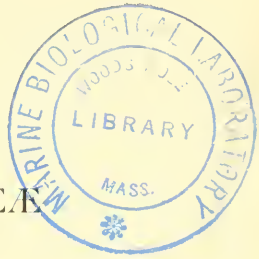
F. BØRGESEN

THE MARINE ALGÆ OF THE DANISH WEST INDIES



VOL. I

CHLOROPHYCEÆ AND PHÆOPHYCEÆ

(WITH A CHART)

COPENHAGEN
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INTRODUCTION TO THE CHLOROPHYCEÆ PART

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Compared with the chlorophyceous algal flora in northern waters that found at the islands here in the tropical sea has proved to be very rich in forms, much richer than those in the temperate and cold seas. To be sure some forms are wanting here, thus it is remarkable that e. g. *Ulothrix*, so common in northern seas, has not been found, but on the other hand several families are represented which are not at all found or only with a single representative in the northern waters.

And while in the northern seas the *Chlorophyceæ* with the exception of the *Ulvaceæ* and some forms of *Cladophoraceæ* are not of much importance as regards the copiousness of the vegetation. in the tropics the *Chlorophyceæ* are of great significance and this applies not only to the above-mentioned *Ulvaceæ* and *Cladophoraceæ*, which at the shores of the Danish West Indies are often abundantly developed, but especially to representatives of the three families: *Codiaceæ*, *Valoniaceæ* and *Caulerpaceæ*. These which are quite or nearly absent in northern seas, are here in the tropics luxuriantly developed and represented by a great number of forms. And by the ability of many of these species to grow in loose, sandy or muddy bottom, being often present in enormous masses there, they also contribute greatly to the luxuriance of the vegetation.

As another difference from the northern seas I may also point out that while in the tropics several of the *Chlorophyceæ* are able to grow abundantly even at a depth of about 20 fathoms, in the northern seas, in

any case at the Færocs, I have found some few *Florideæ* only at this depth; the *Chlorophyceæ* here stop in the uppermost part of the sublittoral region, except only *Gomontia* and *Ostreobium*.

As many of the tropical *Chlorophyceæ* furthermore are incrusted by chalk, they also contribute greatly to the deposits in the sea not only in bays and lagoons but also in the more open sea, and even the gravel along the shores is much mixed with remains of these algæ, sometimes almost consisting of these alone.

On account of the numerons coral reefs surrounding St. Croix it has often been difficult to dredge off the shores of this island; nevertheless, successful dredgins have been undertaking e. g. in the sea round Buck Island, in White Bay and off Frederikssted. At St. Thomas and St. Jan I have often dredged in the sea round Water Island especially in Gregorie Channel, further in the Sound between St. Thomas and St. Jan, where a very rich algal vegetation was found. On the whole the sea round St. Jan has appeared to be very rich both on the north side where I have dredged along most of the coast until near the east end and on the south side until near Rams Head.

In the sea surrounding these islands no very great depth occurs, the deepest part is about 20 fathoms. But on the other hand rather deep water. up so ten fathoms or more comes often quite near the steep, rocky coast; this applies especially to the exposed north side of these islands. In the larger and smaller bays we have shallow water with sandy or muddy bottom often covered with mangroves f. i. the extensive mangrove growth in the Bovoni Lagoon at the east end of St. Thomas.

St. Croix on the other hand has the greater part of the coast surrounded by coral reefs and shallow water, the only exception from this being the northwestern rocky coast, where the great oceanic depths come quite near. But the sea is most often very turbulent and I have therefore not been able to dredge there.

An opportunity of trying to dredge in greater depths and on the whole of examining to what depth the algæ are able to grow, was afforded me when the Ministry of Marine gave me permission to go out with the cruiser »Ingolf«. but the result was negative, as the dredge immediately caught in the rocky bottom and was lost.

When mentioning some of the most important external conditions under which the algæ live at the shores of the Danish Islands I may yet point out that the tide is nearly wanting and in every case of no practical significance to the algæ[1].

The greater part of my collection has been dried but of nearly all the gatherings I have also had material preserved in alcohol or formaline and the examination has nearly always been based upon this.

Of earlier contributors to our knowledge of the algæ of the Danish West Indies Rector Hans West may first be mentioned. West collected algæ and sent them to Professor Martin Vahl who has described several of them in his paper: »Endeel kryptogamiske Planter fra St. Croix« (Skrivter af Naturhistorie-Selskabet, 5te Bd., 2det Hefte, Kiobenhavn 1802).

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In West's book, »Bidrag til Beskrivelse over St. Croix« etc., Kiobenhavn 1793, a few algæ are named, and in John Knox' »A historical account of St. Thomas, W. I.« etc. New York 1852, some few algæ are also mentioned in the plant list p. 230. This list is reprinted in B. v. Petersen, »En historisk Beretning om de dansk-vestindiske Oer, St. Croix, St. Thomas og St. Jan«, Kjobenhavn 1855. Finally in Millspaugh »Flora of the island of St. Croix« some few algæ, determined by Prof. Farlow, are mentioned.

[1]) Regarding the external conditions of life to the algæ compare also my above quoted paper concerning the Caulerpas and as to the algal vegetation in the lagoons also my treatise in »Biologiske Arbejder tilegnede Eug. Warming«, Kobenhavn 1911, p. 41.

Before concluding these introductory remarks I wish to express my thanks to the many botanists who in different ways have helped me in the working out of this paper.

I am especially obliged to Mrs. and Mr. Gepp in London who have not only been of great help to me during my visits to the British Museum (Natural History) but have also, when preparing their monograph of the Codiaceæ, had my material of *Penicillus*, *Udotea* and *Rhipilia* for determination.

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INTRODUCTION TO THE PHÆOPHYCEÆ PART

As in the case of my *Chlorophyceæ* paper the present communication is based upon material collected during my three stays at the islands.

With regard to the collecting of the algæ, reference should be made to the introduction to the *Chlorophyceæ* section for information as to the localities visited and for physiographical details. Here also a chart showing the coral reefs, depths etc. in the sea nearest the islands is published.

Concerning the brown algæ from the islands I have already published some papers on the subject, namely:

Two crustaceous brown algæ from the Danish West Indies (Nuova Notarisia, Serie XXIII Luglio 1912).

The species of *Sargassum* found along the coasts of the Danish West Indies with remarks upon the floating forms of the Sargasso Sea (Mindeskrift for Japetus Steenstrup, Kobenhavn 1914).

For the sake of completeness I also give here the contents of these paper so far as they treat with the fixed algæ living at the shores of the islands.

If we compare the brown algal vegetation of the West Indian islands with that found in northern seas we see clearly the well known fact that the northern brown algal vegetation reaches a luxuriancy which greatly surpass that in the tropics. The group of brown algæ which in the islands is most vigorously developed is the *Fucaceæ* represented by *Sargassum* and *Turbinaria*, and where these are growing in full vigour this tropical *Fucaceæ*-Formation is not much inferior to that found in the northern sea, e. g. at the shores of the Færöes[1]). But this fucaceous vegetation is also the most vigorously developed and as is well known the corresponding vegetation in the northern seas is much behind the vegetation of the *Laminariaceæ*.

[1]) Comp. F. Borgesen The Algæ-vegetation of the Færöese coasts, 1905. (Botany of the Færöes Part III.

After the *Fucaceæ* it is the representatives of the *Dictyotaceæ* and also forms of the *Encœliaceæ* which attain to some size and are found in greater masse sin the West Indies, apart from these most of the forms are small. Upon stones in shallow water brown crusts of *Ralfsia expansa* are common and upon rocks on the north west coast of St. Croix *Aglaozonia canariensis* forms large red brown expansions.

As to the number of species found at the shores of the islands (40 species) this is also not great; compared with that found at the shores of the Færöes (73 species) it is only a little more than half.

The brown algæ occur from low water mark (the tide is nearly wanting at the islands) or a little above, and down to a depth of about 40 meters where *Zonaria variegata* was still found well developed; as mentioned in the introduction to the *Chlorophyceæ* section I have not been able to dredge in greater depth.

With regard to the earlier contributors to our knowledge of the algæ of the islands I refer to the information given in the *Chlorophyceæ*, just as in the case of collectors of algæ etc.

Here I wish only to express my best thanks to the botanists who in different ways have helped me by the working out of the present paper.

I am much indebted to Mme Weber-van Bosse and Professor C. Sauvageau for having been so kind as to send me original specimens of different species to compare with the mine.

And especially my thanks are due to Professor P. Kuckuck who by reason his extensive knowledge especially of the *Phæosporeæ* has been able to give me much valuable information.

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CHLOROPHYCEÆ

I. Ulothrichales.

Fam. 1. Ulvaceæ.

Enteromorpha (Link).

1. Enteromorpha flexuosa (Wulf.) J. Ag.

J. Agardh, Till Algernes Systematik, 3die Afd., VI. Ulvaceæ, p. 126.

The habit of this species is very like that of *Enteromorpha intestinalis* and it grows also in very similar places, as is also pointed out by Collins in »The Green Algæ of North America», p. 203.

It is especially distinguished from *E. intestinalis* by having the cells arranged in longitudinal rows.

It occurs in somewhat or quite sheltered places often in brackish and stagnant water, once it was found in great quantity in quite fresh water near the mouth of the Bethlehem river at Fair Plane.

St. Croix: Lt. Princess, Salt River, Lime Tree Bay, Bethlehem River, Christiansteds Harbour. St. Jan: Cruz Bay.

Geogr. Distrib. All warmer seas.

2. Enteromorpha chætomorphoides Børgs.

Borgesen, F., Some Chlorophyceæ from the Danish West Indies, I, (Botanisk Tidsskrift, vol. 31, 1911, p. 149).

Enteromorpha torta Vickers, Phycologia Barbadensis, tab. VI; non *Enteromorpha torta* Reinb.

In the »Phycologia Barbadensis« Mlle Vickers has figured an *Enteromorpha* which she refers to *Enteromorpha torta* Reinb.[1]). As I have now also found this, it seems to me, very characteristic form in the Danish West Indies, I have arrived at the conclusion that I cannot agree with Mlle Vickers in considering the plant in question as belonging to Reinbold's species. Major

[1]) Reinbold, Th., »Revision von Jürgens' Algæ aquaticæ«; Anhang. (La Nuova Notarisia, vol. 4, 1893, p. 201).

Reinbold has been so kind as to send me several specimens of his species; when compared with these and with the original specimen of Jürgens in »Algæ aquaticæ«, Dec. XIII, No. 6, our plant as pointed out in my above-cited paper has proved to be quite different. For this reason I have described it as a new species.

The Latin diagnosis I have given of this species is:

Fronde filiformi, cylindrica, tortuosa, simplici, vel rarissime prolificationibus instructa. Thallo sæpissime solido, ex tribus (in prolificationibus aut duobus aut singulis) seriebus cellu-

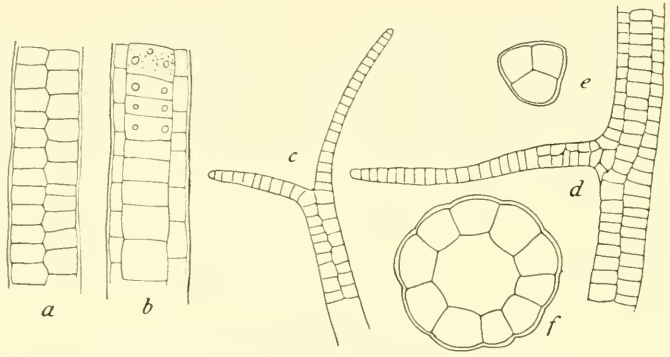

Fig. 1. *Enteromorpha chætomorphoides* Borgs.
a and *b*, parts of filaments; *c*, apex of a filament with proliferation; *d*, filament with proliferation *e* and *f*, transverse section of filaments. (*a*, *b*, *e*, *f*, about 250:1; *c*, *d*, about 80:1).

larum composito; interdum crassiore et tubuloso, plures series cellularum continente. Cellulis majoribus, subquadratis vel rectangularibus, 16—18 μ crassis. Fig. 1.

Lat. fil. 3 ser. cellularum composita = ca. 45 μ.

Lat prolific. tenuior. = 15—16 μ.

To this description I may add that the plant, like *Chætomorpha*, forms loose-lying entangled masses, the filaments twisted between each other. The proliferations occur very seldom, most often only at the apices of the filaments (Fig. 1 *c*): only once have I found a proliferation growing out from the side of a filament far from the top (Fig. 1 *d*). While the filaments commonly consist of three rows of cells (Figs. 1 *a*, *b*, *e*) the thinner proliferations only consist of two and at last of a single row of cells only. The filaments consisting of 3 rows of cells are solid (Fig. 1 *e*) while the thicker but rarer filaments with several rows of cells are hollow in the middle (Fig. 1 *f*). The chromatophore lies near the free wall of the cell and contains two pyrenoids, seldom three (Fig. 1 *b*).

Enterom. chætomorphoides occurs in lagoons and other sheltered places. It is partly met with entangled among various algæ growing upon the roots of the mangroves, partly also forming loose-lying masses often together with other algæ e. g. *Rhizoclonium Kochianum* Kütz., *Lyngbya majuscula* Harv., *Enteromorpha plumosa* Kütz., etc.

St. Thomas: Sheltered places in the Harbour, Bovoni Lagoon. St. Croix: Christiansteds Lagoon.

Geogr. Distrib. Barbadoes, Danish West Indies.

3. **Enteromorpha lingulata** J. Ag.

J. Agardh, Till Algernes Systematik, 3die Afd., VI. Ulvaceæ, p. 143.

The specimens referred to this species seem to agree very well with the description of J. Agardh (l. c.).

At the base of the specimens the filaments are rather thin but richly ramified: higher up they grow broader. The cells are roundish quadrangular and placed in longitudinal series.

Some few more slender specimens of nearly uniform diameter seem to come near to *E. prolifera* var. *tubulosa* as described by Collins l. c., p. 203.

This species is found in sheltered and in more exposed places growing on rocks at or a little above the surface of the sea.

St. Croix: The Harbour of Christianssted, Lt. Princess, Northside: St. Thomas: The Harbour, Store Nordside Bugt; St. Jan: Cruz Bay.

Geogr. Distrib. Extensive.

4. **Enteromorpha plumosa** Kütz.

Kützing, Phycologia generalis, 1843, p. 300, pl. XX, fig. 1.

Enteromorpha Hopkirkii Harv., Phycologia Britannica 1846—51, pl. 258, Nereis Bor.-Am., p. 58.

Vickers, Phycol. Barbad., 1908, pl. V.

Found in more sheltered places in bays or lagoons as well as on rocks in rather exposed places.

St. Croix: Lt. Princess, Cane Bay, Saltriver, Lime Tree Bay; St. Jan: Cruz Bay, Coral Bay.

Geogr. Distrib. The West Indies, The Mediterranean, Atlantic coasts of Europe and America, etc.

5. **Enteromorpha clathrata** (Roth) Greville.

Greville, Algæ Britannicæ, 1830, p. 181. Collins, The Green Algæ of North America, 1909, p. 199.

Found in a rather sheltered place growing in shallow water.

St. Croix: The Harbour of Christianssted.

Geogr. Distrib. Europe, North American coasts and the West Indies, Tasmania etc.

Ulva (L.).

1. Ulva Lactuca L.

Linné, Species Plantarum, vol. II, 1753, p. 1163.

var. *rigida* (Ag.) Le Jolis.

Le Jolis, Algues marines de Cherbourg, 1863, p. 38.

This species occurs in rather exposed places and also quite sheltered places; it is mostly found in quite shallow water near the shore, but it has once been dredged at about 12 meters. It is rather common at the shores of the islands.

Geogr. Distrib. Extensive.

2. Ulva fasciata Delile.

Delile, Flore Egypte, 1813, p. 153, pl. 58, fig. 5. J. Agardh, Till Algernes Systematik, 3die Afd., VI. Ulvaceæ, p. 174, 1883. A. Vickers, Phycologia Barbadensis, 1908, Pl. II. Collins, Green Algæ of North America, 1909, p. 216.

The few specimens I have collected of this plant are easily distinguishable from *Ulva Lactuca*. They are characterized by having the thallus divided in many narrow lobes with the margins irregularly dentate or sinuate. In the living plant the lobes are light green in the middle becoming darker towards the margin, this being nicely shown in the figure of Vickers (l. c.).

In cross section the cells are seen to be very high and narrow and their walls in the middle of the thallus are rather thick, much thicker than in *Ulva Lactuca*. The thickness of the thallus varies about 80 μ. As characteristic of this species J. Agardh has pointed out, that the two layers of cells separate somewhat at the margin, this I have not succeeded in finding in my material.

I have only once found this species, namely at St. Thomas, in the harbour where it was growing in shallow water and in a rather sheltered place.

Geogr. Distrib. All warmer seas.

Fam. 2. Chætophoraceæ.

Blastophysa Reinke.

1. Blastophysa rhizopus Rke.

Reinke, Atlas deutscher Meeresalgen, pl. 23. Huber, Contributions a la connaisance des Chaetophorées épiphytes et endophytes et de leurs affinités. (Ann. sc. nat., bot., 7. sér., t. XVI, p. 332). Borgesen, in Botanisk Tidsskrift, vol. 31, 1911, p. 131.

Growing endophytic in the thallus of *Nemalion Schrammi* (Cr.) Borgs. was found a green alga which seems to come very near to, most probably being identical with *Blastophysa rhizopus* Rke.

Quite in agreement with the description of REINKE the large cells of our plant have a very variable shape and from these long, colourless, rhizoid-like filaments grow out. Upon most of the cells we find a single hair or most often a bunch of several hairs up to 5—7 or more together. In REINKE's plant the hairs were a little swollen at the base like an onion, in my plant such a swelling was most often not present at all, only seldom a lesser thickening could be found. The wall-plasma was granular and several pyrenoids occurred in each cell, but the chromatophore itself was indistinct in most of the cells; a few cells showed traces of its division in the characteristic mode of 5—6 edged plates as found in *Blastophysa rhizopus* and in the other known species, *Bl. arhiza* Wille and *Bl. polymorpha* Kjellm.

Any division of the cells was not found, nor formation of zoospores.

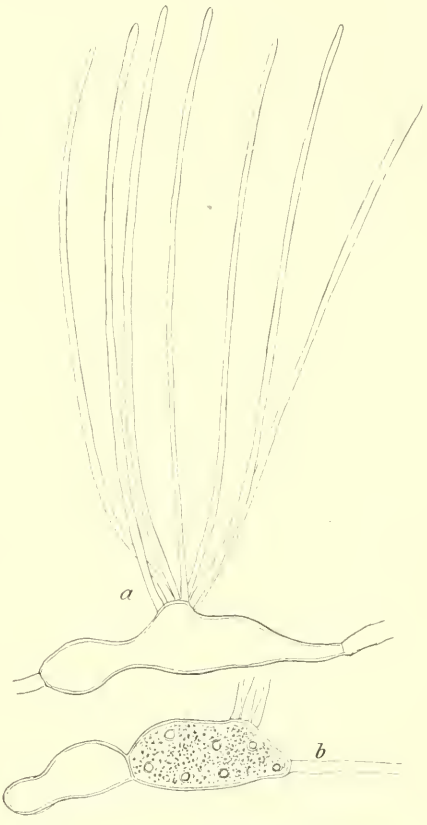

Fig. 2. *Blastophysa rhizopus* Rke. (About 125 : 1).

Ever if our plant as mentioned above shows some few differences from REINKE's description, on the other hand I find these so small and the plant upon the whole so variable, that I think it most correct to refer it to *Blastophysa rhizopus* Rke.

Only found once in *Nemalion Schrammi*, collected in the month of February on the south coast of St. Croix: at Long Point.

Geogr. Distrib. Europe, St. Croix.

Endoderma Lagerh.

Endoderma viride (Reinke) Lagerh.

G. Lagerheim, Bidrag till Sveriges algflora (Öfversigt af K. Vetensk.-Akad. Förh. 1883, p. 75). J. Huber, Chaetophorées épiphytes et endophytes (Ann. Sc. nat., 7. Sér. Bot. tome 16, 1892, p. 326).

Entocladia viridis Reinke in Bot. Zeit., 1879, p. 476, tab. 6, figs. 6—9.

Specimens which seem quite to agree with Reinke's description and figure were found growing in *Chrysymenia Agardhii*.

Lat. cell. = 5—7 μ.
Long. cell. = 10—15 μ.

St. Jan: off America Hill in about 15 fathoms.

Geogr. Distrib. Atlantic coasts of Europe and N. America, West Indies.

Ulvella Crouan.

1. Ulvella Lens Crouan.

P. L. et H. M. Crouan, Notes sur quelques espèces et genres nouveaux d'algues marines de la rade de Brest (Ann. Sci. natur., 4. Sér., Bot., Vol. XII, 1859, p. 288, pl. XXII, figs. 25—28). Huber, J., Contributions à la conn. des Chætophorées épiphytes et endophytes (Ann. Sci. nat., 7. Sér., Bot., vol. 16, 1892, p. 294, pl. XI, figs. 4—6).

Specimens which seem to agree fully with the description of Huber (l. c.) were found growing epiphytic upon *Chætomorpha antennina*.

The cells in the periphery of the discs were 3—4 μ thick and 15—20 μ long; the more roundish cells in the central part of the disc had a diameter of 8—10 μ; they were, as also mentioned by Huber, often divided into 2 or 4 cells.

The chromatophores are very homogeneous and contain no pyrenoid.

Found only once, St. Thomas: The Harbour.

Geogr. Distrib. Europe, North Carolina.

Pringsheimia Reinke.

1. Pringsheimia scutata Reinke.

Reinke, Atlas deutscher Meeresalgen, pl. 25; Algenflora p. 81.

I have found a few specimens, growing epiphytic upon *Bostrychia tenella*, of a green crustaceous alga which most probably belongs to this species. But the material was so scarce that

a certain determination was not possible. On the other hand, as *Pringsheimia scutata* is found at Jamaica and most probably widely distributed, it may also be expected to occur at other places in the West Indies.

The above mentioned specimens were found:

St. Thomas: Store Nordside Bugt.

Geogr. Distrib. Europe, Greenland, Atlantic coast of North America, Jamaica, St. Thomas.

2. **Pringsheimia (?) Udoteæ** nov. spec.

Thallus viridis, disciformis, minutus, horizontalis, tota inferiori parte substrato adfixus; cellulis in media parte disci sæpe irregulariter dispositis ad marginem versus radiantibus sæpe etiam concentrice ordinatis. Discus crescit divisione cellularum peripheriæ. Zoosporangia urceolata, poris rotundatis singulis instructa, in parte superiori apertis.

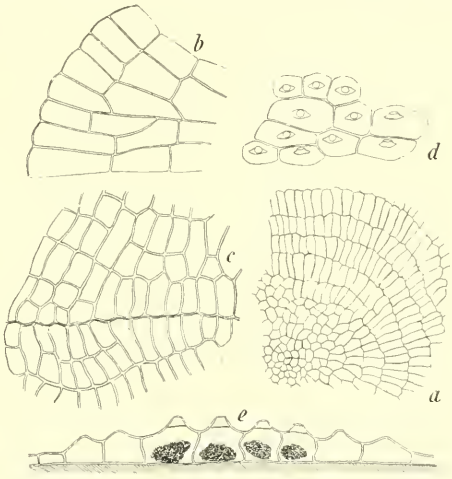

Fig. 3. *Pringsheimia (?) Udoteæ* nov. spec. *a*, part of the middle of the thallus; *b*, the edge of the thallus, *c*, edges of two thallus growing together; *d*, zoosporangia seen from a bove; *e*, transverse section of thallus. (*a*, about 75 : 1, *b*, *d* and *e*, about 200 : 1, *c*, 150 : 1).

Growing epiphytic upon the flabellum of a specimen of *Udotea flabellata* were found numerous small roundish discs of a bright green colour. When examined under the microscope these discs seen from above were found to be composed of mostly rather long cells arranged most often in nice radiating series and also in concentric rings with exception of the middle of the disc where the arrangement was less regular (Fig. 3 *a*). The cells are commonly about 16 μ broad varying from 5 μ—25 μ and about 40 μ long, the shortest found being 17 μ the longest reaching 70 μ.

The disc increases by means of marginal growth (Fig. 3 *b*); all the cells in the periphery are able to divide themselves. Sometimes only one cell is cut off by a cross wall, but most often two

cells are formed by peri- and anticline walls. By this way of growing the most often very regular dichotomously branched, radial series of cells are formed and as the cells often have nearly the same length the concentric arrangement arises at the same time. A transverse section through the disc shows that this consists of a single layer of cells only; the thickness of the vegetative cells is about 10—12 μ.

Here and there in the larger discs we find the vegetative cells transformed into sporangia (Figs. 3 *d*, *e*); these are much higher than the vegetative cells, about 45 μ high, jar-shaped or like a short bottle, and have each a single rather large, round hole at their top. When this is formed the cuticula bursts and the split formed in this way is seen as a rhomboid scar round the opening. A large number of small zoospores seem to be formed in each cell but I may point out that I have had only dried material at my disposal, for which reason I have not been able to see them with certainty.

This has also made the examination of the cell contents difficult but so far I have been able to see, each cell contains a large parietal chromatophore with irregularly lobed edges covering nearly the whole side of the cell; 1—4 pyrenoids are present in each chromatophore.

Being as yet rather imperfectly known it is of course difficult with certainty to indicate the systematic position of this form. But it seems to me that it might be referred to the *Chætophoraceæ*, coming here rather near *Pringsheimia* and *Ulvella* and related forms.

As mentioned above it was found growing epiphytic upon a large specimen of *Udotea flabellata*. Most of the specimens formed small roundish discs but some had grown together as rather large coherent covers. The plant was dredged in a depth of about 20 meters.

St. Jan: In the Sound between this island and St. Thomas off Cruz Bay.

Fam. 3. ***Gomontiaceæ.***

Gomontia Bornet et Flahault.

1. **Gomontia polyrhiza** (Lagerh.) Bornet et Flahault

in Journal de Botanique, vol. II, 1888, p. 163 et Bull. de la Soc. bot. de France, T. XXXVI, 1889, p. CLII, pl. VI—VIII.

Codiolum polyrhizum Lagerh. in Öfversigt af Kungl Vetensk.-Akadem. Förhandl., 1885, p. 21.

Found in dead shells both near the shore in shallow water or lying on the beach as well as in deeper water.

Found in several places and is most probably common.

Geogr. Distrib. Europe, Greenland, Atlantic and Pacific coasts of America etc.

II. Siphonocladiales.

In my paper dealing with *Siphonocladus* (1905) I described for the first time the remarkable »ball-cell-division«, by which the whole protoplasts with nuclei and chromatophores are divided into a number of small clumps, which are soon surrounded by a membrane and grow larger filling out the whole lumen of the mother-cell, which in this way becomes divided into a number of small cells. Later, I have found this mode of cell-division with some variation to be characteristic of several of the forms belonging to the *Valoniaceae*. In e. g. *Siphonocladus*, *Dictyosphæria*, *Struvea*, *Chamædoris* it is the normal mode of cell-division and as described in this paper also in *Cladophoropsis* and *Boodlea* and a tendency towards the same mode is furthermore found in several other forms of the *Valoniaceæ*.

For this curious mode of vegetative cell-division I propose the name of segregative cell-division. As I have pointed out in my paper on *Siphonocladus*, it resembles somewhat the free cell-division as found in the asci of the Ascomycetes or in the sporangia of several algæ and fungi. But the nuclei here take part in the division and the new cells (spores) have only one nucleus each and finally, in the typical free cell-division in any case, some protoplasm is left in the mother cell. On the other hand, in the segregative cell-division all the protoplasm of the mother-cell is used; the numerous nuclei arranged regularly in the protoplasm are present in the mother-cell before the division takes place and these take apparently no active part in the division, each part of the chloroplast at the division getting a number of nuclei smaller or larger according to the size of the divided parts.

Regarding the arrangement of the genera within some of the families of the group Siphonocladiales rather different views are prevalent. In his »Morphologie und Biologie der Algen«

Oltmanns refers to the Siphonocladiales the four families of marine algæ: *Cladophoraceæ*, *Siphonocladaceæ*, *Valoniaceæ*, and *Dasycladaceæ*.

To the Fam. *Cladophoraceæ* besides *Cladophora*, *Rhizoclonium*, *Chætomorpha* etc. Oltmanns also refers, of genera found in the West Indies, *Anadyomene*, *Microdictyon*, *Boodlea* and *Dictyosphæria*. To the Fam. *Siphonocladiaceæ* he reckons *Siphonocladus*, *Struvea* and *Chamædoris*, and to the Fam. *Valoniaceæ* *Valonia*.

On the other hand Wille, in his revision of the *Chlorophyceæ* in Engler and Prantl, »Die natürlichen Pflanzenfamilien», has only three of the above mentioned families, namely: *Cladophoraceæ*, *Valoniaceæ*, and *Dasycladaceæ*. The *Valoniaceæ* are divided into two groups: *Valoniaceæ* and *Anadyomeneæ*; to the first mentioned is referred, of West Indian forms, *Valonia*, *Blastophysa*, *Siphonocladus*, *Chamædoris* and *Dictyosphæria*; to the last-mentioned *Struvea*, *Boodlea*, *Microdictyon* and *Anadyomene*.

In »Nachträge zum 1. Teil«, 2. Abt. 1910—11, some alterations are made, the *Valoniaceæ* comprehend here *Valonia*, *Dictyosphæria* and *Blastophysa*, a new group *Siphonocladeæ Siphonocladus* and *Chamædoris* and the group *Anadyomeneæ Struvea*, *Microdictyon*, *Anadyomene* and *Boodlea*. Furthermore, the genus *Cladophoropsis* founded and separated by me from *Siphonocladus* is referred in accordance with my earlier view to *Cladophoraceæ*.

Of these two rather different groupings I mostly prefer that of Wille. I do not think that some of the genera referred to the *Cladophoraceæ* by Oltmanns can be registered there in a natural way and my observations on my West Indian material also tell against it.

According to my investigations I think that the forms in question can be divided in the following way: *Cladophoraceæ*, to which I refer the same genera as Wille with exception of *Cladophoropsis*, and *Valoniaceæ*, which I divide into four subfamilies, namely, *Anadyomeneæ*, *Valonieæ*, *Boodleæ* and *Struveæ*; these four groups could perhaps quite as well be considered separate families and Wille also points this out for his subdivisions.

To the Subfam. *Anadyomeneæ* I refer, of the West Indian forms, *Microdictyon* and *Anadyomene*. So far as I have been able to see the cell division takes place here nearly in the same way as in *Cladophoraceæ* and lentiform cells do not occur. Ball

formation of the cell contents I have not found. In *Microdictyon* the apices of the branches fix themselves to neighbour-cells and in order to strengthen the attachment a rather thick cellulose ring is formed at the top of the branches, in *Anadyomene*, where the cells grow quite closely together along all their sides, such a thickening is also found at the summit of the cells.

To the *Valonieæ* I refer *Valonia* and *Dictyosphæria*. In regard to their cell division they are certainly rather different, the cells in *Valonia* as is well known being divided by lentiform walls, while in *Dictyosphæria* the cells are divided by segregative cell-division. But on the other hand the two forms show considerable agreement. *Dictyosphæria* has for example numerous small lentiform cells from which the hapters grow out and in some species of *Valonia* the cell contents often are divided into balls.

This group also agrees fairly well with that of WILLE, *Blastophysa* I refer to the *Chætophoraceæ* and *Apjohnia* I should prefer to place near *Struvea*, *Chamædoris* etc.

In the third Subfamily *Boodleæ* I place *Boodlea* and *Cladophoropsis*. Both these forms have irregularly ramified filaments forming *Ægagropila*-like clumps. The division of cells takes place by the segregative cell-division. Unicellular tenacula occurring in the summit of the branches (*Boodlea*), or everywhere at the side of the filaments (*Cladophoropsis*) contribute to fix the filaments together.

Finally, the Subfamily *Siphonocladeæ* comprises *Struvea*, *Chamædoris*, *Siphonocladus* and *Ernodesmis*. Common to all is that the primary, cylindric cell persists as stipes, which by means of rhizoids is fastened to the substratum and in the nethermost part (in *Chamædoris* the whole stipes) is provided with annular constrictions (except in *Struvea anastomosans* which on the whole is a connecting link to *Boodlea*). The cell division is performed by segretative cell-division except in *Ernodesmis*, where, so far I have been able to see in my material, it is accomplished nearly as in *Valonia*, but ball-formation of the cell contents is rather common in this form also.

Common to all the four subfamilies of the *Valoniaceæ* is the shape of the chromatophores and the cell contents upon the whole. The chromatophores consist of numerous small polygonal bodies; in the young cell they are reticularly connected forming in this way a parietal net work, in the older part of the thallus they are most often separated. How far it is possible

to distinguish the forms belonging to the *Valoniaceæ* from all those in the *Cladophoraceæ* by means of this character I am not able to say with certainty, but I am inclined to think it possible. In the *Cladophoraceæ* we have, as is well known, a single, perforated, parietal chromatophore (sometimes with lobes also in the interior), but in some forms, e. g. in *Acrosiphonia*, the perforation is greatly developed and the chromatophore therefore finely reticulated and it comes then very near to that found in the *Valoniaceæ*.

Fam. 1. ***Cladophoraceæ.***

Chætomorpha Kütz.

Excluding the very characteristic species: *Ch. antennina* and *Ch. clavata* (the last-named species I have however found in such small quantity only, that I do not know its capability of variation), the other forms of this genus are so very variable, that it has often been very difficult to determine to what species they belong.

1. **Chætomorpha clavata** (Ag.) Kütz.

Kützing in Bot. Zeit. vol. V, 1847, p. 166. Vickers, Phycol. Barbad., 1908, p. 17, pl. VII.

Conferva clavata Agardh, Systema Algarum, 1824, p. 99.

Only found once at the south shore of St. Croix: Lime Tree Bay.

Geogr. Distrib. West Indies, California, Africa.

2. **Chætomorpha antennina** (Bory) Kütz.

Kützing, Species Algarum, 1849, p. 379. Vickers, Phycol. Barbad., 1908, p. 19, Pl. VIII.

Wittr. et Nordst., Alg. Exsicc., No. 1439.

The basal cell (Fig. 4 *b*), as already pointed out by Borxet in »Algues de P. K. A. Schousboe«, p. 203, is very long, often 10—20 times as long as broad (Fig. 4 *b*), while the other cells in the filaments are much shorter, 2—6 very seldom 8 times their own diameter. At its base the basal cell has annular constrictions. It is fastened to the substratum by means of richly and very irregularly ramified rhizoids (Fig. 5).

The walls of the cells and especially of the basal cell are very thick and consist of several layers (Fig. 5).

The plant occurs in characteristic brush-like tufts. The single filaments are very rigid. A filament cut off near the base

ST THOMAS
ST JAN
TORTOLA I.
CHARLOTTE AMALIA
Hans Lollik
Outer Brass
Inn Brass
Thatch Cay
Gr. Thatch I.
L. Thatch I.
Frenchmans Cay
Salt Cay
W. Cay
Savana I.
Davids Pt
Lucas Pt
Perseverance
Bay
Flat Cays
L. Saba
Flamingo Pt
Water I.
Sorgenfri
Crown Mt
Signal Hill
Mosquito B.
Mandal
Mandals Pt
Frydendal
Smiths B.
Tutu
Bovoni
Long Pt
Jerse B.
L. St. James I.
Gr. St. James I.
Dog I.
THE SOUND
Steven Hall
(SUNDET)
Christiansbay
Cruzbay
Caneelbay
Susannaberg
Catherineberg
Adrian
Carolina
Leinsterbay
Leinster B.
Browns B.
Whistling C.
Mary Pt.
Francis B.
Congo C.
Lovango C.
Fish B.
Lamesure
Bourdeaux
Reef B.
White Pt.
Concordia
CORAL BAY
Red Pt.
Buck I.
Rams Hd.
Hurricane Hole
Rendezvous B.
Turtle Back
The Two Brothers
Durloe C.
Peters Cay
Gr. Cruz B.
0 1 2 3 4 5 Kilometer
ST CROIX
Buck Island
White Horse
Judiths Fancy
Salt River Bay
La Vallee
Hams Bluff
Hams Bay
Spring Garden
Wills B.
Cane B.
Rust op Twist
North Star
Northside
Butlers Bay
Sprat Hole
Williams
La Grange
FREDERIKSTED
Westend Pond
Whites Bay
Sandy Point
Long Point Bay
Long Point
Bettys Hope
Anguilla
Krausses Lagoon
Lime Tree Bay
Kings Hill
Cassava Garden
Longford
Bloc Mt
Mount Eagle
Annally
Little Princess
St Croix Sugar manufact.
LONG REEF
Protestant Cay
Slobs
Christiansteds Lagoon
Green Cay
Coakley Bay
Petronella
Cotton Grove
Great Salt Pond
Castle Nugent
Great Pond
Grange
Williams
CHRISTIANSTED
0 1 2 3 4 5 6 7 8 9 10 Kilometer
The depths in fathoms.
signify Reef
10 fathoms curve.
20
100

can grow out again. Once I have found a filament with a side-branch growing out from the middle of the long basal cell.

In the rhizoids much starch is present often in more or less swollen parts of the rhizoids. That these swellings are able to grow out to erect assimilation filaments and in this way help to the formation of the dense tufts seems very probable, but I have not succeeded in observing the process with full certainty. In any case young specimens originating from zoospores often occur also in the tufts, the zoospores getting shelter to fix themselves here among the felted rhizoids.

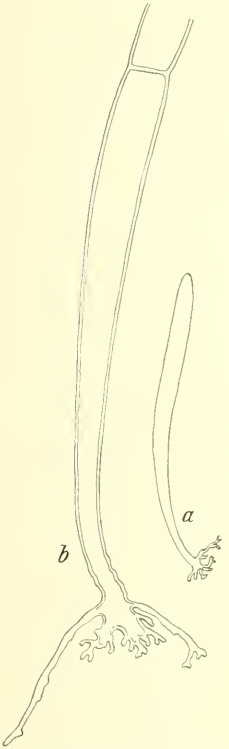

Fig 4. Two young plants of *Chætomorpha antennina*. *a*, a quite young, not divided plant; *b*, an older plant showing the long basal cell with the beginning of annular constrictions at its base (about 7:1).

Fig. 5. Base of *Chætomorpha antennina* showing the nethermost thick-walled part of the filament with annular constrictions and the richly ramified rhizoids provided with starch (about 20:1).

Chætomorpha antennina grows on rocky shores near or a little above the surface of the sea. It is abundant on, and characteristic of, the most exposed places, where it is constantly dashed by the waves.

St. Croix: The west end of the Island e. g. at Frederikssted and Northside Estate, Cane Bay; St. Thomas: Store Nordside Bugt; St. Jan: Cruz Bay.

Geogr. Distrib. West Indies, Atlantic and Pacific coasts of Mexico, Africa.

3. **Chætomorpha crassa** (Ag.) Kütz.

Kützing, Phycologia germanica, p. 204.
— Tabulæ phycologicæ, vol. III, tab. 59.

The form found had cells about 500—550 μ thick. The cells were nearly cylindric or sometimes a little inflated, mostly a little shorter or as long as broad, but cells also occur about twice as long as the diameter.

Found once in shallow water near the shore intermingled between *Hypnea*.

St. Croix: Lt. Princess.

Geogr. Distrib. Mediterranean, Atlantic coast of Europe.

4. **Chætomorpha ærea** (Dillw.) Kütz.

Kützing, Species Algarum, 1849, p. 379. Collins, Green Algæ of North America, p. 324.

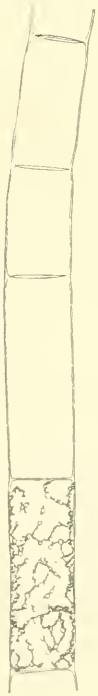

Fig. 6. *Chætomorpha gracilis* Kütz. Part of a filament. About 100:1.

A quite typical form, about 270 μ diam., was found at Lt. Princess, St. Croix.

Some other loose-lying forms come near to forma *Linum*, the diameter of the cells varying about 250-300 μ.

This species was found in shallow water only and in more sheltered or quite sheltered places.

St. Croix: Lt. Princess, Christiansted's Lagoon; St. Thomas: Orkanoen, Store Nordside Bugt.

Geogr. Distrib. Extensive.

5. **Chætomorpha brachygona** Harv.

Harvey, W. H., Ner. Bor.-Am., part 3, 1858, p. 87, Pl. XLVI, A.

The specimens found had cells mostly nearly as long as broad or a little shorter, more seldom with the length 3—4 times the diameter. Cells 100—170 μ diam.

Ch. brachygona Harv. occurs often as large entangled masses in shallow water in sheltered places with loose, sandy or muddy bottom. It lies here as a loose covering over the bottom or it is intertwisted among the sea-grasses growing here or mixed with other more or less loose lying algæ: *Enteromorpha*, *Rhizoclonium* etc. In the lagoons it is found in even rather brackish water. In more

exposed places it is only gathered in deeper water about 12 meters.

It has been found, St. Croix: Christianssted's Harbour and Christianssted's Lagoon, Lt. Princess, off Frederikssted, White Bay, Lime Tree Bay; St. Thomas: Bovoni Lagoon.

Geogr. Distrib. West Indies, Florida, Mexico.

6. **Chætomorpha gracilis** Kütz.

Kützing, Phycologia germanica, p. 203; Species Algarum, p. 276; Tabulæ phycol., vol. 3, pl. 52, fig. 1. Hauck, Meeresalgen, p. 440. Reinke, Algenflora der westl. Ostsee deutschen Antheils, p. 84.

To this species of Kützing I have referred a form with filaments 40—70 μ thick and the length of its cells from twice to four times the diameter.

Found intermingled among other algæ from the reef connecting St. Thomas with the Hurricane Island.

Geogr. Distrib. Mediterranean, France, Singapore.

Rhizoclonium Kütz.

1. **Rhizoclonium Kochianum** Kütz.

Kützing, Phycologia germanica, 1845, p. 206. Stockmayer, Ueber die Algengattung *Rhizoclonium* (Verhandl. d. zool.—bot. Gesellsch. in Wien, 40, 1890, p. 582). Vickers, Phycologia Barbadensis, 1904, p. 18, pl. XI.

The specimens found vary rather considerably; in some the filaments are about 12—14 μ thick and 1—2 diam. long. Other specimens had filaments about 16 μ thick sometimes even reaching 25 μ, the cells being nearly twice the diameter. In one collection from St. Thomas the filaments were about 14 μ thick and 1½—3 diam. long; and rather near to these specimens were also some in a collection from St. Jan, in which the filaments were about 13 μ thick and 1½—3 diam. long (Fig. 7); in specimens from Frederikssted the cells were about 19 μ thick.

Fig. 7. *Rhizoclonium Kochianum* Kütz. Part of a filament. About 75:1.

This species is found entangled among other algæ e. g. *Cladophora crispula*, *Falkenbergia* etc. and occurs both in shallow water and down to a depth of about 12 meters.

It is found St. Croix: Salt River, Long Reef, off Frederikssted; St. Thomas: Store Nordside Bugt; St. Jan: Cruz Bay.

Geogr. Distrib. West Indies, Europe.

2. **Rhizoclonium Kerneri** Stockm.

Stockmayer, Ueber die Algengattung *Rhizoclonium* (Verhandl. d. zool.-bot. Gesellsch. in Wien, 40, 1890, p. 582).

To this species I have referred a few specimens whose cells were about 4 times as long as broad. In one of the collection, found intertwisted among other algæ, the filaments had about 19 μ diam. the cells reaching a length of up to 120 μ (Fig. 8).

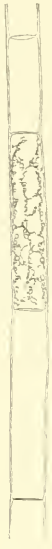

Fig. 8. *Rhizoclonium Kerneri* Stockm. Part of a filament. (About 125 : 1).

Another form was found growing epiphytic upon *Centroceras*, to which it was fastened by means of a small disc at the end of the basal cell; its filaments were 15—18 μ thick, and the cells about 4 times as long as broad.

This species was found St. Croix: At Frederikssted; St. Jan: Coral Bay.

Geogr. Distrib. Europe, North America.

Cladophora (Kütz.).

1. **Cladophora uncinata** nov. spec.

Cæspitibus densis, 4—5 cm. altis; filamentis rhizoideis multipartitis substrato adfixis, inferne rigidis, transverse annulatim constrictis ca. 110 μ crassis; membrana crassiuscula. Filamentis superioribus tenuioribus, ca. 65 μ crassis, lævibus, cylindricis, cellulis diametro 4—6-plo longioribus. Ramulis junioribus 35 μ crassis, sæpe hamatis. Ramis di-trichotomis, superne ramulis sæpe secundis.

The few specimens collected had a 4—5 cm. high, dark green frond. The plant is fastened to the substratum by means of irregularly lobed rhizoids and such also grow out higher up from the nethermost part of the main filaments. Here and for the rest also rather high up in the filaments the wall is thickened, stratified and with annular constrictions (Fig. 9) giving them in this way a moniliform appearance. The main filaments reach a diameter of about 110 μ. In the basal part of the main filaments the cells are about 10—15 diam. long, often much longer. These very long cells are due to the well known cell-perforations as described by Rosenvinge; in the main filament in the middle of Fig. 9 a cell is just about to grow down. Higher up the filaments are thinner as also the walls, these being here nearly cylindrical without annular constrictions. These thinner fila-

ments are about 65 μ; the youngest thinnest ramuli are only about 35 μ. The ramuli are often hooked (Fig. 10).

The ramification is di-trichotomous, in the youngest ramification often secund.

Found only once in rather sheltered places in shallow water near the shore. St. Croix: Lime Tree Bay.

Fig. 9. *Cladophora uncinata* nov. spec. Basal part with rhizoids. (About 15:1).

2. **Cladophora corallicola** nov. spec.

Cladophora pulvinato-cæspitosa, filamentis decumbentibus substrato rhizoideis adfixis; cellulis in filamentis crassioribus 125—150 μ crassis, diametro 5—10 plo longioribus, in ramulis tenuioribus ca. 70 μ crassis, diametro 5—6 plo longioribus. Cellulis in superiorem partem crassioribus sæpe curvatis, ut undulata filamentorum forma efficiatur. Rhizoideis 45 μ crassis. Ramis inferne di-trichotomo ramosis, superne simplicibus rarius ramosis.

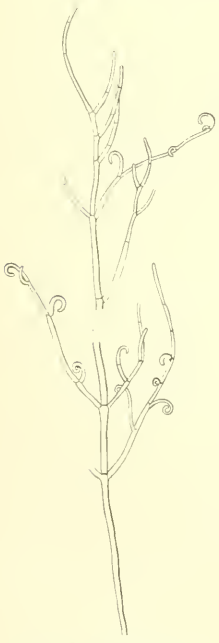

Fig. 10. *Cladophora uncinata* nov. spec. Branch with hooked ramuli. (About 15:1).

This plant was found growing upon dead corals or shells as a low dense cover. The dense growth is due to the fact, that from the decumbent branches erect grow up, some of which again bend down and get fastened to the substratum by means of rhizoids (Fig. 12).

The cells are rather narrowed at the ends and are thickest a little below the uppermost end (Fig. 11). In the main branches the cells are about 125 μ thick, in the thickest part even up to 150 μ and the length up to 10 diam. In the uppermost branches the cells are only about 70 μ thick and the length reaches about 6 diam. The cells especially in the main branches are often somewhat curved and herewith give the whole branch a sinuous appearance. The cell wall is rather thick and stratified, and the plant upon the whole rather stiff.

Fig. 11. *Cladophora corallicola* nov. spec. Habit of a branch. (About 10:1).

The rhizoids have no walls at their base and are about 45 μ thick.

Below the main branches are often rather much branched, ditrichotomously, higher up the filaments get here and there a short branch or most often none at all.

Found twice in the open sea at a depth of about 30 meters off America Hill, St. Jan.

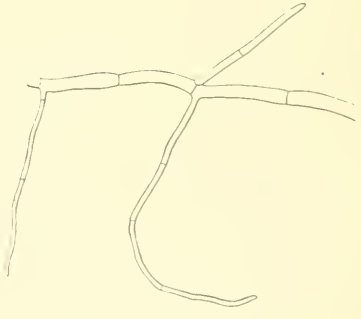

Fig. 12. *Cladophora corallicola* nov. spec. Basal part of filaments with rhizoids. (About 12:1).

3. **Cladophora fuliginosa** Kütz.

Kützing, Species Algarum, 1849, p. 415. Collins, The Green Algæ of North America, p. 348.

Blodgettia confervoides Harvey, Nereis Bor.-Am., p. 48, pl. XLV, C.

Referring to the remarks by Collins l. c. I shall only point out here that all the specimens found were infested by *Blodgettia Borneti* Wright. The specimens form dark brownish-green

tufts and the filaments are very rigid and stiff. The cells are about 200—300 μ thick and 5—6 times as long as broad. with exception of the terminal ones where often, as also pointed out

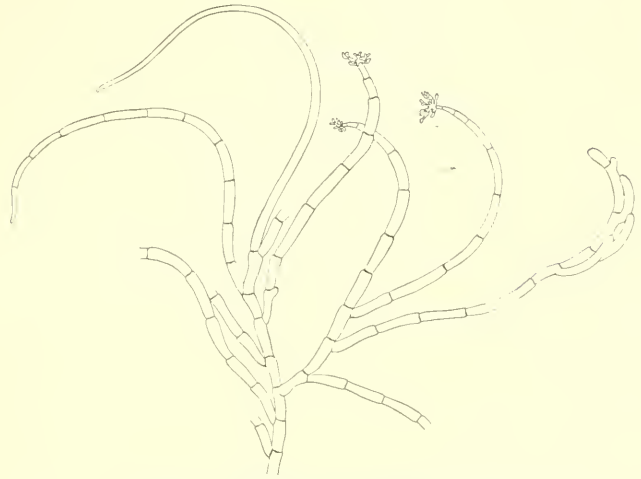

Fig. 13. *Cladophora fuliginosa* Kütz.
Habit of part of a plant with rhizoids. (About 5:1).

by HARVEY, very long cells occur, often a whole branch has no cross wall at all. At the base of the branches cross walls always occur with exception of the quite young branches, where they are sometimes wanting. One specimen from White Bay was remarkable by the fact, that ramified rhizoids were formed in the apices of the long, downward bent branches. Fig. 13 shows a part of this plant and Fig. 14 a more magnified rhizoid. This specimen seems to come very near to *Cladophora* (*Aegagropila*) *Montagnei* Kützing var. *waianæana* Brand as described and figured by BRAND in Beih. zum Bot. Centralbl., Bd. XVIII, Abth. 1, p. 185, pl. V, figs. 21—22.

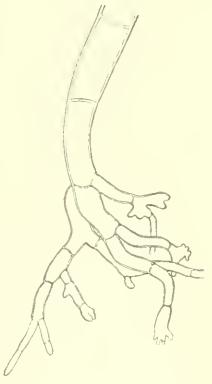

Fig. 14. *Cladophora fuliginosa* Kütz. Rhizoids in the summit of a branch. (About 12:1).

This species has been found both in sheltered and in more exposed places, in shallow water and in deep sea down to a depth of about 30 meters.

It occurs, St. Croix: Rust up Twist, White Bay and Lime Tree Bay; St. Thomas in the sea to the west of Water Island.

Geogr. Distrib. West Indies, Florida.

4. Cladophora fascicularis (Mert.) Kütz.

Kützing, F., Phycologia generalis, 1843, p. 268.
Vickers, A., Phycologia Barbadensis, p. 18, pl. XIII.

Cladophora fascicularis is a rather variable plant. The cells in the main filaments are about 200 μ thick and most often rather short, 2—4 diam. long, but sometimes also specimens with some longer cells occur and these forms then come near to *Cladophora heteronema.*

This species seems to be rather common at St. Croix where it occurs in the more protected localities behind the reefs, often in large entangled masses. It is most often met with in quite shallow water, once it was found in a depth of about 12 meters.

St. Croix: Lt. Princess, off Frederikssted, Lime Tree Bay.
Geogr. Distrib. West Indies, Florida, Brazil, Red Sea.

5. Cladophora crispula Vickers.

Vickers, A., Liste des algues marines de la Barbade (Ann. Sci. Nat., Sér. 9, Bot., vol. 1, 1905, p. 45); Phycologia Barbadensis, p. 19, pl. XVI.

The specimens referred to this species were found often abundantly as loose-lying, spongy masses entangled among sea-grasses. Most of the specimens seem to be in good accordance with the forms described by Mlle Vickers. From some older thicker filaments, often up to 60—80 μ thick, young thinner filaments grow out varying in thickness from 35—50 μ. These thinner filaments are more or less curved and twisted together forming in this way the spongy masses (Fig. 15).

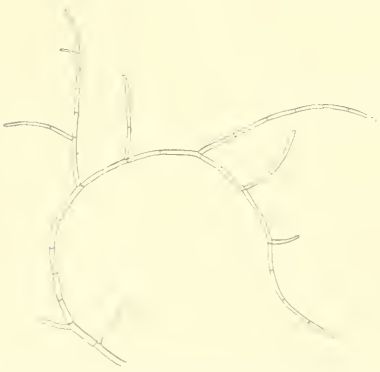

Fig. 15. *Cladophora crispula* Vickers. Part of a filament. (About 15:1).

In the sea to the west of Water Island at St. Thomas in a depth of about 40 meters, a *Cladophora* (my collection no. 1166) was found forming very similar spongy masses. The main filaments were about 100 μ thick, the thinnest ramuli about 30 μ, the cells in the filaments were rather long often up to 8 diam. This form seems to come near to some forms of *Cladophora heteronema.*

Cladophora crispula was found in more sheltered places in shallow water and in open sea down to a depth of about 40 m.

It has been gathered, St. Croix: off Frederikssted, Long Point; St. Jan: Off Cruz Bay.

Geogr. Distrib. Barbados, Danish West Indies.

6. **Cladophora heteronema** (Ag.) Kütz.

Kützing, F., Phycologia germanica, 1845, p. 210. Brand, F., Ueber die Anheftung der Cladophoraceen und über verschiedene polynesische Formen dieser Familie (Beih. z. Bot. Centralbl., Bd. XVIII, Abt. 1, 1904 p. 177).

Clad. fracta f. *marina* Hauck, Meeresalgen, p. 461.

Hauck in his good description of this species mentions *Cl. heteronema* Kütz. as a synonym only; but as pointed out by Brand Hauck's name for this species cannot be used as Lyngbye already has a *Cladophora fracta marina* in his »Tentamen Hydrophyt. Dan.«, p. 152.

The form found in the Danish West Indies seems to agree very well with the description of Hauck. In the main branches the filaments reach a diameter of up to 225 μ and a length of 12 diam. or even more, in the ramuli 30—60 μ.

It was growing in shallow water in sheltered places among sea-grasses etc.

St. Croix: Lt. Princess, Coakley Bay.

Geogr. Distrib. West Indies, Brazil, Mediterranean Sea, Atlantic coast of Europe etc.

*Fam. 2. **Valoniaceæ.***

*Subfam. 1. **Anadyomeneæ.***

Anadyomene Lamx.

1. **Anadyomene stellata** (Wulf.) Ag.

C. Agardh, Species Algarum, 1828, p. 400.

Ulva stellata Wulfen, Cryptogama aquat., p. 6. (Römer, Archiv für die Botanik, vol. 3, 1805).

The ovate or reniform, in older plants more irregularly lobed leaf-like thallus is fastened to the substratum by means of numerous thick-walled rhizines growing out from the lowermost part of the most vigorous cell-ribs. These most often unbranched rhizines grow together to a short stalk; at its base this stalk is broadened out to a small disc, as each of the rhizines of which it consists divides into irregular, coralliform lobes. Walls but

most often only few occur in the rhizines, above these a side-branch sometimes grows out.

The chromatophores are small polygonal plates (mostly trigonal) with prolonged edges and in the young cells forming a net work; in older cells the chromatophores are mostly isolated; each chromatophore contains a pyrenoid.

As to the cell-division, I have not been able to see in my material with certainty how it is accomplished but most probably the walls are formed in a similar way as in *Cladophora*; lentiform cells are wanting. I have never found ball-formation in this form.

The small cells filling up the intervals between the large cells of the radiating branch-system have at their apices a ring-formed thickness by means of which they are firmly attached to the neighbour-cell; this thickened cellulose ring reminds very much of those found in *Microdictyon*.

This species occurs both in shallow water and in deep sea down to a depth of about 50 meters. In shallow water it is found in rather exposed places growing in fissures in rocks. The specimens from deep sea are often large, reaching a length of 4 cm. or more.

It is found: St. Croix: Cane Bay; St. Thomas: The Harbour, the sound between Water Island and St. Thomas; St. Jan: Off Cruz Bay, America Hill, Rams Head., Hermitage and several other places.

Geogr. Distrib. Mediterranean, West Indies, Brazil.

Microdictyon Decsne.

1. **Microdictyon umbilicatum** (Vell.) Zanard.

Zanardini, Iconographia Phycologica Adriatica, vol. I, p. 79, tav. XIX, 1860. Hauck, Meeresalgen, p. 467.

Conferva umbilicata Velley in Transact. Linn. Soc., Vol. V. London 1800, p. 169, tab. VII.

Hydrodictyon umbilicatum C. Ag., Systema, 1824, p. 85.

Microdictyon Agardhianum Decsne, Plantes de l'Arabie heureuse (Archives du Muséum, t. II, Paris 1841, p. 115). Collins, Green Algæ, p. 366.

I have compared the West Indian plant with specimens I have collected at Cadiz; both forms seem to agree very well, the Cadiz plants being somewhat more loosely and openly built (f. *tenuis* of C. Agardh l. c.), most probably due to the condition of life, growing as they did in a sheltered bay among sea-grasses, whilst the West Indian form though found in deep water was growing in localities where strong currents prevail.

I have used the old name of Velley while Collins has preferred that of Decaisne because, as he writes, there is a question whether the European plant is the same as *Conferva umbilicata* Vell. from the Hawaian Islands. Should such a difference prove to be present on an examination of the original specimen of Velley then of course we have to give our plant another name. Judging from the very good figure in Velley's paper I am most inclined to consider his plant as being like ours, this most probably being an old type distributed in all warm seas.

The chromatophores are small polygonal plates and form by means of their prolonged corners a rather open network. Each chromatophore contains a large pyrenoid. Below the chromatophores several nuclei occur distributed rather regularly.

The cell division seems to take place in a similar way as in *Anadyomene*, also in this form I have never found the cell contents divided in parts or balls.

Lat. fil. crassior. = ca. 160 μ.
Lat. fil. tenuior. = ca. 60 μ.

This species occurred in rather deep water only, 20—40 meters, where it was found growing on stones or shells or epiphytic on larger algæ.

I have only found it in open sea: St. Thomas in the sea to the west of Water Island; St. Jan in the Sound between this island and St. Thomas off Cruz Bay in several places.

Geogr. Distrib. Seems to be widely distributed in the warmer seas.

Subfam. 2. ***Valonieæ.***

Valonia Ginn.

1. Valonia ventricosa J. Ag.

J. Agardh, Till Algernes Systematik, 5te Afdeln., VIII. Siphoneæ, 1886, p. 96. Vickers, Phycologia Barbadensis, p. 21, pl. XXIII A. Borgesen, in Botanisk Tidsskrift, 32. Bind, 1912, p. 241.

This species described from specimens from St. Croix collected by Ørsted was already found there in the beginning of the nineteenth century by West, who called the plant *Ulva vesicaria*. Beautiful specimens collected by him are found in Vahl's Herbarium in the Botanical Museum, Copenhagen, but so far as I know no description of the species from that time was published.

In »Hydrophytologia Danica«, Lyngbye p. 72 mentions

these specimens: »Ad insulas Færöenses non nisi parvæ evadunt, sed exemplaria vidi in herbario cel. Vahlii, ex insula St. Crucis, allata, quæ ovum columbinum magnitudine exsuperant«. Lyngbye referred this species to his *Gastridium ovale* (= *Halicystis ovalis* Aresch.) and C. Agardh in »Species«, p. 431, also refers the specimens from St. Croix mentioned by Lyngbye to *Valonia ovalis* and as belonging to this species it is also found in later authors until J. Agardh described it as above quoted.

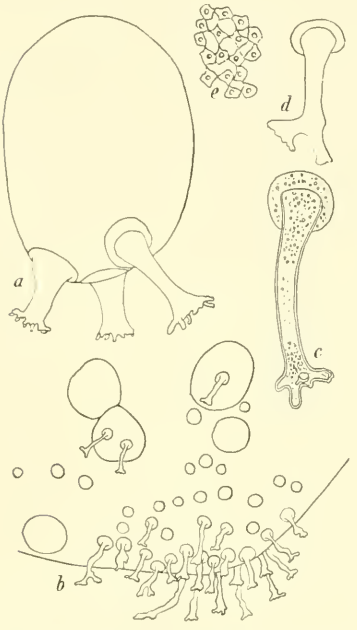

Fig. 16. *Valonia ventricosa* J. Ag. *a*, a young plant (50:1). *b*, basal end of an older plant with numerous small lentiform cells with rhizoids crowded at the base; to the left one and above four large lentiform cells, two of these again with small lentiform cells and rhizoids. *c* and *d*, rhizoids growing out from small lentiform cells (60:1). *e*, chromatophores (300:1).

The morphological and anatomical organisation of *Valonia ventricosa* has been described by Murray in »Phycological Memoirs«, p. 50 and shortly by Kuckuck in Bot. Zeitung 1907.

As already mentioned by Lyngbye the thallus of *Valonia ventricosa* can reach a size of a pigeon's egg, Murray says even that of a hen and some of the specimens I have found myself also came near in size to small hens' eggs.

It is most often egg-shaped or nearly globular, but sometimes also pyriform or more irregular. It is fastened to the substratum by means of numerous small rhizoids growing out at the basal end of the plant (Fig. 16 *b*) from the small lentiform cells occurring here in great number.

The rhizoids are unicellular and end with a small, richly ramified, often coral-like disc (Fig. 16 *c*, *d*). Both the small lentiform cells and the rhizoids are richly provided with starch.

Besides the small lentiform cells, whose diameter is about 250 μ and which are crowded together at the basal end of the plant, we find in the periphery of these crowds some larger lentiform cells. About these Kuckuck l. c. p. 180 writes: »Ausserdem werden freilich nur ganz vereinzelt zwischen den kleinen

auch einige grosse Uhrglaszellen angelegt, die zu kleinen Tochterblasen auswachsen können. Diese wenig in die Augen fallenden Zweigblasen haben hier die Aufgabe, die Hauptblase auf ihrer Unterlage zu stützen und besser festzulagen«. Also in my specimens I have found some few of these cells grown out to small daughter cells which again were provided with a single or a few small lentiform cells with rhizoids. How far these cells are able to grow out to large cells like the mother cell I cannot tell: but most probably this is the case.

The wall of the cell is very tough and elastic: its surface is evidently striated. It shows in the living plant a very nice iridescence, often preserved also in the dried specimens.

In the wall-plasma we find the plate-formed chromatophores; they are irregularly polygonal with more or less elongated corners and forming in this way a net-work (Fig. 16 *c*). A rather large pyrenoid is found in each chromatophore, as pointed out both by Murray and Kuckuck. Below the chromatophores we find the numerous, rather regularly distributed nuclei.

All the specimens I have collected and examined were in a vegetative state; the fructification most probably takes place at another season than when I have collected in the West Indies (Dec.—April). But among the rhizoids of a few specimens I have found some quite young plants with only one or a few rhizoids (Fig. 16 *a*) and these I think originate from germinated zoospores.

In some few specimens I found the cell-contents accumulated in a number of ball-shaped bodies of larger and smaller size, an appearance also common in many related forms. Murray mentions them also (l. c. p. 50—51). He considers them as »the normal reproductive organs of Valonia«. In this I cannot agree with him: these bodies are possibly a kind of aplanospores which the plant develops most probably under not quite normal conditions.

This species is very common in the seas round the Danish Islands; it occurs both in more sheltered and also on exposed coasts and in shallow as well as deep water down to a depth of more than 30 meters. It is most often attached to stones and shells etc., but may also be found growing upon other algæ.

Geogr. Distrib. West Indies.

2. **Valonia macrophysa** Kütz.

Kützing, Phycologia generalis, 1843, p. 307; Species Algarum, 1849, p. 507; Tabulæ phycol., vol. 6, tab. 87, fig. 3. J. Agardh, Till Algernes

Systematik, 5te Afdeln., 1886, VIII, p. 97. Kuckuck, Über den Bau und die Fortpflanzung von Halicystis Aresch. und Valonia Ginn. (Bot. Zeit., 1907). Borgesen, l. c., p. 243.

The specimens found agree very well with the description and figures of Kuckuck, l. c. At the base of the large vegetative cells small lens-shaped cells occur, provided more or less abundantly with rhizoids. Also large lens-shaped cells were present in rather great number.

I would not have kept this form separate from the following species, if Kuckuck had not found differences in their zoospores. This I have not been able to substantiate in my material preserved in alcohol; judging from this alone I would have been most inclined to consider them as forms or varieties of the same species only.

I have found this species growing in rather exposed localities in shallow water and in deep water at a depth of about 30 meters.

It is found, St. Croix: at White Bay; St. Jan: off Cruz Bay. Geogr. Distrib. Mediterranean.

3. **Valonia utricularis** (Roth) Ag.

Fig. 17.
Valonia utricularis (Roth) Ag. forma *crustacea* Kuck. Habit of plant (about 6 : 1).

C. Agardh, Species Algarum, vol. I, 1821, p. 431. J. Agardh, Till Algernes Systematik, 5te Afdeln., VIII, 1886, p. 98. P. Kuckuck, Über den Bau und die Fortpflanzung von Halicystis Aresch. und Valonia Ginn. (Bot. Zeit. 1907). Borgesen, l. c., p. 244.

Conferva utricularis Roth, Cat. I, p. 160, tab. 1, fig. 1; Cat. II, p. 187.

forma *typica* Kuck. l. c.
forma *crustacea* Kuck. l. c.

The forms I have referred to this species seem to agree very well with those described by Kuckuck, l. c. In the specimens which occur on exposed places, the small lens-shaped cells were present in great number. They occurred not only in the basal part of those cells by which the plant is fastened to the substratum, but also in other parts of the cells, especially in the furrow where the

cells meet each other. Here we often find a dense row of these small cells on both sides of the wall and as these small lenticular cells often bear short rhizoids which attach themselves to the neighbour cell they contribute to the firmness of the cell-complex, making it more resistant to the beating of the waves.

Fig. 17 shows a plant of the form I have referred to var. *crustacea* and Fig. 18 a little part of it more magnified. The arrangement of the lens-cells and the manner in which the rhizoids, growing out from the small cells, attach themselves to the neighbouring cells reminds one in a striking way of *Dictyosphæria favulosa*, a plant I also consider nearly related to *Valonia*, as will be mentioned later on.

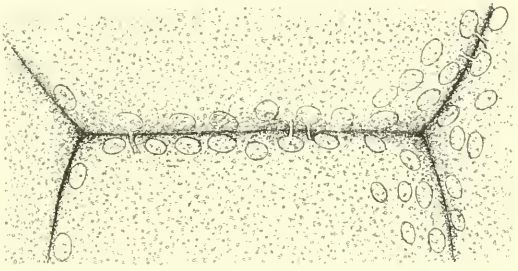

Fig. 18. *Valonia utricularis* (Roth) Ag., f. *crustacea* Kuck.
A little part of the plant pictured in fig. 17. It shows the arrangement of the small lentiform cells along the walls of the cells. (70 : 1).

In the specimens found in more sheltered places or in deep sea the cells are larger, often cylindric and more loosely connected. They are very like the figures 11 and 12 of Kuckuck. The small lens-cells are here more seldom.

As mentioned above, f. *crustacea* is found in exposed localities growing on rock and coral reefs at about the surface of the sea where it is constantly at the mercy of the waves; in such localities it can be found as rather large crusts covering the rocks. On the other hand, f. *typica* when growing in shallow water is found in more sheltered localities or in deep sea down to a depth of about 30 meters or more.

The species is common at the shores of the islands.

Geogr. Distrib. Mediterranean, Spain, Madeira, Bermuda, Bahama.

4. Valonia Ægagropila C. Ag.

C. Agardh, Species Algarum, p. 429. J. Agardh, Till Algernes Systematik, 5te Afdeln., VIII. Siphoneæ, p. 99. Kützing, Spec. Algarum, p. 507; Tab. Phycol. vol. 6, tab. 86, fig. 1. P. Kuckuck, Über den Bau und die Fortpflanzung von Halicystis Aresch. und Valonia Ginn. (Bot. Zeit. 1907).

Valonia utricularis forma *Ægagropila* Hauck, Meeresalgen, p. 469.

The West Indian plant seems to agree very well with the forms from the Mediterranean as described by KUCKUCK. I have only found small lentiform cells and they were very seldom: those I have seen had a short and broad rhizome, very like the clamps described later in *Struvea*. The West Indian form agrees for the rest very well with the specimens pictured by KUCKUCK, l. c., fig. 18.

As already pointed out in mentioning *Valonia macrophysa*, it is only from the observations of KUCKUCK that I consider this plant as a special species and not as a form of *Valonia utricularis* as HAUCK has done.

This species occurs in shallow water in a locality sheltered by coral reef on the south coast of St. Croix; it was found here abundantly lying loose on the sandy bottom between sea-grasses. The balls reached here a size up to a small clenched fist. Furthermore, some few clumps were found in deep water, about 40 meters.

St. Croix: At the shore of Great Pond on the south coast; St. Thomas: In the sea west of Water Island.

Geogr. Distrib. Mediterranean, Indian an Pacific Oceans, West Indies.

Dictyosphæria Decsne.

As already mentioned in my earlier paper Mme WEBER-VAN BOSSE has pointed out in her interesting note[1]) that what has hitherto been referred to *D. favulosa* comprises 3 species, namely besides *D. favulosa* the two new species *D. intermedia* Web.-van Bosse and *D. Versluysi* Web.-van Bosse. According to the description of Mme WEBER-VAN BOSSE *D. favulosa* has always a hollow thallus and lacks the peculiar needles in the interior of the cells, *D. Versluysi* is distinguished by having these and a massive thallus, and finally *D. intermedia* is characterized by having a massive thallus in the young stage and no needles. In the Danish West Indies I have now found the same or corresponding forms.

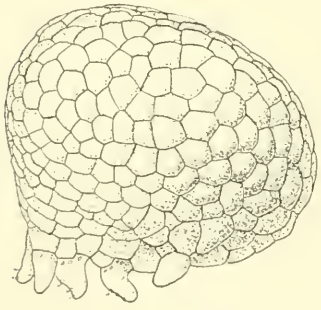

Fig. 19. *Dictyosphæria favulosa* (Ag.) Decaisne.
The thallus is hollow and consists of a single layer of cells. (About 6:1).

[1]) WEBER-VAN BOSSE, A., Note sur le genre *Dictyosphaeria* Dec. »Nuova Notarisia«, Serie XVI, 1905.

Referring to my earlier paper (Bot. Tidsskr. vol. 32, 1912, p. 247) for the different interpretations in the botanical literature with regard to the development and systematic position of the genus I confine myself here to giving a description of the species found and their development.

1. **Dictyosphæria favulosa** (Ag.) Decsne.

J. Decaisne, Classification des Algues, p. 32 (Ann. sc. nat., 2. Sér., t. 16, 1842). Harvey, Ner. Bor.-Am., III, p. 50, tab. XLIV B ex parte. J. Agardh, Till Algernes Systematik, VIII, p. 118, ex parte. Borgesen, F., in Bot. Tidsskr., 32. Bd., 1912, p. 250.

Valonia favulosa Ag., Species Algarum, I, p. 432.

Of this species I have collected an abundant material and it is especially upon this that I have based my investigation of the genus.

As already pointed out by Harvey the young specimens are globose (Fig. 19), later on irregularly torn, forming expanded cartilaginous membranes.

In its first beginning the thallus consists of a single cell (Fig. 20 *d*); this can have a very variable shape, often very irregular, being sometimes somewhat cylindric, sometimes oviform. The basal part of the cell has a longer or shorter root-like prolongation (Fig. 20 *c*, *e*), upon the lowermost end and sides of which we find a great number of small unicellular rhizoids which grow out, one from each of the numerous small cells occurring here very similar to those found in *Valonia*. Also higher up on the cell we often find many of these small cells arranged as a rule in rows (Fig. 20 *d*), some of them also more scattered. How far the origin of these young plants are due to zoospores is difficult to say, most probably they are not; in the abundant material of this species I have examined not a trace of zoospore-formation has been found[1]) and this has never been found by other investigators. Much seems to suggest that these young individuals are due to cells loosened from the thallus of other specimens. This seems also to be indicated by the fact, that the wall of the cells is often densely covered by Melobesieæ and other epiphytes. Perhaps some of them also can have their origin from aplanospores, about which more later on.

As mentioned above the young plants are unicellular but a few were found consisting of a few cells (see Fig. 20 *e*). Most probably the 3 cells in this figure have been torn from an old plant at once.

[1]) compare the note, p. 37.

In the upper end of the young plant a cell-division now takes place, resulting in a number of cells arranged more or less regularly (Fig. 20 *c*). In this stage of development our plant has some likeness with a small *Valonia* but when SCHMITZ also compares it to a *Cladophora* I may point out, that I have never found any specimen resembling that genus. How the cell-division takes place in the quite young plant (see Fig. 20 *c*) I have not seen, but

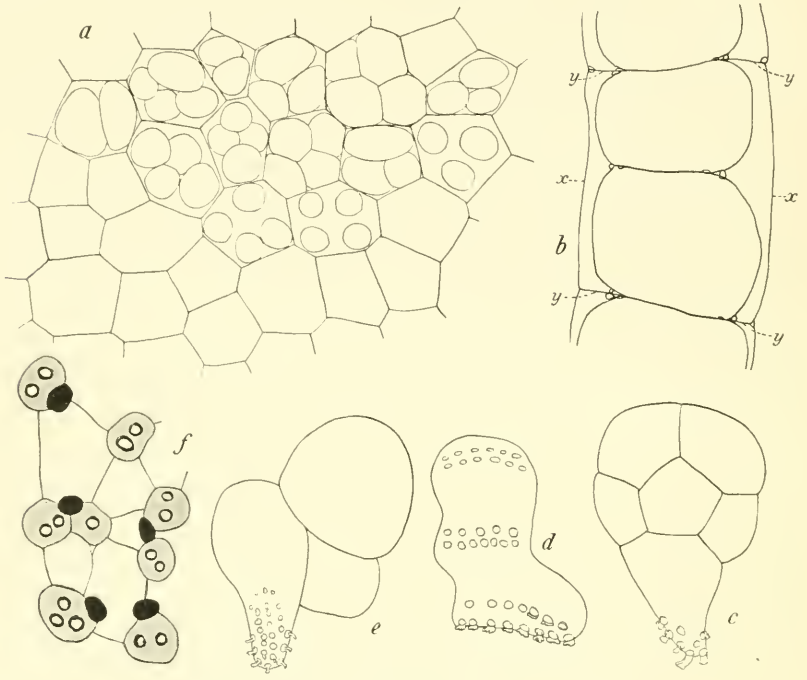

Fig. 20. *Dictyosphæria favulosa* (Ag.) Decsne.
a, part of a thallus with cells in different stages of cell-division (6:1), *b*, transverse section of thallus with cell newly divided (compare text) (20:1), *c*, *d*, *e*, young plants (10:1), *f*, chromatophores with pyrenoids and nuclei (250:1).

I have no hesitation in assuming that it is accomplished quite in the same way as I have found it in older specimens, namely by segregative cell-division.

This is performed in the following way. In some of the cells we find that the whole cell contents with chromatophores, nuclei etc. have been aggregated into a number of spherical clumps from two to six or even more, but most commonly three to four (Figs. 20 *a* and 21 *a*). At first these spherical bodies fill up far from the whole lumen of the mother cell but after becoming surrounded with a membrane they begin to increase (Fig. 21 *b*),

growing closer together and at the same time becoming arranged in the same plane as the other cells in the plant, which as already described by HARVEY consists of a single layer of cells only. When the cells are grown quite together (Fig. 21 *c*) filling up the whole lumen of the mother cell they assume its form, growing poly-

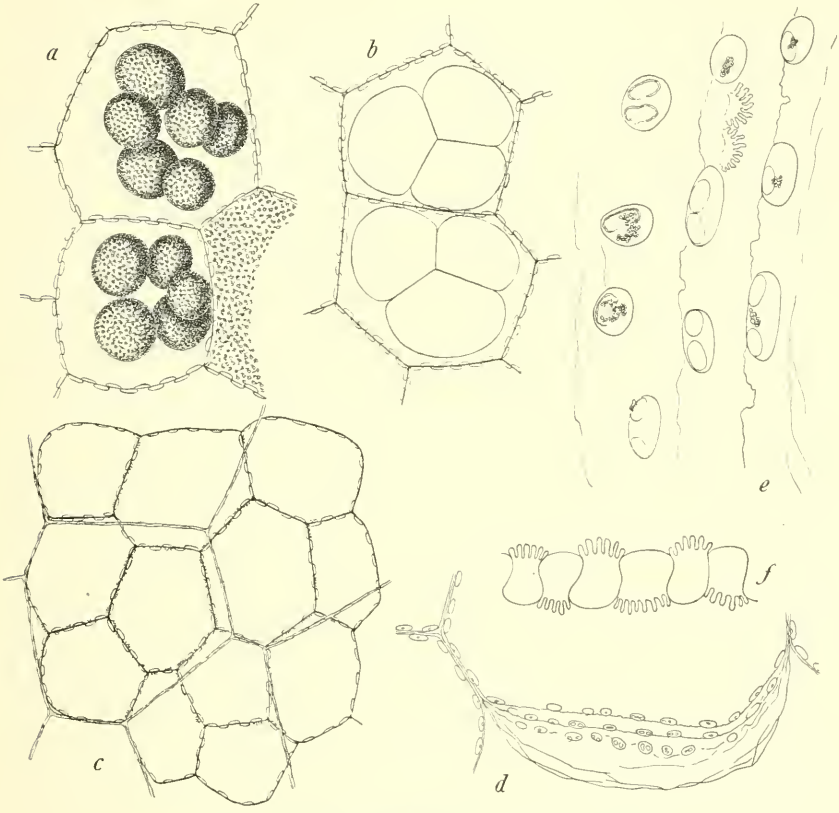

Fig. 21. *Dictyosphæria favulosa* (Ag.) Decsne.
a, *b*, *c*, different stages of cell-division, in *a* the cell contents have been contracted to balls, in *b* the young cells fill up nearly the lumen of the mother-cell, in *c* the young cells are quite developed, the walls of the mother cells are seen over the young cells (10:1). *d*, wall of a cell torn loose from the neighbour-cell showing arrangement of haptera (25:1). *e*, small part of *d* more magnified; in the small cells chromatophores are seen; the oval rings upon them are the bases of the hapteræ, in one place the ends of the hapters broken of from the neighbour-cell are seen (100:1). *f*, hapters between two cells seen from above showing their alternating arrangement (150:1).

gonal, and along their uppermost and lowermost edges appear the small hapters which very regularly and alternately (Fig. 21 *f*) fasten the neighbouring cells together.

Fig. 20 *b* shows a transverse section of a part of a thallus in which the cells have just been divided in this way. We see that the wall of the mother-cell (marked *x* in the figure) covers over the young cells and, further, we find that at each two—three or four cells the cross walls of the mother cells (marked *y* in the figure) run in between the daughter cells. On the exposed outer-side or on the upperside of the flat old thallus the wall of the old cells seems soon to be torn off; on the other hand, in the thallus still in the form of hollow sacs we often find several layers of old membrane covering the sheltered innerside.

The cell-division does not take place simultaneously in all cells of the thallus; we often find, on the contrary, that it is only a group of cells here and there which is divided, sometimes also a single cell only has been divided. Fig. 20 *a* shows a part of an old thallus with divided and not divided cells.

I have mentioned above that the young unicellular specimens might perhaps have their origin from aplanospores. I think it very likely namely, that the above-mentioned balls, formed by the cell division, may occasionally become free and be able to grow to new plants.

In the quite young small plants the thallus is massive (Fig. 20 *c*) but by cell-division the cell layer in the periphery will grow larger and larger, first making the thallus sack-shaped (Fig. 19) and at last it will be torn (Fig. 22) and disc-shaped. These old disc-shaped specimens can be very large; I have collected specimens with a diameter of about 12 cm.

As to the hapteræ found along the edges of the cells, these all grow out from quite small cells which are very similar to the small lentiform cells found in *Valonia*[1]). These small cells are arranged in series (most often 3) along the edges of the large ones (Fig. 21 *d*) and very regularly, alternately opposite each other in such a way that the hapteræ growing out from the small cells attach themselves to the wall of the neighbour cell just in the intervals between the small cells on it (Fig. 21 *e*, *f*). In this way the large cells are very firmly fixed together. The small cells are, when seen from above, oval oblong, sometimes also quite circular. One to two hapteræ grow out from them (Fig. 21 *d*. *e*).

The small cells also occur abundantly upon the sack-like

[1]) It has been of interest to me to see what Heydrich writes about this matter; p. 468 (l. c.) he says: »Jede Fibula bildet an der Stelle, wo sie der Wand der sie erzeugenden Zelle ansitzt, eine uhrglasförmige Vertiefung«.

outgrowth from cells at the base of the plant (Figs. 19, 20 *c*, *d*, *e*). Where their walls come near to the substratum the small cells are present in great number and from them rhizoids grow out and attach the plant. Here the arrangement of the small cells is more irregular.

With regard to the wall-plasma, we find, as also pointed out by Askenasy[1]) and Miss Crosby[2]), the numerous rather large roundish-polygonal chromatophores of the wall plasma becoming connected with thin prolongations forming in this way a more or less open net-work (Fig. 20 *f*). In the chromatophore one—three large pyrenoids are present. Near to the one side of the chromatophores the numerous oblong, rather large nuclei are met with.

In the small cells also some few chromatophores with pyrenoids occur (Fig. 21 *e*), furthermore also a single nucleus or in the larger oblong cells even two. That chromatophores occur in the small cells is also mentioned by Heydrich l. c. p. 468. The outer wall shows cross-wise striations.

With regard to a comparison of the development of the thallus as I have found it with that found by earlier authors[3]) I refer

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[1]) Askenasy in Forschungsreise S. M. S. »Gazelle«, IV. Theil, Botanik. 1888, p. 8.

[2]) Crosby in »Minnesota Bot. Studies«, 3. Series, Part 1, 1903, p. 61.

[3]) After the publication of my paper Professor W. Arnoldi in »Flora«, vol. 105, Heft 2, 1913, p. 144 has given a description of the development of the thallus of this genus and his examination confirms in all essentials the results of mine.

Arnoldi who only mentions mine in a note at the end of his paper, not referring to my description of the cell-division in *Dictyosphæria* nor to the very similar I earlier had found in *Siphonocladus tropicus*, describes the cell division in this way: »Während der Theilung schrumpft nun der Protoplast durch Plasmolysierung auf die Hälfte oder noch mehr seiner ursprünglichen Grösse zurück und teilt sich in radiärer Richtung in zwei, vier, seltener mehr Teile«. Having not been able to study the division of the protoplast upon living material I cannot with certainty say how it is carried out, but I have found the 3—6 or seldom more balls lying without order in the mother-cell, in every case when more than four are present (compare my Fig. 21 *a*); first later on during their growth they are arranged in the same plane as all the other cells in the plant. As to the propagation Prof. Arnoldi writes p. 157: »Unter dem grossen Material von *D. faculosa* und *D. Versluysi*, das mir zur Verfügung stand, gelang es mir, einige Zellen zu finden, welche entweder sich zur Fortpflanzung vorbereiteten oder schon bewegliche Elemente ausbildeten«. As I have pointed out, I have not succeeded in finding any trace of

to my paper quoted and shall only point out here that I consider *Dictyosphæria faculosa* as very nearly related to *Valonia*; the form of *Valonia utricularis* (Roth) Ag. I have figured (Fig. 18) shows a striking likeness, also having along the edges of the cells a row of small lentiform cells from which rhizoids grow out and fix themselves to the neighbouring cells. I therefore quite agree with MURRAY, who considers our plant as »one of the simplest forms of valonioid organism«, when he gives the following description of it: »In *Dictyosphæria faculosa* we have simply an aggregate of similar cells not forming a definite frond, but cohering in

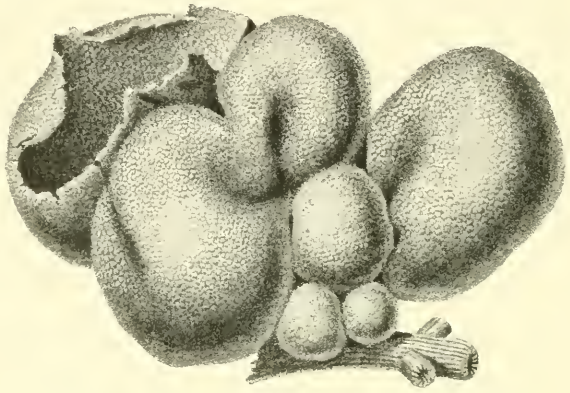

Fig. 22. *Dictyosphæria faculosa* (Ag.) Decsne.
Habit of plant. (About 1 : 1).

an unbranched mass, this colony of units being held together solely by tenacula«.

Dictyosphæria faculosa occurs in shallow water and often on rather exposed coasts, growing on coral reefs where it is constantly under the influence of the waves. Here the specimens are not so very large, seldom more than 4—5 cms in diameter and are most often sack-shaped (Fig. 22). But, furthermore, it is found abundantly in deep water down to a depth of about 40 meters. Here in the quieter surroundings and in the moderate

zoospore-formation in my abundant material of *Dictyosphæria faculosa* but in *Dictyosphæria van Bosseæ* it was found several times and this form is very nearly related to *Dictyosphæria Verstuysii*.

Having had well fixed material at his disposal ARNOLDI has been able to give more detailed descriptions of the cell-wall and cell-contents and he has also succeeded in observing the zoospores, which are pyriform and about 8—10 μ long.

light it often forms large flat expansions, some of the specimens reaching in diameter 12 cm.

It is a very common species at the shores of the Islands.

Geogr. Distrib. West Indies, Indian and Pacific Oceans.

2. **Dictyosphæria van Bosseæ** Borgs.

Borgesen, F., Some Chlorophyceæ from the Danish West Indies, II (Botanisk Tidsskrift, vol 32, 1912, p. 256).

Judging from the rather short diagnosis in M^me^ Weber-van Bosse's note I had at first referred my form to *D. Versluysi*, but after having seen an original specimen of this species which M^me^ Weber has been so very kind as to lend me, I think it is more convenient to consider my plant as a different species even if it shows a great likeness with M^me^ Weber's species. Quite in agreement with *D. Versluysi* our form is characterized by having a massive thallus and by the presence of the needle-formed processes upon the inner walls of the cells. But my form differs from that from the Malayan Archipelago by its much smaller cells, on an average reaching only about half the size of those in *D. Versluysi*; and while the needles in M^me^ Weber's specimens are about 150 μ long those in my form reach only a length of about 70 μ, very seldom up to 100 μ. Furthermore, the spines had a rather uneven surface in my specimen whereas they were quite even in *D. Versluysi*. And judging from the specimen I have seen of this species the spines seem to be present here in all the cells while in my West Indian form cells often occur where they are quite wanting. When to these characters we add the different geographical distribution, I think it justifiable to consider our plant as a new species, for which I have taken the liberty of proposing the above name in honour of M^me^ Weber-van Bosse[1]).

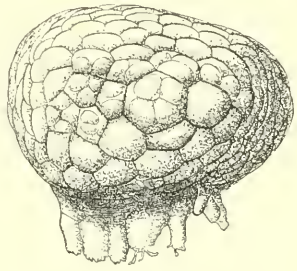

Fig. 23.
Dictyosphæria van Bosseæ Borgs.
Habit of young plant.
(About 6 : 1).

The cells are about half the size of those in *D. faculosa*, being on an average about 500 μ in diameter, but varying, many cells

[1]) The *Ulva cellulosa* Mert. msct. named with a? as a synonym to *Valonia faculosa* by C. Agardh is this species, judging from a specimen found in the Herbarium of the Botanical Museum, Copenhagen.

being much smaller, others reaching up to 700—800 μ in diameter. Between the cells intercellular openings often occur in which the hapteræ grow rather long.

Since I wrote my paper above quoted I have found much more material of this species in my collections and have by means of it been able to see that the cell-division takes place by segregative cell-division and quite in the same manner as in *D. favulosa* only with a few differences. Also in this species the whole protoplasts with the numerous nuclei and chromatophores are divided into a number of balls most often 3—5, but while in *D. favulosa* these during their growth are arranged in the same plane as all the other cells in the thallus, here in *D. van Bosseæ* they are arranged also above each other in two or sometimes 3 layers according to the size of the cells and by this way of division the polystromatic thallus is developed. Another difference is also present; while namely in *D. favulosa* the cell division most often takes place in a group of cells in *D. van Bosseæ* it is found here and there often in a single cell or in some few together (compare Figs. 23 and 24 *a*). My supposition that in this species also *Valonia*-like cell-division should take place, I have not confirmed, having now examined more material.

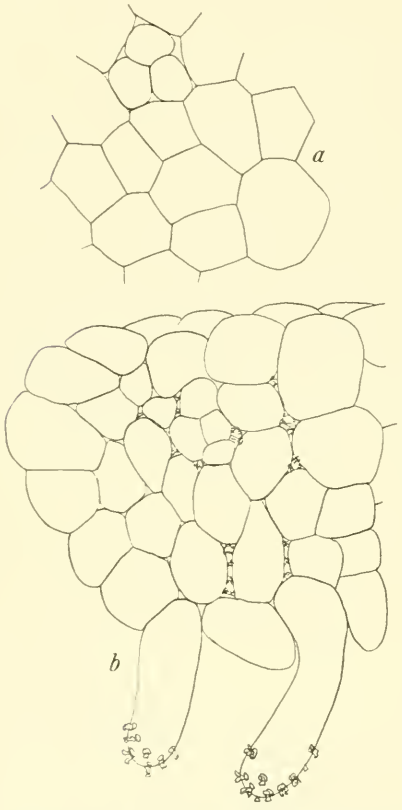

Fig. 24. *Dictyosphæria van Bosseæ* Borgs. *a*, part of the thallus seen from above, the cell above has been divided in three cells. *b*, transverse section of a young plant showing the massive thallus. In the intervalls between the cells the haptera are seen (10:1).

Whilst, as mentioned above, I have not succeeded in finding any trace of zoospore-formation in *D. favulosa*, I have been so fortunate as to find a specimen of *D. van Bosseæ*, whose cells were about to form zoospores (Fig. 25).

Whilst in the normal vegetative cells the chromatophores with pyrenoids and nuclei form a net-work in the wall-plasma, in those in question the cell contents were aggregated into irregularly formed bodies consisting of a larger broad plate with or without opening in the middle of the cell, from which narrower prolongations ran down along the sides of the cells, giving them a very characteristic appearance; in the walls of some of these cells 2—4 holes were found, through which the zoospores could escape (Fig. 25).

Also in specimens from the Malayan Archipelago Prof. Arnoldi has found zoospore-formation (comp. the note p. 37).

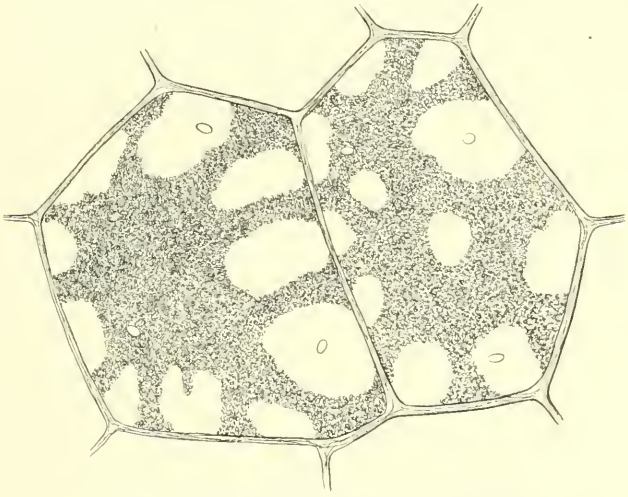

Fig. 25. *Dictyosphæria van Bosseæ* Borgs.
Cells in zoospore-formation (ca. 20:1).

The cell contents in the vegetative cells have a very great likeness to what is found in the above-mentioned species. With regard to the hapteræ along the edges of the cells I may refer to Miss Crosby's description and figures with which they show a great likeness, though on the other hand they are not so regularly arranged and also differ somewhat in shape from those in *D. favulosa*.

This species is found in rather exposed localities in shallow water growing on rocks where it is constantly dashed by the waves.

St. Croix: Cane Bay, Sandy Point.

The small specimen I had referred to *Dictyosphæria intermedia* Weber-van Bosse with much doubt and which was found growing together with *Dictyosphæria van Bosseæ* I prefer here to leave undetermined as it most probably belongs to *D. van Bosseæ*.

Subfam. 3. ***Boodleæ.***

Cladophoropsis Borgs.

In my paper »Contribution à la connaissance du genre *Siphonocladus* Schmitz« I have pointed out that the forms Schmitz has referred to this genus are so different that they cannot be kept together in the same genus. The one form of Schmitz' *Siphonocladus Psyttaliensis*, I referred to my new genus *Cladopho-*

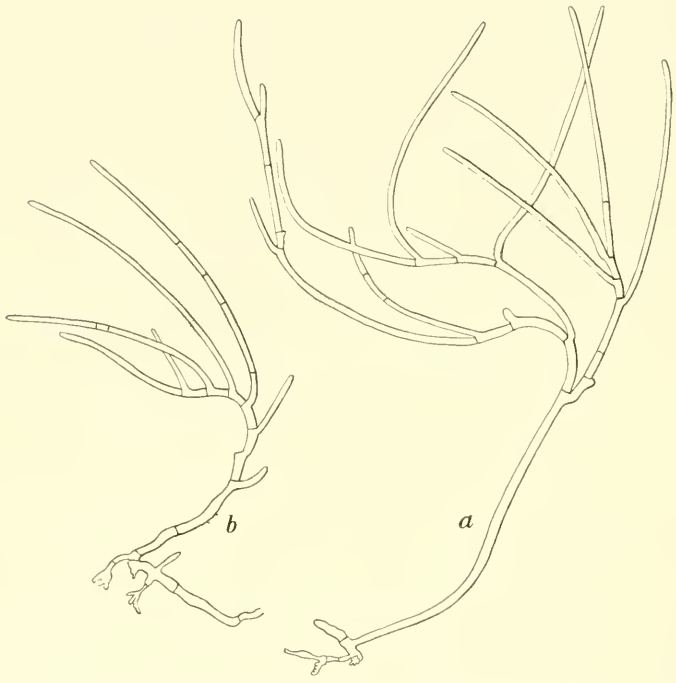

Fig. 26. *Cladophoropsis membranacea* (Ag.) Borgs.
Two specimens prepared out from a cushion. (About 5:1).

ropsis. I was at that time, (for more detail see my paper), most inclined to place *Cladophoropsis* in the family of the *Cladophoraceæ*. Having since then not only examined much more material of *Cladophoropsis membranacea* but also become acquainted with so many other forms of the *Valoniaceæ* I have arrived at the conclusion, that I was wrong at that time in referring *Cladophoropsis* to the *Cladophoraceæ*; it has its natural place among the *Valoniaceæ*, being most nearly related to the genus *Boodlea*.

To confirm this my altered view, I shall here give a short

description of *Cladophoropsis membranacea* mostly based upon that in my earlier paper but with some few additions.

The plant grows in the form of cushions upon rocks or epiphytic upon other algæ, or it is found as *Ægagropila*-like clumps lying

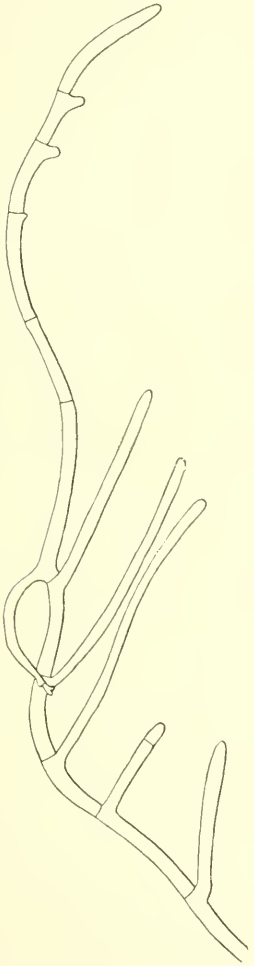

Fig. 27. *Cladophoropsis membranacea* (Ag.) Borgs. Part of a filament. About in the middle a rhizoid. (About 8:1).

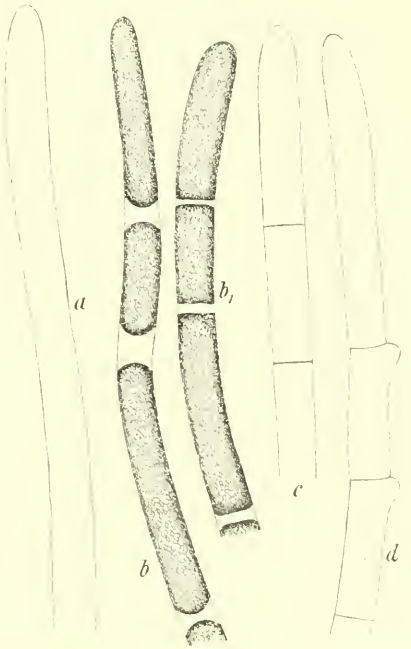

Fig. 28. *Cladophoropsis membranacea* (Ag.) Borgs. Summit of filaments in different stages of segregative cell-division. Compare text (About 15:1).

loose upon the bottom. It consists of much ramified filaments twisted together (Fig. 26). The filaments increase by apical growth.

The ramification is very irregular. Sometimes a branch divides itself into several cells from which side branches, mostly unilaterally arranged, grow out and these branches (comp. Fig. 27) are all nearly at the same point of development, though often the uppermost branches are the most developed: sometimes a filament for a long distance is not at all branched (Figs. 26 and 27); often also new filaments grow out from older parts of the thallus.

But a common feature is, that no walls are present at the base of the branches, these being always in open connection with the mother cells.

Regarding the cell-division, so far I have been able to see in my material fixed in spirit only, this takes place by segregative cell-division in a very similar way as I have found it in e. g. *Struvea*, *Chamædoris* etc., namely the plasma in a part of the filament is at once divided into two or more parts which again grow together, being then separated by a wall (Fig. 28).

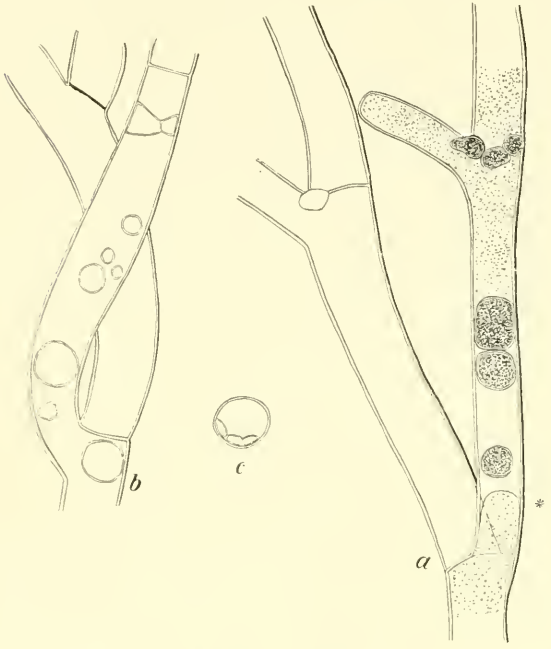

Fig. 29. *Cladophoropsis membranacea* (Ag.) Borgs. *a* and *b*, parts of filaments in which the cell contents are more or less contracted to balls. *c*, transverse section of a filament with 3 small cells. (About 30:1).

For a long time I had a suspiction that the formation of the wall was performed in this way but in spite of much search I had not been so fortunate as to find it, until in a not yet examined collection from St. Croix I was so happy as to find several filaments in division. Of course, in order to arrive at any quite safe result as to the cell-division it would be of great help to examine living material but still I think the process is carried out in the following way. The filaments grow out to a certain length (Fig. 28 *a*, compare also Figs. 26 and 27) and then the cell contents are simultaneously divided in several parts. Fig. 28 shows the development as it takes place. In Fig. 28 *a* we have a long, not yet divided apical cell. In Figs. 28 *b* and *b*', the cell-contents are divided in some longer and shorter parts and these parts are surrounded by a membrane. Finally in Fig. 28 *c* the cell-division is fulfilled, the separate parts are grown together but now separated

by walls and in Fig. 28 *d* the newly divided cells begin to grow out at their uppermost end.

As I have pointed out in my earlier paper the cell contents have also a marked disposition to be divided into balls (Fig. 29): this formation of balls seems mostly to take place when the filaments are hurt in some way. These balls can grow out to new filaments; most often I think they serve as a kind of aplanospores.

Now and then upon the inner-wall of the filaments some small lentiform cells occur reminding one somewhat of those found in *Valonia* (Fig. 29); also from these cells branches can grow out.

At their base the filaments are fastened to the substratum by means of shorter or longer, more or less ramified rhizoids (Fig. 30 *a*) and *Cladophoropsis membranacea* has furthermore some attachment organs very like the tenacula found e. g. in *Struvea*, *Boodlea* etc. These tenacula-like rhizoids (Fig. 30 *b*, *c*) are found not only at the base of the filaments but often also higher up growing out anywhere in the filaments, often in the middle of the cell at a long distance from any cross wall. They have sometimes a wall at their base most often not. But never, or in any case very seldom[1]), do they grow out from

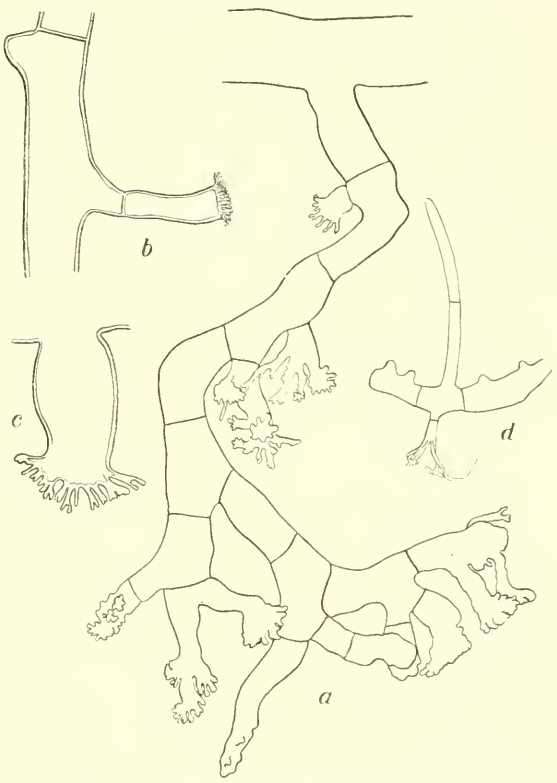

Fig. 30. *Cladophoropsis membranacea* (Ag.) Borgs. *a*, rhizoids near the base of a filament; *b* and *c*, tenacula: *d*, small piece of a filament with a young shoot and a rhizoid (*a*, 20:1; *b* and *c*, 30:1; *d*, 15:1).

[1]) Only in one of the many gatherings I have examined of *Clad. membranacea*, namely, one from St. Thomas growing on rocks in exposed

the apex of the cells as is normally the case in *Boodlea* and *Struvea*.

Annular constrictions at the base of the cells do not occur.

The parietal, numerous, small chromatophores are plate-formed, roundish or somewhat polygonal (Fig. 32 *c*) and in the young part of the filaments connected together with very fine prolongations, forming in this way a dense network. In the older cells these prolongations disappear and the chromatophores occur separated or often together in small clumps. Each chromatophore contains generally a pyrenoid.

Fig. 31. *Cladophoropsis membranacea* (Ag.) Borgs. Part of a filament growing out to an independent plant with young branches at the summit and rhizoids at the base. (About 10:1).

The numerous small nuclei are arranged regularly in the wall plasma as already pointed out by Schmitz (Fig. 32 *a*).

Finally, I may point out that the cell wall is thin and seems not to be stratified.

Hitherto we have only considered *Cl. membranacea*. As to the other species referred to *Cladophoropsis* we find in the literature for the most part only such short and fragmentary descriptions, referring only to their outer appearance, that they are of little value for the question of the systematic position of the genus[1]).

An exception is *Cladophoropsis brachyartra* described in detail by Svedelius[2]). From *Cladophoropsis membranacea* it especially differs by its short cells and rigid filaments, by its distinctly stratified walls and by having the nuclei also in the interior of the cells; but on the other hand it agrees otherwise quite with *Cl. membranacea* with regard to the whole structure of the cell and the way of growing. How the formation of the wall takes place Svedelius does not mention[3]).

places, I have a few times found the apex of a filament first growing narrow like a rhizoid and this ended with a small attachment disc and Svedelius also mentions that in *Cladoph. brachyartra* the apex of the filaments sometimes changes its character, being rhizoid-like.

[1]) Most of these species are mentioned in my paper quoted.

[2]) Svedelius, N., Algen aus den Ländern der Magellansstrasse und Westpatagonien. (Svenska Exp. till Magellansländerna, Bd. III, 1900, p. 304).

[3]) In this connection I also want to point out, that the *Siphonocladus*

Taking now all the particulars mentioned above as characteristic of *Clad. membranacea*, referring also to the other species belonging so far as we know to the genus it is clear, that *Cladophoropsis* shows great differences from the *Cladophoraceæ* while it can be placed on the other hand in a natural way in the family of the *Valoniaceæ*, being very nearly related to the genus *Boodlea*. From *Cladophoropsis Boodlea* nevertheless is easily recognizable by the presence of cross walls at the base of the branches, in any case in the older part of the thallus, and of apical tenacula in the end of the branches.

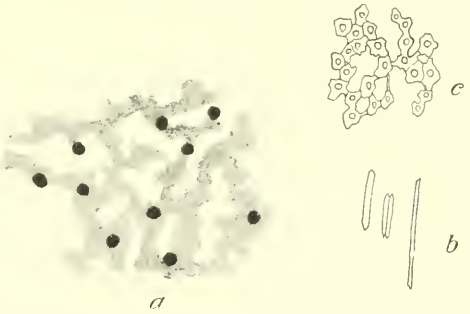

Fig. 32. *Cladophoropsis membranacea* (Ag.) Borgs. *a*, chromatophores and nuclei, *b*, cristals, *c*, chromatophores with pyrenoids. (*a* and *c*, 250:1; *b*, 100:1).

1. **Cladophoropsis membranacea** (Ag.) Borgs.

Borgesen, F., l. c., 1905, p. 275. Vickers, Phycologia Barbadensis, p. 20, pl. XVII.

Siphonocladus membranaceus (Ag.) Bornet in Journal de Botanique, vol. 1, 1887, p. 56.

Conferva membranacea Ag., Systema, p. 120.

Cladoph. membranacea is a common species at the shores of the islands, where it occurs both in sheltered and in more exposed places. In the last mentioned localities it is found growing on rocks covering them as a low very dense cushion constantly dashed by the waves. Furthermore, it occurs epiphytic upon other algæ especially *Gelidium rigidum* and finally it is found as *Ægagropila*-like clumps lying loose upon the bottom and cast ashore often in great quantities.

As I have mentioned above and also in my earlier paper, the cushions or clumps consist of numerous filaments woven

rigidus of Howe (Phycological studies, I, in Bull. Torr. Bot. Club, vol. 32, 1905, p. 244) published at nearly the same time as my paper on *Siphonocladus*, cannot after my opinion in a natural way be grouped in the genus *Siphonocladus* as confined by me. On the other hand, it seems to me that it can without difficulty be considered as a *Cladophoropsis*, being especially related to *Cl. brachyartra*, as is also pointed out by Dr. Howe (l. c.).

together and sometimes also fixed together by means of rhizoids or tenacula. The ramification of the filaments is very irregular, branches growing out on all sides, sometimes, especially at the apex of the filaments, several branches grow out secundly. The cells have a very different length and short and long cells are mixed together, quite as some of the cells bear branches, others none. The branches grow out from the upper end of the mother-cell and only one from each cell.

The diameter of the filaments varies round about 200 μ, from 150—280 μ.

In one of the collections I have succeeded in finding zoosporangia (Fig. 33). They agree very well with those I have found in *Boodlea* (comp. p. 50). In the wall of the cells, which are transformed to zoosporangia, a single or a few conical outgrowths are formed. In the apices of these outgrowths a hole is formed through which the zoospores can escape. The whole cell-contents with nuclei etc. are transformed to numerous small balls richly provided with starch, being very similar to the ripe zoospores of *Valonia macrophysa* as figured by Kuckuck in Bot. Zeit., 1907, pl. IV, fig. 5.; more advanced stages of the development I have not been able to find.

Fig. 33. *Cladophoropsis membranacea* (Ag.) Borgs. Zoosporangia, *a*, in summit; *b*, in the middle of a filament.

It is often the upper end of the filaments or short side-branches which are transformed to sporangia, but such are also found in the middle of the filaments with vegetative cells still at both sides.

As mentioned above, *Clad. membranacea* is a very common species at the shores of the islands, occurring in shallow water both in sheltered and in more exposed places. Once I have taken it in a depth of about 10 meters off Frederikssted, St. Croix.

Geogr. Distrib. Florida, West Indies.

Boodlea Murr. et De Toni.

1. **Boodlea Siamensis** Reinb.

Reinbold, Th., in Schmidt, Flora of Koh Chang, part V (Bot. Tidsskr., vol. 24, 1901, p. 107).

For comparison with my West Indian plant I have had authentic material preserved in alcohol and collected by Dr Johs. Schmidt in Siam. By means of it I have been able to persuade myself as to their identity.

In agreement with the Siamese plant the West Indian form is found as rather soft and loose, sponge-like clumps consisting of the filaments twisted together. And quite as is the case in the Siamese plant, as pointed out by Reinbold, the primary filaments in the West Indian form are also less ramified and have long cells up to 20 diam. Higher up the ramification is richer, as each cell here from its uppermost end produces 1—2, sometimes even more branches. The ramification is very irregular and the branches grow out in all directions: sometimes opposite branches occur and where this

Fig. 34. *Boodlea Siamensis* Reinb.
a, part of thallus showing ramification, at its base with rhizoids; *b* and *c*, parts of the thallus with opposite branches getting herewith a *Struvea*-like appearance. *d* and *e*, summits of branches with tenacula. *f*, zoosporangia (*f* from a specimen from Siam). (*a*, about 15 : 1; *b*, *c*, *d*, *f*, 25 : 1; *e*, 35 : 1).

is carried through more regularly the shoots get a *Struvea*-like appearance (Fig. 34 *b* and *c*), sometimes also and especially in the uppermost part of the branches each cell only bears a single branch and these are arranged secundly upon the lowermost side of the upward curved mother branches (Fig. 34, *a*). But as a rule the ramification is very irregular and new adventitious branches contribute to it.

Fig. 35. *Boodlea Siamensis* Reinb. Summit of filament in cell division. (About 25 : 1).

The cell-division (Fig. 35) is, so far I have been able to see, carried out by segregative cell-division and quite in the same way as I have found it in *Cladophoropsis*. The uppermost end of the filaments grows rather long and the protoplasm together with the chromatophores, nuclei etc. is then at once divided in 2—4 parts in proportion to the length of the filaments; these parts grow again closely together, being now separated by a wall.

The thick primitive filaments reach a diameter of about 160—200 μ seldom even 300 μ, the ramuli about 70—100 μ.

At their base the quite young branches lack cross walls but in older parts of the thallus it is only exceptionally that these are not found.

The entangled filaments are further fixed together by means of the rather numerous tenacula, found at the apices of the branches (Fig. 34 *d*, *e*). They have a cross wall at their base and a richly ramified attachment disc, by means of which they are strongly fixed to the neighbouring filaments.

Fig. 36. *Boodlea Siamensis* Reinb. Part of a filament showing chromatophores and nuclei. (175 : 1).

The small chromatophores are parietal and connected by thin threads to a network (Fig. 36); in each chromatophore a pyrenoid is present. The numerous nuclei are arranged regularly in the wall plasma.

I have not succeeded in finding fertile cells in my collections but in the Siamese specimens such occurred; the whole cell is transformed into a sporangium and the zoospores escape through a rather large hole on the one side of the sporangium (Fig. 34 *f*).

This species was found in shallow water in rather sheltered places where it was growing in crevices in rocks.

St. Thomas: In the Harbour at the French wharf; St. Jan: Cruz Bay; St. Croix: Lt. Princess.

Geogr. Distrib. Siam.

Subfam. 4. ***Siphonocladeae.***

Struvea Sond.

1. **Struvea elegans** Borgs.

Borgesen, F., Some Chlorophyceæ from the Danish West Indies, II (Botanisk Tidsskrift vol. 32, 1912, p. 264).

This very nice plant was found rather abundantly in deep water in the sea around St. Jan. In habit and size it comes near to *Str. plumosa* but shows differences in several ways, having also some likeness with the following species.

The basal part of the plant consists of decumbent creeping filaments attached to the substratum by means of rhizoids. These rhizoids are very irregularly ramified, sometimes quite short, sometimes also longer, irregularly septated. They are richly provided with starch.

From the creeping filaments grows the erect part of the thallus, the stalk crowned with the frond. From its earliest stage of development the stalk consists of a single, nearly cylindric cell. At its base, at least in more mature specimens, we find a few, 6—8 annular corrugations though not very deep (Fig. 37). When the stalk has reached nearly the normal height of the plant it divides into a number of cells. The forming of these cells is said by J. Agardh (l. c. p. 108), who founds his description on that of

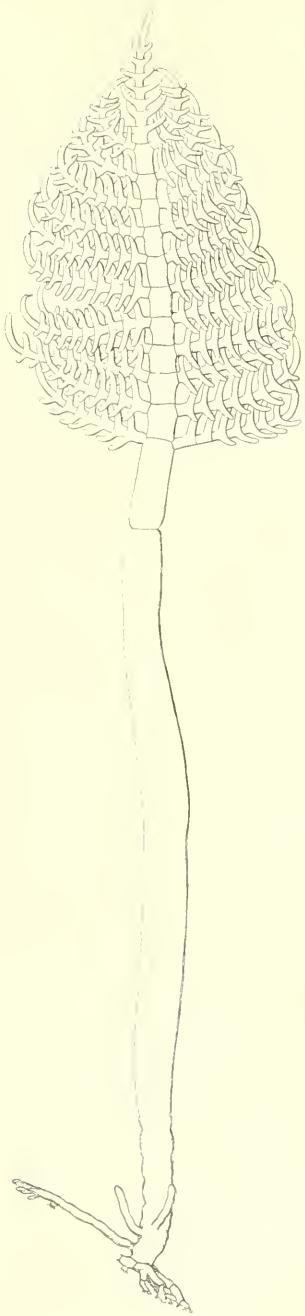

Fig. 37. *Struvea elegans* Borgs. A young plant. (About 3:1).

Harvey[1]), to be due to an apical cell, but this is not right, judging from what I have found in my material. The cell-division is namely carried out by segregative cell-division. I have observed the cell-division in the frond of a young plant, of which Fig. 38 *c* shows the uppermost halfpart. We see here that the side branches and the apical cell first grow out to a considerable length (compare also Fig. 38 *a*, *b*) and then the cell contents in each branch are divided simultaneously into a number of smaller parts of nearly the same size, with exception of the apical part in each branch, which is longer. Each of these smaller parts becomes surrounded by a membrane. The figure shows that the branches nearest the top are yet undivided. Somewhat lower down, where the division of the contents has recently begun, we find that the single parts of the contents are separated from each other by a rather large open space, larger perhaps owing to the influence of the alcohol than in the living plant. These parts are surrounded by a membrane and then, as we see in

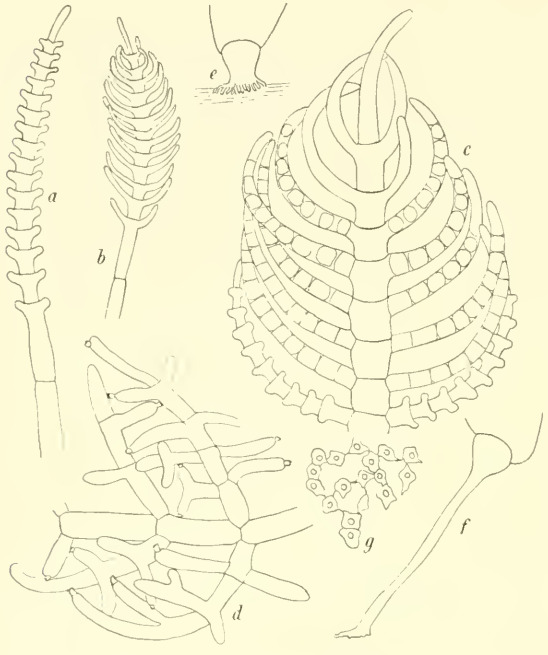

Fig. 38. *Struvea elegans* Borgs.
a, *b*, *c*, tops of young stalks showing development of the frond and *c* the cell division also, the uppermost branches in this figure and the top-cell are yet undivided, then branches occur where the cell contents are aggregated in clumps and lower down again the cell-division has been completed and in the lowest pair of branches new side branches begin to grow out. *d*, part of older thallus. *e*, *f*, hapteræ. *g*, chromatophores. (*a*, *b*, about 3:1; *c*, 6:1; *d*, 10:1; *e*, *f*, 70:1; *g*, 300:1).

[1]) Compare also Murray and Boodle, l. c.; Oltmanns, Morphologie, p. 267; Wille in Engler und Prantl, Natürl. Pflanzenfam., Chlorophyceæ, Nachtr., p. 113.

the branches lower down, where the cell division is in a more advanced stage of development, they grow quite near each other and are now separated by a wall. The apical cell is also divided later on in this way. When these cell parts or cells, as we may now call them, have reached a certain degree of maturity they all with exception of the top cell begin to grow out in their uppermost end into two opposite branches lying in the same plane as the whole frond (see the lowermost branches in Fig. 38 *c*). These new branches again grow out to a certain length and then they divide quite in the same way and so on. In Fig. 38 *a* we see the uppermost part of a young stalk in about the same stage of development as the last-mentioned side branches in Fig. 38 *c*; and Fig. 38 *b* shows a more advanced stage, where the side branches have grown much longer but are yet undivided. In my material I have not succeeded in finding the first beginning of the cell division in the stalk, this at first being a long cylindrical cell with no walls at all, but I have no doubt that this is performed quite in the same way as mentioned above with regard to the side-branches.

The ramification of the branches can take place several times; in an old frond I have found branches of the 4th order. While the branching is very regular in the young specimens, as the figure shows, the ramification in the older leaves is more anomalous, branches of the highest order being not formed everywhere (Fig. 38 *d*).

At the same time as the side branches of the first order have begun to divide, the top cells of each branch develop at their apices rhizoid-like organs of attachment which Murray and Boodle have called tenacula. These consist of a little cell (Fig. 38 *e*) ending in a broader, irregularly lobed disc, by means of which the top cell of each of the inward bent branches fastens itself to the cell-wall of the branch nearest above. Most of the apices of the top cells touch the branches above even before the tenaculum has grown out and this need only be quite short, but sometimes it happens that it does not succeed in coming into close connection with another branch and then it can grow rather long like a rhizoid (Fig. 38 *f*). To begin with it is only the top cell of each branch which fixes itself in this way, forming a kind of edge along the side of the frond, but later on in the older frond nearly all the side branches of the second, third and higher order are provided with tenacula at the top and fastened to other branches (Fig. 38 *d*). In this way, in good accordance with what is well-known in other *Struvea*-species, all the branches, loose at first,

form a connected whole. Sometimes, but more seldom, I have found two tenacula growing out from the same top of the cell.

In the frond the lowest cell in the midrib is considerably larger (about 3 times) than the other cells in it, as is the case also in *Struvea anastomosans.*

With regard to the cell-wall this is rather thick in the lowest part of the stalk, growing thinner upwards and in the frond. The wall shows longitudinal and transverse striations, as is also mentioned by Murray and Boodle (l. c. p. 271) for *Struvea plumosa.*

As to the wall plasma and its contents this is very like what we find in *Valonia.* The chromatophores (Fig. 38 *g*) are plate-shaped, of irregular polygonal form, often with elongated angles forming in this way a net-work. In each chromatophore a rather large pyrenoid is nearly always present. Behind the chromatophores we find the numerous nuclei rather regularly distributed.

The whole plant with stem and frond together reaches a height of about 10 cm, the length of the frond may measure up to 4 cm and the breadth 2½ cm. The stalk is normally unbranched but a single specimen was found having a side-branch also crowned with a frond.

This species seems to be rather nearly related to *Struvea anastomosans* by its large basal cell in the frond and by the mode of ramification, but this is much more regularly distichous, the frond has another form, is longer, containing several, more opposite pairs of branches, the top cells in the branches of the first order are longer etc.: furthermore, the stem has a number of annular constrictions at its base. which is not the case in *Struvea anastomosans* and finally, the size of our plant is much larger.

Struvea elegans was dredged in deep water only, down to about 40 meters.

It occurs at several places in the Sound between St. Thomas and St. Jan, further near Thatch Cay at St. Thomas where it was collected by Dr. Th. Mortensen and off America Hill on the north side of St. Jan.

2. Struvea anastomosans (Harv.) Piccone.

A. Piccone, Alghe in »Crociera del Corsaro alle Isole Madera e Canarie del Capitano Enrico d'Albertis«, p. 20, Genova 1884[1]). *Cladophora? anastomosans* Harv. in Trans. R. I. Acad., vol. 22, p. 565; Phycologia Australica, vol. II, pl. 101. Borgesen, l. c., p. 268.

[1]) The variety *canariensis* of Piccone described here is = *Struvea ramosa* Dickie, as pointed out by Murray and Boodle.

Struvea delicatula Kütz., Tab. Phycol., vol. 16, tab. 2. Murray and Boodle, A structural and systematic account of the genus Struvea. (Annals of Bot., vol. 11, p. 265).

This nice little plant occurs in small, dense tufts in fissures of rocks. The tufted form is due to its mode of growth. From irregularly ramified rhizome-like filaments creeping on the substratum grow the erect stalks which at their summit bear the more or less regularly branched fronds. The ends of the branches in this leaf-like part of the thallus fix themselves, as is well known, by means of clamps not only to other filaments in their own leaf but also to other fronds with which they come in contact and in this way the small tufts are formed. Mme Weber-van Bosse has described this way of growing in a very detailed manner in »Études sur les Algues de l'Archipel Malaisien« (Ann. du Jard. de Buitenzorg, vol. VIII, p. 86—87).

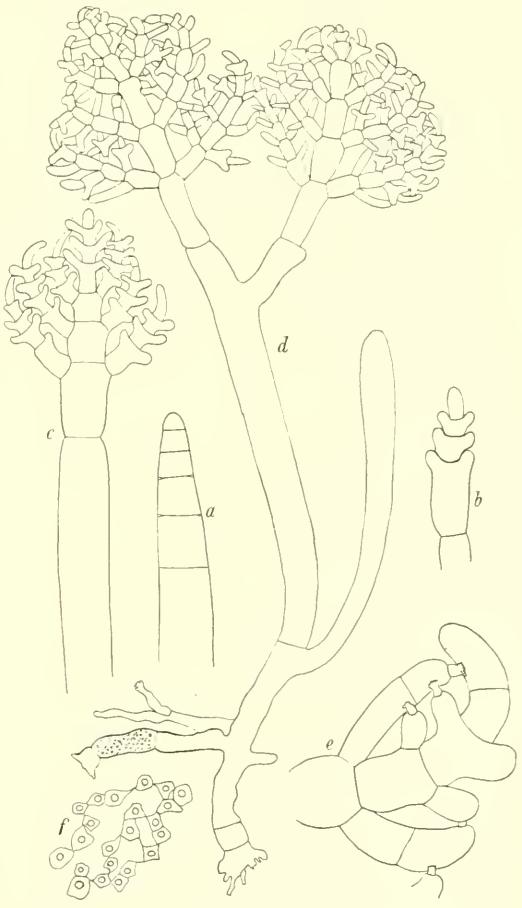

Fig. 39. *Struvea anastomosans* (Harv.) Piccone. *a* and *b*, tops of young stalks showing development of the frond. *c*, somewhat more developed frond. *d*, plant prepared out from a tuft, with rhizoids and ramified stalk so common in this species; below to the right a young stalk is growing out. *e*, parts of the frond showing the mode of attachment by means of tenacula. *f*, chromatophores with pyrenoids. (*a*, *b*, *c*, *d*, about 6:1; *e*, 20:1; *f*, 250:1).

The development of the thallus takes place in the following way. From the irregularly ramified and septate rhizoids, by means of which the plant is fastened to the substratum, nearly

cylindric cells tapering somewhat in both ends grow up. These long cells, the stalks in the full grown plant, have quite even walls and have no annular constriction at their base. They are often ramified.

When the stalk has reached a certain degree of development the cell contents are densely accumulated in the top of the cell and then divided into a number of cells (Fig. 39 *a*). This division takes place by segregative cell-division and so far I have been able to see quite in the same manner as in the above-mentioned species. In spite of the fact, that I have had a fairly large material I have nevertheless only found very few cells in the first stages of development, most probably because the division of the cell contents takes place very quickly. One of the youngest stages I have seen is shown in Fig. 39 *a*. We see here that 5 cells are formed, a larger cell below which is always found here at the base of the frond and 4 smaller cells above it.

Fig. 39 *b* shows a somewhat more advanced stage of development, the side-branches of first order here beginning to grow out from the cells in the stalk. This mode of growth is quite in accordance with that in the above-mentioned species and on the whole the ramification takes place in the same way as in *Struvea elegans*, only not quite so regularly.

As to the cell contents the plate-shaped irregular polygonal chromatophores (Fig. 39 *f*) form a net-work in the wall plasma. In each chromatophore a large pyrenoid is present and under the chromatophores the numerous nuclei are arranged rather regularly. In the rhizoids much starch is often accumulated.

In some specimens I have found the cell contents in a great number of the cells in the frond congregated in larger and smaller balls, some few in each cell, most probably an aplanospore formation.

This species occurs in shallow water often in rather exposed localities.

It is found, St. Thomas: in the Harbour and in the Great Northside Bay on the north side of the island; St. Croix: Christianssteds Harbour.

Geogr. Distrib. Seems to occur in all warmer seas.

Chamædoris Mont.

Chamædoris Peniculum (Sol.) O. Kuntze.

Kuntze, O., Revisio generum plantarum, Pars III, 1893, p. 400. Borgesen, F., in Botanisk Tidsskrift, vol. 32, 1912, p. 270.

Corallina Peniculum Solander in Ellis, The Natural History of many

curious and uncommon Zoophytes collected from various parts of the globe, London 1786, p. 127, tab. 7, figs. 5—8, tab. 25, fig. 1.

Chamædoris annulata (Lamarck) Mont. Montagne, Troisième centurie de plantes cellulaires exotiques nouvelles (Ann. des sc. nat., II. Sér., t. 18, Octobre—Nov. 1842. Harvey, Nereis Bor.-Am. part III, p. 42, tab. 42 B. J. Agardh, Till Algernes Systematik, VIII, Siphoneæ, p. 113.

Nesea annulata Lamouroux, Histoire de Polypiers coralligènes flexibles, Caen 1816, p. 256.

Penicillus annulatus Lamarck in Ann. du Museum, t. 20, 1813, p. 299.

Scopularia annulata Chauvin, Recherches sur l'organisation, la fructification et la classification de plusieurs genres d'Algues. Caen 1842.

As is well known from the description of Harvey (l. c. p. 42) the thallus of this plant, when fully developed, consists of the nearly cylindrical stem with annular constrictions from base to top where it ends in the cup-shaped head, giving the whole plant a mop-like appearance. When living the stem has a more or less striking red-violet colour and is rather iridescent, the head is dark-green on the outer side lighter grey-green on the upward turned side.

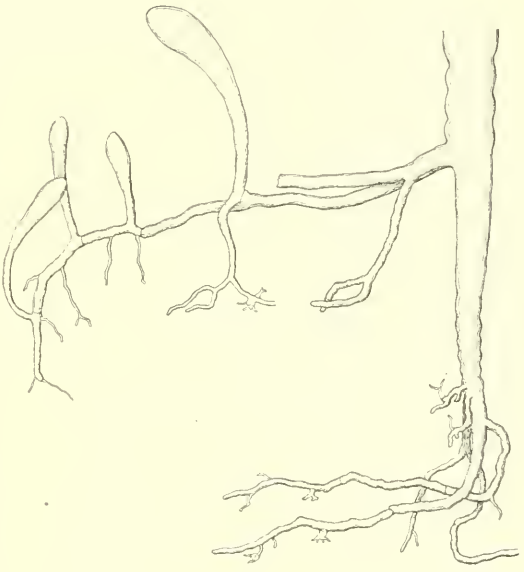

Fig. 40. *Chamædoris Peniculum* (Sol.) O. K. Base of a plant. Young stems growing up from the rhizome-like filament. (About 3:1).

At its base (Fig. 40) the stem is fastened to the substratum by irregularly branched and septate rhizoids which penetrate often rather deeply into the loose limestone, upon which especially I have found the plant growing. In the cells of the rhizoids starch is richly present. The uppermost rhizoids growing out from the stalk are more rhizome-like, creeping as they do on the surface of the substratum, and from these new stems grow up often in great number (Fig. 40). Owing to this mode of growth the plant also grows gregariously often in large tufts. How far all the individuals in a tuft have their origin from this mode of

propagation I cannot say: many of the plants in a tuft were so loosely connected and so easily separated that one could doubt their origin in this way, but the connection between the single plants can of course early decay. If we consider Fig. 40 we find, that each of the young plants growing up from the rhizome-

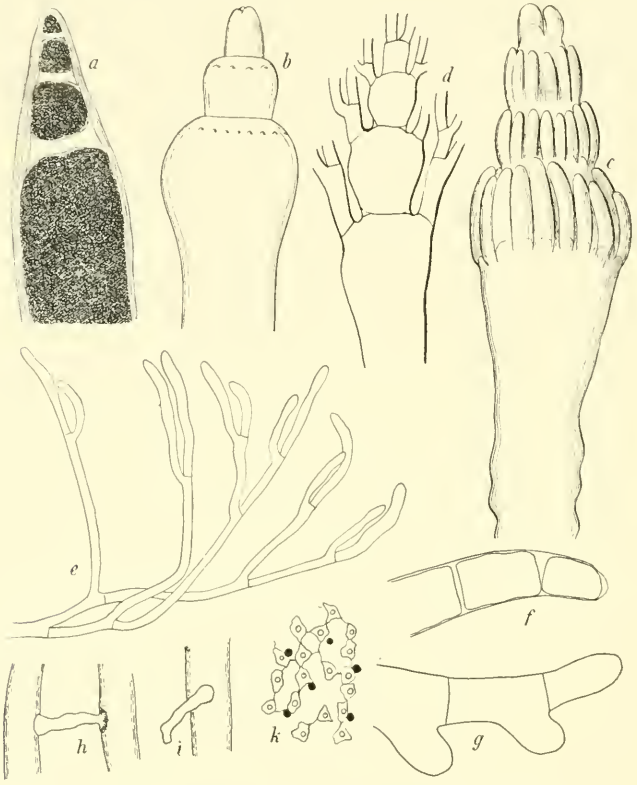

Fig. 41. *Chamædoris Peniculum* (Sol.) O. K.
a, *b*, *c*, tops of young plants in different stages of development, in *a* the cell contents have newly been divided, in *b* the young cells have swollen, the ring of warty outgrowths showing the first beginning of the filaments in the head, in *c* the warty outgrowths have grown longer. *d*, shows a longitudinal section through a somewhat older specimen in which the filaments have begun to be divided. *e*, part of filaments. *f* and *g*, young filaments showing the mode of cell division. *h* and *i*, rhizoid-like hapteræ growing out from the filaments. *k*, chromatophores with pyrenoids and nuclei. (*a*, *b*, *c*, *d*, *e*, about 10:1; *f*, *g*, *h*, *i*, 25:1; *k*, 250:1).

like rhizoid to the left is separated by a cell wall in the rhizome-like filament from the next young plant, each in this way receiving a piece of the rhizome from which rhizoids grow out downwards. Most probably the young plants are easily

separated at these walls and in this way become independent individuals.

The quite young stem has rather thin walls and no constrictions, but these begin at an early stage to be developed from the base, progressing upwards. When the stem has reached a height of about 4—5 cm it will be quite annularly constricted with exception of the uppermost part. Then the formation of the cup-shaped head will take its beginning (Fig. 41 *a*, *b*, *c*, d). First, much of the cell-content accumulates in the top of the cell and the obtuse apex elongates, becoming conical. Then the cell contents here divide by segregative cell-division simultaneously into two or most often three (Fig. 40 *a*) separate parts, the largest lowest, the smallest at the top. Each of these parts becoming surrounded with a membrane grow again closely together, the plant in this way now consisting of a very large cell in the stem and three (seldom only two) smaller at its top. These cells and the uppermost end of the stem swell somewhat and after reaching a certain thickness a whorl of some small warty outgrowths emerge at their uppermost end (Fig. 41 *b*). These small outgrowths are the beginning of the filaments of which the head is composed. In the lowest of these four (seldom three) whorls of filaments we find a number of about 20, in those higher up fewer, from the uppermost small cell only 3 or 4 filaments grow out. Near their base a wall is formed in the filaments. These filaments grow longer (Fig. 41 *c*) and divide very regularly many times pseudo-dichotomously having a wall just over each side-branch (Fig. 41 *e*). Fig. 41 *f*, *g* show the ramification as it takes place in a young filament. We find that also here as in the stem the cell-division is carried out by segregative cell-division, the protoplasm first divides into some smaller parts (Fig. 41 *f*) which grow

Fig. 42. *Chamædoris Peniculum* (Sol.) O. K. Habit of plant from exposed coast. (About 1 : 1).

together being at the same time separated by a wall and then a side-branch grows out from the uppermost end of each of the parts in which the filaments have been divided (Fig. 41 *g*). The branched filaments are felted together and the coherence is moreover increased by means of some small, short, rhizoids growing out here and there from the filaments and attaching themselves very strongly to the neighbouring filaments (Fig. 41 *h*, *i*). By this fact and their whole way of growing these filaments show a great likeness to the filaments of *Cladophoropsis*.

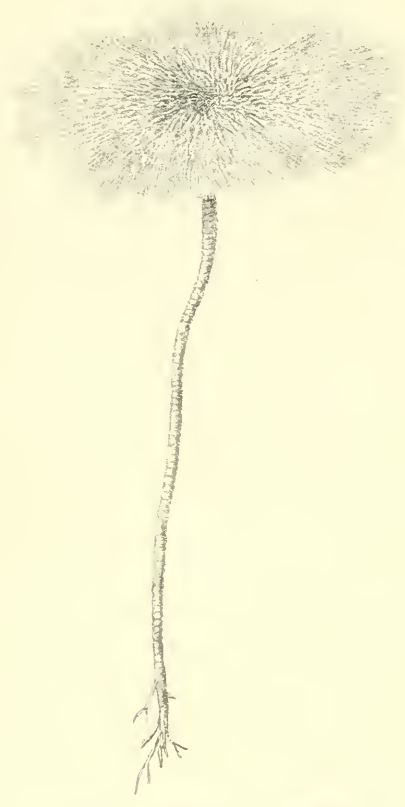

Fig. 43. *Chamædoris Penicilum* (Sol.) O. K. Habit of plant from deep water. (About 1:1).

Harvey gives in several respects a good description of the development of the plant, but he lets firstly one cell be developed at the top of the stem and this divides again successively once or twice.

As mentioned above, the head in the well-developed plant is cup-shaped, being somewhat depressed in the middle, but one also finds specimens with nearly ball-shaped heads as also others more irregularly formed (Fig. 42). In specimens growing in shallow water the stipe reaches a length of about 4—5 cm and the head a diameter of 3 cm, but in those from deep water the stem can even be 15 cm long and the head 10 cm broad. In these specimens the head was flattened and thin, forming a circular expansion, most probably an adaptation to the subdued light (Fig. 43).

I may also add that old stems, having lost the head, are able to produce a new; I have several times found very old stems with a quite young, not yet annulated apex.

As to the cell contents, we find in the wall-plasma the irre

gularly polygonal plate-shaped chromatophores, forming by means of their prolonged corners a rather dense network in the young parts of the thallus (Fig. 41 *k*), in the older the chromatophores are of a more elongated form and more openly placed. In the middle of the chromatophore a pyrenoid is present. Below the chromatophores the numerous nuclei occur distributed rather regularly.

This species has been gathered in shallow water 2—3 feet, and here in a rather exposed locality, and in deep water, down to about 50 meters.

It is found: St. Croix, at White Bay on the south side of the island and St. Jan in the sea round this island: off Cruz Bay, Marys Bluff, Ramshead, Annaberg etc.

Geogr. Distrib. West Indies, South America, Indian Ocean.

Siphonocladus (Schmitz) Borgs.

Siphonocladus tropicus (Crouan) J. Ag.

J. Agardh, Till Algernes Systematik, 5te afd., p. 105. (Lund Univ. Årsskr. 23, 1887). Borgesen, F., Contributions à la connaissance du genre Siphonocladus Schmitz (Overs. k. danske Vidensk. Selsk. Forhandl., 1905, p. 259). Howe, Phycological Studies, I. (Bull. Torr. Bot. Club. 32, 1905, p. 241).

Apjohnia tropica Crouan in Mazé et Schramm., Alg. Guadel. p. 105.

Siphonocladus tropicus grows in tufts epiphytic upon other algæ or is found loose lying as *Ægagropila*-like clumps; it is often cast ashore in rather large quantities. I have not succeeded in finding it growing on rocks but most probably it also does so.

Referring for more detail to my above-quoted paper I shall here give a short survey of the development of the thallus.

As is the case in so many related forms so also here the thallus at first consists of a single large cylindric-claviform cell fastened to the substratum by means of irregularly ramified rhizoids (Fig. 44 *a*). In the older plants these rhizoids get very thick walls (Fig. 45). In my earlier paper I mention that I have not succeeded in finding cross walls in the rhizoids; having now during my last visit to the islands gathered a rich material also of epiphytic specimens fixed to other algæ I have been able to examine the basal part of the plant in more detail and have found that cross walls occur often in the rhizoids (Fig. 45). Likewise I have seen that young erect shoots can grow out from the rhizoids (Fig. 46). In these much starch is present.

At its base the primordial cell has annular constrictions and the wall here is very thick and stratified (Fig. 45), higher up the cell wall is smooth and rather thin (Fig. 49).

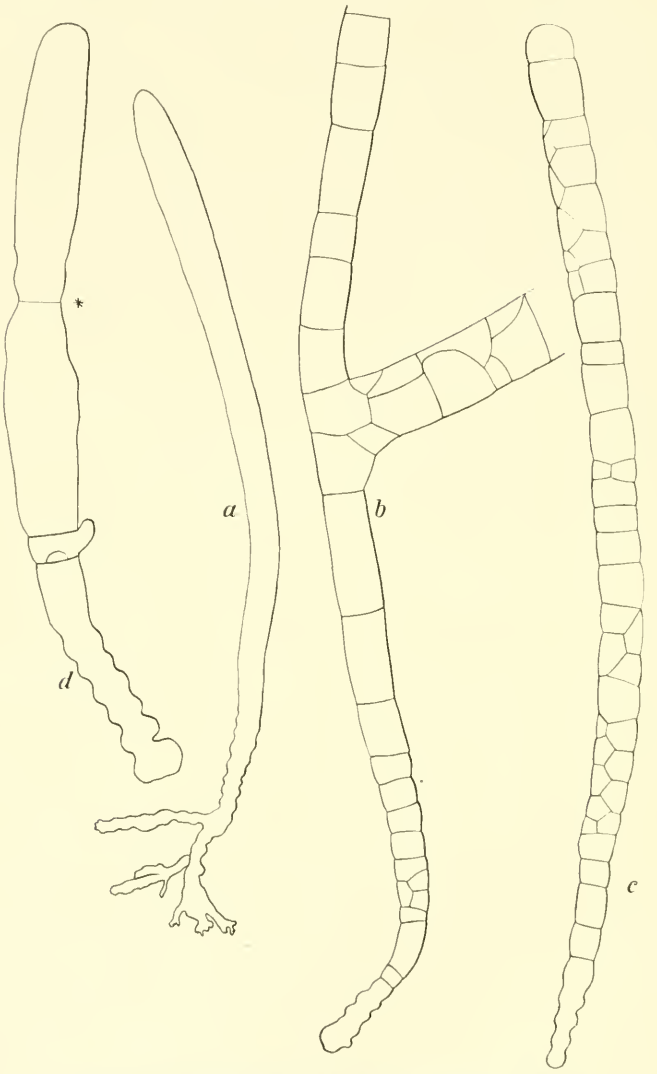

Fig. 41. *Siphonocladus tropicus* (Crouan) J. Ag.
a, young plant: *b*, *c*, *d*, different parts of filaments. (About 10:1).

When the young cell has reached a certain degree of maturity, it is divided by segregative cell-division. The whole cell contents (protoplasm with nuclei, chromatophores etc.) are divi-

ded into a large number of balls (Fig. 47 *a*, *b*, *c*). These have to begin with no membrane (Fig. 47 *a*) but get soon a distinct wall (Fig. 47 *b*). They are of different size, larger and smaller and at first spherical but gradually as they increase in size (Fig. 47 *c*), filling up the whole lumen of the mother cell and growing closely to each other, they assume by mutual pressure a polygonal form (Fig. 44 *b*, *c*). The primary, unicellular cell is in this way now divided into a number of smaller cells.

The mother cell, having been divided in this way into a great number of cells, is now ready to be ramified. This takes place in the following way. From each of the small cells cupola outgrowths emerge (Fig. 47 *d*). These grow longer and longer, cylindric-claviform, assuming by and by quite the same form as the mother cell only as a rule somewhat smaller, especially shorter (Fig. 48 *a*). Each cell has annular constrictions at its base like the mother cell but fewer in number. The branches are always in open connection with the cell from which they have grown out and they are so strongly connected with it, that this nearly always follows the branch, when it is torn off (Fig. 48 *a*).

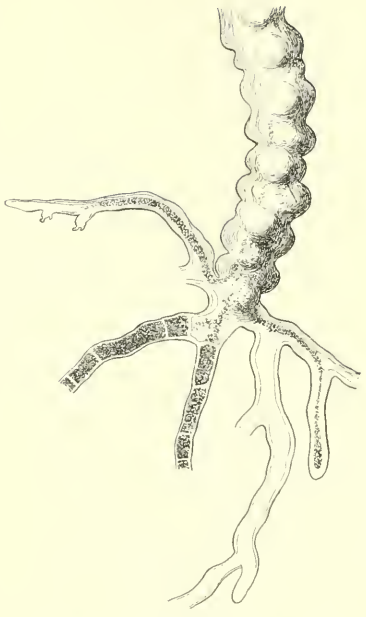

Fig. 45. *Siphonocladus tropicus* (Crouan) J. Ag.
Base of a plant showing the annularly constricted nethermost part of the stipe and the rhizoids, some of them with cross walls and provided with starch. (12 : 1).

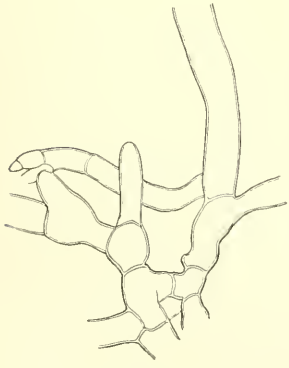

Fig. 46. *Siphonocladus tropicus* (Crouan) J. Ag.
Part of the base of a plant. From some of the cells in the rhizoids young erect shoots grow up. (12 : 1).

The branch cells are to begin with unicellular; but soon the same development as described in the mother cell takes place in them, the cell contents are divided into a number of balls, which by and by grow together filling up

the cell lumen and when these young cells have reached a certain degree of maturity, branches begin to grow out from them again. This action can be repeated several times, the plant in

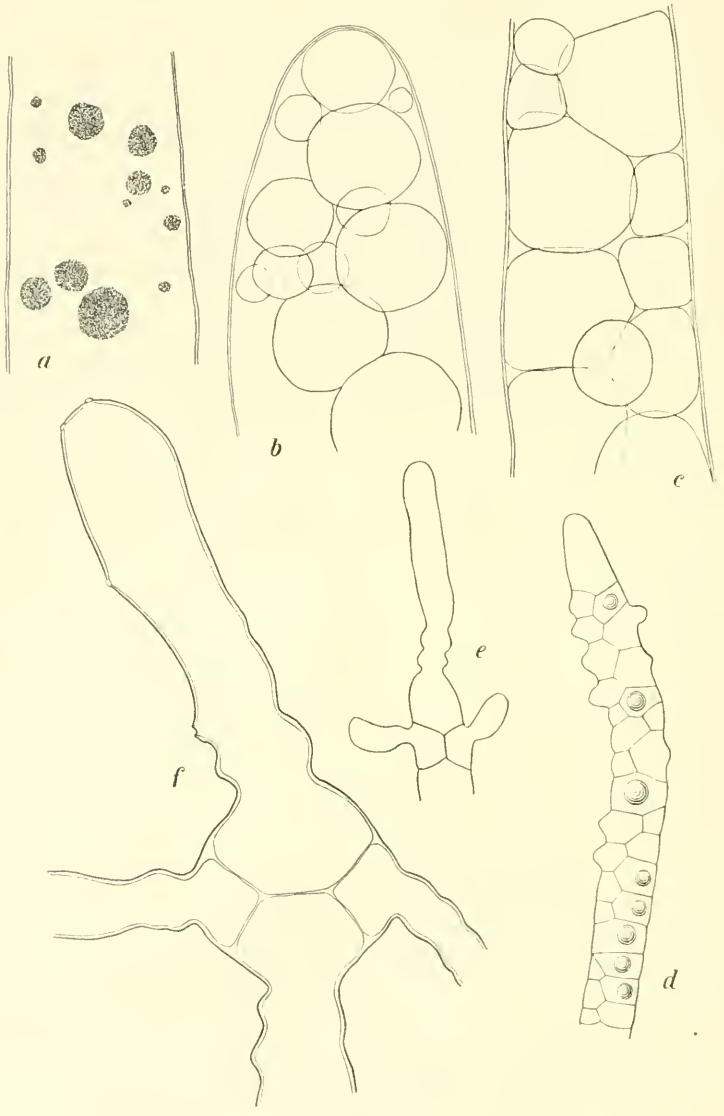

Fig. 47. *Siphonocladus tropicus* (Crouan) J. Ag.
a, *b*, *c*, different stages of cell division; *d*, young branches begin to grow out; *e*, summit of a branch growing out; *f*, transverse section of a ramified filament with four branches, the fully drawn branch is a zoosporangium). (*a*, *b*, *c*, *f*, about 30:1, *d*, *e*, 10:1).

this way being composed of several stories of coordinate systems of branches (Fig. 49).

As to the structure of the cells, the wall is rather thick and

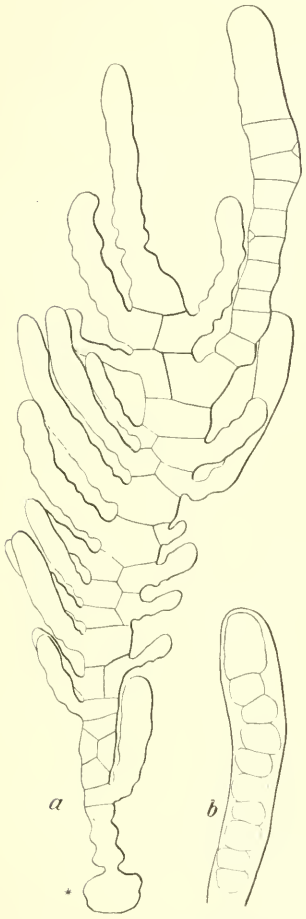

Fig. 48. *Siphonocladus tropicus* (Crouan) J. Ag.
a, a ramified branch with its mother-cell (marked with *). All the branches are still unicellular with exception of the second to the right from the top. Having treated this with glycerine, it assumed the appearance as shown in fig. *b*: by plasmolysis the cells have again become roundish. (About 15 : 1).

Fig. 49. *Siphonocladus tropicus* (Crouan) J. Ag. Habit of plant (3 : 1).

consists of several layers (Fig. 45). The numerous small plate-formed and polygonal chromatophores (Fig. 50 *a*) are parietal. They are connected together by means of very fine prolongations from their corners. In nearly all the chromatophores a pyrenoid is present. In the wall plasma we further find the numerous nuclei regularly distributed (Fig. 50 *c*).

As to the reproduction of the plant, zoospore formation takes place in the cell-branches (Fig. 51). The cell contents with chromatophores, nuclei etc. congregate to thicker strings (Fig. 51 *a*). These again are united in some irregular clumps from which the zoospores take their origin (Fig. 51 *b*). The sporangium consists both of the original cell in the mother branch and the branch grown out from it. In the wall several holes are formed through which the zoospores can escape (Fig. 51 *b*).

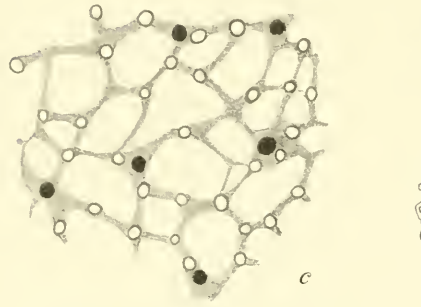

Fig. 50. *Siphonocladus tropicus* (Crouan) J. Ag. *a*, chromatophores with pyrenoids; *b*, pyrenoids; *c*, nuclei, chromatophores with pyrenoids. (*a*, about 200:1); *b*, 250:1; *c*, 300:1).

Siphonocladus tropicus has been met with in more sheltered places and in shallow water only. It is, as mentioned above, found growing epiphytic upon other algæ or loose lying as *Ægagropila*-like clumps.

It has only been found at the shores of St. Croix: in several places in Lime Tree Bay and White Bay on the south side and at Coakley Bay on the north side of the island.

Geogr. Distrib. West Indies, Florida.

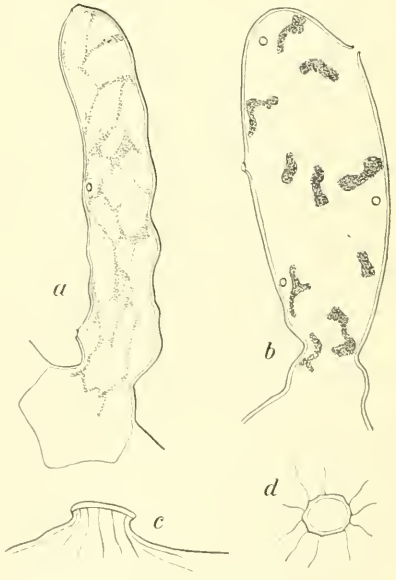

Fig. 51. *Siphonocladus tropicus* (Crouan) J. Ag. *a* and *b*, zoosporangia; *c* and *d*, surroundings of the holes in the membrane seen from the side and above. *a*, *b*, 30:1, *c*, *d*, 200:1.

Ernodesmis Borgs.

Ernodesmis verticillata (Kütz.) Borgs.

Borgesen, F., Some Chlorophyceæ from the Danish West Indies, II (Botanisk Tidsskrift, 32. Bd., 1912, p. 259).

Valonia verticillata Kütz., Species Algarum, p. 508; Tab. phycol., vol. VI, tab. 88. J. Agardh, Till Algernes Systematik, VIII, p. 100. P. Kuckuck,

Über den Bau und die Forpflanzung von Halicystis Aresch. und Valonia Ginn. (in Bot. Zeit., 1907).

Valonia ægagropila β *elongata* C. Ag., Spec. Alg., p. 430.

Conferva diaphana West e specim. in Herb. Vahl in Museo Bot. Hauniensi (cfr. C. Agardh, l. c.).

From an examination of my rich material of this interesting plant I have arrived at the result that, even if it is in several regards nearly related to *Valonia*, it nevertheless shows important differences approaching it to several other genera e. g. *Apjohnia*, *Siphonocladus* etc., for which reason I have thought it most suitable to consider it as representing a new genus.

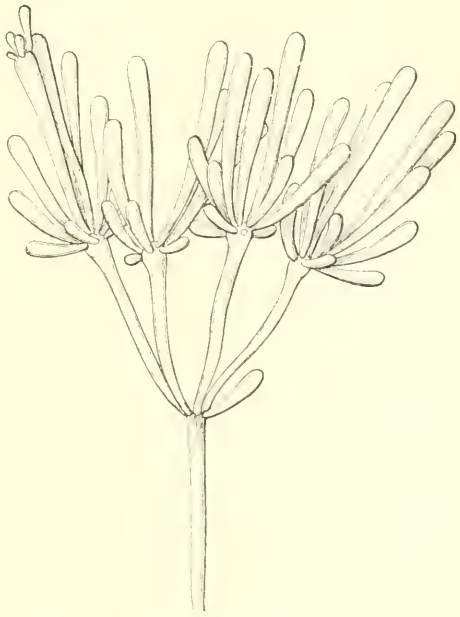

Fig. 52. *Ernodesmis verticillata* (Kütz.) Borgs. Part of a plant. (About 4:1).

Before pointing out the ways in which it shows likeness with and differences from the above-mentioned genera, I shall give a description of the plant. As is the case with so many related forms our plant when young consists of a single clavate cell forming the basal stalk of the older plant. This at its base is fixed to the ground by irregularly ramified and septated rhizoids (Fig. 53 *a*). The wall of the cells in the rhizoids is thick and much starch is found in the cells. Also the wall in the stalk itself, in any case in older plants, is rather thick in its lower part and here some annular corrugations occur, most strongly developed lowermost (Fig. 53 *a*), leaving only a small passage open in the middle of the cell.

In its broadly rounded, sometimes even a little swollen, uppermost end the clavate stalk bears a bundle of branches most often five to eight but sometimes up to a dozen or more (Fig. 52). These branches are quite like the mother-cell, clavate, thinnest at their base. Here, in any case when they grow older, we find a single swelling (Fig. 53 *b*, *c*). The branches are separated by

an often somewhat concave wall from the mother cell. In their upper end these branches again are ramified quite in the same way and this very regular ramification takes place several times, with the result that the plant gets a nice candelabrum-like appearance (Fig. 52).

So far as I have been able to follow the development in my material, the formation of the branches takes place in the following way; first much cell plasma with chromatophores and nuclei accumulate at the point where a branch will grow out. The accumulation is separated from the mother-cell by a membrane and then begins to grow out like a cupola outgrowth. This becomes more and more prolonged and gradually assumes the shape of the mother-cell. The branches in each bundle are established successively, so that branches in different stages of development are found in the young bundle and even in the older a young branch occurs now and then (compare Fig. 52).

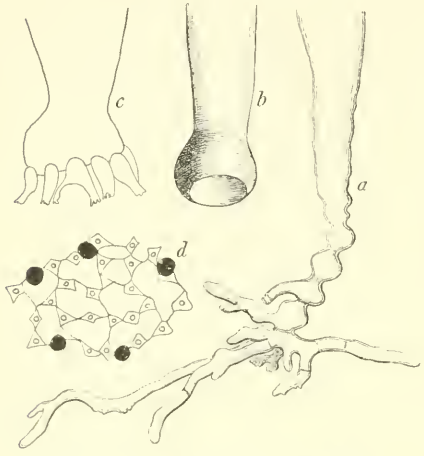

Fig. 53. *Ernodesmis verticillata* (Kütz.) Borgs.
a, base of the plant (8:1). *b*, basal end of a branch (12:1). *c*, do. with a ring of clamps (12:1). *d*, chromatophores with pyrenoids and nuclei (300:1).

Some small, short, thick rhizoid-like organs grow often out from the lower side of the above-mentioned swellings at the base of the branches in the older part of the thallus; they grow downwards and when they meet the wall of the cell below they attach themselves very firmly to it and serve to strengthen the plant (Fig. 53 *c*, 54 *b*). These organs remind one very much of the clamps, as Murray and Boodle (in Annals of Botany, vol. 2, p. 276) call them and which they have found in *Struvea ramosa*. Often only one or two of these clamps are found but sometimes a whole ring of them are developed quite near each other (Fig. 53 *c*).

Furthermore, in some specimens but far from common some longer rhizoid-like appendices grow out from the swelling (Fig. 54 *c*, *d*). These appendices are so far as I have seen not separated by a wall from the mother cell, in contrast to the above-

mentioned clamps where a wall is present. KUCKUCK who has examined a dried specimen collected by the late Mlle VICKERS at Barbadoes has also found them. He writes l. c. p. 181: »Dagegen zeigten die Sprossenden im unteren Teile des Büschels Gruppen von locker stehenden Rhizinen, die aus der oberen stumpfen Kuppe des Sprosses zwischen und neben den Tochtersprossen abzweigen«. I think that these organs may also serve to strengthen the plant, just as these and the clamps can help to attach loose fragments of the plant to the bottom again.

The cell-wall in the older part of the thallus is rather thick, thinner in the younger; it is nicely striated in an irregularly undulating way. The cell-plasma contains numerous plate-shaped small chromatophores of irregular polygonal outline with the corners running out into shorter or longer, thin prolongations connected in a reticular way (Fig. 53 *d*). In the middle of the chromatophore a rather large pyrenoid is present. Underneath the chromatophores we find the numerous nuclei in regular arrangement.

Fig. 54. *Ernodesmis verticillata* (Kütz.) Borgs. *a*, the upper end of a branch transformed to zoosporangium (25:1). *b*, a single clamp (20:1). *c*, the top of a branch with small branches, one of these with a rhizoid-like appendix, in the middle the annular cicatrix from a branch torn of (8:1). *d*, branch with a rhizoid-like appendix (8:1).

As in so many related species the contents of the cell are often found contracted to some larger and smaller balls richly filled with chromatophores and nuclei etc.; we find them figured by KÜTZING, »Tab. phycol.«, vol. VI, tab. 88. How far these balls becoming free are able to produce new plants I cannot tell, but it is very likely.

Fructiferous cells occurred rather often in my collections. The whole cell is transformed into a sporangium (Fig. 54 *a*) and the zoospores escape through numerous holes formed in the cell wall in exactly the same way as found in *Siphonocladus tropicus*. Quite in accordance with this species the holes protrude a little and have radiating striations. Also the cell

plasma with chromatophores and nuclei is contracted to an irregular network or to more irregular clumps, from which the zoospores are formed in good accordance with other algæ e. g. *Bryopsis*, *Valonia* etc. As to the last mentioned genus KUCKUCK in his paper above-quoted has given a detailed description of the formation of the zoospores based upon the study of living material.

The plant occurs not only fixed but also loose as *Ægagropila*-like clumps. These are very often cast ashore. In these loose-lying specimens the basal part as described above is usually lacking, and as most specimens collected are those cast ashore I think the basal part will only seldom be found in the collections.

As to the relationship of our plant I would point out that it comes rather near to *Valonia*, *Apjohnia*, *Siphonocladus* etc.

Though in several regards very like a *Valonia* I think that our plant cannot in a natural way be placed in this genus. Thus it differs from it by having a stem-like, annularly constricted, basal part which is fastened to the substratum by means of irregularly ramified and septate rhizoids and by having a single annular constriction at the base of the branches; further by the absence of both the larger and smaller lentiform cells so characteristic in *Valonia*. And to these characters we may add the very regular ramification; to be sure we can find forms of *Valonia ægagropila* which are very regularly ramified with nearly all the branches growing out from the top of the mother-cell (compare KUCKUCK, l. c., p. 176, fig. 20) but some anomalies always occur.

Compared with *Siphonocladus tropicus*, the basal part of both plants seems to be quite alike and these plants are also very similar in several other regards, e. g. the formation of the zoosporangium; but in the development of the thallus the difference on the other hand is very great.

And *Apjohnia*, which also comes near to our plant, differs in several regards, in the annular constrictions not only of the basal stem but also of the base of the branches and in the very regular ramification, in the upper part of the thallus only producing 3 branches. And these branches have no walls at their base, only the above-mentioned constrictions which in any case in the younger part of the thallus leave a narrow passage open.

This species, which has already been gathered at St. Croix by WEST who called it *Conferva diaphana* and of which well-kept specimens are still preserved in VAHL's Herbarium in the Botanical Museum, Copenhagen, has first been described by KÜTZING

upon specimens also from this island. It is rather common here, occurring both in shallow and deeper water down to a depth of about 5 fathoms. It is found both in more open but especially in sheltered localities in the shallow areas of sea behind the coral reefs. Here it often occurs loose in the form of *Egagropila*-like clumps. It was found with sporangia in January—March.

St. Croix: Off Frederikssted, Lt. Princess, the harbour of Christiansted, Long Reef, Casavagarden.

Geogr. Distrib. The West Indies, Brazil.

Fam. 3. ***Dasycladaceæ.***

The following remarks on the species found are nearly the same as those given in my preliminary note: »The Dasycladaceæ of the Danish West Indies« (Botanisk Tidsskrift, 1908, vol. 28, p. 271).

Subfam. 1. ***Dasycladeæ.***

Neomeris Lamouroux.

Neomeris annulata Dickie.

Dickie, On the Algæ of Mauritius (Journal Linnean Society, vol. 14, p. 198). H. Solms-Laubach, Ueber die Algengenera Cymopolia, Neomeris und Bornetella (Ann. du Jardin bot. de Buitenzorg, Vol. XI. 1893). Borgesen, l. c., p. 271.

Neomeris Kelleri Cramer, Ueber die verticillirten Siphoneen besonders Neomeris und Cymopolia (Neue Denkschriften der schweiz. naturf. Gesellschaft, Bd. XXX, 1887), and Ueber die verticillirten Siphoneen besonders Neomeris und Bornetella (Neue Denkschriften, Bd. 32, 1890). Vickers, Phycologia Barbadensis, tab. 46, 1908.

Exsicc., Phycotheca Boreali-Americana, Nr. 668.

Besides the typical form, which I have collected in great quantities, I have found a few specimens which in the form and size of the sporangia show some difference. The sporangia were namely cylindrical about 2½ times as long as broad with the apex obtuse, rounded (see Fig. 55 *d*). The spore was about 190 μ long and 70 μ broad. As to the size of the spores of *N. annulata* Solms (l. c. p. 71) gives the length to be 140 μ and the breadth 65—70 μ and these dimensions agree very well with those of the common typical form. But sometimes also other sizes are to be found, in one specimen e. g. the dimensions of the spores were 160 μ long and 80 μ broad and in another from deep water (25 fathoms) the spores were 175 μ long and 80 μ broad, and as the form of the spores also seems to be rather variable (compare the

accompanying figures *a*, *b* and *c*) I do not think it necessary to consider the above-named form as a special variety. At the end of the spore turning towards the axis of the plant I have also

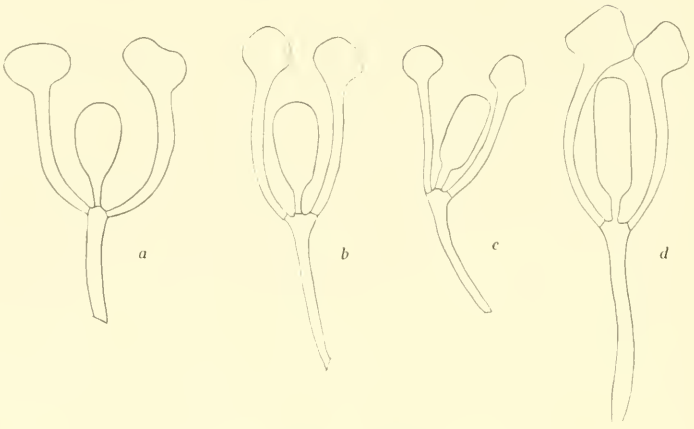

Fig. 55. *Neomeris annulata* Dickie.
Different forms of the sporangia (compare text). (About 40 : 1).

clearly seen the cover mentioned and figured by Solms (l. c. p. 68, pl. 8 b, fig. 8), recalling the cover in the spores of *Acetabularia* (cfr. Fig. 56).

In Phycotheca Boreali-Americana (668) I some years ago, without examining the material very closely, wrongly gave specimens of this species the name of *N. dumetosa*; Howe has already pointed this out (Bull. Torr. Club, Vol. 31, pag. 99).

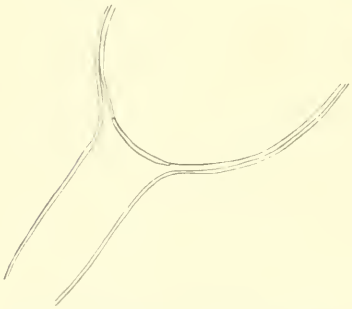

Fig. 56. *Neomeris annulata* Dickie. Base of sporangium (compare text). (About 150 : 1).

Neomeris annulata occurs both on sheltered coasts and on exposed. In the first mentioned locality I found it growing gregariously on stones quite below the surface of the sea in the full daylight and in clear water without being covered by other algæ.

In the Bovoni Lagoon it occurs together with *Acetabularia crenulata* on stones near the shore in shallow water. On more exposed shores it is most often to be found on rocks of coral in small crevices and depressions receiving thus some shelter. A single specimen was found in deep

water (about 50 m.). This specimen was large, about 2 cm. high and occurred in a collection of various other algæ which Dr. MORTENSEN most kindly sent me.

Neomeris annulata seems to be rather common on the shores of the Danish West Indies.

I have specimens from St. Thomas, the French Wharf in the harbour at Charlotte Amalie, Bovoni Lagoon; St. Jan, off Ramshead (leg. Dr. MORTENSEN) in a depth of about 50 m; St. Croix, Lime Tree Bay.

Geogr. Distrib. West Indies, South America, Indian and Pacific oceans.

Fig. 57. *Neomeris annulata* Dickie. Habit of plants in different stage of development. (About 3:1).

Subfam. 2. ***Bornetelleae.***

Batophora J. Ag.

Batophora Oerstedi J. Ag.

J. AGARDH, Nya algformer. Öfversigt af kungl. Vetenskaps-Akademiens Förhandlingar, Årg. 11, 1854, Nr. 4, p. 107. M. A. HOWE, Phycological Studies, II. Bulletin Torr. Bot. Club, Vol. 32, 1905, p. 578. BORGESEN, l. c., p. 273.

Dasycladus occidentalis Harvey, Nereis Bor. Americ., Part III, 1858, p. 38.

Botryophora occidentalis (Harv.) J. Ag., Till Algernes System., 5. Afdeln., p. 141, 1887.

Coccocladus occidentalis Cramer, Ueber die verticillirten Siphoneen (Neue Denkschr. schweiz. naturf. Gesell. Bd. XXX, 1887, p. 37).

Coccocladus occidentalis, laxus Howe, Bull. Torr. Bot. Club, Vol. 31, 1904, p. 95.

Exsicc. COLLINS, HOLDEN and SETCHELL, Phycotheca Boreali-Americana, Nr. 667.

As HOWE has pointed out (l. c. 1905, p. 579), J. AGARDH most probably forgot his old description of this species from 1854, as in 1887 when writing his paper on the *Siphoneæ* he had this alga before him and then gave it the new name *Botryophora.*

Of the original material collected by ORSTED at St. Croix several (7) specimens are to be found in the Botanical Museum of the University in Copenhagen; on the label which belongs to them, ORSTED has written: »*Bryopsis*??? Ad radices Rhizophorae Mangle in sinu substagnante, Krauses lagoon, insul. St. Crucis« and above it on the same label J. AGARDH has written: »*Bo-*

tryophora Oerstedi J. Ag. mscr. Genus novum«. The fact that J. Agardh wrote on this certainly the original label *Botryophora Oerstedi* is rather remarkable, as at the same time on the specimens he kept back in his own herbarium he has written as already pointed out by M. A. Howe »*Batophora Oerstedi*« and it is rather remarkable also, when he (l. c. 1887, p. 139) writes: »Antea quam suum *Dasycladum occidentalem* descripserat Harvey, speciem hanc in collectione Algarum ab Oerstedio sub itinere ad Americam centralem lecta, nomine Botryophorae Oerstedi jam designaveram«, that he does not mention at all the name *Batophora*, as just this name is to be found on his own specimens. However this may be, I think it is necessary in accordance with the laws of priority to call the genus *Batophora* in agreement with Dr. Howe.

Fig. 58. *Batophora Oerstedi* J. Ag. Tuft of plants, some of which sterile, others fructifying. (About 1:1).

In Bulletin Torr. Bot. Club, Vol. 31, 1904, p. 95, Howe has described a new variety of this species which he has called var. *laxus*: it is said to be specially distinguished by its open, loose structure and by having the sporangia obovoid, oblong — ellipsoid or pyriform in shape. Later on Howe has himself (l. c. 1905, p. 580) deleted it again and with good reason. For one reason the original material has just this loose habit, also we find all possible intermediate forms. Even in the same locality (Krause's Lagoon in St. Croix) I have found not only the already mentioned forms of the sporangia but also spherical and a little flattened forms as Harvey figures them. The accompanying Fig. 60

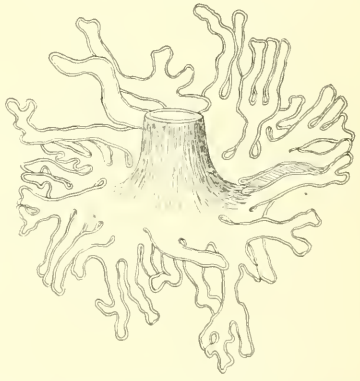

Fig. 59. *Batophora Oerstedi* J. Ag. Base of a specimen showing the irregular lobed and ramified rhizoids without walls. (About 20:1).

shows a pyriform sporangium of a specimen from New Providence collected by the late Baron H. Eggers.

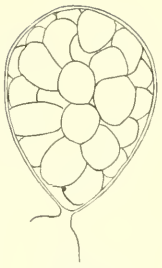

Fig. 60. *Batophora Oerstedi* J. Ag. Sporangium (About 30:1).

Batophora Oerstedi in the Danish West Indies has hitherto only been found in Krause's Lagoon on the south side of St. Croix were it was first, detected by Orsted; later on specimens were sent me by Mr. O. Hansen Ganneskov, St. Croix, no locality stated, but most probably from Krause's Lagoon, and finally I have myself found it there. It was growing in the westerly part of the lagoon in abundance but in a very restricted domain on roots of mangroves and on old pieces of branches etc. lying on the soft muddy bottom: the water was quite shallow and unclear.

Geogr. Distrib. West Indies, Florida.

Subfam. 3. ***Acetabularieæ.***

Acetabularia Lamouroux.

As pointed out in my earlier paper, l. c. p. 274—5 I am of opinion that the name *Acetabularia* has to be maintained and not replaced by *Acetabulum* as Kuntze and Howe following him has done. Compare also »Actes du IIIme Congrès International de Botanique«, Bruxelles 1910, Vol. 1, p. 108.

Acetabularia Caliculus Quoi et Gaimard.

Quoi et P. Gaimard: Zoologie, Voyage autour du Monde exécuté sur les Corvettes l'Oranie et la Physicienne (Freycinet), Paris 1824, p. 621, p anche 90, figs. 6 et 7. Harvey, Phycologia Australica, Vol. V, Pl. 249. H. Solms-Laubach, Monograph of the Acetabularieæ (Transactions of the Linnean Society, Second Series, Vol. V, Botany, London 1895—1901). Borgesen, l. c., 1908, p. 275.

Acetabularia Suhrii Solms, l. c. p. 25.

I have referred to this species a smaller *Acetabularia* which I collected in quantities along the shores of St. Croix. It seems in the main to agree well with the description of Solms-Laubach and at the same time it seems to me to be like specimens of this species I have seen in the British Museum of Natural History, London, from Fremantle, W. Australia (Bowerbank) and which are regarded by Solms-Laubach as correctly named. As Solms points out (l. c.), the original specimens of this species seem to

be no longer in the Paris Museum. As it would have been of great interest to have them for comparison I wrote to M. P. Hariot in Paris about this matter but got the answer that the specimens were not in the Paris Museum. Most fortunately we have a very good figure by Quoi et Gaimard (l. c.) and this seems to me to be in good accordance with my specimens (Fig. 61).

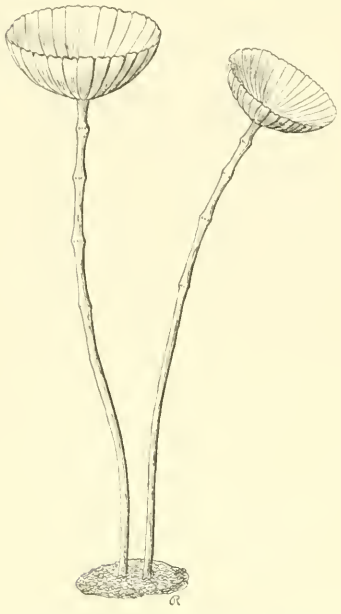

Fig. 61. *Acetabularia Caliculus* Quoi et Gaimard (about 3:1).

The plant reaches a height of about 2—3 cms.; the stalk is rather rigid and calcified; on the uppermost halfpart, sometimes even lower, it has spindle-shaped swellings bearing on their thickest part a whorl of hair-scars after deciduous assimilation-hairs, in accordance with the figure of Quoi et Gaimard (l. c.) and as figured by Harvey (l. c.) and mentioned by Solms (l. c.). By means of a ramified, lobed rhizome the stalk is at the base fastened to limestones or shells. As pointed out by De Bary and Strasburger[1]) for *Acetabularia mediterranea*, this rhizoidlike base penetrates into the substratum most probably by decomposition of the latter and it is therefore so strongly connected with it that one always only gets the uppermost part of the rhizome when trying to tear the plant free. Only by loosening a small piece of the stone on which the plant is growing and afterwards dissolving the stone by means of acid we get the base of the plant intact. As the Fig. 62 shows this is an irregularly lobed body: it has a large contraction almost in the middle so it is quite in accordance with the description of De Bary and Strasburger of the base of *A. mediterranea* which has below the contraction what

Fig. 62. *Acetabularia Caliculus* Quoi et Gaimard. Base of the plant. About 20:1.

[1]) De Bary, A., and E. Strasburger, *Acetabularia mediterranea*. Bot. Zeit. 1877.

they call the »Basalblase« and above it the »Fuss«. In the »Basalblase« and by the way also in the »Fuss« amylum is found in quantities.

On the uppermost part of the stalk there is a basin-shaped disc in consequence of the upwards curved rays; it has about 26—28 rays which are united in the living plant but immediately separate after decalcification with acid. According to Solms the plant ought to have: »Rays even in the living state separate and free«. This however was not the case with my specimens and this is the most essential difference between my specimens and the description of Solms. Yet I do not think this is so very important. One of the above-named specimens from Fremantle in the British Museum and conserved in spirit, really had a few separate rays but most of them were connected and when seen under the microscope a calcified mass was also visible on the few separate rays with which they most probably have all been pasted together. In the original figure also by Quoi and Gaimard they are connected and Harvey writes l. c. tab. 249: »The coherence between the cells also appears to be less strong than in other species«, but that they might be free he does not say. In this connection I may also point out that Howe in *Acetabularia Farlowii*, which according to Solms has separate rays, by examination of the plant in the living state has found that »only about one in four or one in five« of a thousand specimens has these free.

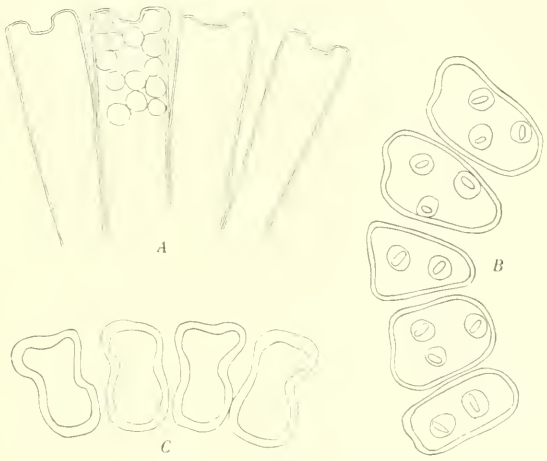

Fig. 63. *Acetabularia Caliculus* Quoi et Gaimard. *A*, Part of the rays with gametangia. *B*, Corona superior with hair-scars. *C*, Corona inferior. *A* about 10:1, *B* and *C* about 60:1.

The apices of the rays have broadly rounded corners and in the middle often a large broad deepening (Fig. 63 *A*). This is especially developed in the older disc but is also often to be found even in quite young. However it may be pointed out that spe-

cimens occur where the apices of the rays are truncate or have only an undulated margin.

The segments of *Corona superior* (Fig. 63 *B*) have a somewhat irregular form, oblong cordate, often somewhat emarginated on the side turned outward and bear 2—3 hair-scars. In some specimens we generally find two scars, seldom three, in others three and only seldom two. They may be found one behind the other or quite irregularly. The shape of the Corona superior therefore agrees well with the figure of Solms and the same may be said of that of the Corona inferior (Fig. 63 *C*); the segments are here almost rectangular, but somewhat laced in the middle. The breadth of the disc is about 3—5 mm.

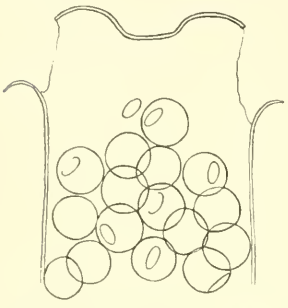

Fig. 64. *Acetabularia Caliculus* Quoi et Gaimard. Summit of a sporangium with two large holes one in each corner and containing emptied gametangia. (About 35 : 1).

The gametangia (Fig. 64) are spherical and occur in a number of about 80 in each ray. They are about 160 μ broad. A very large number of gametes are developed in them. Contrary to what is the case in *Acetabularia mediterranea* where the gametangia get free and only after a resting period, often lasting several months, develop the gametes, these here come to existence while the gametangia are still enclosed in the rays. The gametangia are opened by means of a similar cover as in *A. mediterranea*. At the same time as the gametangia are opened, large holes are formed in each corner of the rays, through which holes the gametes can escape (Fig. 64). It seems that these holes arise simultaneously in all the gametangia of the disc, at all events it has been the case in all the discs I have seen in this stage of development. The gametes are ovate: the cilia I have not been able to see with certainty, though the gametes occurred here and there in the emptied gametangia or in the rays; I have seen them lying in couples or more or less joined together, also some larger roundish bodies were found, most likely zygotes, and longer cylindrical cells: young plants.

Yet I may add that the plant does not seem to have any fixed growing or resting period: at any rate plants collected in the months of January and February were found in all different stages of development. I have found quite young plants without disc but with two or three whorls of hairs in accordance with

Harvey's Fig. 2, Pl. XLII (Nereis Bor.-Am., Part III) of *Acet. crenulata*; plants were found on which the disc was as yet quite small and had a whorl of hairs in the corona superior; individuals were found on which this whorl of hairs had fallen off but where the formation of the gametangia had not yet begun and so on, until also individuals with emptied gametangia were found. Now the disc and stalk die away; whether the basal cell like that of *A. mediterranea* lives longer and is able to develop a new plant I am unable to ascertain; but it seems most probable.

This small *Acetabularia* seems to me to be very closely related to *Acet. Farlowii* and *Acet. Suhrii*.

Acetabularia Farlowii, of which species I have had specimens for comparison from the Bermudas collected by M. A. Howe, seems however to be distinguished commonly from *A. Caliculus* in having the apices of the rays in the disc more or less broadly rounded, and in that the *Corona superior* only has two hair-scars and also that the stalk has no or in any case only feeble and few spindle-shaped swellings on the uppermost part and finally that the disc according to Howe is flattened. But I may point out that the specimens in one of my gatherings (Nr. 1617) from Long Point in some regards bear a close resemblance to *Acetabularia Farlowii*, especially by having the apices of the rays most often broadly rounded and by seldom showing any indication of emargination (Fig. 65). As the figure *B* shows, the *Corona superior* almost had the same form as in my other specimens of *A. Caliculus* (cfr. Fig. 63 *B*) and had 2—3 hair-scars. The form of the disc was basin-shaped. Yet this collection showed a peculiarity, namely, that two of the specimens had two discs one over the other thus resembling *Acet. crenulata*, but even quite young plants had the rays rounded or feebly undulated in the margin and not at all apiculate as in *A. crenulata*, from which the plants were very different. That however specimens are found, of which it may be difficult to decide the species, is seen by M. Howe's remark (l. c. 1905, p. 577): »The zones occupied by the two species (*A. Far-*

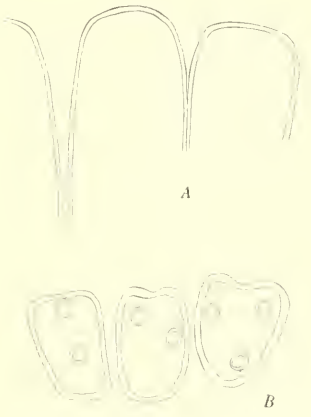

Fig. 65. *Acetabularia Caliculus* Quoi et Gaimard. Forma. *A*, summits of rays. *B*, Corona superior. (*A* about 15:1, *B* about 60:1).

lowii and *A. crenulata*) occasionally, however, overlapped; the individuals intermingling in this common region were, as a rule, easily referred at sight to the one species or other, though once in a while an individual was met with whose affinities seemed at first a little dubious«.

Another closely related species, if it is specifically different from *A. Caliculus*, is *A. Suhrii* of which I have had authentic material from the Botanical Museum in Berlin for comparison.

The reason why this species especially is said to be different from *A. Caliculus* is, according to Solms, that the segments of the corona superior have about four hair-insertions and that the rays in the disc are united by calcification of the side-walls, but completely separate after treatment with acid, whereas *A. Caliculus* according to Solms has the segments of the corona superior with two hair-insertions and the rays even in the living state separate and free. As to the last point I have already shown that this character is scarcely of much importance. And as to the hair-insertions I would also remark that there can scarcely be much difference; in two original specimens from the Botanical Museum in Berlin which I have examined I as a rule found 3 hair-scars in the segments which I saw most distinctly, in one I only found two; several of the segments were somewhat shrivelled and some of them may have had 4 scars. Even then the difference is not so great, as *A. Caliculus*, according to Solms, sometimes has three scars which were also sometimes found in my specimens. In the number of the rays also, Solms says that there is some difference, as in the *A. Suhrii* we have 25—30 as compared with *A. Caliculus* which only has 22—25. To this I may point out that in my material of the last named species I have found specimens with up to 31 rays, most frequently they had about 27. The specimen I have seen in the Brit. Museum of *A. Caliculus* had 26 rays[1]). Lastly, I would remark that the stipe in *A. Suhrii*, in any case on the specimens examined from the Museum in Berlin, has quite similar spindle-shaped swellings as are found in *A. Caliculus*; this is not mentioned by Solms.

Therefore I do not think it possible to take *A. Suhrii* as a species.

As pointed out in my earlier paper *Acetabularia caraibica* Kütz. is a very dubious form. Already in 1901 M. A. Howe has

[1]) The specimen drawn by Quoi and Gaimard seems also to have this number!

remarked that this species of Kützing cannot be satisfactorily distinguished from *A. crenulata*. On the faith of some original specimens in Kützing's Herbarium he has referred this species to *A. crenulata*, being most probably founded on few and badly developed specimens. The figure of *A. caraibica* of Kützing in »Tabulæ phycologicæ«, vol. VI, tab. 93 also resembles somewhat *A. Caliculus* and related forms, a fact Solms points out when writing: »On the other hand, it may resemble the following form (A. Suhrii) very much if the apiculum disappears; indeed Agardh has united them, as appears from his diagnosis; however, they are to be distinguished by the number and positions of the coronal segments«. As to the last remark of Solms, referring to Dr. Howe's paper l. c., I may point out that in a specimen from the Museum of Berlin and without locality, determined by Solms as *A. caraibica*, three and four hair-scars were found whereas this species according to Solms is said to have only two hair-scars. In accordance with Howe I therefore think it impossible to maintain Kützing's species[1]).

Acetabularia Caliculus was found in shallow water both in sheltered places and in more exposed localities. In the first mentioned locality it was growing at the entrance of a little lagoon, with mangroves on sandy bottom, fastened to shells and stones. In the other locality it was found on a coral-reef near the shore and was here constantly washed over by the small waves.

St. Croix: Lime Tree Bay, Long Point, White Bay. St. Thomas: Specim. ex herb. Mertens et Suhr (sub. nom. A. Suhrii Solms) in herb. Berol.

Geogr. Distrib. West Indies, Indian Ocean, Australia.

Acetabularia crenulata Lamx.

Lamouroux, J. V., Histoire des Polypiers coralligènes flexibles, Caen 1816. Solms-Laubach, Monograph, p. 24. Borgesen, l. c., 1908, p. 281. *Acetabulum crenulatum* (Lamx.) Kuntze, Howe, Observations on the algal genera Acicularia and Acetabulum (Bull. Torr. Bot. Club, vol. 28, 1901, p. 331).

[1]) It is much to be regretted that W. Arnoldi in a newly published paper (Algologische Studien. Zur Morphologie einiger Dasycladaceen (Bornetella, Acetabularia), Flora, Bd. 104, 1912) has referred an *Acetabularia* from the Malayan Archipelago to *A. caraibica* without knowing Howe's and my treatises. When Arnoldi here writes that both the figures of Kützing and the new figure of *A. caraibica* of Mlle Vickers are useless, then as to Kützing's I quite agree with him, but that of Mlle Vickers is a very good picture of a quite different plant, namely *Acicularia Schenckii*.

Fig. 66. *Acetabularia crenulata* Lam. Two plants fixed on a shell. (About 1:1).

The specimens found (Fig. 66) seem to agree very well with the description of Solms and Howe. Younger specimens were often found with 2—3 discs above each other, the older ones generally had only one. Plants in all stages of development occurred. The gametangia were spherical except the innermost of them nearest the stipe which were oval, the space in the rays being very narrow here. The gametangia have a very thick wall about 8 μ thick; their diameter is about 140 μ.

I have only once found this species in a mangrove swamp in shallow water near the shore on shells etc. in muddy bottom.

St. Thomas: Bovoni Lagoon.

Geogr. Distrib. West Indies, Florida.

Acicularia d'Archiac.

Acicularia Schenckii (Möb.) Solms.

Solms-Laubach, H., Monograph of the Acetabularieæ (l. c.); Howe, M. A., Observations on the algal genera Acicularia and Acetabulum (Bull. Torrey Bot. Club, 28, 1901, p. 321). Borgesen, F., l. c. 1908, p. 281.

Acetabularia Schenckii Möbius, Bearbeitung der von H. Schenck in Brasilien gesammelten Algen. Hedwigia, Bd. 28, 1889, p. 309.

Acetabularia caraibica, Vickers, Phycologia Barbadensis, tab. 49.

A few specimens were found in a collection of *Acetabularia crenulata*. They agree very well with the description of Howe (l. c. p. 323—4). In specimens with gametangia these before decalcification stuck together in the calcareous mass mentioned by Solms. The gametangia were about 70—80 μ in diameter. Corona superior and inferior have both rather thick walls and agree very well with the figures by Solms (l. c. pl. 3, figs. 12 and 4): the first has two hair-scars one behind the other. The disc is flattened or a little bent

Fig. 63. *Acicularia Schenckii* (Möb.) Solms. (About 2½ : 1).

upward. On the rounded apex of the rays a small apiculum is to be found in these specimens.

While these specimens occurred in shallow water growing on small shells and stones on muddy bottom together with *A. crenulata*, I have further found some very few individuals (Fig. 67) in deeper water and as these specimens seem to show a few differences I shall describe them a little more in detail. The plants were of intermediate size; the largest I have seen had a disc about 8 mm. broad. The length of the stipe varies from 1 to 3 cm.; it is vigorous, rather thickwalled and has no spindle-shaped swellings.

The disc is flattened; it has about 50 rather thinwalled rays which are all firmly united even after treatment with acid. The wedge-shaped rays end in a rounded apex which often quite lacks the small apiculum (Fig. 68 *A*). The corona superior and inferior (Fig. 68 *B* and *C*) are of almost the same oblong — cordate shape, with a rather deep sinus in the end turned outwards, deepest in the corona inferior. Corona superior has two hair-scars one behind the other.

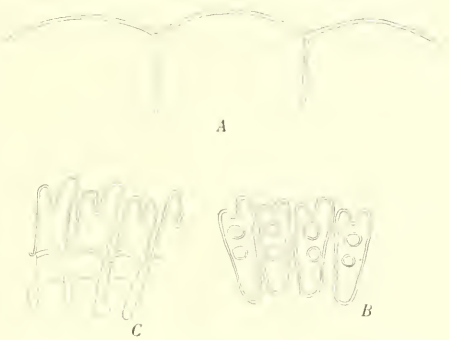

Fig. 68. *Acicularia Schenckii* (Möb.) Solms. *A*, ends of rays; *B*, Corona superior with hair-scars; *C*, Corona inferior. (*A*, 10:1, *B* and *C*, 60:1).

Rather a large number of gametangia (about 200) were found in the rays of one of the specimens; they were about 60 μ broad, but I may mention that the plant was yet quite immature: the calcareous massula in which the gametangia ought to be embedded I was unable to see in this specimen.

This species was found: St. Croix, at Long Point most probably in shallow water; St. Thomas: The Lagoon of Bovoni in shallow water; St. Jan: Off Cruz Bay in about 30 meters depth (only one specimen found), and off America Hill in about 16 meters depth (only two specimens found).

Geogr. Distrib. South America, West Indies.

III. Siphonales.

Fam. 1. ***Codiaceæ.***

Subfam. ***Flabellarieæ.***

Avrainvillea Decsne.

1. **Avrainvillea nigricans** Decsne,

Decaisne, Sur les Corallines (Ann. Sci. Nat. 2. sér., t. 18, 1842, p. 108). Howe, Phycological Studies III (Bull. Torr. Bot. Club, vol. 34, 1907, p. 491). Børgesen, The species of Avrainvilleas hitherto found on the shores of the Danish West Indies (Vidensk. Medd. naturh. Foren., 1908, p. 30). Vickers, Phycologia Barbadensis, 1908, p. 23, pl. XXX and XXXI (the last named figure sub nomine *Avr. longicaulis*). A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, Monographie LXII, 1911, p. 23, figs. 78—80.

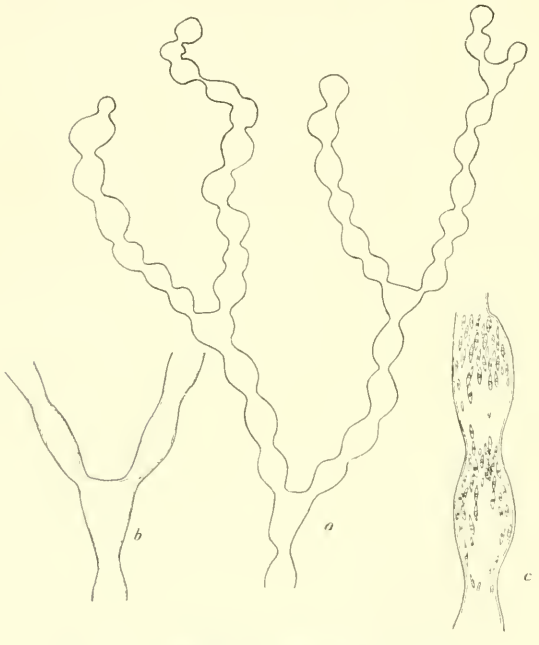

Fig. 69. *Avrainvillea nigricans* Decsne. *a* and *b*, parts of filaments; *c*, chromatophores. (*a* and *b*, about 70:1, *c*, 170:1).

This species is characterized by its very regularly moniliform filaments (Fig. 69 *a*); those of the interior are rather thick varying from about 50—70 μ, near the surface they grow thinner about 30 μ and get shorter links: the filaments are here woven together forming a rather loose and open cortical layer.

Avr. nigricans has a rather heterogeneous habitus. The stipe, which takes its rise from a terete rhizome fixed to the bottom, is terete, though often flattened in the uppermost part, passing evenly into the flabellum: the stipe can be 10—15 cm long and even more, or quite short. The shape of the flabellum also varies much.

It can be suborbicular or reniform often with cordate or cuneate base, the margin is entire or more or less lacerated, or even lobed. Most often it is not at all zonate, but specimens occur which are very clearly zonate.

On account of its very loose and felt-like texture *Avr. nigricans* is easily recognized by the numerous small openings in the flabellum through which the light passes when the specimens are held up against it.

The chromatophores in the young well-preserved filaments are small spindle-shaped plates and contain one or sometimes two pyrenoids (Fig. 69 *c*). Much amylum is often present especially in the older filaments. In these the chromatophores are often more roundish. It may be to these that Mr. & Mrs. Gepp allude (l. c. p. 26) when they have only found round chromatophores.

Avr. nigricans is the most common species of the Avrainvilleas in the Danish West Indies, where it occurs in deeper water at a depth of about 20—30 meters.

It has been found at St. Thomas: in the sea west of Water Island; St. Jan: in the Sound between St. Thomas and St. Jan at many places and near the Gr. St. James Island.

Geogr. Distrib. Florida, West Indies, Brazil.

2. **Avrainvillea Mazei** Murray & Boodle.

Murray & Boodle, A systematic and structural account of the genus Avrainvillea Decsne (Journ. of Botany. vol. 27, 1889, p. 70—1, tab. 288, fig. 6). Borgesen, The species of Avrainvilleas hitherto found on the shores of the Danish West Indies. (Vidensk. Medd. fra den naturh. Foren. 1908, p. 32). A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, Monographie LXII, 1911, p. 27, figs. 81—83.

Avrainvillea longicaulis Howe, Phycological Studies III. (Bull. of the Torrey Bot. Club, vol. 34, 1907, p. 509). Collins, The green Algæ of North America (Tufts College Studies, vol. II, 1909, p. 391).

In my paper quoted I have given my reasons why I think we may call this species *Avr. Mazei* and not *longicaulis* as Howe has done and Mr. & Mrs. Gepp agree with me in their monograph, giving there a very detailed survey of the intricate synonymy.

At the shores of the Danish Isles I have only found a single small, but quite typical specimen of this species. The stipe is about 3 cm. long, the breadth of the flabellum 7 cm; the whole length of the plant is 7½ cm. The form and size of the filaments agree very well with the figure of Mr. & Mrs. Gepp; they are about

50 μ thick not tapering at the apices, cylindric or a little torulose now and then.

The single specimen found was gathered in the sea west for Water Island at St. Thomas. It was found in a depth of about 30 meters.

That form (my collection nr. 1106) which (l. c. p. 34) I referred with doubt to *Avr. Mazei* seems to be an intermediate form showing likeness with several other forms. As I have described in my paper, the specimen in question is rather large, the stipe being about 20 cm. long and the flabellum 8 cm. high and 11 cm. broad; the margin of the flabellum is irregularly lobed. The filaments of the interior of the flabellum are cylindric (Fig. 70 *a*, *b*) about 50 μ thick, those of the surface thin about 20 μ and rather torulose or sometimes moniliform. The dried specimen has a brown olive-green colour, its surface is somewhat uneven, very indistinctly zonate; the consistency is rather firm. In its thicker cylindric inner filaments it agrees with *A. Mazei* but the variation in size of the filament and the thinner, torulose surface ramuli brings it nearer to *Avr. sordida*. After the monograph of Mr. & Mrs. Gepp appeared, I have shown my specimen to Mrs. Gepp during a visit to London and Mrs. Gepp after a short examination came to the result that the specimen in question most probably was the *Avr. canariensis* Gepp. Having now again examined the specimen and made a thorough comparison with the description and figures of Mr. & Mrs. Gepp I agree with Mrs. Gepp, that my specimen also shows much likeness with *Avr. canariensis*, but in one regard it differs essentially from the latter, namely, by the filaments growing thinner towards the surface while they do not taper in *Avr. canariensis*.

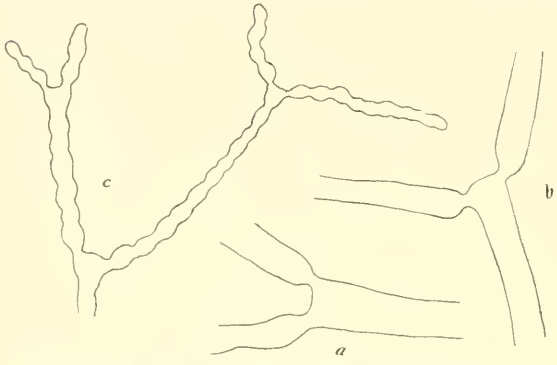

Fig. 70. *Avrainvillea Mazei* Murray and Boodle. Forma. Compare text. (About 70:1).

This specimen was found in a depth of about 30 meters in the sea west of Water Island at St. Thomas.

Geogr. Distrib. West Indies.

3. Avrainvillea Geppii nov. spec.

Avrainvillea spec., Børgesen, The Avrainvilleas hitherto found on the shores of the Danish West Indies (Vidensk. Medd. fra den naturh. Foren. i Kbhvn., 1908, p. 36).

Avrainvillea brunneo-viridis, 12 cm. alta, solitaria, stipitata; rhizoma rectum, 2 cm. longum, 1 cm. crassum, substrato adfixum, stipite $^1/_3$ cm. crasso, in superiore parte complanata. Flabellum transverse oblongum, 8 cm. latum, 5 $^1/_2$ cm. altum, leviter zonatum, margine flabelli lacerato vel lobato; filamentis frondis cylindricis, vel interdum hic illic subtorulosis, 30—40 μ crassis, superficiem versus tenuioribus (14—17 μ crassis) irregulariter torulosis, apicibus filamentorum crassioribus, subclavatis vel obtusis ad 19—25 μ, raro 27 μ crassis.

Fig. 71. *Avrainvillea Geppii* Børgs. Habit of plant. (About 1:1).

In my paper dealing with the Avrainvilleas from the Danish Isles I have mentioned an *Avrainvillea* species, which I at that time preferred to leave undescribed, having only gathered one specimen.

As Mr. & Mrs. Gepp's monograph has now appeared, I have again examined the specimen in question and feel quite convinced that my plant may be considered as a representative of

a new species for which I propose the name *Avr. Geppii* in honour of the authors of the very valuable monograph.

In discussing my plant Mr. & Mrs. Gepp write (l. c. p. 41): »The *Avrainvillea* spec. of Dr. Borgesen (loc. cit.) we have once seen, but have not had the opportunity of submitting to a searching examination. Judging from Dr. Børgesen's description and figures of the plant, we should suppose it to be a form of *A. sordida*, unless indeed it be a form of *A. asarifolia* Borg.«.

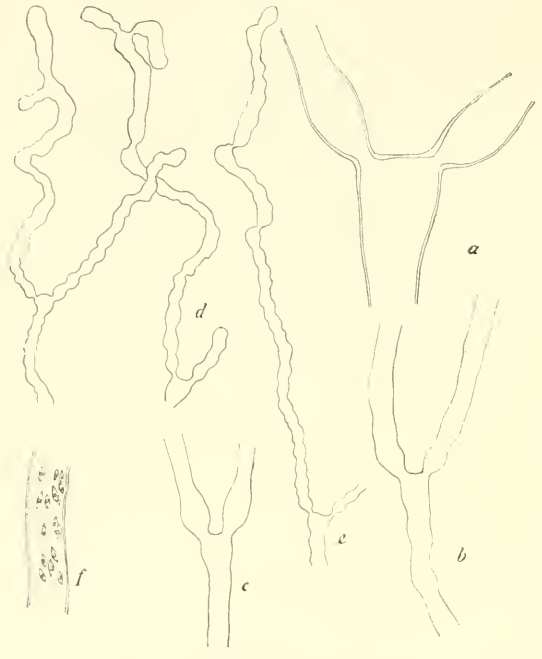

Fig. 72. *Avrainvillea Geppii* Borgs. *a*—*e*, parts of filaments; *f*, chromatophores. (*a* and *f*, about 170:1; *b*, *c*, *d*, *e*, 70:1).

I cannot agree with this view and shall in the following give my reasons for this.

The description given l. c. p. 36 I shall first of all reprint here with some few additions.

The colour of the dried specimen grey-green with a sordid yellow tinge. It has a short vertical rhizome covered quite densely with sand and gravel and very like those of e. g. *Penicillus* and *Halimeda*. From this short rhizome a slender stipe grows up; this is quite flat in the dried specimen most probably also in the living plant; the length of the stipe is 4½ cm., the breadth only 4 mm. It tapers somewhat upwards and passes rather suddenly into the flabellum. The flabellum is transverse oblong with a broad rounded base, 8 cm. broad, 5½ high, of a rather loose consistency and with a more or less lacerated and lobed margin; the surface is somewhat uneven and only very indistinctly zonate. The flabellum is very thin especially in the parts near the periphery.

Filaments in the interior of flabellum cylindric or some-

times a little torulose, about 30 μ in average diameter, only just below the dichotomy reaching 40 μ or a little more, rather strongly constricted above the dichotomy and above the constriction often a single moniliform swelling (Fig. 72 *a*, *b*), nearer the surface the filaments first taper (about 14—17 μ) becoming irregularly torulose and often somewhat constricted; towards the apices they again grow thicker, the apices being subclavate and obtuse and reaching a thickness of about 19—25 μ, seldom even 27 μ (Fig. 72 *d*, *e*).

Of forms characterized by such clavate apices Mr. & Mrs. Gepp mention three species, namely: *A. obscura*, *A. clavatiramea* and *A. Ridleyi*.

Of these the first mentioned species has much thicker filaments, these being nearly cylindric; the habit of the plant is also very different from my species.

In *A. clavatiramea* the filaments are more torulose reminding one in a way more of *A. Geppii*, but the filaments are much thicker and more straight; also the habit of this Australian plant is quite different.

And this is far more the case with the *A. Ridleyi* with its tufted, very irregularly branched growth.

St. Jan: Off Maho Bay in a depth of about 16 meters.

To this form most probably belongs a quite small plant found in the sea to the west of Water Island in a depth of about 30 meters. It only reaches a height of about 5¾ cm. and has a short, 1 cm. high, vertical rhizome covered with sand; the stipe is 1¾ cm. long and ¼ cm. broad, simple, expanding suddenly into the broad oblong frond. This is 2½ cm. high and 3½ cm. broad, of a tawny green colour and obscurely zonate.

The filaments in the flabellum nearly cylindric, sometimes a little torulose about 20—30 μ thick, near the surface somewhat thinner 15—20 μ and more torulose and irregularly bent sometimes also in the apices a little thicker again.

Mrs. Gepp to whom I have shown the specimen during a visit to London in 1911 was of the opinion, that it might perhaps be referred to the *Avr. Elliottii* known from Grenada and it cannot be denied that it shows much likeness with this species but it differs by the more torulose, irregularly bent and tapering surface filaments.

4. **Avrainvillea asarifolia** Borgs.

Børgesen, F., The species of Avrainvilleas hitherto found on the shores of the Danish West Indies (Vidensk. Meddel. fra den naturh. Foren. i Kbhvn.,

1908, p. 34, fig. 4 and tab. III). A. & E. S. Gepp, The Codiaceae of the Siboga Expedition, Monographie, LXII, 1911, p. 44.

The dried specimens have a dark olive-green colour sometimes with a greyish tinge, most probably the living specimens have nearly the same colour, perhaps somewhat more green. Stipe cylindric in the nethermost part becoming more flattened higher up, 6—23 cm. long, 7 mm in diam. Flabellum oblong-reniform with cordate or especially in older specimens more or less cuneate

Fig. 73. *Avrainvillea asarifolia* Borgs.
Habit of plant. (About $^3/_4$:1).

base up to about 10 cm. high and 14 cm. broad, entire or lobed, thin and membranous, of a rather firm consistency and in most of the specimens clearly zonate: the surface subglabrous, under a lens finely granulated.

Filaments in the interior of the flabellum cylindric or often slightly moniliform or torulose with a rather strong constriction above the dichotomy (Fig. 75 *a*, *b*). The diameter of the filaments about 20—30 μ, more often reaching only 24—27 μ. Near

the surface the filaments grow gradually slender, becoming more and more torulose and more richly ramified (Fig. 75 *c*, *d*), woven together, forming a rather firm but yet, seen under the microscope, open plectenchyma (Fig. 75 *e*); the diameter of the outermost filaments varies from 8—10—13 μ; the walls here in the outermost filaments are rather thick, thicker than those of the

Fig. 74. *Avrainvillea asarifolia* Børgs.
Habit of plant. (About $^{3}/_{4}$:1).

filaments in the middle of the flabellum. Sometimes the apex of the filaments runs out in a long hair (Fig. 75 *f*).

The chromatophores are roundish or oblong and contain a pyrenoid (Fig. 75 *g*). In older filaments a good deal of starch is present.

This characteristic species has its nearest ally, as to the structure of the filaments, in the Indian *Avr. amadelpha* described

at about the same time by Mr. & Mrs. Gepp[1]). As pointed out later on in their monograph, p. 45, the similarity of the structure of the frond is very striking, this species also having: »the tortuous, branched, irregularly swollen peripheral filaments felted into a pseudo-cortex of the frond« but on the other hand their habit and geographical distribution are very different.

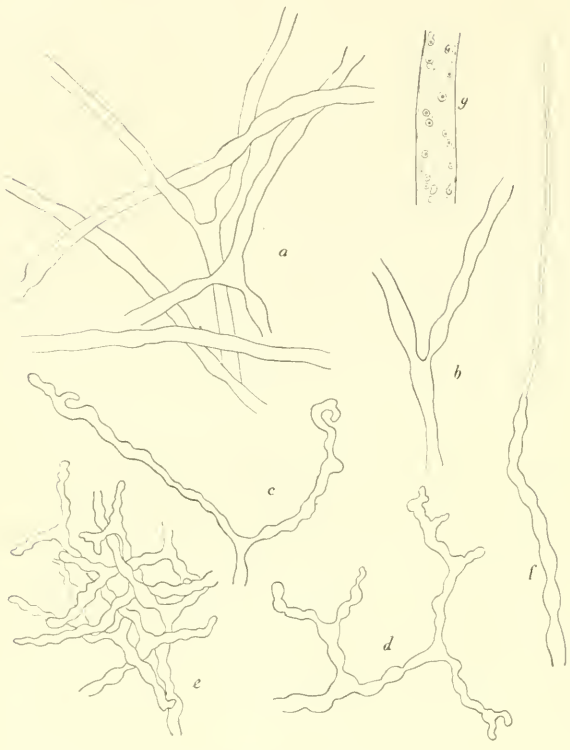

Fig. 75. *Arrainvillea asarifolia* Borgs. *a—f*, part of filaments, *g*, chromatophores. (*a—f*, about 70:1, *g* about 170:1).

This species was found at St. Thomas: at several places in the sea to the West of Water Island at a depth of about 20 meter. St. Jan: of Christiansfort in about 30 meters of water, and near the isle Gr. St. James in the Sound between St. Thomas and St. Jan at the same depth.

Rhipilia Kütz.

1. Rhipilia tomentosa Kütz.

Kützing, Tab. Phyc., vol. VIII, 1858, pag. 12, tab. 28, fig. 1. Murray & Boodle in Journ. of Bot. vol. XXVII, 1889, p. 72. A. & E. S. Gepp, The Codiaceæ of the Siboga expedition, Monographie LXII, 1911, p. 54, figs. 126—129.

[1]) A. and E. S. Gepp, Marine Algæ (Chlorophyceæ and Phæophyceæ) and marine Phanerogams of the »Sealark« Expedition (Transact. Linn. Soc. Bot., VII, 1908, p. 178, pl. 23, fig. 20,; pl. 24, figs. 21, 22,; Zool., vol. XII, 1909, p. 388, pl. 48, fig. 20; pl. 49, figs. 21, 22).

Udotea tomentosa Murray, Catalogue of the mar. Alg. of the West Indian Region (Journ. of Bot., vol. XXVII, 1889, p. 239). Howe in Bull. Torr. Bot. Club, vol. XXXIV, 1907, p. 512.

f. *zonata* Gepp, l. c. p. 55, fig. 129.

As Mr. and Mrs. Gepp had my material of various *Codiaceæ*, on loan they also got the two dried specimens of *Rhipilia* which I had succeeded in finding and upon which they have described the new forma *zonata*. Of one of my collections no. (2218) I meanwhile also had a specimen preserved in alcohol which I have examined somewhat more in detail.

Fig. 76. *Rhipilia tomentosa* Kütz.
a, *b*, filaments from near the surface; *c*, trichotomically divided filament from the interior; *d*, edge of the thallus.
(*a* and *d*, about 25:1, *b* and *c*, about 70:1).

The specimen I have found was of a very loose, soft and flabby consistency, the filaments being very loosely felted together. In Fig. 75 *d* I have given a part of the edge. The filaments divide themselves pseudodichotomously, some of these growing out again to long filaments, most of them only to quite short, rhizoid-like branchlets ending with 3—5 short spines or processes, by means of which the filaments of the thallus fix themselves to other filaments (Fig. 76 *a* and *b*).

While the greater part of these quite short rhizoid-like branchlets are in open connection with the mother filaments, some of them, especially the longer ones, are separated from it by a wall

and such walls occur also now and then in the filaments especially where they are divided. The walls always occur a little out in the branches and the filaments are most often somewhat slender here. The walls are formed quite in the same manner as e. g. is the case in *Codium*; an annular thickening appears which by and by grows thicker and at last quite closes the connection between the two cell-parts. The walls are first formed in the somewhat older thallus; quite near the edge of the thallus they are not yet found but the narrowings in the filaments are present (Fig. 76 *d*).

The cell wall of the plant is very thin. There is a great number of quite small, oval or lens-shaped chromatophores; any pyrenoids I have not found in them. The assimilation product is starch, which is found here and there as rather large oval bodies. Many nuclei are found in the protoplasm.

This nice and as it seems very seldom plant was only found twice in the Sound between St. Thomas and St. Jan: Off Crux Bay. It was gathered in a depth of about 30 meters.

Geogr. Distrib. Guadeloupe, St. Jan.

Cladocephalus Howe.

Cladocephalus luteofuscus (Crouan) Borgs.

Borgesen, F., The species of Avrainvilleas hitherto found on the shores of the Danish West Indies (Vidensk. Medd. naturh. Foren., 1908, p. 39). Gepp, A. & E. S., Marine Algæ of the »Sealark« Expedition (Transac. Linn. Soc., ser. 2, Bot., vol. VII (1908) and Zool. vol. XII, part 4, 1909). Gepp, A. & E. S., The Codiaceæ of the Siboga Expedition, Monographie LXII. 1911, p. 60.

Flabellaria luteofusca Crouan, in Mazé et Schramm, Essai de Classification des Algues de la Guadeloupe, p. 88.

Udotea luteofusca Murray, in Journ. of Bot., 27, 1889 p. 239; Howe, Phycological Studies III. (Bull. Torr. Bot. Club, 34, 1907, p. 513).

Of this species only a single but large and well-developed specimen has been found. It had a dark-green colour. The stipe (the basal part was wanting) is rather thin, about 4 mm. in diameter; it is cylindrical in the basal part, more flattened upwards and passes evenly into the flabellum; in the specimen found the length of the stipe was about 4 cm., between the stipe and the flabellum there was a broader flattened part, on the side of which most probably some laterally placed flabella have been present. The flabellum in the specimen found is transversely suborbicular, 8 cm. broad and $5\frac{1}{2}$ cm. high, entire, only with a

little lacerated margin, rather thin and membranaceous, but of a rather firm texture, reminding one somewhat of *Udotea*, the surface being rather dense and glabrous with distinct zonation.

In the interior of the flabellum the filaments are cylindric or sometimes a little subtorulose, seldom even moniliform (Fig. 78 *a—d*); above the dichotomy, which is not always so very typical, as one of the branches is most often somewhat thinner and placed to the side, just as sometimes filaments divided into three branches (Fig. 78 *e*) occur, the filaments are less or not at all constricted; the thickness of these main filaments varies from 60—70 μ or a little more. At the surface the filaments divide several times and grow here, rather suddenly, quite thin, the apical filaments reaching 6—8 μ in diameter (Fig. 78 *f, g*). These thin, irregularly branched and rhizoid-like ends of the filaments are rather firmly woven together and transformed to rather a dense and firm plectenchyma (Fig. 78 *h*). The stipe has a very similar anatomy. The plant is uncalcified.

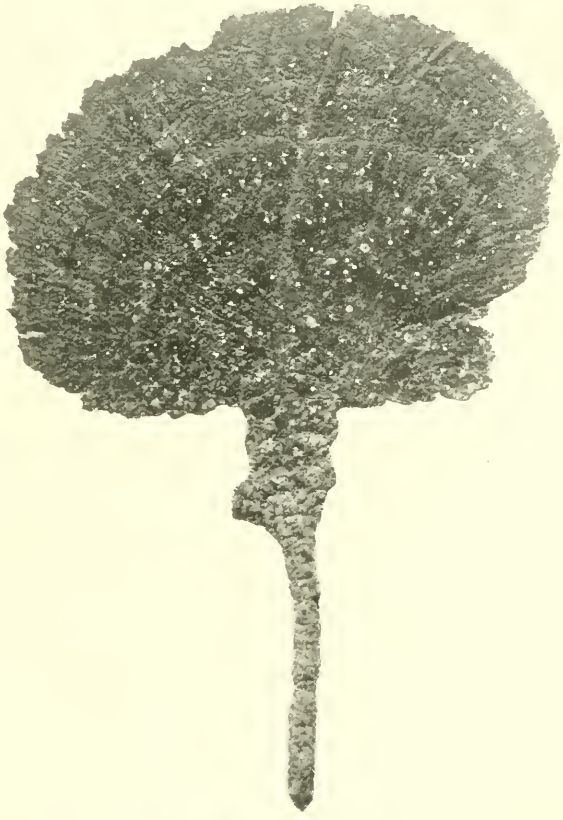

Fig. 77. *Cladocephalus luteofuscus* (Crouan) Borgs. Habit of plant. (About 1:1).

The chromatophores are roundish or oblong (Fig. 78 *i*), lying quite near the thin wall of the cell; they contain a pyrenoid and are often filled with amylum.

As I have pointed out in my paper, Howe (l. c.) was the

first who gave a description of this species, which he referred to the genus *Udotea* in accordance with Murray (l. c.).

As our plant shows exactly the same anatomical structure

Fig. 78. *Cladocephalus luteofuscus* (Crouan) Borgs.
a—*e*, part of filaments in the interior, *f*—*h*, of the plectenchyma; *i*, chromatophores. (*a*—*e*, about 20:1; *f*—*h*, about 70:1; *i*, 175:1).

as the *Cladocephalus scoparius* of Howe, I have suggested their identity in my paper quoted and may refer to it here.

It was found at St. Thomas: in the sea to the west of Water Island, where it was growing in a depth of about 20—30 meters.

Geogr. Distrib. West Indies.

Subfam. 2. ***Udoteae.***

Penicillus Lamx.

1. Penicillus capitatus Lamarck.

Lamarck, Sur les Polypiers empâtés (in Ann. Mus. Hist. Nat., vol. XX, Paris 1813, p. 297—299). A. & E. S. Gepp, The Codiaceæ of the Siboga Exped., 1911, p. 81.

Exsicc. Wittrock & Nordstedt, Algæ exsicc. nr. 1203.

Penicillus capitatus is one of the most common species in the Danish Islands, where it occurs on somewhat exposed and especially on quite sheltered places. It is a very characteristic species of the loose bottom, whether it consists of sand or mud. It varies considerably according to the different growing places. In the more exposed places, where it grows in strong light upon the dazzling white coral-sand, it is commonly short and robust. Capitulum dense, nearly globular, stipes 4—6 cm., seldom longer. Filaments ca. 200 μ in diameter sometimes somewhat thicker. My figure (Fig. 79) represents such a specimen. This is the typical form.

Fig. 79. *Penicillus capitatus* Lamarck f. *typica*. Habit of plant from more exposed place. (About 1 : 1).

In the sheltered localities in the lagoons, where the water is stagnant and often brackish and very unclear, our plant has a somewhat different appearance. The stipes grow longer, often up to 10 cm. or even more, capitulum loose and flabby, the filaments are longer, more openly placed and less incrusted; they are rather thin, varying in diameter from 125—150 μ, seldom thicker (Fig. 80). The specimens from deep water are very like those from the lagoon, only the capitulum is here often somewhat larger and more expanded.

The longer stalk approaches this form to the forma *elongata*, but this form as described by Mr. & Mrs. Gepp is different in the narrow, oblong capitulum and the much thicker filaments. On more exposed places sometimes specimens with rather long stalk occur which I think come near to the forma *elongata*.

For the lagoon form as described above I propose the name forma *laxa* (Fig. 80).

As above mentioned *Penicillus capitatus* is a very common species along the shores of the Danish West Indies. Regarding its way of growing I refer to my earlier papers (see f. i. in »Biologiske Arbejder tilegnede Eug. Warming«, 1911, p. 52), and shall only add here, that it is found in open sea down to a depth of about 40 m. growing on loose, sandy bottom.

Geogr. Distrib. West Indies, Florida.

Fig. 80. *Penicillus capitatus* Lam. forma *laxa*. Habit of plant from sheltered place. (About 1:1).

2. Penicillus Lamourouxii Decaisne.

Decaisne, Mém. sur les Corallines (Ann. Sci. Nat. sér. 2, t. XVIII, 1842, p. 109). A. & E. S. Gepp in Journ. of Bot. vol. XLIII, 1905, p. 2. A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, 1911, p. 78.

var. *gracilis* A. & E. S. Gepp, l. c.

Of this species only the var. *gracilis* has been found. It seems to be rather seldom and seems only to occur more scattered, in contrast to the gregarious growth of *P. pyriformis* and especially of *P. capitatus*.

It has been found in shallow water in rather exposed places and in deep sea also down to a depth of about 30 meters. It grows on sandy and muddy bottom, once it was also gathered on rocky coast.

St. Croix: Christianssteds Lagoon, Long Reef, near Buck Island in a depth of about 12 meter, Casava Garden, White Bay. St. Thomas: In the sea west of Water Island in a depth of about 30 meters.

Geogr. Distrib. West Indies, Florida.

3. Penicillus pyriformis A. & E. S. Gepp.

A. & E. S. Gepp in Journ. of Bot., XLIII, 1905, p. 1, pl. 468, fig. 1; The Codiaceæ of the Siboga Expedition, p. 85, fig. 169—171.

f. *typica*. Fig. 81.

A. & E. S. Gepp, l. c.

f. *explanata* n. f. Fig. 82.

Stipe often rather long, 6 cm. or even more. Capitulum of different form, often nearly plateformed expanded with a diameter of 10 cm. and more. Filaments in capitulum flabby much more loosely connected than in f. *typica*; they are also less incrusted.

The specimens referred to f. *typica* (Fig. 81) agree very well with the description and figures of Mr. and Mrs. Gepp. The stipe is short, somewhat thickened above, growing evenly over into the pyriform capitulum. This often has a deepening in the middle and herewith assumes an infundibuliform appearance.

While this form occurs in more shallow water and often in somewhat exposed places, the f. *explanata* has its home in deep water and can be considered as a form adapted to live in the altered conditions of life prevailing here. Thus the flat plateformed capitulum is assuredly an adaptation to the moderate light, the surface of assimilation being larger, and also the flabby and loosely connected filaments may be ascribed to the more quiet surroundings. But even if these specimens in this way often differ considerably in appearance from the f. *typica*, they are nevertheless easily recognised by means of the densely papillose surface of the stalk, a character which, I quite agree with Mr. & Mrs. Gepp, is an infallible character of this species.

Fig. 81. *Penicillus pyriformis* A. & E. S. Gepp. Habit of the typical form. (About 1:1).

The f. *typica* occurs at the Danish Islands commonly in a moderate depth (3—6 fathoms), only once have I found it in quite shallow water, namely in Krause's Lagoon; in other parts of the West Indies it seems to be common in quite shallow water; f. *expansa* is found in deep water down to a depth of about 40 meters.

P. pyriformis is a common species at the shores of the Danish Islands.

St. Croix: Off Frederikssted, Long Point, Krauses Lagoon. St. Thomas: In the sea west of Water Island. St. Jan: Off Cruz Bay, America Hill, near the island Great St. James and several other places.

Geogr. Distrib. West Indies, Florida.

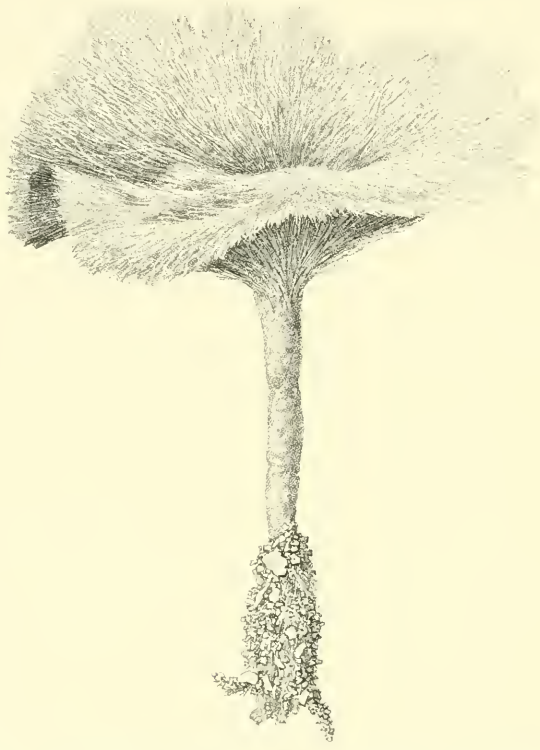

Fig. 82. *Penicillus pyriformis* A. & E. S. Gepp. f. *explanata* n. f. Habit of plant. (About 1:1).

4. **Penicillus dumetosus** Blainville.

Blainville, Manuel d'Actinologie, 1834, p. 553. A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition 1911, p. 76, figs. 156—159.

This species seems to be very rare at the Danish Islands and is only found in deep water.

The few specimens found here differ somewhat from the description of Mr. and Mrs. Gepp l. c. and their figure 156 which I think represents the forma *typica* of this species.

The capitulum of my specimens was very flabby, loose and large, surpassing many times the rather short stalk in length. Thus in one specimen the stalk was only two cm. long, while the capitulum reached a length of seventeen cm., being about 16 cm. broad, and another specimen had a 3 cm. long stalk and a capitulum 16 cm. high and nearly the same breadth. The proportionally few filaments are very long and wide apart, spreading to all sides; their diameter reaches 500—600 μ.

This form I call forma *expansa*.

It is found: St. Thomas, in the sea to the west of Water Island at a depth of about 30 meters, near Thatch Cay at the same depth (leg. Dr. Th. Mortensen). St. Jan: Off America Hill (30 meters).

Geogr. Distrib. West Indies, Florida.

Udotea Lamx.

1. **Udotea conglutinata** (Ellis & Solander) Lamx.

Lamouroux, Hist. Polyp. flex., 1816, p. 312. Howe, Phycological Studies IV, p. 96 (Bull. Torr. Bot. Club, vol. 36, 1909), A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, Monographie LXII, 1911, p. 114.

Corallina conglutinata Ellis et Solander, Nat. Hist. Zoophytes, 1786, p. 125, pl. 25, fig. 7.

Only a few specimens of this species have been found. The largest specimen was about 7 cm. high, the flabellum 5 cm. and 6 cm. broad, another had a total length of about 5 cm. and the flabellum of about 4 and 7 cm. broad. It is found growing in loose sandy or muddy bottom in sheltered places in shallow water and in open sea in deeper water at a depth of about 5 fathoms.

It is only found at St. Croix: Buck Island, off Frederikssted, Krauses Lagoon.

Geogr. Distrib. West Indies, Florida.

2. **Udotea cyathiformis** Decsne.

Decaisne, Mémoire sur les Corallines ou Polyp. calcif. (Ann. Sci. Nat., 2. sér., t. XVIII, 1842, p. 106). Howe, Phycological Studies, IV, (Bull. Torr. Bot. Club, 36, 1909, p. 96, pl. 3 and pl. 8 figs. 8—10. A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, Monographie LXII, 1911, p. 117, figs. 2, 6, 9.

Udotea conglutinata Vickers, Phycologia Barbadensis, 1908, p. 24, pl. XXXII.

Of this species I have a rather large collection. The largest specimen is about 13 cm. high, the flabellum alone 10. As pointed out by Mr. & Mrs. Gepp the flabellum when typically developed

is cyathiform but often it is split or unilaterally developed and specimens occur with quite flat flabellum.

It is only found in deep water down to a depth of about 40 meters and grows upon sandy bottom.

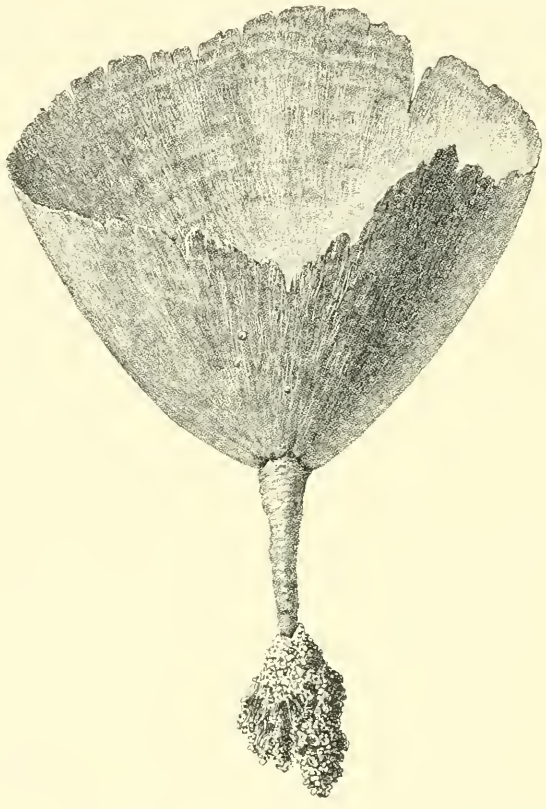

Fig. 83. *Udotea cyathiformis* Decsne. Habit of plant. (About 1:1).

St. Croix: White Bay; St. Thomas: In the sea to the west of Water Island, also found at this island by the »Challenger« Expedition; St. Jan: Off Cruz Bay, off America Hill,

Geogr. Distrib. West Indies.

3. **Udotea spinulosa** Howe.

M. A. Howe, Phycological Studies, IV (Bull. Torr. Bot. Club, vol. 36, 1909, p. 97, pl. 4, fig. 2, pl. 8, figs. 1—7). A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, Monographie LXII, 1911, p. 124, figs. 12, 55.

Only two specimens have been gathered, the one, my collection no. 1915, is after the determination of Mr. & Mrs. Gepp quite typical, the other one, a small specimen, my collection no 2101 b, approaches the forma *palmettoidea*.

It is found in deep water about 30—40 meters and growing upon loose, sandy bottom.

St. Thomas: The »Challenger« Expedition, 5—15 fathoms, (in Herb. Kew). St. Jan: Off Cruz Bay, off America Hill.

Geogr. Distrib. Bahama, Danish West Indies.

4. **Udotea occidentalis** A. & E. S. Gepp.

A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, Monographie LXII, 1911, p. 127, figs. 18, 22 a, 22 b, 63—65.

This species is nearly related to *Ud. argentea* from the Indian and Pacific Oceans but as pointed out by Mr. & Mrs. Gepp different from it in several regards.

It seems to be a very seldom plant. In spite of my many dredgings only three specimens have been gathered. They are all complete with stalk and a much lobed flabellum. One of the specimens is pictured in the monograph of Mr. & Mrs. Gepp, pl. VII, fig. 64. The accompanying figure (Fig. 84) shows another specimen.

Fig. 84.
Udotea occidentalis A. & E. S. Gepp.
Habit of plant (my collection Nr. 2101 a).
(About 1 : 1).

It was found in deep sea only at about 30—40 meters depth, where it was growing upon sandy bottom. It has only been gathered in the sea round St. Thomas and St. Jan.

St. Thomas: »Challenger« Expedition, 5—15 fathoms in Herb. Mus. Brit.; St. Jan: Off America Hill, off Cruz Bay.

Geogr. Distrib. This species has hitherto only been found in the Danish West Indies.

5. **Udotea verticillosa** A. & E. S. Gepp.

in Journal of Botany, vol. 47, 1909, p. 269; The Codiaceæ of the Siboga Expedition, Monographie LXII, p. 128, figs. 16, 19, 23, 25 b, 25 c.

Of this species a rather large collection has been gathered. Referring to the thorough description of Mr. & Mrs. Gepp, based essentially upon my collection, I shall only point out here that the species seems to be rather common in deep water about 20—40 meters, where it grows upon sandy bottom.

It is only found at the shores of St. Thomas and St. Jan, namely, St. Thomas: in the sea to the west of Water Island in many dredgings

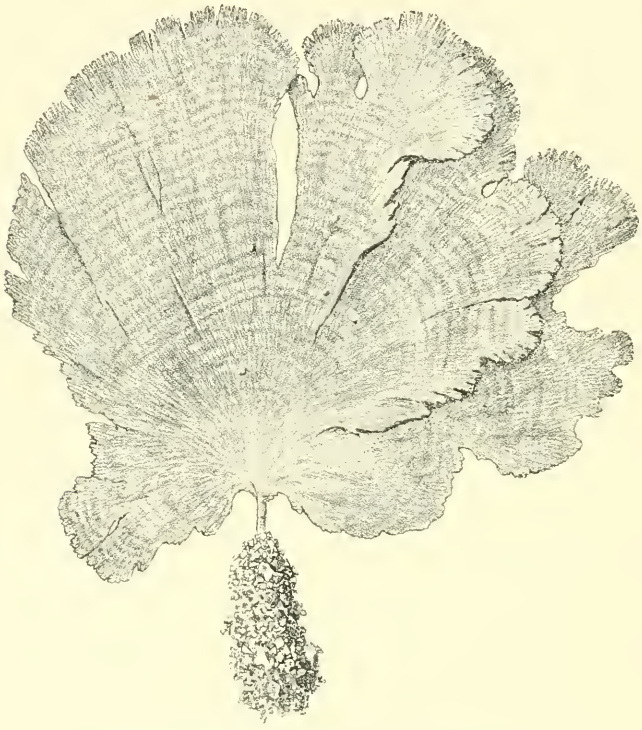

Fig. 85. *Udotea verticillosa* A. & E. S. Gepp.
Habit of plant, my collection, nr. 2211. (About 1:1).

and in a depth of 20—40 water. St. Jan: Off Cruz Bay in the Sound between St. Jan and St. Thomas also at many places. At St. Thomas it was also earlier found by the »Challenger« Expedition in 5—15 fathoms.

Geogr. Distrib. Hitherto only found in the Danish West Indies.

6. **Udotea Flabellum** (Ellis et Solander) Howe.

Howe, Bull. Torr. Bot. Club, vol. 31, 1904, p. 94. A. & E. S. Gepp, The Codiaceæ of the Siboga Expedition, Monographie LXII, 1911, p. 131, figs. 26—28.

Corallina Flabellum Ellis & Solander, Nat. Hist. Zoophyt., 1786, p. 124, tab. 24.

Udotea flabellata Lamouroux, Hist. Polyp. corall. flex. 1816, p. 311, tab. XII, fig. 1.

Exsicc., Wittrock et Nordstedt, Algæ exsicc. no. 1202.

As pointed out by Mr. & Mrs. Gepp *Udotea Flabellum* is a very variable plant as to its outer appearance, being often simple with entire margin, but most often it is irregularly lobed and has plenty of proliferations. And just as its outer habit is very variable, so also it is found growing under very different external conditions of life. Thus it occurs often in great numbers in the lagoons in shallow water growing upon the muddy or sandy bottom. And it is found in more exposed places in those areas of the sea with shallow water and sandy bottom lying behind the coral reefs, which are so common along the shores of St. Croix. And finally it is found in deep water down to a depth of about 30—40 meters, here also growing upon loose sandy bottom.

We may now ask how far the different external conditions of life make differences in the habit of the plant. These are present of course, even if they do not always seem so very clearly expressed.

The deep-water form has most often a rather thin thallus, is very distinctly zonate and has a lighter green colour, moreover it is often much divided and proliferous.

The specimens growing in shallow water but in more exposed places are often very firm and thick, undulated-folded, not zonate or in any case indistinctly, often entire but often also richly lobed and proliferous.

Near Krause's Lagoon on the south side of St. Croix, growing in shallow water among sea-grasses where small waves were rolling constantly towards the shore, a more slender form with narrow proliferations was found. Elsewhere in the lagoons in quite sheltered places the specimens occurring were often quite entire with no proliferations and nearly flat not folded fronds, but proliferating specimens were also often found here.

Udotea Flabellum is a common species nearly everywhere at the shores of the islands with exception of the most exposed localities.

Geogr. Distrib. Found in all tropical oceans.

Halimeda Lamour.

1. **Halimeda Tuna** (Ellis et Solander) Lamx.

Lamouroux, Extrait d'un mémoire sur la classification des Polypiers coralligènes non entièrement pierreux (Nouv. Bulletin Soc. Philom. Tome III, Paris 1812, p. 112). Barton, The Genus Halimeda (Siboga Expeditie, Monogr. LX, 1901, p. 11). Howe, Phycological Studies III (Bull. Torrey Bot. Club, vol. 34, 1907, p. 494). Borgesen in Bot. Tidsskrift, vol. 31, 1911, p. 134.

Corallina Tuna Ellis and Solander, Nat. Hist. Zoophytes, London 1786, p. 111, tab. 20, fig. c.

var. *typica* Barton l. c. p. 13, pl. 1, fig. 1.

Of this form I have only collected a few specimens in rather deep water (5 fathoms) in open sea off White Bay on the south side of St. Croix.

var. *platydisca* (Decsne) Barton, l. c. p. 14, pl. 1, fig. 2.

The specimens referred to this form have rather thin but large (up to 4½ cm. broad) joints; they have when dried a whitish-green colour and are less calcified than the var. *typica*. They occur often fixed to shells, corals etc. lying on the bottom, but they are also able to grow upon the loose bottom, fixing themselves by means of rhizoids to coarser sand particles etc.

Only found in the open sea in deep water (10—20 fathoms).

St. Thomas: in the sea to the west of Water Island, St. Jan: in the sound between this island and St. Thomas off Cruz Bay and in the sea north of St. Jan off America Hill.

Geogr. Distrib. Found in nearly all warm seas.

2. **Halimeda discoidea** Decaisne.

J. Decaisne, Sur les Corallines (Ann. Sc. Nat. Sér. II, 18). M. A. Howe, Phycological Studies III (Bull. Torr. Bot. Club, 34, 1907, p. 495). Borgesen, l. c., p. 134.

As pointed out in my above quoted paper I agree with Howe in considering *H. discoidea* as well separated from *Halimeda Tuna*.

var. *typica* Howe, l. c. p. 495, pl. 25, figures 11—20; pl. 26.

The specimens referred to this variety seem to agree rather well with Howe's description and figures, being only somewhat smaller. They were all found in moderately deep water (about 5 fathoms) in open sea off White Bay on the south side of St. Croix.

var. *platyloba* Borgs., l. c. Fig. 86.

Different from var. *typica* by having broader (up to 40 cm. broad) joints and, especially the younger ones, being only very little calcified. As to the anatomical characters var. *platyloba* agrees very well with var. *typica*, only the peripheral utricles seen from above seem to be a little larger in this form than in var

Fig. 86. *Halimeda discoidea* Decaisne var. *platyloba* Borgs. A young plant with new joints above. (About 1:1).

typica. Compared with var. *platydisca* of *H. Tuna* in external habit the two forms show great agreement, nevertheless some lesser differences are present; of these may be mentioned that the thallus is thinner, more greenish and less calcified in var. *platyloba* than in var. *platydisca*, just as the surface of the joints seems to be a little smoother in var. *platyloba*, more uneven in var. *platydisca*. But in the anatomical characters, as stated before, the two

forms are easily separated, each having the characters of the respective typical forms.

Quite in the same way as var. *platydisca*, var. *platyloba* is a deep-water form occurring at the Danish Isles in depths from 10—20 fathoms.

It is found in the sea round St. Jan. Off Cruz Bay and off America Hill. It was growing partly on shells and stones, partly also upon the loose bottom itself.

Geogr. Distrib. Found in most warm seas.

3. **Halimeda Opuntia** (L.) Lamx.

Lamouroux, l. c., p. 186. Barton, l. c. p. 18. Borgesen, l. c. p. 136.

var. *typica* Barton, l. c. p. 20.

var. *triloba* (Decsne.) Barton, l. c. p. 20.

H. Opuntia occurs most often in shallow water, but once I have found it in deeper water in about 10 fathoms; it occurs both on sheltered and on more exposed coast, var. *triloba* being a more sheltered form, var. *typica* also occurring on more open coast; it is often found in the lagoons lying like large cakes loose upon the bottom.

It is a very common species, found everywhere with the exception of the most exposed localities only.

Geogr. Distrib. In all tropic oceans.

4. **Halimeda gracilis** Harv.

Harvey, Alg. Ceylon, No. 72. Barton, The genus Halimeda, p. 22.

Of this nice species I have found a form in rather deep water at St. Jan, which I think may be considered as new and for which I have proposed the name:

var. *opuntioides* Borgs., Fig. 87.

Joints large, broadly suboval—reniform often distinctly crenulated at the upper margin or sometimes even trilobed, having upon the whole a very great resemblance to forms of *Halimeda Opuntia*. The dried specimen is whitish-green in colour. The joints are rather thick but easily breakable, the calcification being not very strong.

Joints up to 14 mm broad and 9 mm high.

Whilst its outer appearance is in this way rather different from the two forms (f. *typica* and f. *laxa*) we find figured in Mrs.

Gepp's monograph, the anatomical structure of our form agrees exactly with the description and figures given by Mrs. Gepp.

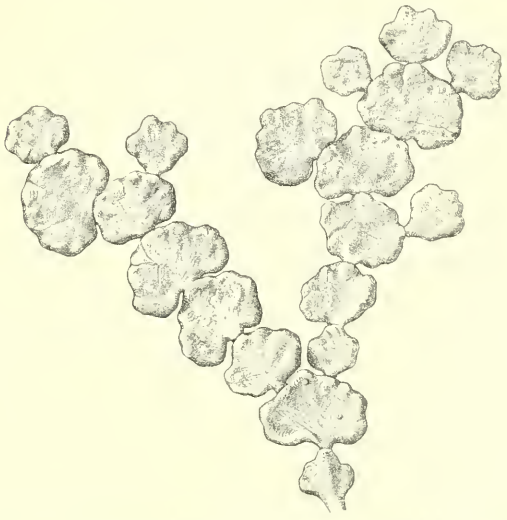

Fig. 87. *Halimeda gracilis* Harv. var. *opuntioides* Borgs. (About 1:1).

St. Jan: Off Hermitage in the sound to the north of this island and Tortola in a depth of about 30 meters. It was earlier found at St. Thomas by the »Challenger« Expedition and Mrs. Gepp tells me that forms from this island exactly like mine are in the British Museum.

Geogr. Distrib. In the tropic parts of the Indian and Pacific Oceans, more seldom in the Atlantic.

5. **Halimeda incrassata** (Ellis et Solander) Lamx.

Lamouroux, Sur la classification des Polypiers etc. (l. c. 1812, p. 186); Barton, The genus Halimeda l. c. p. 25. Børgesen, l. c. p. 136.

Corallina incrassata Ellis et Solander, The natural history of many curious and uncommon Zoophytes, London 1786, p. 111, tab. 20, figs. d, d_1—d_3, D_1—D_6.

Halimeda tridens Howe, Phycological studies III, (Bulletin of the Torr. Bot. Club, vol. 34, 1907, p. 501).

In my paper quoted I have given my reasons why I mean we may use the specific name *incrassata* and refer to it here.

Howe refers four species to his *Halimeda tridens* group, namely, *H. faculosa* Howe characterized by very large peripheral utricles; a form like this I have not found in the Danish West Indies. Further besides the typical *H. incrassata* he considers the var. *monilis* as a species and describes finally the new species

H. simulans. As distinctions between the species besides differences in their outer appearance Howe also lays stress upon histological characters, namely the peripheral utricles, as after Howe these in *H. tridens* are 49—77 μ in average maximum diameter while in *H. monile* and *H. simulans* they are 30—40 μ in average maximum diameter, these two species being otherwise kept separated by the forms of the joints which are mostly subterete in the first mentioned, discoid in the last.

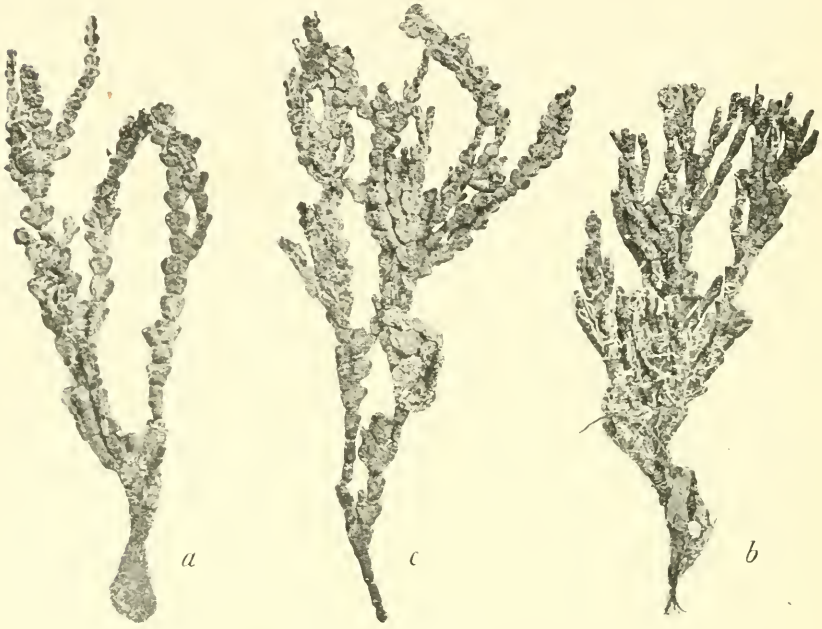

Fig. 88. *Halimeda incrassata* (Ellis et Solander) Lamx.
Three different forms from Krause's Lagoon (my collections nr. 1484). Regarding the habit of these plants, *a* and *c* may be referred to var. *typica*, *b* to var. *monilis*. As pointed out in my paper l. c. p. 139 the size of the peripheral utricles shows much variation. (About $^2/_3$:1).

Having now examined a very large number of specimens in my collection I willingly admit that these characters in the different forms very often agree with what Howe has found, in that the peripheral utricles are large in specimens belonging to the typical form and smaller in forms coming near to *monile* and *simulans*. But just as intermediate stages occur in the outer appearance of these forms, so we often also find specimens with large and small cells intermingled or specimens in which the outer form and the dimensions of the peripheral utricles point against

each other. In my paper quoted I have given some examples illustrating this fact.

Referring to these observations, therefore, I cannot consider the forms found by me at the Danish West Indies as different species but only as varieties of the same species.

var. *typica* Barton.

Barton, l. c., p. 27.

Most of the specimens referred to this variety were in good accordance with the figure of Mrs. Gepp, some of the specimens had some resemblance with forma *tripartita* Gepp, l. c., p. 27, fig. 43, though not quite so typically developed as this figure; some others had a little broader joints approaching them somewhat to var. *simulans*. As to the size of the peripheral utricles, the diameter of these in most of the specimens was found to be about 40—50 μ, in others cells were found with diameter up to 100 μ.

In Christiansted's Lagoon I have found a nice little form which I think deserves to be considered as a new form.

f. *gracilis* Borgs. Fig. 89.

Joints small, nearly circular or broad oval and indistinctly ribbed. Not much calcified and rather flexible. The diameter of the peripheral utricles varies from 40—67 μ. The filaments of the central strand communicate at the apex of the joints by means of pits. Of the forms described by Mrs. Gepp I think it comes nearest to forma *rotunda*

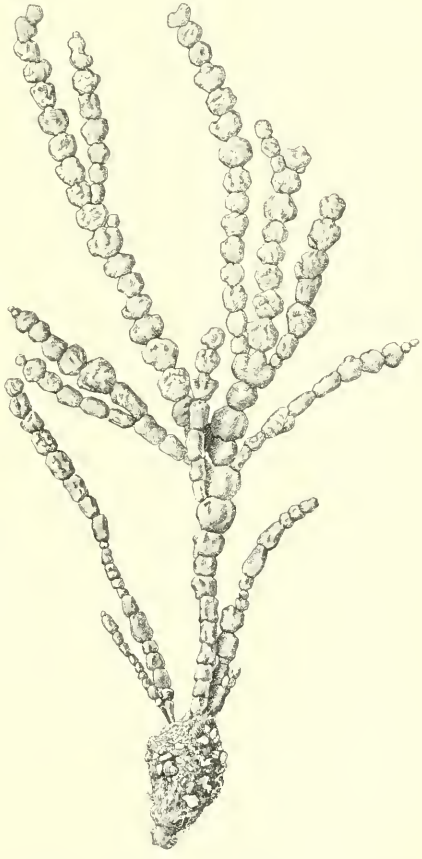

Fig. 89. *Halimeda incrassata* (Ellis et Solander) Lamx. var. *typica*, forma *gracilis* Borgs. (About 1:1).

but in the dimensions and form of the joints it is well separated.

Var. *typica* is found in shallow water in sheltered localities, especially in the lagoons where it often grows abundantly in the soft bottom but also on more exposed coast and in deep water down to a depth of about 30 meters. It is common at the islands.

Forma *gracilis* was only found in Christiansteds Lagoon, where it was growing in shallow water upon the soft bottom.

Fig. 90. *Halimeda incrassata* (Ellis et Solander) Lamx. var. *monilis*, *f. robusta* Borgs. (About $^2/_3$:1).

var. *monilis* (Ell. et Sol.).

Barton, The genus Halimeda, p. 27. *Corallina monile* Ellis and Solander, Nat. Hist. Zooph. 1786, p. 110, pl. 20, fig. c. *Halimeda monile* Lamx., Sur la classif. d. Polyp. corall., (N. Bull. Soc. Philom., Paris 1812, p. 186). Howe, Phycol. Studies III, l. c., p. 501.

The specimens referred to this variety have commonly small peripheral utricles as pointed out by Howe, in average maximum diameter from 30—44 μ, but exceptions often occur; one specimen in my collection (nr. 1695) had such groups of cells reaching even a dimension of 80 μ while most of the surrounding cells had a diameter of 35—40 μ. Other specimens from Rendezvous Bay, St. Jan (nr. 1873 b) had also rather large cells (diameter from 35—60 μ). Compare also the specimen (nr. 1601) mentioned in my earlier paper p. 140.

The specimens of this variety from the Danish Isles can be referred to two forms:

f. *robusta* Borgs. Fig. 90.

Plant of a robust vigorous growth with numerous branches densely crowded. Joints at the base broad, cuneate, strongly calcified growing together to form a short stem, higher up narrower, tridentate or often nearly cylindrical. The peripheral utricles in the specimen shown in Fig. 90 were from 30 μ—51 μ in diameter. This form comes rather near the typical figure of Ellis and Solander (l. c. p. 110, tab. 20, fig. c). On the other hand it differs rather much from the figure of var. *monile* given by Mrs. Gepp, l. c. fig. 40.

f. *cylindrica* Borgs. Fig. 91.

= ? *Halimeda cylindracea* Decaisne, Sur les Corallines (Ann. sc. nat., 2. sér., t. 16).

Distinguished by having only few erect branches which give the plant a slender appearance. The joints are nearly cylindric in the lower and middle part of the plant, somewhat flattened and tridentate at the uppermost end. The peripheral utricles were in the specimen figured from 35—60 μ in diameter.

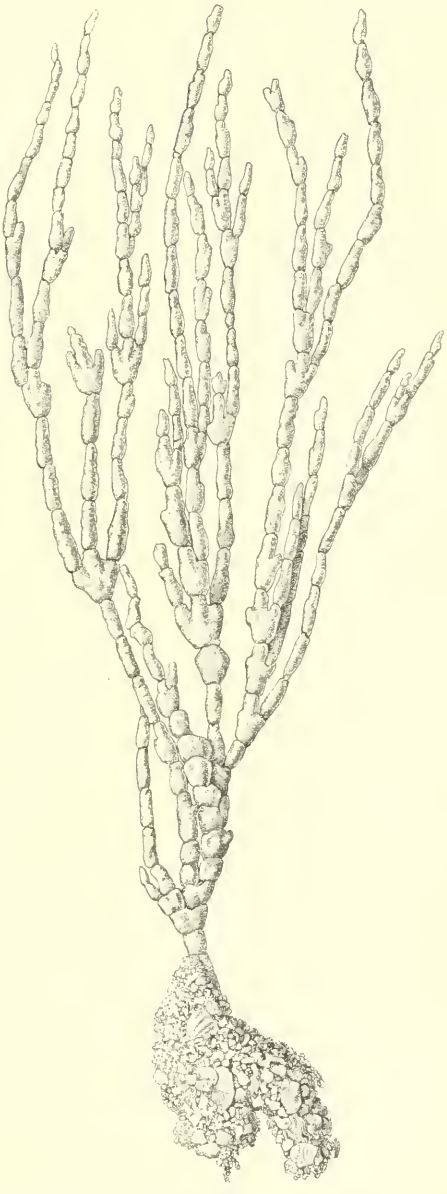

Fig. 91. *Halimeda incrassata* (Ellis et Solander) Lamx. var. *monilis*, f. *cylindrica* Borgs. (About 1 : 1).

Forma *robusta* is a rather common form and occurs in rather open and somewhat exposed localities.

It is found at St. Croix: on sandy shores behind Long Reef and on the south side in Lime Tree Bay and White Bay; further at Buck Island.

Forma *cylindrica* occurs in more sheltered localities with muddy bottom.

It is found at St. Croix: near Krauses Lagoon.

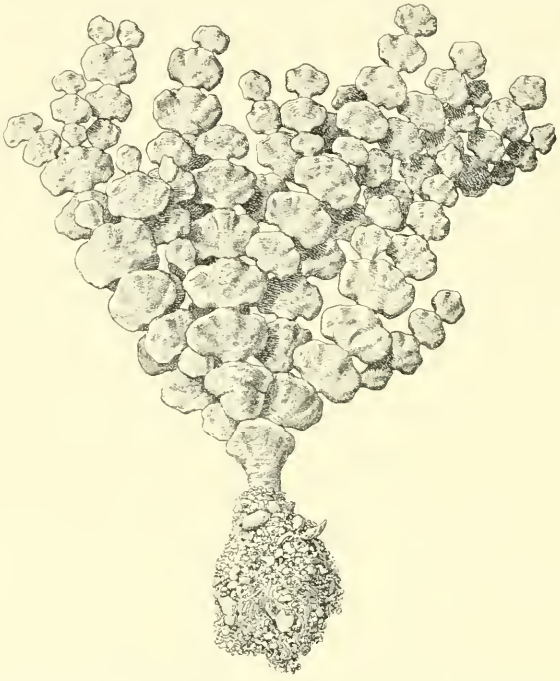

Fig. 92. *Halimeda incrassata* (Ellis et Solander) Lamx. var. *simulans* (Howe) Borgs. (About 1:1).

var. *simulans* (Howe) Borgs., l. c. p. 144. Fig. 92.

Halimeda simulans Howe, Phycological Studies III (Bullet. Torr. Bot. Club, vol. 34, p. 491, 1907).

This nice variety is a characteristic form with broad oval joints; it possesses, when living, a nice, light-green colour. The diameter of the peripheral utricles lies mostly between 35—54 μ; but as mentioned above variations often occur.

This form is found partly in the lagoons, growing in shallow water upon the loose bottom, partly also in deep water down to 30—40 meters or more.

St. Croix: Christianssteds Lagoon, common in shallow water upon soft muddy bottom, White Bay (10 meters of water). St. Thomas: Bovoni Lagoon in shallow water, in the sea west of Water Island in a depth of about 30—40 meters of water.

Geogr. Distrib. West Indies, Indian and Pacific Oceans.

Subfam. 3. Codieæ.

Codium Stackh.

Of this genus I have only collected rather scanty material, so that I have not been able to make any detailed examination of the species belonging to it.

1. **Codium difforme** Kütz.

Kützing, Phycologia generalis, 1843, p. 309; Tabulæ phycologicæ, vol. VI, pl. 99. Vickers, Phycol. Barbad., tab. XXV.

The size of the utricles varies considerably, their diameter being mostly about 150 μ, but sometimes reaching even 300 μ.

Only a few specimens have been found. I have collected it near Lt. Princess, St. Croix, in rather shallow water; another specimen was sent by Mr. O. Hansen Ganneskov at St. Croix and most probably collected at the south coast of the island.

Geogr. Distrib. Mediterranean, West Indies, warmer Atlantic and Pacific Oceans.

2. **Codium tomentosum** (Huds.) Stackh.

Stackhouse, Nereis Britannica, 1795, p. 21, pl. VII. Harvey, Phycologia Britannica, pl. XCIII. J. Agardh, Till Algernes Systematik, VIII, Siphoneæ, p. 40.

Utricles 100—150, seldom 200 μ diam.

This species occurs both in more open places in shallow water, where it is under the influence of the waves and in sheltered localities, lagoons etc. and also in deep water.

St. Croix: Christianssteds Lagoon, Cane Bay. St. Thomas: In the harbour (leg. Orsted). St. Jan: Near Thatch Island in a depth of about 30 meters.

Geogr. Distrib. Widely spread in all temperate and warmer seas.

3. **Codium isthmocladum** Vickers.

Vickers, Liste des Algues marines de la Barbade (Ann. sc. nat. 9. série, vol. 1, 1905, p. 57); Phycologia Barbadensis, tab. XXVIII.

I have referred several rather variable forms to this species, quite typical specimens not being found.

One form (my collections nr. 1364) had a habit rather like the figures of M^lle^ Vickers, but some of the utricles were up to 350 μ thick and among these some smaller ones often not more than 90 μ diam. occur; and as these thin utricles were also found bearing sporangia I think they have been full grown. The thick sporangia were about 3 times as long as the diameter.

Some other specimens (nr. 1962) of which one was richly proliferous had some very irregularly shaped utricles, more or less jar- or barrel-shaped, the apices of the utricles were broadly rounded, one utricle was ending in a point, reminding one of *C. mucronatum*. Also the size of the utricles was very variable from 80 μ diam. up to 200—300 μ and more, a single one was found reaching even 600 μ in diam.

Other specimens again were rather like the figure of M^lle^ Vickers but the utricles were often a little too thick up to 320 μ.

This species was found both in shallow water in a rather exposed locality and in deep water down to a depth of about 30—40 meters.

It was found, St. Croix: Coakley Bay on the east end of the island. St. Jan: in the sea round this island: off Cruz Bay, off America Hill, off Annaberg.

Geogr. Distrib. West Indies.

4. **Codium elongatum** C. Ag.

C. Agardh, Spec. Alg., vol. 1, p. 454. J. Agardh, Till Algernes Systematik, VIII, Siphoneæ, p. 46. Vickers, Phycol. Barbad., p. 22, pl. XXVII.

Some few specimens were found; the whole plant was nearly terete also at the dichotomies; it was only very little narrowed here.

Utricles, obovate-clavate, about 400 μ diam., four times as long as broad.

Found at St. Jan: Off America Hill in a depth of about 30 meters.

Geogr. Distrib. Mediterranean, West Indies, Brazil, Atlantic coast of Africa etc.

Fam. 2. ***Bryopsidaceæ.***

Bryopsis Lamouroux.

1. **Bryopsis Duchassaingii** J. Ag.

J. Agardh, Nya algformer. Öfvers. K. Vet.-Akad. Förh., Stockholm 1854, p. 107; Till Algernes Systematik, 5te afd., VIII. Siphoneæ, p. 31. Collins, Green Algæ of N. Am., p. 403.

Trichosolen Antillarum Montagne in Ann. des Scienc. Nat., IV. Série, Bot., T. XIV, 1860, p. 171.

Of this species I have found in my collection two specimens preserved in alcohol which agree very well with COLLINS' description of this species and with the specimen (nr. 474) of »Phycotheca Bor. Am.« quoted by COLLINS.

Also the few dried specimens I earlier had referred to *Br. hypnoides* Lamx. (cfr. Botanisk Tidsskrift, vol. 31, p. 147) belong to *Br. Duchassaingii.*

This species has been found in sheltered places in lagoons or bays and most often growing upon roots of mangroves.

It was gathered St. Croix: Christianssteds Lagoon, Saltriver Lagoon. St. Thomas: In the harbour.

Geogr. Distrib. Florida, West Indies.

2. **Bryopsis plumosa** (Huds.) Ag.

C. AGARDH, Species Algarum, vol. I, p. posterior, 1822, p. 448. HARVEY, Nereis Bor.-Am., Pt. III, 1858, p. 31. J. AGARDH, Till Algernes Systematik, 5te Afdn., VIII. Siphoneæ, p. 24. BORGESEN, Some Chlorophyceæ from the D. W. I., Bot. Tidsskr., vol. 31, 1911, p. 147.

As I have pointed out in my paper quoted above I have arrived to the conclusion that *Bryopsis pennata* Lamx., *Br. Harveyana* J. Ag. and *Br. Leprieurii* Kütz. not only are connected together by intermediate forms but also cannot be separated from *Bryopsis plumosa.* Therefore I have preferred to follow HARVEY's conception of these species as pointed out by him in »Nereis Bor.-Am.«, p. 31 and consider them as different forms of *Bryopsis plumosa* only.

var. *typica.*

Any quite typical specimens of *Br. plumosa* I have not found; the specimens were not so regularly divided and also somewhat more flabby than in the typical form. Some of the specimens referred to this variety were much branched bringing them near to forma *arbuscula* J. Ag. l. c.

This variety is very common in sheltered places, in lagoons etc. where it often covers the roots of the mangroves quite densely.

St. Croix: Christianssteds Lagoon, Saltriver; St. Thomas: Crum Bay; St. Jan: Cruz Bay.

var. *pennata.*

Bryopsis pennata Lamouroux.

LAMOUROUX, Mémoire sur troix nouveaux genres de la famille des Algues marines (Journ. de Bot., vol. II, p. 134, pl. III, fig. 1). J. AGARDH, l. c. p. 23. VICKERS, Phycologia Barbadensis, Pl. LII.

Of this variety some specimens were found which are rather typically developed but a great many specimens were intermediate between this form and var. *Harveyana*, var. *Leprieurii* and var. *typica*.

This variety is very common both on more exposed and on sheltered coasts in shallow water. It grows most often on rocks and stones but is also found on the roots of the mangroves.

var. *secunda* Harv.

Harvey, Nereis Bor.-Am., Pt. III, p. 32.

Bryopsis Harveyana J. Ag., Till Algernes Systematik, 5te Afdeln., VIII. Siphoneæ, p. 22. Vickers, Phycologia Barbadensis, Pl. LI.

Of this variety rather typical forms were found but also many transitional forms occurred, this variety being only a secund form of the typical *Br. plumosa*.

Found in shallow water in sheltered places, e. g. in lagoons where it was growing on the roots of the mangroves, and in somewhat exposed locality also.

St. Croix: Christianssteds Lagoon, Long Reef; St. Jan: Cruz Bay.

var. *Leprieurii*.

Bryopsis Leprieurii Kützing, Species Algarum, p. 490. Vickers, Phycologia Barbadensis, Pl. L.

Of this variety also some rather typical specimens were found but others were more or less intermediate between the above-mentioned varieties.

Occurred in rather sheltered places in shallow water.

St. Croix: Christianssteds Harbour; St. Thomas: The Harbour: St. Jan: Cruz Bay.

Geogr. Distrib. A widely spread form in temperate and warm seas.

Fam. 3. ***Caulerpaceæ.***

Caulerpa Lamouroux.

1. **Caulerpa fastigiata** Mont.

Montagne in Ramon de la Sagra, Hist. Cuba, pl. 2, fig. 3. Weber-van Bosse, Monographie des Caulerpes (Ann. du Jard. bot. de Buitenzorg, vol. 15, p. 262). Vickers, Phycologia Barbadensis, tab. XXXVI. Børgesen, in Botanisk Tidsskrift, vol. 31, 1911.

This species was found in a collection from the small lagoon at Cruz Bay, St. Jan. It occurred here nicely developed on muddy bottom in quite shallow water and was growing as *Egagropila*-like clumps formed by the entangled rhizomes together with rhizoids, and erect axes.

The form I have found (Fig. 93) had commonly a rather well-developed rhizome, from which partly rhizoids, partly assimilation-axes grew out and the last named had sometimes many and closely placed, sometimes few and scattered ramuli: these are sometimes opposite or most often alternate or several occur at the same height pointing in different directions. The ramuli are longer or shorter, often nearly cylindric, often also clavate, swollen towards the obtuse apex. As pointed out by REINKE[1]) the different parts of the plant are only very little differentiated; probably the erect axes can easily be transformed to rhizomes and even the ramuli sometimes grow rhizome-like. *Caulerpa fastigiata* and the nearly related, if on the whole specifically separated, *C. filiformis*, I agree with REINKE in considering as the lowest forms of the genus.

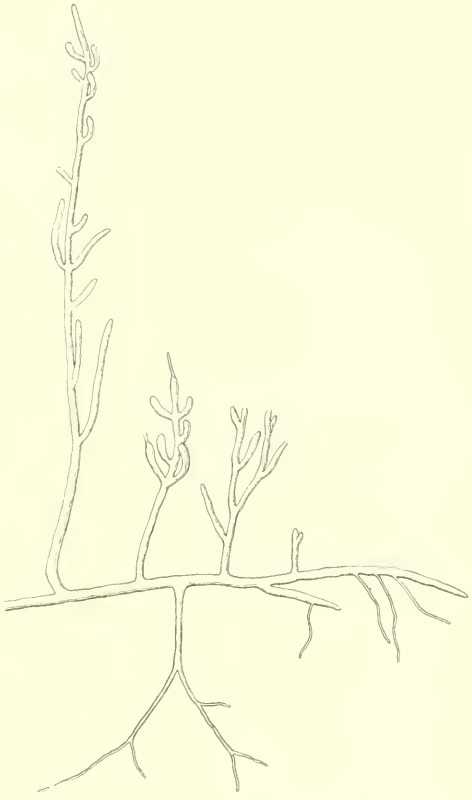

Fig. 93. *Caulerpa fastigiata* Mont. Habit of plant. (About 10:1).

Only found once in quite sheltered places, St. Jan: Cruz Bay.

Geogr. Distrib. West Indies, Brazil, Pacific.

2. **Caulerpa Vickersii** Borgs.

BORGESEN, F., in Botanisk Tidsskrift, vol. 31, 1911, p. 129, fig. 2.

Caulerpa ambigua VICKERS, Phycologia Barbadensis, pl. XXXVII. COLLINS, The green Algæ of North America (Tuft College Studies, vol. II, No. 3, 1909, p. 421). OKAMURA, On the Algæ from Ogasawara-Jima (Bonin Islands) in Bot. Magazine, Tokyo 1897, vol. XI, ex parte?

[1]) J. REINKE, Ueber Caulerpa. Ein Beitrag zur Biologie der Meeres-Organismen, pag. 7. (Wissensch. Meeresunters., N. F., Bd. 5, Kiel 1899).

During the examination of my *Bryopsis*-material I found this nice, small *Caulerpa* growing entangled in a large *Bryopsis*-tuft. The specimens met with quite agree with those found earlier in the West Indies by the late Mlle Vickers at Barbadoes and so well pictured in her »Phycologia«. Mlle Vickers has referred our plant to *C. ambigua* Okam. and I agree with her, that this is most probably right but only in part. Whilst, namely, our plant seems to agree with, or in any case to come very near to, that form figured by Okamura, l. c., on pl. 1, figs. 7, 8, 9, 10, it seems to be rather different from that shown in figs. 3, 4, 5, 6. To be sure Okamura considers these two forms as belonging to the same species, but I cannot help having some doubt in this matter and my West Indian material, in any case, seems only to come near to the first mentioned form. For the rest referring to the more detailed report I have given in my earlier paper I shall here only give a description of the West Indian plant.

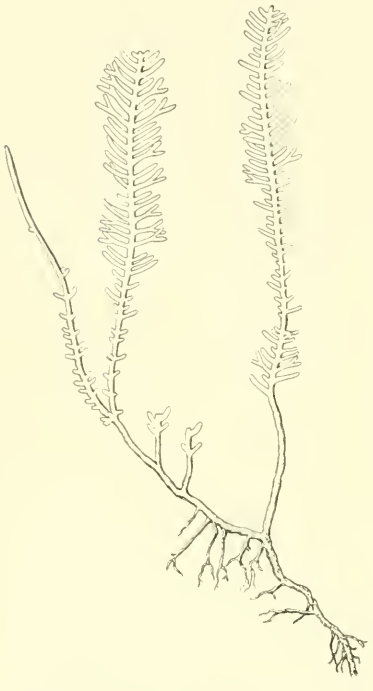

Fig. 94. *Caulerpa Vickersii* Borgs. Habit of plant. (About 6:1).

As mentioned above, it was found growing intermingled in tufts of *Bryopsis* and it was therefore also rather difficult to get the plant separated out; most often at the base of the erect axes only some few rhizoids were present quite in accordance with what Okamura has found in his plant. But afterwards I also found plants with a part of the rhizomes, shorter or longer, most often very irregularly bent, squeezed into the *Bryopsis*-tuft and in one specimen a rather well-developed creeping rhizome was present (Fig. 94) with irregularly branched rhizoids growing downward and the axes upward. I may point out, however, that like *Caulerpa fastigiata* the difference between rhizome and axes seems to be rather slight and the rhizome sometimes bears ramuli.

From this to be sure often rather indistinct rhizome the erect axes grow up. They are provided with shorter or longer, disti-

chously arranged ramuli, only very seldom a single or few ramuli are found with a different arrangement (comp. Fig. 94 and Vickers, l. c., pl. 37, figs. 3 and 6). The ramuli are opposite or sometimes also alternating; they are of varying length, from rather short (2—3 times as long as broad) to long and cylindrical (4—5 times as long as broad); they are not constricted at their base and have a rounded apex.

The largest and most vigorous ramuli are furthermore distinguished by having their apices bipartite or even tripartite (comp. Vickers, l. c. fig. 6). The plant shows a rather distinctly periodic growth; every fifth or sixth pair of ramuli are more vigorously developed and furcate; from these the next decrease gradually in size, they are most often still furcate, while the 3rd—4th next pairs of ramuli are simple.

The thickness of the erect axes is about 150 μ, that of the ramuli about 100 μ and the length of the ramuli up to 450 μ. While Okamura placed his species by reason of the constricted or articulated rachis in the group of *Sedoideæ*, where we also find it in the Monograph of M^me^ Weber-van Bosse, I think that our plant comes very near to *Caulerpa fastigiata*, with some forms of which (comp. Vickers, l. c., pl. 36, figs. 3—4) it seems to be closely related.

Caulerpa Vickersii was found growing entangled among *Bryopsis* upon rocks near the surface of the sea and in a somewhat sheltered locality.

Found only once: St. Jan, Cruz Bay.

Geogr. Distrib. Barbados, Bonin Islands (?).

3. **Caulerpa verticillata** J. G. Agardh.

J. G. Agardh, Nya alger från Mexico, p. 6, the note. J. G. Agardh, Till Algernes Systematik, I, p. 6. Weber-van Bosse, Monographie des Caulerpes, p. 267. Borgesen, An ecological and systematic account of the Caulerpas of the Danish West Indies (K. Danske Vidensk. Selsk. Skr., 7. Rk. Naturv.-math. Afd. IV, 5, 1907, p. 355).

Exsicc. Wittrock & Nordstedt, Algæ exsicc. No. 1020. Collins, Holden and Setchell, Phycotheca Bor. Am., No. 665.

f. *typica*. The opposite or verticillate ramuli, arranged in distinctly separate whorls. (Figs. 95 and 96).

f. *charoides* (Harv.) Web. v. Bosse. The ramuli are scattered over the erect shoot[1]). (Fig. 97).

This nice little plant is very common on the shores of the Danish West Indies in the more sheltered places. Its real home is the

[1]) A type-specimen of this form, Harvey, Friendly Islands Algæ, No. 97,

lagoons, where as I have already mentioned in my earlier papers[1]) it is one of the most common algæ in the very characteristic algal vegetation, which covers the mangrove roots. As a dark-green, 6—7 cm. high covering it grows quite dense on the roots and like most of the other richly ramified mangrove algæ gradually collects mud and organic particles between its fine ramifications.

By reason of the exceedingly dense mode of growth, arising from the fact that the creeping rhizomes on the mangrove roots are woven together and form often a thick layer composed of the

Fig. 95. *Caulerpa verticillata* J. Ag.
From the Lagoon of Christianssted, St. Croix. (1½:1).

intertwined rhizomes, mud etc., and from the fact that the older rhizomes die away by degrees, there will gradually arise a great many separate plants the bases of which often consist of fragments

to be found in the Botanical Museum of the University of Copenhagen, has however the ramuli rather distinctly arranged in whorls. Harvey's paper, List of Friendly Islands Algæ, I have not been able to see.

[1]) F. Borgesen og Ove Paulsen, Om Vegetationen paa de dansk-vestindiske Oer Kobenhavn 1898 (Bot. Tids. 22). (French edition in »Revue générale de Botanique, vol. 12, 1900).

F. Borgesen, A contribution to the knowledge of the marine Alga vegetation on the coasts of the Danish West Indian Islands (Bot. Tidsskr. vol. 23, 1900, p. 49). The algal vegetation of the lagoons in the Danish West Indies (Biologiske Arbejder tilegnede Eug. Warming, p. 41, 1911).

of rhizomes only, so that it is often rather difficult to see that the plant really has a creeping rhizome (Fig. 96). Reinke, also, questions whether the plant really has a creeping rhizome[1]). In my paper above cited (1910) I have pointed out that this apprehension is not right and I have there given the figure which I again reproduce here (Fig. 95).

Caulerpa verticillata grows in Danish West India in sheltered places only and it shows in this fact a difference in comparison with its occurrence in Ceylon where as mentioned by Svedelius it is to be found on rather exposed coasts[2]).

Fig. 96. *Caulerpa verticillata* J. Ag. (About 1 : 1).

Fig. 97. *Caulerpa verticillata* J. Ag. f. *charoides* (Harv.) Weber-van Bosse. From Krause's Lagoon (St. Croix). (About 1 : 1).

In the adjoining illustration, Fig. 98 *a* shows the uppermost part of an erect growing shoot with two whorls of leaves of which the uppermost is yet quite young consisting only of roundish swellings; the lowermost are already dichotomously divided. Fig. 98 *b* shows a some-

[1]) Reinke, J., l. c. p. 27.

[2]) Svedelius, W., Ecological and systematic Studies of the Ceylon species of Caulerpa. (Ceylon marine biological Reports, No. 4, 1900, p. 93).

what older more developed leaf. In the fully developed leaf the outermost apices of the ramuli are 2—4-divided (Fig. 98 *c*). Finally, Fig. 98 *d* shows the ends of a pair of rhizomes.

Orsted was the first who found this species in St. Croix and his specimens have at any rate partly served J. Agardh as material

Fig. 98. *Caulerpa verticillata* J. Ag. Compare text. (About 50:1).

for his description of it. It is very common on the shores of the Danish West Indies in sheltered localities in lagoons with mangroves; f. *charoides* I have only found in Krause's Lagoon on the south coast of St. Croix, where it grows abundantly on the roots of the *Rhizophora* on the outside of the mangrove forest in the

south-west corner of the lagoon. It grows here together with the forma *typica* but is recognizable by its much lighter green colour.

Geogr. Distrib. The West Indies, Brazil, The Friendly Islands, Siam, East India, Ceylon etc.

4. **Caulerpa Webbiana** Montagne.

Montagne, C., De l'organisation et du mode de reproduction des Caulerpes, et en particulier du *Caulerpa Webbiana*, espèce nouvelle des îles Canaries (Ann. des sciences naturelles, 2. sér., t. 9, botanique, Paris 1838). Weber-van Bosse, A., Monographie, p. 269. Borgesen, F., l. c. 1907, p. 357.

f. *disticha* Weber-van Bosse, l. c. p. 270. (Fig. 99).

This nice little plant was found twice in the sea around the island St. Jan, one time at a depth of about 30 meters, another

Fig. 99. *Caulerpa Webbiana* Mont., f. *disticha* Weber-van Bosse. From deep water (50 m.) off Ramshead, St. Jan. (About 7 : 1).

time in more than 50 meters. It grows together with other algæ e. g. *Anadyomene stellata* and creeps on the bottom fixed to gravel and pieces of coral. The rhizome on its under side bears numerous rhizoids which are sometimes finely ramified, sometimes ending in small discs by help of which the plant is fixed to the gravel.

The erect shoots have two rows of opposite ramuli. These are flat, their edges turned towards the somewhat compressed shoot. They are wedge- or fan-like in shape with the broadest end turned outward and are several times dichotomously divided. The last emarginated ramifications end with small spines. In the herbarium of M^me^ Weber-van Bosse a small specimen of this form is to be found; it was collected by the late M^lle^ Vickers in the Canary Islands and agrees very well with my West Indian

form. The only difference I have observed was that the West Indian specimens were somewhat larger than the Canary specimen and that the rhizome was glabrous in the former but covered with ramuli in the latter. How far the erect shoots in the Canary specimen were flat like the West Indian I am unable to say exactly; judging from Mme Weber-van Bosse's Fig. 1 b, Pl. XXI the midrib seems in every case to be round, and the same seems to be the case with the basal part of the ramuli; in the description of this species Mme Weber-van Bosse writes, p. 269: »Ramules cylindriques à la base«.

I have further had a specimen from Tongatabu for comparison, collected by Grunow »am Corallenriff«, and to be found in the collection of the Botanical Museum in Hamburg. It differs from my specimens by being a little smaller, the erect shoots especially are a little narrower and the ramuli consequently shorter; like the Canary specimen and in contrast to mine the plant from Tongatabu has scattered ramuli.

Judging from a specimen of mine preserved in formalin and collected in about 50 meters, the shoots are first erect but bend soon to the side in such a way that they turn the flat side upward, probably an adaptation to intercepting the greatest possible amount of light.

The greater breadth of the erect shoots is also perhaps to be considered as an adaptation both to the quiet place and the feeble light where it grows.

While it is a common thing in other forms of this species, e. g. f. *tomentella*, that the erect leaf-bearing shoots bend downwards at an early stage, obtain rhizoids and grow further on like the rhizomes fixed to the bottom, this is not to be found in the admittedly small material from the West Indies I have had at my disposal.

If we consider the figure 99 it will easily be observed, that the erect shoots show a very distinctly rhythmical growth: every three, or more seldom four, pairs of ramuli are especially well developed and from these the next decrease gradually in size. Such a rhythmical growth has also often been found by Svedelius in the Ceylon *Caulerpa*. How far the segments which arise in this way correspond with the growth of a year I am unable to say but it seems to me quite natural that this should be the case; I should think that the greatest increase occurs about the month of June when the sun is vertically or nearly vertically above and the light therefore the most effective.

This species has hitherto only been found twice in the sea around the island of St. Jan and both times by Dr. Th. Mortensen, e. g. off Ramshead on the south coast of St. Jan in about 50 meters and in the sound between St. Thomas and St. Jan near the little island St. James in about 30 meters depth.

Geogr. Distrib. Seems to occur in all the warmer seas: The West Indies, Pernambuco, Canary Islands, Red Sea, Japan, Friendly Islands etc.

5. **Caulerpa prolifera** (Forsk.) Lam.

Lamouroux, Mémoire sur les Caulerpes, p. 30. J. Agardh, Till Algernes Systematik, I, p. 11. Weber-van Bosse, Monographie, p. 278. Borgesen, l. c. 1907, p. 359.

Fucus prolifer Forskål, Flora ægypt.-arab., p. 193.

In the West Indian material we can distinguish the following two forms:

f. *obovata* J. Agardh l. c. p. 11. (Fig. 100). The leaf oblong-obovate, with few or very often with no proliferations at all.

f. *zosterifolia* n. f. (Fig. 101). The leaves narrow lineate-lanceolate, interrupted and very richly proliferous. This form seems to be rather near the dichotomous form which Janse has mentioned from the Gulf of Naples (Pringsh. Jahrb. Bd. 21, p. 168—9, pl. 6, figs. 6 and 7).

On the shores of the Danish West Indies *Caulerpa prolifera* is to be found both littoral and in deeper water, and on exposed and sheltered coasts. Forma *obovata* I have especially found in deeper water down to a depth of about 40 meters; the leaves are here often quite without proliferations at all or if these are present there are only some few. The leaves are broad and short, often nearly ovate; at the apex they are often rather deeply emarginate. Forma *obovata* also occurs in shallow water near the shores and on even rather exposed localities, I have e. g. found it on the south shore of St. Croix rather near Sandy Point where there is often rather a strong surf and the leaves were also distinctly marked by it. It grows here on low-lying coral reefs in and a little below the surface of the sea and swings to and fro with the action of the waves. The leaf has here a somewhat smaller size, is rather thick and of a leathery consistency, most likely an adaptation to the exposed locality, while the specimens growing in deeper water are thinner. Though it seems to me that the West Indian specimens are throughout thicker than the specimens I have seen living in the Mediterranean and surrounding seas, e. g. from the bay at Ajaccio and especially in great quantity from the bay at Cadiz.

Kützing has also designated the West Indian form (Tab. phyc. vol. 7, tab. 3 *d*) as »forma *firma*«.

Forma *zosterifolia* I have only found in shallow water from the surface of the sea down to some few feet. This form is distinguished by having a narrow leaf, only about 5—6 mm broad. It is as a rule very richly proliferous and shows often a distinct twisting.

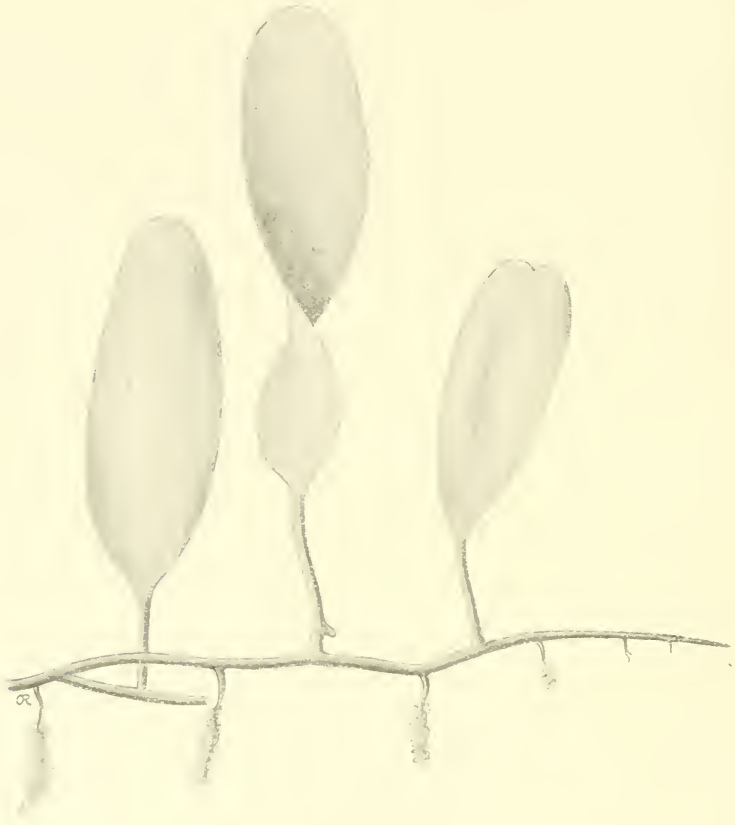

Fig. 100. *Caulerpa prolifera* (Forsk.) Lam. f. *obovata* J. Ag. From the sea to the west of Water Island (St. Thomas). (About 1 : 1).

This form grows richly between sea-grasses e. g. *Thalassia testudinum* and *Cymodocea manatorum* in shallow water in the neighbourhood of Krause's Lagoon on the south coast of St. Croix. A very weak surf can here enter from the sea and in this the leaves of *Caulerpa prolifera* wave to and fro.

Besides the two forms mentioned above, I have also found some few specimens whose leaves were 1 1/2 cm. broad and 17 cm.

long and thus on the whole rather like the common European form; in its more leathery consistency it was however somewhat different. This form was found at White Bay on the south side of St. Croix in about half a meter of water on a rather exposed coast.

Caulerpa prolifera is rather common on the shores of Danish West India. Forma *zosterifolia* is found in several places at St. Croix, e. g. in the sea-grass-formation west of Krause's Lagoon and in Limetree Bay to the east

Fig. 101. *Caulerpa prolifera* (Forsk.) Lam. f. *zosterifolia* n. f. From Krause's Lagoon, St. Croix. (About 1 : 1).

of this lagoon on the south coast of the island; further, on the north side on the shores of Green Cay Estate where the leaf nevertheless was a little broader. Forma *obovata* is found in shallow water in several localities near Sandy Point on the south coast of St. Croix, in deeper water it is found in great quantities in the sea to the west of Water Island at St. Thomas in about 20—30 meters of water, and at St. Jan in the sound between St. Thomas and St. Jan and in the sea to the north of America Hill and west of Tortola.

Geogr. Distrib. The West Indies, Florida, Bermudas, Canary Islands, Cadiz, Tangiers, Mediterranean.

6. Caulerpa crassifolia (Ag.) J. Ag.

J. Agardh, Till Algernes Systematik, I, p. 13. Howe, Phycological Studies II, p. 574. Borgesen, l. c., 1907, p. 302.

Caulerpa pinnata (L.) Weber-van Bosse, Monographie p. 289.

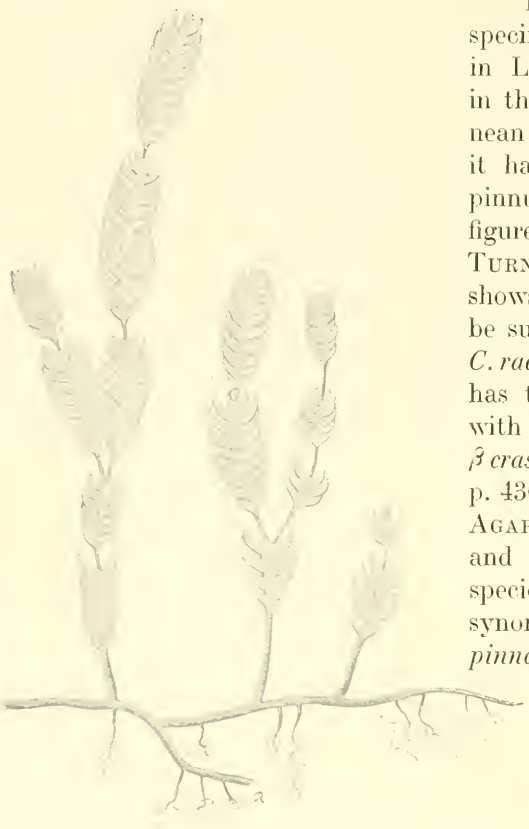

Fig. 102. *Caulerpa crassifolia* (Ag.) J. Ag. Form growing in shallow water in the Lagoon of Christianssted. (About 1 : 1).

Howe has found in a specimen of *Fucus pinnatus* in Linné's Herbarium, now in the possession of the Linnean Society in London, that it has distinctly cylindrical pinnules, as is also later figured and described by Turner, Fuci, I, pl. 53, which shows a form which must be supposed to belong to the *C. racemosa*-group. This form has therefore nothing to do with the *Caulerpa taxifolia* β *crassifolia* C. Ag. (Spec. Alg. p. 436) on which variety J. Agardh has based his species, and in the remarks to the species he also writes: »utrum synonyma ibidem allata (*F. pinnatus* Linn. & Turn. Hist. tab. 53) ad eandem pertineant, dicere non auderem«. Agardh's name must therefore be used.

Fucus crassifolius is to be found both in shallow water and deeper down to a depth of at least 30 meters. It prefers sheltered coasts; on somewhat exposed places it can exceptionally be found but it is rare here and the specimens are only badly developed. At Cane Bay on the north side of St. Croix I thus found some small and few specimens growing behind a small coral reef near the shore and at White Bay I have found it in about ½ meter of water growing among other algæ. In the last mentioned locality, somewhat far out in the open bay between the last westerly part of the long coral reef which stretches along the south coast of St. Croix and

the land I have found it growing on *Halimeda*-gravel in about 10 meters depth. But its real home is partly the well-sheltered places, especially the lagoons, partly deeper water. In the first mentioned places it grows very commonly in 1—2 feet of water, creeping on the soft bottom with its nearly thread-like rhizome; a few times I have also found it growing on the roots of the mangroves. In deep water, where it also finds a quiet growing place, I have as mentioned taken it down to a depth of about 30 meters.

While Svedelius only exceptionally found a periodical growth in his material from Ceylon, this is very clearly present in the specimens from shallow water in the lagoons (Fig. 102). On the other hand I have not seen such a rhythmical growth in the individuals from deep water (Fig. 103), where the conditions of life naturally are considerably more uniform than in the lagoons.

Two forms can be distinguished of this species.

Forma *typica* (Weber-van Bosse, l. c. p. 290) is recognizable from having the pinnules nearly linear and not narrowed at the base.

Forma *mexicana* distinguished by having the pinnules a little narrowed at the base and broader at the apices. The sinus between the pinnules is roundish.

The two forms are very nearly related and intermediate forms occur very often.

Forma *mexicana* is the most common form on the shores of the Danish West Indies and occurs in sheltered localities everywhere. In deeper water I have got it at St. Croix in White Bay in a depth of about 10 meters, at St. Thomas in the sea west of Water Island in about 20—30 meters and at St. Jan off Christiansfort and America Hill in the same depth.

Forma *typica* I have only found in the sea west of Water Island in about 30 meters of water.

Geogr. Distrib. The West Indies, Florida, Guyana, Bermudas, Canary Islands etc., Red Sea, Indian Sea, Friendly Islands etc.

Fig. 103. *Caulerpa crassifolia* (Ag.) J. Ag. In deep water off Christiansfort (St. Jan). (About 1 : 1).

7. **Caulerpa taxifolia** (Vahl) Ag.

C. Agardh, Spec. Alg. p. 435. Weber-van Bosse, Monographie p. 292. Borgesen, l. c. 1907, p. 363.

Fucus taxifolius Vahl, Skrivter af Naturhistorie-Selskabet, t. V, 2det Hefte, 1802, p. 36.

This species which in the Danish West Indies does not seem to show any appreciable variations in form is found in very different localities. It thus occurs in shallow water near the surface of the sea in rather exposed localities, e. g. on the north side of St. Croix at Green Cay Estate and on the south coast at White Bay. In both localities it is gregarious, growing in rather large tufts on rocks and stones; in the first-mentioned locality it was partly laid dry when collected. Further, it is found in quite sheltered localities in lagoons, e. g. in the Lagoon of Christianssted, where it creeps round on the muddy bottom. Also in deeper water it seems to occur commonly. In White Bay I have thus taken it in about 10 meters depth, where it was creeping on the *Halimeda*-gravel which here covers the bottom in great quantities. And in the sea at St. Jan I have taken it off America Hill in about 30 meters. The specimens collected were in all essentials of the same form, only with regard to the size was some difference evident, the leaves of specimens from deep water being very long (16 cm. or more, Fig. 105), while the leaves of specimens from shallow water were much shorter (Fig. 104). Moreover, in the specimens from deep water the leaves show a very uniform growth while these in the specimens

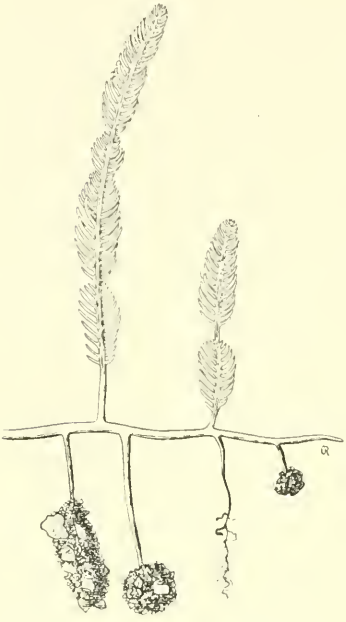

Fig. 104. *Caulerpa taxifolia* (Vahl) Ag. In shallow water from the Lagoon of Christianssted. (About 1:1).

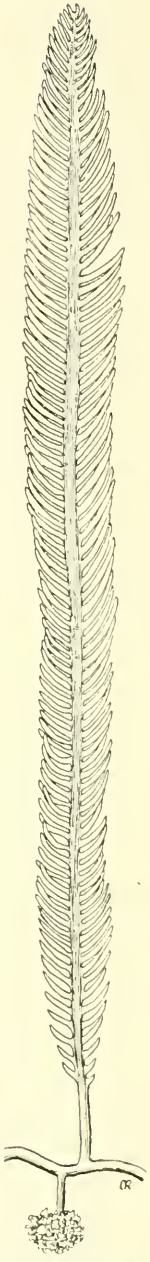

Fig. 105. *Caulerpa taxifolia* (Vahl) Ag. From deeper water off America Hill (St. Jan). (About 1:1).

from shallow water have a very distinct periodical growth, quite in the same way as in *C. crassifolia*.

Fig. 104 shows a small specimen from St. Croix, from which island this species, as is well known, was originally described and which is quite like the specimens to be found in the Botanical Museum in Copenhagen upon which Vahl founded his description. They are in good accordance with the description of Mme Weber-van Bosse l. c. and with the forma *typica* of Svedelius (l. c. p. 112), Syn. *Caulerpa falcata* Kütz., Tab. phyc. Bd. VII, tab. 5, fig. V.

This species is rather common on the shores of the Danish West Indies.

Geogr. Distrib. West Indies, Florida, Ceylon, Floris, and the Sandwich Islands.

8. **Caulerpa sertularioides** (Gmel.) Howe.

M. A. Howe, Phycological studies II, p. 576. F. Borgesen, l. c., 1907, p. 365.

Fucus sertularioides Gmelin, Historia Fucorum p. 151, tab. 15, fig. 4.

Caulerpa plumaris (Forsk.) Ag., Weber-van Bosse, Monographie p. 294.

Exsicc. Wittr. & Nordst., Algæ exsiccatæ, Nr. 1585.

f. *typica* Borgs., l. c.

f. *brevipes* (J. G. Ag.) Weber-van Bosse, Monographie p. 294.

f. *longiseta* (J. G. Ag.) Weber-van Bosse, Monographie p. 295.

f. *Farlowii* Weber-van Bosse, Monographie p. 295. (Fig. 106).

Caulerpa sertularioides is a distinctly littoral alga which is very common from the surface of the sea down to a depth of some few meters. It occurs both on rather exposed coasts and in quite sheltered localities. On exposed coasts it is partly f. *typica*, characterized by its rather thick, not very densely placed pinnules, partly forma *brevipes* that occur. They often grow in rather large tufts sometimes together with other Caulerpas, e. g. *C. taxifolia*, and wave to and fro in the swell.

In localities where it is steadily exposed to some swell, e. g. at the landing place at Christiansfort in St. Jan, I have found a form distinguished by having a long and narrow leaf which I think is to be considered as a wave-beaten form, similar to the forms of *C. racemosa* var. *occidentalis* and var. *uvifera* with long erect shoots I have found in the same locality and which will be mentioned later on.

While the two above-mentioned forms are for the most part to be found on more exposed coasts, forma *longiseta*, characterized by its longer, thinner and densely placed pinnules, is especially

restricted to the more sheltered localities. It is thus rather common in the lagoons, e. g. the Lagoon of Christianssted, where it creeps in the soft bottom; but I have also found this form in a somewhat more exposed locality, e. g. behind Long Reef near Little Princess on the north side of St. Croix, but here it is united by many transitional forms with the typical form or with forma *brevipes*. In shallow water it occurs down to a depth of about 2—4 meters. In such greater depths as 10—15 m. in which SVEDELIUS (l. c. p. 115) has found it on the shores of Ceylon I have never seen it.

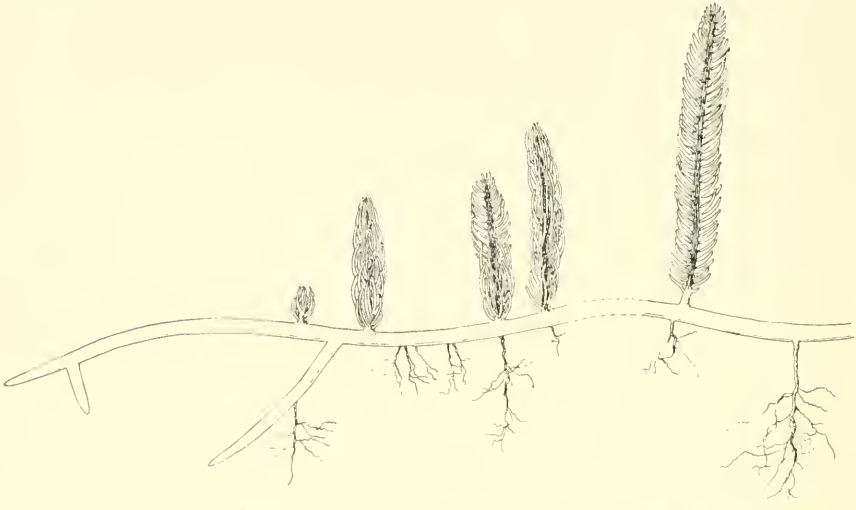

Fig. 106. *Caulerpa sertularioides* (Gmel.) Howe f. *Farlowii* Weber-van Bosse. From Durloes Bay (St. Jan). (About 1 : 1).

The form of this species which shows the most interest is f. *Farlowii*, of which Fig. 106 gives an illustration. As the figure shows, one finds in the same rhizome leaves which are quite normal like those of f. *typica* and further leaves which, instead of having the pinnules arranged as normally distichously, bear pinnules in several rows. One can even find the two cases represented in the same leaf as the figure shows, where the third leaf from the growing point is radial at the base but distichous in the uppermost part. The erect leaves with pinnules in all directions are, as Mme WEBER has pointed out, quite like those in *Caulerpa Selago*, to which species *C. sertularioides* seems to be very nearly related, quite in the same manner as the forma *tristichophylla* of *C. taxifolia* connects this species with *Caulerpa falcifolia*. Forma *Farlowii* is found on the beach in shallow water quite near the surface of the sea

and was growing on coral-sand in a smaller basin with fresh sea-water and with some swell.

A rhythmical growth quite like that described by Svedelius l. c. p. 114 and which I have already mentioned for other species is also often to be found in this species in the West Indies. It is present e. g. in the specimens I have distributed in Wittrock and Nordstedt, Algæ exsiccatæ Nr. 1585.

Caulerpa sertularioides is a very common species along the shores of the Danish West Indies. Forma *typica* and *brevipes* are commonest in more exposed localities, e. g. St. Croix: Lime Tree Bay, White Bay, behind Long Reef etc., St. Thomas: The harbour. St. Jan: The bay at Christiansfort etc. Forma *longiseta* is most common in lagoons, e. g. St. Croix: the Lagoon of Christianssted, behind Long Reef in sheltered localities with sea-grass, in the Bovoni Lagoon at St. Thomas etc. Forma *Farlowii* was only found once at St. Jan in Durloes Bay (leg. Dr. Th. Mortensen).

Geogr. Distrib. The West Indies, Florida, Red Sea, Ceylon, Friendly Islands etc.

9. **Caulerpa Ashmeadi** Harv.

Harvey, Nereis Boreali-Americana, p. 18, pl. 28, fig. A. J. Agardh, Till Algernes Systematik, I, p. 16. F. Borgesen, l. c., p. 367.

This splendid species (Fig. 107) I have found several times in the sea around St. Thomas and St. Jan. It is distinguished by its distichous, sometimes spread, sometimes oppositely placed ramuli. These are cylindric-conical as the figure shows, being evenly thicker upward with the apex stubby, rounded. The species seems to vary very little, only regarding the size there is some variation. The largest specimens I have found do not quite reach the size of Harvey's plant, the smallest were only 3 cm. high and the whole plant both the rhizome and the leaves were proportionally small.

The plant is found in a depth of about 20—30 meters where it creeps on the sandy bottom.

It has hitherto been found: at St. Thomas in the sea west of Water Island; St. Jan in the sound between St. Thomas and St. Jan off Christiansfort; in the sea to the north of St. Jan west of Tortola and off Maho Bay and Linster Bay. Murray (23, p. 32) mentions this species from St. Thomas where it was found by the »Challenger« Expedition.

Geogr. Distrib. This species is a distinctly Atlantic-American species and is found at the shores of the West Indies and Florida only.

10. **Caulerpa cupressoides** (Vahl) Ag., Weber-van Bosse emend.

Weber-van Bosse, Monographie, p. 323. Borgesen, l. c. p. 368.

Fucus cupressoides Vahl, En deel kryptogamiske Planter fra St. Croix. Skrivter af Naturhistorie-Selskabet, 5te Bind, 2det Hefte, Kiobenhavn 1802, p. 29.

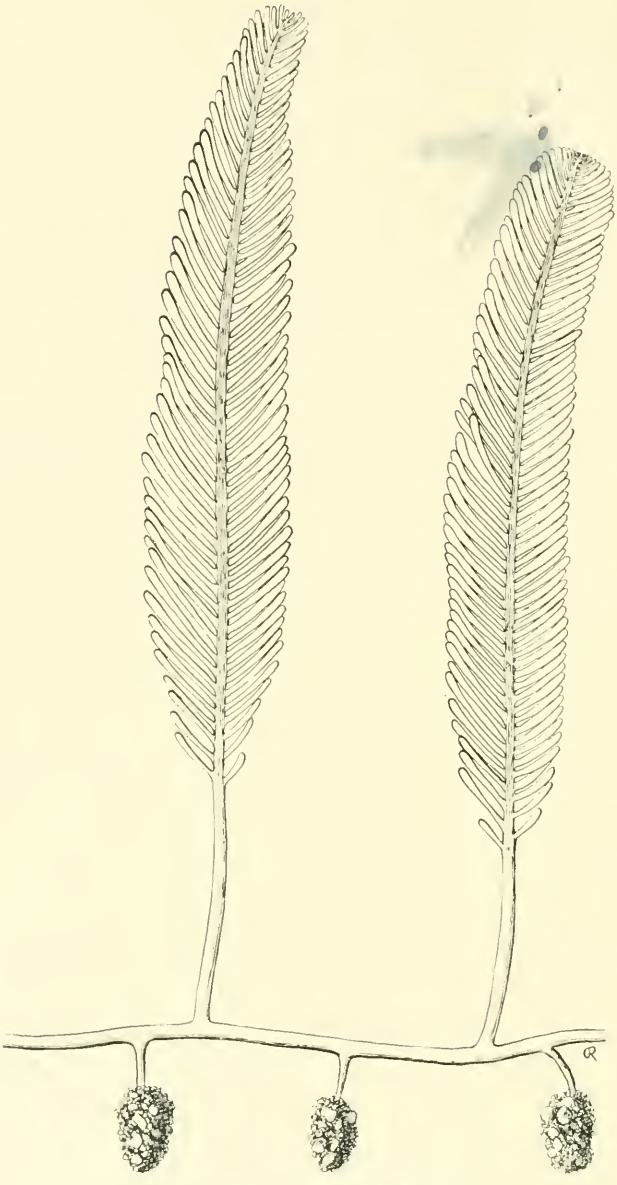

Fig. 107. *Caulerpa Ashmeadi* Harv.
In deeper water off America Hill (St. Jan). (About 1 : 1).

Exsicc. Wittrock & Nordstedt, Algæ exsicc., no. 1206 (sub nom. *Caulerpa juniperoides* J. Ag.).

var. *mamillosa* (Mont.) Weber-van Bosse, Monographie, p. 332. (Fig. 108).

var. *typica* Weber-van Bosse, Monographie, p. 327. (Figs. 109, 110, 111).

var. *plumarioides* Borgs.

A rather large form with somewhat flabby, spread branches. The ramuli occur both in two and three rows; they are bent upward, cylindrical, 3—4 times, sometimes even longer, the breadth of the midrib. This form has most often a very clearly marked periodical growth. (Fig. 112).

var. *flabellata* Borgs.

A rather richly dichotomously ramified form with the branches lying nearly in the same plane, so that the erect shoot becomes more or less distinctly flabellate. The ramuli are rather short, 1—3 times as long as the midrib. (Fig. 113 and 114).

var. *elegans* (Crouan) Weber-van Bosse. Monographie, p. 336.

Clearly dichotomously ramified with the branches lying in the same plane; the ramuli long, 3—6 or more times longer than the midrib. (Fig. 115).

Caulerpa cupressoides is a very commonly distributed species on the shores of the Danish West Indies and occurs in very different localities with highly varying external conditions of life; this can be clearly seen in the form the plant has in a given locality.

Caulerpa cupressoides is namely to be found in a great multitude of forms most often mutually united to each other by imperceptibly transitional forms.

Before trying to give a more detailed description of the forms I have found in Danish West India, I may just mention that each of these is directly connected with a definite locality. Regarding the localities I may here refer to what I have said on this matter in the introduction of my paper on the Caulerpes (l. c. p. 340). I need only mention here, that *Caulerpa cupressoides* is to be found on more exposed coasts behind the coral reefs creeping here in dazzling white coral sand, that it occurs in sheltered localities in the interior of the lagoons in the often very muddy water we find there, growing in the soft muddy bottom, and finally that it is found in deeper water down to a depth of about 20—30 meters; but just as there is a very even and gradual change between these in themselves very different localities, in the same way the forms of *C. cupressoides* in the different localities are evenly united by transitional forms. But it is just in the above-named localities,

where the conditions of life are so very different, that we find the types of alga round which the remaining forms group themselves in a natural way.

Several of the forms which occur at each of these different localities may by themselves be very diverse, so that one could perhaps entertain doubts whether it was not most correct to consider them as separate species; but on the other hand, they are

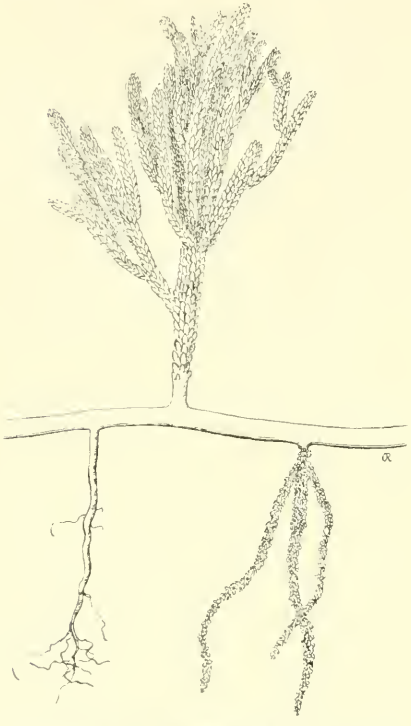

Fig. 108. *Caulerpa cupressoides* (Vahl) Ag. var. *mamillosa* (Mont.) Weber-van Bosse. From shallow water. Off Longford (St. Croix). (About 1:1).

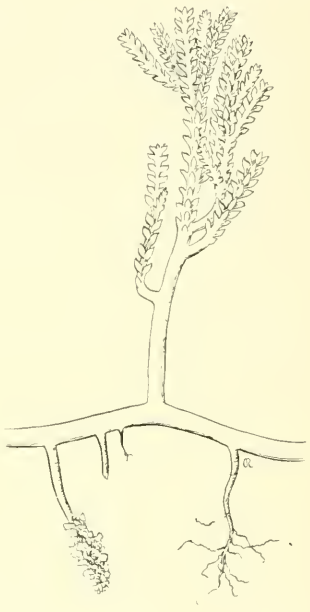

Fig. 109. *Caulerpa cupressoides* (Vahl) Ag. var. *typica* Weber-van Bosse. In shallow water. Protestant Cay (at Christiansted). (About 1:1).

commonly so connected with intermediate forms, often the same specimen shows so considerable variation in the one or other direction, that it seems to me until further information is obtained most natural to keep them together. We can only settle the matter definitely by the help of culture experiments, e. g. transplant specimens from exposed to sheltered localities and vice-versa, an experiment which would surely not be difficult in practice. Should it then appear that a certain form even after having

been cultivated for some time had not changed its external form, it would most probably be right to consider such a fixed form as a species. Unfortunately I only stayed a short time in the different parts of the islands and it was therefore impossible for me to undertake such experiments.

If we now first consider the specimens we meet with in the more exposed localities behind the coral-reefs, it will appear that these are characterized by being relatively small, but on the other hand rather strongly developed. The erect shoots are often only 5—6 cm high, but richly ramified with densely-crowded branches,

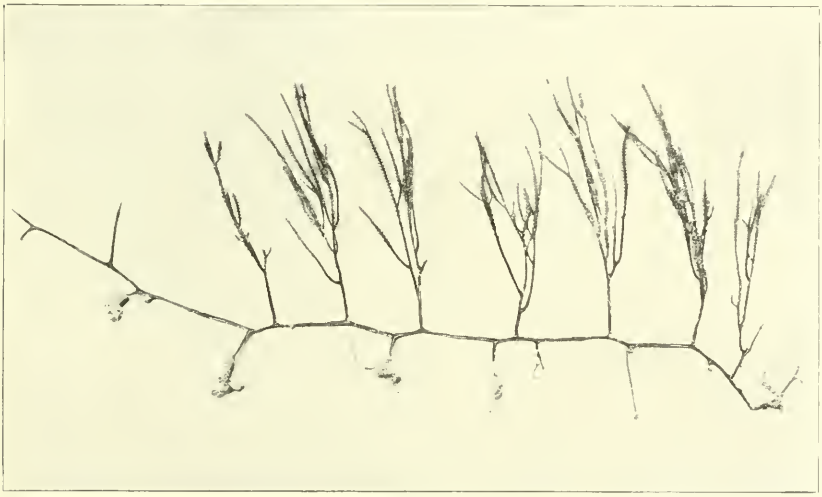

Fig. 110. *Caulerpa cupressoides* (Vahl) Ag. var. *typica* Weber-van Bosse. In shallow water. The Lagoon of Christianssted.

which bear about 3—6 (sometimes still more) rows of ramuli. These are present not only on the branches themselves but also often on the main shoot quite down to the rhizome. It is especially forms of the var. *mamillosa* (Fig. 108) we have here and which are characterized by the short obovate, densely-placed ramuli which cover the erect shoots often down to the rhizome (see Fig. 108, cfr. also M^me^ Weber, l. c., Pl. XXVIII, figs. 3, 5 and 6).

When the ramuli are a little longer and more widely placed, forming commonly 3 or 4 rows, we get forms of the var. *typica* (Fig. 109), which also occur in these localities, perhaps however in places a little more sheltered or in somewhat deeper water. Even small differences in the local conditions of life seem often to give a corresponding difference in the specimens occurring. On the shores

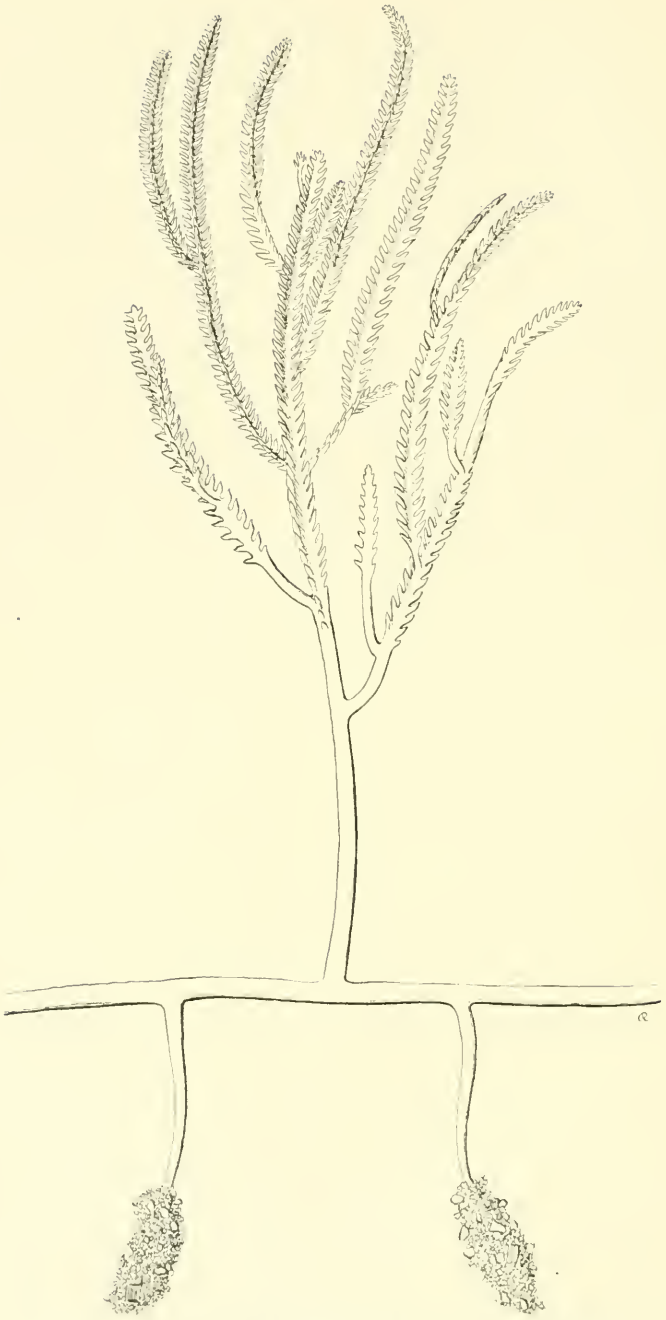

Fig. 111. *Caulerpa cupressoides* (Vahl) Ag. var. *typica*.
In shallow water. The Salt River Lagoon. (St. Croix). (About 1:1).

Fig. 112. *Caulerpa cupressoides* (Vahl) Ag. var. *plumarioides* n. var. In shallow water from Christianssteds Lagoon. (About 1:1).

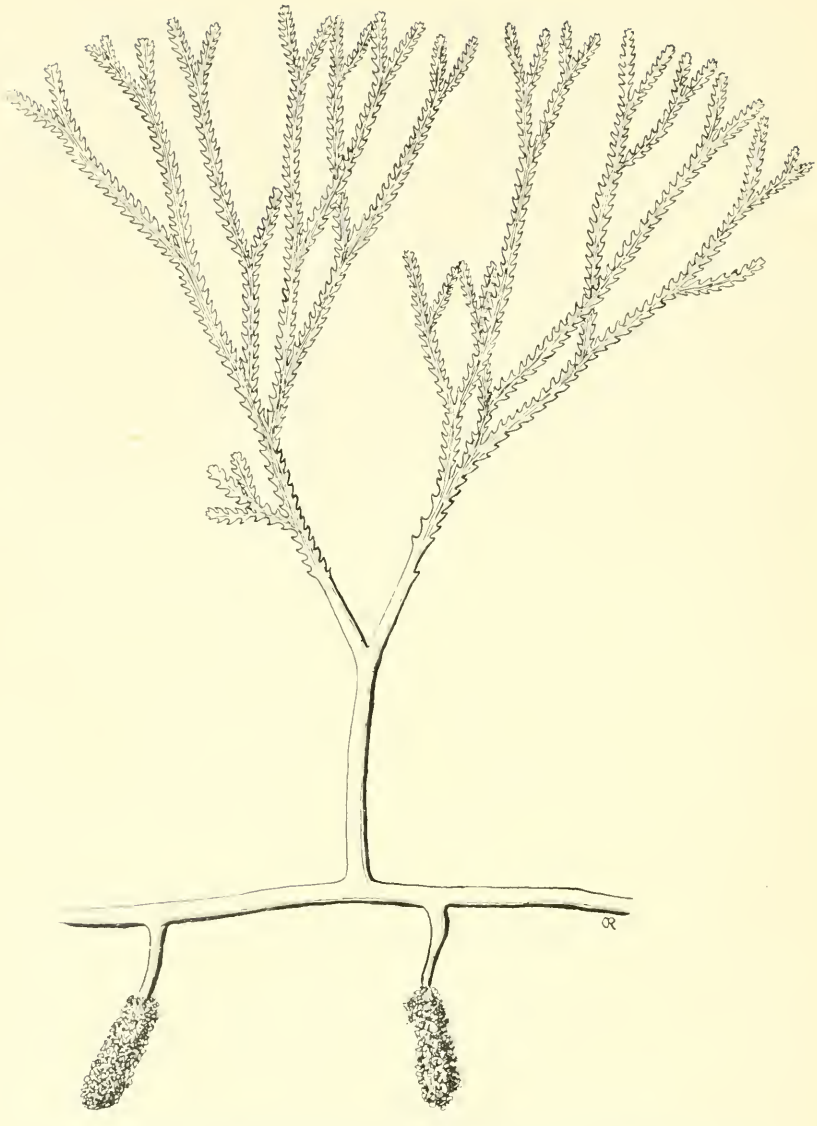

Fig. 113. *Caulerpa cupressoides* (Vahl) Ag. var. *flabellata* n. var.
In deep water (about 20 m) off Christiansfort (St. Jan). (About 1 : 1).

of the pilot isle, Protestant Cay as it is called, at Christianssted, I have thus found in shallow water near the surface of the sea, where it was somewhat exposed, a low compact form with 4—5 rows of ramuli, which in my opinion must be considered as an intermediate form between var. *mamillosa* and var. *typica*; but

further from the shore where the bottom fell steeply, the var. *typica* was growing in about 6—8 feet of water with only about 3 rows of somewhat longer ramuli. Fig. 109 shows one of the forms of var. *typica* we meet here; compare also Weber-van Bosse, Monographie, pl. XXVII, fig. 1 and especially pl. XXVIII, fig. 1.

If we now go to the more sheltered localities and first consider those, where the water is still clear, we find here specimens whose erect shoots are about 6-12 cms high, more or less richly ramified and with rather spread branches (see Figs. 110 and 111). These bear commonly 3 rows of ramuli, seldom more; often especially in the upper part of the branches however we find only two rows. The ramuli are ovate to oval-cylindrical or quite cylindrical with a short spine at the apex; they are commonly about twice as long as the breadth of the midrib and in the distichous branches often opposite. The forms we meet with here are of the var. *typica* and commonly agree with the figures 2 and 3 in Plate XXVII in M^me^ Weber's Monograph and with Reinke's figure 42, l. c. If we pass further into the lagoon where the water is often muddy and the light therefore less, the forms become gradually larger up to 20 cm high sometimes even higher and moreover more flabby, generally they are also less ramified. The branches are somewhat spread out having the ramuli placed sometimes in 3 sometimes in 2 rows. They are cylindrical somewhat bent upwards, 3—4

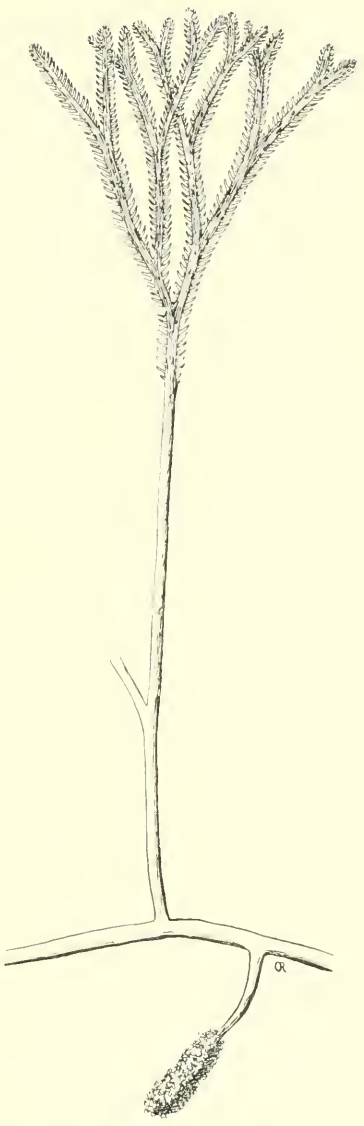

Fig. 114. *Caulerpa cupressoides* (Vahl) Ag. var. *flabellata* Borgs. In deep water (about 25 m) off America Hill (St. Jan). (About 1:1).

times as long as the breadth of the midrib, often even more. These forms have a great likeness to the figures 8, 12 and 13 of pl. XXVII and figures 10 and 12 of pl. XXVIII in Mme Weber-van Bosse's Monograph. These specimens I have called var. *plumarioides* (Fig. 112). They are the forms which Mme Weber-van Bosse has called f. *elegans*, f. *alternifolia* and f. *amicorum*, and are referred by her to the var. *lycopodium*. This name I prefer to use only for the typical form (*C. Lycopodium* J. Ag.) which is characterized by having the long cylindrical ramuli placed in several rows. Beautiful specimens of this form are present in Mme Weber's Herbarium originating from the Barbados, where they were collected by Mlle Vickers. In Danish West India I have not met with this form.

I cannot however lay too much stress on the fact that transitional forms occur in great number between the var. *typica* and var. *plumarioides*, and regarding a great number of my specimens e. g. from Christianssteds Lagoon, it is impossible to decide to which form they belong.

Finally, we meet with *Caulerpa cupressoides* in deeper water in the open sea. The forms we find here are rather large. They are dichotomously branched and the branches, which have the edge turned towards the midrib, are all placed in nearly the same plane, in such a way that the erect shoots have more or less an obviously flabellate form. The ramuli are always distichous and variable as to the length, from a little longer than the midrib to 5—6 times as long. The plant is of a fresh-green colour.

Two forms can be distinguished. One of these is rather richly dichotomously branched in such a way that the erect shoots are more or less flabellate. Ramuli are rather short, 1—3 times as long as the midrib. This form I have called var. *flabellata* (Fig. 113 and 114). The other form is likewise clearly dichotomously but less ramified. The ramuli are long, cylindrical and bent somewhat upward. It has a great resemblance to the figure 9, pl. XXVII in Mme Weber's Monograph, a form she has called f. *elegans* and which name I also have used for my form (Fig. 115). These two varieties though they seem very different are nevertheless so nearly related that one can find both forms on the same rhizome (see Fig. 116).

Mlle Vickers has found var. *elegans* at the Barbados in shallow water. Through the kindnes of Mme Weber I have had the opportunity to see several specimens of this var. preserved in her Herbarium. They agree very well with mine, though generally

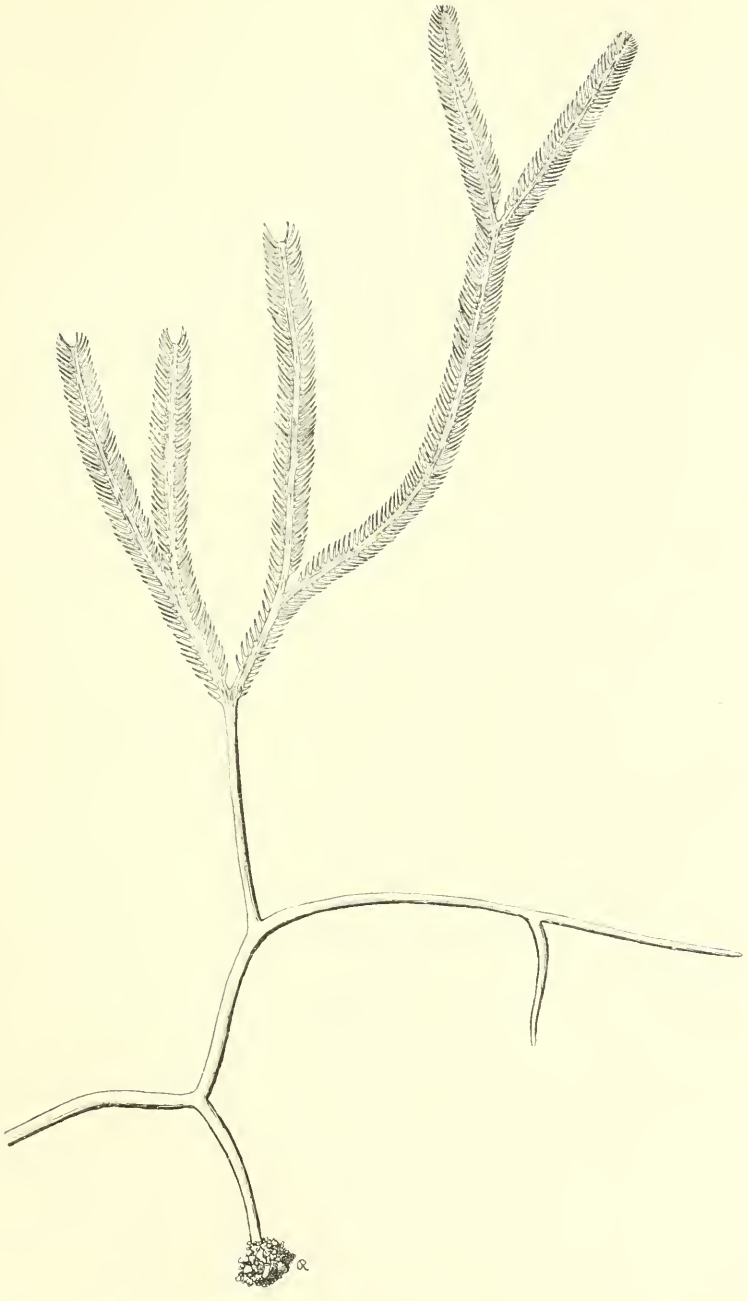

Fig. 115. *Caulerpa cupressoides* (Vahl) Ag. var. *elegans* (Crouan) Weber-van Bosse. In deep water (about 25 m) off America Hill (St. Jan). (About 1:1).

somewhat more ramified and the ramuli also a little shorter. As to the locality, at Hastings, from where the most beautiful specimens originate, M^lle^ VICKERS gives a rather complete description in the introduction to her paper. From this it is evident that the plant has been growing in rather shallow water and further in

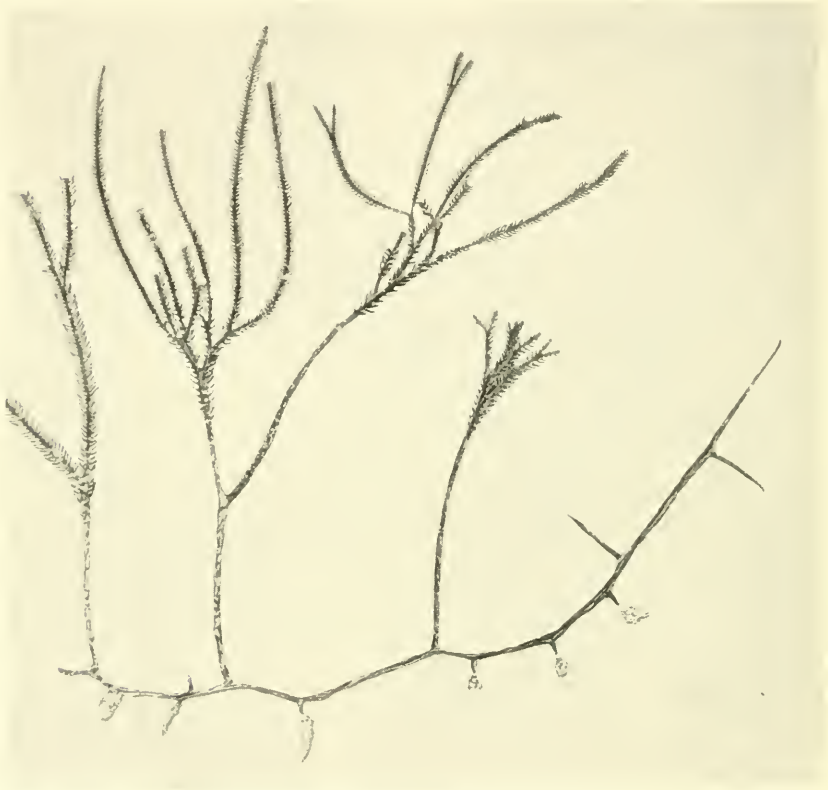

Fig. 116. *Caulerpa cupressoides* (Vahl) Ag.
The leaf to the left most like var. *elegans*, the others like var. *flabellata*.
In deep water off America Hill (St. Jan.) (About 1 : 1).

perfectly quiet water. Whether the water has been clear or not, or whether the plant has grown in more or less shadow from the rocks or stones we do not know. I do not think there has been any great difference between this locality and the growing place in the lagoons where I found var. *plumarioides*, and some of M^lle^ VICKERS' specimens show also a considerable resemblance to the broadest specimens from the lagoons and form in this way a transition to the specimens of var. *elegans* I have found in deep water

C. cupressoides is a rather common species along the shores of the Danish West Indies.

Var. *mamillosa* is found at St. Croix on the south coast at Longford and on the north side at Cane Bay. Var. *typica*, St. Croix: Christianssted, Saltriver; St. Thomas: The lagoon at Bovoni. Var. *plumarioides*, St. Croix: The lagoons of Christianssted and Saltriver. Var. *flabellata*, St. Thomas: West of Water Island in about 30 m. St. Jan: off Christiansfort in about 30 meters and in Lt. Maho Bay in about 20 meters. Var. *elegans*, St. Jan: America Hill in about 30 meters and in Lt. Maho Bay in about 20 meters.

Geogr. Distrib. The West Indies, Indian Ocean, Pacific.

11. **Caulerpa racemosa** (Forsk.) Weber-van Bosse.

Weber-van Bosse, Monographie, p. 357. Borgesen, l. c., 1907, p. 378.

Fucus racemosus Forskål, Flora Ægypt.-Arab., p. 191.

var. *clavifera* (Turner) Weber-van Bosse, l. c. p. 361.

f. *reducta* Borgs. l. c.

A small dwarflike form. The rhizomes are often scarcely a millimeter broad and downwards bear richly ramified rhizoids, upwards few and scattered, often not a centimeter high shoots with few and often rather irregularly shaped, sometimes cylindrical ramuli; only seldom has it normal ramuli swollen at the apex.

var. *uvifera* (Turner) Weber-van Bosse, l. c., p. 362.

var. *occidentalis* (J. Ag.) Borgs., l. c , p. 379.

C. Chemnitzia β occidentalis J. Ag , Caulerpa p. 37. Svedelius, l. c. p. 130.
C. racemosa var. *Chemnitzia*, Reinke, l. c. p. 38, fig. 57. Exsicc. Wittr. & Nordst., Algæ exsicc. Nr. 1586.

var. *lætevirens* Mont., Weber-van Bosse, l. c., p. 366.

var. *Lamourouxii* (Turner) Weber-van Bosse, l. c., p. 368.

Before describing all the above-mentioned forms I may point out that what I have said concerning *C. cupressoides* holds good here also, namely, that in my opinion it seems impossible to consider all the above mentioned varieties as separate species; I quite follow the views of M^me^ Weber-van Bosse. If one has a large material it will soon be evident that the different forms are often united to such a degree by transitions that the boundaries can only be made quite arbitrarily.

Thus, I believe that it is impossible to consider var. *clavifera* and var. *uvifera* as separate species, as Svedelius tries to make them, as these forms in my material are very evenly connected with each other. As to this question referring for more detail

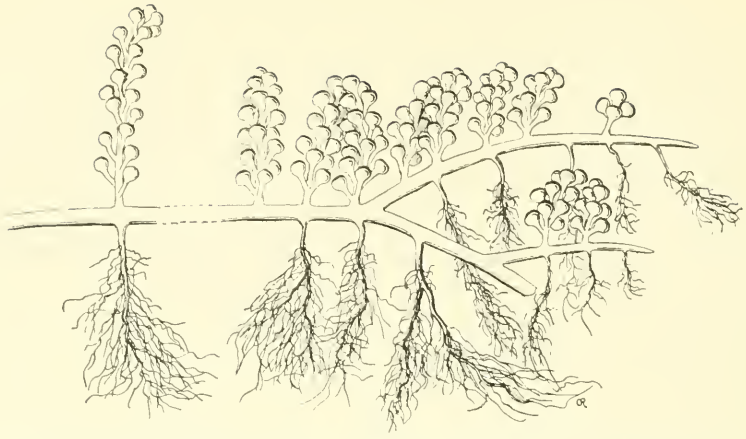

Fig. 117. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *uvifera* (Turner) Weber-van Bosse. From Longreff (St. Croix). (About 1 : 1).

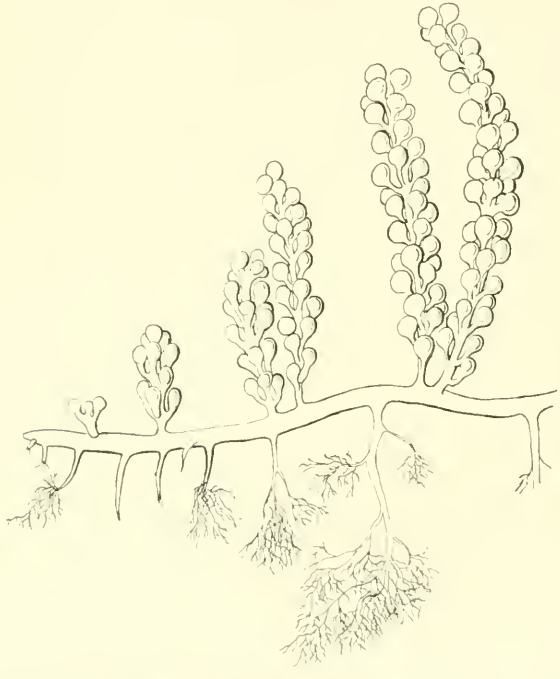

Fig. 118. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *uvifera* (Turner) Weber-van Bosse. From Cruz Bay (St. Jan). (About 1 : 1).

to my paper cited above, I shall only here point out that the forms of var. *clavifera* and var. *uvifera* are all to be considered as rock and coral reef forms growing generally in quite shallow water and in intense light.

A quite typical var. *uvifera* I do not think I have found in the Danish islands. The forms (Figs. 117 and 118) I have referred to this variety are most like f. *intermedia* Weber-van Bosse (l.c. pl. XXXIII, fig. 24a) distinguished by the ramuli being rather long-stalked with a ball-shaped swelling at the apex. As the name indicates, this is to be considered as an intermediate form be-

tween the typical var. *uvifera* and var. *clavifera* (see my Figs. 118 and 119) and is, at least the West Indian form, connected by numerous intermediate forms to the var. *clavifera*. Any flattening of the ramuli as mentioned by Mme Weber-van Bosse and also found by Svedelius who gives this form the name *planiuscula* I have never seen in the Danish West Indies.

Fig. 119. *Caulerpa racemosa* Forsk.) Weber-van Bosse var. *clavifera* (Turner) Weber-van Bosse. Growing on flat cliffs in the bay behind Christiansfort (St. Jan). F. B. fot.

Var. *clavifera* is characterized by shorter erect shoots and especially by the fact that these have fewer ramuli. In somewhat exposed localities it often forms on rocks and coral-reefs large flat tufts, which on the upper side consist of the densely placed, grape-like, short, erect shoots, on the downward side of the close tissue of the rhizomes, which twisted and entangled together form the underside of the tufts and by means of numerous, finely ramified rhizoids are firmly fastened to the substratum. The grape-like assimilators are thus put together nearly in a horizontal

layer on the surface of the patches (Figs. 119 and 120), as is described by SVEDELIUS p. 120 and as I have already myself mentioned briefly in my paper (Bot. Tidsskr., vol. 23, 1900, p. 51).

Fig. 120. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *clavifera* (Turner) Weber-van Bosse. From Longreef St. Croix). Creeping on a dead coral and intermingled with a Corallinacea. (About 1:1).

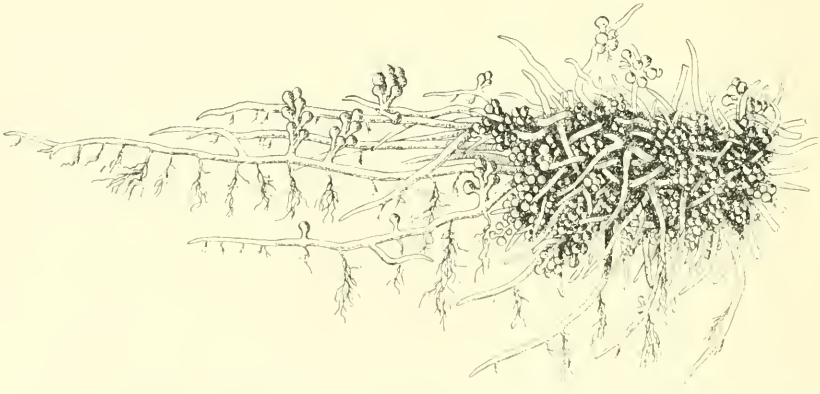

Fig. 121. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *clavifera* (Turner) Weber-van Bosse. A form approaching forma *reducta*. From the reef between the Hurricane Island end St. Thomas. (About 1:1).

The locality gradually becoming more exposed the erect shoots grow shorter and shorter and the plant on the whole smaller. As the assimilators often consist only of a single ramulus and are at

the same time more and more distantly placed, the plant becomes like the figure 121, where one sees between the assimilators the

Fig. 122. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *clavifera* (Turner) Weber-van Bosse f. *reducta* n. f.
From the reef between the Hurricane Island and St. Thomas. (About 5:1).

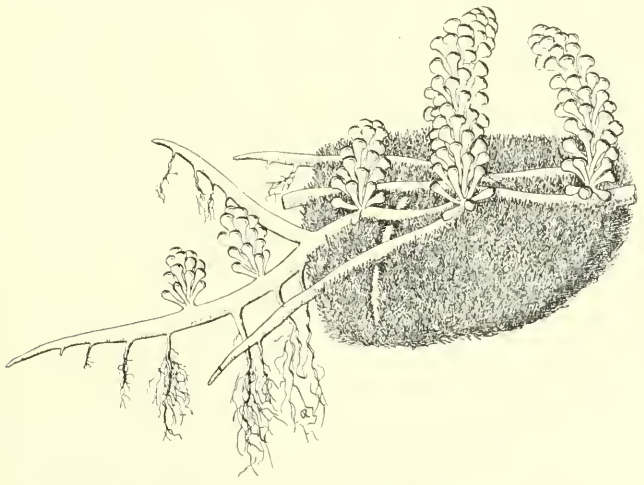

Fig. 123. *Caulerpa racemosa* (Forsk. Weber-van Bosse var. *occidentalis* (J. Ag.). From Longreef, St. Croix. Creeping on a piece of a Corallinacea. (About 1:1).

numerous, densely entangled rhizomes. The figure shows a little piece of a large tuft preserved in formalin; the tuft has over the

whole the same appearance as the small compact part shows. On specially exposed localities the assimilators grow smaller and smaller, at the same time being less numerous; in such localities the plant nearly entirely consists of the rhizomes.

In the most exposed localities the plant becomes so reduced and different in appearance that I have described it as a special form: f. *reducta* (Fig. 122). This form is characterized by its, in all respects dwarf-like organs. The rhizomes are scarcely a millimeter thick and bear on the downward side numerous richly ramified rhizoids, by means of which it is firmly fastened to the substratum. On the upward side the rhizomes are either naked or have short, often only a centimeter high assimilators with more or less irregularly shaped, often nearly cylindrical ramuli; only more seldom do we find more normally developed ramuli swollen at the apex. The ramuli often grow out to new rhizomes (see Fig. 112 *d* and *e*) and contribute thus to producing the entangled tissue of the rhizomes. This form was found in large mats covering the most exposed places where *Caulerpa* is to be found at all. The sea breaks fiercely over the alga, which motionless bids defiance to the waves and just in its firmness possesses the necessary protection. Following the plant from these the most exposed places to more sheltered we have the most even transitions to the typical form of var. *clavifera*. Of all Caulerpas occurring in the Danish West Indies, this form is certainly the one which can grow in the most exposed places.

Yet a third form of *Caulerpa racemosa* is found on rocks and coral-reefs, namely, the form to which I have given the name var. *occidentalis* (Fig. 123).) This variety which I earlier in agreement with Reinke referred to var. *Chemnitzia* and under which name I have distributed it in the Exsiccatæ of Wittrock & Nordstedt, I now believe on more thorough examination to be separated from the *Chemnitzia*-group and thus to be considered as a special variety. I have used the name of J. Agardh for it, as I think there is no doubt that my form is identical with the form of Agardh, as Svedelius (l. c. p. 130) has also maintained. J. Agardh gives the following short diagnosis (l. c. p. 37): »frondibus erectiusculis fere clavæformibus, inferne laxe ramentaceis superne dense imbricatis«. And in the description further down on the page he adds: »In forma *occidentali* sæpius ramenta ad rachidis partes supremas densiora, immo dense imbricata fiunt, parte apotheciiformi extrorsum oblique versa, rachides ita omnino obtegentia: frondes his locis immo digitum minorem crassæ«. From var. *Chemnitzia* this form differs by

having the uppermost swollen part of the ramuli convex and not more or less disciform or even concave. The lowest ramuli are commonly more or less cylindrical, higher up they become more and more swollen at the apex; they have a rather long, thin stalk often over ¾ of the length of the whole ramulus and then swell suddenly. The swollen part is flattened convex in the uppermost,

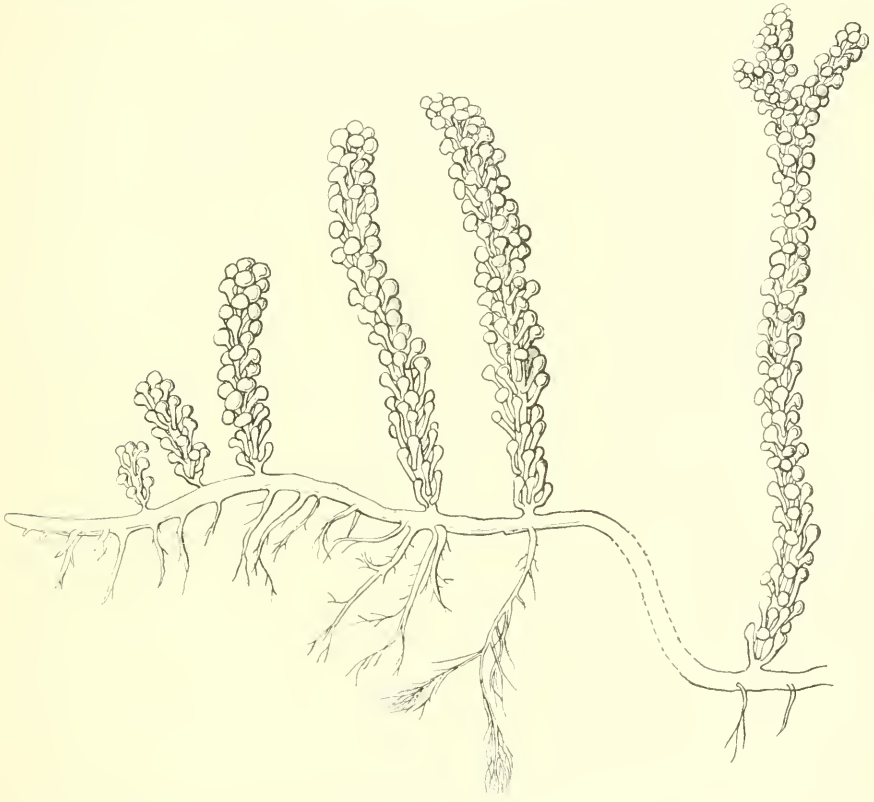

Fig. 124. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *occidentalis* (J. Ag.. From Christiansfort (St. Jan). (About 1 : 1.)

outwardly bent side. The figure quoted of Reinke gives a very good illustration of this variety; cfr. also the figures given here (Figs. 123 and 124).

Var. *occidentalis* besides often showing a great resemblance to var. *uvifera* can also bear a great likeness to var. *lætevirens* Mont.; but while the characteristic for this form is, that the ramuli are either cylindrical or grow evenly thicker upwards, the ramuli in var. *occidentalis* become suddenly swollen at the apex.

This variety occurs as mentioned in coral-reefs and similar localities with fresh sea-water and some motion of the sea. On the coral-reefs e. g. Long Reef on the north side of St. Croix it seems only to reach a small size (Fig. 123). The assimilators become here seldom higher than 3—5 cm as the specimen delineated here shows, which was found growing between *Corallinaceæ*. On the landing bridge at Christiansfort on St. Jan, a locality a little more sheltered even if we can have some surge, the erect shoots reach a length of about 10 cm and wave to and fro following the motion of the sea; fig. 124 shows a specimen from here. It can nevertheless reach a still more considerable size. A specimen from the Bermuda Isles in the herbarium of M^me^ Weber-van Bosse and collected by Dr. M. A. Howe had feet-long assimilators. It was determined as *C. racemosa* var. *lætevirens* but in my opinion it belongs to var. *occidentalis*.

To the var. *lætevirens* I have referred a large vigorous plant (Fig. 125) which occurs in a restricted locality in the Lagoon of Christianssted in rather considerable quantity. It grows in a very sheltered place at a depth of about two meters in soft bottom of mixed sand and mud. The water here seems always to be filled with mud and is therefore quite unclear (on each of my three visits to the West Indies I have visited the locality several times and always found it so muddy that is was impossible to see the bottom). The erect shoots reach a length of up to 16—18 cm and are covered with ramuli placed in several rows but rather open; these are cylindrical-clavate being evenly thicker towards the apex. The rhizome is thick and creeps in and on the soft mud in which it is fastened by vigorous roots. The plant is of a pale-green colour somewhat glassy, translucent and of a flabby consistency.

With the figure of *Chauvinia lætevirens* by Kützing (Tab. phyc. Bd. 7, tab. 12) my specimens have a great resemblance; often the ramuli are however, as the illustration given here shows (Fig. 125), somewhat more openly placed than in the figure of Kützing; but specimens are to be found which quite agree with this. On the other hand the figure of Montagne has more and more closely placed ramuli than the West Indian specimens and the same is also the case by comparison with a little piece of an original specimen from the herbarium of Montagne collected at »île de Toud«, which is to be found in the herbarium of M^me^ Weber-van Bosse. The ramuli in my specimens are more scattered and the erect shoots and most probably the whole plant longer than that of Montagne,

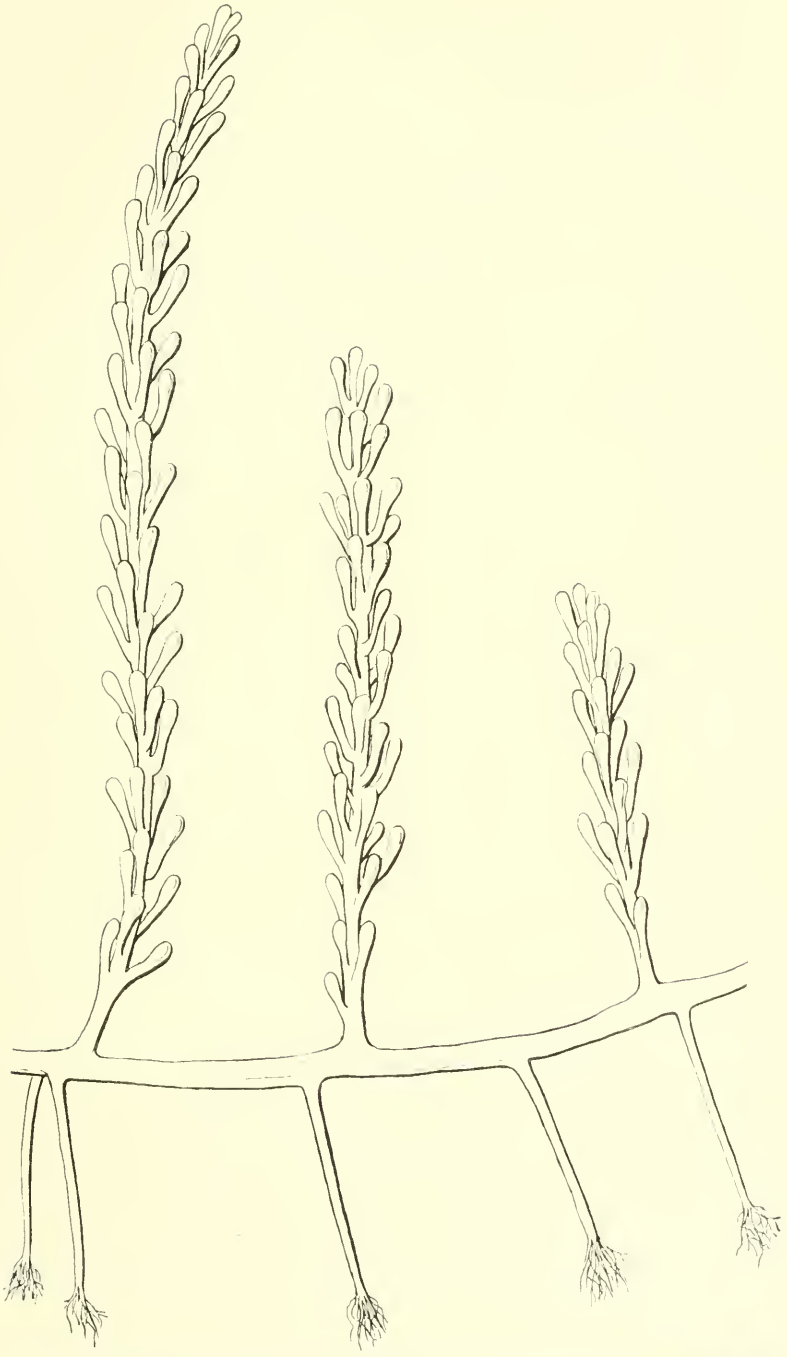

Fig. 125. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *lætevirens* Mont. From the Lagoon of Christianssted. (About 1 : 1.)

but the form of the ramuli is about the same and the likeness seems to me on the whole very great.

As pointed out by Mme Weber, var. *lætevirens* may show a not inconsiderable likeness with var. *corynephora* as Sonder[1]) has already mentioned. What is most characteristic of this variety is that the ramuli are distichous and opposite but sometimes one can find an erect shoot with multiseriated ramuli. An otherwise normally developed specimen from Celebes in the herbarium of Mme Weber-van Bosse has just a single assimilator with multiseriated ramuli (cfr. Mme Weber-van Bosse's Monograph, tab. XXXIII, fig. 14) and the likeness with var. *lætevirens* is thus very great. That var. *lætevirens* also shows a great resemblance to the above-mentioned var. *occidentalis* I have already shown.

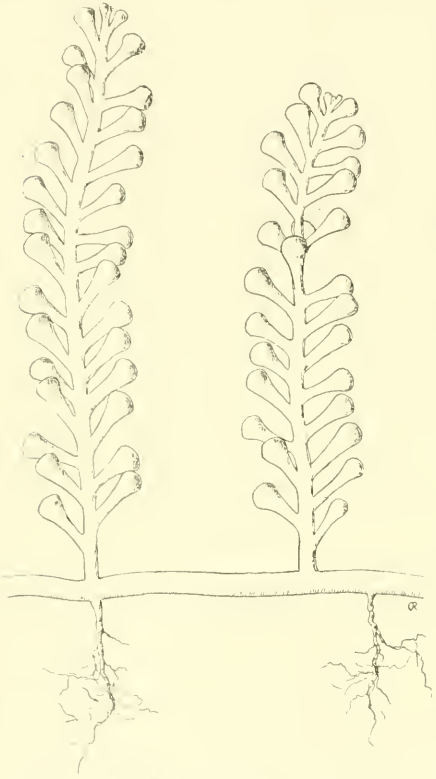

Fig. 126. *Caulerpa racemosa* (Forsk.) Weber-van Bosse var. *Lamourouxii* (Turner) Weber-van Bosse. From deeper water off Hermitage (St. Jan). (About 1 : 1.)

To the var. *Lamourouxii* I have referred some few specimens growing in deeper water. They are characterized by having the ramuli distichous; sometimes also many-sided occur (see Fig. 126). The ramuli are distichous not oppositely placed, somewhat upward bent, and the uppermost swollen part is broadly convex. My specimens agree well with the figures given by Turner (32, tab. 229) and Kützing (20, Bd. 7, tab. 14). Just as these figures show, the ramuli are somewhat flattened on the upward turned side; for my specimens, living as they did in deeper water, this can perhaps have some importance, the ramuli turning by this fact a proportionally broad surface towards the light.

[1]) Sonder, W., Die Algen des tropischen Australiens, p. 65. Hamburg 1871.

My specimens of var. *Lamourouxii* show for the rest a considerable variation. A specimen (Nr. 2036) collected off America Hill at St. Jan in about 30 meters depth was very like the figure of Turner and especially the fig. c, tab. 14 in Kützing »Tabulæ phycol.«. Other specimens (Nr. 1121) from St. Thomas collected in the sound to the west of Water Island in about 20 meters of water had some likeness with var. *lætevirens*, having rather long, but somewhat feeble swollen ramuli, but these were distichous. Again, others like that here delineated (Fig. 126) collected off Hermitage at St. Jan in the sound between this island and Tortola in about 30 meters of water, seem to me to approach the var. *corynephora*; this was especially the case with a small specimen found off Christiansfort at St. Jan in the sound between St. Thomas and St. Jan in about 25 meters of water.

Caulerpa racemosa is a very common species along the coast of the Danish West Indies, especially the varieties *clavifera* and *uvifera*; f. *reducta* is found at St. Thomas: on the coral-reef which unites the Hurricane Island with St. Thomas. Var. *occidentalis* was gathered in St. Croix: Long Reef at Christianssted and near Sandy Point, St. Thomas: in the harbour at Charlotte Amalie and St. Jan: at Christiansfort; var. *lætevirens* is only found St. Croix: in the Lagoon of Christianssted; var. *Lamourouxii* St. Thomas: in the sea west of Water Island, St. Jan: in the sound between St. Thomas and St. Jan off Christiansfort and to the north of St. Jan off America Hill and Hermitage.

Geogr. Distrib. In all tropical seas.

Fam. 4. ***Vaucheriaceæ.***

Vaucheria dichotoma (L.) Ag.

C. Agardh, Synopsis Alg. Scand. 1817, p. 47. Borgesen in Botanisk Tidsskrift, vol. 31, 1911, p. 148.

In the dimensions of the thallus the form found seems to agree very well with f. *marina* Hauck, »Meeresalgen«, p. 412.

Lat. thall.	=	90—150 μ.
— oospore	=	ca. 270 μ.
— antherid.	=	ca. 100 μ.
Long. —	=	ca. 175 μ.

It was found St. Croix: Krauses Lagoon, on soft, moist bottom near the shores.

In »Algologiska småsaker« (Bot. Notiser 1879) Nordstedt mentions that he had found a specimen of this species from St. Thomas in Herb. J. Agardh: »hab. in lignis fluitantibus. Ser. E no. 36 (»Duchassaing«).

During a visit to Paris (Oct. 1908) I was able through the courtesy of M. Paul Hariot to examine a specimen of Mazé & Schramm's Algues de la Guadeloupe determined as *Chlorodesmis comosa* and it seemed to me rather probable that this plant was the male plant of *Vaucheria dichotoma*. As now this specimen bears a great likeness to the sterile one I referred with much doubt to *Avr. comosa* in an earlier paper[1]) I think it very probably that my specimen belongs to this species.

In their recent work on the *Codiaceæ* of the Siboga Expedition Mr. & Mrs. Gepp discuss the *Chlorodesmis comosa* of Mazé et Schramm, which in their opinion is an undescribed species of *Derbesia*. It is possible; when I collected my abovementioned sterile plant I also took it for a *Derbesia*. When Mr. & Mrs. Gepp describe the sporangia of Mazé and Schramm's plant as globose I may point out, that in the Paris Museum specimen I found them obovoid much resembling in form the antheridia of *Vaucheria dichotoma*.

Geogr. Distr.: Europa, America.

[1]) Borgesen, F., The species of Avrainvilleas hitherto found on the shores of the Danish West Indies (Vidensk. Meddel. fra den naturh. Foren. i Kbhvn. June 1908).

18/VI 1913.

INDEX SPECIERUM

F. BØRGESEN

THE MARINE ALGÆ OF THE DANISH WEST INDIES

PART 2. PHÆOPHYCEÆ

COPENHAGEN
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1914

DANSK BOTANISK ARKIV,
UDGIVET AF DANSK BOTANISK FORENING
BD. 2, NR. 2

INTRODUCTION

As in the case of my *Chlorophyceæ* paper the present communication is based upon material collected during my three stays at the islands.

With regard to the collecting of the algæ, reference should be made to the introduction to the *Chlorophyceæ* section for information as to the localities visited and for physiographical details. Here also a chart showing the coral reefs, depths etc. in the sea nearest the islands is published.

Concerning the brown algæ from the islands I have already published some papers on the subject, namely:

Two crustaceous brown algæ from the Danish West Indies (Nuova Notarisia, Serie XXIII, Luglio 1912).

The species of *Sargassum* found along the coasts of the Danish West Indies with remarks upon the floating forms of the Sargasso Sea (Mindeskrift for Japetus Steenstrup, Kobenhavn 1914).

For the sake of completeness I also give here the contents of these paper so far as they treat with the fixed algæ living at the shores of the islands.

If we compare the brown algal vegetation of the West Indian islands with that found in northern seas we see clearly the well known fact that the northern brown algal vegetation reaches a luxuriancy which greatly surpass that in the tropics. The group of brown algæ which in the islands is most vigorously developed is the *Fucaceæ* represented by *Sargassum* and *Turbinaria*, and where these are growing in full vigour this tropical *Fucaceæ*-Formation is not much inferior to that found in the northern sea,

e. g. at the shores of the Færöes [1]). But this fucaceous vegetation is also the most vigorously developed and as is well known the corresponding vegetation in the northern seas is much behind the vegetation of the *Laminariaceæ*.

After the *Fucaceæ* it is the representatives of the *Dictyotaceæ* and also forms of the *Encœliaceæ* which attain to some size and are found in greater masses in the West Indies, apart from these most of the forms are small. Upon stones in shallow water brown crusts of *Ralfsia expansa* are common and upon rocks on the north west coast of St. Croix *Aglaozonia canariensis* forms large red brown expansions.

As to the number of species found at the shores of the islands (40 species) this is also not great; compared with that found at the shores of the Færöes (73 species) it is only a little more than half.

The brown algæ occur from low water mark (the tide is nearly wanting at the islands) or a little above, and down to a depth of about 40 meters where *Zonaria variegata* was still found well developed; as mentioned in the introduction to the *Chlorophyceæ* section I have not been able to dredge in greater depth.

With regard to the earlier contributors to our knowledge of the algæ of the islands I refer to the information given in the *Chlorophyceæ*, just as in the case of collectors of algæ etc.

Here I wish only to express my best thanks to the botanists who in different ways have helped me by the working out of the present paper.

I am much indebted to M^me^ Weber-van Bosse and Professor C. Sauvageau for having been so kind as to send me original specimens of different species to compare with the mine.

And especially my thanks are due to Professor P. Kuckuck who by reason his extensive knowledge especially of the *Phæosporeæ* has been able to give me much valuable information.

Finally, I am much obliged to the Direction of the Carlsberg Fund for the grant in aid of the drawings and reproduction.

[1]) Comp. F. Børgesen, The Algæ-vegetation of the Færöese coasts, 1905. (Botany of the Færöes, Part III).

PHÆOPHYCEÆ

I. Phæosporales.

Fam. 1. ***Ectocarpaceæ.***

Ectocarpus Lyngb.

1. Ectocarpus Duchassaingianus Grun.

Grunow, A., Algæ, in »Reise der Österreichischen Fregatte Novara um die Erde«, Botan. Theil, 1ster Bd., 1870, p. 45, tab. IV, fig. 1.

Vickers, A., Phycologia Barbadensis, Part. II, tab. 27.

To this species of Grunow I have referred an *Ectocarpus* which seems to agree with it very well even if there are a few differences.

It occurs as rather large 2—4 cm high tufts growing epiphytically upon other algæ or on stones, piles and similar substrata in harbours or bays.

The basal part consists of rather thick-walled, yellow-brown, irregularly bent and ramified, rhizoid-like filaments woven together (Fig. 128 *a*). From this basa lpart the erect filaments grow up. At first the filaments increase by division of all the cells but soon marked intercalary growth takes place (comp. Fig. 127 and 128 *c*); the filaments terminate in rather long, nearly colourless hairs, the uppermost cells of which reaching a length of 5—6 times their own breadth. Elsewhere the cells in the filaments are 1—2, sometimes even 3 times, as long as broad. The diameter of the cells reaches 20—22 μ.

The ramication is spreading and very irregular; often large parts of the filaments are not ramified at all (Fig. 127).

The chromatophores consist of small, irregularly shaped discs, often roundish, or in the younger cells, oval (Fig. 128 *g*).

The plurilocular sporangia are as a rule sessile (Fig. 127 and Fig. 128 *b*, *c*), occasionally they are found ending a short branch (Fig. 128 *e*). They are very variable in size and form; sometimes long and nearly cylindrical (Fig. 128 *b*), sometimes short and often clavate and with walls more or less undulating. They may reach a length of more than 250 μ, most commonly they are only the

half this length; their diameter may reach 50 μ, but is usually about 25—27 μ.

The unilocular sporangia (Fig. 127, Fig. 128 *f*) are obovate-oval, sessile, attaining a length up to 110 μ and a breadth of about 70 μ.

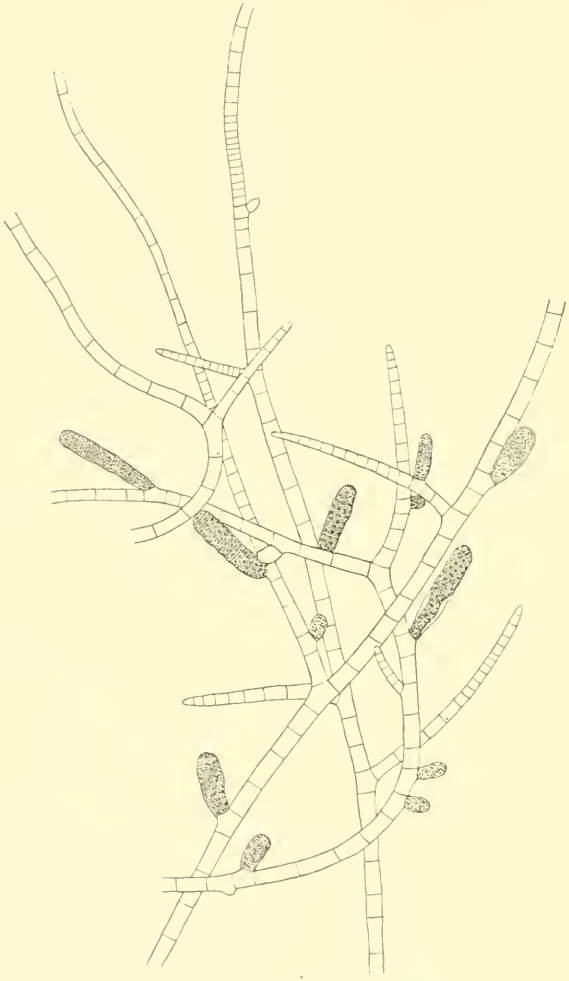

Fig. 127. *Ectocarpus Duchassaingianus* Grun.
Filaments with plurilocular sporangia and a single unilocular.
(About 90 : 1).

The present species was found with both kinds of sporangia in the months December—March.

This species seems to be nearly related to *Ectocarpus indicus* Sonder (comp. the figure given by M^me^ Weber in "Algues du

Siboga", I, 1913, p. 130) and to *Ectocarpus simpliciusculus* of Askenasy (Alg. Gazelle, p. 20, tab. V, fig. 1, 11) which, as pointed out by Mme Weber, most probably belongs to *Ectocarpus indicus*. Mme Weber does not mention the shape of the chromatophores of

Fig. 128. *Ectocarpus Duchassaingianus* Grun.
a, basal, creeping filament. *b*, filament with a long, cylindrical plurilocular sporangium and unilocular sporangia. *c*, plurilocular sporangia placed upon the main filament. *d*, plurilocular sporangia upon a branchlet. *e*, a terminal, plurilocular sporangium. *f*, an unilocular sporangium. *g*, cell with chromatophores. (*a*, about 50 : 1; *b*—*e*, about 90 : 1; *f*, about 140 : 1; *g*, about 225 : 1).

Ect. indicus; if these agree with those of *Ect. Duchassaingianus* I think the latter is merely a form of the former.

It grows in the littoral and uppermost part of the sublittoral region, most often in sheltered places, but also in more exposed and seems to be a common species.

It was found, St. Croix: Christiansteds Harbour and in the lagoon near this town. St. Thomas: The Harbour in several places. St. Jan: Cruz Bay and off America Hill in a depth of about 20 metres.

Geogr. Distrib. West Indies.

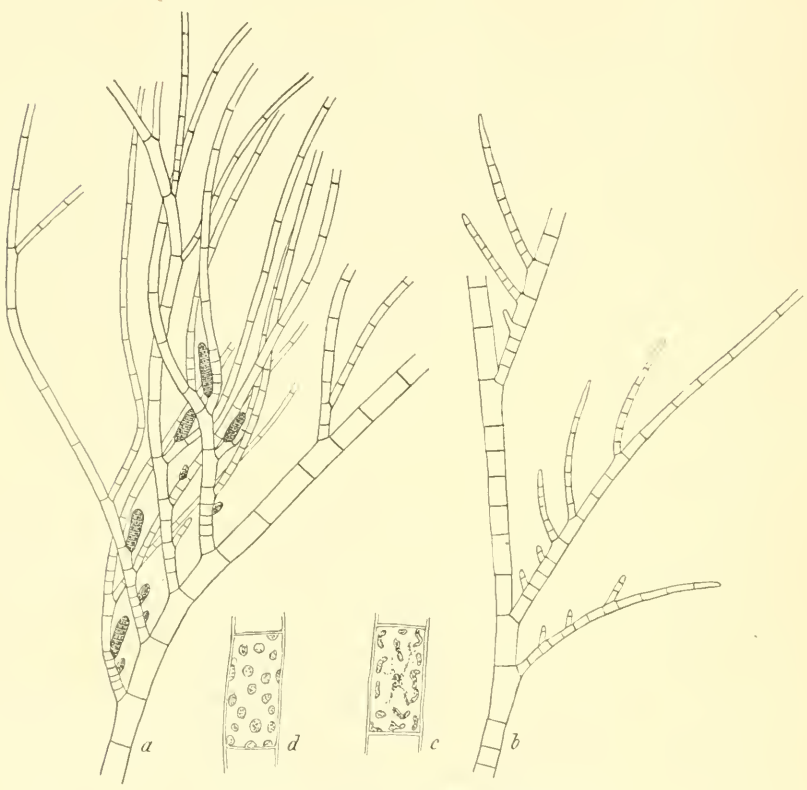

Fig. 129. *Ectocarpus Mitchellæ* Harv.
a, part of thallus with plurilocular sporangia. *b*, part of thallus with young branchlets. *c*, chromatophores in a young cell. *d*, chromatophores in an older cell. (*a* and *b*, about 100 : 1; *c* and *d*, about 200 : 1).

2. **Ectocarpus Mitchellæ** Harv.

Harvey, Nereis Boreali-Americana, Part I, p. 142, pl. XII, G.

The specimens referred to this species form two—three cm and higher tufts.

From the lowermost cells in the filaments rhizoids grow out (Fig. 130), fixing the filaments to the substratum, stones, shells

or larger algæ, e. g. *Codium*. The rhizoids are about 11 μ thick and consist of proportionately long cells.

In the basal part the main filaments are thinner, reaching only a thickness of about 22 μ; higher up they grow thicker, the diameter of the cells here being from 35—45, seldom 50 μ, while their length is about 2—3 times as long. In the upper part of the thallus the filaments become thinner again, the cells at the same time becoming proportionately longer.

The cells are cylindrical or sometimes very slightly barrelshaped; in the lower part of the thallus their walls are often brownish coloured.

The lowermost parts of the main filaments are not ramified; higher up branches grow out from almost every cell, most often in a secund manner (Fig. 129 *a*), sometimes alternating. The young branches are somewhat attenuated towards their apex (Fig. 129 *b*) and composed of cells which are somewhat longer upwards and have fewer chromatophores. Later on the branches show a marked growing point near their base and terminate with long nearly colourless hairs (Fig. 129 *a*). The branches are about 15—20 μ thick, the hairs 10—15 μ.

The chromatophores (Fig. 129 *c*, *d*) have the shape of short ribbons in the young cells, in the older they are small roundish discs [1]).

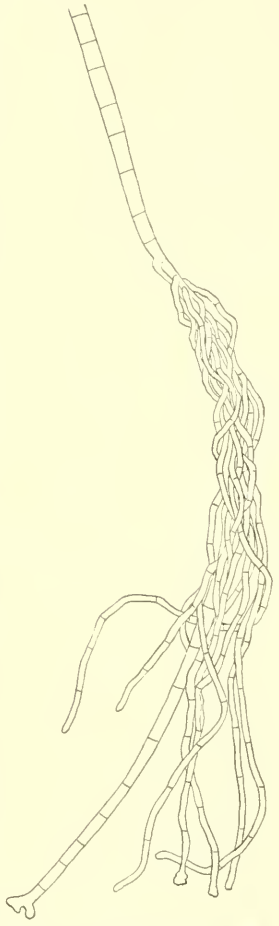

Fig. 130. *Ectocarpus Mitchellæ* Harv. Base of a plant. (About 100 : 1).

Upon their upper side the branches again bear smaller ones also terminating with hairs and further plurilocular sporangia (Fig. 129 *a*). These are developed successively upwards from the growing point in perfect accordance with those in *Ectocarpus virescens* as pointed out by Sauvageau [2]). The plurilocular sporangia are sessile, lanceolate cylindrical, with obtuse

[1]) Comp. Sauvageau, C., Sur l'Ectocarpus virescens Thuret, (Journal de Bot., T. X, 1896, p. 101, fig. 2 *B*, *C*).

[2]) Sauvageau, l. c., p. 101, fig. 2 *A*.

apex and base, reaching to a length of about 70—100 μ, and a breadth of 15—20 μ.

Unilocular sporangia were not found.

Harvey's description and figure of this species being not sufficiently good for an absolutely certain determination to be made I have been very thankful to receive from Professor Sauvageau some fine preparations of Harvey's original plant. Compared with these my plant shows some differences, the most essential of these being that the hairs in the West Indian plant are more richly developed and the ramuli not so much attenuated as in the original plant; in the latter also the cells seem to be somewhat more barrelshaped, while in mine they are most often quite cylindrical. But I do not think that these differences are of sufficient importance to separate my plant from Harvey's.

As is well known it is rather doubtful how far *Ectocarpus virescens* Thur. is a distinct species from that of Harvey. Of this species also Prof. Sauvageau has been so kind as to send me not only specimens from Herb. Thuret, but also some collected by himself at Guéthary, one of which has plurilocular sporangia with large spores, and other with small spores.

Having compared these specimens with mine and also with Harvey's plant I find that while the shape of the sporangia agree well in all the specimens, the French material has more attenuated branchlets and not such well developed hairs as in mine. In this respect they agree with Harvey's. But in the American plant and so also in mine we have not yet found more than a single kind of plurilocular sporangia. Furthermore *Ectoc. Mitchellæ* becomes somewhat more brownish in colour when dry and seems also to be somewhat more rigid and robust as the whole.

At the Danish Islands this species was found in somewhat exposed localities in the upper sublittoral region.

St. Thomas: Several places in the harbour, Store Nordside Bugt.
Geogr. Distrib. Atlantic coast of North America.

3. **Ectocarpus coniferus** nov. spec.

Ectocarpus mediocris, axi primario distincto, filamentis erectis, rhizoideis brevibus substrato adfixis, ca. 40 μ crassis, articulis $^1/_2$ usque 4 plo longioribus quam latioribus, in parte basali simplicibus, dein ramosis ramis irregulariter dispositis, interdum alternis, secundis aut sparsis, curvatis, apicem versus attenuatis in pilum longum articulatum productis.

Sporangia plurilocularia plerumque axillaria, sessilia, dense aggregata, conico-elongata, magnitudine variabili, minora = 40 μ long. et 24 μ lat., majora = 110 μ long. et 40 μ lat., plerumque 1—3, rarius plura aggregata. Sporangia unilocularia ovata. Chromatophora disciformia numerosa in cellulis præsentia.

The plant is fixed to the substratum by means of short

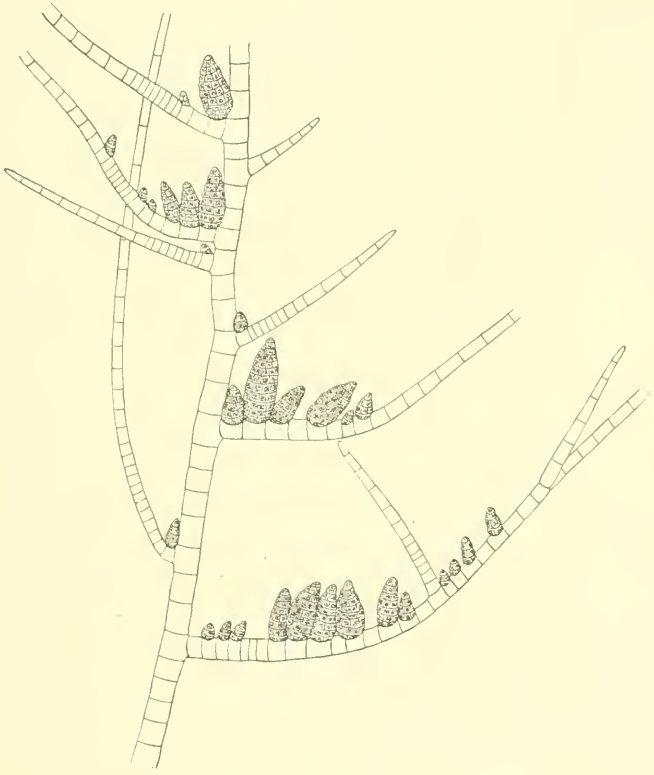

Fig. 131. *Ectocarpus coniferus* nov. spec.
Part of a plant with plurilocular sporangia. (About 60 : 1).

rhizoids growing out from the lowermost cells in the filaments (Fig. 132 *e*).

The main filaments are about 40 μ thick consisting of cells from nearly $^1/_2$ to 3—4 times longer than broad. The lengthening of the main filaments is mostly restricted to limited intercalary growing-points which occur near the insertion of a branch (Fig. 132 *a*) but now and then, also, a single cell here and there in the filaments may start to divide. All the filaments and lateral branches

are terminated with long hairs consisting at the end of long and nearly colourless cells and having a growing-point at their base.

The ramification is very irregular being sometimes nearly secund, sometimes alternating, just as the distance between the

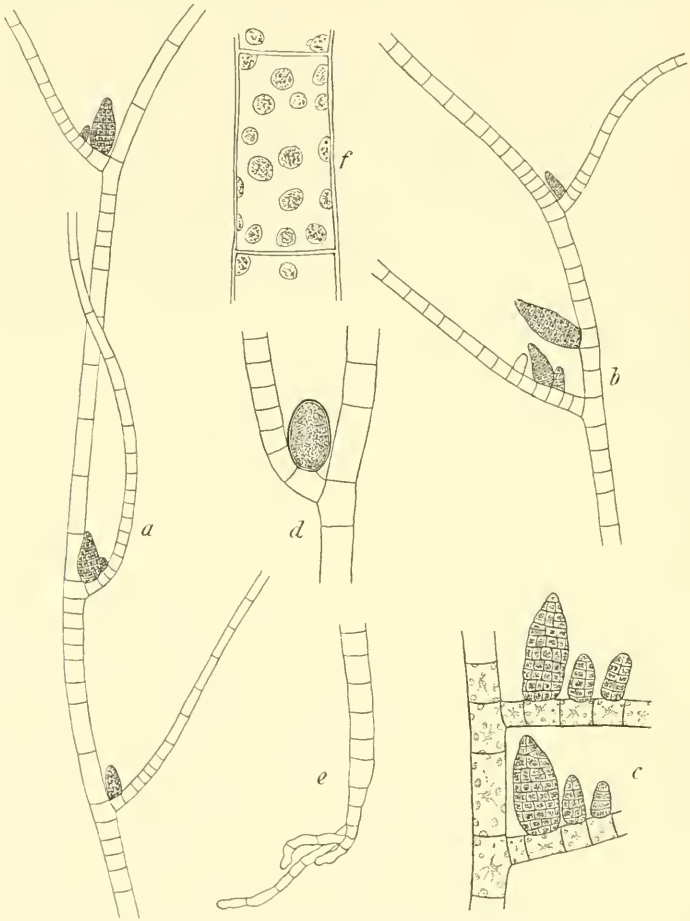

Fig. 132. *Ectocarpus coniferus* nov. spec.
a, part of thallus with a few plurilocular sporangia in each angle of branch. *b*, part of thallus with a plurilocular sporangium upon the main branch. *c*, plurilocular sporangia. *d*, unilocular sporangium. *e*, base of a filament. *f*, cell with chromatophores.
(*a*, *b*, *e*, about 50 : 1; *b*, *c*, *d*, about 90 : 1; *f*, about 250 : 1).

insertions of the branches is much variable. Some of the branches, especially in the lowermost part of the thallus, grow out to filaments like the main filaments; the others, especially the uppermost, are not branched or have only a single or few ramuli.

The branches are inserted in a right or somewhat acute angle to the main filaments (Fig. 131) and they are most often curved upwards (Fig. 132 *a*).

Upon their upper side in the angle between the branch and the mother-cell the sporangia are found.

The plurilocular sporangia are oblong-ovoid to conical and always sessile. Most often only a few, 1—3, sporangia occur in each angle, the largest of these, as a rule, being nearest to the main filaments (Fig. 132 *a*); but now and then a greater number develop; though a case with as many sporangia as is found in the fig. 131 (lowermost branch) is rare. More rarely plurilocular sporangia also were met with upon the main filaments (Fig. 132 *b*).

The plurilocular sporangia are of rather variable size, the smaller ones about 40 μ long and 24 μ broad while the larger may reach a length of up to 110 μ and a breadth of about 40 μ.

The few unilocular sporangia found occur at the same place as the plurilocular sporangia, namely in the axis between the main filament and the branch (Fig. 132 *d*); they were nearly ovoid in shape and always solitary.

The chromatophores consist of small roundish discs, fairly numerous in each cell (Fig. 132 *f*).

It cannot be denied that this plant shows some likeness to *Ectocarpus Hincksiæ* Harv. but on the other hand it differs so much in several respects from Harvey's species that it cannot be considered a form of this species.

Thus the ramification is much more irregular than in *Ectocarpus Hincksiæ* with its usually regularly arranged, short, secund, pectinated, ramuli.

Furthermore the ramuli in the West Indian plant have marked intercalary growth-points near their base and invariably terminate with long, nearly colourless hairs, while in *E. Hincksiæ* the cells of the ramuli are divided nearly everywhere [1]) and are short and all nearly the same size. Sauvageau however (l. c.) mentions that occasionally some specimens are provided with short hairs. In specimens from the Færöes I have found no hairs.

The plurilocular sporangia occur usually solitary or a few (2—4) together in the axils of the ramuli in contradistinction to the usually numerous seriated sporangia of *Ect. Hincksiæ*.

And the elongated conical shape of the sporangia in the

[1]) Sauvageau, C., Observations relatives a la sexualité des Phéosporées, Journal de Botanique, 1897, p. 66.

present species is also different from the shorter, conical-piriform ones of *Ect. Hincksiæ*. The size of the plurilocular sporangia is more variable in *E. coniferus* and the larger ones exceed in size those in *Ectoc. Hincksiæ*.

The unilocular sporangia have only been found solitary in the axils of the branches while in *E. Hincksiæ* many occur together in a row along the upper side of the branch, and the involucre often found here (compare SAUVAGEAU l. c., and my remarks in The Marine Algæ of the Færöes, Botany of the Færöes, Part II, 1902, p. 412) has never been found in the West Indian plant.

In "Alg. Novara", p. 45 GRUNOW described a var. *australis* of *Ect. Hincksiæ* in which the ends of the ramuli sometimes ended in long hairs showing in this respect a likeness to the present plant.

After the above was written I received from Professor KUCKUCK (to whom I had sent a preparation of my plant) some drawings of his of *Ectocarpus irregularis* Kütz. and having seen these I saw at once that my plant was very nearly related to this species of KÜTZING being perhaps merely a form of it. Nevertheless some differences are present and as it comes from quite another geographical region to KÜTZING's plant (which is found in the Adriatic Sea) I think it justifiable to keep it as a full species. Judging from the very beautiful and instructive figures which Professor KUCKUCK most kindly allowed me to see, and further from the rather incomplete description found in the literature, the Adriatic plant seems to be somewhat smaller in all respects to the West Indian. This also Prof. KUCKUCK pointed out in his letter to me.

Further in the West Indian plant the plurilocular sporangia are found upon the upper side of the branches and nearly always in the corner between these and the main filaments only rarely do they occur upon the main filaments.

In the Adriatic alga, judging from the drawings of Prof. KUCKUCK, the sporangia seem to occur much more irregularly, very often upon the main filaments, sometimes even quite below the branches and also not so strictly confined to the upper side as in my plant, which just in this respect shows likeness with *Ectocarpus Hincksiæ*.

I may further add that when determining my plant I tried to refer it to *Ectocarpus irregularis* but the very misleading figure of KÜTZING ("Tab. Phycolog.", vol. 5, fig. 62) led me to give up the idea.

This species was found in the littoral and upper sublittoral region, growing epiphytic upon other algæ or on stones etc. It has been collected in much exposed as well as in more sheltered localities.

St. Croix: Christiansteds Harbour, Northside. St. Jan: Cruz Bay.

4. Ectocarpus Rallsiæ Vickers.

Vickers, A., Liste des Algues marines de la Barbade (Ann. Sc. Nat., Botanique, 9ième Série, vol. 1, 1905, p. 59); Phycologia Barbadensis, Part II, pl. 32.

Amongst *Ect. Mitchellæ* I found a small *Ectocarpus* which seems to agree with the figure of *E. Rallsiæ*, given by Mlle Vickers, l. c. As Mlle Vickers' description is rather poor I give here a further description from my plant.

The basal part consists of creeping, irregularly bent filaments (Fig. 133 *d*) twisted together. Underneath the filaments are fastened to the substratum by means of short rhizoids.

From their upper side the erect filaments spring up. These are composed of cells from nearly as long as broad, to about 5 times the length of their own diameter. Long and short cells are found intermingled owing to the fact that intercalary division may take place everywhere in the filaments (Fig. 133 *b*); in their upper end the filaments terminate in very long, colourless hairs. The diameter of the filaments reaches a length of about 27 μ.

The ramification is not very great and rather irregular. Sometimes several branches are crowded together, sometimes the filaments for a long while remain unbranched. Some of the branches are short, others long and terminating in a long hairs.

Several small discoid chromatophores are found in each cell.

The plurilocular sporangia are fusiform with attenuated apex, sessile or often pedicellate. They are rather variable in size, the length varying from 80 μ—120 μ or more and their diameter from 27 μ—40 μ.

The unilocular sporangia (Fig. 133 *b*) are oval-ovate, reaching a length of about 70 μ and a breadth of about 45 μ.

Far up in a long hair in the end of a filament (Fig. 133 *d*) I noticed a series of short cells with chromatophores etc.; these cells were certainly actively dividing, also producing a branch from one of the cells. If this phenomenon is a common event I think it may be of some importance, as a method of propagation, to a plant living as it does intermingled between larger algæ.

Ectocarpus Rallsiæ is evidently nearly related to *Ectocarpus coniferus* and *Ectocarpus irregularis*. The most essential differences are as follows: the frequently stalked sporangia, the shape of the plurilocular sporangia, this being more cylindrical, tapering rather suddenly towards the apex (comp. Mlle Vickers' fig. l. c.), and also the distribution of the sporangia, these being placed anywhere upon the filaments, much more irregularly than in *Ectocarpus coniferus*. Furthermore the filaments in *Ectocarpus Rallsiæ* are nearly all fairly uniform, reaching a diameter of about 27 μ.

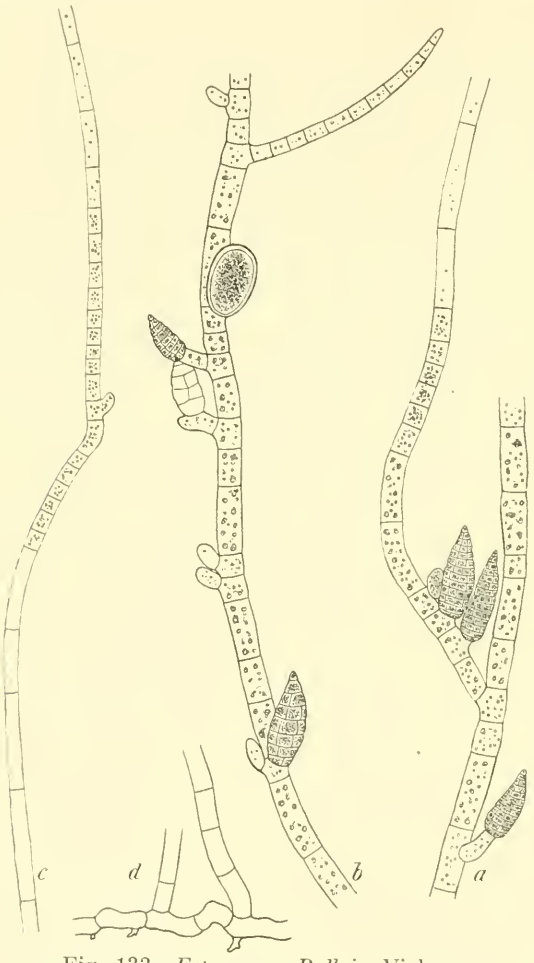

Fig. 133. *Ectocarpus Rallsiæ* Vickers.
a, part of thallus with plurilocular sporangia. *b*, filament with plurilocular and unilocular sporangia. *c*, cells in active state in the upper end of a hair. *d*, base of a plant.
(*a* and *b*, about 90 : 1; *c* and *d*, about 70 : 1).

This species was only found once, St. Thomas: Store Nordside Bugt.

Geogr. Distrib. West Indies.

5. Ectocarpus rhodochortonoides nov. spec.

Ectocarpus filamentis erectis e filis repentibus, horizontalibus, irregulariter flexuosis, egredientibus instructus.

Filamenta erecta, parce ramosa, 21 μ crassa, superne in pilum transformata. Articuli in inferiori parte filorum usque ad 3 plo longiores quam latiores, in pilis usque ad 14 plo.

Sporangia plurilocularia sessilia, interdum breve pedicellata,

ovalia—rectangularia, 33 μ long. et 22 μ lat., interdum elongata clavataque usque ad 64 μ long., 27 μ lat.

Growing upon an old *Padina* together with some other *Ectocarpi* were found a few specimens of a small *Ectocarpus*.

The plant had creeping, irregularly bent, basal filaments from which the erect filaments grow up (Fig. 135 *f*). The cells in the basal, rhizoidal filaments have rather thick walls and are about three times as long as broad, the diameter being about 8—9 μ.

The erect filaments have cylindrical cells, which in the lower part of the filaments are 2—3 times as long as their own diameter, which is about 11 μ. Higher up the cells can reach a length of up to 150 μ or nearly 14 times their own breadth. The long cells in the end of the filaments make these hairlike, and are devoid or almost devoid of chromatophores etc. (Fig. 134). The growth of the filaments takes place by division of the cells in the middle and lower part of the filament. A marked growing zone is found at times, but not always.

The chromatophore is ribbonlike and irregularly ramified (Fig. 135 *b*).

From the cells in the middle and lower part of the filaments thin rhizoids are occasionally found growing downwards (Fig. 135 *a*).

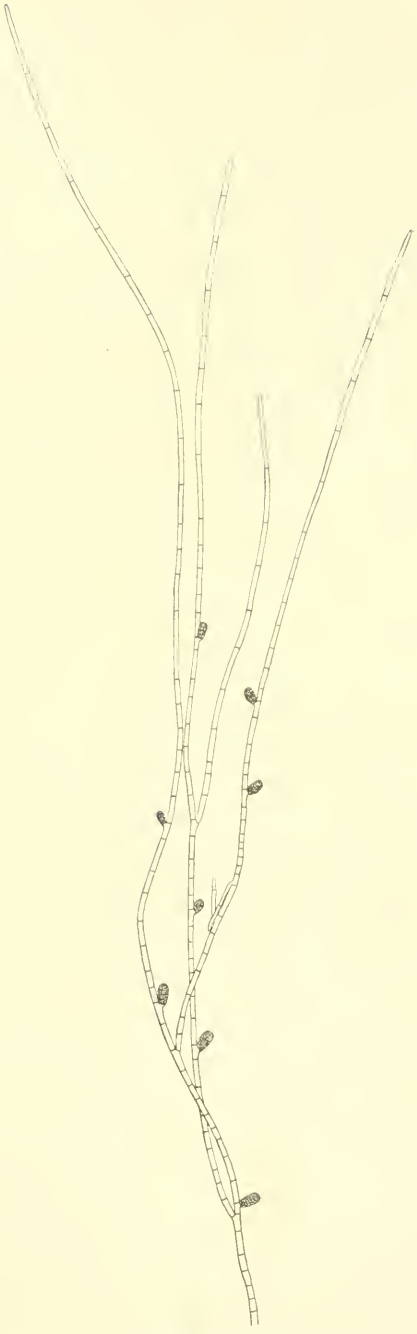

Fig. 134. *Ectocarpusrhodochortonoides* nov. spec. Part of a plant. (About 40 : 1).

Only plurilocular sporangia were met with; their shape was rather characteristic being oval-rectangular with roundish angles (Fig. 135 *a* and *b*); a few longer, clavate sporangia with undulated walls were also found (Fig. 135 *c*, *d*). The loculi are large, about 8 μ high and 10 μ broad.

The oval sporangia were about 22 μ broad and 33 μ long; the longer, clavate ones up to 64 μ long and 27 μ broad.

The sporangia are mostly sessile, rarely borne on a short stalk (Fig. 135 *e*).

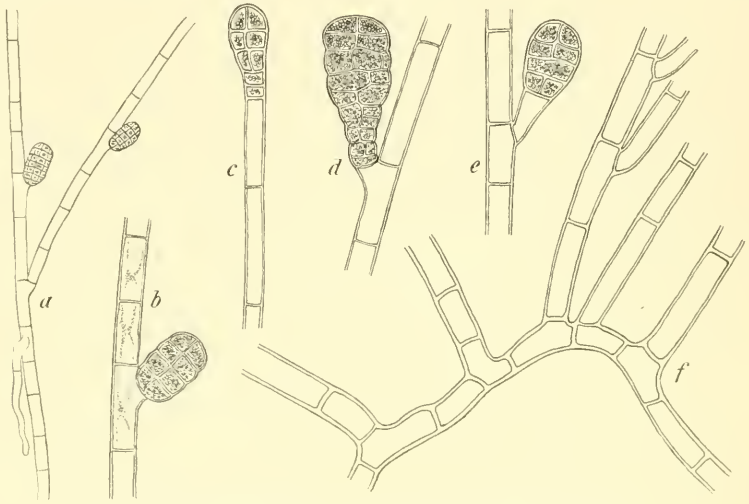

Fig. 135. *Ectocarpus rhodochortonoides* nov. spec.
a, part of a plant with plurilocular sporangia and a rhizoid. *b*, a plurilocular sporangium and cells with chromatophores. *c*, a terminal plurilocular sporangium. *d*, a clavate plurilocular sporangium. *e*, a stalked plurilocular sporangium. *f*, base of a plant. (*a*, about 90 : 1; *b*—*f*, about 200 : 1).

In the shape of the plurilocular sporangia with their large loculi our plant strongly reminds one of *Ectocarpus breviarticulatus* but in this species the sporangia are placed at right angles to the filaments while these are here curved upwards. In addition to this there is much difference in the vegetative parts of the plants.

This species shows also some likeness to *Ectocarpus variabilis* of Mlle Vickers (Phycologia Barbadensis, Part II, pl. 31); but this form differs from mine in its much shorter cells which seem to be of the same length in the whole plant. Further the shape of the plurilocular sporangia is also different.

The few specimens found were collected in exposed places in the littoral region.

St. Croix: Northside, Cane Bay.

6. Ectocarpus breviarticulatus J. Ag.

J. Agardh, Nya alger från Mexico (Öfversigt af K. Vetensk.-Akad. Förhandl. 15. Jan., 1847, p. 7).

Ectocarpus hamatus Cr. in Mazé et Schramm, Essai de classification des Algues de la Guadeloupe, 2e Edit. 1870—1877, p. 111.

Vickers, A., Phycologia Barbadensis, part II, pl. 29.

By means of original specimens collected by Liebmann near St. Augustin in Mexico and determined by J. Agardh I have been able to see that *Ectocarpus hamatus* of Crouan, so well figured in the "Phycologia" of Mlle Vickers belongs to this species. As the description of J. Agardh is rather deficient and Mlle Vickers in her "Liste" does not give any description of it I here mention it in a little more detail.

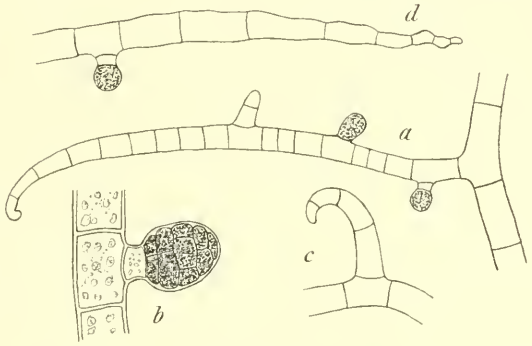

Fig 136. *Ectocarpus breviarticulatus* J. Ag. *a*, a branch with young plurilocular sporangia. *b*, cells with chromatophores and a ripe plurilocular sporangium. *c*, a hookformed ramulus. *d*, a branch with rhizoid-like apex. (*a*, *c* and *d*, about 90 : 1; *b*, about 190 : 1).

The plant forms rather large tufts, 2—4 cm high or even more, and these tufts are again composed of thinner and thicker rope-like spongy masses. By means of the numerous hooks and short bent ramuli, spread along the main filaments the whole becomes twisted together just as in *Ectocarpus tomentosus*. The growth takes place at any point in the filaments. These are about 27 μ thick. The length of the cells is usually 1—2 times their own diameter, rarely a little shorter or longer.

The plurilocular sporangia are nearly spherical in shape or somewhat ovoid (Fig. 136 *b*). They are placed nearly at right angles upon the filaments and have a very short stalk consisting only of a single small cell. The length of the sporangia is about 62 μ; the breadth about 57 μ.

Unilocular sporangia were not found.

Instead of hooks the ramuli sometimes run out into thin rhizoids (Fig. 136 *d*).

Several small roundish or more irregular discoid chromatophores are present in each cell (Fig. 136 *b*).

This species belongs to the littoral and the upper sublittoral region.

It occurs upon rocks and stones and is found even in the most exposed places where the waves constantly splash the rocks.

St. Croix: Cane Bay, Northside; St. Thomas: Store Nordside Bugt, near the entrance of the harbour.

Geogr. Distrib. Mexico, West Indies.

7. Ectocarpus elachistæformis Heydr.

Heydrich, F., Beitäge zur Kenntnis der Algenflora von Kaiser-Wilhelms-Land (Deutsch Neu Guinea). Berichte der deutsch. bot. Ges., Bd. X, 1892, p. 470, pl. XXV, fig. 14.

In the cryptostomata of an old *Sargassum vulgare* which was quite overgrown by various algæ, e. g. *Chantransia*, *Erythrotrichia*, *Rivularia* etc. was found a small *Ectocarpus* which filled up nearly the entire cavity.

This plant I think can be referred to *Ectocarpus elachistæformis* Heydr. even if it shows some differences.

It reached a height of about 1—3 mm and had horizontal, irregularly bent, basal filaments growing more or less together forming in this way a small irregular disc (Fig. 137 *a*). From this, short rhizoids, consisting only of a few cells, penetrate downwards into the tissue of the host plant (Fig. 137 *b*, *c*); and upwards long assimilating filaments and plurilocular sporangia are produced.

The assimilating filaments are thickest at their base, here about 10—14 μ broad, upwards thinner, about 8 μ; they consist of cylindrical cells which below are only a little longer than broad, the growing point being here; higher up the cells grow longer reaching a length of up to 5 times their own width. The assimilating filaments are simple throughout with the exception of a few quite short branches near their base upon which terminal plurilocular sporangia are placed.

These short branches consist most often of only a single cell sometimes of a few. Such short branches with plurilocular sporangia are also found growing immediately out from the cells in the basal filaments.

Now and then also sessile sporangia placed immediately upon the filaments occur.

The plurilocular sporangia are elongated lanceolate, broadest a little below their middle. They are about 100—140 μ long and 16—23 μ broad. The zoospores escape by means of a hole in their top (Fig. 137 *b*).

The chromatophores have the form of irregularly bent filaments.

This species seems to come quite near if it is not indeed identical with the form described and figured by Mme Weber in "Liste des Algues du Siboga", I, p. 128 and here designated *Ectocarpus elachistæformis* Heydr. prox. The way of growing, the shape and size of the sporangia, the breadth of the assimilating filaments all seem exactly the same.

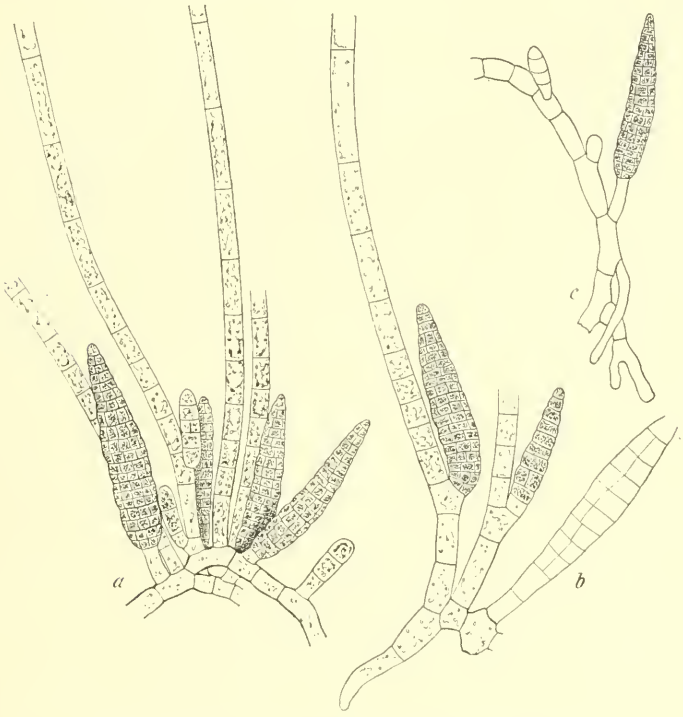

Fig. 137. *Ectocarpus elachistæformis* Heydr.
Parts of thallus with plurilocular sporangia.
(*a*, *b*, about 200 : 1; *c*, 150 : 1).

The only differences I have found were that the length of cells in the upper part of the assimilating filaments attain a greater length than in my plant (more than double), and that "le sommet de ces derniers [filaments longs] se transforme en longues cellules hyalines: le pseudo poil", while those in my plant all contain chromatophores. The shape of the chromatophore is not mentioned by Mme Weber.

Judging from the description and figure of Heydrich his plant shows the following differences.

The erect filaments are here more branched, thicker, with shorter cells and bear the sporangia on short side-branches somewhat over their base (comp. HEYDRICH's figure, pl. XXV, fig. 14), now and then sporangia are also found higher up upon the filaments. The sporangia are somewhat thinner (15—20 μ) and judging from the figure of HEYDRICH they also seem to be shorter.

St. Thomas: French Wharf.
Geogr. Distrib. New Guinea, Gulf of Aden.

Fam. 2. ***Encoeliaceæ.***

Colpomenia Derb. et Sol.

1. Colpomenia sinuosa (Roth) Derb. et Sol.

DERBÈS, A., and A. J. J. SOLIER, Mémoire sur quelques points de la Physiologie des Algues, p. 11 (here called *sinuata* but in the description of the figures (p. 119) and at the plate 22 we find *sinuosa*).

Ulva sinuosa Roth, Catalecta Botanica, III, p. 327, tab. XII, fig. a.

Asperococcus sinuosus Bory, Expedition scientifique du Morée, t. III, p. 326 (non vidi). Nouvelle Flore du Péloponnèse et des Cyclades, 1838, p. 76. J. AGARDH, Spec. Alg., I, p. 75.

Encoelium sinuosum Ag., Spec. Alg., I, p. 146; Systema p. 262. KÜTZING, Spec. Alg., p. 552; Tab. Phycol., vol. IX, pl. 8.

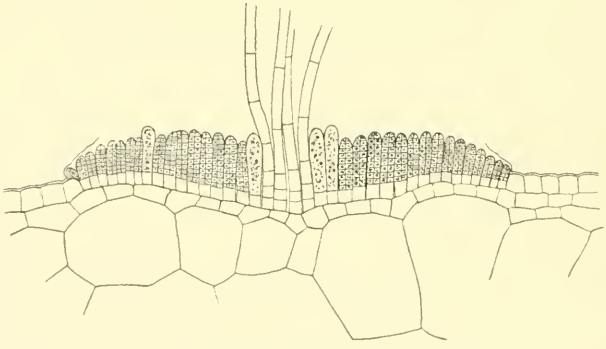

Fig. 138. *Colpomenia sinuosa* (Roth) Derb. et Sol.
Transverse section of the thallus showing plurilocular sporangia together with paraphyses surrounding a group of hairs. (About 90 : 1).

Fructifying specimens with ripe plurilocular sporangia were collected in the area of the sea with shallow water behind Long Reef at Christianssted. As described by MITCHELL in MURRAY „Phycological Memoirs", Part II, p. 53 the plurilocular sporangia occur in dense groups scattered over the whole surface of the thallus being formed round the depressed groups of hairs.

The sporangia are cylindrical or somewhat clavate and dispersed between them we find the club-shaped paraphyses sometimes rather numerous, sometimes very scarce or even wanting. According to MITCHELL the paraphyses originate from the basal cell of the sporangia and therefore are not formed until after the disappearance of the sporangia. As to this I must point out that I have found paraphyses scattered also between the plurilocular sporangia in the sori (see Fig. 138).

It is a common species and occur mostly in sheltered or not much exposed places in shallow water.

Geogr. Distrib. Widely distributed in all warmer seas so far north as to the south coast of England.

Hydroclathrus Bory.

1. Hydroclathrus cancellatus Bory.

BORY, Dict. class. VIII, p. 419 (non vidi). HARVEY, Phycologia Australica, pl. 98; Nereis, p. 120, tab. IX A. MITCHELL, M., in MURRAY, Phyc. Memoirs, p. 53, pl. XV, fig. 2—4. THURET, G. et Ed. BORNET, Études phycologiques, 1878, p. 12—13. VICKERS, A., Phycologia Barbadensis, Part II, pl. 23.

Asperococcus cancellatus Endl., Mantissa Botanica altera, Suppl. 3, 1843, p. 26.

Halodictyon cancellatum Kütz., Phycologia generalis, 1843, p. 336.

Encoelium clathratum Ag., Spec. Alg. p. 412.

Stilophora clathrata Ag. in "Flora", 1827, p. 642.

Asperococcus clathratus J. Ag., Spec. Alg. I, p. 75.

In "Études Phycologiques", l. c., THURET and BORNET have pointed out that while the sporangia entirely cover the surface of the young plants the old specimens with the well known peculiar reticular appearance are quite sterile with the exception of some few sporangia occurring now and then near the groups of hairs. Having only collected old specimens mine, in accordance with this observation, were sterile; even near the hair groups I have not succeeded in finding sporangia.

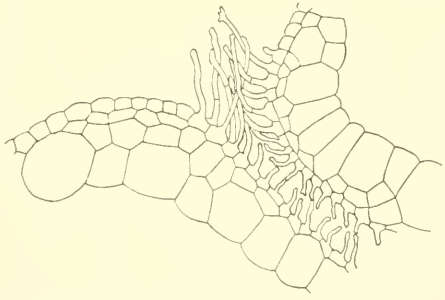

Fig. 139. *Hydroclathrus cancellatus* Bory. Transverse section of the thallus showing rhizoids growing out from the surface cells. (About 170 : 1).

As pointed out by

Mitchell, l. c., p. 56, the innerside of the strand in the netlike thallus is often ruptured in such a way that a large area of the cells in the interior of the thallus are exposed. The edges of these fissures have an inclination to curl inwards. If it happens that the edges come near each other the small surface cells grow out into shorter or longer rhizoid-like prolongations and in this way the fissure may be closed (comp. Fig. 139).

This species is common on the shores of the Islands. It occurs in the littoral and upper sublittoral region, in sheltered or not very much exposed localities.

Geogr. Distrib. Seems to occur in all warmer seas.

Rosenvingea nov. gen.[1]).

Frons tubulosa, cylindracea, vel leviter compressa, disco radicali adfixa, ramosa, ramis sparsis vel pseudodichotomis. Incrementum intercalare divisione cellularum frondis totius adest. Frons ex 3—4 stratis cellularum composita, cellulis exterioribus minoribus ad cavitatem versus majoribus, cellulis peripheræ chromatophora disciformia singula continentibus. Pila aut singula aut plura aggregata, per totam frondem sparsa aut in soris aut in parte sterili præsentia.

Sori maculis valde irregularibus per totam superficiem frondis dispersi.

Sporangia pluriłocularia subcylindracea aut clavata, e cellularum corticalium divisione orta.

1. Rosenvingea Sanctæ Crucis nov. spec.

Frons cylindracea aut leviter compressa, ca. 20 cm alta, superficie irregulariter rugosa, disco basali ex rhizoideis numerosissimis composito adfixa.

Rami sparsi, interdum pseudodichotomi, ad apicem et interdum ad basem attenuati. Pila aut singula, aut pauca aggregata per totam superficiem frondis aut sterili, aut sporiferi sparsis.

Lat. pilorum = 8—9 μ.

Sporangia plurilocularia, subcylindracea aut clavata, in soris irregularibus per totam superficiem frondis distributa.

Long. spor. pluriloc. = 20—40 μ.
Lat. — — = 5—12 μ.

[1]) Named after my compatriot, the well known phycologist, Dr. L. Kolderup Rosenvinge.

Fronds tufted up to 20 cms high; mostly nearly cylindrical, sometimes somewhat compressed, the surface being more or less uneven. It is irregularly ramified (Fig. 140); the ramification is monopodial, but the lateral branches are often vigorously developed in this way being more or less pseudodichotomious and the apices of the branches in the same time getting an antler-like appearance (Fig. 141 *a*, *b*, *c*).

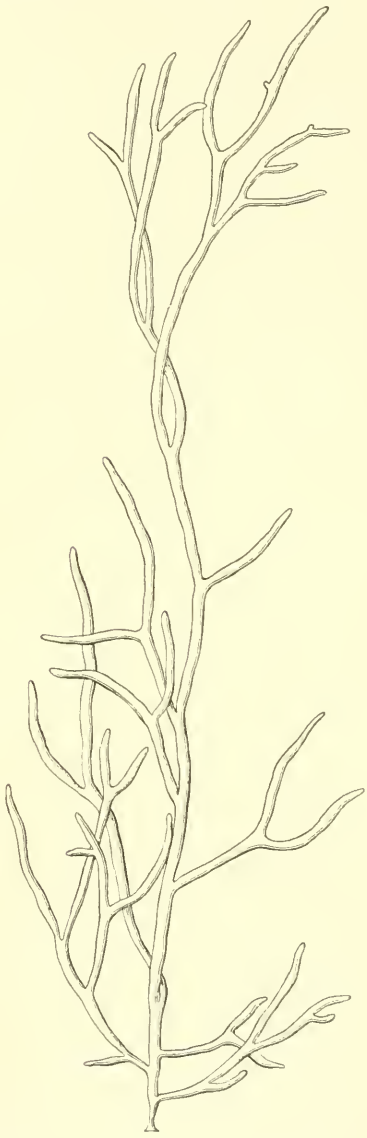

Fig. 140. *Rosenvingea Sanctæ Crucis* nov. spec. Habit of plant. (About natural size).

The thallus is hollow (Fig. 142) with the exception of the lowermost part where the interior of the tubular frond is filled with hyphal filaments growing downwards from the innermost cells (Fig. 141 *d*). These filaments together with numerous rhizoids growing out from the peripheral cells in the basal part of the frond form a small disc by means of which the plant is fastened to the substratum.

The growth takes place by intercalary division through the whole thallus; yet we may conclude that a vigorous division of cells also takes place in the ends of the branches though any true apical cell division is out of the question.

The diameter of the thallus reaches about 2 mm. The branches taper somewhat towards their apices and also sometimes towards their bases.

In a transverse section (Fig. 142) the thallus is seen to consist of 3—4 layers of cells; these are small, epidermal-like with rather thick walls at the surface, large, irregularly roundish-polygonal with thin walls against the hollow interior. Seen from above the surface cells are irregularly polygonal (Fig. 141 *f*); the cells in the interior,

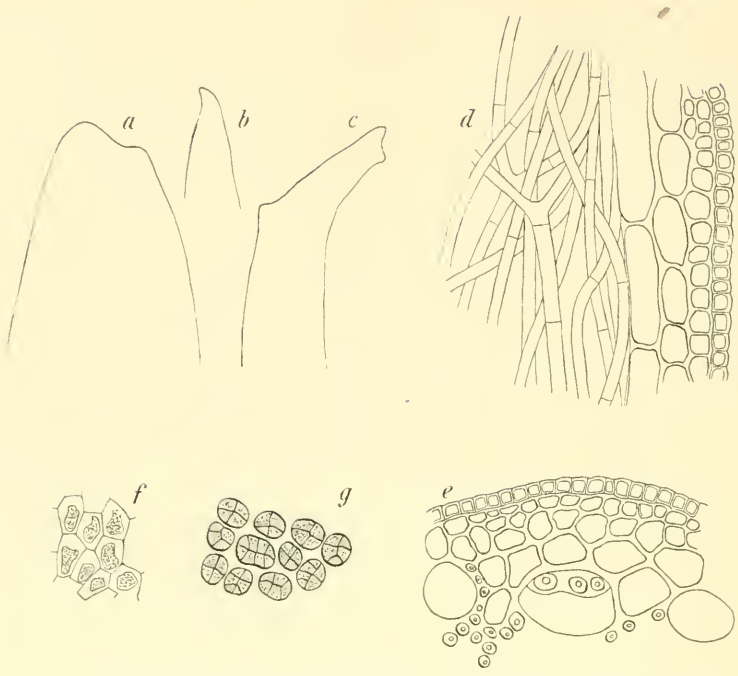

Fig. 141. *Rosenvingea Sanctæ Crucis* nov. spec.
a, *b*, *c*, the antler-like apices of the plant. *d*, longitudinal section through the basal part of the plant showing the hyphal filaments in the interior. *e*, transverse section of the basal part. *f*, surface cells with chromatophores. *g*, plurilocular sporangia seen from above.
(*a*, *b*, *c*, about 15 : 1; *d*, *e*, about 150 : 1; *f*, *g*, about 200 : 1).

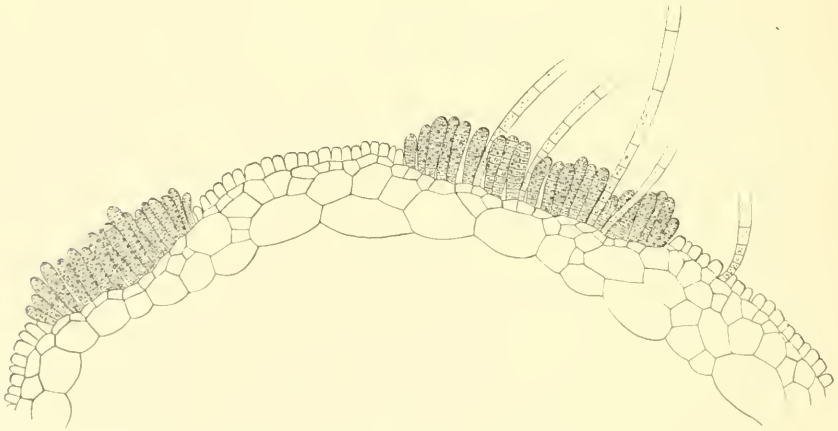

Fig. 142. *Rosenvingea Sanctæ Crucis* nov. spec.
Transverse section of the thallus with sori of plurilocular sporangia and hairs. (About 150 : 1).

especially the innermost, are lengthened, often nearly cylindrical. Here occur also now and then a few hyphal filaments running along the walls of the large cells.

The surface cells each contain a small, irregularly lobed, flat chromatophore (Fig. 141 *f*). The large cells in the interior seem to be nearly or quite colourless.

Hairs, isolated or a few together, occur scattered over the whole surface of the thallus (Fig. 142). They are found in the sterile as also in the fertile part of the thallus but most commonly in the latter, where they are present sometimes in the middle sometimes in the periphery of the sori and most often isolated though occasionally two-three together.

The diameter of the hairs is about 8—9 μ.

The plurilocular sporangia occur in irregularly formed groups spread over the whole surface of the frond (Fig. 143). The sporangia are developed from the surface cells. They are cylindrical, or often somewhat clavate (Fig. 142) and reach a length of 20 μ—40 μ and even more and a breadth of 5—12 μ. Paraphyses are wanting. At the edges of the sori the sporangia become gradually shorter and pass evenly into the sterile surface cells. A small depression is sometimes found in the middle of the sori but not always.

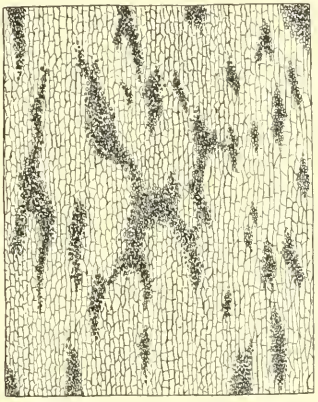

Fig. 143. *Rosenvingea Sanctæ Crucis* nov. spec. Surface view of a plant showing the irregular groups of plurilocular sporangia. (About 20 : 1).

I had no sooner started to examine this plant than I began to realize that I was probably dealing with a new genus. The plant appeared related to the family *Encoeliaceæ* and especially to the group *Scytosiphoneæ*, comp. Kjellman in "Die natürl. Pflanzenfam.", 1. Theil, 2. Abt., p. 197. Certain difficulties arise in referring this plant to this group e. g. its ramification. I therefore asked the opinion of Professor Kuckuck and he most kindly gave me very useful information.

Professor Kuckuck agreed with me that my plant was a representative of a new genus and that it was nearly related to *Scytosiphon*. He directed my attention to some species till now usually referred to *Asperococcus* and to *Chnoospora fastigiata* and most kindly sent me drawings as well as preparations of these for comparison.

As to the last mentioned plant this was already known to me from the description of *Chn. fastigiata* by Mrs. Gepp[1]). And further I have been able to examine *Chn. implexa* by the kindness of Mme Weber. Even if these species are nearly related to *Rosenvingea*, it is to be remarked on the other hand that as I shall mention later on in more detail, they, especially *Chn. fastigiata*, differ so much from it, that they can not be referred to a common genus.

With the above mentioned *Asperococcus* species the case is quite different. The species in question are: *Asperococcus orientalis* J. Ag., *Asperococcus intricatus* J. Ag. and *Asperococcus fastigiatus* Zanard. Here the correspondence is so great that there can be no doubt that they must be very closely related to my plant and therefore I have not hesitated to refer these species to *Rosenvingea.*

Nearest related to my plant seems to be *Rosenvingea orientalis.* It was originally described by J. Agardh in "Spec. Gen. et Ord. Alg.", vol. I, 1848, p. 78 and has later on been referred to *Encoelium* by Kützing („Spec.", p. 551) and to *Hydroclathrus* by Heydrich in "Hedwigia", vol. 33, 1894.

From Professor Kuckuck I obtained for comparison with my plant drawings and preparations. Judging from these *Rosenvingea orientalis* differs essentially by the absence of hairs, further the sporangia and the cells on the whole seem to be somewhat smaller. As I wished very much also to see the habit of the plant I asked Mme Weber to allow me to see her specimens from the Indian Ocean and she most kindly sent me all her dried material of this species to examine. These differ from my plant in their more slender thallus, especially the ends of the branches which are nearly hairlike; on the other hand the plant has more than the double height of the mine and it is more richly branched.

Of *Rosenvingea intricata* I have had a collection of dried original specimens from Vera Cruz, collected by Liebmann and determined by J. Agardh, further a dried specimen collected at Barbadoes by Mlle Vickers and material in spirit collected during the "Siboga"-Expedition, which Mme Weber- van Bosse has most kindly lent to me.

It is described by J. Agardh in "Alg. Liebm.", p. 7 and in "Species Alg.", 1, p. 77. Kützing in "Species Alg.", p. 551 calls it *Encoelium intricatum* and gives a good figure of it in "Tab.

[1]) E. S Barton, On the Fruit of Chnoospora fastigiata, J. Ag. in Journal of the Linnean Society, vol. XXXIII, 1898, p. 507.

Phycologicæ", vol. IX, pl. 5. HEYDRICH, l. c. refers it to *Hydroclathrus*.

Rosenvingea intricata is a much and very irregularly branched species; Mlle VICKERS figure is a good one.

So far I have been able to see hairs occur in groups several together both in the sterile part of the thallus and in the sori. In Mlle VICKERS' specimen the sori are roundish and sharply defined. This agrees with HEYDRICH'S statement that: "*H. intricatus* hat ziemlich scharf begrenzte Sori mit dicht gedrängt stehenden langen Gametangien, welche 12—15 meist doppelte Gameten enthalten". The specimens of LIEBMANN I have examined were sterile. So far as I have been able to see the cells contain a single chromatophore.

The third species, *Rosenvingea fastigiata* (Zanard.), is described by ZANARDINI in „Phycearum Indicarum Pugillus", p. 134, tab. 3, fig. 1—3[1]) and where we have also a good figure of the plant; of the f. *major* Reinb. (in SCHMIDT, Flora of Koh Chang, Part IV, Bot. Tidsskrift, vol. 31, 1901) I have been able to examine original specimens and finally Prof. KUCKUCK has most kindly sent me a preparation and a drawing of its sori.

A well marked character is the group of hairs in the middle of the roundish sori. A small disc-shaped chromatophore is present in each of the epidermal cells. The habit of this plant is very different from mine.

As mentioned above *Rosenvingea* is nearly related to *Chnoospora* in several ways. This genus has e. g. the same apex and ramification but it differs essentially in its solid somewhat compressed thallus[2]).

[1]) In Memorie del Reale Instituto Veneto, vol. 17, Venezia 1872.

[2]) Mme WEBER-VAN BOSSE has had the great kindness to allow me to examine a collection of *Chnoospora implexa* from the "Siboga"-Expedition. As this species seems to differ considerably from *Chn. fastigiata* I give a short description. The solid thallus is somewhat compressed and consists of larger cells in the middle, and small cells with chromatophores at the periphery. Groups of plurilocular sporangia were found scattered over the surface of the thallus. In these I found no hairs; the latter occurred scattered in the sterile part of the thallus, but not in great numbers. The plurilocular sporangia differ somewhat from these I found in *Rosenvingea*; they are more clavate and in the uppermost end divided into several rows of small cells. Above each sporangium we find the membrane of the mother cell. In each cell was an irregularly lobed chromatophore, and sometimes two occurred. From *Chnoosp. fastigiata* as we know this plant from Mrs. GEPP's description l. c. p. 507, this species differs in its marked

From *Seytosiphon Rosenvingea* differs especially in its ramification and the want of paraphyses.

With regard to the anatomical structure and as to the arrangement and shape of the sporangia *Rosenvingea* comes also near to *Hydroclathrus* and *Colpomenia*.

Fam. 3. ***Mesogloiaceæ.***

Castagnea Derb. et Sol.

1. Castagnea Zosteræ (Mohr) Thur.

Thuret in Le Jolis, Liste des Algues marines du Cherbourg, 1863, p. 85. Farlow, W. G., The Marine Algæ of New England, 1881, p. 86, pl. 7, fig. 2. Bornet, E., Les Algues de P. K. A. Schousboe, 1892, p. 236.

Rivularia Zosteræ Mohr, Bemerkungen über die Rothischen Rivularien in Weber, Beiträge zur Naturkunde, vol. 2, 1810, p. 367.

A great confusion as to the definition of species and also of genera prevails in the group of *Mesogloiaceæ*, and several of the species of earlier authors are sometimes referred to one form, sometimes to another. When comparing my plant with earlier described forms it seemed to me that judging from their figure it showed no little likeness to *Castagnea polycarpa* Derb. et Sol. But great similarity with Farlow's figure of *Castagnea Zosteræ* was also obvious. On the other hand the method of growing in my plant seemed to differ essentially from the description of Schmitz (as to which more later) and having only very little authentic material (and that only dried) to compare with I asked Prof. Kuckuck as to his opionion of my plant.

Prof. Kuckuck has now most kindly communicated to me that it seems to him that my plant comes near to *Castagnea Zosteræ*, but he added that he had not yet arrived to any definite conclusion as to the generic and specific arrangement in the group of *Mesogloieæ*.

In the following I now give a description of my plant so detailed that I hope it may be possible to recognize it when Prof. Kuckuck's work: "Die Phæosporeen" has appeared.

The specimens found were growing in tufts, 15—20 cms and more high, epiphytic upon the leaves of *Thalassia testudinum*. They were fixed to the leaves of the host plant by means of a small disc.

The central main filaments are connected rather firmly together to form an axial fistulous layer, leaving a cavity open

cryptostomata with numerous hairs around which the nearly cylindrical plurilocular sporangia occur.

in the middle. The union of the filaments is due to a tough mucilage which holds them together. But after boiling the plant for a short time in water the filaments easily separate in such a way that their mode of growth was observable.

As the figures (Fig. 144 *a*, *b*, *c*) show the central filaments increase by means of intercalary growth. Each filament termi-

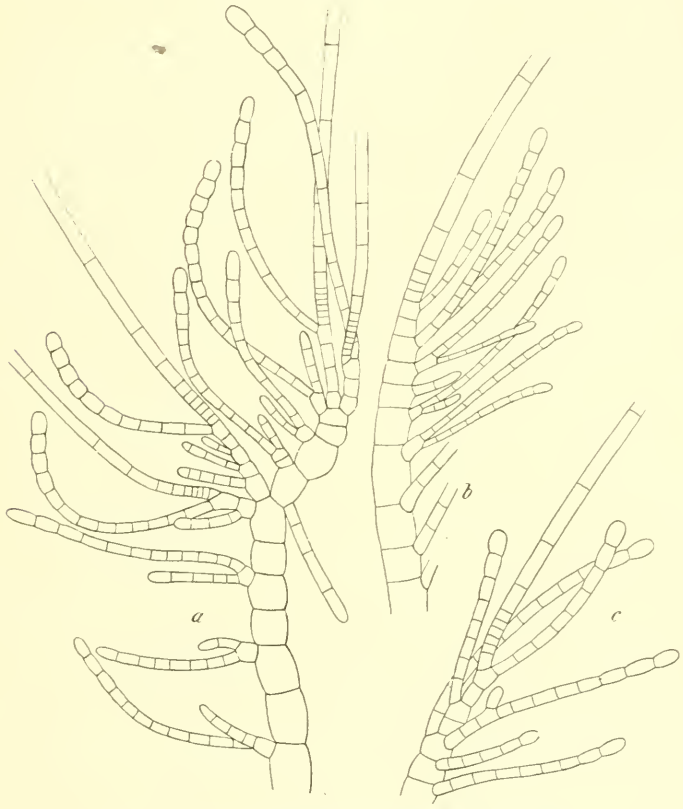

Fig. 144. *Castagnea Zosteræ* (Mohr) Thur.
Summits of filaments showing way of growing.
(*a*, *c*, about 150 : 1; *b*, about 200 : 1).

nates with a long hair, the cells of which are long and colourless at the upper end being shorter and shorter towards its base. Here we have the growing point from below which the cells of the main filaments are formed, and above those of the hairs. At their base the hairs have a thin sheath.

When this method of growth has continued for a time the end of the filament is bent out laterally and a side branch similar

to the mother filament grows out as a prolongation; after some time this again is bent outwards and a new branch continues the

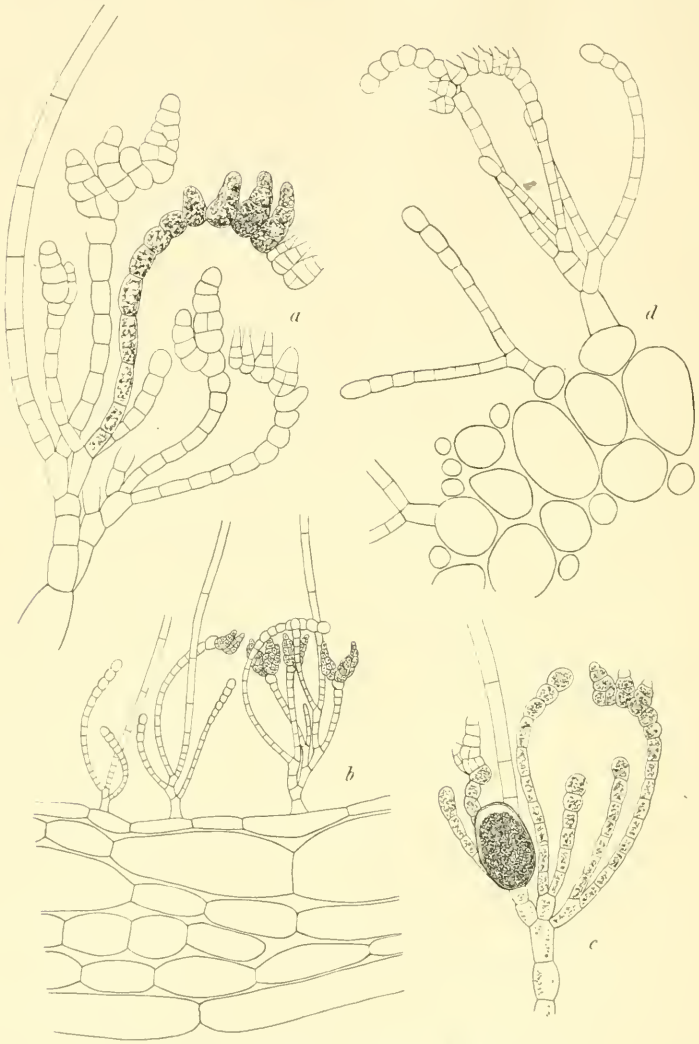

Fig. 145. *Castagnea Zosteræ* (Mohr) Thur.
a, summit of assimilation-filaments transformed to plurilocular sporangia; *b*, longitudinal section of the thallus; *c*, unilocular sporangium; *d*, transverse section of the thallus. (*a*, *c*, *d*, about 200 : 1; *b*, about 90 : 1).

growth and so forth. The growth of the filaments is in this way sympodial (Fig. 144 *a*). Now and then it happens that the lengthening of the filaments also takes place monopodially for some time as the figure shows (Fig. 144 *b*).

Occasionally from the basal cell in the sympodium rhizoid-like filaments grow downwards between the larger barrel-shaped cells of the main filaments (Fig. 144 *a*).

Below the growing point the cells in the filaments remain short, further down they grow longer, nearly barrel-shaped, reaching a length of up to 200 μ or even more and a breadth of up to 80 μ. The cells are nearly colourless and as mentioned above firmly connected; upon a transverse section (Fig. 145 *d*) we find this central tube to be composed of several layers of cells.

This central tube is entirely surrounded with the dense layer of assimilating filaments. From the outer side of nearly all the cells in the peripheral filaments short branches grow out (Fig. 145 *b*, *d*). Their basal undivided part mostly consists of a single cell or rarely of two or three, these cells bear the assimilating filaments sometimes also a hair.

The assimilating filaments consist of a series of cells, the lowermost nearly cylindric and thin, those higher up thicker and moniliform; they have all, especially the uppermost cells, well-developed chromatophores. The diameter of the basal cylindrical cells reaches a length of about 8 μ, that of the upper moniliform cells of about 13 μ.

The diameter of the hairs is about 11 μ long and the uppermost cells in these reach a length of up to 12 times the diameter.

The plurilocular sporangia are formed by outgrowths from the uppermost cells of the assimilating filaments (Fig. 145 a). These cells, often several together, grow out to conical, or sometimes quite irregular, or even branched bodies which are divided by means of transverse and longitudinal walls. The gametes escape through an opening in the upper end of the sporangia (Fig. 145 *a*, *d*).

A few unilocular sporangia were found together with the plurilocular sporangia in the same plant (Fig. 145 *c*); these are placed at the base of the assimilating-filaments. They are oval-ovate of shape, about 40 μ long and 60 μ broad.

The description of the method of growth of *Castagnea* (*Eudesme*) *virescens* given by Reinke[1]) and especially by Schmitz[2]) differs, it cannot be denied, most essentially from that I have found in my plant. Besides *Castagnea*, Schmitz also examined a *Myriocladia* sp. and as to them he writes as follows: "Dabei fand ich nun, übereinstimmend bei den beiden genannten Arten, dass in

[1]) Reinke, J., Algenflora der westlichen Ostsee, p. 76.

[2]) Schmitz, Fr., Kleinere Beiträge zur Kenntniss der Florideen, V. (Nuova Notarisia, vol. 5, 1894, p. 707).

jedem fortwachsenden Spross ein centraler Leitfaden, eine ächte Centralachse, das Spitzenwachsthum vermittelt. Diese monopodial fortsprossende Centralachse bildet nach allen Seiten aus ihren Gliederzellen Zweiglein, die theils langsamer, theils rascher heranwachsen". This short quotation shows clearly the differences that exist as in my plant I have always found several filaments in the growing point, and these filaments had a sympodial growth.

On the other hand the growth of my plant seems to agree well with that which Mme Weber found in the plant referred by her to *Bactrophora nigrescens*[1]). Mme Weber has given a very detailed description and beautiful figures of its method of growth. In response to my request Mme Weber has also been so very kind as to allow me to examine her plant and having compared it with the mine I cannot deny that upon the whole it has much resemblance. The specimen I saw was sterile but Mme Weber has found unilocular sporangia. In this connection I wish also to draw attention to that which Prof. Kuckuck has written in a review[2]) of Mme Weber's paper: "Die Identifizierung einer Mesogloeacee als *Bactrophora nigrescens* erscheint dem Ref., der die Harvey'sche Originalpflanze untersuchen konnte, sehr zweifelhaft. Das bei der malayischen Pflanze beobachtete sympodiale Wachstum kann er für andere Mesogloeaceen bestätigen".

My plant was only found once in a somewhat sheltered place in shallow water ; it was growing epiphytic upon the leaves of *Thalassia testudinum.*

St. Croix: At the estate Lt. Princess behind Long Reef.
Geogr. Distrib. Atlantic coast of Europe and North America.

Fam. 4. ***Myrionemaceæ.***

Myrionema Grev.

1. Myrionema spec.

Upon an old *Padina* a small disc-shaped alga was found which showed much likeness to *Myrionema*, e. g. to forms of *Myrionema vulgare* as figured by Sauvageau in his paper treating of the Myrionemaceæ.

The disc in this specimen increases by means of marginal growth ; seen from above it is found to be composed of horizontal filaments, radiating from the centre, being now and then dichotomously divided.

[1]) Weber- van Bosse, A., Liste des Algues du Siboga, I, 1913, p. 139.
[2]) In "Zeitschrift für Botanik, 6. Jahrg., 4. H., 1914, p. 361.

The size of the cells differs rather much, their length being about 20 μ and their breadth 10 μ more or less.

Near the periphery the disc consists of a single layer of cells, in the middle of several. From the surface long hairs and short assimilating filaments grow upwards. The hairs have a basal growth zone and long colourless cells at their top. They have a well-developed sheath at their base.

Their diameter is about 14 μ.

The assimilating filaments consist of 2—3 cells and reach a height of about 35 μ; the cells contain some irregularly shaped small chromatophores.

In the middle of the disc the cells in the upper end of the assimilating filaments were divided by longitudinal walls being at the same time also darker coloured, this most probably being the beginning of the plurilocular sporangia. Above these divided cells the epidermis of the mother cell was often present in the mucilage. No further developed sporangia were found and a more definite determination is therefore impossible.

Only found once, St. Thomas: at the shore of Water Island.

Fam. 5. ***Ralfsiaceæ.***

Ralfsia Berk.

1. Ralfsia expansa J. Ag.

J. Agardh, Species Algarum, I, p. 63. F. Borgesen, Two crustaceous brown algæ from the Danish West Indies (Nuova Notarisia, Serie XXIII, 1912). A. Weber, Algues du Siboga, I, p. 146.

Myrionema (?) *expansum* J. Ag., Nya alger från Mexico (Öfversigt af K. Vetenskaps-Akademiens Förhandlinger, 4, 1847, p. 5, Stockholm 1848).

Though using the name of J. Agardh for this plant I may point out that the description of Agardh (l. c.) is so poor that an identification by means of it is impossible and as, moreover, the original specimen of *Ralfsia expansa*, collected by Liebmann at Vera Cruz and now in the Botanical Museum, Copenhagen, is sterile, an exact identification by means of it is also excluded. The using of Agardh's name in spite of this is chiefly because the sterile thallus of Liebmann's specimen seems quite to agree with my specimens and furthermore also, because the plant in question has been found in nearly the same flora-district.

The plant when young forms orbicular later on more irregular crusts, often growing together to coriaceous expansions on

stones and rocks. It has a dark brown colour. In young specimens the surface is nearly even and smooth with more or less conspicuous concentric striations, in older ones rather uneven, bullate and often somewhat folded. The thallus is rather easily separated from the substratum.

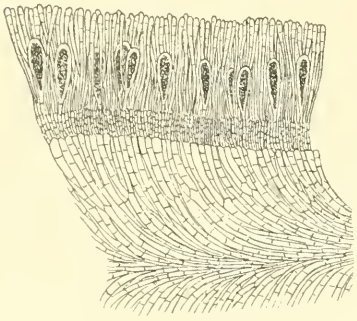

Fig. 146. *Ralfsia expansa* J. Ag. Transverse section of the thallus with unilocular sporangia (40 : 1).

The sterile part of the thallus is built in good accordance with that of *Ralfsia verrucosa*: from a horizontal layer of cells, arch-formed cell-threads grow up turning their convex side against the edge of the thallus, forming in this way a parenchymatical layer in good agreement with REINKE's schematic figure of *Ralfsia verrucosa* in "Algenflora" p. 48; often the leaf is more or less bilateral as shown in Figs. 146 and 147 being like the figure *c* of REINKE l. c., referring to some form from the Channel of *Ralfsia verrucosa* and in this way showing much likeness to *Ralfsia deusta*.

The chromatophore in the material preserved in alcohol was not especially prominent; it was plate-shaped and a single one was found in each cell.

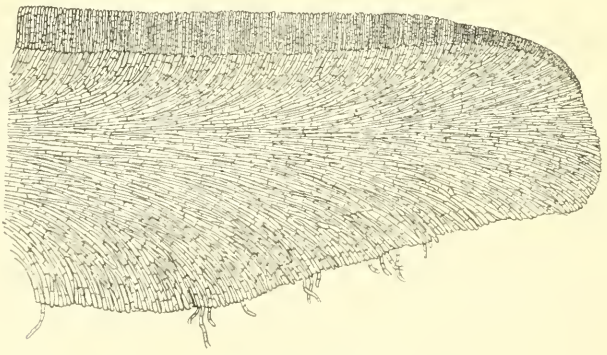

Fig. 147. *Ralfsia expansa* J. Ag.
Transverse section of the thallus near the edge (40 : 1).

Groups of hairs occur rather abundantly.

Both unilocular and plurilocular sporangia were met with, occurring on different plants. The unilocular sporangia (Fig. 148 *a* and *b*) are laterally placed upon the assimilating filaments and

nearly always stalked, having a single basal cell, very seldom I have found sporangia without this cell. They are oblong-pyriform; but as to the form and size some differences occur. In one specimen from the reef between the Hurricane Island and St. Thomas they were nearly oval-pyriform, 75 μ long and 30 μ broad and the assimilating filaments about 100 μ long (Fig. 148 *a*); in another specimen collected at the French wharf in the harbour of St. Thomas they were much longer, oval-pyriform to clavate

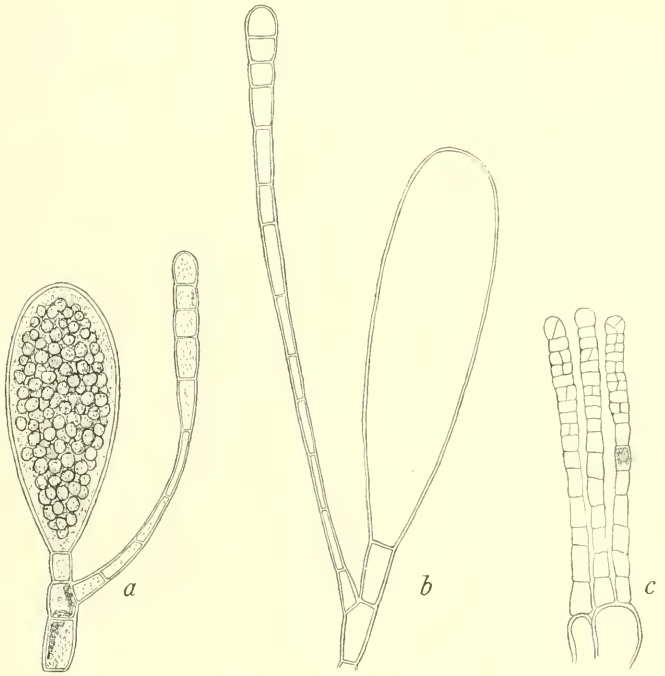

Fig. 148. *Ralfsia expansa* J. Ag.
a and *b*, unilocular sporangia; *c*, plurilocular sporangia. (About 300 : 1).

until 120 μ long without the basal cell and 30 μ broad and the assimilating filaments up to 170 μ long (Fig. 148 *b*).

The assimilating filaments consisting of from 8 to 14 cells are thinnest (about 3 μ) and the cells of which they are composed longest somewhat below their middle, the cells growing thicker and shorter towards their base and especially towards their top, the filaments assuming herewith a clavate appearance.

The plurilocular sporangia (Fig. 148 *c*) are formed by the assimilating filaments, the cells in their uppermost part being

divided by vertical and horizontal walls into smaller, more or less cubical cells. The sporangia are about 5—6 μ thick.

So far as I can see, this form seems to be very nearly related to *Ralfsia verrucosa* and especially it comes near to that large form collected by Schousboe in Maroc and described by Kuckuck in "Bemerkungen zur marinen Algenvegetation von Helgoland", I, p. 244. The most essential differences between the West Indian form and *Ralfsia verrucosa* are, that the sporangia in the first-mentioned form seem to be somewhat longer sometimes nearly clavate, that the sporangia have a small cell at their base, which is not mentioned in Kuckuck's description nor found in the excellent figures of *Ralfsia verrucosa* in Reinke's "Atlas"; only in Harvey, "Phycologia Britannica", pl. XCVIII, fig. 5 such a cell is figured. As to the plurilocular sporangia a difference is also present, the large top cell of the sporangia in *Ralfsia verrucosa* being after Kuckuck, l. c. p. 242, colourless and sterile. On the other hand, the paraphyses of the West Indian form seem quite to agree with those of *Ralfsia verrucosa*.

So long as our knowledge of *Ralfsia verrucosa* and its different forms remains somewhat deficient (cfr. Reinke, l. c. and Kuckuck, l. c.) I think it most correct to consider our form as a special species. Should later examinations of the different forms now referred to *Ralfsia verrucosa* show, that they all really belong to this species, it would perhaps be most natural to consider the West Indian form also as a variety of *R. verrucosa*.

This species occurred in shallow water near the surface of the sea on rocks and stones in rather exposed as well as more sheltered localities. It is found with unilocular and plurilocular sporangia in the months December—March.

It is a common species at the shores of the Danish Islands, especially at St. Thomas and St. Jan.

Geogr. Distrib. West Indies, Indian Ocean.

Fam. 6. ***Lithodermataceæ.***

Lithoderma Aresch.

1. Lithoderma spec.

Upon a stone together with *Ralfsia* were found some thin crusts of a brown alga. It has marginal growth and consists of a basal layer of cells from which the erect filaments grow upwards (Fig. 149).

The basal cells are oblong rectangular and arranged in fairly clear rows, occasionally dichotomously divided (Fig. 149 *b*).

From these cells the assimilating filaments grow up. These are likewise now and then dichotomously divided and composed of rather short cells; the diameter of the filaments, which are rather firmly connected, is about 8—10 μ.

The chromatophores were not very clear, even after having been stained; nevertheless I think that each cell contains a few irregular discs.

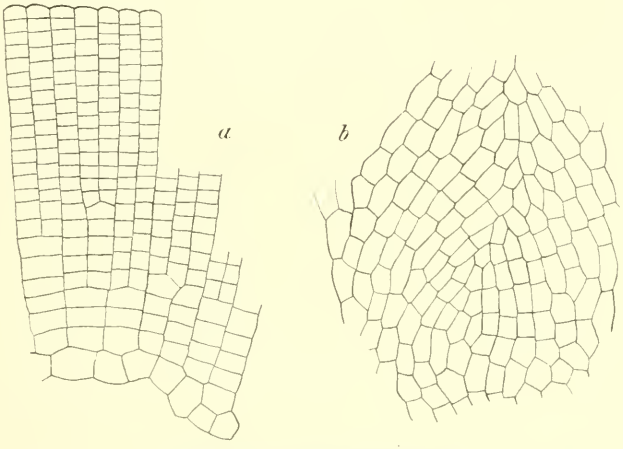

Fig. 149. *Lithoderma* spec.
a, transverse section of thallus. *b*, part of the disc. (About 200 : 1).

As the plant was sterile any more precise determination was excluded.

Only found once upon a stone in quite shallow water.

St. Jan: Cruz Bay.

Fam. 7. ***Cutleriaceæ.***

Aglaozonia Zanard.

1. Aglaozonia canariensis Sauv.

C. Sauvageau, Observations sur quelques Dictyotacées et sur un *Aglaozonia* nouveau (Bulletin de la Station biologique d'Arcachon, 8, 1904—5).

Borgesen, F., Two crustaceous brown algæ from the Danish West Indies (Nuova Notarisia, Serie XXIII, 1912).

On the exposed coast of the rocky north-west side of St. Croix I have collected a crust-shaped alga which seems quite to

agree with *Aglaozonia canariensis* described by SAUVAGEAU. As his preliminary note on this alga is without any figures and a certain identification therefore was difficult, I have sent a drawing to Professor SAUVAGEAU and asked him if my supposition was correct. Professor SAUVAGEAU quite agreed with me and has also most kindly sent me some material of his plant, to compare with the mine.

As already mentioned, my plant was found on exposed coasts and it was here growing as large expansions covering the rocks

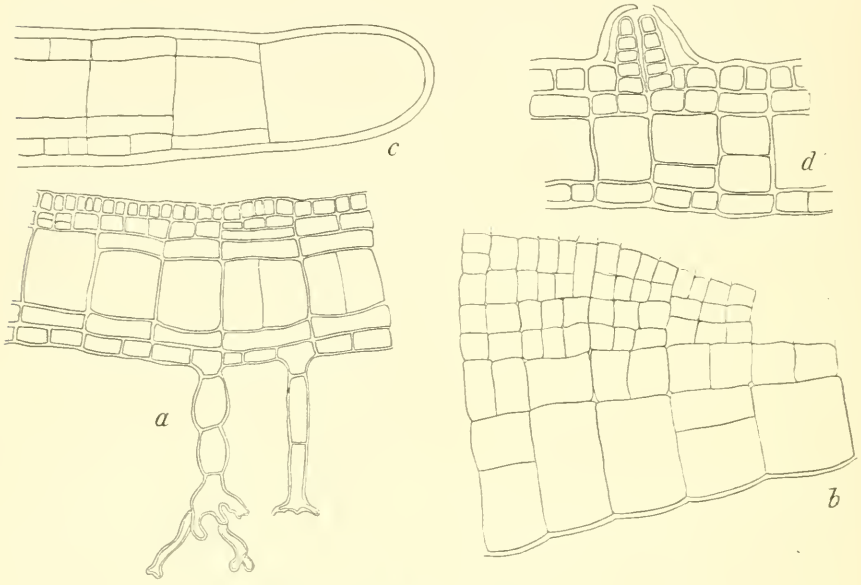

Fig. 150. *Aglaozonia canariensis* Sauv.
a, transverse section of the thallus with rhizoids. *b*, edge of the thallus seen from above. *c*, transverse section of the edge of the thallus. *d*, transverse section of the thallus with young hairs. (About 70 : 1).

with a dark-brown crust. It is of a coriaceous consistency. The edges of the thallus are roundish lobed and the lobes grow more or less over each other in a similar way as in *Ralfsia*. It adheres firmly to the substratum by means of numerous multicellular rhizoids (fig. 150 *a*) ending in a disc with irregularly divided, often coralliform prolongations. The cells in the unbranched part of the rhizoids are often swollen in the middle, this assuming thereby a moniliform appearance, but quite cylindric cells also occur.

If we examine the thallus from above (Fig. 150 *b*) we find

that it is composed of numerous rows of cells radiating flabelliform out from the margin; along this we find a series of large cells and these divide themselves gradually by longitudinal and transverse walls, each in this way giving rise to 2—4 rows of cells. In a transverse section (Fig. 150 *a*) we find that the thallus consists of a medullary layer of large cells with dark brown contents in the middle, and one or two, on the upper side occasionally even three, large flat cells; at the surface on both sides an epidermal layer of small cells. The large flat cells nearest the periphery are most often, in any case in older parts of the thallus, divided by vertical, secondary walls into two to four cells, more seldom horizontal walls also occur.

A transverse section of the edge (Fig. 150 *c*) shows the development of the thallus. First by a vertical wall a large cell is cut off from the topcell and at the new cells upper and under side two flat cells are formed from which the epidermal layer has it origin, the cells on the upper side being gradually divided into 4—6 small cells those below most often only in two or not at all (comp. Fig. 150 *a*). From the large cell in the middle of the thallus one, two or sometimes even three flat cells are cut off on the upper side, one or sometimes two from its under side. While these cells on the side below most often are undivided, sometimes though divided by a vertical wall into two cells, those on the upper side are somewhat more divided especially the uppermost cells. The large cells in the middle are sometimes also divided by vertical walls into two cells (the two cells to the right in Fig. 150 *a*).

The rhizoids are outgrowths from the epidermal cells below. Upon the upper side of the thallus here and there scattered groups of hairs occur; the hairs have their origin from epidermal cells (Fig. 150 *d*).

Unfortunately all my material was sterile.

As will be clear from this description, my plant seems to agree with that of Sauvageau, only that it is sterile, and this I have also confirmed by examination of original material from the Canary Isles which Prof. Sauvageau has most kindly sent to me.

In my preliminary paper I have pointed out that *Ralfsia ceylanica* Harv. most probably belongs to this species. And the same I think is also the case with *Zonaria parvula* Grev. var. *duplex* Heydrich.

In the Danish West Indies *Aglaozonia canariensis* was found on very exposed coast incrusting the rocks at about high water

mark and somewhat below. It was gathered in February and was then sterile.

St. Croix: at Northside estate.
Geogr. Distrib. Canary Isles, Indian Ocean?

Fam. 8. ***Sphacelariaceæ.***

Sphacelaria Lyngb.

1. Sphacelaria tribuloides Menegh.

Meneghini, Lettere al Corinaldi, 1840, p. 2, No. 1 (non vidi).
Sauvageau, C., Remarques sur les Spacélariacées, p. 123 and p. 237. (Extr. du Journal de Botanique, 1900—1904).
Vickers, A., Phycologia Barbadensis, Part II, pl. XXVI.

Specimens occurred with propagula and plurilocular sporangia.

This species is found growing upon stones, shells and similar objects.

It occurs in the upper sublittoral and in the littoral region and in both exposed and sheltered places.

St. Croix: Northside. St. Thomas: The Harbour, Water Island, Store Nordside Bugt.
Geogr. Distrib. All warm and temperated seas as far north as Scotland in the Atlantic.

2. Sphacelaria furcigera Kütz.

Kützing, Fr., Tabulæ Phycologicæ, vol. V, p. 27, tab. 90, fig. II. Sauvageau, C., Remarques sur les Sphacélariacées, p. 145. (Journal de Botanique, vol. XV, p. 1901).
Vickers, A., Phycologia Barbadensis, Part II, pl. XXV.

Specimens were found with plurilocular sporangia and propagula.

The plant occurred partly upon stones etc. twisted among other small algæ e. g. *Struvea anastomosans*, partly also upon larger brown algæ, *Sargassum* etc.

It grows in the littoral and upper sublittoral region and is collected in exposed as well as more sheltered places.

St. Thomas: St. Nordside Bugt, the Harbour.
Geogr. Distrib. All warm and temperated seas as far north as Heligoland and the Færöes.

II. Cyclosporales.

Fam. 1. ***Dictyotaceæ.***

Zonaria Draparn.

1. **Zonaria variegata** (Lamx.) Mert.

Mertens in Martius, Icones plant. cryptog., p. 6, tab. II, fig. II[1]). Richards, H. M., Notes on Zonaria variegata, Lamx. (Proceed. of the American Acad. of Arts and Sciences, 1890). Sauvageau, C., Observations sur quelques Dictyotacées et sur un Aglaozonia nouveau (Bullet. de la Station biolog. d'Arcachon, 8, 1904—5). Vickers, A., Phycologia Barbadensis, part II, pl. VI b.

Dictyota variegata Lamx., Essai, p. 57, tab. V, figs. 7—9.

Gymnosorus variegatus (Lamx.) J. Ag., Analecta algolog., cont. I, p. 11, 1894.

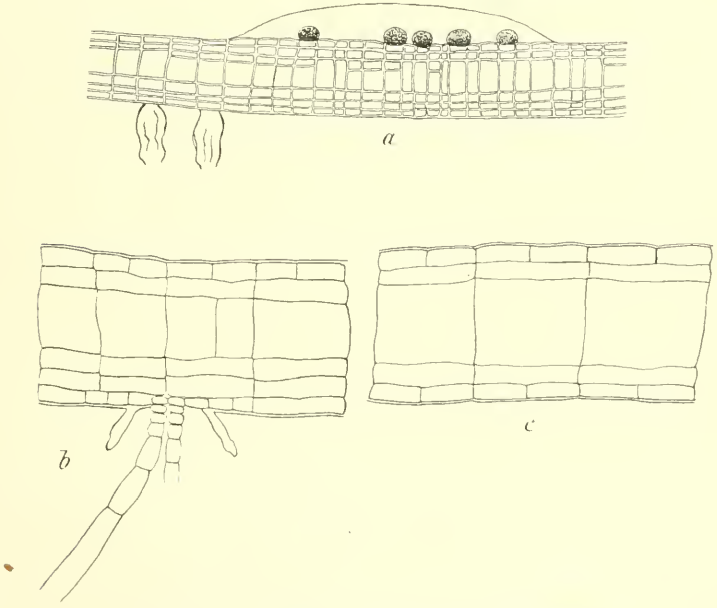

Fig. 151. *Zonaria variegata* (Lamx.) Mert.
Transverse sections of the thallus. *a*, with a young sorus upon the upper side and old, emptied sporangia upon the lower; *b*, with a group of hairs upon the lower face; *c*, of a young thallus.
(*a*, about 50 : 1; *b*, *c*, about 90 : 1).

In the above mentioned important paper, Sauvageau has in much detail described specimens of this plant, collected by him at Teneriffe.

[1]) The figure is rather unlike my specimens.

It is upon this species especially that J. AGARDH has based his new genus *Gymnosorus*, as according to his idea the sori should have no indusium. As pointed out by SAUVAGEAU this is quite wrong, a well developed indusium being present (see Fig. 151 *a*).

On the whole I can confirm the observations of SAUVAGEAU. In the West Indies I have found the plant in deep water only and in the Indian Ocean M^me^ WEBER has dredged it in depths from 15 to 150 meters; SAUVAGEAU on the other hand found it in shallow water.

I have mostly found the erect form; decumbent, creeping specimens occurred but they were not so firmly attached to the substratum as to be compared with *Aglaozonia canariensis* as SAUVAGEAU has done. But it should be remembered that SAUVAGEAU collected his plant in shallow and perhaps in exposed places where a firm attachment is necessary to the plant. The West Indian plants were found growing upon *Lithothamnion*, pieces of corals and similar bodies, spreading over these, and when reaching the edges the free lobes turn upwards, mostly in an oblique direction, seldom or perhaps never quite vertically. These free lobes reach a length up to 5 cms or more.

In transverse section (Fig. 151) we find that they are only very slightly dorsiventral; as pointed out by SAUVAGEAU an extra layer of cells are found upon the lower face of the erect thallus. Groups of hairs occur upon both sides of the plant: they are usually spread as well in the sterile part and sometimes also in the sori, now and then they are arranged in rather distinct concentric rings.

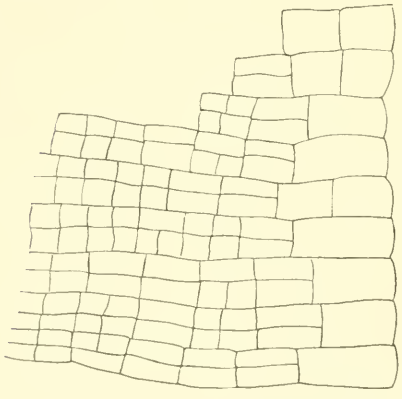

Fig. 152. *Zonaria variegata* (Lamx.) Mert. Margin of the thallus. (About 90 : 1).

The sori especially the smaller ones are often elongated and arranged in concentric rings, but large irregularly formed groups are often present. The sori occur upon both sides of the thallus perhaps most commonly upon the lower face as pointed out by SAUVAGEAU. They have always a well developed indusium (Fig. 151 *a*). As my specimens had either old emptied sporangia or quite young ones I have not been able to see the number of spores in each sporan-

gium. The sporangia are not pedicellated. In my specimens I have not found paraphyses.

I have collected the plant in February and March and as mentioned above in deep water only, from 10—40 meters. It occurred in open sea or in places where strong currents prevailed.

St. Croix: near Buck Island, off Frederiksted. St. Jan: in the Sound between this island and St. Thomas in several places, and near Thatch Island, off Annaberg, Hermitage etc. St. Thomas: in the sea west of Water Island.

Geogr. Distrib. Seems to be common in all warmer seas.

2. **Zonaria lobata** Ag.

C. Agardh, Systema Algarum, 1824, p. 265. J. Agardh, Species Algarum, vol. I, 1848, p. 109. J. Agardh, Till Algernes Systematik, II, 1872, p. 46. Harvey, Nereis Bor.-Am., Part I, 1851, p. 105, pl. VII C. C. Sauvageau, Observations sur quelques Dictyotacées et sur un Aglaozonia nouveau. (Bull. de la Station biol. d'Arcachon, 1904—1905, 8e année). A. Vickers, Phycologia Barbadensis, part II, pl. VI.

Stypopodium lobatum Kütz., Tabulæ Phycologicæ, vol. IX, p. 25, pl. 63, fig. I.

Of this species I have myself collected only a very few specimens, but I have received several from Mr. O. Hansen Ganneskov collected on the coast of St. Croix but without locality.

The specimens I have collected were taken in shallow water and in a somewhat exposed locality.

St. Croix: Cane Bay.

Geogr. Distrib. West Indies, Brasilia, Canary Isles, Cape, Galapagos Island, Japan?

Padina Adans.

Up to the present time much confusion has prevailed as to the synonomy of the species belonging to this genus.

In her latest large paper concerning the Algæ of the »Siboga« Mme Weber-van Bosse has given very useful information as to several incompletely described species, having examined the original specimens in Herb. Thuret-Bornet, in Herb. Kützing and others and given a detailed description of each.

The characteristic features of the species are based upon 1) the mutual distribution of the organs of propagations and series of hairs, 2) the presence or absence of indusium and 3) the number of cell layers in the thallus.

J. Agardh[1]) was the first to point out that the mutual arrangement of the hairs and the frutifying organs could be used to distinguish the species. Later on Hauck[2]) put this into

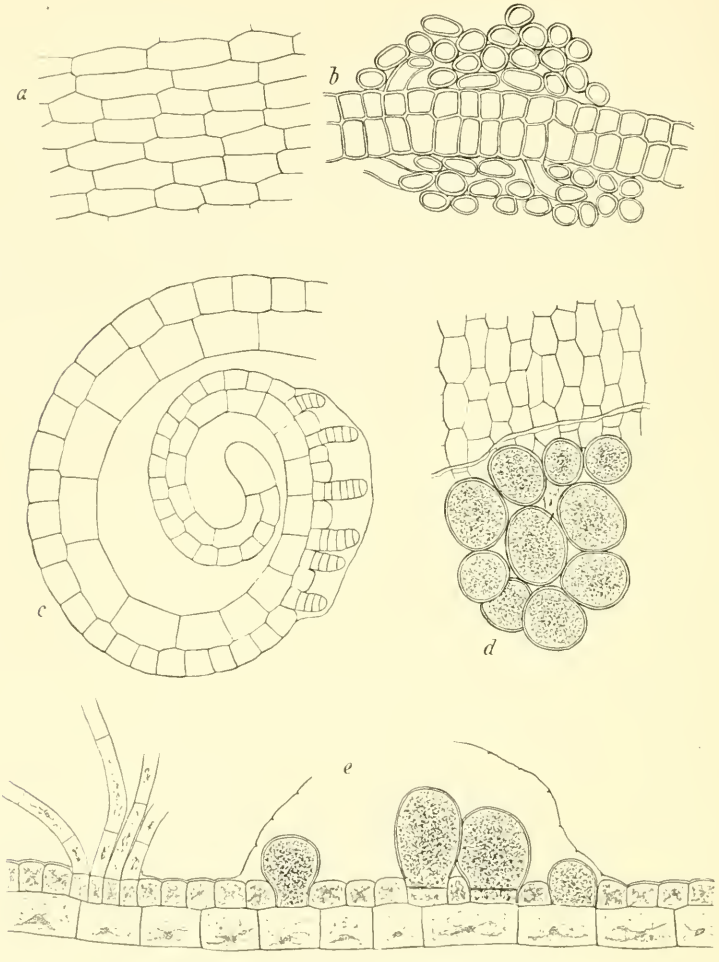

Fig. 153. *Padina Sanctæ Crucis* nov. spec.
a, cells from the lower face of the thallus. *b*, transverse section of thallus near the base. *c*, transverse section of the margin of the thallus with a young group of hairs. *d*, vegetative cells from the surface together with sporangia and indusium. *e*, transverse section of the thallus with sporangia and hairs. (About 90 : 1).

[1]) J. Agardh, Till Algernes Systematik, 2dra Afdeln., p. 115. (Lunds Univ. Arsskrift, T. XVII).

[2]) F. Hauck, Ueber einige von I. M. Hildebrandt im Rothen Meere und Indischen Ocean gesammelte Algen ("Hedwigia", vol. 26, 1887, p. 41).

practice and he proposed three groups. His classification ought now to be essentially modified after the examination of Mme Weber.

Referring for detail to the paper itself I shall only here mention what has a special interest concerning the West Indian species. Thus it is pointed out that J. Agardh has been wrong in referring *Padina gymnospora*, *P. Antillarum* and *P. variegata* to *P. Durvillaei* and that Hauck also has been mistaken when he refers *P. gymnospora* Kütz., distributed in the exsiccata of Hohenacker (no 515) to *Padina Commersonii*. To be sure Mlle Vickers had even in 1905 *Padina gymnospora* and *P. variegata* in her "Liste des Algues marines de la Barbade" but she gives no reasons for taking up these species. Of course it is most probable that she has got some information from Dr. Bornet.

The West Indian forms collected by me I have referred to the two species of Kützing: *P. gymnospora* and *P. variegata* and further to a new species.

1. **Padina Sanctæ Crucis** nov. spec.

Frons membranacea, 10—15 cm alta, pluries subfissa, segmentis terminalibus flabellatis, duobus cellularum stratis composita, rhizoideis numerosissimis e parte basali angustiore ortis adfixa. Pili in zonas concentrales ordinati, sori tetrasporangiorum supra alternas series pilorum concentrice distributi sunt.

As pointed out in the diagnosis this species is characterized by having a distromatic thallus through its whole length (comp. Fig. 153 *b*, *c*, *e*), by the distribution of the tetrasporangia, the latter occurring in broad series along the upper side of every second row of hairs (Fig. 154) and by the presence of a well-developed indusium covering the tetrasporangia-sori (Fig. 153 *d*, *e*).

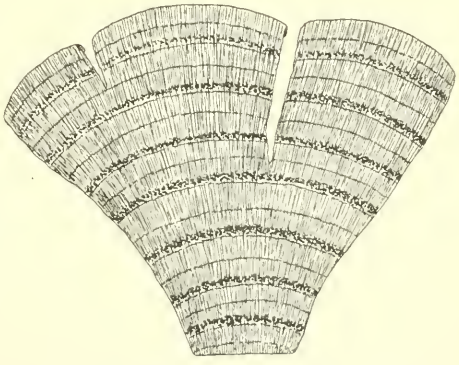

Fig. 154. *Padina St. Crucis* nov. spec. Part of the thallus seen from above showing the mutual arrangement of the series of hairs and tetrasporangia. (About 1½ : 1).

The plant reaches a height of about 10—15 cms and is somewhat incrusted with chalk upon the lower surface, hence the dried plant has here a whitish colour with dark brown rings, while the upper side is yellow brown with darker rings.

As above mentioned the thallus consists of two layers of cells, a thinner one with nearly rectangular cells upon the surface (Fig. 153 *c*, *e*), and a layer of larger cells below. The whole thallus has a thickness of about 90 μ, the cells of the surface of about 35 μ. In the basal part the cells have thick walls (Fig. 153 *b*) and are of nearly the same size upon both side of the thallus; from both cell-layers numerous rhizoids grow out forming a dense cover and below the attachment-disc.

Series of hairs occur upon both sides of the thallus but most richly upon the upper surface.

In several respects this species very much reminds one of *P. gymnospora* having nearly the same arrangement of the tetrasporangia though with the difference that the upper series of hairs occur at some distance from the tetrasporangia; further it differs in the presence of the indusium and by the distromatic thallus.

This species has only been found once in the upper sublittoral region in a somewhat exposed place.

St. Croix: Coakley Bay.

2. **Padina gymnospora** (Kütz.) Vickers.

Vickers, A., Liste des Algues de la Barbade (Ann. des sc. nat., Bot., 9e série, t. I, 1905, p. 58); Phycologia Barbadensis, pl. VII. Weber-van Bosse, A., Liste des Algues du Siboga, I, 1913, p. 178—180.

Zonaria gymnospora Kütz., Tab. Phycolog., vol. IX, 1859, p. 29, tab. 71, fig. II.

To this species, originally described from St. Thomas I have referred several specimens of which in the following lines I give a more detailed description.

In its upper part near the margin the thallus only consists of two layers of cells namely upon the upward turned side a layer of small cells, in transverse section nearly square, and below a layer of larger cells, rectangular, higher than broad. The thickness of the whole thallus is about 110 μ, while the upper small cells only reach about 35 μ in height and the larger cells below about 75 μ. Lower down in the thallus the large cells are gradually divided by a horizontal wall (Fig. 155 *a*) and the thallus consists now of three layers of cells. It is the same also near the base but here the cells of the lower face are also divided by vertical walls into small cells similar to those of the upper surface (Fig. 155 *d*).

In the basal part the cell walls are very thick and numerous rhizoids grow out from the surface cells on both side of the thallus. These rhizoids consist of thickwalled, nearly cylindrical

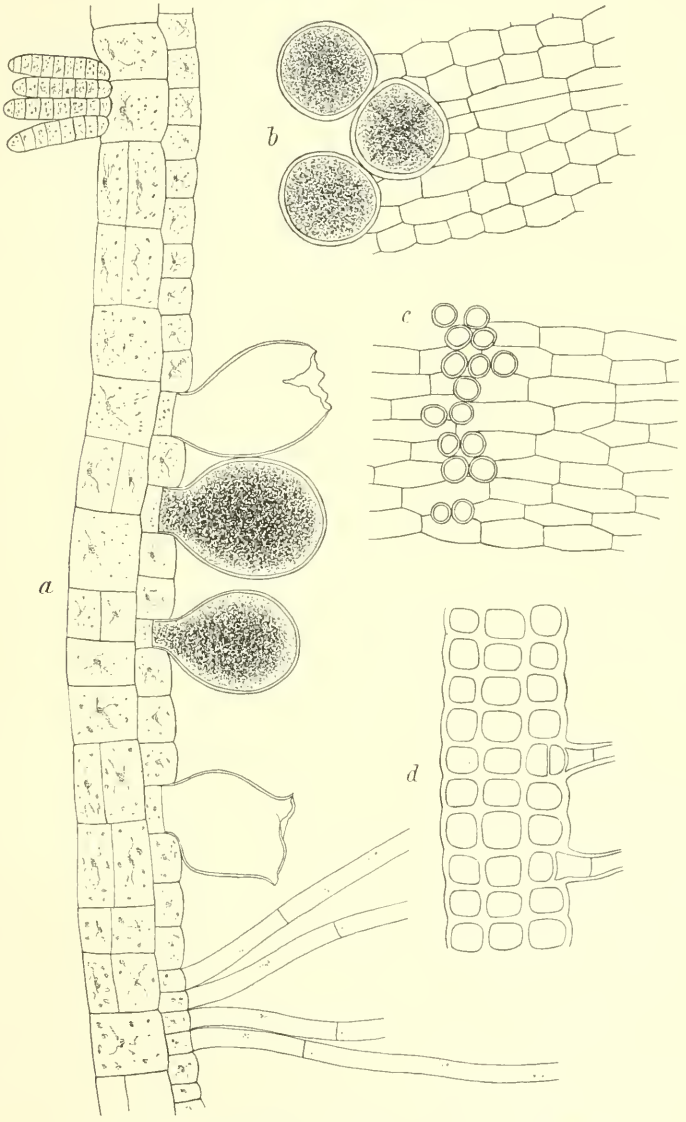

Fig. 155. *Padina gymnospora* (Kütz.) Vickers.
a, transverse section of thallus with emptied and not emptied tetrasporangia and hairs. *b*, surface of thallus with tetrasporangia. *c*, lower face of thallus with hairs. *d*, transverse section of thallus near the base. (About 90 : 1).

cells and are much ramified. They enclose the narrow, basal part of the thallus and form together with it the flattened disc by means of which the plant is fastened to the substratum.

Groups of hairs in concentric rings occur upon both sides of the thallus (Fig. 155 *a*) but mostly upon the upper surface.

The tetrasporangia are disposed mostly in regular concentric rings; these are rather regularly arranged in such a way that each series of tetrasporangia has a row of hairs on each side (Fig. 156).

The groups of tetrasporangia are not covered by any indusium (Fig. 155 *a*, *b*); the tetrasporangia originate each from a single surface cell (Fig. 155 *a*) as already described by Nägeli and Reinke for *Padina Pavonia*. The surface cells are vaulted upwards and when they have grown somewhat they are divided by a horizontal wall near their base into two cells, the uppermost being the sporangia. These are spherical or pyriform of shape and are opened by a large hole at their apex (Fig. 155 *a*).

In referring this form to Kützing's *Zonaria gymnospora* I must point out that compared with the figure of Kützing it differs considerably; for instance the transverse section of the thallus with tetrasporangia (l. c., pl. 71, II, fig. *c*) does not quite agree with what I have found and that the plant near the base should be composed of so many layers of cells as shown in fig. *d* is quite in contradiction to my observations; I only have found 3 layers of cells though surrounded certainly by a thick layer of rhizoids. Yet I want to point out that if we look more carefully at Kützing's figure *b*, representing surface view of thallus with tetrasporangia, we will find that these are drawn in groups and each of these groups is surrounded by a common line, suggesting an indusium, compare my figure 153 *d* of *P. Sanctæ Crucis*; in the corresponding figure of *P. Antillarum* (Kütz., Tab. Phycol., pl. 12, fig. II *d*) such a common ring is not present. How these matters stand in reality is not easy to say without access to original specimens, but in any case Kützing in the diagnosis of *Zonaria gymnospora* says: "sporis nudis".

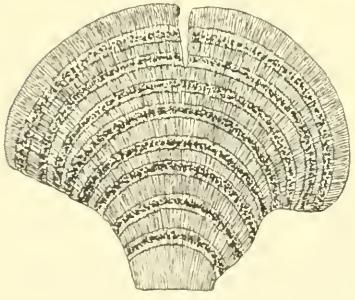

Fig. 156. *Padina gymnospora* (Kütz.) Vickers. Part of the thallus showing the mutual arrangement of the series of hairs and tetrasporangia. (About $1^1/_2 : 1$).

Mme Weber-van Bosse points out that *P. australis* Hauck is very nearly related to this species and from my own observation that the frond of *Padina gymnospora* is distromatic in the upper part of the thallus this relation is yet more evident. Regarding *P. australis* Hauck[1]) himself says: "Der Blattkörper besteht jedoch bis zur Basis nur aus zwei Zellenlagen", but Mme Weber has also found specimens with three layers of cells.

Padina gymnospora occurs in the littoral and upper sublittoral region and is found both in more sheltered and in quite exposed places. It has been collected with tetraspores in the months Dec.—March.

It has been gathered: St. Thomas, in several places in the harbour; St. Croix: Cane Bay, North Side; St. Jan: Cruz Bay.

Geogr. Distrib. West Indies.

3. **Padina variegata** (Lamx.) Hauck.

Hauck, F., Ueber einige von I. M. Hildebrandt im Rothen Meere und Indischen Ocean gesammelte Algen (Hedwigia, vol. 28, 1887, p. 42). Kützing, F., Tabulæ Phycolog., tab. 73, fig. II. Vickers, A., Phycolog. Barbadensis, part II, pl. VIII.

Dictyota variegata Lamx., Expos. des caractères du genre Dictyota (Journ. de Bot., t. II, 1809, p. 40).

Zonaria variegata C. Agardh, Species Algarum, vol. I, 1823, p. 127.

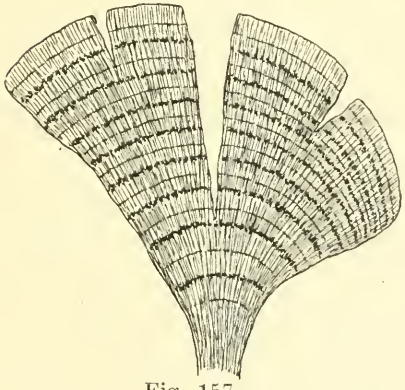

Fig. 157.

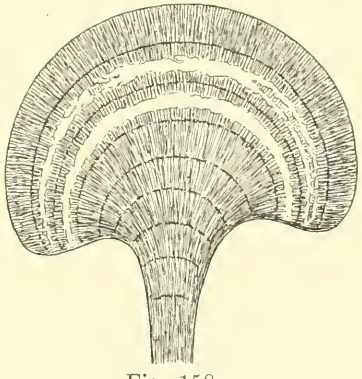

Fig. 158.

Fig. 157. *Padina variegata* (Lamx.) Hauck.
Part of the thallus showing the mutual arrangement of the series of hairs and tetrasporangia. (About 1½ : 1).

Fig. 158. *Padina variegata* (Lamx.) Hauck.
Part of the thallus with series of hairs and antheridia (the white zones). (About 1½ : 1).

[1]) Hauck, F., Ueber einige von I. M. Hildebrandt im Rothen Meere und Indischen Ocean gesammelte Algen ("Hedwigia", 1887, vol. 26, p. 44).

This species has a well developed indusium and is furthermore characterized by the fact that the organs of propagation and the series of hairs alternate regularly (Figs. 157, 158).

At the extreme edge the thallus consists only of two layers of cells, namely: a surface layer consisting of smaller cells nearly square in transverse section and a layer of larger cells below. These last mentioned cells are soon divided by horizontal walls into a number of cells, varying somewhat in the different specimens. The cell-layer below is again divided by vertical walls into small cells similar to those of the surface.

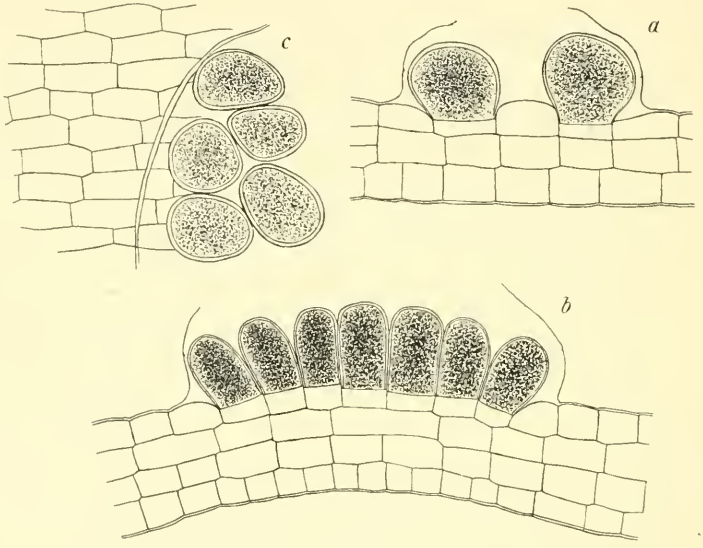

Fig. 159. *Padina variegata* (Lamx.) Hauck.
a, transverse section of the thallus with tetrasporangia. *b*, transverse section of the thallus with oogonia. *c*, surface view of thallus with tetrasporangia. (About 90 : 1).

The cells between the two epidermal layers are mostly rather long and flat; we find here up to six layers varying in the different specimens.

Lower down in the thallus near the base almost all the cells are divided into smaller cells nearly quadratic when seen on transverse section (Fig. 160 *b*).

Hairs occur upon both sides of the thallus (Fig. 160 *a*) most numerous upon the surface; sometimes a corresponding series of hairs are found upon both sides of the thallus.

The rows of tetrasporangia are as already mentioned regu-

larly alternating with the series of hairs (Fig. 157); they are placed most often nearest the lower row of hairs. The rows of

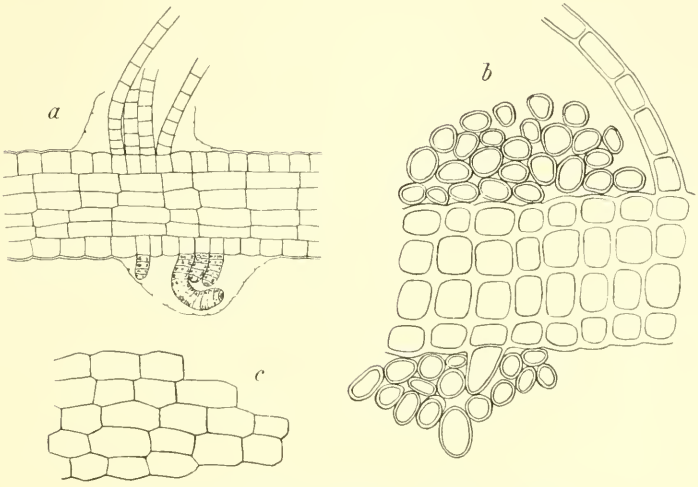

Fig. 160. *Padina variegata* (Lamx.) Hauck.
a, transverse section of the thallus with groups of hairs. *b*, transverse section of the thallus with rhizoids near the base. *c*, epidermal cells from the lower fase of the thallus. (About 90 : 1).

tetrasporangia are not always uniform but often separate in dispersed smaller groups of sori. As mentioned above these are

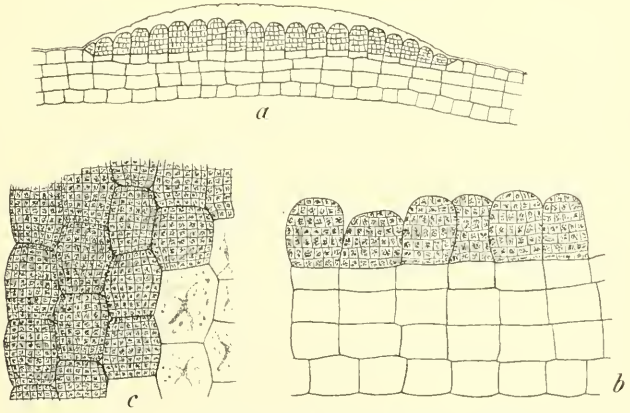

Fig. 161. *Padina variegata* (Lamx.) Hauck.
a, transverse section of the antherial zone with indusium. *b*, antheridia. *c*, antheridia seen from above. (*a*, about 50 : 1; *b*, *c*, about 170 : 1).

covered by a well-marked indusium (Fig. 159 *a*, *c*). The shape of the tetrasporangium is roundish pear-shaped.

The oogonia (Fig. 159 *b*) occur in the area of the frond between the series of hairs thus corresponding with the distribution of the tetrasporangia. They are found either in series and then sometimes in two parallel rows, or they are often scattered into numerous small roundish groups. The single oogonium is pear-shaped cylindric with broad base; it is about 80 μ long and 45 μ broad.

Of this species I have also collected antheridia-bearing plants. These were rather small, about 2 cm high, and have the antheridia arranged in rather broad series alternating regularly with the rows of hairs (Fig. 158) just as is the case of the tetrasporangia.

The antheridia (Fig. 161) are of nearly cubic form, ca. 30 μ broad and 75 μ high; they originate from a surface cell and, just as is the case with the mother cell of the tetrasporangia, so here a small cell is cut off at the base. Sometimes I have found antheridia also upon the lower face of the frond and corresponding with the series upon the surface. No trace of oogonia were found in these plants. M^lle^ Vickers gives a picture of the antheridia of this species but without any description. Judging from the description by Hauck (l. c.) concerning *P. dubia* the distribution of the antheridia in this species seems to come very near to that in the present plant. On the other hand the distribution of the antheridia in *Padina Paronia* differs much from our plant. Here the antheridia occur together with the oogonia in the same plant and the antheridia form radiating series at right-angle to the concentric series of oogonia[1]).

This species occurs in the littoral and upper sublittoral region in sheltered or somewhat exposed places. It has been found with tetrasporangia in Dec.—March and with antheridia in December.

It is most probably a common species. St. Croix: Christiansted, Longford, Great Pond. St. Thomas: Store Nordside Bugt. St. Jan: Cruz Bay.

Geogr. Distrib. West Indies.

Dictyota Lamx.

With regard to the determination of the species of this genus I may point out that the very good figures in M^lle^ Vickers

[1]) Reinke, J., Entwicklungsgeschichtliche Untersuchungen über die Dictyotaceen des Golfs von Neapel. (Nova Acta d. k. Leop.-Carol.-Deutschen Academie, Bd. XL, 1878, p. 24).

"Phycologia Barbadensis" have been of much help to me, the more so since I think Dr. BORNET assisted her a good deal in their preparation.

While some of the species found seem to be fairly well defined, others are much more variable and therefore often difficult to recognize. As is the case with many other algæ so also here the external conditions of life seem greatly to alter the appearance of the thallus. It seems therefore most probable that an examination of a large collection from different localities and in different stages of development will prove that some of the plants now considered as distinct species are really only forms.

1. **Dictyota Bartayresiana** Lamx.

LAMOUROUX, Exposition des caractères du genre Dictyota (Journ. de Botanique, t. II, 1809, p. 43). J. AGARDH, Species Algarum, vol. I, p. 94. J. AGARDH, Till Algernes Systematik, V, p. 97. J. AGARDH, Analecta algol., cont. I, p. 66. HARVEY, Nereis Bor.-Am., p. 110, pl. VIII C. A. VICKERS, Phycol. Barbad., pl. XII and XIII.

The specimens referred to this species are rather variable; on the whole they agree well with the figures of M^lle^ VICKERS. Some of the specimens also show some likeness with *Dictyota volubilis* and especially with *Dict. pardalis*. The ends of the branches are sometimes acute, sometimes more rounded; M^me^ WEBER-VAN BOSSE[1]) also mentions a form with rounded summits.

Only tetrasporangia-bearing specimens were found. The tetrasporangia occur upon both sides of the frond. They are either solitary or placed a few together and scattered over the whole surface.

This species mostly occurs in shallow water in sheltered places. Often it is lying loose, covering the sandy bottom behind the coral reefs.

Once I dredged it at a depth of about 20 meters.

With the exception of the more exposed coasts it is a common species on the shores of the Danish Islands.

Geogr. Distrib. West Indies, Indian Ocean, tropical Australia.

2. **Dictyota linearis** (Ag.) Grev.

GREVILLE, Algæ Britannicæ, p. XLIII. J. AGARDH, Species Algarum, I, p. 90. J. AGARDH, Till Algernes Systematik, V, p. 101. J. AGARDH, Analecta algol., cont. I, p. 77. KÜTZING, Tab. Phycolog., vol. IX, tab. 21, fig. II.

[1]) WEBER-VAN BOSSE, Liste des algues du Siboga, p. 182.

Dictyota angustissima Sonder in Kützing, l. c., tab. 21, fig. IV.
Zonaria linearis Ag., Species Algarum, I, p. 134.
Dictyota fibrosa Kütz., l. c., tab. 15, fig. II.
Dictyota divaricata Kütz., l. c., tab. 23, fig. I.

The specimens found were much like the figures of Kützing quoted above.

All were sterile.

They were dredged in the open sea in a depth of about 40 meters.

St Croix: Off Frederiksted.
Geogr. Distrib. Tropical America, Mediterranean Sea, Canary Isles etc.

3. **Dictyota volubilis** Kütz.

Kützing, F., Species Algarum, 1849, p. 554.
Vickers, A., Phycol. Barbad., pl. XX.

The specimens referred to this species accord well with the good figure of M^lle^ Vickers. But how far this form of Vickers rightly is considered as belonging to the species of Kützing seems to me doubtful. In any case it cannot be denied that the figure of Kützing in "Tabulæ Phycologicæ", vol. IX, pl. 13, fig. II, is very different from the West Indian plant. This question can of course only be settled by means of the original specimens.

The most characteristic features of the plant are the marked twisting of the whole frond and the broad sinus between the branches, the angles being often obtuse.

All my specimens were sterile.

This species is found in shallow water and in somewhat deeper, down to a depth of about 10—12 meters. When found in shallow water it was in sheltered places and here it was generally lying loose upon the bottom forming entangled masses.

It has been found: St. Croix: Christiansted, Longford, off Frederiksted and near Buck Island.
Geogr. Distrib. West Indies, Mediterranean Sea?

4. **Dictyota pardalis** Kütz.

F. Kützing, Tabulæ Phycologicæ, vol. IX, p 16, tab. 39, fig. II. J. Agardh, Till Algernes Systematik, V, p. 100. J. Agardh, Analecta algolog., Contin. I, p. 68. A. Vickers, Phycologia Barbadensis, pl. XXI.

The specimens considered as belonging to this species were more irregularly dichotomously ramified than *Dictyota volubilis* and not or only very little twisted. Some of the specimens show

much likeness to *Dictyota Bartayresiana*. Mme Weber has also suggested (in "Algues du Siboga", p. 182) that the present plant may perhaps be nothing more than a form of this species.

The specimens were found in shallow water and in sheltered places only. Most of them were lying loose upon the bottom.

It has been collected, St. Croix: Behind Long Reef, Salt River.
Geogr. Distrib. West Indies.

5. **Dictyota Indica** Sond.

Sonder in Kützing, Tab. Phycol., vol. IX, p. 8, tab. 17, fig. I.
Vickers, A., Phycologia Barbadensis, pl. XVIII.

The specimens referred to this species were much like the figure of Mlle Vickers (l. c.). They are repeatedly dichotomously ramified and somewhat twisted.

The tetrasporangia and oogonia occur upon both sides of the frond, the first-mentioned in small scattered groups, mostly two to three together.

In the open sea the specimens are rather rigid, in sheltered places more flabby.

When found in the open sea it is usually in deeper water down to a depth of about 10—12 meters, when found in sheltered places it occurs only in shallow water.

St. Croix: off Frederiksted, Longford, near Buck Island, Lt. Princess, Christiansteds Lagoon; St. Thomas: Bovoni Lagoon; St. Jan: Reef Bay.
Geogr. Distrib. West Indies.

6. **Dictyota ciliata** J. Ag.

J. Agardh, In Historiam Alg. Symbolæ ("Linnæa", XV, 1841, p. 5). J. Agardh, Spec. Alg., I, p. 23. J. Agardh, Till Algernes Systematik, V, p. 94. J. Agardh, Analecta Algologica, Contin. I, p. 75. Harvey, Nereis Bor.-Am., p. 110, pl. VIII A. F. Kützing, Tab. Phycol., vol. IX, pl. 27. A. Vickers, Phycol. Barbad., pl. XVII.

This species is as well known characterized by the presence of small acute teeth along the margin of the thallus. When it is growing in sheltered places it has a tendency to become proliferous along the margins as shown in the one figure of Mlle Vickers.

The tetrasporangia occur in small scattered groups on both sides of the frond and contain a few, or up to ten sporangia in each group. The oogonia form small roundish sori also upon both sides of the thallus. And the same is the case with the distribution of the antheridia which form rather large, oblong to oval groups. The single antheridium is about 50 μ long and 30 μ

broad and somewhat broader upwards. Seen from above the antheridia are more or less quadratic by mutual pressure.

This species is found in much exposed localities and also in quite sheltered. It occurs in shallow water and in deeper, down to a depth of about 10 meters.

It has been collected round St. Croix, at Northside, Longford, Buck Island and in the Lagoon of Christiansted.

Geogr. Distrib. West Indies, Vera Cruz, Red Sea etc.

7. Dictyota crenulata J. Ag.

J. Agardh, Nya alger från Mexico (Öfvers. k. Vetensk., Akad. Förhandl., 1847, p. 7). J. Agardh, Species Alg., vol. I, p. 94. J. Agardh, Till Algernes Systematik, V, p. 99. A. Vickers, Phycologia Barbad., pl. XVI.

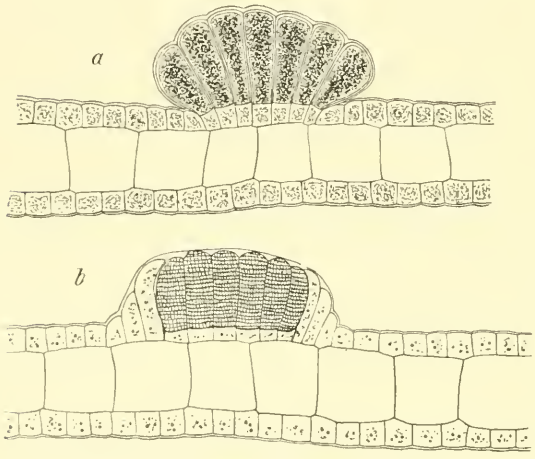

Fig. 162. *Dictyota crenulata* J. Ag.
a, transverse section the thallus with oogonia. *b*, transverse section of the thallus with antheridia. (About 90 : 1).

In "Species Algarum", l. c., J. Agardh describes *Dictyota crenulata* as: "pulchra et distinctissima species" and in this I agree with him. The specimens found agreed well with the figure of M^lle^ Vickers (l. c.). The plant is rather regularly dichotomously ramified and further characterized by the presence of numerous teeth, shorter or longer, along the margin of the frond. Compared with original specimens from St. Augustin (Mexico) collected by Liebmann, the Mexican specimens seem to be even more irregularly dentate.

In transverse section (Fig. 162) the frond is seen to be composed of a medium layer of large, nearly quadrate cells sorrounded by a layer of small epidermic cells.

Both oogonia- and antheridia-bearing plants were collected; each kind of reproductive-organs occurs upon separated individuals.

The antheridia (Fig. 162 *b*, Fig. 163) form small oval groups

upon both sides of the frond; their development is quite in accordance with those of *Dictyota dichotoma* as described by THURET [1]). They are developed from a group of the epidermal cells. The cells in the periphery of such a group are sterile; these cells are lengthened, mostly the innermost, and bent somewhat towards the middle forming a kind of involucre round the proper antheridial cells in the middle. When the antherial cells have reached a certain length a small basal cell is cut off at their base and the large upper cell is divided very regularly into a great number of quite small cells. Seen from above the antheridia are more or less polygonal by mutual pressure (Fig. 163).

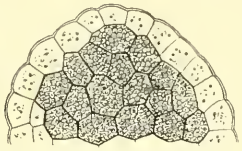

Fig. 163. *Dictyota crenulata* J. Ag. Part of a group of antheridia seen from above. (About 90 : 1).

The oogonia occur likewise upon both sides of the frond and their development is quite in accordance with the description and figures of THURET et BORNET [2]). Groups of epidermal cells become lengthened and when they have reached a certain length a small cell is cut off at their base, while the upper large cells grow into the oogonia. Individuals with tetrasporangia were not found.

Found once only, growing upon buoys in the harbour of Christiansted, St. Croix.

Geogr. Distrib. Pacific Ocean at the shores of Mexico, West Indies.

8. **Dictyota dentata** Lamx.

LAMOUROUX, Exposit. des Caract. du genre Dictyota (Journ. de Botanique, t. II, 1809, p. 42). KÜTZING, Species Algarum, p. 556; Tab. Phycologicæ, vol. IX, pl. 35, fig. I. J. AGARDH, Species Alg., vol. I, p. 96. J. AGARDH, Till Algernes Systematik, 2dra afdeln., p. 98. J. AGARDH, Analecta algologica, Contin. I, 71. F. HAUCK, Meeresalgen von Puerto-Rico. (Englers bot. Jahrb., Bd. 9, 1888, p. 466). A. VICKERS, Phycologia Barbadensis, pl. XIV.

All the specimens collected being sterile I cannot give any information as to the organs of reproduction; but HAUCK (l. c.) gives a short description of the tetrasporangia-bearing plants as well as of the oogonia and antheridia which occur in separate plants.

[1]) THURET, G., Recherches sur la fécondation des Fucacées et les anthéridies des algues, 2. partie, (Ann. des Sciences Nat., 4. série, t. III, 1855, p. 5, pl. 2).

[2]) THURET, G. et E. BORNET, Études phycologiques, 1878, p. 53, pl. 27—30.

Besides *D. Brongniartii* J. Ag. Hauck refers some other species to this plant e. g. also *D. Mertensii* Kütz. Most probably Hauck is right in referring the latter to this species; in my collection I have not found any form which I feel can be referred to it.

Dictyota dentata occurs in shallow water in sheltered places and in deeper water (about 10 meter) in more open sea.

It has been found: St. Croix: At the entrance to Christiansted's Lagoon, Saltriver, Casavagarden, Green Key and near Buck Island.

Geogr. Distrib. West Indies, Brazil.

Dilophus J. Ag.

1. Dilophus alternans J. Ag.

J. Agardh, Till Algernes Systematik, V, Dictyoteæ, p. 108; Analecta algologica, Continuatio I, 1894, p. 93. A. Vickers, Phycologia Barbadensis, pl. X.

The specimens found agrees well with the figure of Mlle Vickers (l. c.). All were sterile.

This species has been found in the upper sublittoral region and in somewhat sheltered places.

It was collected, St. Croix: Lime Tree Bay; St. Jan: Coral Bay.

Geogr. Distrib. West Indies and surrounding coast.

2. Dilophus guineensis (Kütz.) J. Ag.

J. Agardh, Till Algernes Systematik, 2dra Afd., p. 108. J. Agardh, Analecta algologica. Cont. I, p. 89. A. Vickers, Phycologia Barbadensis, Part II, pl. IX.

Spatoglossum guineense Kütz., Phycologia generalis, p. 339; Species Algarum, p. 560; Tabulæ Phycologicæ, vol. IX, pl. 46, fig. I.

In the upper part of the thallus the flat frond consists of a single layer of large cells surrounded by a layer of small epidermical cells (Fig. 165 *a*). Lower down in the thallus we find in transverse section the large cells to be divided mostly into two layers of cells (Fig. 165 *b*) sometimes in the middle of the frond even into several layers.

The base of the plant consists of terete, rhizome-like filaments composed of several cells with thick walls. These filaments are creeping and from their lower side numerous rhizoids grow out ending with small attachment discs fixed to the substratum.

The tetrasporangia (I take it for granted that they are such but I have not seen their actual divisions) occur upon both sides of the lobes of the flat frond. They are scattered or some few together, sometimes also confluent into larger sori. They are nearly spherical and have no indusium. Their diameter reaches a length of about 100 μ and more. Scattered between the tetrasporangia groups of hairs are present.

This species originally described from specimens from St. Thomas seems to be a common species on the Danish Isles. It has been found in much exposed as also in sheltered places and in shallow water and deeper down to a depth of about 10 meters.

St. Croix: Northside, Casavagarden, Longford, near Buck Island.

Geogr. Distrib. West Indies.

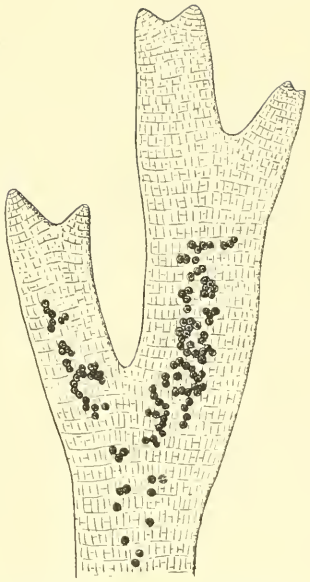

Fig. 164. *Dilophus guineensis* (Kütz.) J. Ag. Part of the thallus with tetrasporangia. (About 12 : 1).

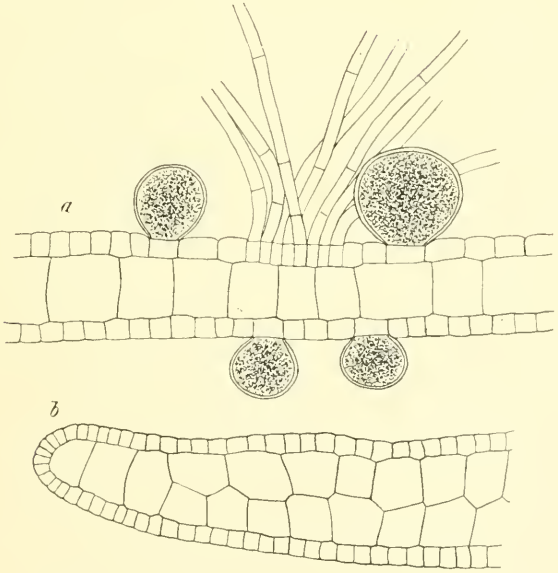

Fig. 165. *Dilophus guineensis* (Kütz.) J. Ag.
a, transverse section of thallus with tetrasporangia and hairs. *b*, transverse section of a sterile part of the thallus. (About 100 : 1).

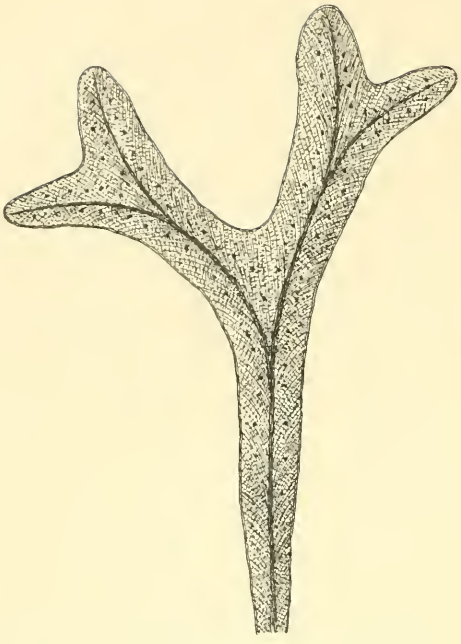

Fig. 166. *Dictyopteris delicatula* Lamx. A part of the thallus. (About 3 : 1).

Dictyopteris Lamx.

1. D. delicatula Lamx.

Lamouroux in Journ. Philom., 1809, no.20, tab.6, fig.B. A. Vickers, Phycologia Barbadensis, part II, pl. III.

Haliseris delicatula C. Ag., Species, p. 144. J. Agardh, Spec. Alg., vol. I, p. 116. Kützing, Tabulæ Phycologicæ, vol. IX, pl. 56, fig. II.

The thallus consists of two layers of cells (Fig. 167 *a*) with the exception of the ribs in the edges and in middle of the frond where it is composed of several layers of cells. In transverse sections these ribs are seen to contain a string composed of cells with very thick walls in which pores are present (Fig. 167 *b*). Of these Mlle Vickers reproduces figures drawn by Bornet. The wall consists of cellulose; it is coloured blue by chlor-zinc-iodine. In a longitudinal section the cells of the strings are found to be long, cylindrical with oblique end-walls.

The hairs are only present upon the one side of the thallus; they are placed many together in roundish or oval groups and occur regularly upon both sides of the mid-rib.

In the basal part the plant is fastened to the substratum by means of rhizoids. These grow out partly from the cells along the margin of the thallus

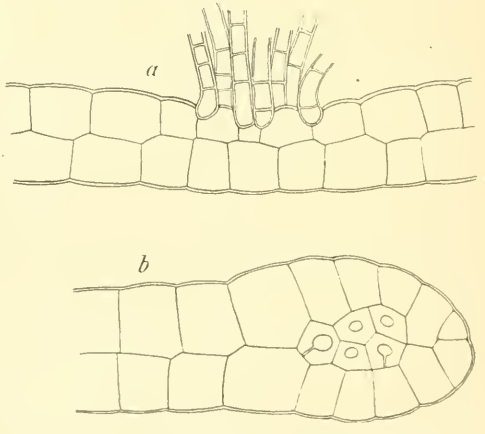

Fig. 167. *Dictyopteris delicatula* Lamx. *a*, transverse section of the thallus with a group of hair. *b*, transverse section of the edge of the thallus.

and partly from the cells above the midrib. The rhizoids consist of cylindrical cells 6—8 times as long as their own diameter and end with a small irregularly lobed disc. These rhizoids can grow out from any parts of the thallus which come near to the substratum.

Only sterile plants were collected. They were gathered in shallow water and in a sheltered place.

St. Croix: Lime Tree Bay.
Geogr. Distrib. The West Indies, Mexico, Brazil etc.

2. **Dictyopteris plagiogramma** (Mont.) Vickers.

Vickers, A., Liste des Algues de la Barbade (Ann. sc. nat., Bot., 9e sér., t. I, 1905, p. 58); Phycologia Barbadensis, part. II, pl. IV.
Haliseris plagiogramma Montagne, Centurie de plantes cell. exot. nouv. (Ann. sc. nat., Bot., 2e sér., t. 8, 1837, p. 356).

In a collection of algæ which were sent me by Mr. O. Hansen Ganneskov I found a single specimen of this beautiful plant. It was provided with tetrasporangia. These occur in small groups 2—3 together which often coalesce into larger ones. They are found in the middle of the frond and form a broad row placed on both sides of the midrib.

The plant was gathered at the shore of St. Croix.
Geogr. Distrib. West Indies, Brazil, Pacific Ocean, Australia.

3. **Dictyopteris Justii** Lamx.

Lamouroux in Journ. Philom., 1809, no. 20, tab. 6, fig. A. Vickers, A., Phycologia Barbadensis, part II, pl. V.
Haliseris Justii C. Agardh, Species Alg., vol. I, p. 142. J. Agardh, Species Algarum, vol I, p. 118.

The specimen collected is so small that a certain determination is impossible.

It was dredged in deep water about 20 meters in the Sound between St. Thomas and St. Jan: off Cruz Bay.
Geogr. Distrib. West Indies.

Fam. 2. ***Fucaceæ.***

Turbinaria Lamx.

1. **Turbinaria trialata** Kütz.

Kützing, Tab. Phycol., vol. X, 1860, p. 24, tab. 67. Barton, E. S., A systematic and structural account of the genus Turbinaria Lamx. (Transact. Linn. Soc. of London, 2. Ser., Bot., vol. III, 1891, p. 218).

The specimens found (Fig. 168) agree very well with the description of Mrs. Gepp (née Barton) l. c. In one specimen from Coral Bay, the lowermost peltate leaves had no vesicles, these were on the other hand well developed in the upper fructifying part of the plant.

Fig. 168. *Turbinaria trialata* Kütz. (About natural size).

It is found in fruit from December to March.

T. trialata occurs together with species of *Sargassum* in the littoral and uppermost sublittoral region and on exposed as well as more sheltered places.

It is a common species along the shores of the Danish Isles.

Geogr. Distrib. Seems to occur in all warm seas.

Sargassum C. Ag.

1. Sargassum vulgare C. Ag.

C. Agardh, Species Algarum, vol. I, p. 3. J. Agardh, Species Sargassorum Austral., p. 108. A. Vickers, Phycologia Barbadensis, part II, pl. II. F. Børgesen, in Mindeskrift for Japetus Steenstrup, 1914, No. XXXII, p. 3.

Fucus natans Turner, Fuci, p. 99 (101), pl. 46, fig. a.

var. *typica*. (Fig. 169).

The specimens which I have referred to the typical form are very much like the figure given by Turner (l. c.). The linear-lanceolate leaves possess a dentate-sinuate margin, a distinct midrib, and quite numerous, but small and irregularly placed cryptostomata; the latter are sometimes very indistinct or quite absent in some of the leaves.

The vesicles are sometimes few, sometimes numerous; they are globular, of the size of a small pea, and most often they are without prolongations at the top; such ones occur, however, now and then.

The receptacles are cylindric, filiform and irregularly ramified.

var. *foliosissima* (Lamx.) J. Ag.

J. Agardh, Spec. Sargassorum Austral., p. 108.

Fucus foliosissimus Lamouroux, Essai Thalassiophytes (Ann. du Muséum d'Hist. nat., vol. 20, 1813, p. 36, pl. 7, fig. 1).

This form is different from the typical one by having numerous, closely packed leaves which are smaller, proportionally shorter, and more or less undulate, frequently somewhat twisted.

The receptacles are shorter and similar to the vesicles hidden between the leaves.

This species is very common along the shores of the islands and occurs in exposed or sheltered places. In exposed localities, where the sea constantly splashes the rocks, *Sargassum vulgare* is able to thrive above the ordinary water mark; in the more sheltered places it occurs close to it, or a little below.

Sargassum vulgare is the dominant species in the *Sargassum*-vegetation forming with *Turbinaria trialata* a vegetation of large, brown algæ corresponding with the Fucaceæ-vegetation in northern seas.

Fig. 169. *Sargassum vulgare* C. Ag. Part of a plant with receptacles and vesicles. (A little over natural size, about 1/6 magnified).

Geogr. Distrib. This species is said to occur at nearly all subtropical and tropical shores of the Atlantic Ocean: America and the West Indies, Africa, Spain etc.

2. Sargassum lendigerum (L.) Kütz.

Kützing, Species Algarum, p. 612; Tabulæ Phycologicæ, vol. XI, tab. 19, fig. II. J. Agardh, Species Sargassorum Austral., p. 110. F. Borgesen, l. c. p. 4.

Fucus lendigerus L., Species plant., p. 1628. Turner, Fuci, p. 107, tab. 48.

The specimens which I have referred to this species possess leaves with a distinct midrib and small, most often scattered cryptostomata; these are, sometimes, arranged more or less regularly in a single series on both sides of the midrib.

The basal leaves are more or less dentate; the upper have a somewhat sinuate to entire margin.

The leaves are linear-elliptic 4—5 mm. broad, and up to 3 cm. long, with a short stalk or sessile. The vesicles are scarce, often quite absent; when present, according to my observations, they occur only at the upper end of the branch; they reach the size of a small pea, and are often somewhat oval, now and then provided with a small, leaf-like prolongation at their apex.

Fig. 170. *Sargassum platycarpum* Mont. Part of a branch with receptacles and vesicles. (About 1/6 magnified).

The receptacles are mostly aggregated at the upper end of the branches; they are cylindric and irregularly branched.

This species appears to be closely related to *Sargassum vulgare*, representing probably merely variety of it.

St. Thomas: Store Nordside Bugt, growing in a rather exposed place.

Geogr. Distrib. West Indies, Bermuda, Teneriffa etc.

3. **Sargassum platycarpum** Mont.

Montagne, Cent. III, p. 18, n. 51; Sylloge generum specierumque Cryptogamarum, 1856, p. 385. J. Agardh, Species Sargassorum Austral., p. 89, tab. VI. A. Vickers, Phycol. Barbad., Part II, pl. II. F. Borgesen, l. c., p. 5.

Characteristic of this species (Fig. 170) are the rather large, often oval cryptostomata, arranged in a single series on both sides of the midrib. The leaves are lanceolate, dentate along the margin. The vesicles are not very numerous; in the diagnosis in "Sylloge", l. c., Montagne writes: "vesiculis nullis". In my specimens the vesicles were only noticed in the fertile part of the thallus; they are globular, sometimes ellipsoid, now and then with a short prolongation at the top.

The receptacular branches are flat, bearing long projections at their margin.

The species was found on rocks close to, or a little above the surface of the sea, in rather exposed or somewhat sheltered places.

St. Croix: Green Cay, Coakley Bay, Long Reef.
Geogr. Distrib. West Indies and warmer shores of America.

4. Sargassum Hystrix J. Ag.

J. Agardh, Nya Alger från Mexico (Öfversigt K. Vet. Akad. Förhandl. 1847); Spec. Alg., p. 322; Species Sargassorum Australiæ, p. 91, tab. VII, figs. 1—5. F. Borgesen, l. c., p. 5.
Carpacanthus spinulosus Kütz., Tab. phycol., vol. XI, p. 15, tab. 46, fig. 2.

As pointed out in my paper quoted above the two rather damaged specimens found floating in the sea and referred to this species closely resemble the figure of *Carpacanthus spinulosus* of Kützing. As characteristic of my specimens and as it seems judging from his figure in accordance also with Kützing's, may be pointed out (1) that the rather thin leaves have a strongly serrated or dentated margin and many small cryptostomata spread over the whole surface, (2) that the branched receptacles are provided with acute processes along the margin; and (3) that the vesicles are rather thin-walled. How far this form of Kützing's really belongs to *Sargassum Hystrix* J. Ag. seems to me rather doubtful.

In order to obtain clearer light in the matter I paid a visit to Lund to compare my specimens with the original material in J. Agardh's Herbarium. These latter agreed well with those in the Herbarium of the Botanical Museum at Copenhagen, all the specimens being collected by Liebmann at Campeche Banks. From my specimens these plants differ in several respects. For instance most of the different organs of the plant seem to be smaller and markedly firmer and darker coloured; the vesicles are mostly somewhat smaller and have thicker walls, the leaves are smaller but thicker and have only a few but larger cryptostomata though these may be often quite wanting. The receptacles are shorter, but broader. I happened to come into correspondence with Mr. A. Gepp concerning this question and asked him if there was much material of *Sargassum Hystrix* in the British Museum. In reply to my query he most kindly wrote: — "As to your question about *S. Hystrix*, we have only one trustworthy specimen of it; and that I found some years ago at the end of the genus and bearing these words: — "*Carpacanthus* — Kg. Ins. Ind. occ. Dan." [possibly issued by Hohenacker]. It corresponds exactly with Kütz., Tab. Phyc., XI, tab. 46, II. So I placed it at once under *Sarg. Hystrix*. I noted on it:

"vesicles thin, short-stalked, leaves thin, yellow-brown. Cryptostomata small, scattered. Receptacles very toothed". The receptacles make it appear to be a well marked species". Judging also from this I am inclined to think that KÜTZING's and J. AGARDH's plants do not belong to the same species, but to decide this matter, much more material is necessary than I have had at my disposal[1]).

[1]) In this connection I wish also to point out here that I have had and have now still more doubt as to how far it is justifiable to refer the floating *Sargassum* from the Sargasso Sea (which I in my paper have called *S. Hystrix* var. *fluitans*) to J. AGARDH's species. When I referred it to this plant it was — as I have pointed out in my paper — because J. AGARDH himself had already done so. As mentioned in my paper quoted we have in the Botanical Museum here a specimen of the floating form collected by Capt. ANDREA in the Old Bahama Channel I/VIII 1870 which J. AGARDH has determined as *Sargassum Hystrix*. This specimen is just like those I have collected in the Sargasso Sea but both this one and also mine are decidedly different from the fixed form collected by LIEBMANN; on the other hand it cannot be denied that the fig. 1 of a sterile plant in J. AGARDH's "Species Sargassorum Australiæ", pl. VII shows much resemblance to the floating form; it differs however in the almost entire absence of cryptostomata[1]) which are most often well-developed and numerous in the floating form though occasionally leaves are found which quite or nearly lack them.

That I considered the floating form different to the fixed I have already shown in that I gave it the rank of variety. But with the further knowledge I now have as to *S. Hystrix* I think it best to consider var. *fluitans* as a proper species coordinate with *S. natans*. As to the origin of *S. fluitans*, we have, just as is the case with *S. natans* only supposition to go upon. It may be derived from *S. Hystrix*, but it might equally well have had other parents.

Herewith a short diagnosis:

Sargassum fluitans nov. spec.

Sargassum Hystrix J. Ag. var. *fluitans* Borgs. l. c., p. 11, Fig. 8.
Sargassum Hystrix J. Ag. ex parte. J. AGARDH, Spec. Sargass. Austral., p. 91.

Axis teretiusculus, ramosus, foliis lanceolatis vel linearibus, margine irregulariter dentato, distincte costatis, cryptostomatibus pro ratione majoribus conspicuisque. Vesiculi numerosi, sphærici, magnitudinem seminis pisi fere æquantes duplo longioribus quam pedicellis eorum.

Long. fol. = ca. 25—30 mm; lat. fol. = ca. 4—5 mm.
Lat. vesic. = ca. 5—6 mm; long. pedicell. vesic. = ca. 3 mm.

[1]) In the text to the plate J. AGARDH says: cryptostomatibus nullis aut obsoletis instructa

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(The figures in parantheses refer to the pages in "Arkiv for Botanik").