion of the frond below this is not much larger.

Ceramium Johnstonii S. and G. sp. nov.

Plates 76, 77

Fronds up to 3 cm. high, and 80 μ diam., dichotomously branched, producing below numerous, lateral, secondary branches simple or dichotomously branched, completely and densely corticated, but the corticating cells of the upper branches slightly separating at the center of the internodes, forming a very narrow clear ring; corticating cells not arranged in rows, much rounded, 7-10 μ diam.; at maturity the apical cells become very acute; tetrasporangia completely immersed, scattered irregularly in the main fronds and more or less regularly in 2-3 whorls in the small lateral ramuli; cystocarps and antheridia unknown.

Found floating among other algæ. San Pedro Martir Island, Gulf of California, Johnston, no. 104, April; San Esteban Island, Gulf of California, Johnston, No. 111, April.

Type: No. 1367, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 104), in April, at San Pedro Martir Island, Gulf of California.

The distinguishing characters of this species are the development of the tetrasporangia immersed in the dense cortex of the main fronds and in the short-lateral ramuli towards the base; and the slight separation of the corticating cells forming a narrow clear area or ring at the internodes in the ramuli and

upper branches. The height and general size of the plants can not be definitely stated, as we have but a few fragments to judge from. From the general appearance of the lower parts of these, it seems that the species is rather diminutive.

Ceramium serpens S. and G. sp. nov.

Plate 27, fig. 58

Thallus microscopic, creeping on the host and attached by short rhizoids, arising singly at a node, only sparsely forking, giving rise to a few sparsely branched, erect, fructiferous ramuli; mature creeping filaments 30-40 μ diam., at the nodes, corticated only at the nodes, the internodes naked and equal to, or up to, 4 times as long as the nodes; tetrasporangia usually single at the nodes, spherical, 20-25 μ , up to 40 μ , diam., extruding through the cortex; cystocarps and antheridia unknown.

Growing on *Laurencia* sp. La Paz, Lower California. Type, Marchant, no. 67c, May.

This is a very delicate and inconspicuous species, and although the material at hand is very scanty and only tetrasporic plants having been observed, the character of these having the tetrasporangia extruded and borne singly at the nodes, makes it entirely distinct from any known species. Its nearest relative, among the known Mexican forms, is *C. procumbens* of this paper, from which, however, it may be readily recognized by the tetrasporic characters.

Ceramium interruptum S. and G. sp. nov.

Plate 26, fig. 47

Fronds 8-12 mm. high, 180-250 μ diam. towards the base, enlarged above, branching regularly dichotomous, densely corticated above, except the first internode just above the forkings, corticated only at the nodes below; tetrasporangial branches up to 500 μ diam., decidedly torulose, tetrasporangia imbedded beneath the cortex, disposed more or less irregularly in 2-3 whorls, slightly ellipsoidal, 30-35 μ diam., 40-45 μ long; cystocarps mostly single, sessile on an enlarged obconical base, sur-

rounded by a whorl of 5-8 ramuli which are either short and in part incurved or long and at times giving rise to other cystocarps; carpospores numerous, pyriform to slightly angular, enclosed within a very hyaline membrane; antheridial ramuli less enlarged and less torulose than the tetrasporic ramuli; antheridia completely covering their outer ends.

Epiphytic upon other algæ. Eureka, near La Paz, Lower California. Type, Marchant, no. 78, May.

But a single small tuft of this species was gathered among the other forms found cast ashore. Fortunately all three forms of reproductive cells were present in these specimens, and the whole material seems in typical condition. Having such a small quantity of material, however, leaves us in doubt as to whether or not these are typical in height. The method of attachment to the host is by short, thick rhizoidal branches, a few from a node.

A conspicuous character present in practically all of the fronds, especially prominent in the tetrasporic and antheridial fronds, is the uncorticated internode just above the forking. The upper parts of all the fronds are densely corticated except these special internodes, a character which we have not seen, nor have we read of it in any other species. This is apparently too regular to be accidental, and we are using it as a basis for the specific name. Towards the base, the internodes become less and less corticated, but the length of the internodes only slightly exceeds the length of the nodes.

Ceramium caudatum S. and G. sp. nov.

Plate 27, figs. 55-57

Fronds 10-15 mm. high, branching dichotomous by splitting of the apical cell, many uncinat secondary branches of different lengths, at times in whorls, arising at the nodes; corticated only at the nodes; internodes of main filaments 120-140 μ diam. at the base of the fronds and nodes 180-200 μ diam.; internodes 290-350 μ long at the base of the fronds; tetrasporangia numerous in whorls at the upper margin of the corticating cells, decidedly pedicellate; cystocarps and antheridia unknown.

Floating among other algæ. Eureka, near La Paz, Lower California. Type, Marchant, no. 48b, May.

Ceramium fimbriatum S. and G. sp. nov.

Plate 26, figs. 43, 44

Fronds diminutive, regularly dichotomous, corticated only at the nodes; main filaments 70-90 μ diam. at the nodes, the internodes 2-3 times as long as the nodes in the main fronds; the outer cell on each node on the convex surface of the forcipate apices develops into a short thick hair, rounded at the outer end, 55-65 μ long, 28-32 μ broad, unseptate, soon deciduous; fruiting characters unknown.

Found floating among *Centroceras clavulatum*. Eureka, near La Paz, Lower California. Type, Marchant, no. 87a, May.

We hesitate to name this species of *Ceramium* based on such scanty material at our disposal. Only a few fragments were observed while studying specimens of *Centroceras*. However, the vegetative characters are so unlike those of any described species of which we have any definite knowledge, that we feel justified in naming and describing it as well as the material will permit. The presence of a single row of thick, short, unseptate hairs, which are soon deciduous, on the outer curves of the apices, is the distinguishing character.

Ceramium horridum S. and G. sp. nov.

Plate 26, figs. 49, 50 and plate 79

Fronds 6-8 cm. high, completely corticated throughout, dichotomously branched, the branches gradually attenuated upwards, at maturity terminating in acute cells, clothed throughout with whorls of short, lateral, tetrasporic ramuli arising at each node, which in turn are beset with numerous, short, lateral, sharp spines; main fronds 700-900 μ diam.; tetrasporangia immersed without definite order in the ramuli; cells arranged more or less in longitudinal rows, especially in the internodes 2-3 times as long as broad; cystocarps and antheridia unknown.

Cast ashore among other algæ. Guaymas, Mexico. Type, Marchant, no. 91, May.

The two outstanding characters of this species are the whorls of short tetrasporic ramuli, three to five at each node, and the acute, spine-like growing points at their apices and for some

distance back, as well as on the main branches. The growing points, apical cells, are normal cells during the period of rapid growth, but on nearing maturity of the tetraspores, they practically all divide two to three times and the branches become very acute. The size of the mature plants, the complexity of branching, their habitat, whether epiphytic or growing on rocks, the character of the attaching portions, and the character of the cystocarps and antheridia are matters for further investigation. The few fragments obtained, however, are so decidedly different from any known species, that it seems the part of wisdom to put it on record.

Ceramium sp.

Plate 29, figs. 70, 71

Growing on *Eucheuma* sp. Mazatlan, Mexico, Marchant, no. 63a, May.

Only some small fragments of this species of *Ceramium* were found among other algæ, and these are of antheridial plants. The ramuli were completely corticated only at the fruiting ends, the remaining lower parts are corticated only at the nodes. It seems to be an undescribed species, at least nothing like it was admitted by Agardh in his latest revision, but the absence of other fruit, especially the tetraspores, makes its identity too uncertain and therefore unwise to name it at present.

CENTROCERAS KUETZING, in *Linnaea*, vol. 15, "1841," p. 731

Volume 15 of *Linnaea* bears the imprint 1841, Kuetzing's paper "Ueber *Ceramium* Ag.," appeared in the last Heft of this volume. In this paper, among other genera, he erected the genus *Centroceras*. In *Phycologia Generalis*, 1843, he treats of the genera and species mentioned in his previous paper, and consistently cites 1841 as the date of publication. Later, in *Species Algarum*, 1849, he consistently refers only to the *Phycologia Generalis* in citing the place of publication of the new genera erected in the above mentioned publication, which

is manifestly misleading. At the same time, in citing the species treated in *Linnaea*, he uses the date 1842 instead of 1841. Howe (1914, p. 158) cites 1842.

Centroceras clavulatum (Ag.) Mont.

Growing on rocks in the upper sublittoral belt. Tortuga Island, Gulf of California, Johnston, no. 144, May; Eureka, near La Paz, Lower California, Marchant, no. 87, May, and no. 42, May.

Montagne, in *Durieu, Flore d'Algerie*, p. 140; Howe, *Mar. Alg. Peru*, 1914, p. 158. *Ceramium clavulatum* Agardh, in *Kunth, Syn. Pl. Aeq.*, vol. 1, 1822, p. 2.

Centroceras bellum S. and G. sp. nov.

Plate 26, fig. 48 and plates 40c and 78

Fronds 1-1.5 cm. high, more or less prostrate at the base and attached by numerous pluricellular hairs, 1-3 arising at a node, becoming erect at the outer ends, completely corticated, subsecundly branched; main fronds 110-130 μ diam.; branches all arising at the nodes back of the growing point; tetrasporic ramuli stichidia-like, considerably enlarged above the base for some distance, each tapering very gradually to a blunt terminal growing cell and more or less curved at the apex; corticating cells in very regular longitudinal rows on the older parts of the frond and quadrate, except at the slightly swollen nodes, where they are divided into 2-4 smaller cells, and on the fruiting part of the tetrasporic ramuli; tetrasporangia completely immersed, a single whorl at each node; cystocarps and antheridia unknown.

Cast ashore at Guaymas, Mexico. Type, Marchant, no. 85, June.

The complete cortication with quadrate cortical cells arranged very definitely in longitudinal rows on the main fronds seem undoubtedly to ally this plant with the genus *Centroceras*, rather than with the genus *Ceramium*, to which, however, it is very closely related. These characters, along with the size of the cells and the diameter of the main filaments, make it almost

identical with *Centroceras clavulatum* with respect to those characters in that species, but the total absence of sharp-pointed surface cells, particularly at the apices, so characteristic of *C. clavulatum*, the method of branching which is always subterminal, whereas all described species of *Centroceras* have dichotomous branching brought about by longitudinal division of the apical cell, and the method of tetraspore formation, the tetraspores being formed by specialized ramuli, for the most part, make it a very distinct and beautiful species, decidedly different from any other known at present.

Family GRATELOUPIACEÆ

GRATELOUPIA AGARDH, Sp. Alg., vol. 1, part 2, 1822, p. 221

Grateloupia prolongata J. Ag.

Plate 80

Growing in the upper sublittoral belt. San Francisquito Bay, Lower California, Johnston, no. 25, June; San Esteban Island, Gulf of California, Johnston, no. 53a, April; Isla Partida, Gulf of California, Johnston, no. 87, July.

J. G. Agardh, Nya Alg., 1847, p. 10.

We have grouped a series of several plants under this species varying greatly in size and in width of fronds. The type of the species was collected at "Pochetti," Mexico, and Agardh does not mention the size of the plants. De-Toni (Syll. Alg., vol. 4, p. 1565) gives the height of the plant as 10-18 cm. Some of our specimens are 50 cm. high and only 3-5 mm. wide, but others come within the range of the description given by De-Toni. It is quite possible that we are here dealing with more than one species, but until a greater quantity of material can be examined, preferably in its native habitat, the question of their identity will have to remain somewhat in doubt.

Grateloupia squarrulosa S. and G. sp. nov.

Plates 81, 82

Fronds 40-55 cm. high, branching exceedingly variable, of 5-8 orders; main frond more or less percurrent, flat, 5-15 mm. wide, pinnately branched at the margins, with branches very

variable in size, some erect, some patent, others recurved, all with broad bases; the surface, as well as the margins of the main frond, more or less covered with branches, the whole frond thickly beset with short, blunt, branched spines; reproduction unknown; color dark purplish red.

Cast ashore. Smith Island, Gulf of California.

Type: No. 1368, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 60), in June, at Smith Island, Gulf of California.

Although we have no fruiting specimens of this species, the gross morphological characters are so unlike any described species that we feel certain of its specific identity. It probably grows at some depth below low tide as the specimens, all incomplete, were found cast up on the shore.

Grateloupia acroidalea S. and G. sp. nov.

Plate 26, figs. 45, 46

Fronds flabellate, flattened, up to 2 cm. high, 0.5-1 mm. wide, attached by a small disk; branching dichotomous from near the base; terminal ramuli swollen at the apices; center of the frond stuffed with fine, branched filaments merging into filaments with larger arachnoid cells, these in turn merging into larger, more or less irregular, cells giving rise to the anticlinal rows of the cortex; tetrasporangia 50-60 μ long, 12-20 μ broad; tetraspores cruciate; cystocarp completely embedded within the frond; antheridia unknown; color very dark purplish red, almost black on drying.

Guaymas, Mexico, Marchant, no. 58, May; on rocks in the upper sublittoral belt, Johnston, no. 121.

Type: No. 1369, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 121), in June, at Tortuga Island, Gulf of California.

This species of *Grateloupia* clearly belongs to J. G. Agardh's section of the genus *Chondrophyllum*. It differs from *G. dichotoma* J. Ag. in having decidedly swollen apices, for which character it is named. It is quite near to *G. fastigiata* J. Ag. but is shorter and narrower. Ours has the cystocarps and tetraspores only in the terminal segments.

Grateloupia Howei S. and G. sp. nov.

Plate 83

Fronds membranaceous, up to 30 cm. high and 6 cm. wide, tapering to a small, short stipe attached by a disk, unbranched, or forked near the base and with an occasional marginal lanceolate branch; the whole beset with numerous Gigartinoid spines; color brownish red, nitent on drying; large cells of the subcortex 25-50 μ long.

Cast ashore.

Type: No. 1370, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 113), in April, at San Esteban Island, Gulf of California.

We are dedicating this species to Dr. M. A. Howe, to whom we sent specimens for study and for comparison with *G. denticulata* Mont., to which it seems closely related. After comparing it with sections and a photograph of the type specimen of *G. denticulata* he concludes that our plant is not identical with that species.

Grateloupia Johnstonii S. and G. sp. nov.

Plate 84

Fronds flat, membranaceous, up to 40 cm. high, varying much in width, of the same branch in different parts, up to 20 cm. branching pinnate, of 5-6 orders; ultimate pinnules short, subulate, acute, perpendicular to the frond, main branches arising at about 45° angle; color coral red; reproduction unknown.

Cast ashore.

Type: No. 1371, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 88), in July, at Angel de la Guarda Island, Gulf of California.

This species of *Grateloupia* seems closely related to *G. squarulosa* but differs in thickness, color, number and character of the ultimate pinnules, and the angle at which the branches arise. Unfortunately the whole life history can not be presented here on account of the lack of fruiting material.

Estebania S. and G. gen. nov.

Fronds complanate, firm-mucilaginous, profusely anastomosing at the dichotomously branched tips; center of the fronds packed with fine, densely intertwined, much branched filaments, surrounded on all sides by 1-2 layers of large ovoid cells merging outwardly into smaller cells, in turn merging into short anticlinal rows of small cells; tetraspores cruciate, not in sori; sexual reproduction unknown.

Lacking cystocarps, we are unable, at present, to classify with complete satisfaction the plants which we are here placing in the new genus *Estebania*. We are assigning them provisionally to the family Grateloupiaceæ. They resemble *Polyopes Bushii* in general appearance, but this resemblance is only superficial or remotely so in structure. There is also a resemblance to *Grateloupia dichotoma*. In *Polyopes* the tetraspores are aggregated into sori or nemathecia, while in *Estebania* they are evenly distributed over the fruiting area of the fronds. The general structure, the absence of an apical cell and the cruciate tetraspores more strongly suggest the Grateloupiaceæ than any other family.

Estebania conjuncta S. and G. sp. nov.

Plate 25, figs. 35, 36 and plates 85, 86

Fronds up to 4 mm. broad, dichotomously branched, the branches anastomosing with each other soon after arising; color coral red; central or medullary filaments 3-4 μ diam.; surrounding ovoid cells up to 200 μ diam., thick walled; anticlinal rows of cortical cells 4-7 cells long, 4-6 μ diam., subspherical; tetrasporangia elongated radially; tetraspores cruciate, dividing in three planes.

Floating and entangled among other algæ. San Esteban Island, Gulf of California, Johnston, nos. 53f and 115; San Pedro Martir Island, Gulf of California, Johnston, no. 103, April; Angel de la Guarda Island, Gulf of California, Johnston, no. 130, June.

Type: No. 1372, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 115), in June, at San Esteban Island, Gulf of California.

The very pronounced character of this species, a character which we have considered to be of generic rank, is the firm coalescence of the young branches almost as soon as they have arisen, leaving at first a very small open space, almost microscopic. As the fronds grow, this space increases until it may become one or two inches across. This branching is fundamentally dichotomous and is extensive. However, as the plants age proliferations, more or less profuse along the edges of the frond, arise. These very frequently begin to divide dichotomously and a flabellate lateral is produced.

The plants at our disposal are all fragmentary, hence the actual size can not be stated. Nothing is known of their method of attachment or whether they are epiphytic or saxicolous. The fronds are very fragile and flabby. On being soaked in fresh water after having been dried, they soon dissolve, making it very difficult to handle them under such treatment.

POLYOPES J. G. AGARDH, Oefver., 1849, p. 85

Polyopes sinicola S. and G. sp. nov.

Plate 28, fig. 61 and plate 42, b

Fronds complanate, 3-5 cm. high, 3-5 mm. wide, width diminishing from the center of the frond towards the apices at each forking; dichotomously branched; color brown, almost black on drying; medulla composed of very densely compact and intertwined branched filaments merging abruptly on all sides into rows, 10-13 cells long, as seen in cross section, of closely compact, short, cylindrical cells, the terminal cell of each row, or the surface cells being more or less pearshaped; reproduction unknown.

Growing on rocks, in the lower littoral and upper sublittoral belts. Los Angeles Bay, Lower California, Johnston, no. 38, June; Isla Partida, Gulf of California, Johnston, no. 85, July; Angel de la Guarda Island, Gulf of California, Johnston, no. 84d, June.

Type: No. 1373, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 85), in July, at Isla Partida, Gulf of California.

PRIONITIS J. G. AGARDH, Sp. Alg., vol. 2, part 1, 1851, p. 185

Prionitis Sternbergii (Ag.) J. Ag.

Growing on rocks in the upper sublittoral belt. Georges Island, Gulf of California, Johnston, no. 100, April; Tortuga Island, Gulf of California, Johnston, no. 119, June; San Marcos Island, Gulf of California, Johnston, no. 6, June.

J. G. Agardh, Sp. Alg., 1851, p. 190. *Sphaerococcus Sternbergii* Agardh, Sp., 1822, p. 275.

We have a series of specimens of *Prionitis* which agree fairly well with the description of *P. Sternbergii* (Ag.) J. Ag. as given by De-Toni (Syll., Alg., p. 1851). The species of this genus are subject to much variation in form, size and extent of branching. Our material proves this to be no exception to the rule. Careful study in the field may reveal several overlapping species.

Prionitis abbreviata S. and G. sp. nov.

Plate 25, fig. 39 and plate 50, b

Fronds fasciculate, 4-6 cm. high, 1.5-3 mm. wide, 500-600 μ thick, tapering to a narrow subcylindrical stipe; apices blunt, branching di-tri-chotomous, the margins with numerous fructiferous (?) pinnules; color dark red; reproduction unknown; medulla packed with fine branched filaments, merging on either side into small parenchymatous cells giving rise to anticlinal rows of cortical cells 2-3 μ diam., 4-6 μ long; cortex about 125 μ thick.

Growing on rocks.

Type: No. 1374, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 53e), in April, at San Esteban Island, Gulf of California.

This species appears to be most closely related to the group of plants of various forms which we have tentatively placed under *P. Sternbergii* (Ag.) J. Ag. The fronds are chiefly thinner, the branching more regularly dichotomous, and the pinnules less numerous than the smaller forms of that species.

Family NEMASTOMACEÆ

SCHIZYMENIA AGARDH, J., Sp. Alg., vol. 2, part 1, 1851, p. 169*Schizymenia Johnstonii* S. and G. sp. nov.

Plate 88

Fronds wide-ligulate to lanceolate, with more or less undulate and crisped margins, up to 25 cm. long and 8 cm. broad, about 400 μ thick, tapering abruptly at the base to a short, 1.5-2.5 cm. long, stipe, attached by a very small disk; color dark dull coral red; medulla composed of loose fine hyphæ with thick, soft gelatinous walls, extending in all directions and giving rise towards the surface to dichotomously branched erect filaments terminating in anticlinal rows of 1-3 cells; the basal cells of the short erect filaments spherical, 6-8 μ diam.; surface cells cylindrical, 3-4 μ diam. and 2-2.5 times as long; cystocarps large, completely embedded within the fronds, extending inwards beyond the middle of the frond; antheridia and tetrasporangia unknown.

Growing on rocks in the upper sublittoral belt.

Type: No. 1375, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 56), in July, at Isla Partida, Gulf of California.

Schizymenia Johnstonii seems closely related to *S. undulata* J. Ag. It is, however, slightly thicker, different in color, has a more ovate base and oblong shape, and larger cystocarps which extend deeper into the frond.

Schizymenia violacea S. and G. sp. nov.

Plate 25, figs. 37, 38 and plate 87

Fronds up to 30 cm. long, 15 cm. broad, 230 μ thick, broadly ovate, more or less lacerate and margin slightly undulate; base broad and rounded to subcordate; stipe complanate, about 1 cm. long, attached by a very small disk; color violet purple; medulla composed of fine hyphæ closely packed, merging into

spherical, subcortical cells 10-14 μ diam. terminating in anticlinal rows of 1-2 cells, 4.5 μ diam., 1.5 times as long; cystocarps variable in size, some superficial and some extending to the middle of the frond, very compact; tetrasporangia ellipsoidal, 28-32 μ long, 14-16 μ broad, with cruciate tetraspores very numerous, nearly over the entire frond, except the base.

Growing on rocks in the upper sublittoral belt.

Type: No. 1376, Herb. Calif. Acad. Sci., collected by Ivan M. Johnston (No. 82), in April, at San Esteban Island, Gulf of California.

This species of *Schizymenia* has near relations in *S. cordata* J. Ag., *S. apoda* J. Ag., and *S. erosa* J. Ag., judging from the general shape. It has, however, fewer cells in the anticlinal rows and is thinner than any of the three, in fact is the thinnest one yet described except *S. Dubyi*. From this species it differs in having fewer cells in the anticlinal rows and has a more compact medulla.

HILDENBRANDTIA NARDO, Isis, von Oken, 1834, p. 675*Hildenbrandtia rosea* Kuetz.

Kuetzing, Phyc. Gen., 1843, p. 384

A few specimens of an encrusting red alga have been found on small pebbles among larger algæ. They have the structure of *Hildenbrandtia rosea* Kuetz. but are sterile.

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EXPLANATION OF PLATES

The drawings have been prepared under the direction of N. L. Gardner by Miss Ruth J. Powell ("del. P."), Miss Anna Hamilton ("del. H.") and by Mr. W. P. Keasby ("del. K."). The photographs were made by Mr. W. C. Matthews.

Plate 12

Chlorogloea regularis S. and G.

Fig. 1. a. Surface view. b. Section view. X 500 (del. H.)

Xenococcus deformans S. and G.

Fig. 2. A sketch showing the plants within the cuticle of the host. X 500 (del. H.)

Hydrocoleum codicola S. and G.

Fig. 3. A group of ends of filaments. X 750 (del. P.)

Entocladia condensata S. and G.

Fig. 4. A surface view. X 125 (del. K.)

Fig. 5. A section view, showing the plant within the cell wall of the host. X 125 (del. K.)

Dermocarpha Reinschii S. and G.

Fig. 6. A group of plants, mostly mature. X 250 (del. K.)

Calothrix nidulans S. and G.

Fig. 7. A group of plants in various stages of development. X 250 (del. K.)

Pringsheimia Marchantæ S. and G.

Fig. 8. A surface view. X 250 (del. H.)

Calothrix nodulosa S. and G.

Fig. 9. A group of mature plants. X 125 (del. K.)

Fig. 10. A group of plants in various stages of development. X 100 (del. P.)

Dermocarpha sp.

Fig. 11. A group of immature plants. X 500 (del. P.)

Dermocarpha Marchantæ S. and G.

Fig. 12. A group of plants, some showing gonidia. X 500 (del. P.)

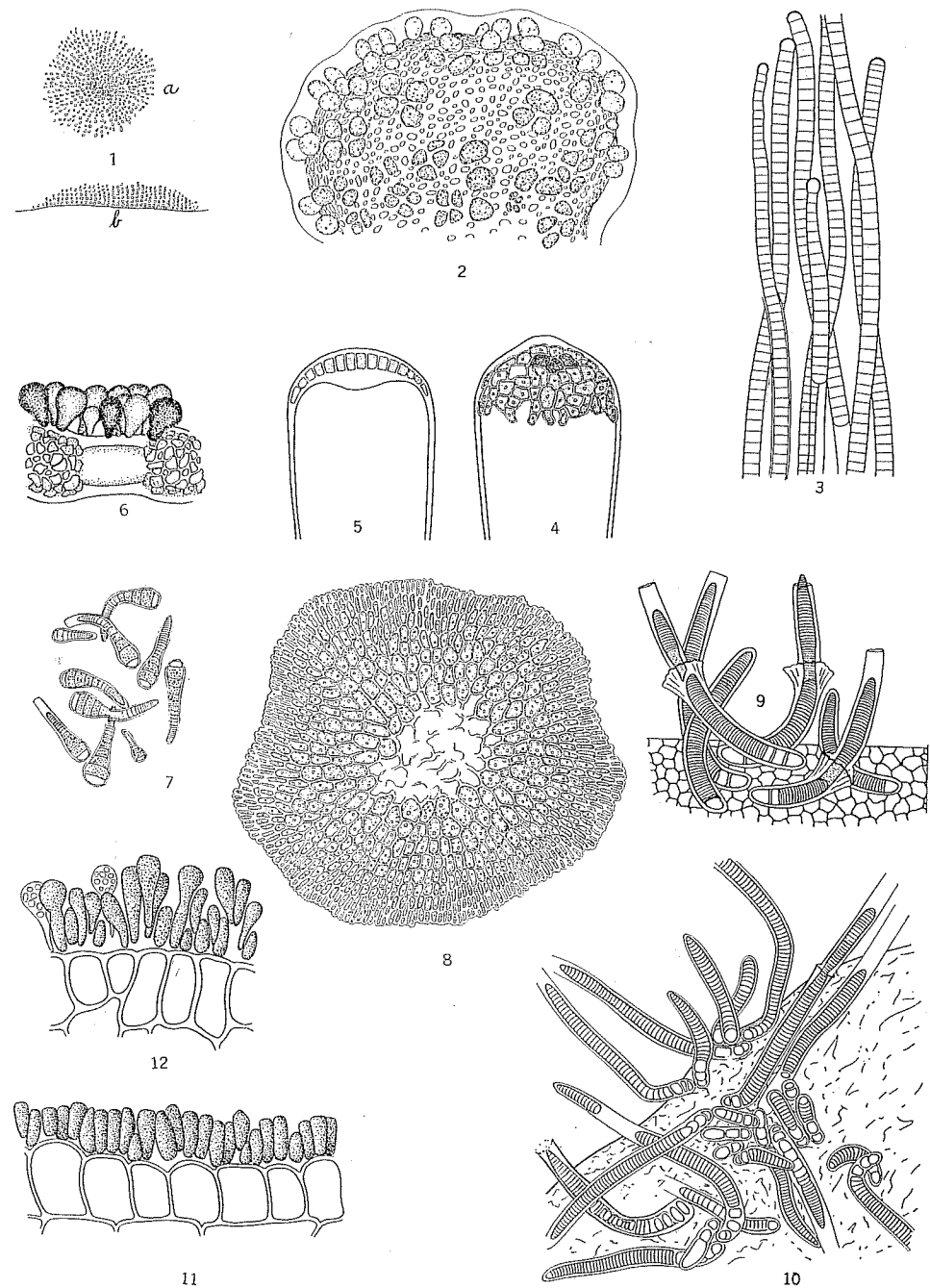


Plate 13

Caulerpa Vanbosseae S. and G.

Fig. 13. A habit sketch. X 0.5 (del. P.)

Fig. 14. A sketch of a portion of a plant showing method of branching and a few rhizoids. X 2 (del. P.)

Fig. 15. A piece of a filament showing trabeculae. X 25 (del. H.)

Cladophoropsis robusta S. and G.

Fig. 16. A habit sketch. X 2 (del. H.)

Cladophora hesperia S. and G.

Fig. 17. A habit sketch. X 40 (del. P.)

Entocladia Polysiphoniae S. and G.

Fig. 18. A habit sketch of a portion of a plant showing sporangia X 125 (del P.)

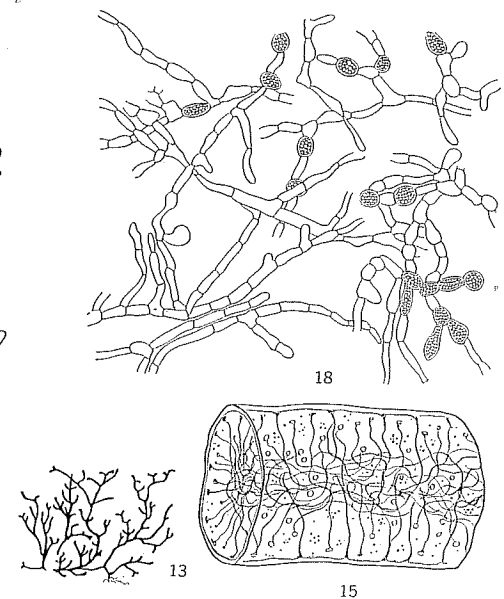
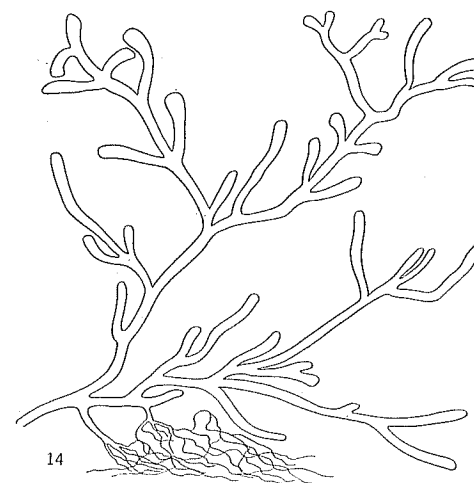
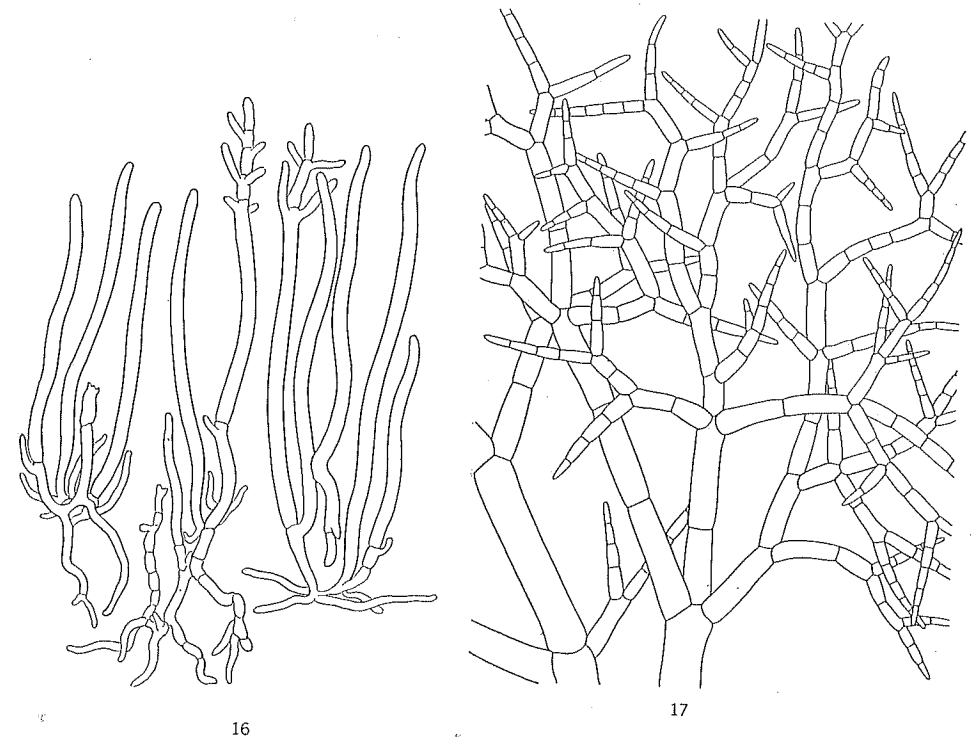


Plate 14

Codium cervicorne S. and G.

Fig. 19. A group of utricles showing variation in shape and size. X 65 (del. P.)

Fig. 20. A group of typical utricles. X 25 (del. P.)

Codium simulans S. and G.

Fig. 21. A group of utricles showing variation in shape and size. X 65 (del. P.)

Fig. 22. A group of typical utricles. X 25 (del. P.)

Codium reductum S. and G.

Fig. 23. A group of utricles showing variation in shape and size. X 65 (del. P.)

Fig. 24. A group of typical utricles. X 25 (del. P.)

Codium Brandegei S. and G.

Fig. 25. A group of utricles showing variation in shape and size. X 65 (del. P.)

Fig. 26. A group of typical utricles. X 25 (del. P.)

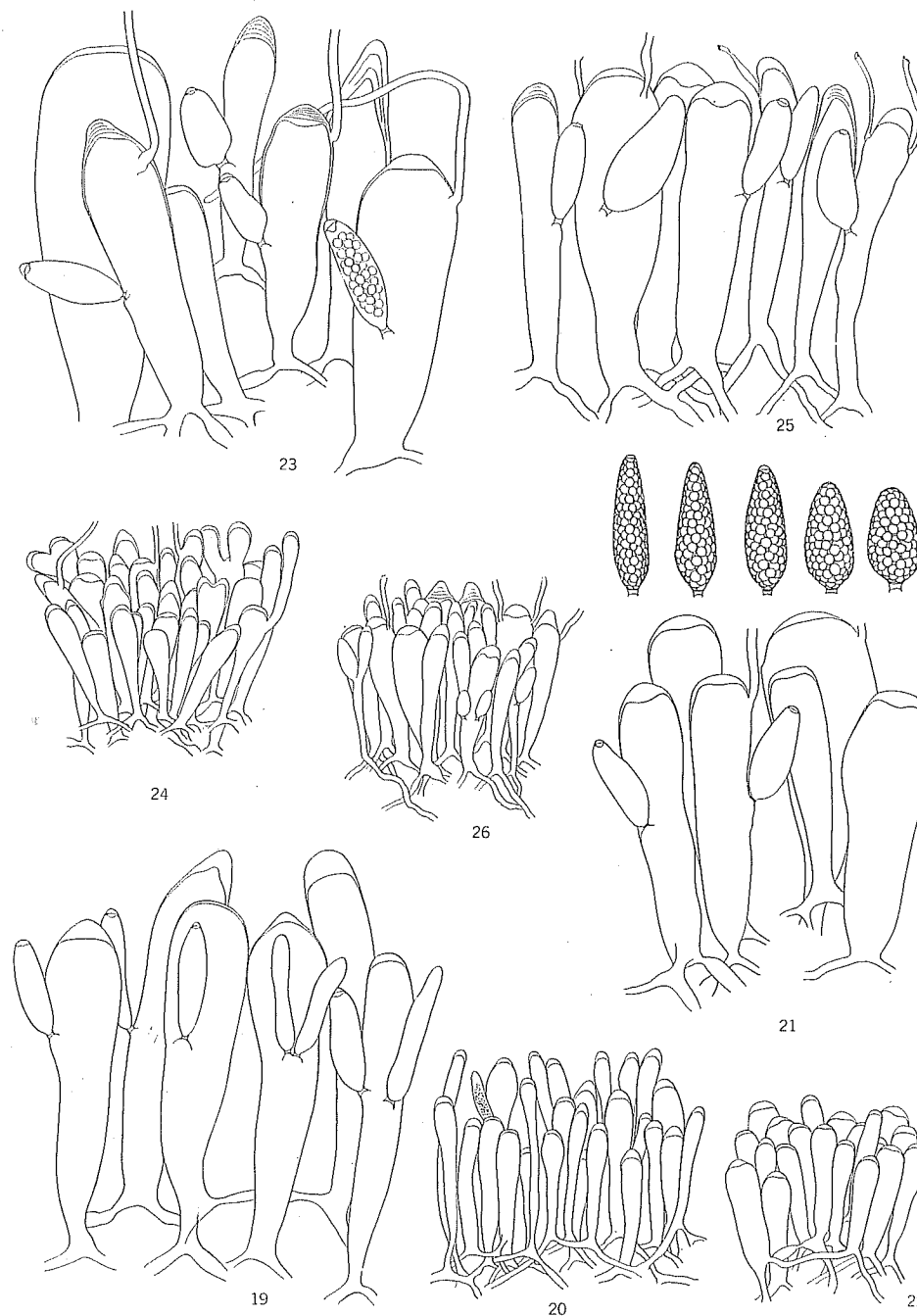


Plate 15

Codium longiramosum S. and G.

Fig. 27. Three utricles showing different shapes and sizes, the largest ones always having the thinnest end wall. X 38 (del. P.)

Codium amplivesiculatum S. and G.

Fig. 28. A single utricle of the large thin walled type. X 38

Fig. 29. Two utricles of the smaller type, typical in shape and size. X38 (del. P.)

Codium unilaterale S. and G.

Fig. 30. A group of utricles showing variation in shape and size. X 65 (del. P.)

Fig. 31. A group of typical utricles. X 25 (del. P.)

Codium conjunctum S. and G.

Fig. 32. A group of utricles showing variation in shape and size. X 65 (del. H.)

Fig. 33. A group of typical utricles. X 25 (del. H.)

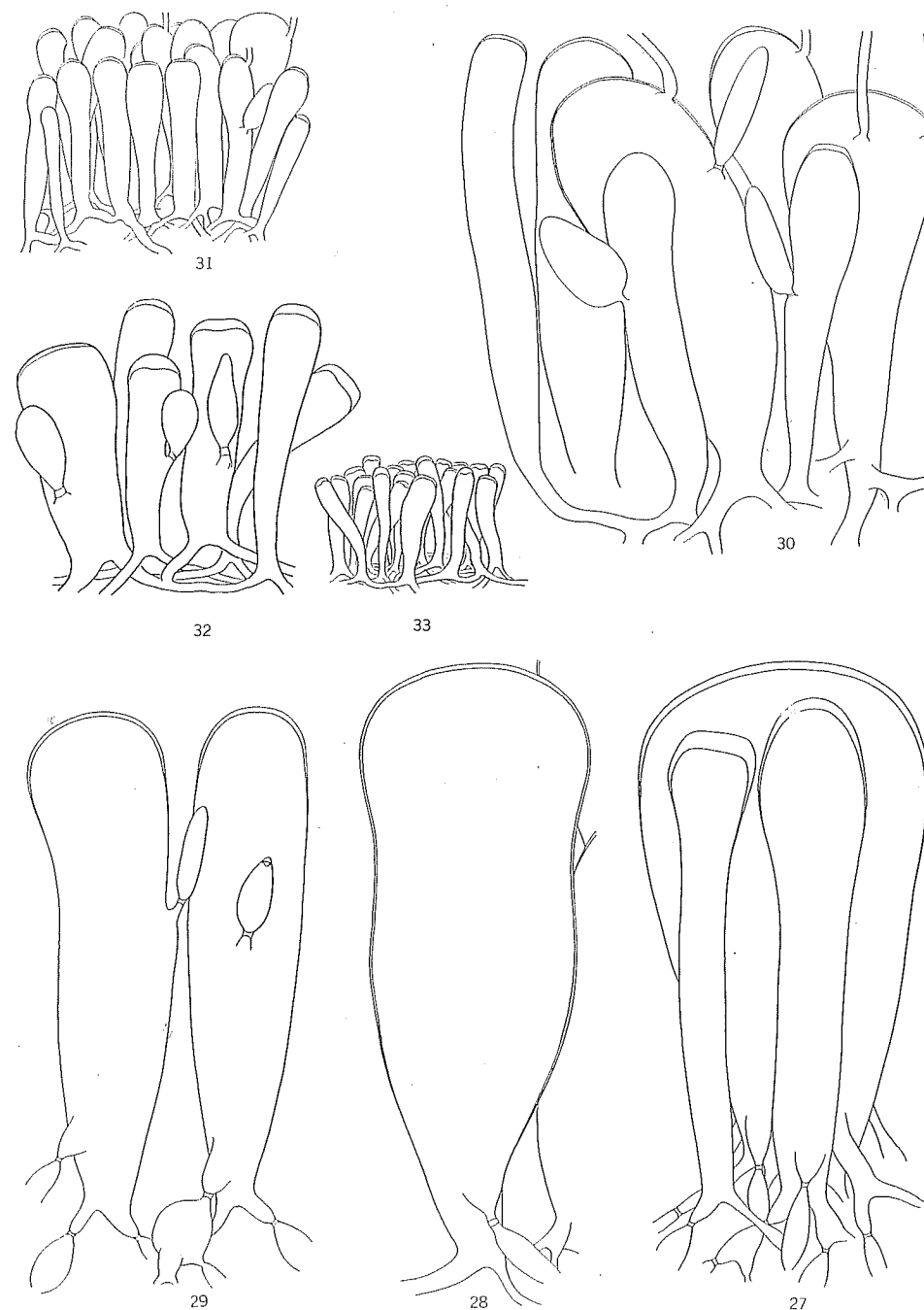


Plate 16

Codium cuneatum S. and G.

Fig. 34. A group of utricles showing variation in shape and size. X 65 (del. P.)

Fig. 35. A group of typical utricles. X 25 (del. P.)

Codium anastomosans S. and G.

Fig. 36. A group of utricles showing variation in shape and size. X 65 (del. P.)

Fig. 37. A group of typical utricles. X 25 (del. P.)

Codium tomentosum (Huds.) Stackh.

Fig. 38. A group of utricles showing variation in shape and size. X 65. From W. A. Setchell's copy of Le Jolis Alg. Mar. de Cherbourg, no. 204. (del. K.)

Fig. 39. A group of typical utricles. X 25. Ibid. (del. K.)

Enteromorpha Marchantæ S. and G.

Fig. 40. Habit sketch of a group of plants. X 0.5 (del. P.)

Fig. 41. Surface view. X 250 (del. P.)

Fig. 42. Cross section view. X 250 (del. P.)

Enteromorpha acanthophora Kuetz.

Fig. 43. A habit sketch of a portion of a frond. X 3 (del. H.)

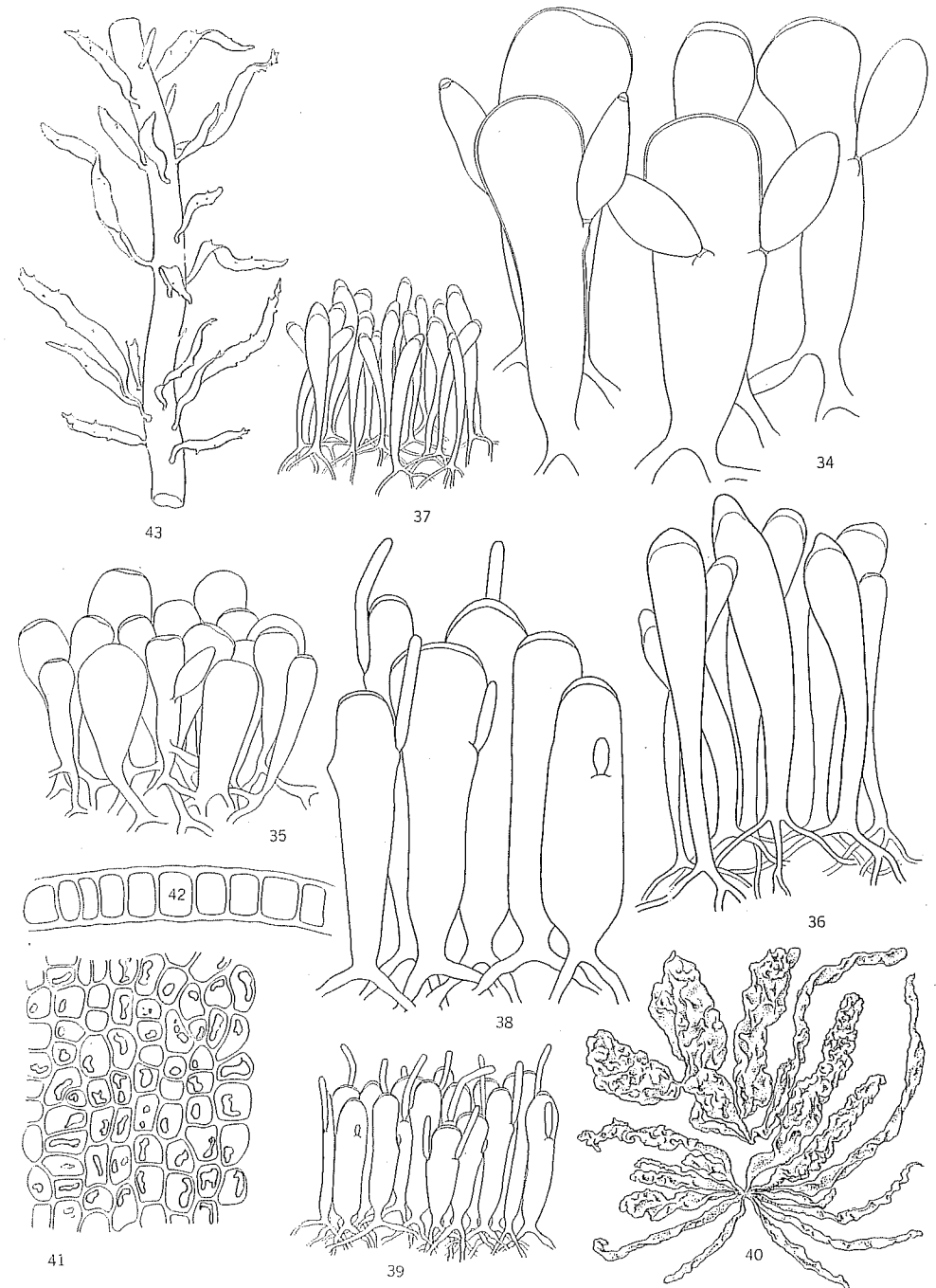


Plate 17

Ectocarpus gonodioides S. and G.

Fig. 44. Habit sketch of a small tuft of plants, showing the rhizoidal penetrating portion below the gametangia, which are outside of the host. X 125 (del. H.)

Ectocarpus Bryantii S. and G.

Fig. 45. A series of gametangia showing extremes in shape and size X 250 (del. H.)

Gonodia Johnstonii S. and G.

Fig. 46. Two branches showing both gametangia and zoosporangia on the same plant. X 250 (del. P.)

Fig. 47. A plant showing only gametangia. X 250 (del. P.)

Gonodia Marchantæ S. and G.

Fig. 48. A group of filaments with gametangia and one zoosporangium. X 125 (del. H.)

Compsomena immixtum S. and G.

Fig. 49. A section through the host, showing the gametangia extending beyond those of the host. X 250 (del. P.)

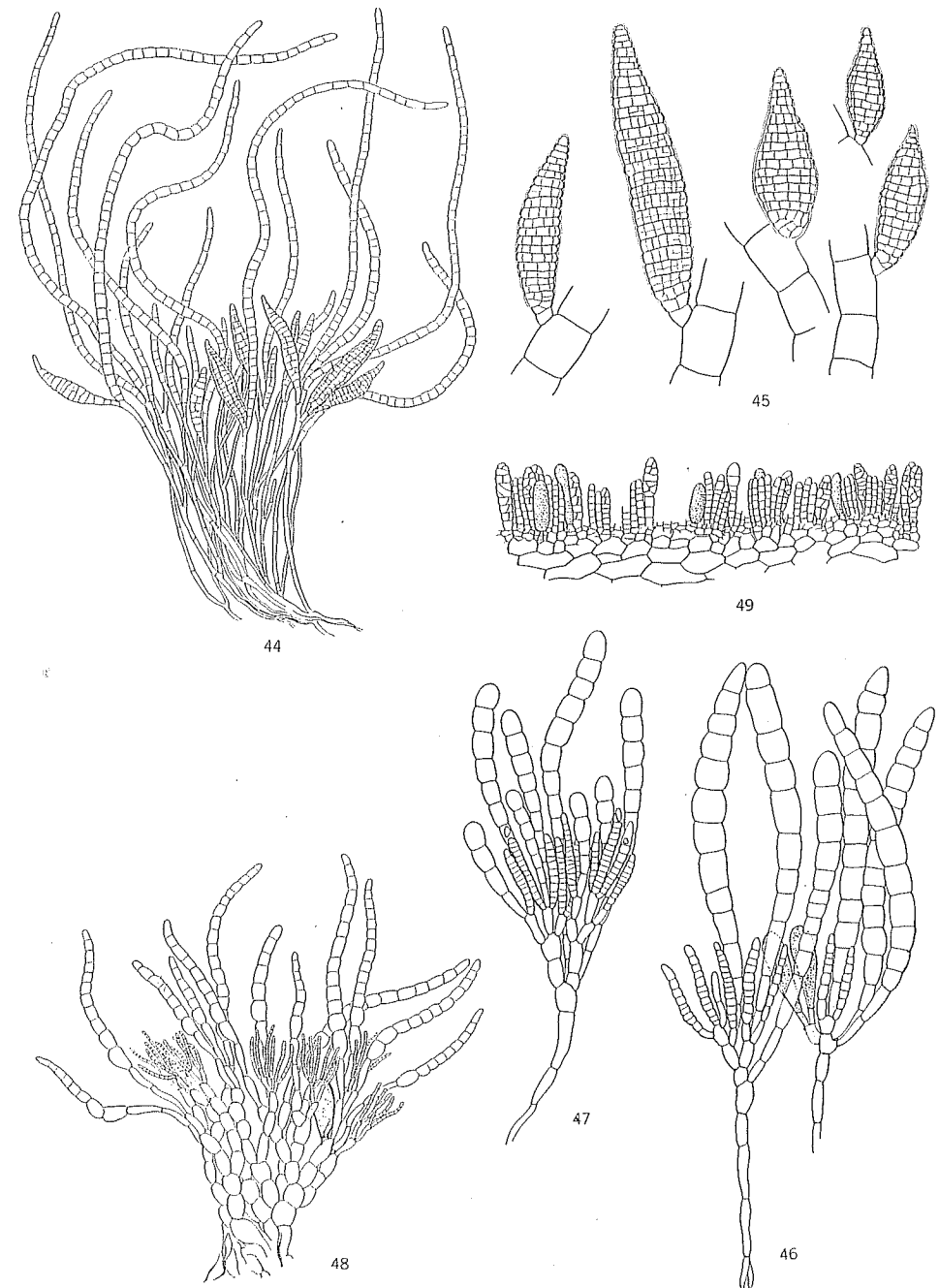


Plate 18

Dictyota crenulata J. Ag.

- Fig. 50. A habit sketch of a portion of a frond, showing numerous young plants germinating in position from oögonia. X 2 (del. H.)
- Fig. 51. A surface view of a portion of a frond, showing arrangement of cells, a group of antheridia and a group of oögonia. X 50 (del. H.)

Dictyota hesperia S. and G.

- Fig. 52. A habit sketch of a portion of a frond. X 0.5 (del. H.)
- Fig. 53. A surface view showing arrangement of cells, a group of antheridia and scattered oögonia. X 100 (del. H.)

Dictyota Johnstonii S. and G.

- Fig. 54. A habit sketch of a portion of a frond, showing the method of branching and the distribution of the groups of oögonia. X 0.5 (del. H.)
- Fig. 55. A cross section at the margin of the frond, showing a single oögonium and the double layer of cortical cells and of medullary cells. X 100 (del. H.)
- Fig. 56. Same as fig. 55. X 50 (del. H.)

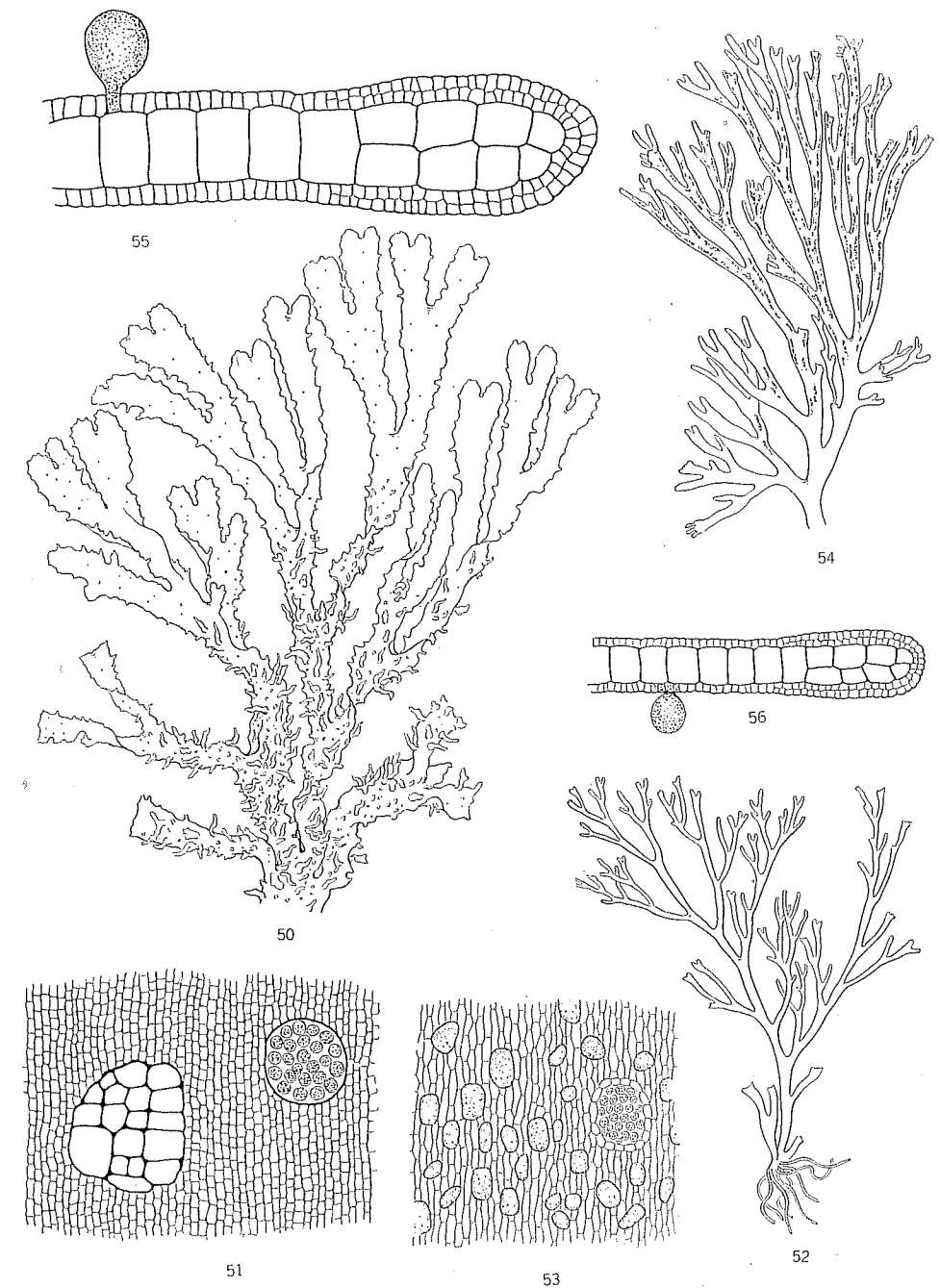


Plate 19

Entocladia mexicana S. and G.

- Fig. 57. A surface view of a portion of a thallus, showing sporangia scattered over the center and the free filaments around the margin. X 250 (del. H.)

Sphacelaria furcigera Kuetz.

- Fig. 58. Sections of a frond showing one male gametangium and one female gametangium. X 125 (del. K.)

Sphacelaria brevicorne S. and G.

- Fig. 59. A sketch showing a few sections of the frond and a single propagulum. X 250 (del. H.)
- Fig. 60. A sketch to illustrate the character of a hair. X 250 (del. H.)

Colpomenia sinuosa f. *deformans* S. and G.

- Fig. 61. A habit sketch showing the great predominance of the finger-like portions of the frond over the base portion. X 0.5 (del. P.)
- Fig. 62. A section through the fruiting portion, showing the character of the soma cells and of the gametangia. X 250 (del. P.)

Sargassum Marchantæ S. and G.

- Fig. 63. A habit sketch of a fragment of a frond, showing the characters of the leaves, the vesicles and the receptacles. X 2 (del. H.)

Sargassum guardiense S. and G.

- Fig. 64. A habit sketch of a fragment of a frond, showing the characters of the leaves, the vesicles and the receptacles. X 2 (del. H.)

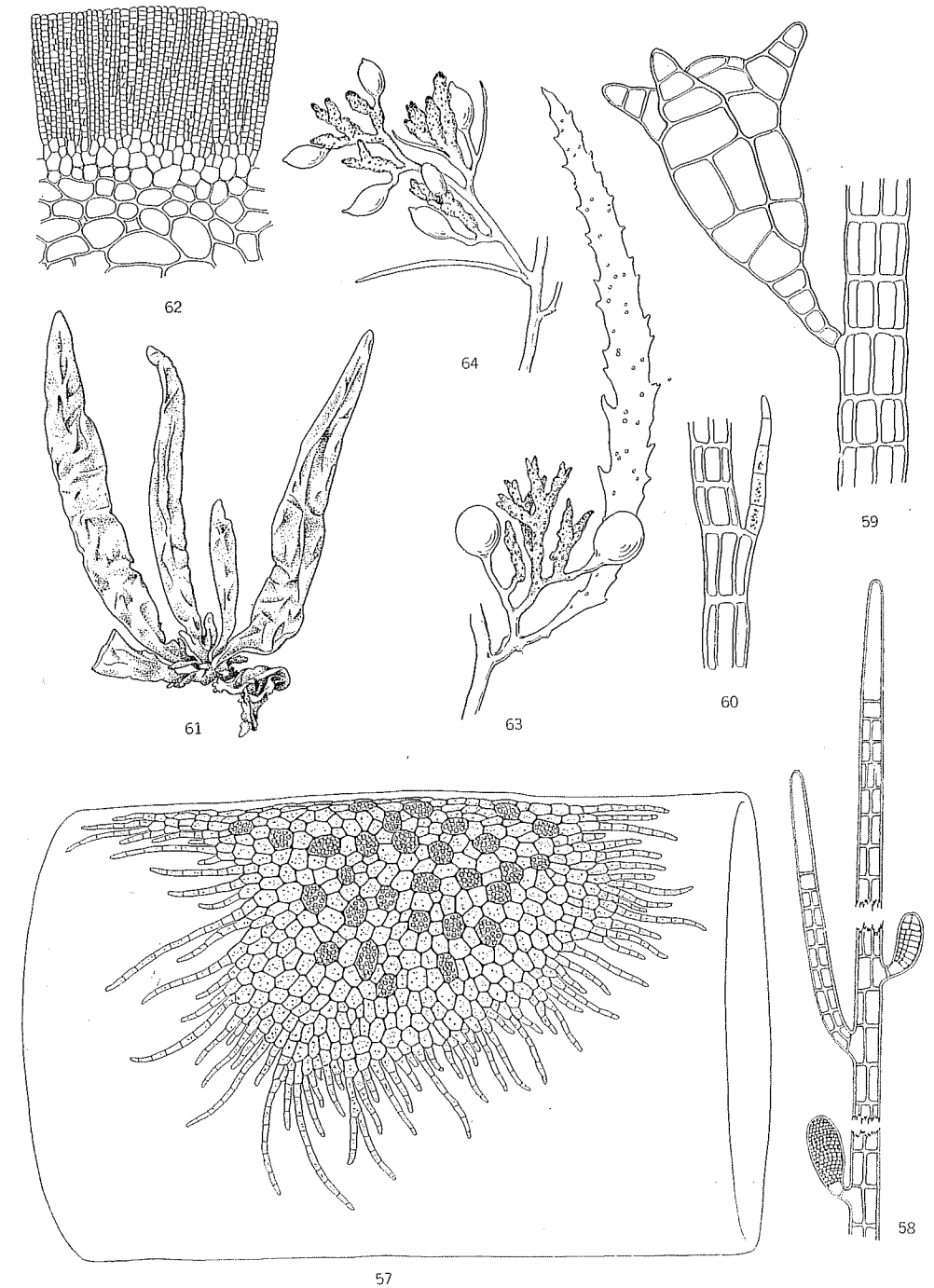


Plate 20

Sargassum horridum S. and G.

Fig. 65. A habit sketch showing the character of the leaves. X 1 (del. P.)

Fig. 66. A habit sketch of a fragment of the frond, showing the characters of the vesicles and the receptacles. X 1.5 (del. P.)

Sargassum insulare S. and G.

Fig. 67. A habit sketch of portions of a frond, showing the characters of the leaves, vesicles and receptacles. X 1.5 (del. P.)

Fig. 68. The same as fig. 67, but showing more profuse branching of the receptacles. X 1.5 (del. P.)

Sargassum herporhizum S. and G.

Fig. 69. A habit sketch of a portion of a frond, showing the characters of the leaves, vesicles and receptacles. X 1 (del. P.)

Fig. 70. A habit sketch showing the original short stipe and holdfast at the left, a horizontal creeping frond with holdfasts below and erect fronds above. X 0.5 (del. P.)

Fig. 71. A habit sketch to show different positions of the vesicles. X 1.5 (del. P.)

Sargassum Johnstonii S. and G.

Fig. 72. A terminal segment of the frond showing the arrangement and characters of the leaves, vesicles and receptacles. X 1 (del. P.)

Sargassum sinicola S. and G.

Fig. 73. A habit sketch of a fragment of a frond showing the characters of the leaves, vesicles and receptacles. X 2 (del. H.)

Sargassum lapazeanum S. and G.

Fig. 74. A habit sketch of a portion of a frond showing the characters of the leaves, a single vesicle and the receptacles. X 1.5 (del. P.)

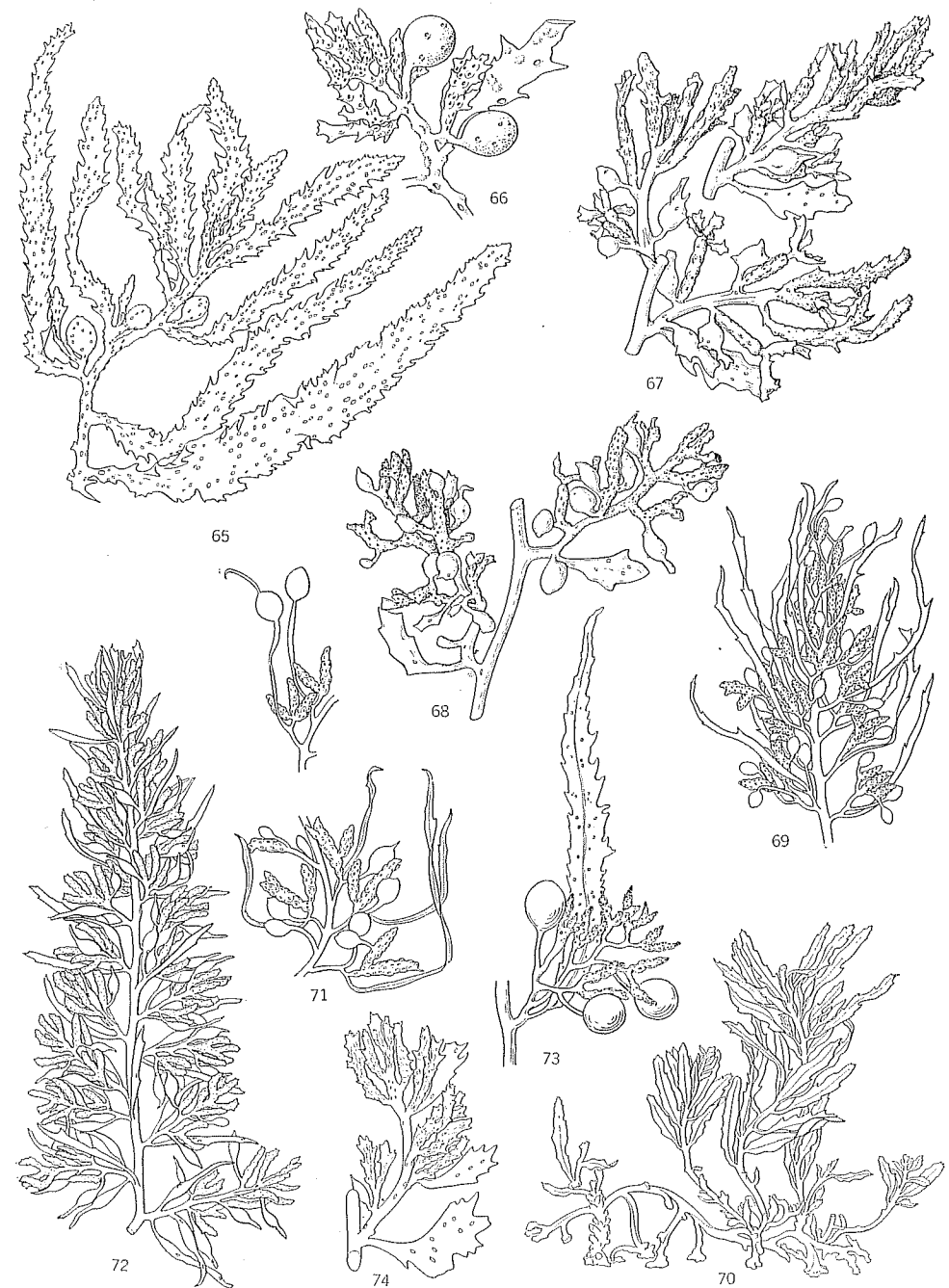


Plate 21

Sargassum Johnstonii f. *laxius* S. and G.

- Fig. 75. A habit sketch of terminal segments of a frond, showing the characters of the leaves, vesicles and receptacles. X 1.5 (del. H.)

Sargassum Johnstonii f. *gracile* S. and G.

- Fig. 76. A habit sketch of a fragment of a frond, showing the characters of the leaves, vesicles and receptacles. X 2 (del. H.)

Sargassum cylindrocarpum S. and G.

- Fig. 77. A habit sketch of a terminal fragment of a frond, showing the characters of the leaves, vesicles and receptacles. X 1 (del. P.)

Sargassum insulare S. and G.

- Fig. 78. A habit sketch of the terminal portion of a frond, showing the arrangement and characters of the leaves and receptacles. X 1.5 (del. P.)

Sargassum Brandegeei S. and G.

- Fig. 79. A habit sketch of a fragment of a frond, showing the characters of the leaves, vesicles and receptacles. X 2 (del. H.)

Sargassum Johnstonii S. and G.

- Fig. 80. A habit sketch of a portion of a frond, showing the characters of the leaves, vesicles and receptacles. X 1.5 (del. P.)

Sargassum Johnstonii f. *laxius* S. and G.

- Fig. 81. A habit sketch of a fragment of a frond, showing the characters of the leaves, vesicles and receptacles. X 1 (del. P.)

Sargassum acinacifolium S. and G.

- Fig. 82. A habit sketch of a fragment of a frond, showing the characters of the leaves, vesicles and receptacles. X 2 (del. H.)

Sargassum Bryantii S. and G.

- Fig. 83. A habit sketch of a portion of a frond, showing the characters of the leaves, vesicles and receptacles. X 1 (del. P.)



Plate 22

Gymnogongrus carnosus S. and G.

Fig. 1. A cross section of a portion of a frond. X 125 (del. H.)

Gelidiopsis tenuis S. and G.

Fig. 2. A longitudinal section of a portion of a frond. X 125 (del. H.)

Asparagopsis Sanfordiana f. *amplissima* S. and G.

Fig. 3. A short lateral branch bearing antheridia. X 30 (del. K.)

Anatheca elongata S. and G.

Fig. 4. A section view showing the characters of the tetrapores. X 200 (del. P.)

Fig. 5. A cross section view of a tetrasporic frond. X 50 (del. P.)

Dicranema rosaliae S. and G.

Fig. 6. A cross section of a mature frond. X 125 (del. H.)

Gracilaria crispata S. and G.

Fig. 7. A habit sketch of a fragment of a frond. X 1 (del. P.)

Fig. 8. A surface view showing groups of antheridia among the soma cells. X 250 (del. P.)

Fig. 9. A cross section of a tetrasporic plant. X 100 (del. P.)

Fig. 10. A section view showing the antheridia in pits. X 125 (del. P.)

Gracilaria Johnstonii S. and G.

Fig. 11. A surface view showing the groups of antheridia among the soma cells. X 125 (del. P.)

Fig. 12. A cross section showing the cortical and subcortical cells of a sterile frond. X 125 (del. P.)

Fig. 13. A cross section showing the antheridia in pits.

Fig. 14. A portion of a complete cross section of a sterile frond. X 50 (del. P.)

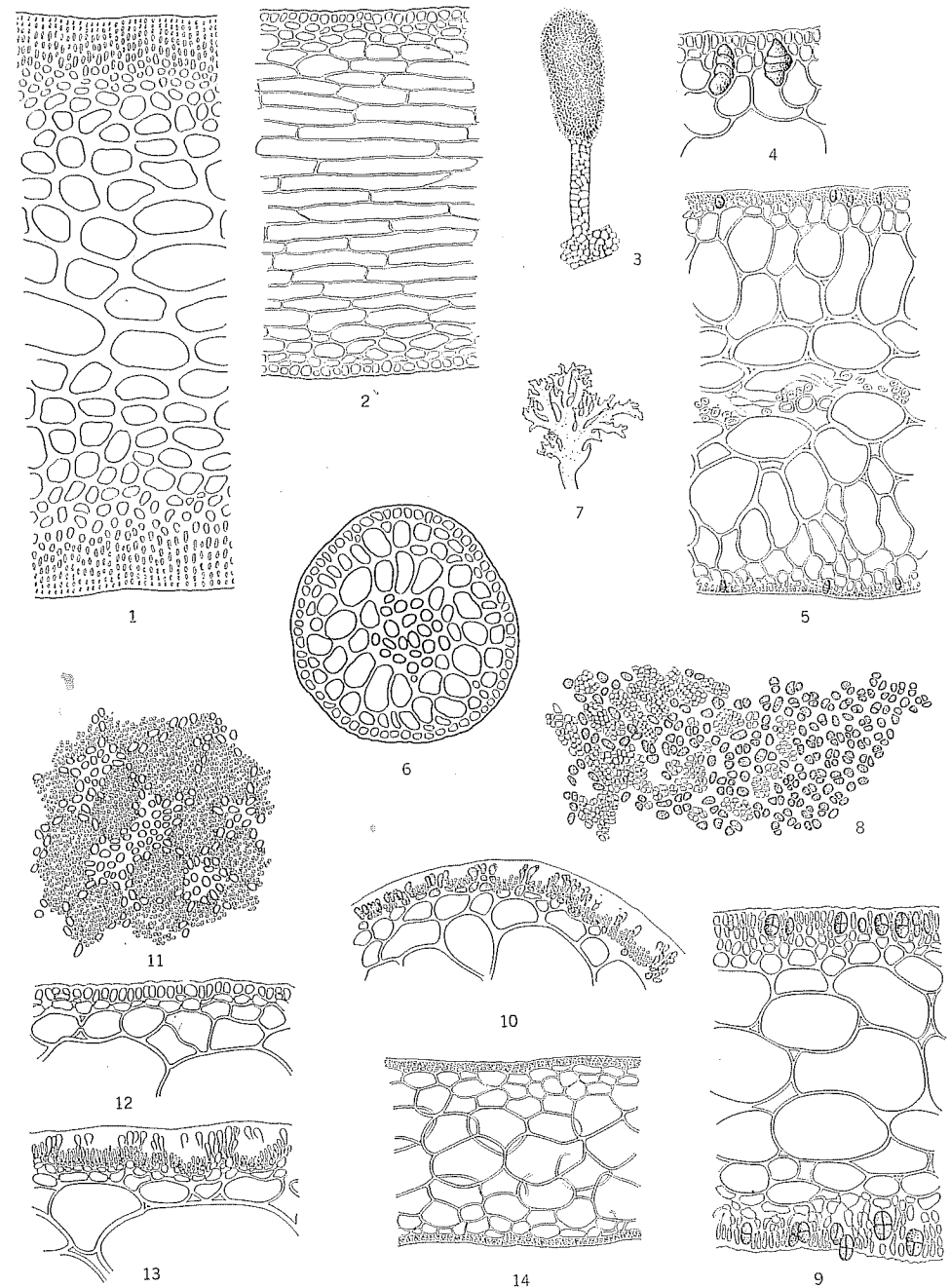


Plate 23

Laurencia obtusiuscula var. *corymbifera* S. and G.

Fig. 15. A habit sketch of the end of a frond. X 2 (del. K.)

Fig. 16. A sketch of a group of tetrasporic ramuli. X 10 (del. K.)

Laurencia obtusiuscula S. and G.

Fig. 17. A sketch of a group of tetrasporic ramuli. X 10 (del. K.)

Laurencia papillosa var. *pacifica* S. and G.

Fig. 18. A sketch of an antheridial ramulus. X. 10 (del. K.)

Hypnea Johnstonii S. and G.

Fig. 19. Sketch of the end of a branch showing the character of the growing region. X 125 (del. K.)

Fig. 20. A sketch of a group of tetrasporic ramuli. X 15 (del. K.)

Fig. 21. A sketch showing the shape, size and arrangement of tetraspores. X 200 (del. K.)

Hypnea Marchantæ S. and G.

Fig. 22. A sketch of a branch with tetrasporic ramuli. X 15 (del. K.)

Fig. 23. A sketch of the end of a branch showing the character of the growing point. X 125 (del. K.)

Corallopsis excavata S. and G.

Fig. 24. A sketch of a cross section of a tetrasporic branch, showing the disposition of the tetrasporangia, the arrangement of tetraspores and the openings through which the tetraspores escape. Diagrammatic (del. P.)

Fig. 25. A sketch of a tetrasporic ramulus. X 2.5 (del. P.)

Gracilaria subsecundata S. and G.

Fig. 26. A cross section of a tetrasporic frond, showing the cortical and subcortical cells and tetraspores in position. (del. P.)

Fig. 27. A cross section of a tetrasporic frond. (del. P.)

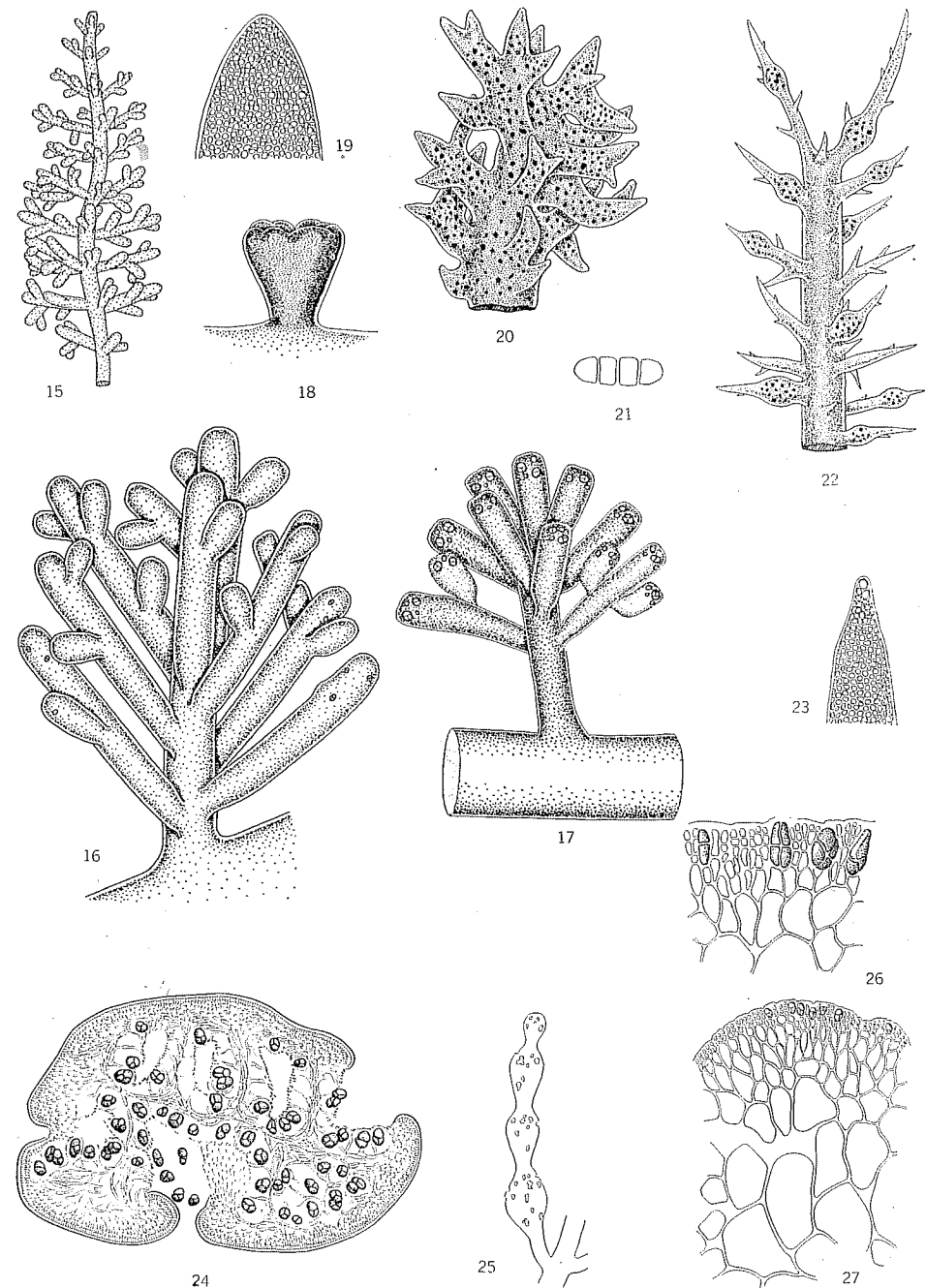


Plate 24

Gracilaria vivipara S. and G.

- Fig. 28. A portion of a cross section of a sterile frond. X 125 (del. H.)
 Fig. 29. A portion of a cross section of a tetrasporic frond. X 125.
 (del. H.)

Gracilaria pachydermatica S. and G.

- Fig. 30. Habit sketch of a mature frond. X 1 (del. P.)
 Fig. 31. A portion of a cross section of a frond near the base. X 125.
 (del. H.)

Gymnogongrus carnosus S. and G.

- Fig. 32. A complete cross section of a frond. X 25 (del. H.)

Laurencia papillosa var. *pacifica* S. and G.

- Fig. 33. A sketch of a cluster of antheridia. X 125 (del. K.)

Laurencia estebaniana S. and G.

- Fig. 34. A sketch of a cluster of antheridia. X 150 (del. K.)

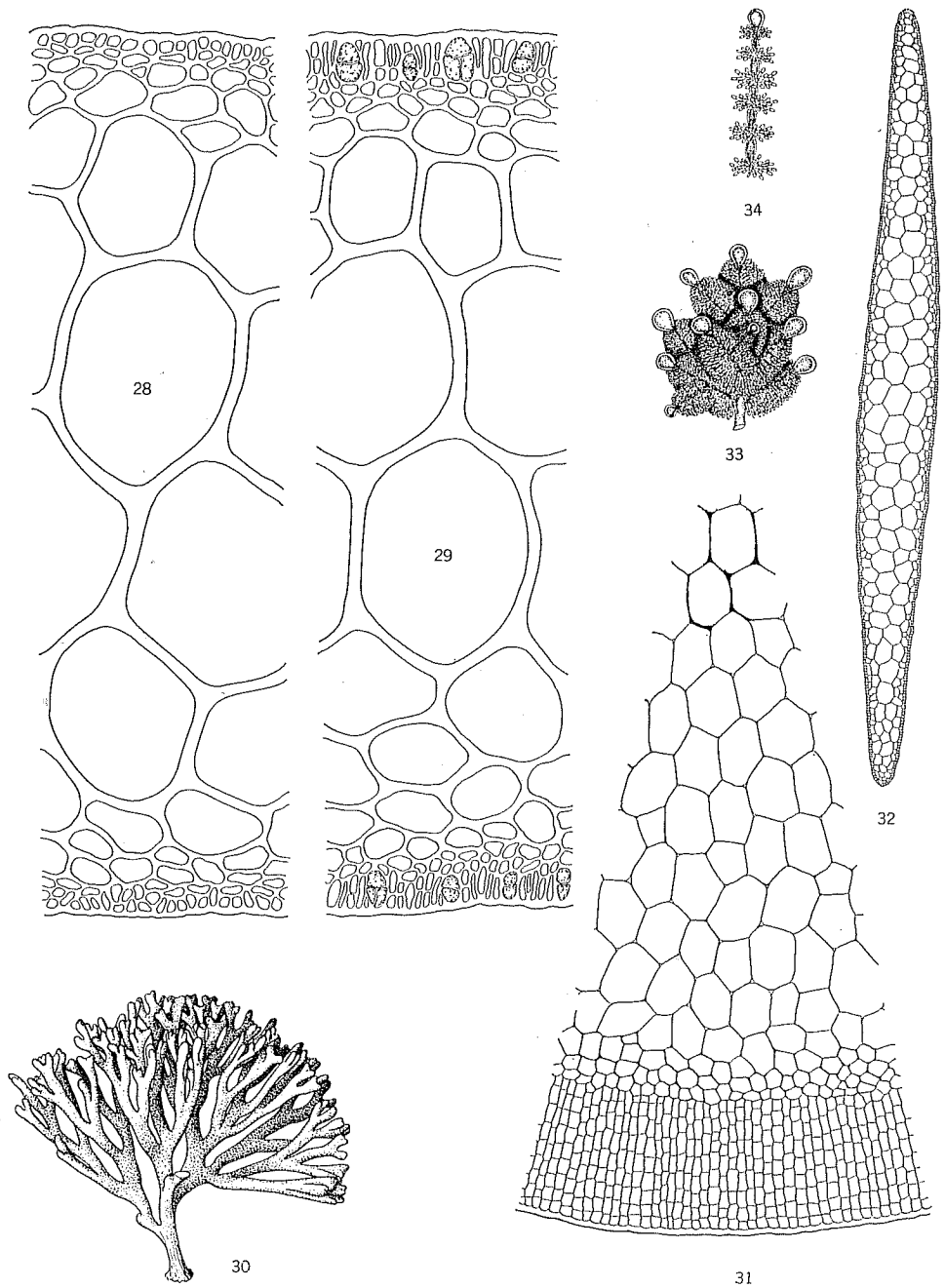


Plate 25

Estebania conjuncta S. and G.

Fig. 35. A portion of a cross section of a tetrasporic frond. X 125 (del. H.)

Fig. 36. A portion of a cross section of a tetrasporic frond. X 75 (del. K.)

Schizymenia violacea S. and G.

Fig. 37. Sketch of a part of a cross section of a cystocarpic frond. X 150 (del. K.)

Fig. 38. Sketch of a part of the cortex of a tetrasporic frond. X 150 (del. K.)

Prionitis abbreviata S. and G.

Fig. 39. A sketch of a cross section of a frond extending from the center to the surface. X 250 (del. H.)

Ceramium sinicola S. and G.

Fig. 40. A sketch of a segment of a tetrasporic branch. X 125 (del. K.)

Fig. 41. End of the same branch shown in fig. 40. X 125 (del. K.)

Eucheuma Johnstonii S. and G.

Fig. 42. A sketch of a single tetrasporangium, showing the inequality in size of the tetraspores. X 125 (del. P.)

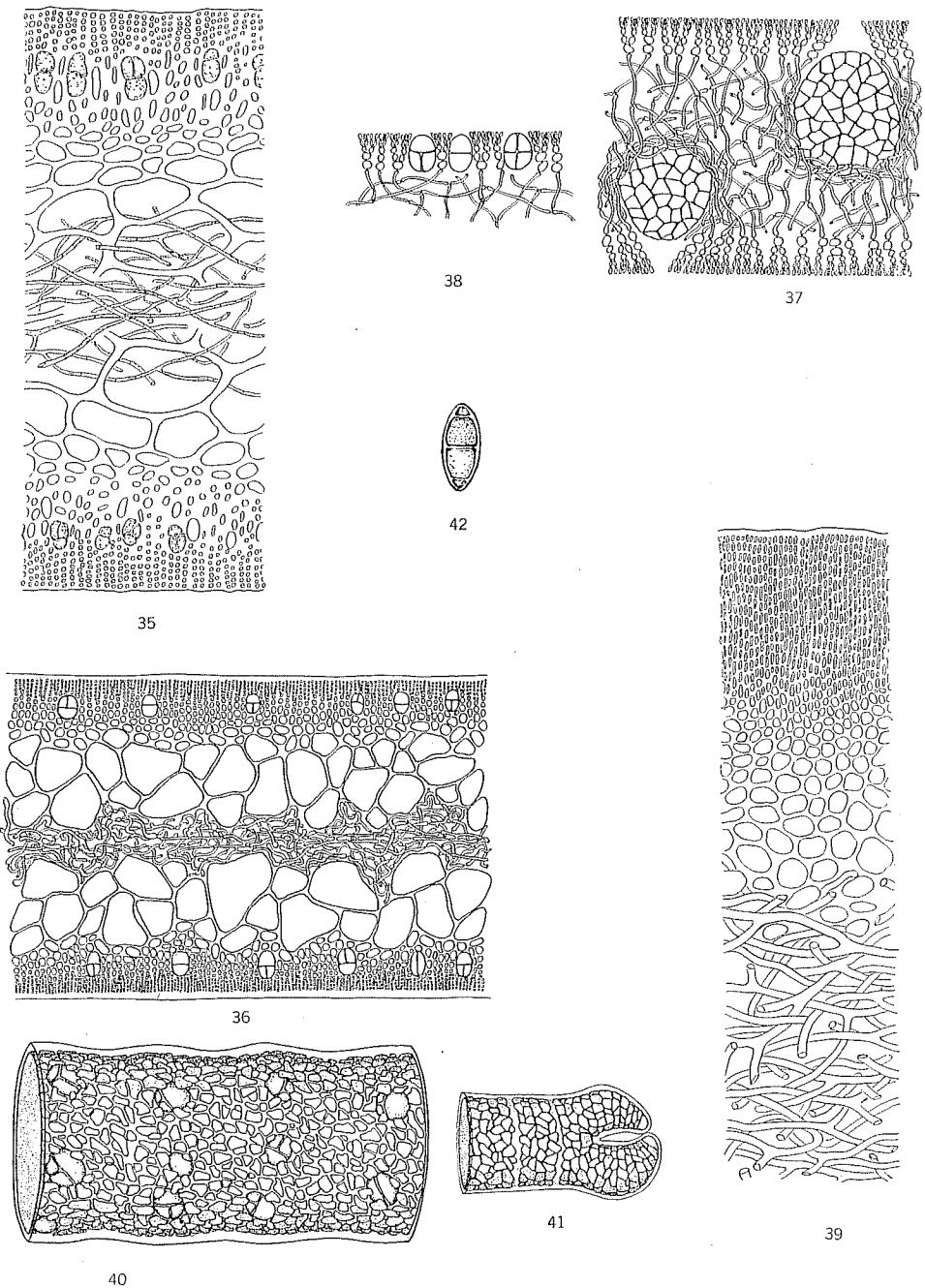


Plate 26

Ceramium fimbriatum S. and G.

Fig. 43. A diagrammatic sketch of a fragment of a frond.

Fig. 44. A sketch of a terminal branch. X 125 (del. P.)

Grateloupia acroidalea S. and G.

Fig. 45. A sketch of a portion of a cross section, vegetative to the left and tetrasporic to the right. X 250 (del. P.)

Fig. 46. A sketch of a mature whole frond. X 1 (del. P.)

Ceramium interruptum S. and G.

Fig. 47. A sketch of a branched segment of a tetrasporic frond, showing the interrupted cortication. X 50 (del. K.)

Centroceras bellum S. and G.

Fig. 48. A sketch of segments of a tetrasporic plant. X 125 (del. P.)

Ceramium horridum S. and G.

Fig. 49. A sketch of a terminal fragment of a frond. X40 (del. P.)

Fig. 50. A sketch of the ends of three branches, the upper one having two growing points. X 125 (del. P.)

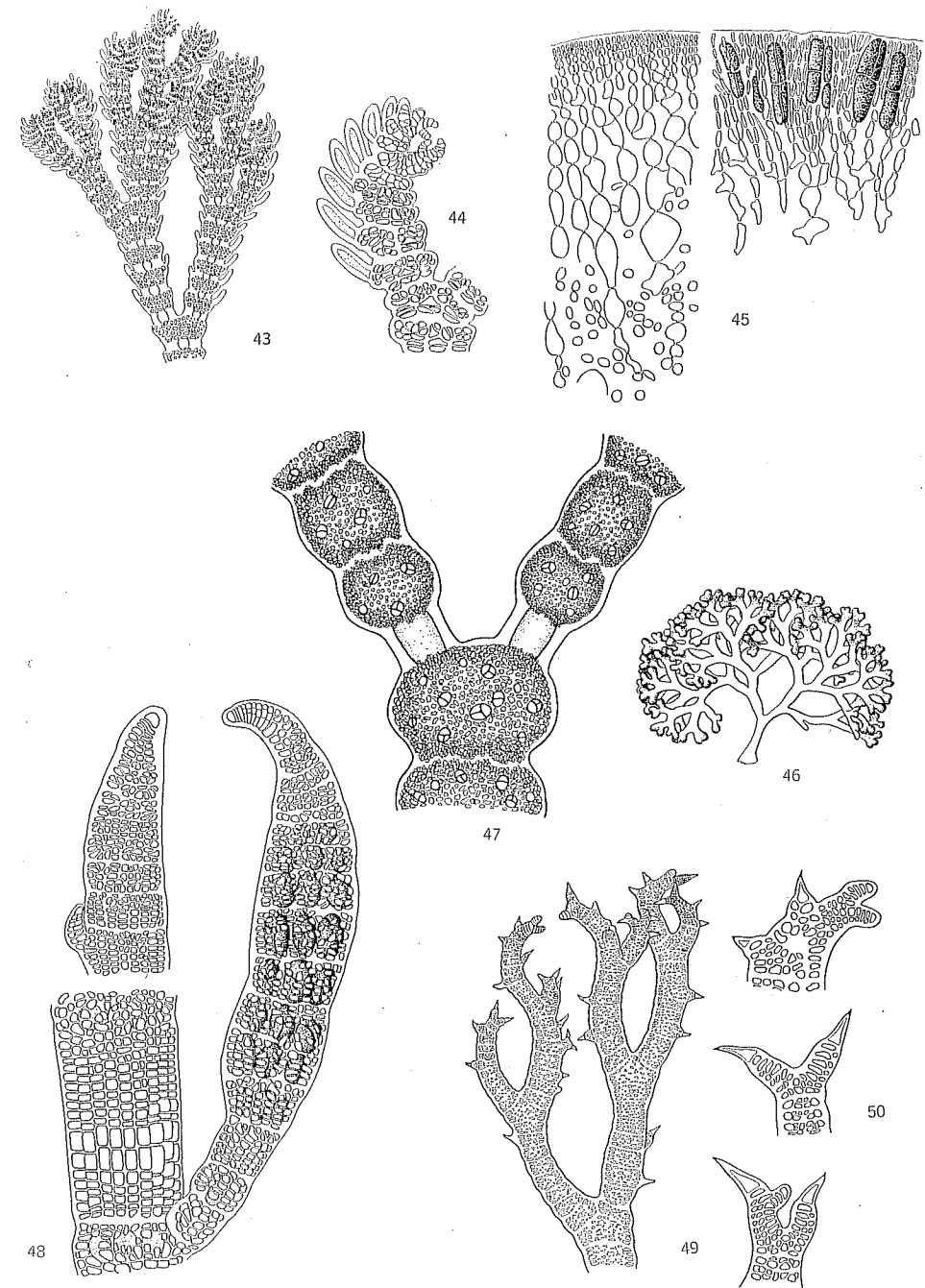


Plate 27

Ceramium procumbens S. and G.

- Fig. 51. A sketch of a portion of a mature frond, showing mostly opposite branching. X 30 (del. K.)
 Fig. 52. A sketch of a short lateral tetrasporic ramulus. X 125 (del. K.)
 Fig. 53. A sketch of a cystocarpic ramulus. X 125 (del. K.)
 Fig. 54. A sketch of an antheridial ramulus. X 125 (del. K.)

Ceramium caudatum S. and G.

- Fig. 55. A sketch of a segment of a mature tetrasporic ramulus. X 125 (del. K.)
 Fig. 56. A sketch of a segment of the main frond near the base. X 125 (del. K.)
 Fig. 57. A sketch of the end of a tetrasporic branch. X 125 (del. K.)

Ceramium serpens S. and G.

- Fig. 58. A sketch of a portion of a tetrasporic plant, showing a horizontal filament with attachments and with erect free branches. X 125 (del. P.)

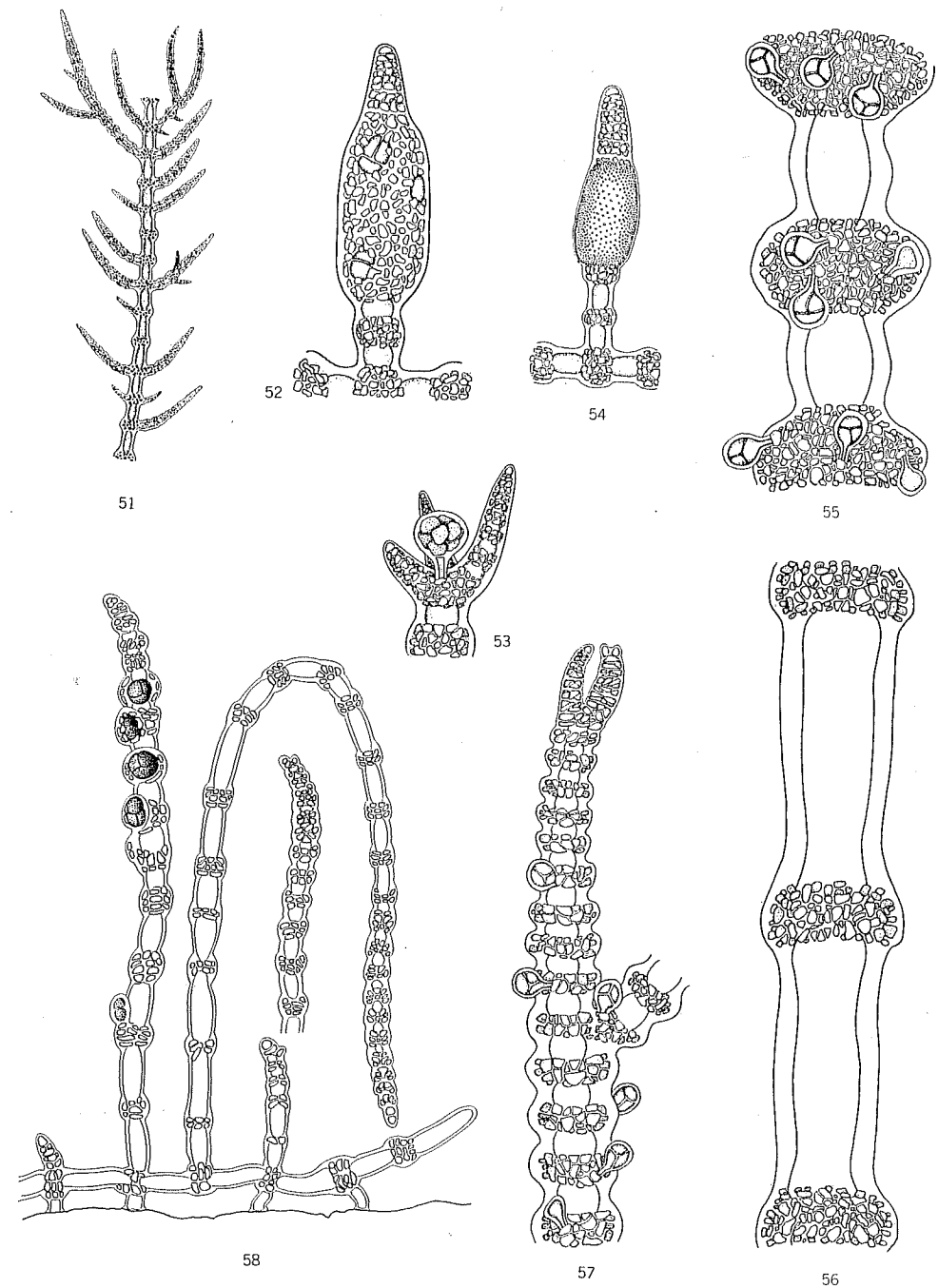


Plate 28

Heterosiphonia sinicola S. and G.

Fig. 59. A sketch of a segment of a frond showing the character of the surface cells and of the interior cells. X 60 (del. H.)

Fig. 60. A cross section of a mature frond. X 75 (del. H.)

Polyopes sinicola S. and G.

Fig. 61. A cross section of a frond at the margin. X 75 (del. K.)

Callithamnion endovagum S. and G.

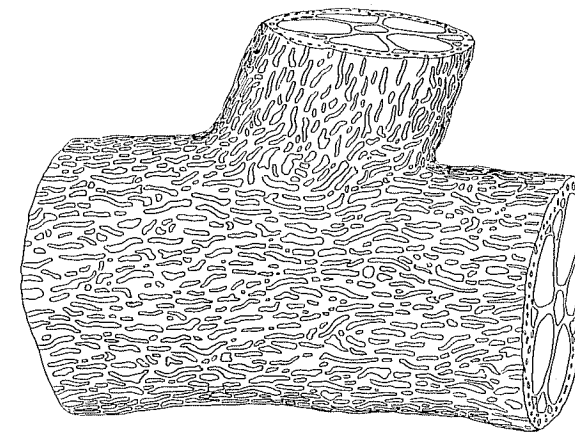
Fig. 62. A sketch of a cross section of the host, showing the penetrating filaments of the *Callithamnion*, and the free filaments with procarys. X 125 (del. K.)

Colacodasya sinicola S. and G.

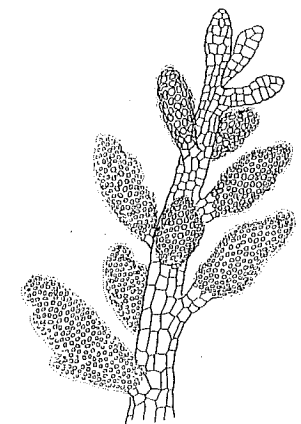
Fig. 63. A sketch of a free filament showing numerous antheridia. X 125 (del. H.)

Ceramium bicorne S. and G.

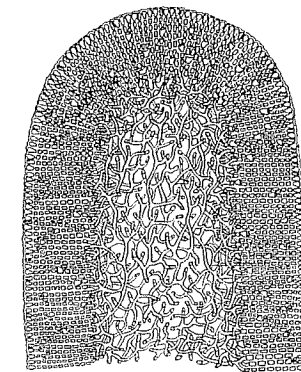
Fig. 64. Sketches of terminal fragments. X 250 (del. H.)



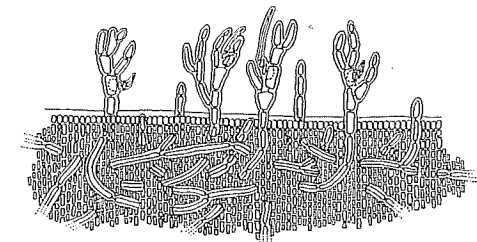
59



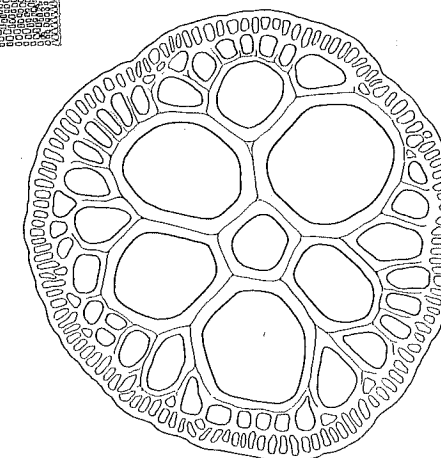
63



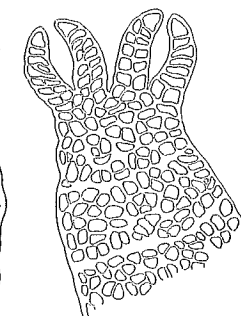
61



62



60



64



Plate 29

Laurencia sinicola S. and G.

Fig. 65. A sketch of a fragment of a tetrasporic frond. X 4 (del. K.)

Fig. 66. A sketch of a fragment of a cystocarpic frond. X 10 (del. K.)

Laurencia obtusiuscula var. *laxa* S. and G.

Fig. 67. A sketch of a few tetrasporic ramuli. X 10 (del. K.)

Laurencia sp.

Fig. 68. A sketch of a tetrasporic ramulus. X 40 (del. P.)

Fig. 69. A sketch of a fragment of a plant. X 1.5 (del. P.)

Ceramium sp.

Fig. 70. A sketch of a terminal fragment of an antheridial frond. X 125 (del. P.)

Fig. 71. The same as fig. 70. X 25 (del. P.)

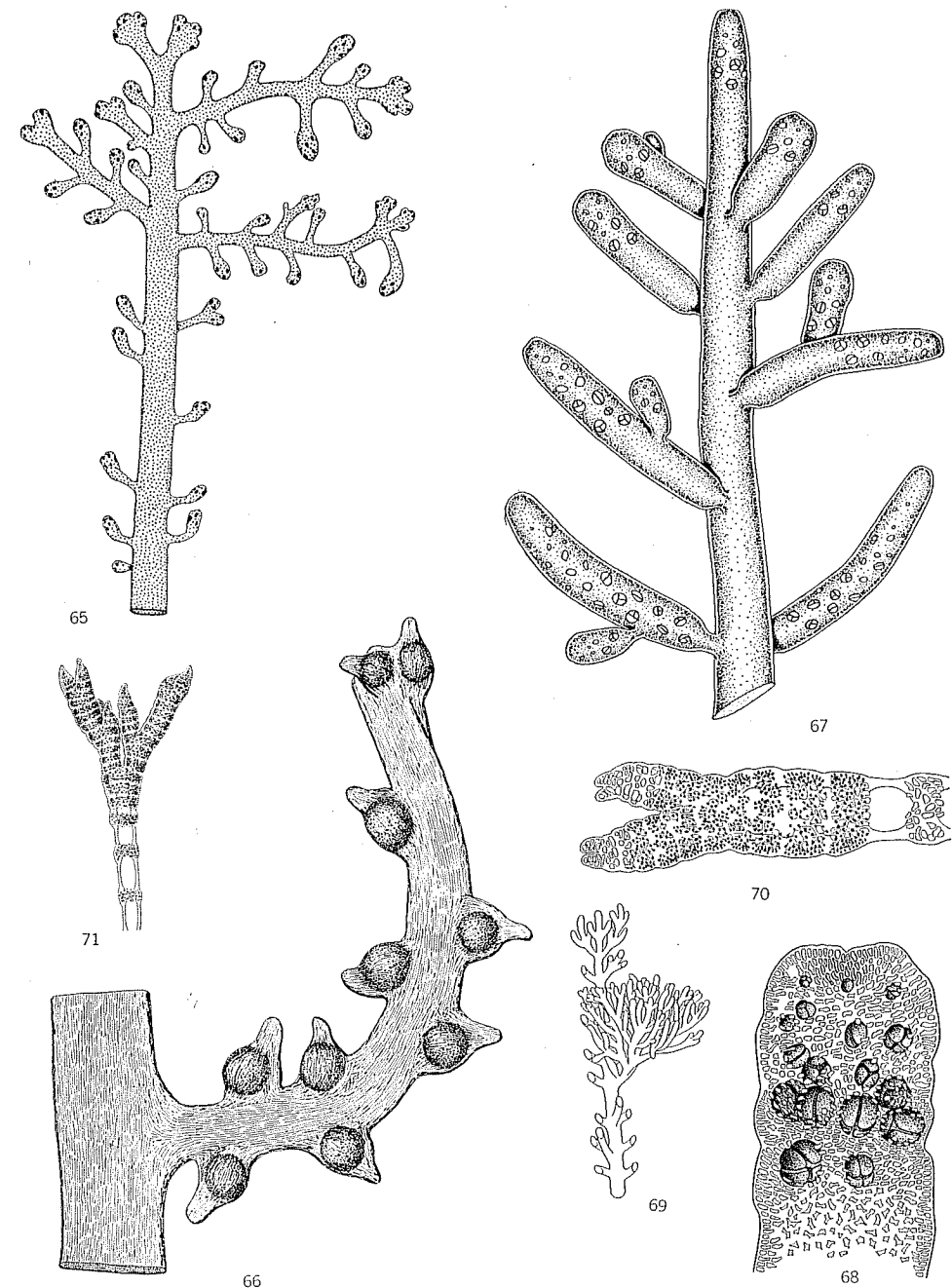


Plate 30

Codium Brandegeei S. and G.

A photograph of the type specimen.

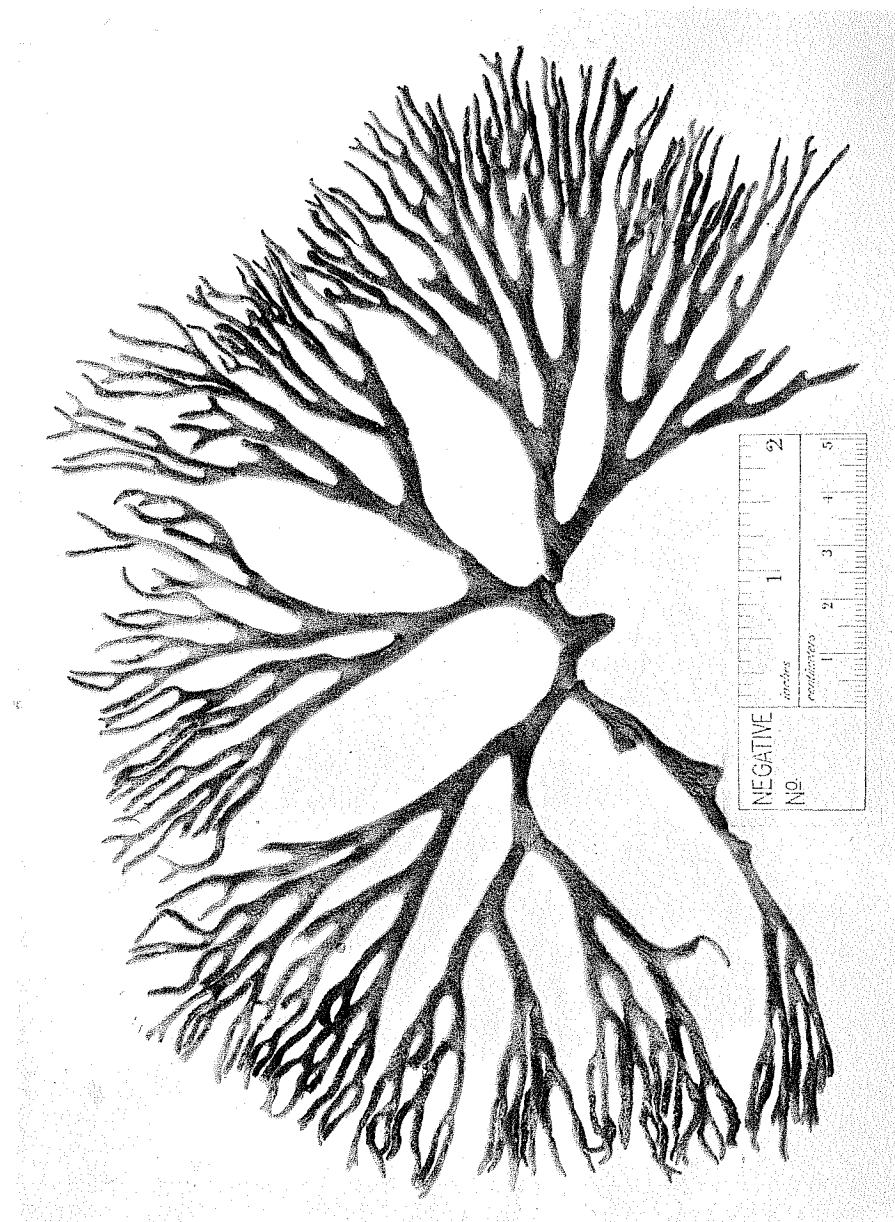


Plate 31

Codium simulans S. and G.

A photograph of the type specimen.

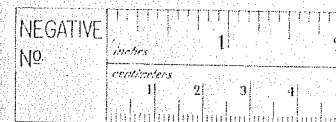
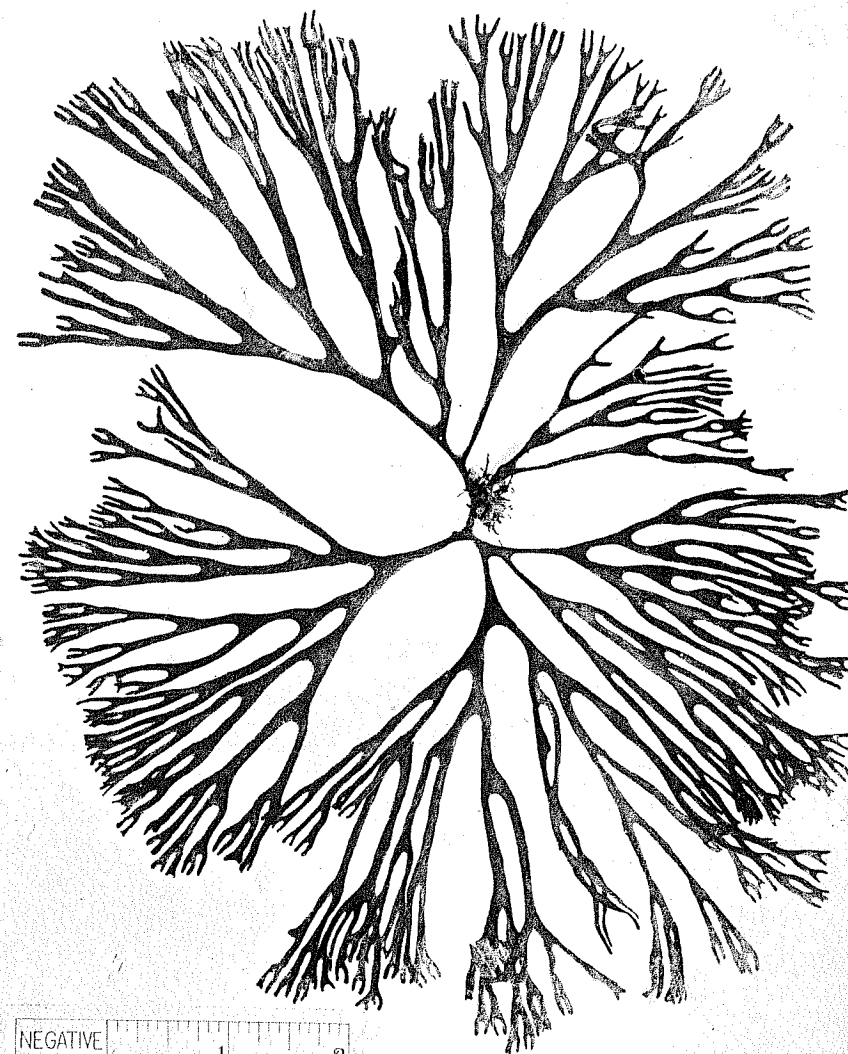


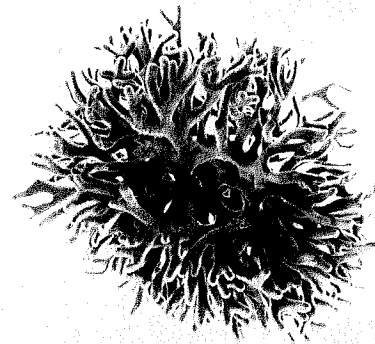
Plate 32

A. *Codium conjunctum* S. and G.

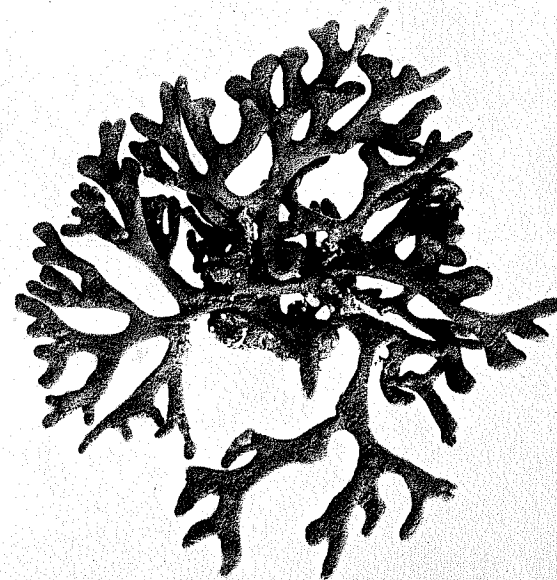
A photograph of the type specimen. X 1.

B. *Codium cervicorne* S. and G.

A photograph of the type specimen. X 1.



a



b

Plate 33

Codium reductum. S. and G.

A photograph of the type specimen dried. X 1.

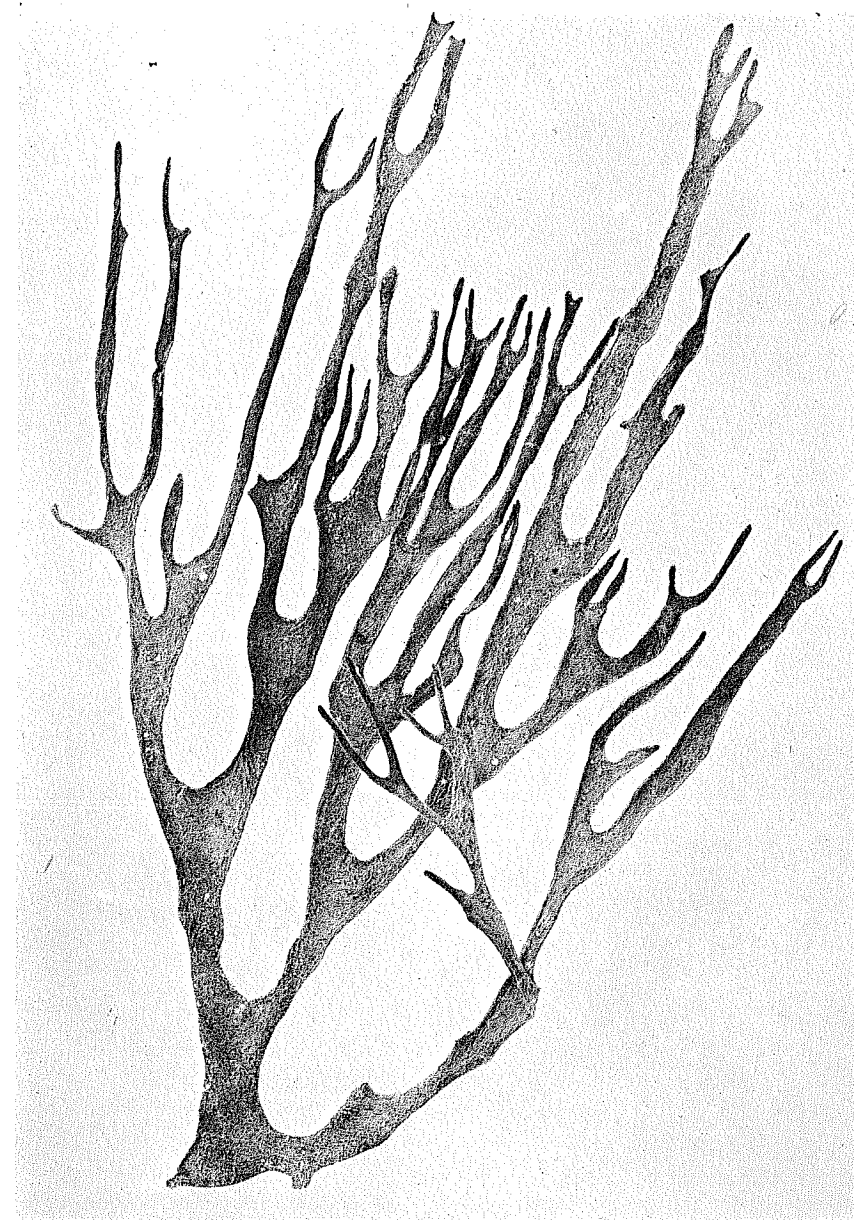


Plate 34

Codium cuneatum S. and G.

A photograph of the type specimen.

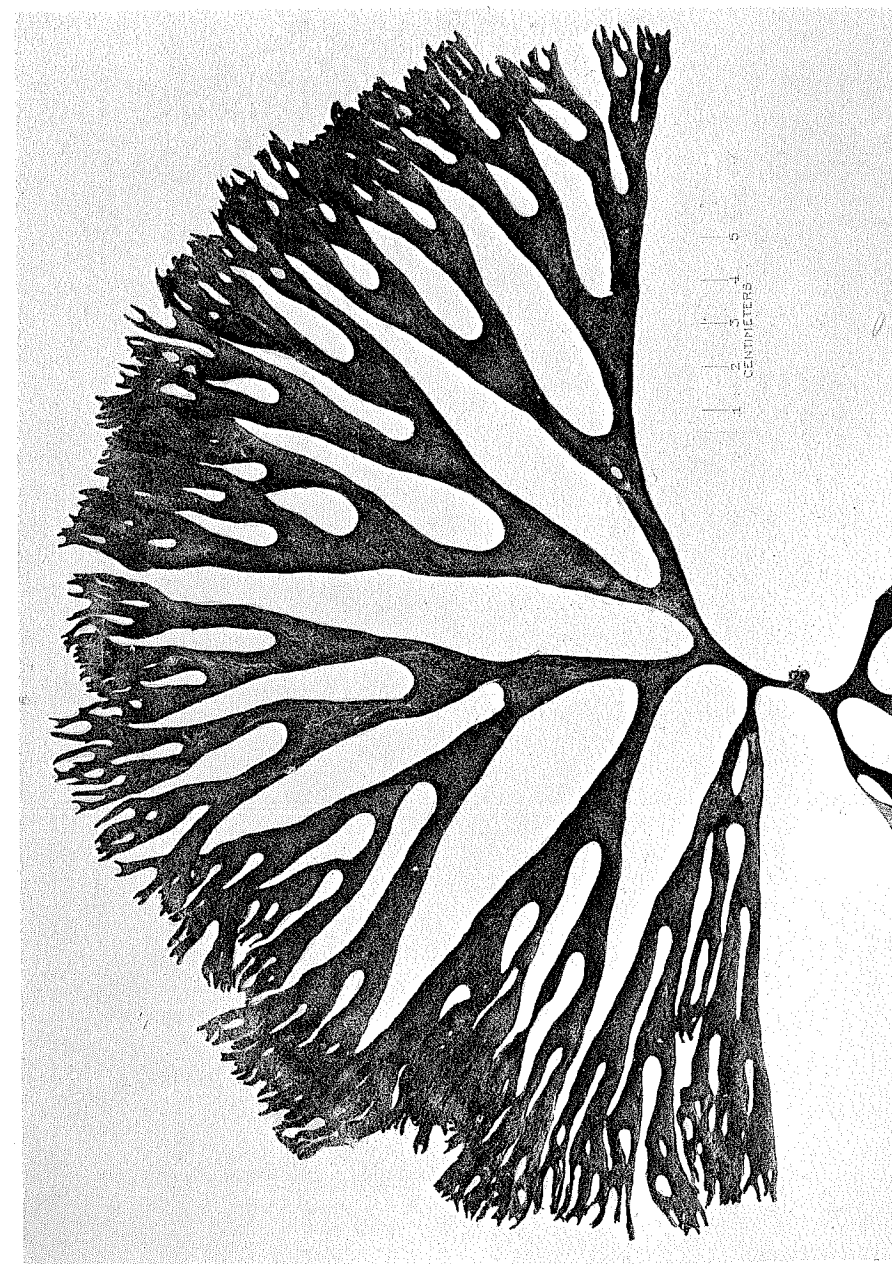


Plate 35

Codium amplivesiculatum S. and G.
A photograph of a portion of the type specimen, dried.



Plate 36

Codium unilaterale S. and G.

A photograph of the type specimen. X 1.

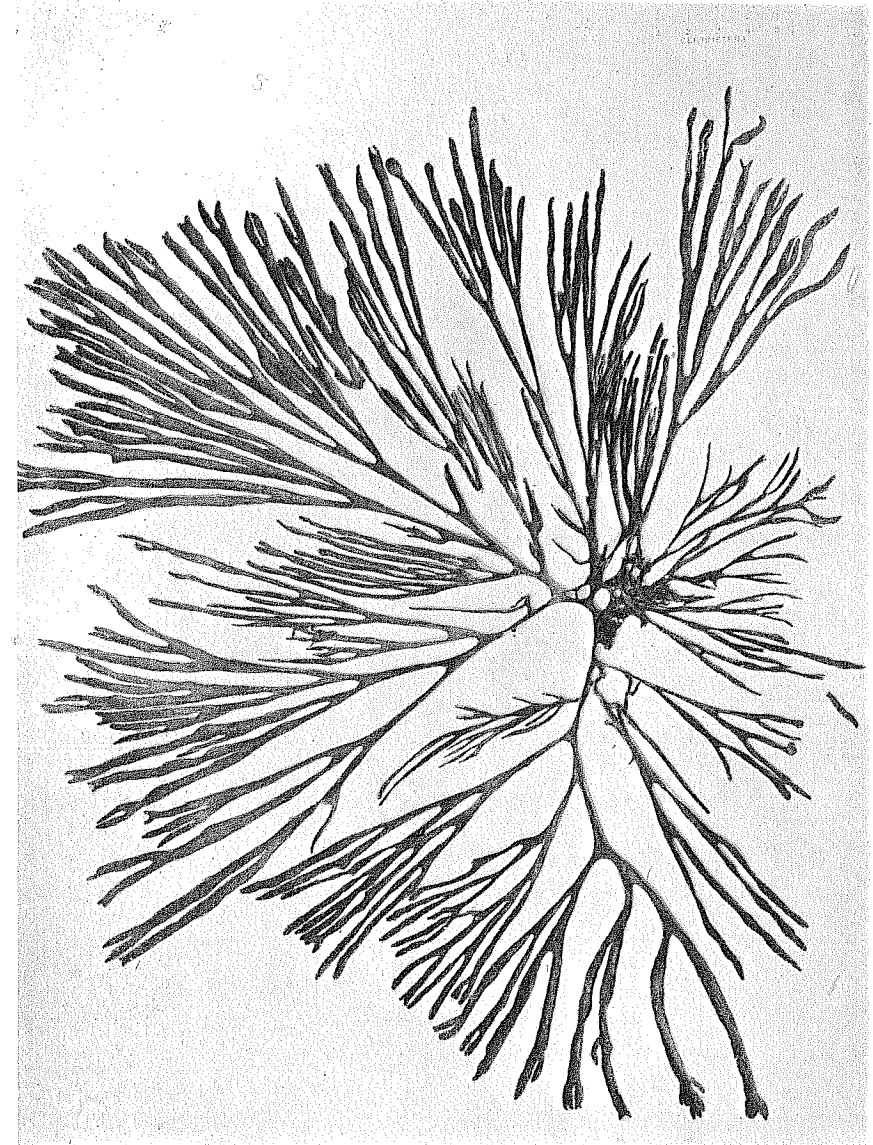


Plate 37

Codium longiramosum S. and G.

A photograph of the type specimen.

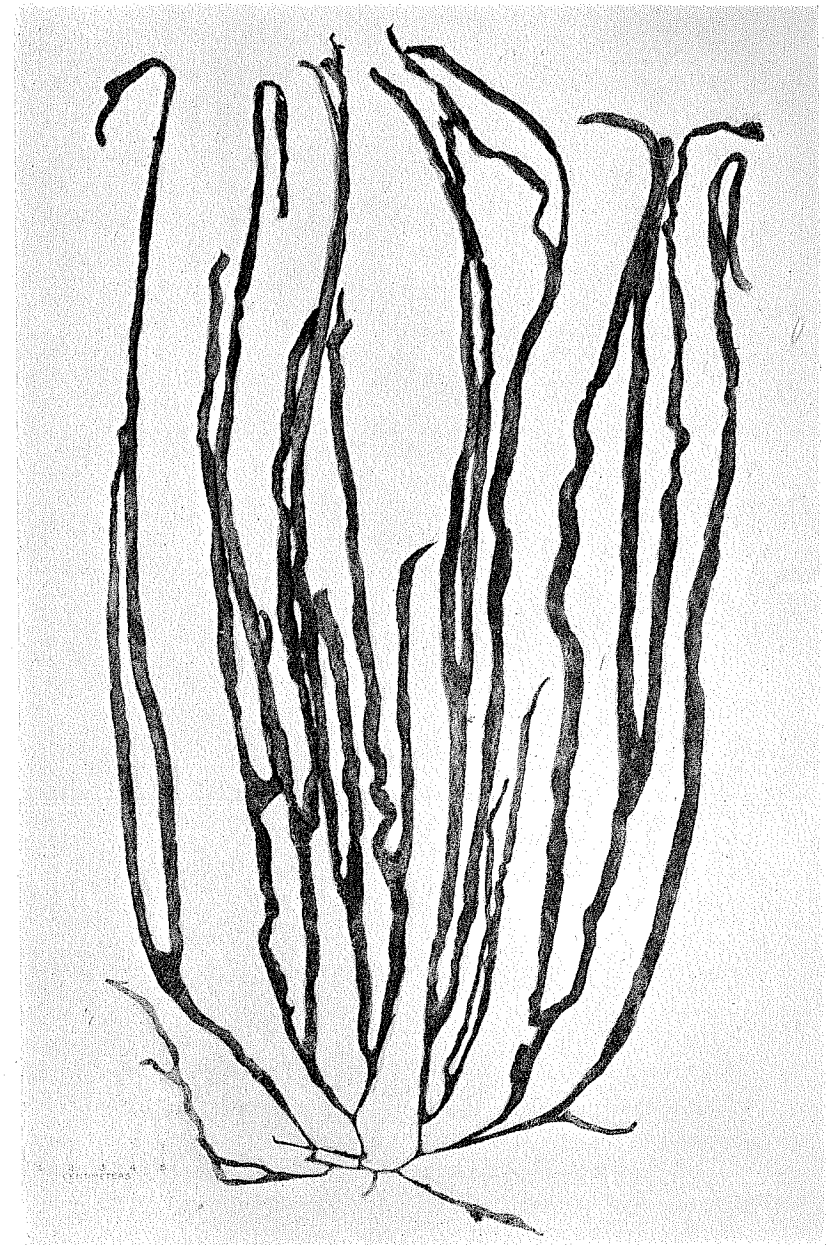


Plate 38

Enteromorpha acanthophora Kuetz.

A photograph of a few typical specimens of the collection, Johnston, no.
39. X 1.

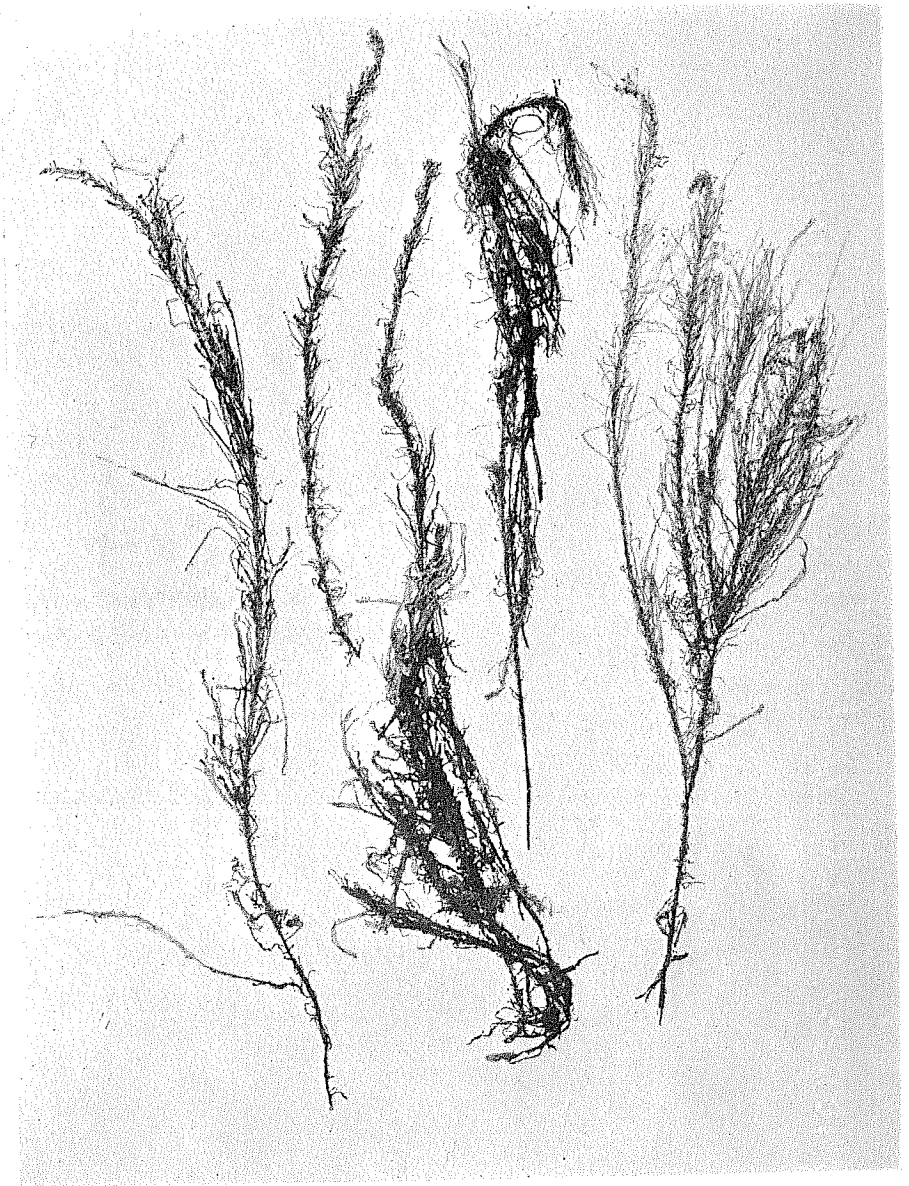


Plate 39

Dictyota Johnstonii S. and G.

A photograph of the type specimen. X 1.

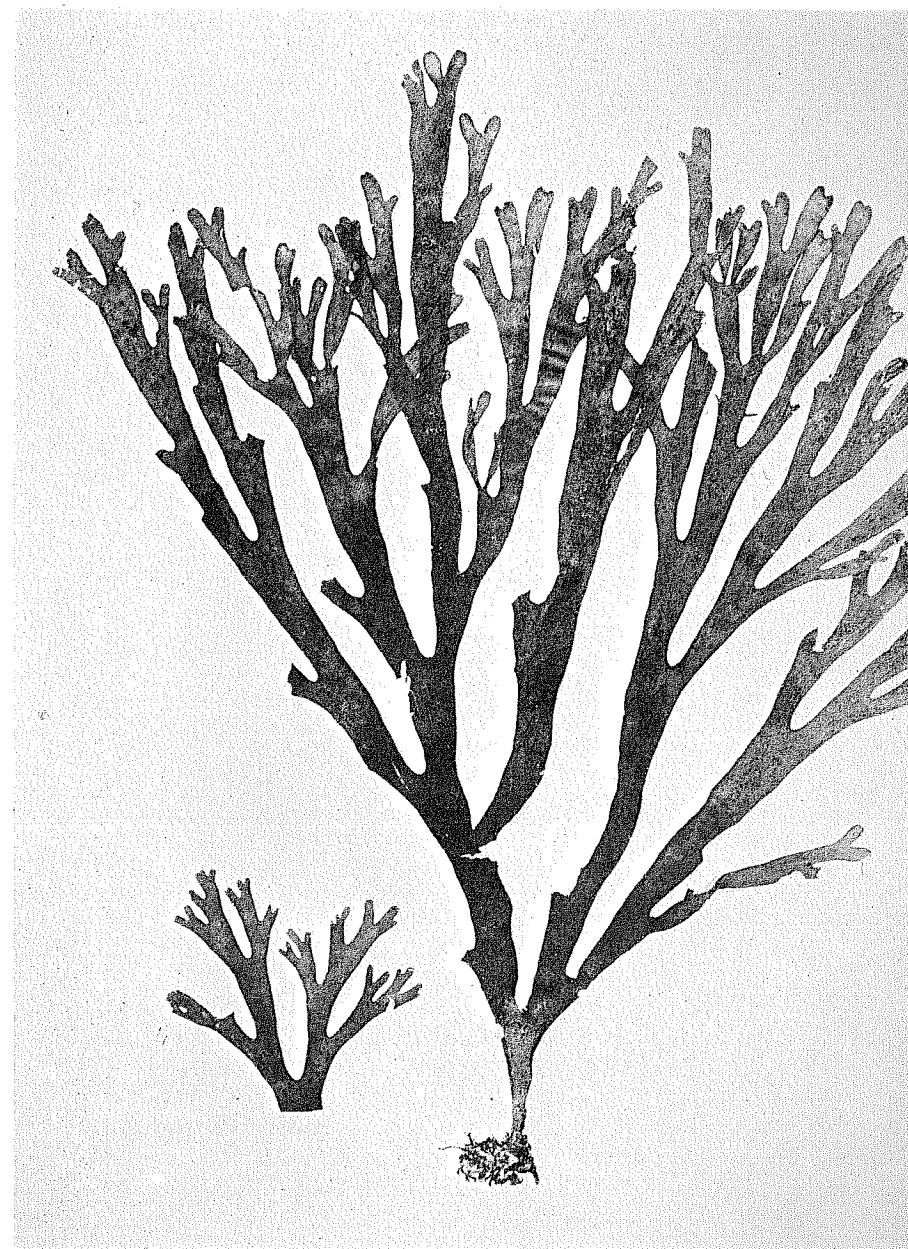


Plate 40

A. *Xenococcus deformans* S. and G.

A photograph showing the deformed host.

B. *Chondria acrorhizophora* S. and G.

A photograph of two tetrasporic plants showing habit. X 1.

C. *Centroceras bellum* S. and G.

A photograph showing the character of the end of a filament. X 145.

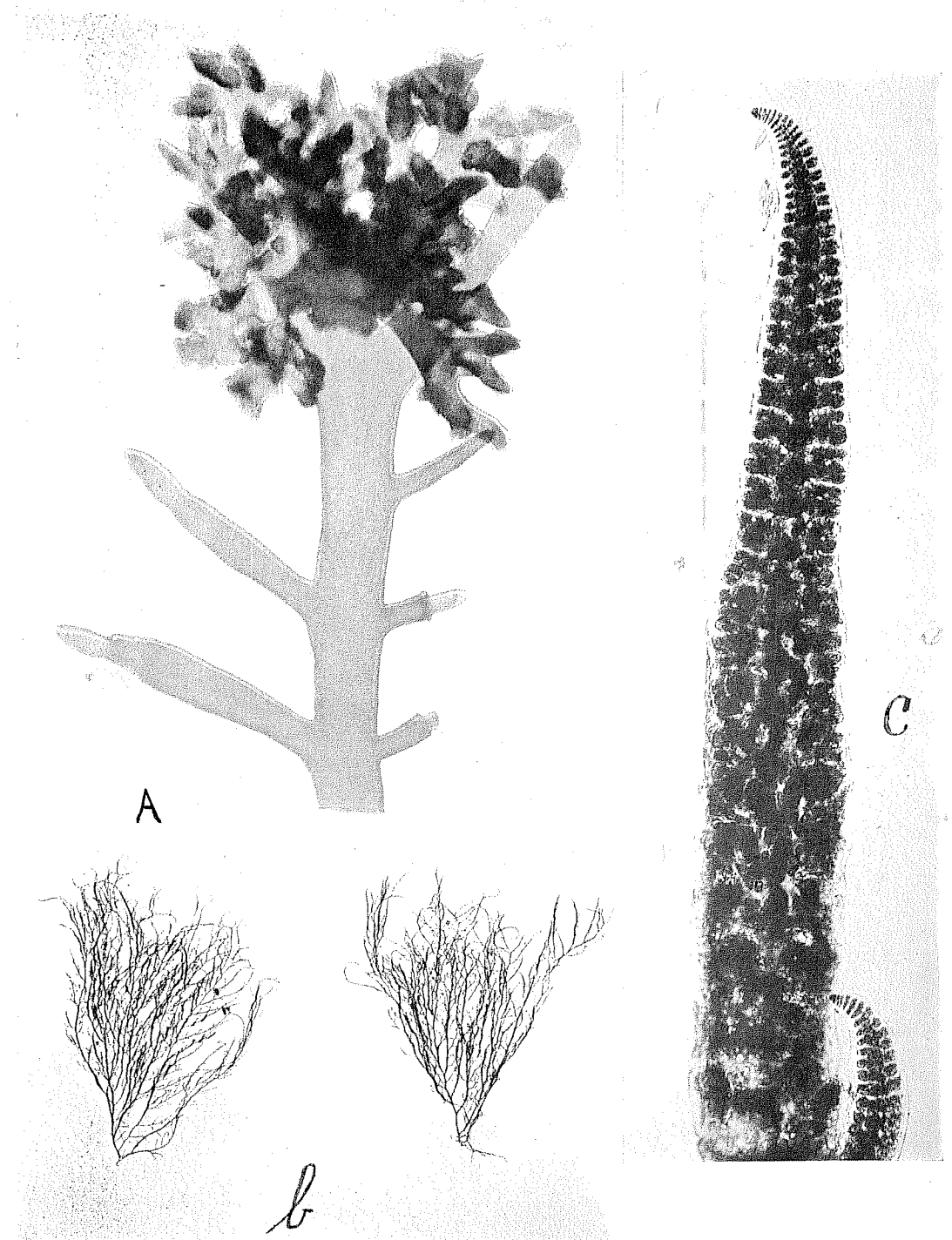


Plate 41

Asparagopsis Sanfordiana f. *amplissima* S. and G.
A photograph of the type specimen showing the general habit.

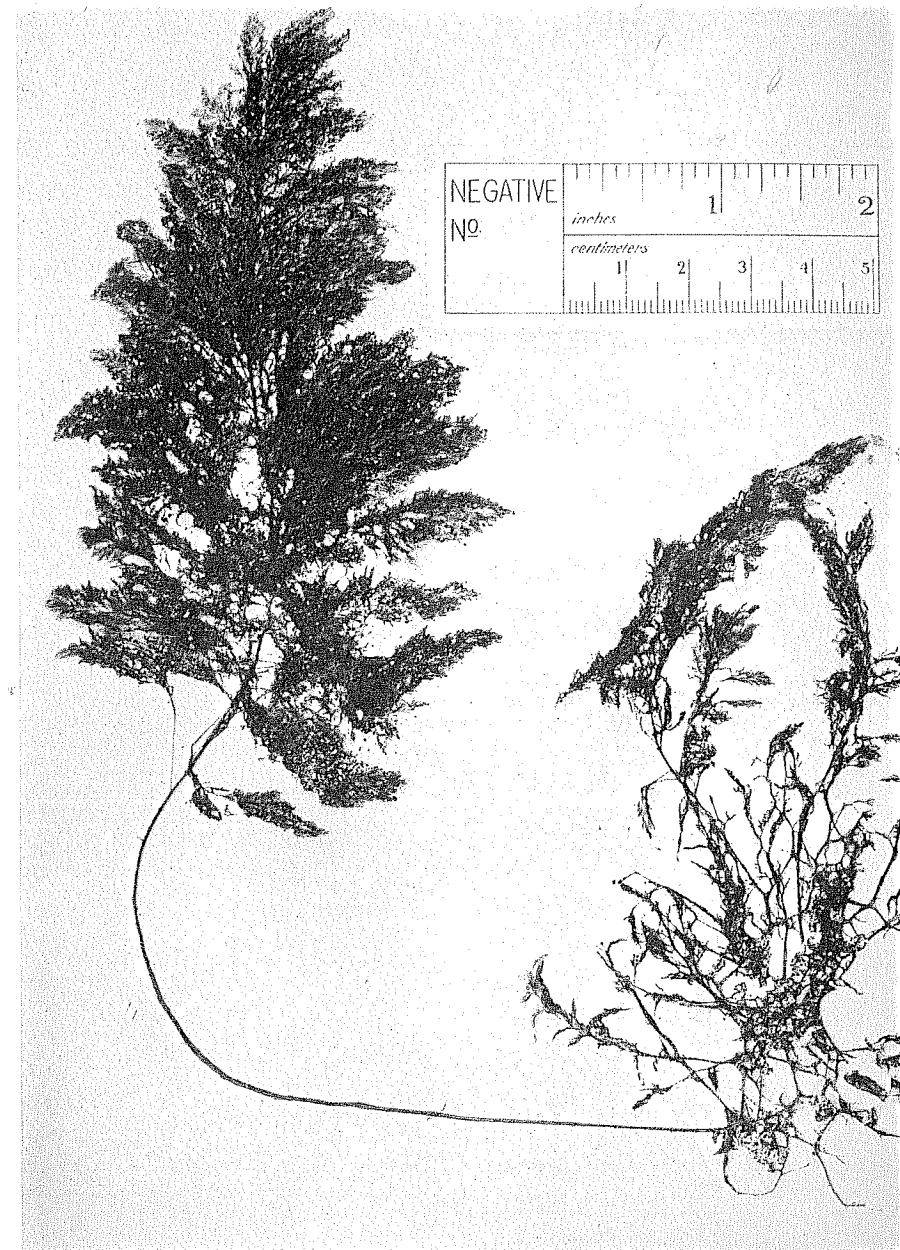


Plate 42

A. *Hypnea Marchantæ* S. and G.

A photograph of a fragment of a tetrasporic plant. X 10.

B. *Polyopes sinicola* S. and G.

A photograph of the type specimen. X 1.

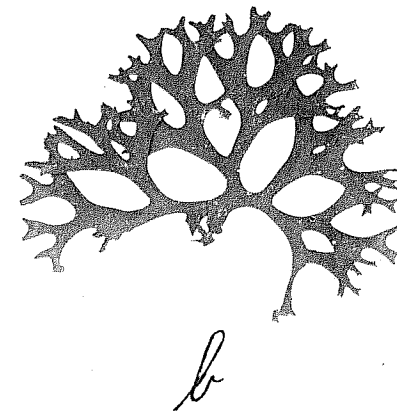


Plate 43

Laurencia papillosa var. *pacifica* S. and G.

A, X 1. B, X 3.

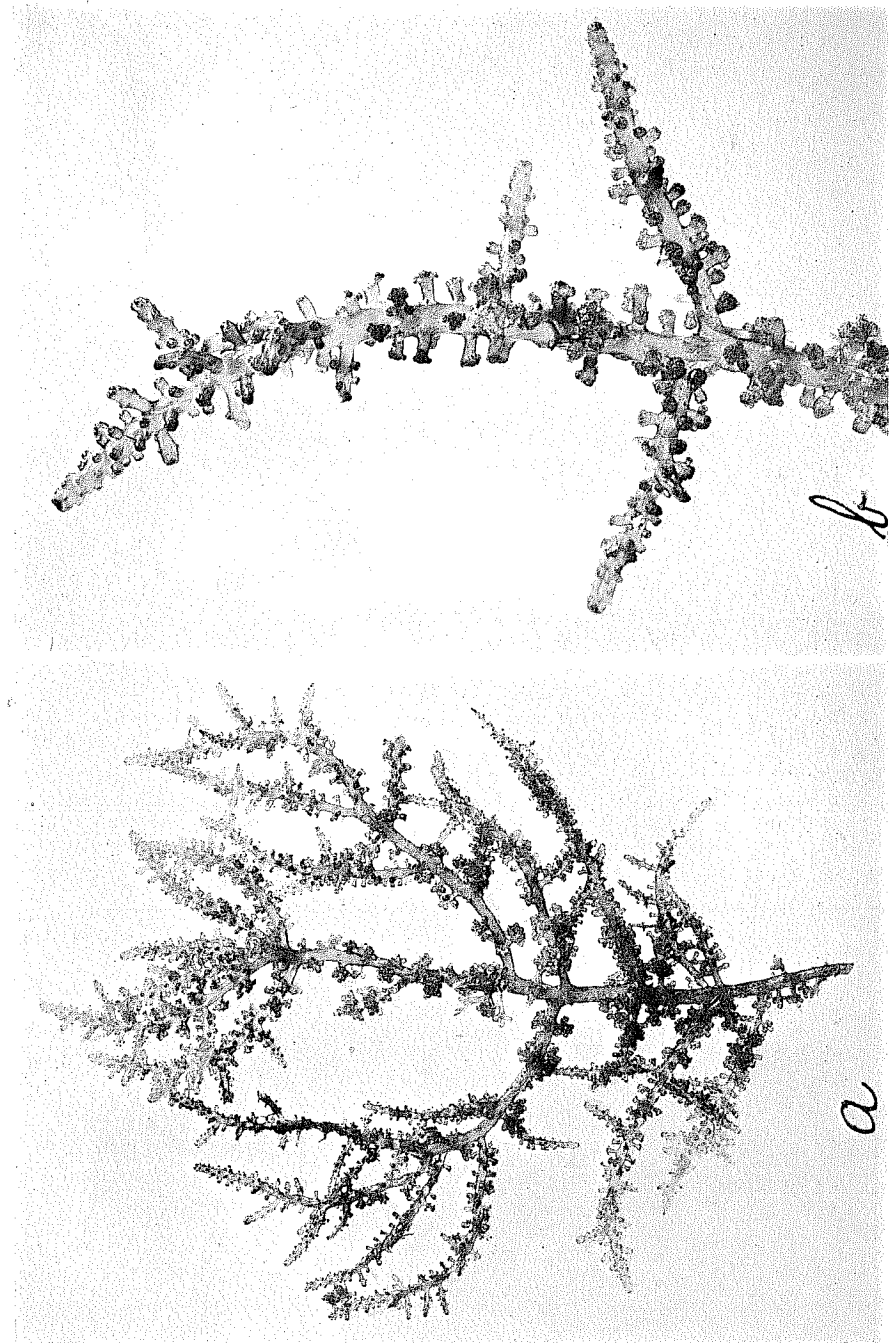


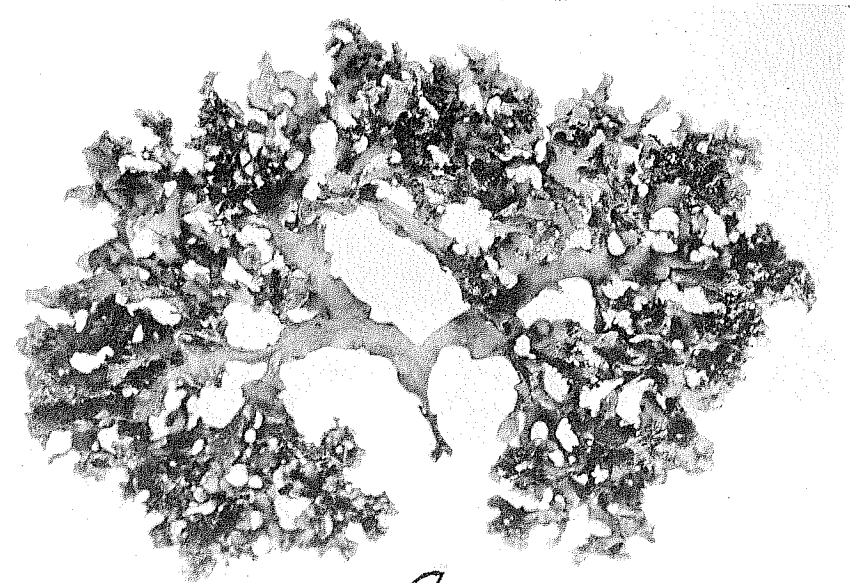
Plate 44

A. *Gracilaria crispata* S. and G.

A photograph of the type specimen. X 1.

B. *Corallopsis excavata* S. and G.

A photograph showing the moniliform tetrasporic branches. X 1.



a



b

Plate 45

A. *Laurencia estebaniana* S. and G.

A photograph of the type specimen. X 1.

B. *Laurencia obtusiuscula* var. *corymbifera* S. and G.

A photograph of the type specimen. X 1.

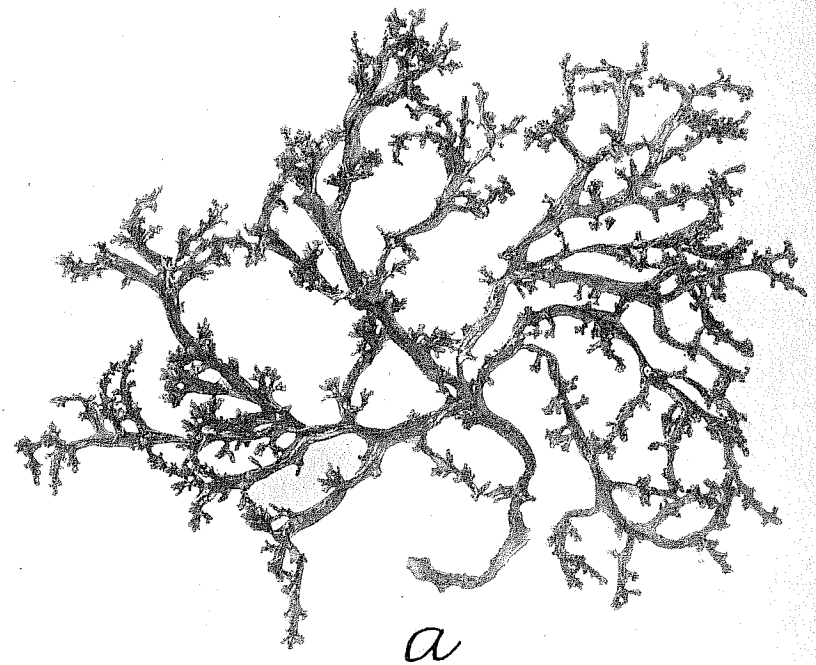
*a**b*

Plate 46

A. *Gelidium Johnstonii* S. and G.

A photograph of a fragment of a cystocarpic plant. X 4.

B. *Gigartina Chauvinii* (Bory) Mont.

A photograph of the type specimen. X 1.

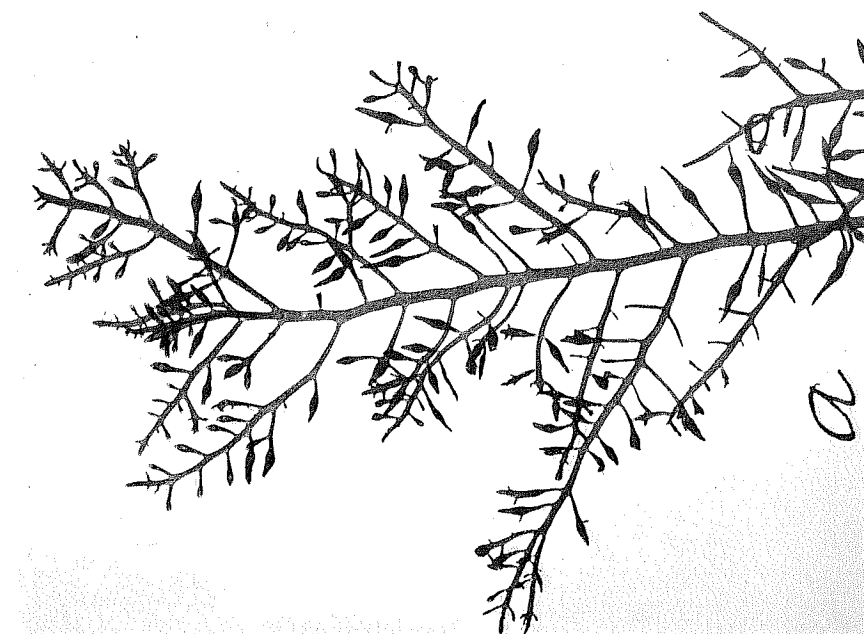


Plate 47

A. *Gymnogongrus carnosus* S. and G.

A photograph of the type specimen. X 1.

B. *Heterosiphonia sinicola* S. and G.

A photograph of the type specimen. X 1.

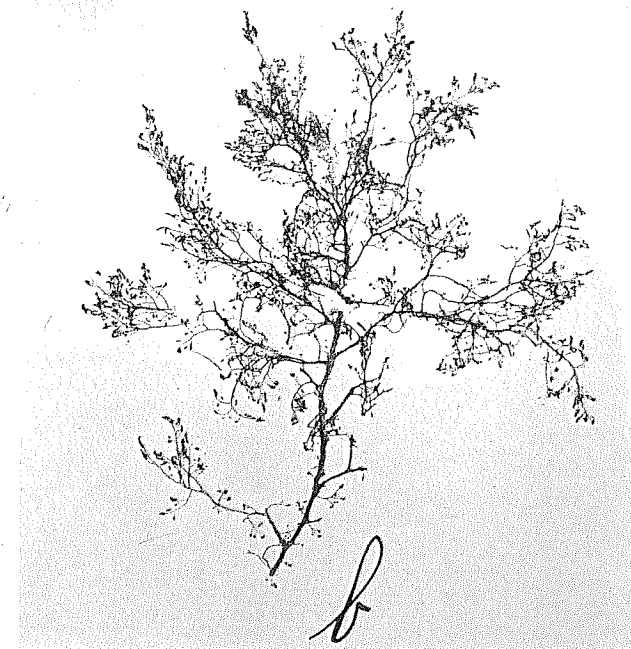
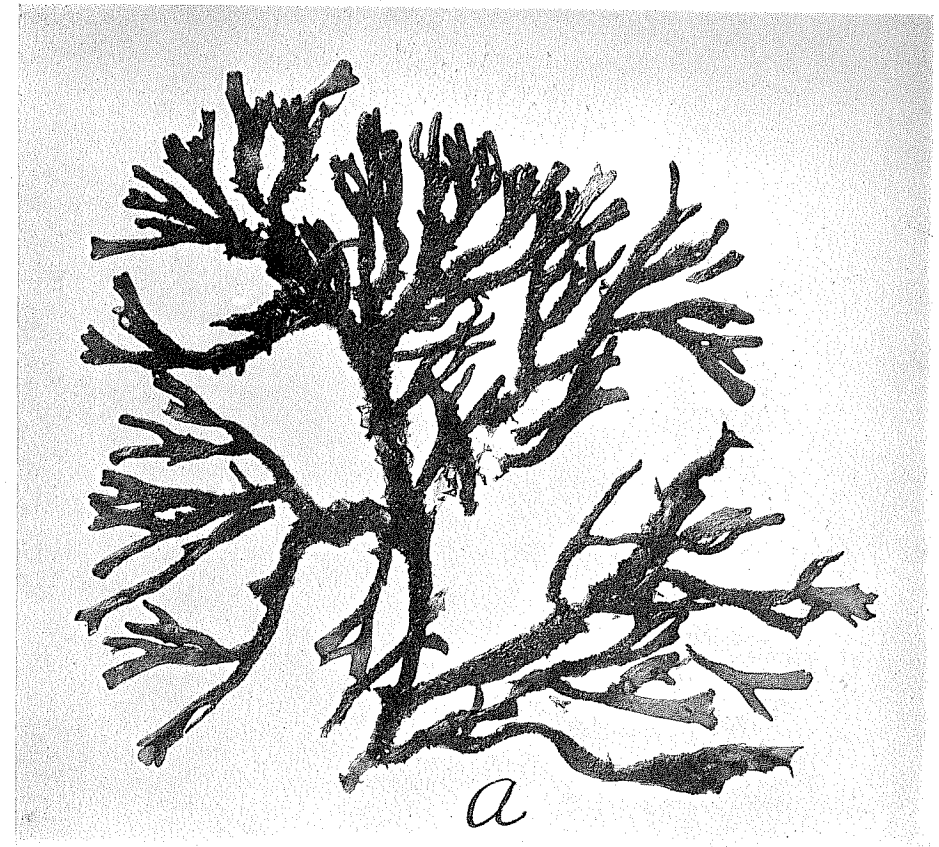


Plate 48

Corallopsis excavata S. and G.

A photograph of the type specimen. X 0.5.

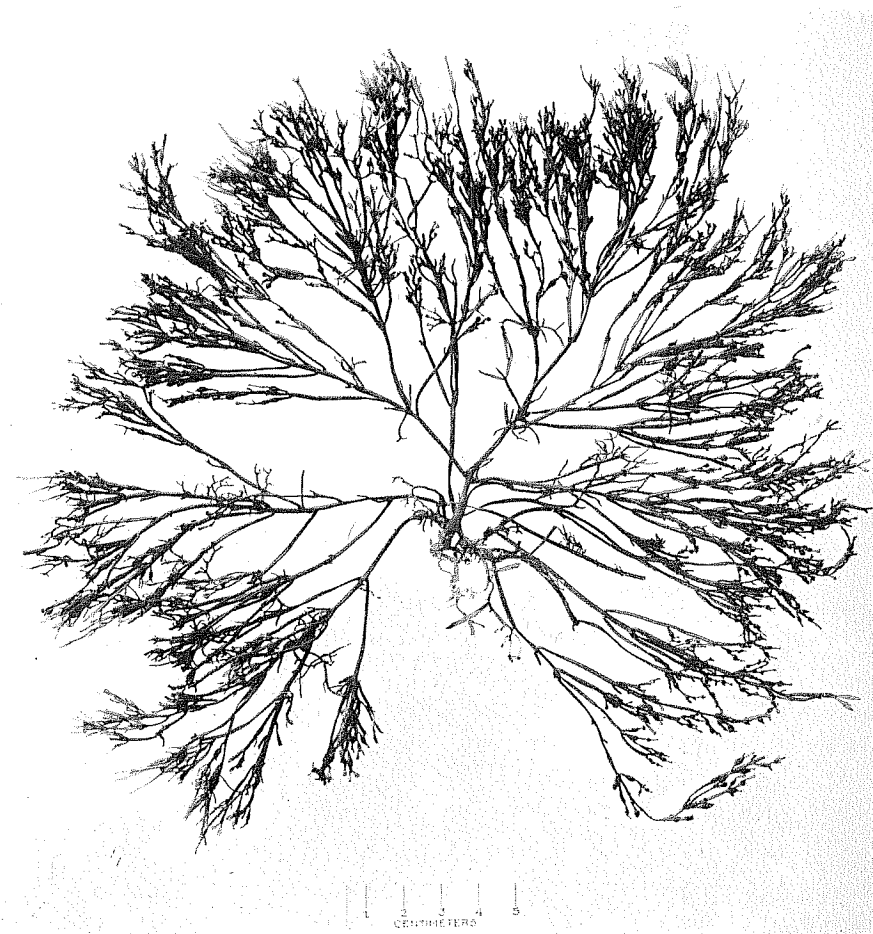


Plate 49

A. *Polysiphonia Marchantæ* S. and G.

A photograph of the type specimen. X 1.

B. *Callymenia pertusa* S. and G.

A photograph of the type specimen. X 1.

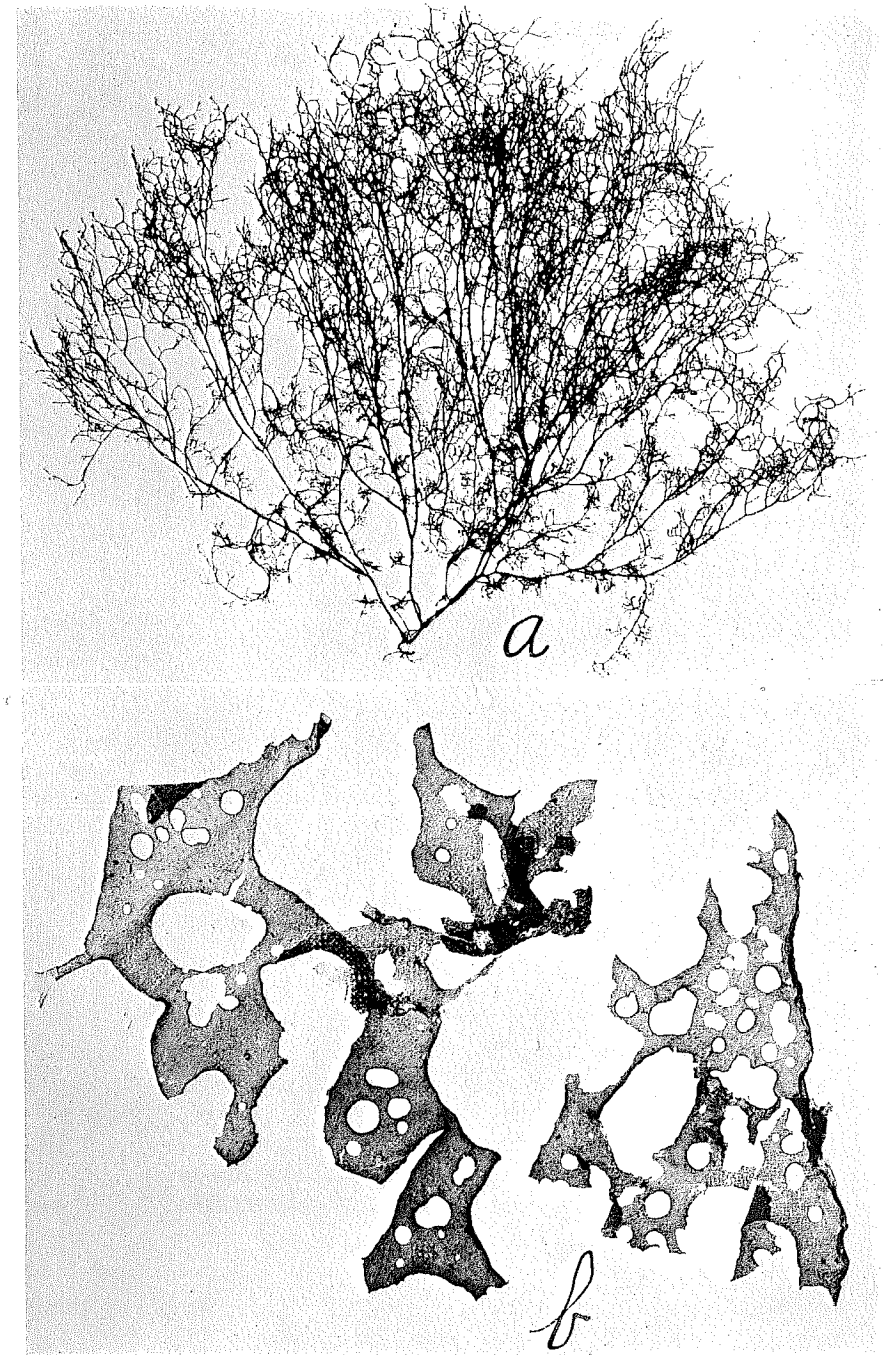


Plate 50

A. *Laurencia sinicola* S. and G.

A photograph of the type material.

B. *Prionitis abbreviatus* S. and G.

A photograph of the type specimen. X 1.

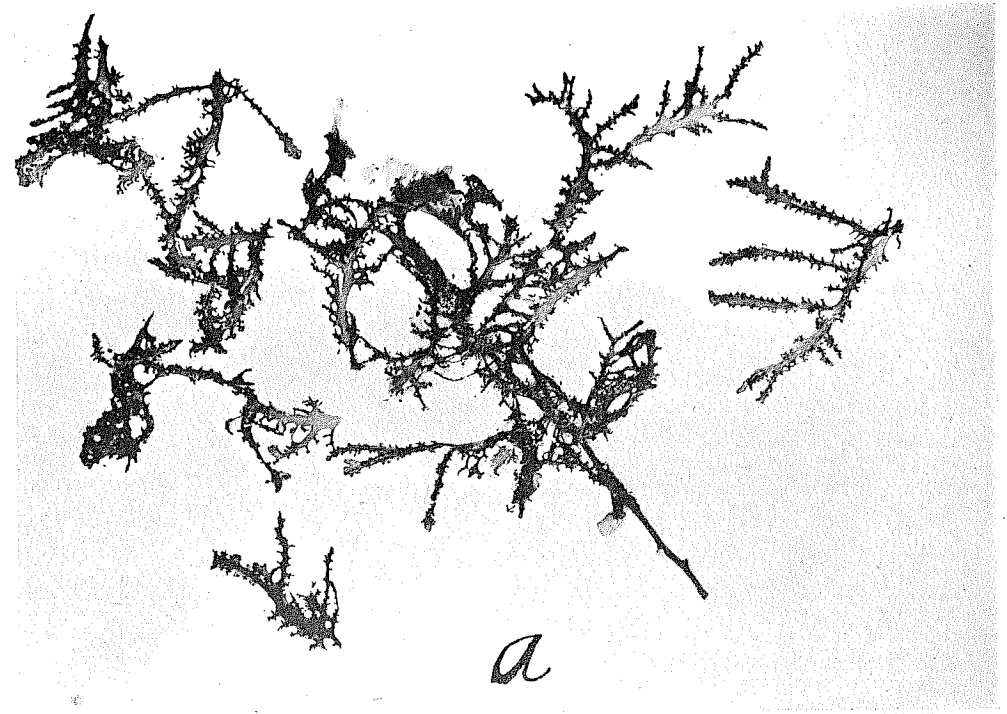


Plate 51

A. *Callophyllis Johnstonii* S. and G.

A photograph of the type specimen of a cystocarpic plant. X 1.

B. *Callophyllis Johnstonii* S. and G.

A photograph of a tetrasporic plant. X 1.

C. *Gracilaria lacerata* S. and G.

A photograph of typical specimens. X 1.

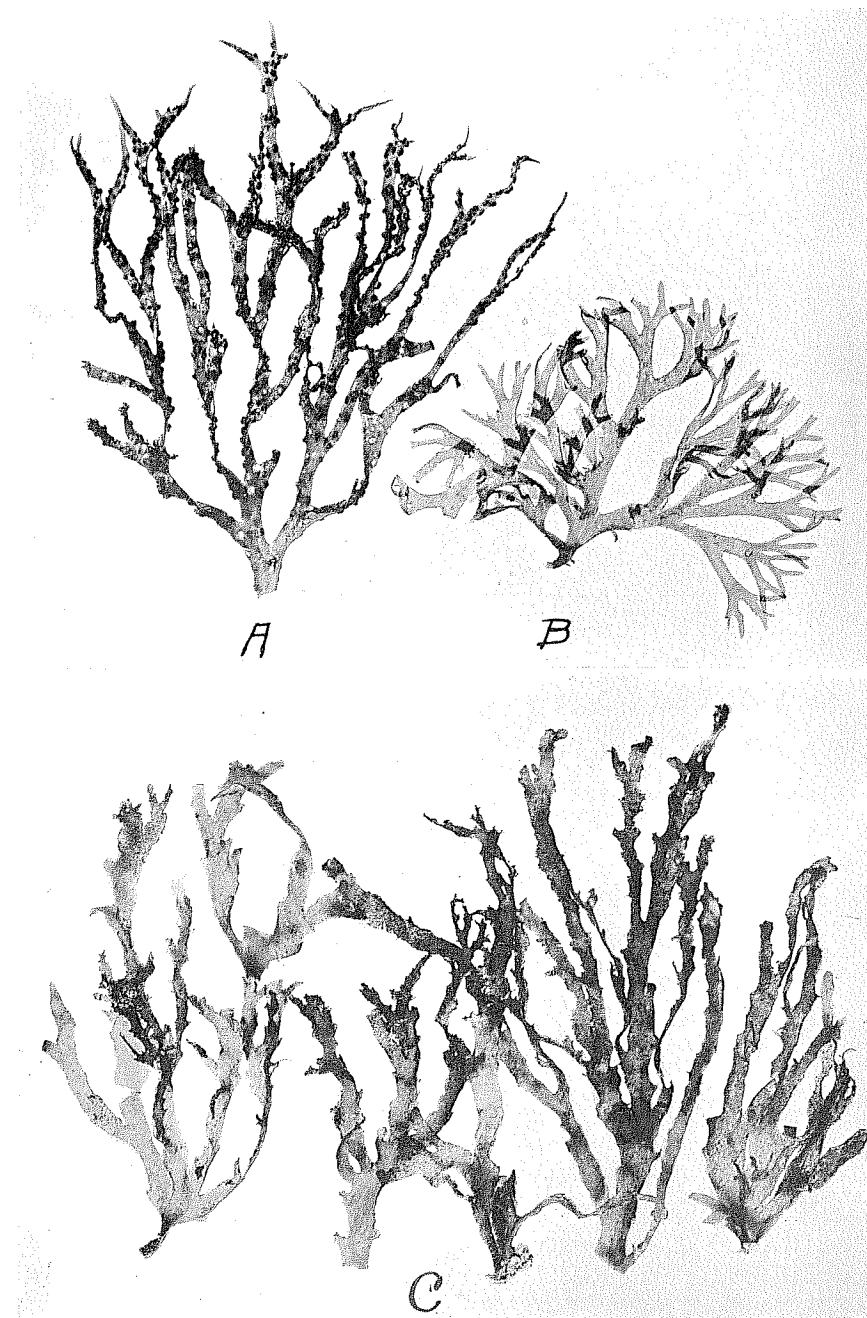


Plate 52

A. *Laurencia Johnstonii* S. and G.

A photograph of a small plant. X 1.

B. *Laurencia obtusiuscula* var. *laxa* S. and G.

A photograph of the type specimen. X 1.

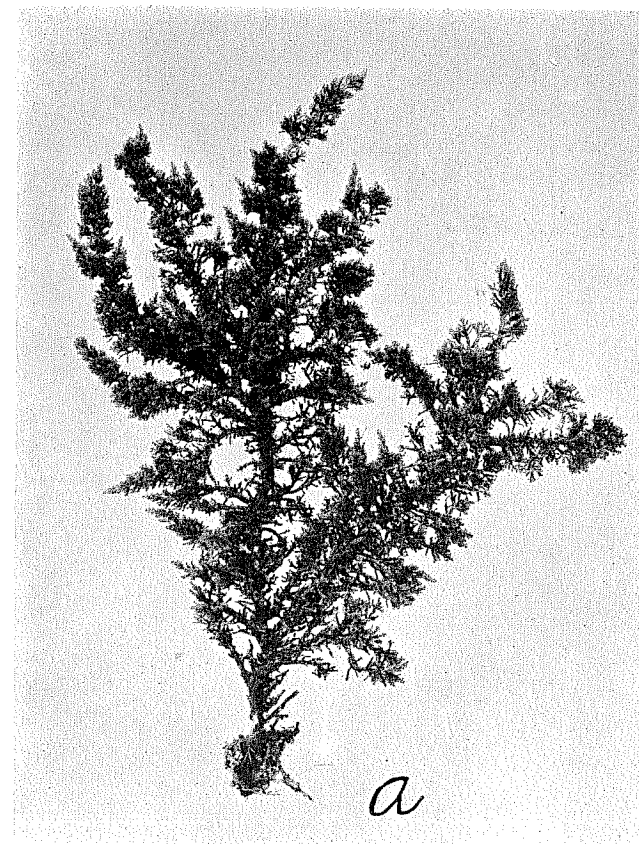


Plate 53

Laurencia Johnstonii S. and G.

A photograph of the type specimen. X 1.

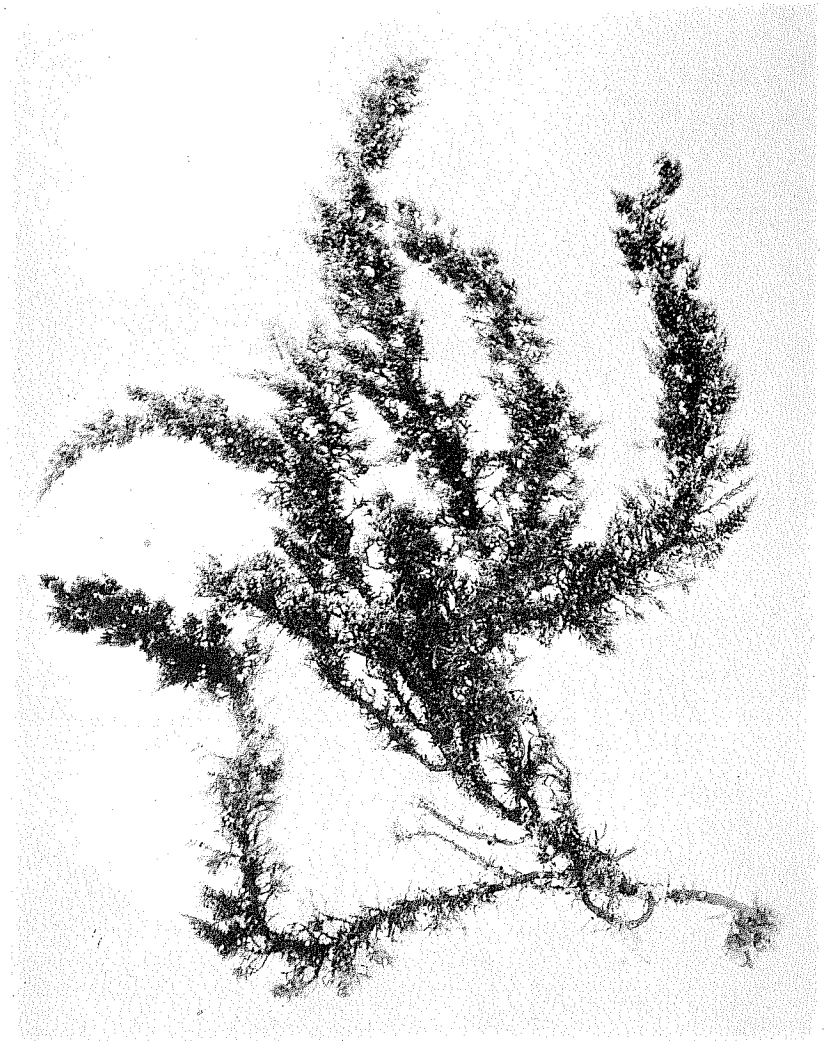


Plate 54

Laurencia papillosa var. *pacifica* S. and G.
A photograph of the type specimen. X 1.



Plate 55

Laurencia obtusiuscula S. and G.

A photograph of the type specimen. X 1.

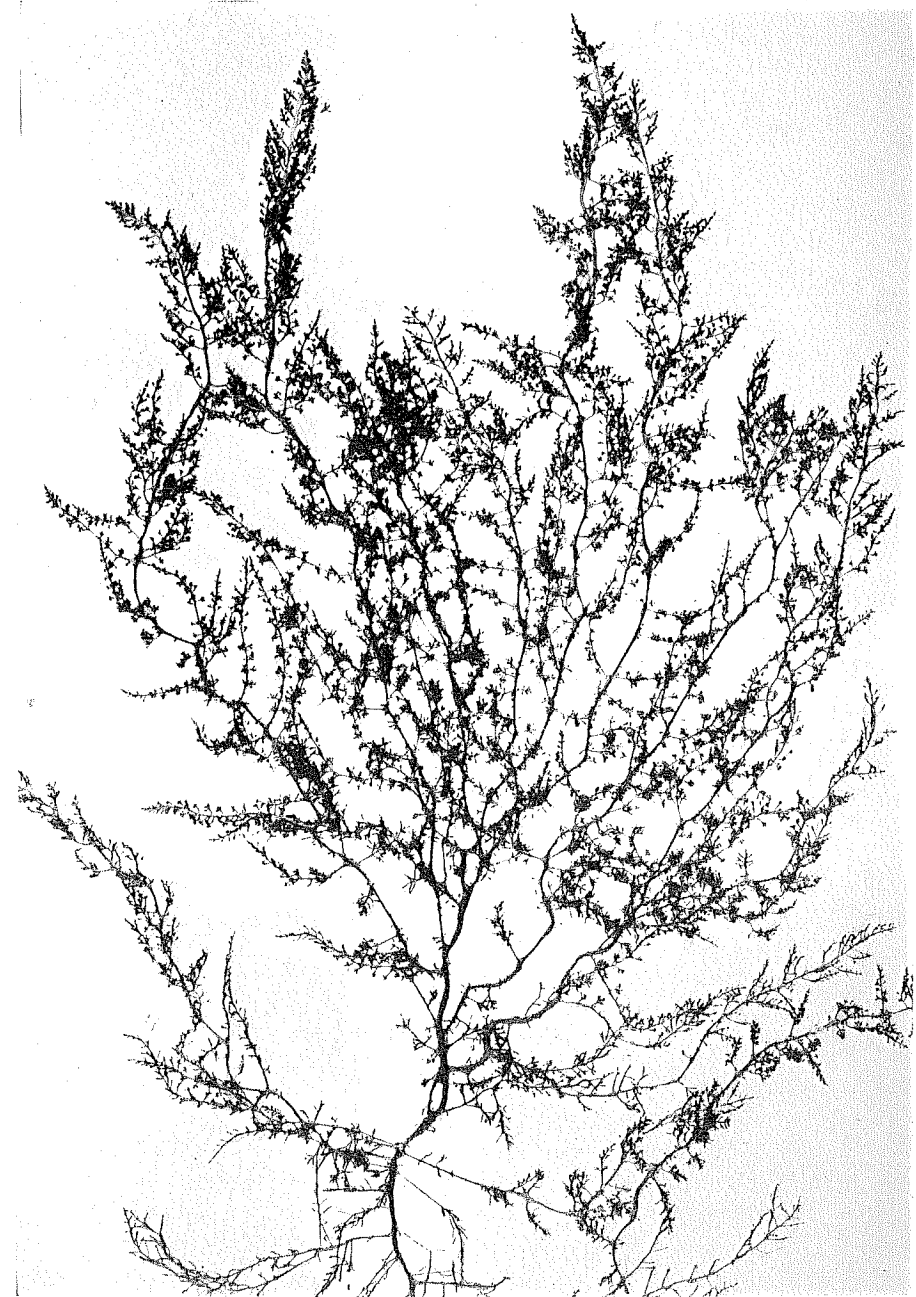


Plate 56

Hypnea Marchantæ S. and G.

A photograph of the type specimen, (a) tetrasporic, (b) sterile. X 1.

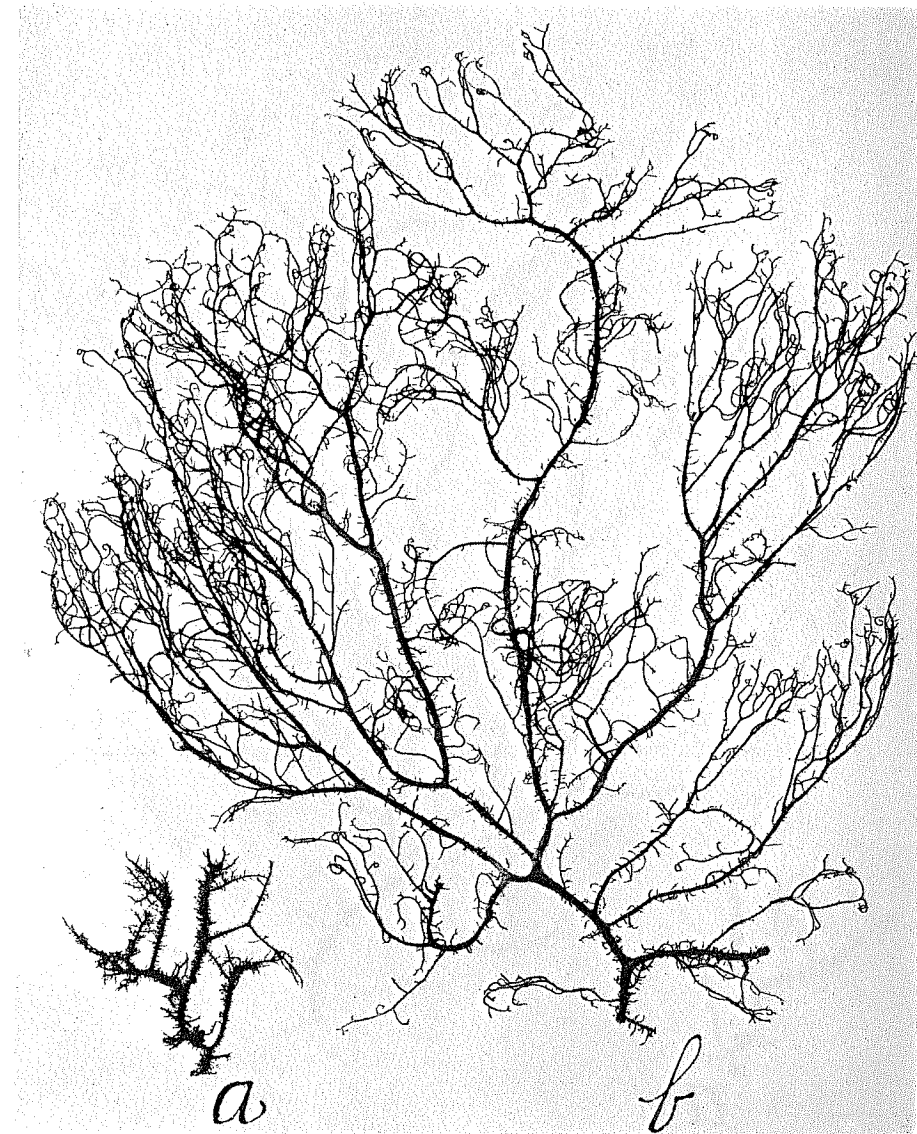


Plate 57

Hypnea Johnstonii S. and G.

A photograph of the type specimen. X 1.

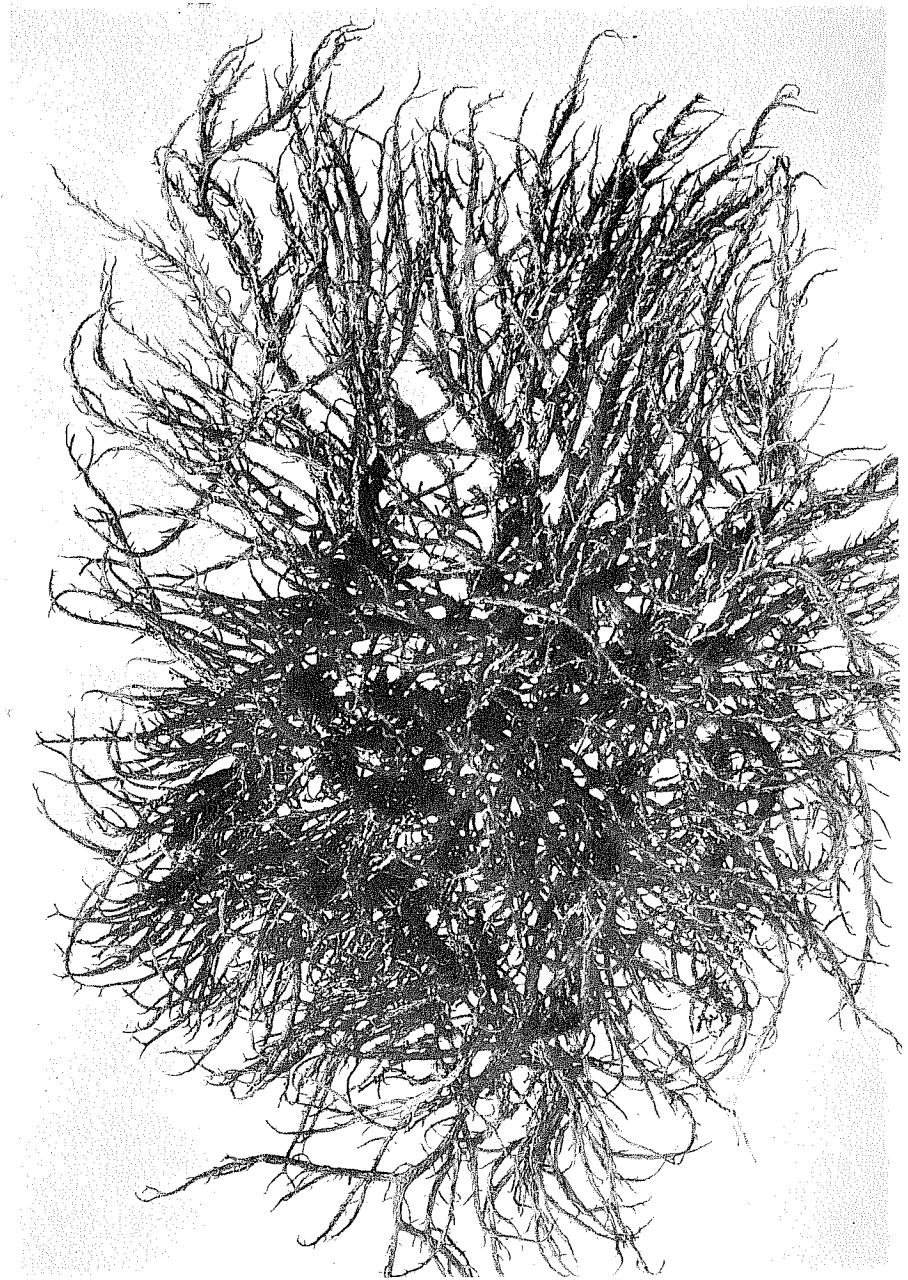


Plate 58

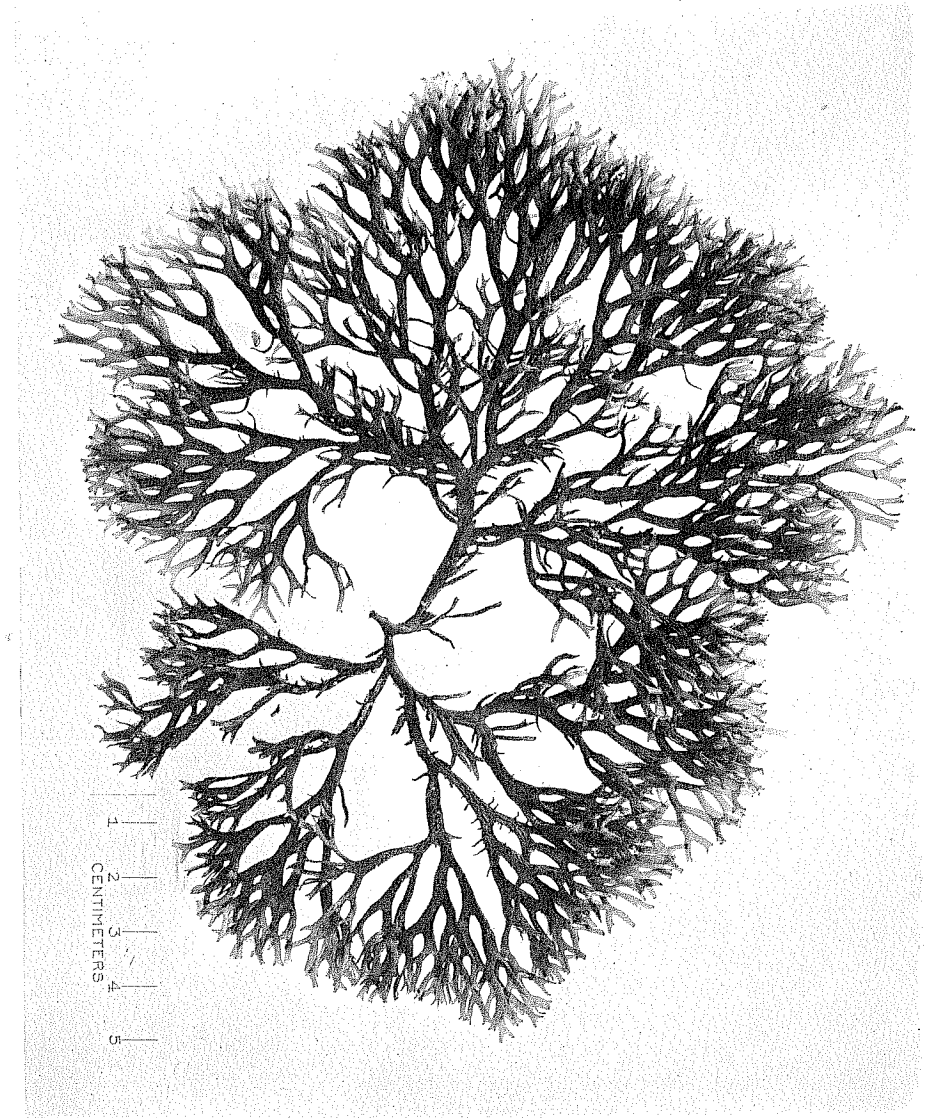
Gracilaria sp. X 1.

Plate 59

Gracilaria subsecundata S. and G.

A photograph of the type specimen. X 1.

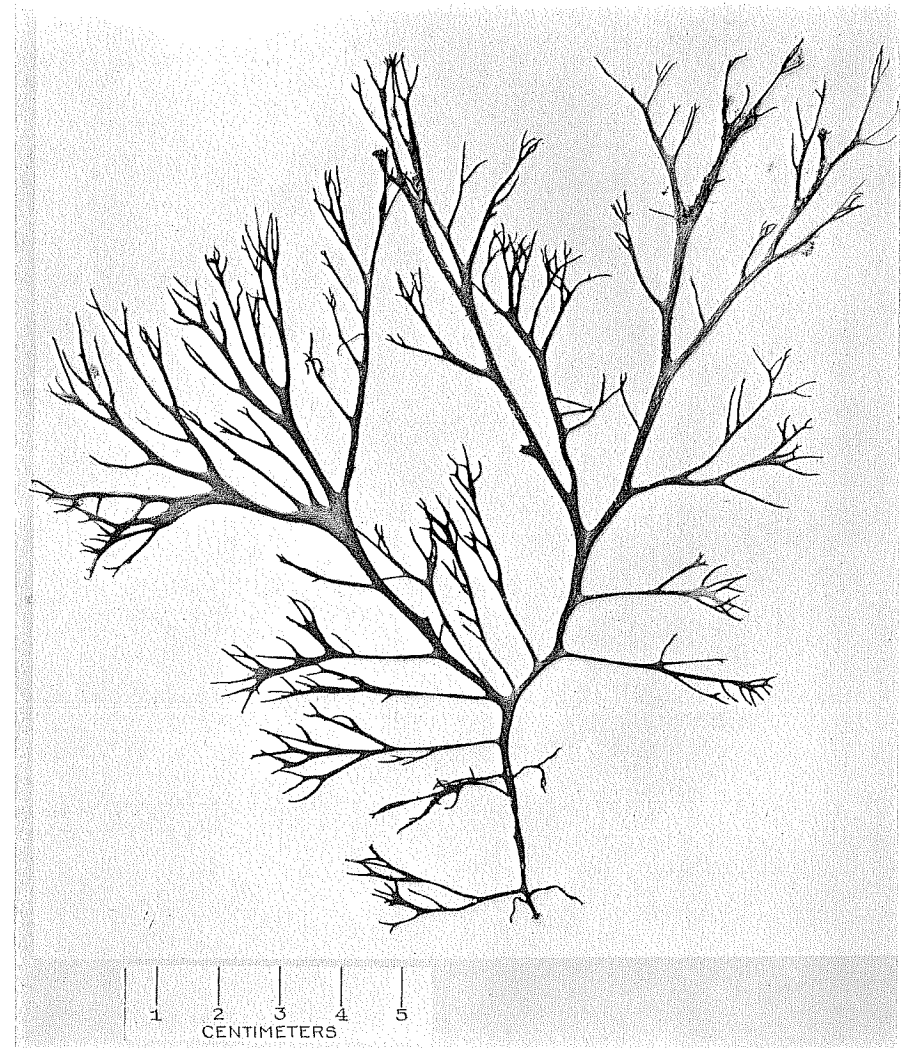


Plate 60

Gracilaria Johnstonii S. and G.

A photograph of the type specimen. X 0.5.

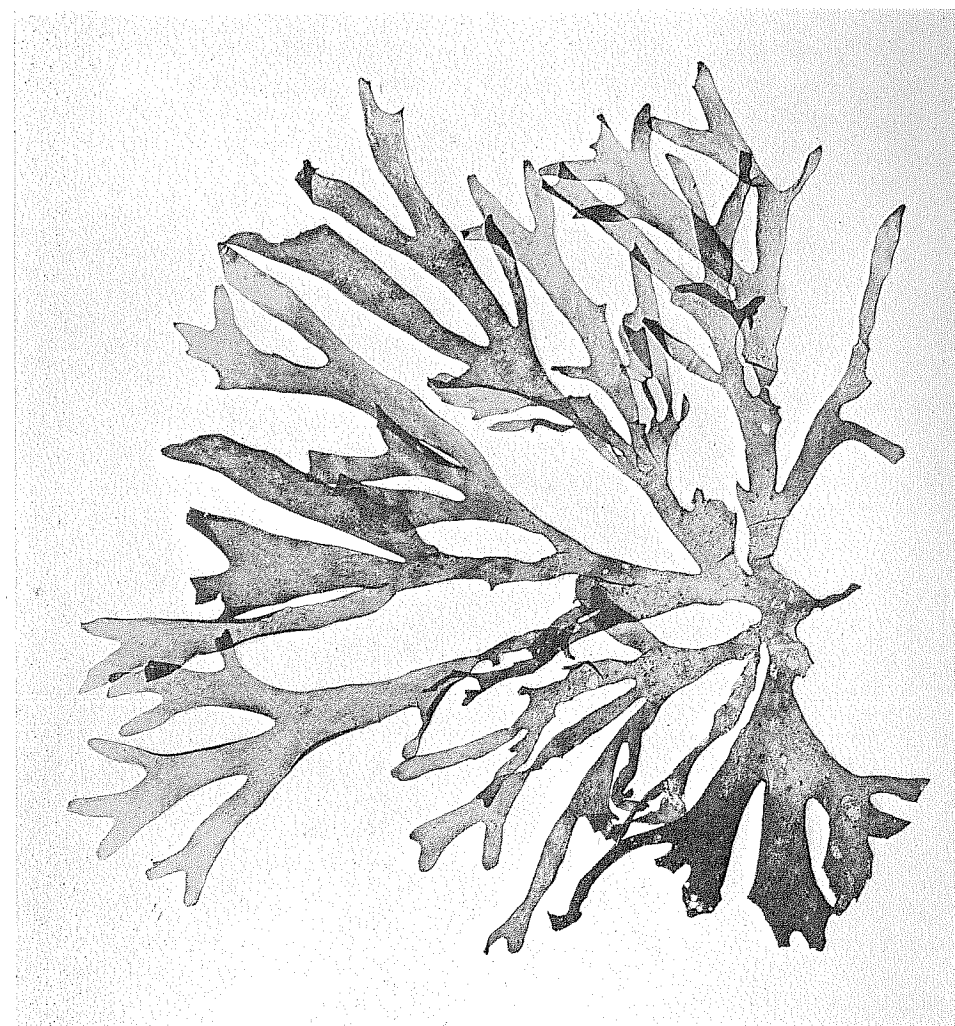


Plate 61

Gracilaria pinnata S. and G.

A photograph of typical fragments of sterile plants. X 1.

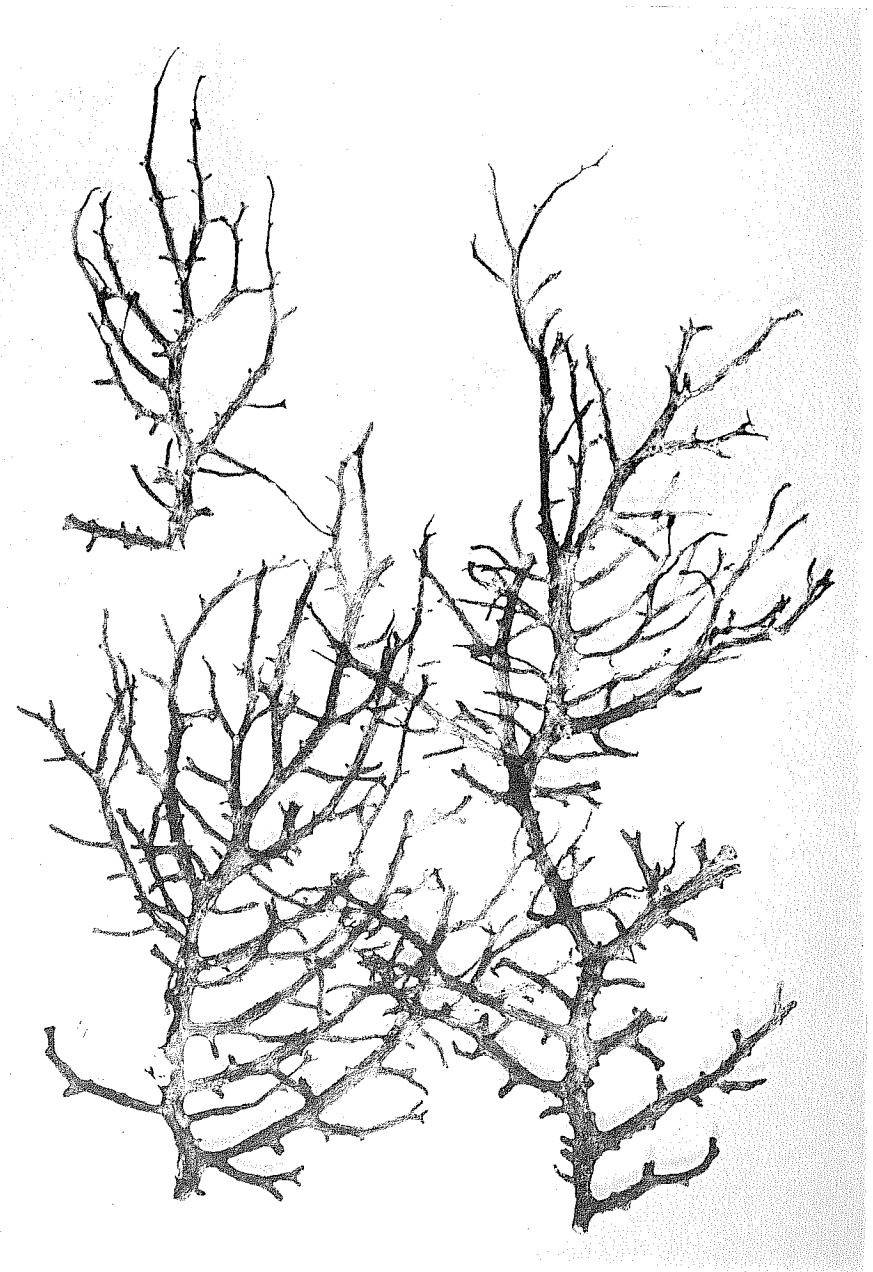


Plate 62

Gracilaria sinicola S. and G.

A photograph of the type specimen. X 2/3.



Plate 63

Gracilaria vivipara S. and G.
A photograph of the type specimen. X 2/3.

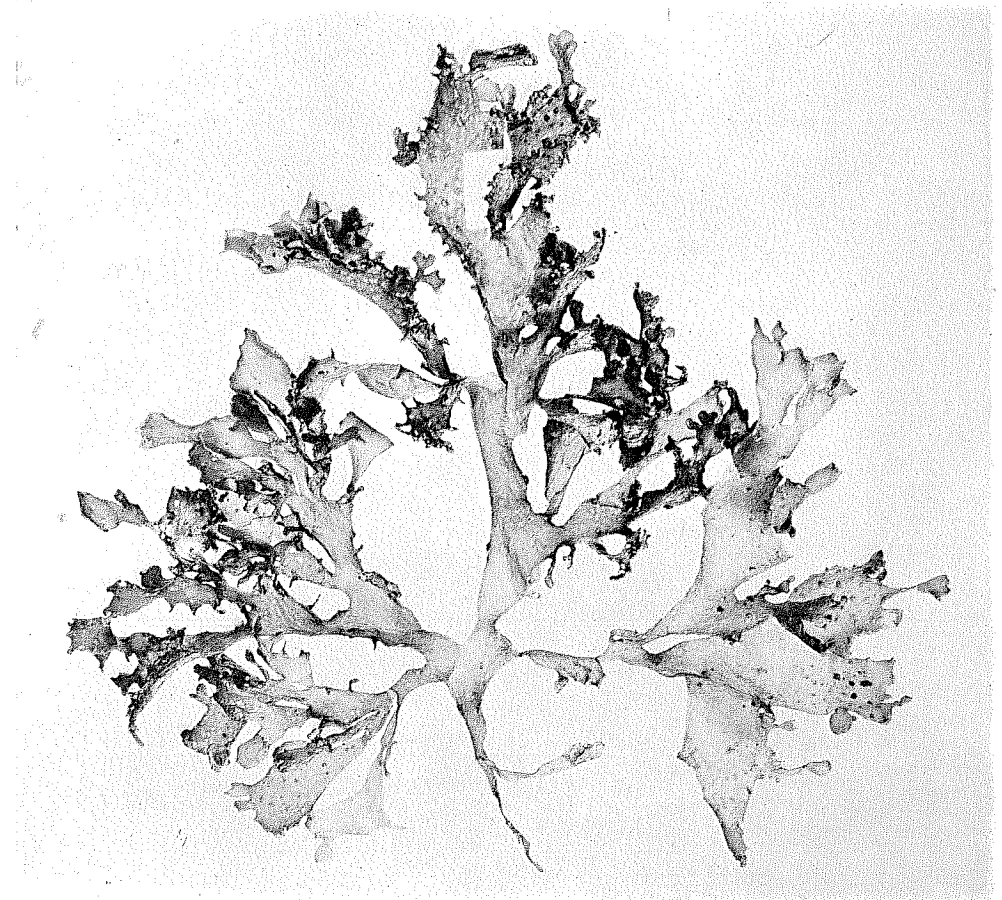


Plate 64

Gracilaria Vivesii Howe.

A photograph of a sterile specimen.

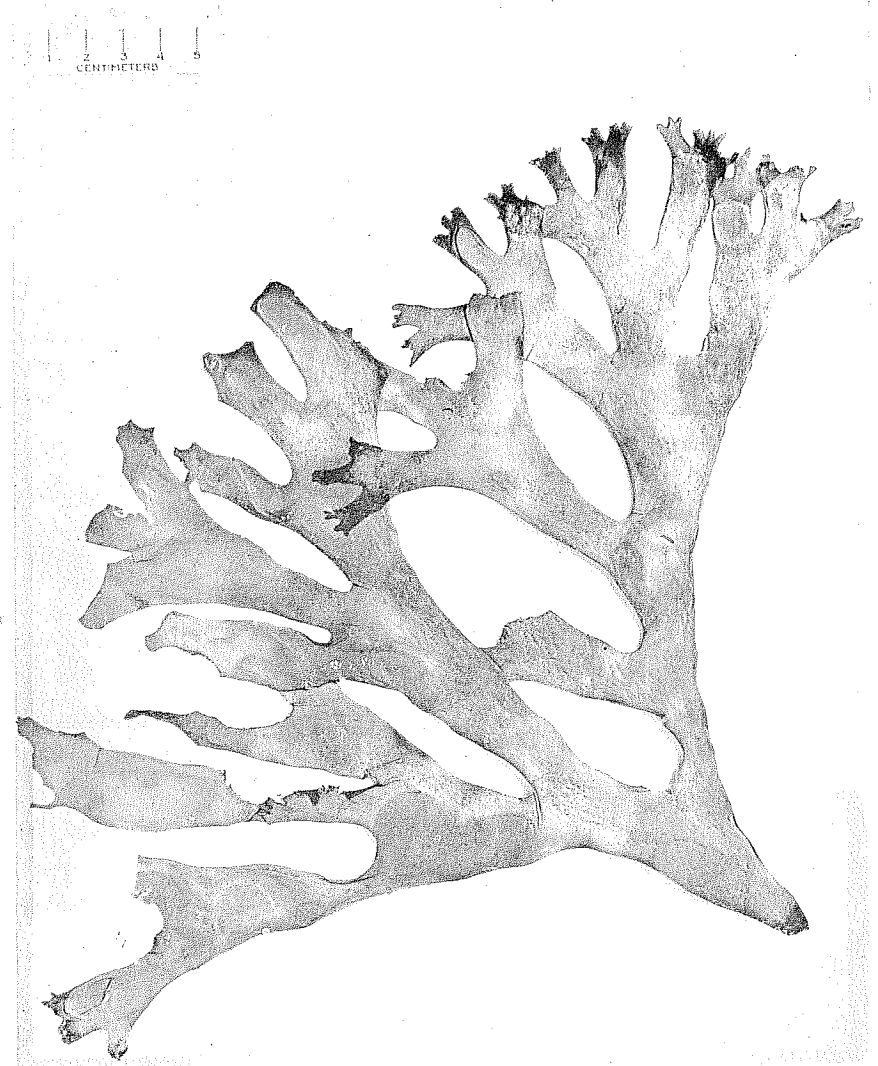


Plate 65

Eucheuma Johnstonii S. and G.

A photograph of a fragment of a tetrasporic plant. X 1.

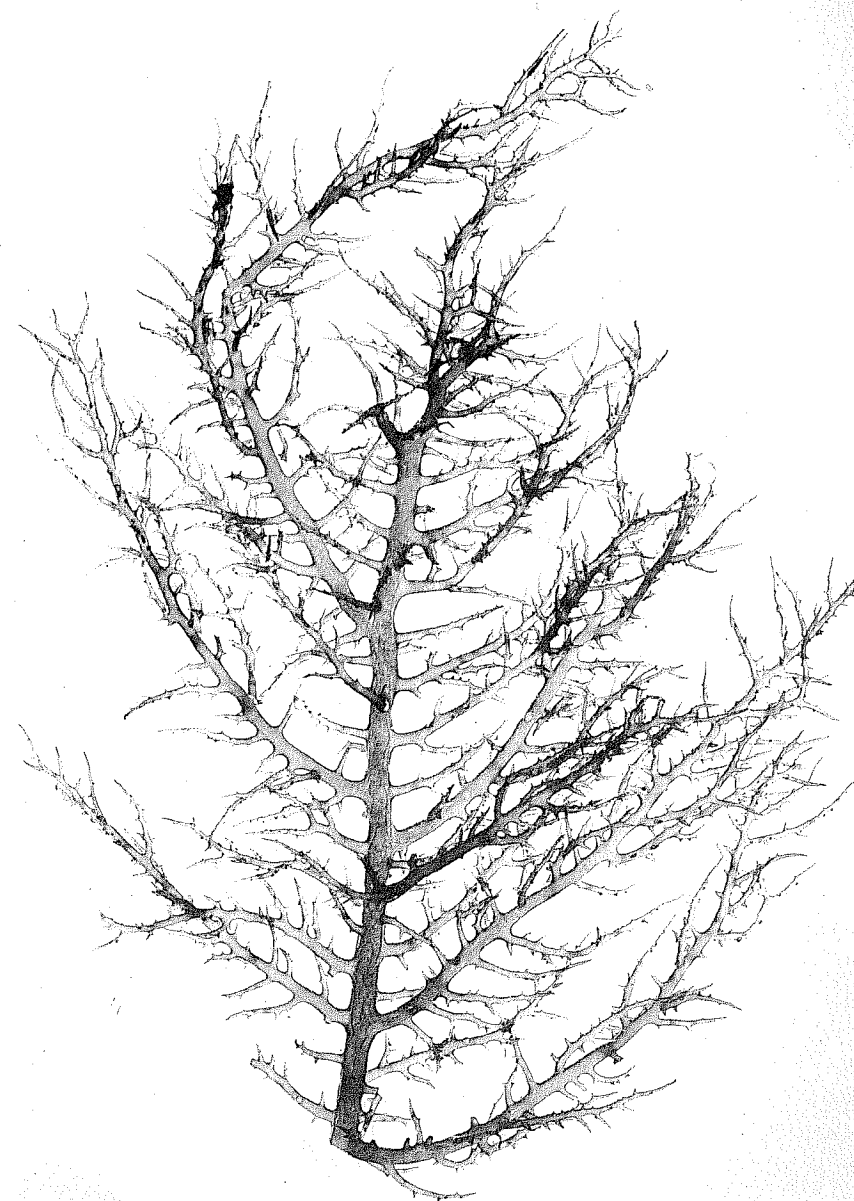


Plate 66

Eucheuma Johnstonii S. and G.

A photograph of a fragment of a tetrasporic plant. X 2.

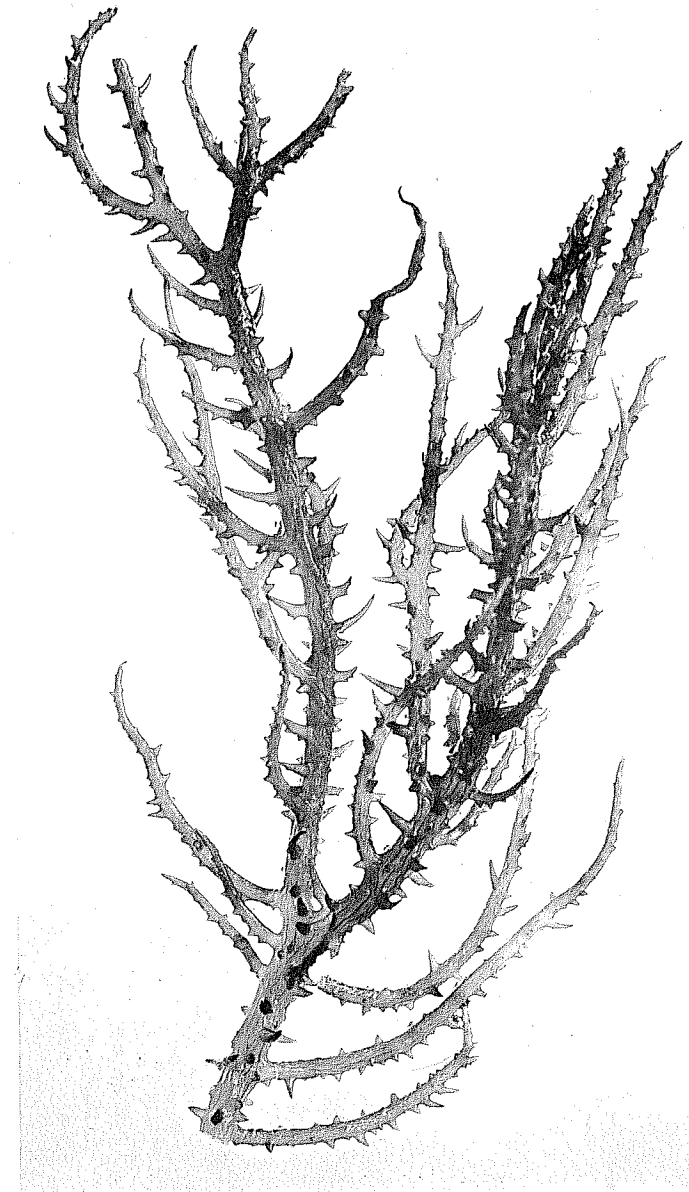


Plate 67

Eucheuma uncinatum S. and G.

A photograph of a fragment of a tetrasporic plant, showing the branched character of the uncinata ramuli. X 3.



Plate 68

Eucheuma uncinatum S. and G.

A photograph of the type specimen of cystocarpic plant. X 1.



Plate 69

Anatheca elongata S. and G.

A photograph of the type specimen.

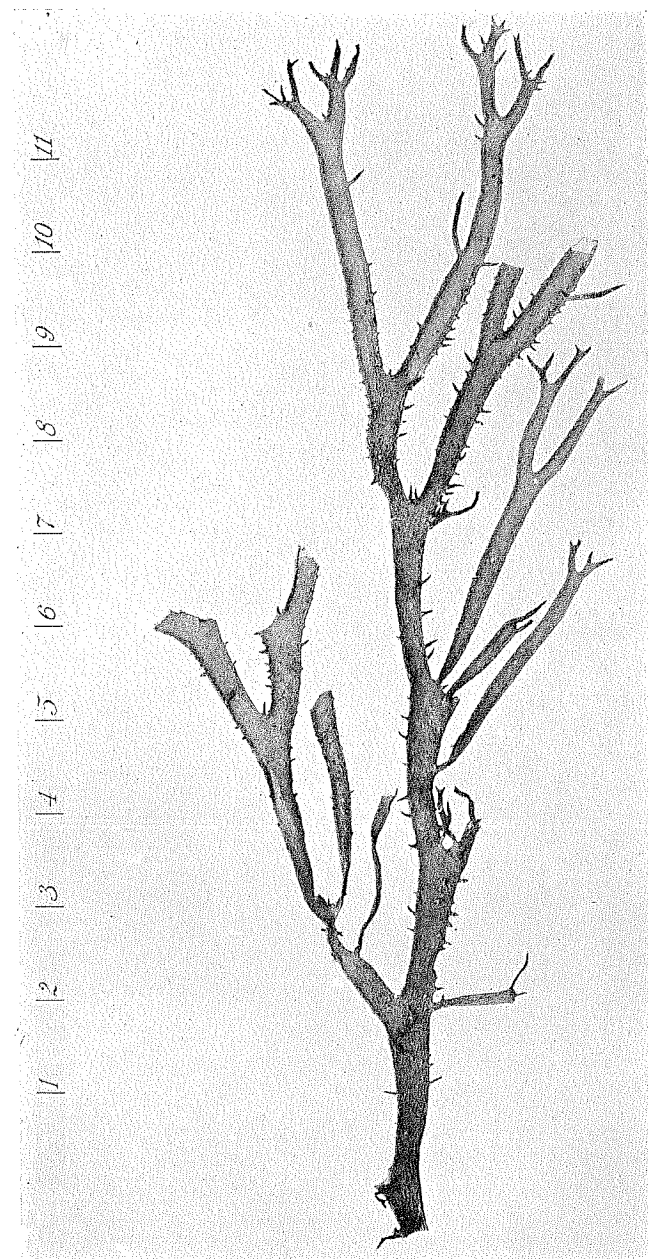


Plate 70

Gigartina Chauvinii (Bory) Mont.
A photograph of a wide specimen. X 2/3.

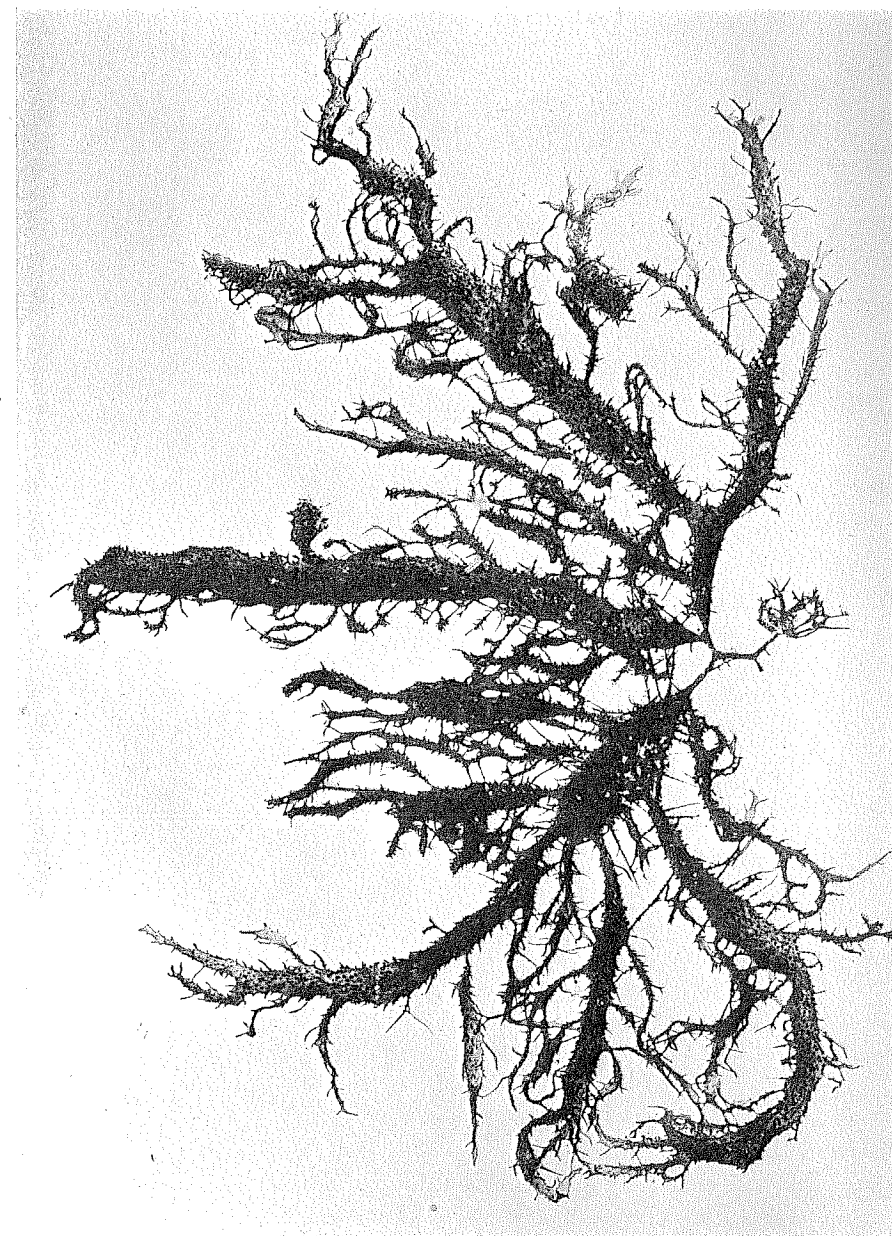


Plate 71

Gelidium decompositum S. and G.

A photograph of the type specimen. X 1.

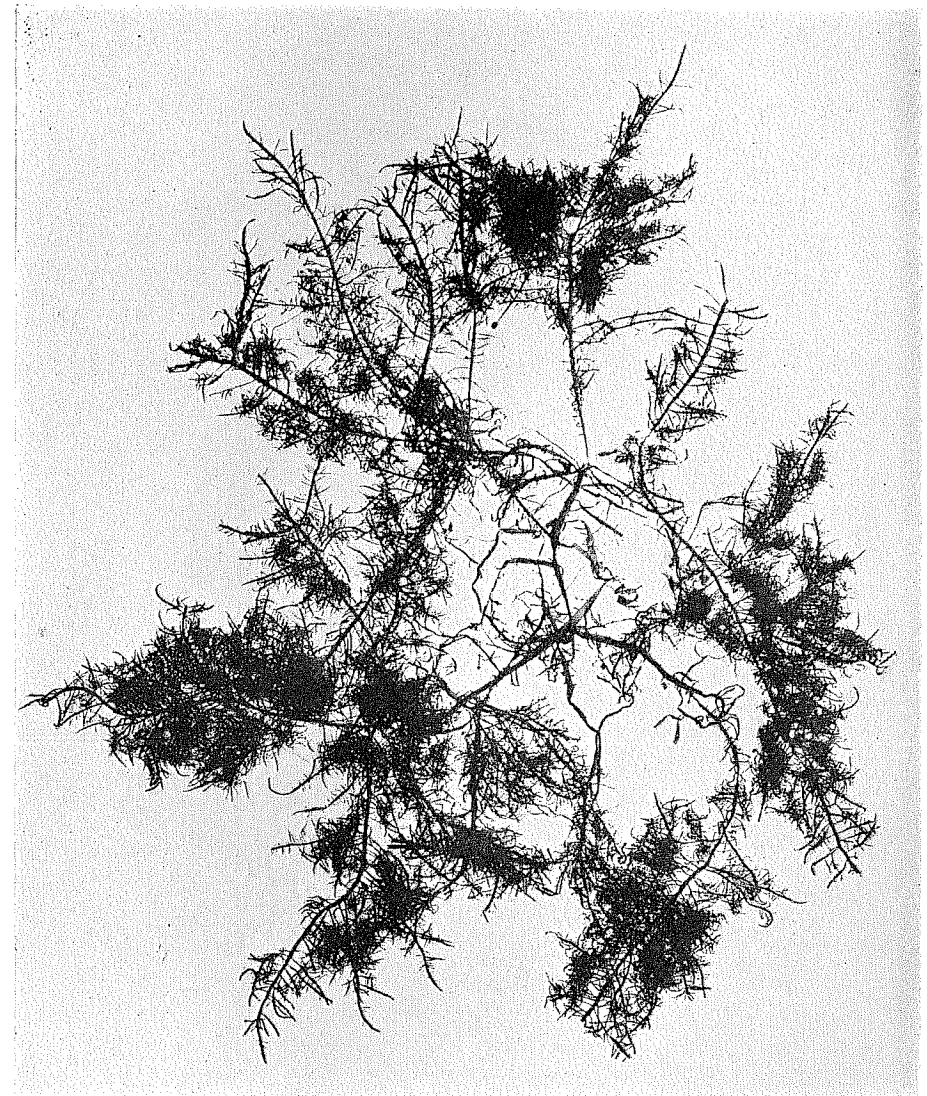


Plate 72

Gelidium Johnstonii S. and G.

A photograph of the type of a cystocarpic specimen. X 1.

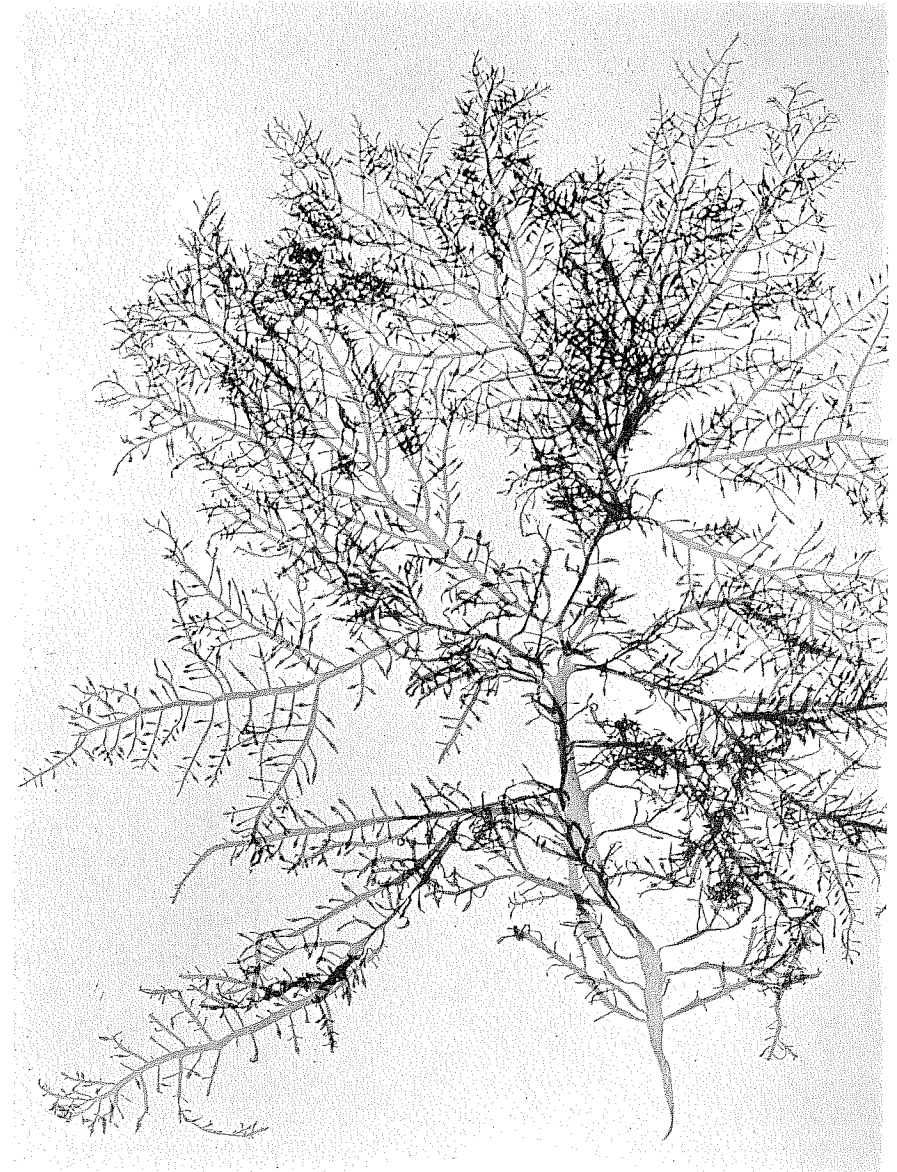


Plate 73

Gelidium Johnstonii S. and G.

A photograph of the type of a tetrasporic specimen. X 1.

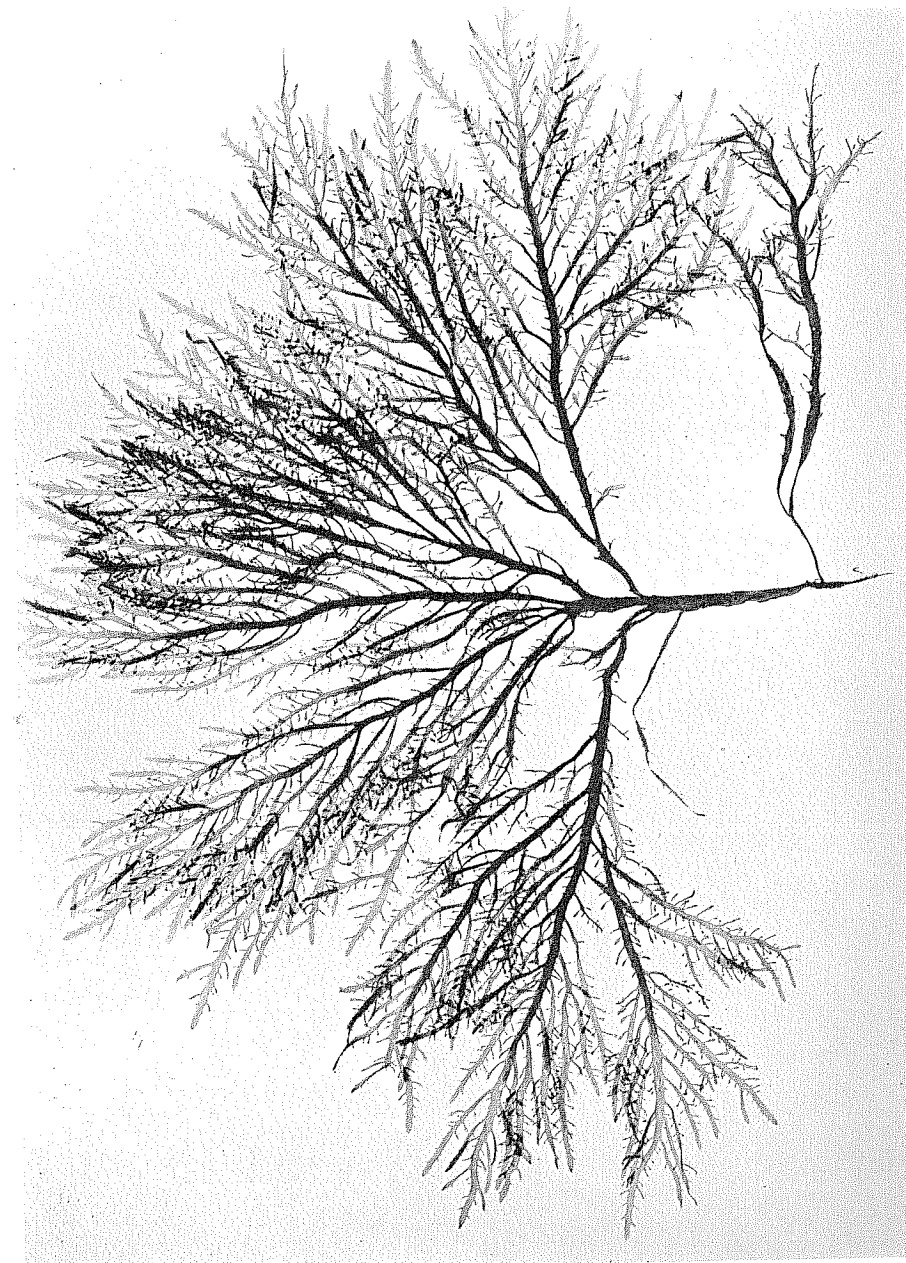


Plate 74

Ceramium bicornis S. and G.

A photograph of the type specimen, cystocarpic. X 10.



Plate 75

Ceramium sinicola S. and G.

A photograph of fragments of tetrasporic plants. X 10.



Plate 76

Ceramium Johnstonii S. and G.

A photograph of a typical portion of a tetrasporic plant with numerous proliferations. X 6.5.

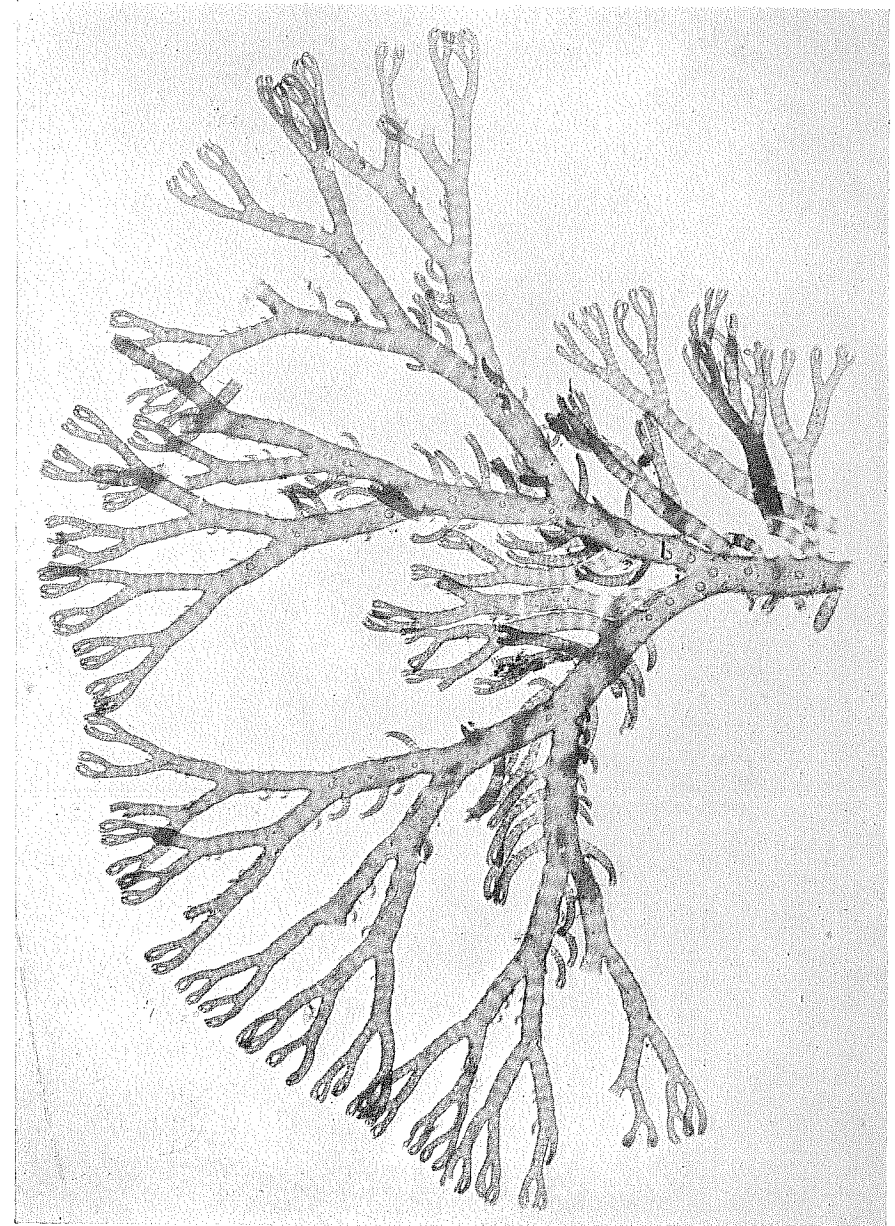


Plate 77

Ceramium Johnstonii S. and G.

A photograph of typical fragments of a tetrasporic plant nearly free from proliferations. X 10.

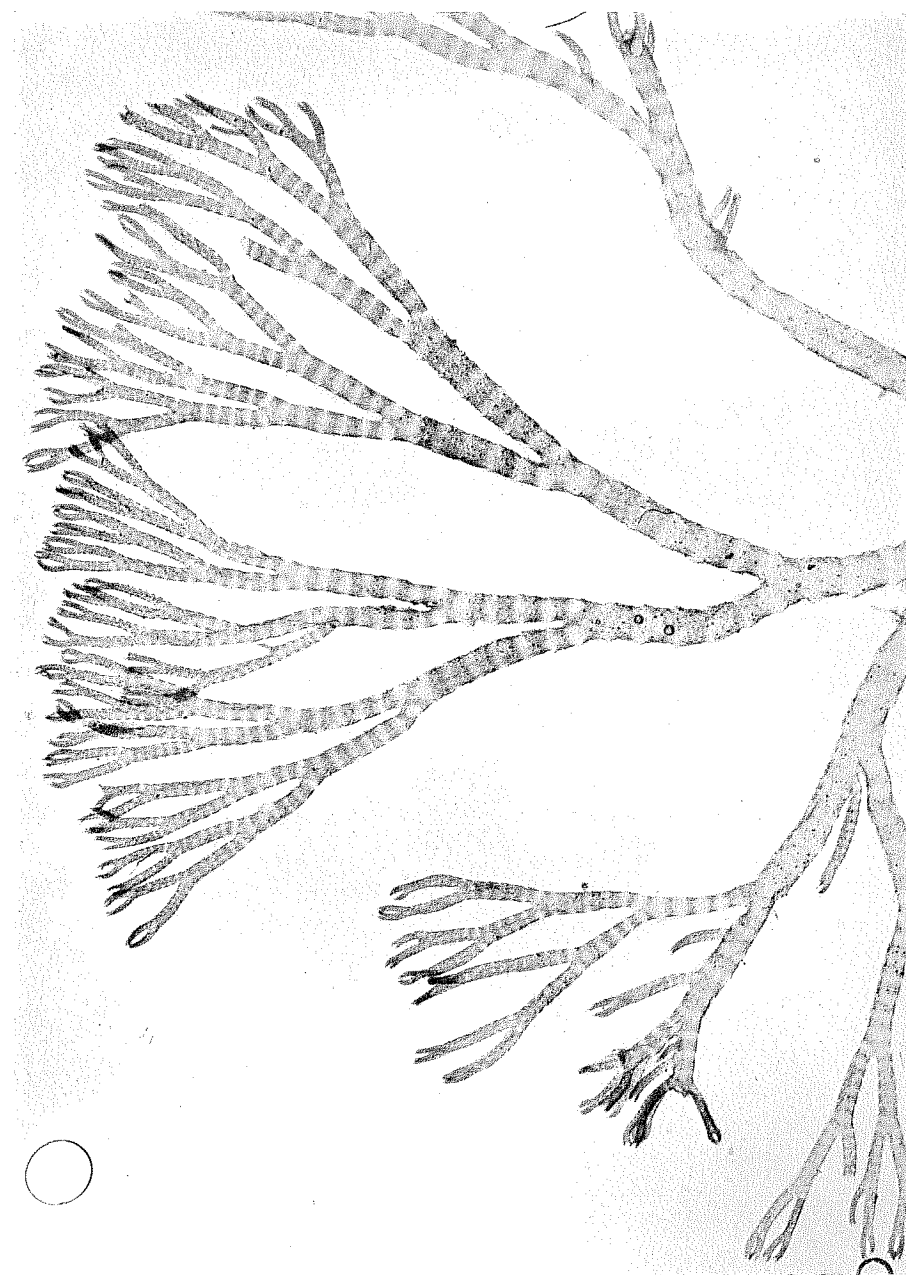


Plate 78

Centroceras bellum S. and G.

A photograph of typical fragments of tetrasporic plants, showing the single undivided growing points. X 10.



Plate 79

Ceramium horridum S. and G.

A photograph of typical tetrasporic plants. X 5.

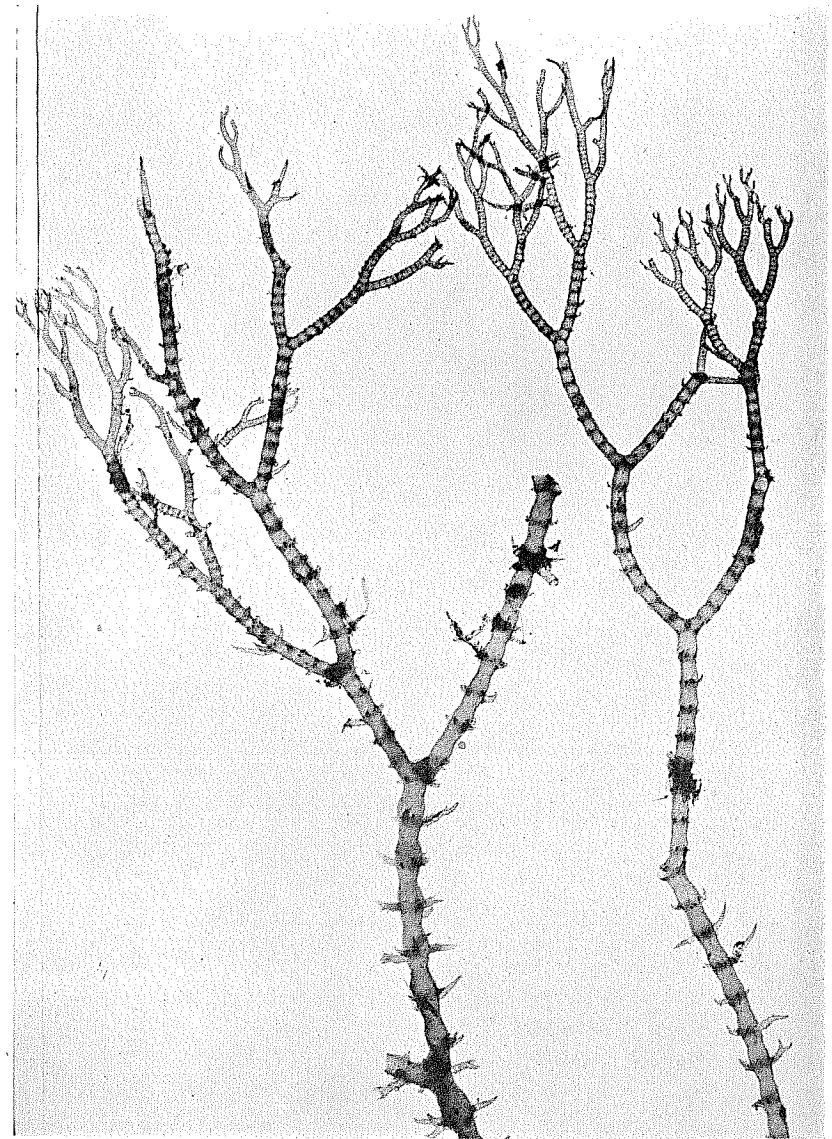


Plate 80

Grateloupia prolongata J. Ag.

A photograph of a group of long narrow plants. X 0.3.

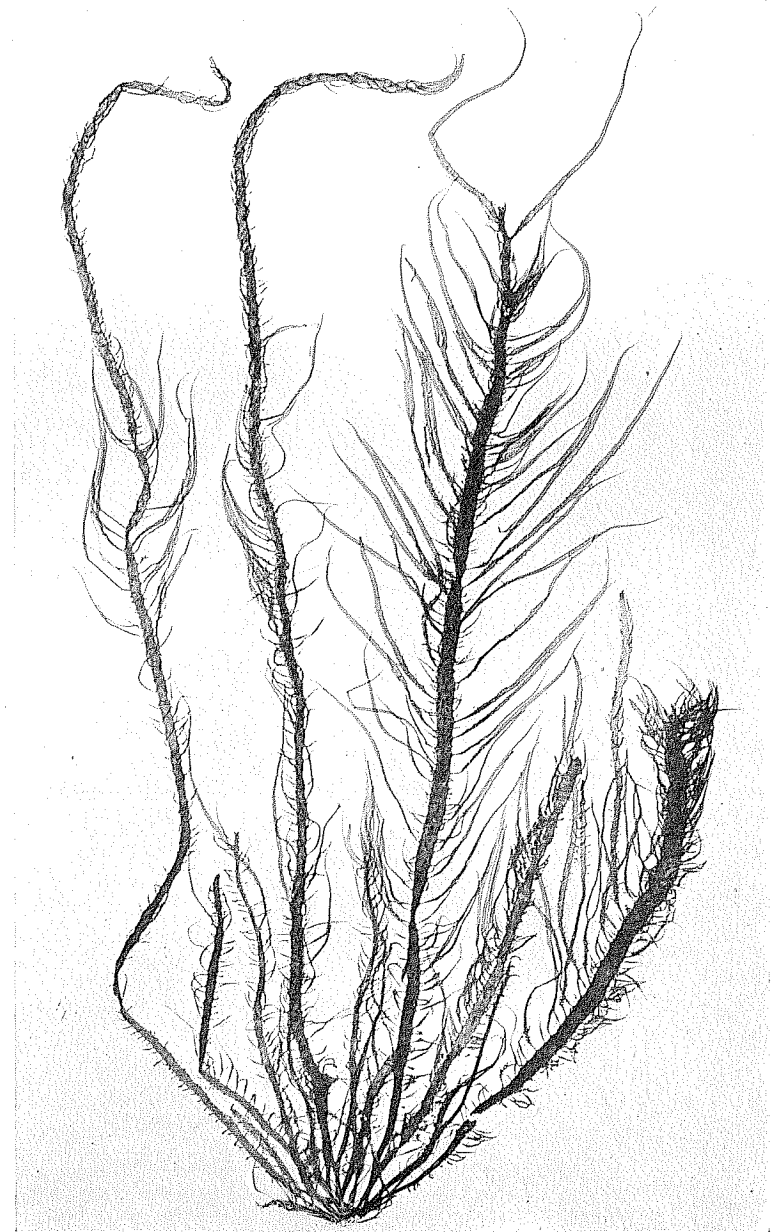


Plate 81

Grateloupia squarrosa S. and G.

A photograph of a portion of the type specimen. X 0.75.

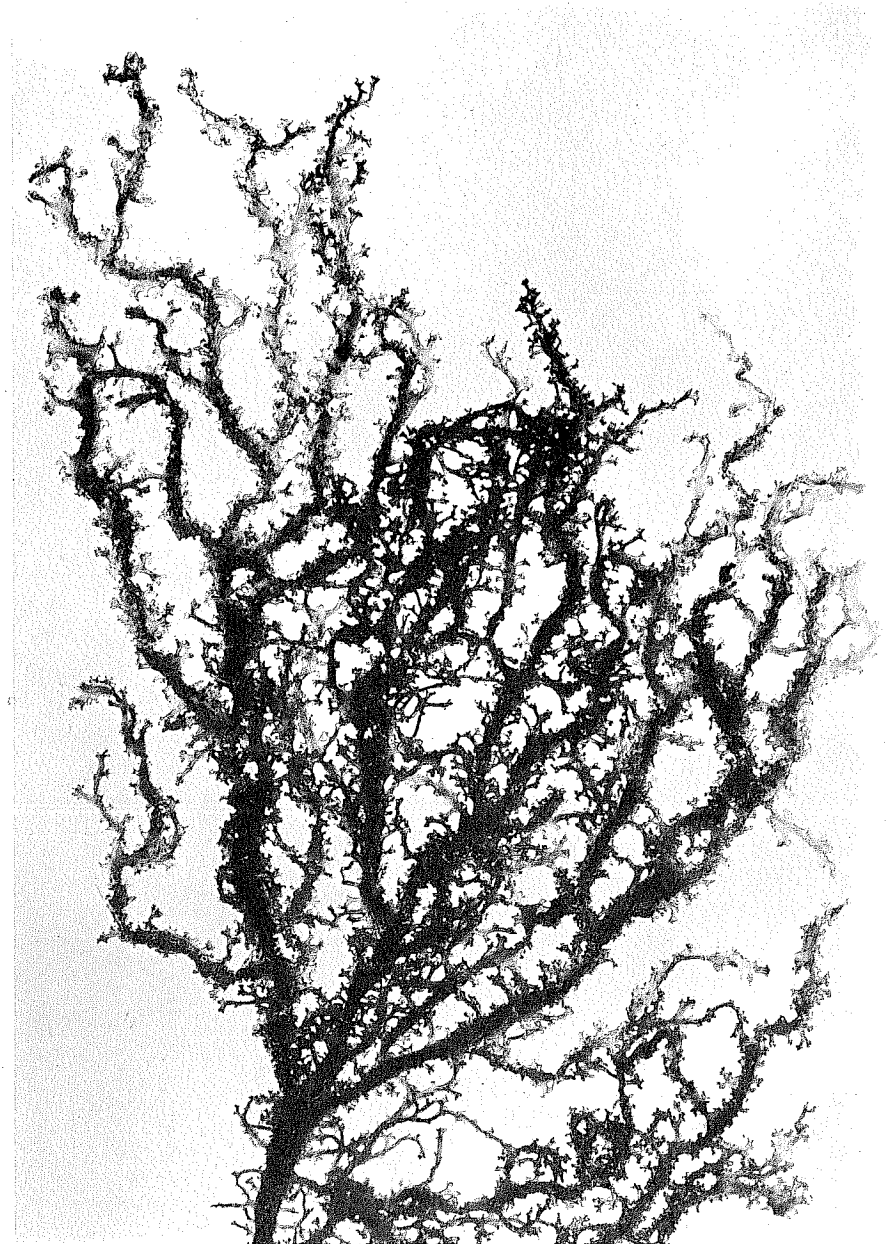


Plate 82

Grateloupia squarrosa S. and G.

A photograph of a portion of a sterile frond. X 3.

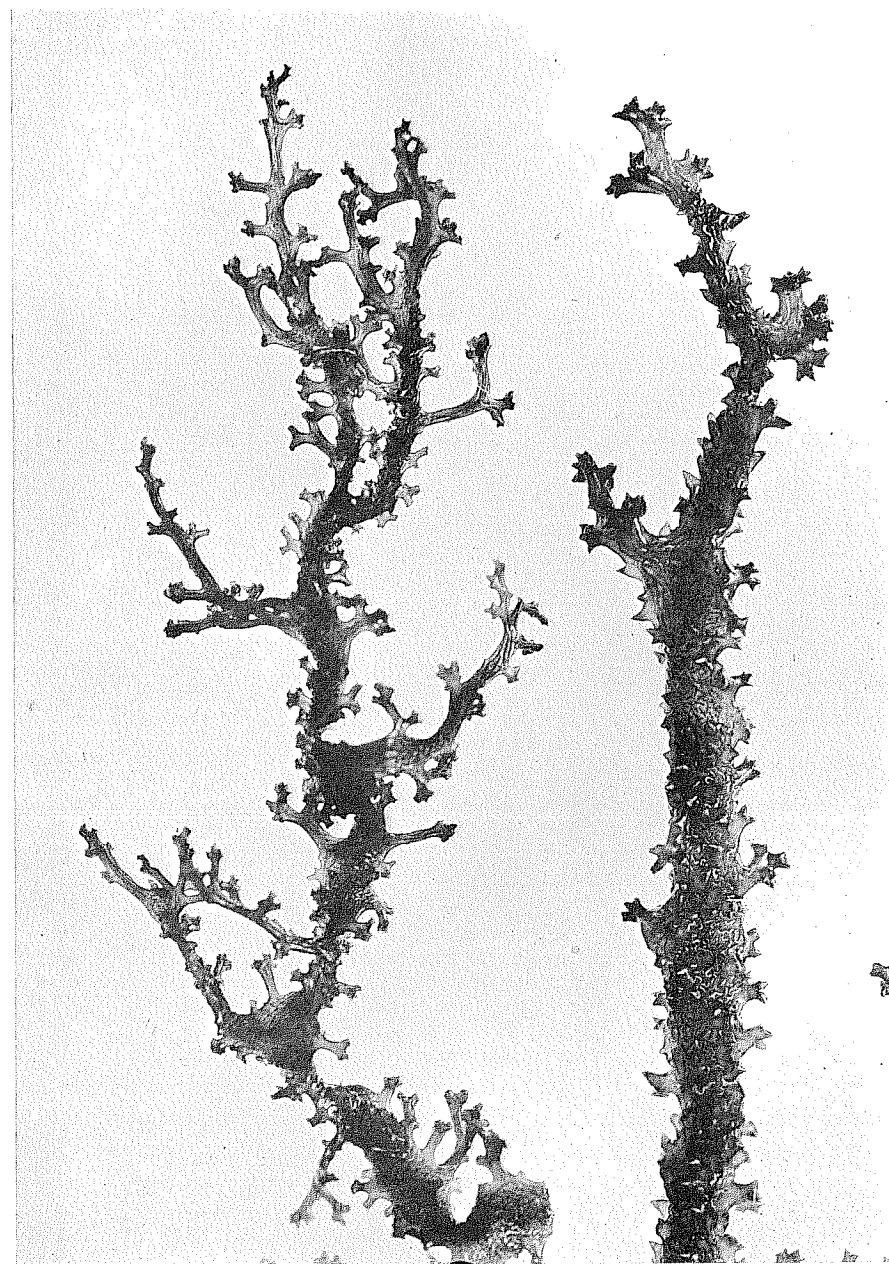


Plate 83

Grateloupia Howei S. and G.

A photograph of a group of typical specimens.

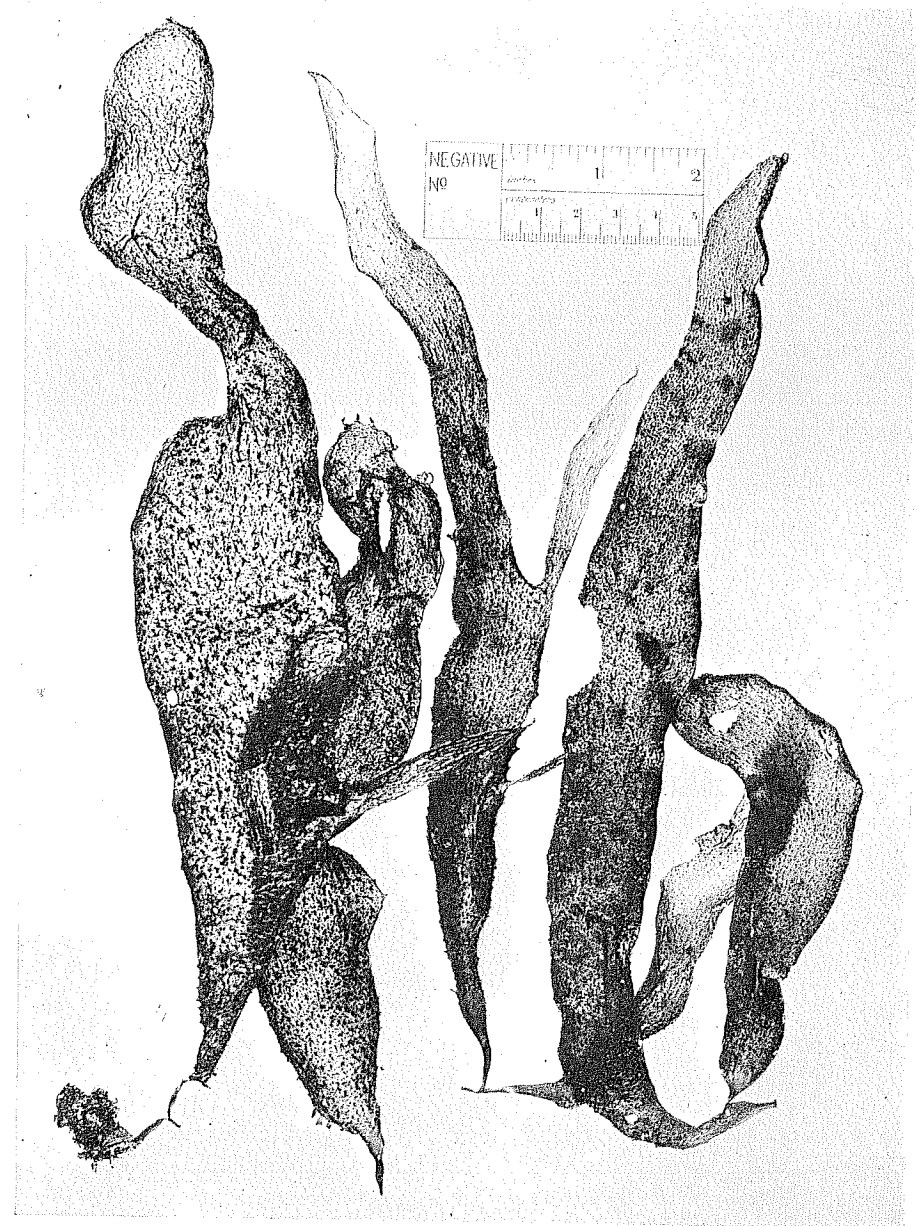


Plate 84

Grateloupia Johnstonii S. and G.

A photograph of the type specimen. X 0.5.

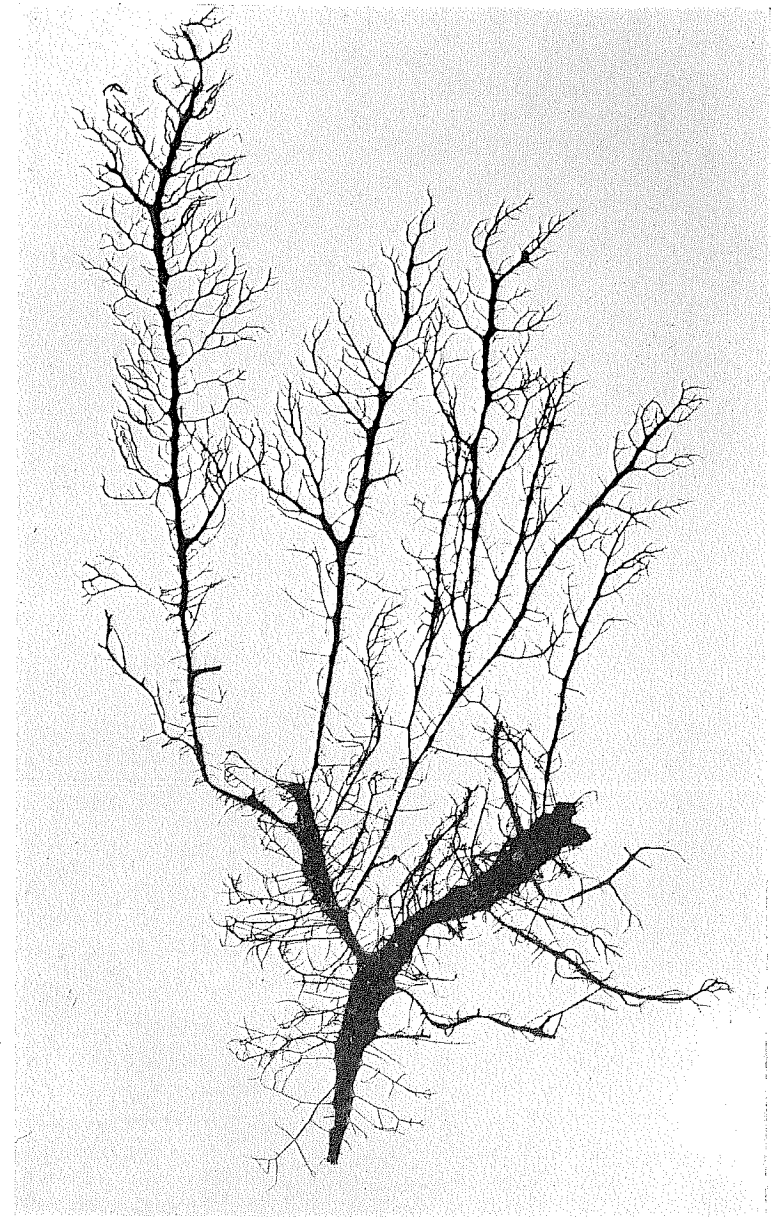


Plate 85

Estebania conjuncta S. and G.

A photograph of the type specimen. X 2.

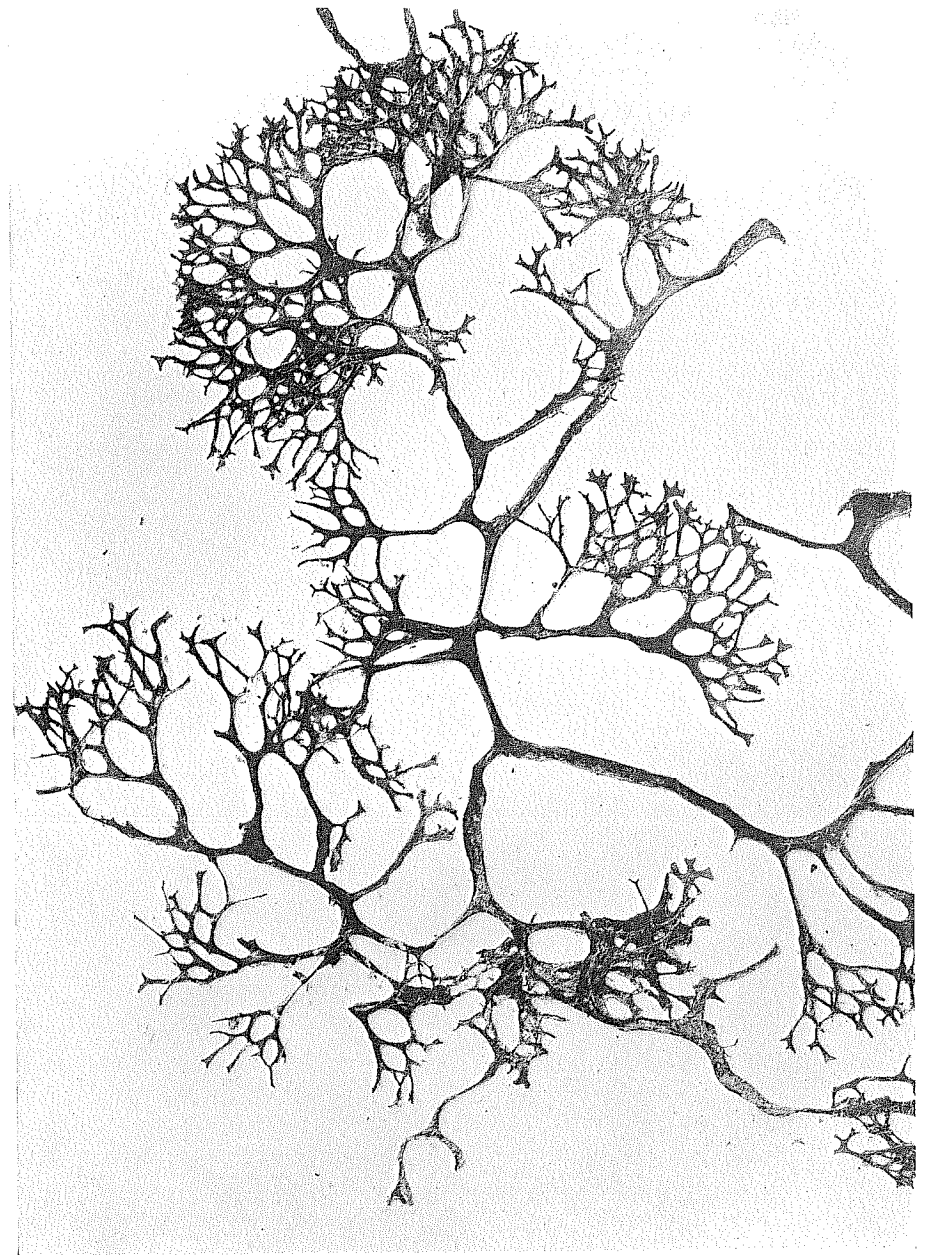


Plate 86

Estebania conjuncta S. and G.

A photograph of a specimen with only slight anastomosing. X 2.



Plate 87

Schizymenia violacea S. and G.

A photograph of the type specimen.



Plate 88

Schizymenia Johnstonii S. and G.

A photograph of the type specimen.

