formed everywhere from the surface of the thallus. By means of such discs the filaments of the plant, too, fix themselves mutually together to each other. The connection is so intimate that mostly it is impossible to decide from which of the two connected filaments the hapteron is given off.

If we examine the apex of the filaments (Fig. 361 *c*) it appears that the thallus increases by means of several filaments placed

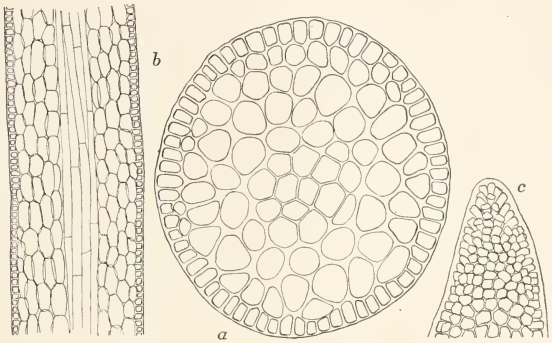

Fig. 361. *Wurdemannia setacea* Harv.
a, transverse section of the thallus. *b*, longitudinal section of the thallus. *c*, apex of a filament.
(*a*, about 240:1; *b*, about 130:1; *c*, about 80:1).

close together and from which the different cell-tissues are formed. Upon a transverse section of the thallus (Fig. 361 *a*) three different layers are visible. In the middle a medullary tissue is present composed of smaller thick-walled, roundish polygonal cells; from a longitudinal section (Fig. 361 *b*) it appears that these cells are rather long, cylindrical, but of variable length about 250 μ long at their greatest; the transverse walls are often somewhat oblique. Then follows a parenchymatic tissue, whose innermost cells are larger gradually diminishing outwards. A transverse section shows these cells to be nearly circular in outline, while a longitudinal section shows them to be actually oblong about 60 μ long. Finally, the epidermal tissue consists of a single layer of cells only; the cells are nearly as long as broad; when seen from above roundish polygonal; their diameter is about 12 μ.

My material was sterile.

The only known organs of reproduction are tetraspores; these have zonate division and occur immersed in the swollen ends of the branchlets.

At the islands I have dredged this plant in deep water only, at depths of about 20—30 meters.

St. Jan: In the sound between this island and St. Thomas in several places. St. Thomas: In the sea to the west of Water Island.

Geogr. Distrib.: West Indies.

V. Rhodymeniales.

Fam. 1. Sphæroccocaceæ.

Subfam. 1. Ceratodictyeæ.

Gelidiopsis Schmitz.

1. Gelidiopsis rigida (Vahl) Weber-van Bosse.

Weber-van Bosse, A., Note sur deux algues de l'Archipel Malaisien (Recueil de travaux bot. Néerl., Vol. 1, p. 104, 1904). Okamura, K., Icones of Japanese Algæ, vol. II, 1912, p. 34 and p. 188, pl. 59, figs. 1—6.

Fucus rigidus Vahl, Beskrivelse over endeel cryptog. Planter fra St. Croix (Skrivter af Naturhistorie-Selskabet, 5. Bd., 2. Hefte, Kiobenhavn 1802, p. 46).

Gelidium rigidum (Vahl) Grev., Alg. Brit., p. LVII. Kützing, Spec. Alg., p. 766; J. Agardh, Spec. Alg., vol. II, p. 468; Epicrisis, p. 548.

Sphærococcus rigidus Ag., Spec. Alg., p. 285; Syst., p. 227.

Fucus corneus var. *spinæformis* Turn., Fuci, IV, p. 149.

Echinocaulon spinellum Kütz., Phyc. gen., p. 40; Spec., p. 762; Tab. phycol., vol. 18, tab. 38.

Echinocaulon ramelliferum Kütz., Tab. Phycol., vol. 18, p. 14, pl. 39.

Echinocaulon rigidum Kütz., Tab. Phycol., vol. 18, pl. 40.

Gelidiopsis rigida is a common alga upon coral reefs, stones, shells etc. upon which its decumbent base creeps; it forms more or less dense tufts upto a heigth of about 10 cm or more. It has a terete thallus of a very rigid, cartilaginous consistency and is rather

irregularly branched, some of the branches being very regularly pinnate or bipinnate, others bearing a few scattered pinnules or being quite barren.

Regarding the anatomical structure we find in the apex of the plant an apical cell usually rather broad with convex sides, sometimes also more conical (Fig. 362 *d*, *e*). At the base of this, watch-glass-shaped segments are cut off. From these segments

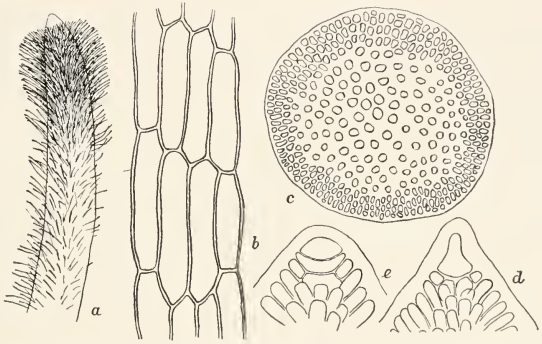

Fig. 362. *Gelidiopsis rigida* (Vahl) Weber-van Bosse.
a, summit of young thallus covered with hairs (about 50:1); *b*, longitudinal section of medullary cells (about 200:1); *c*, *d*, apices of two filaments showing the apical cell (about 500:1); *e*, transverse section of the thallus (about 70:1).

short filaments originate, diverging in all directions and these filaments are again gradually, by various divisions, transformed into a medullary tissue composed of thick-walled cells all of nearly the same size and an epidermal layer of densely placed small cells (Fig. 362 *e*). From a longitudinal section it appears that the cells of the medullary tissue are subcylindrical, about six times as long as broad with more or less oblique walls (Fig. 362 *b*).

When referring this plant to the genus *Gelidiopsis* M^me^ Weber was of the opinion that it had no apical cell, Okamura (l. c., fig. 6) being the first who observed it. Later on in the paper on "The Rhodophyceæ of the Percy Sladen Trust Expedition" (Transact. Linn. Soc., London 1914, vol. XVI, Zoology, p. 280) M^me^ Weber has corrected this mistake. In the above mentioned paper of Okamura good figures of this plant are found.

In the young parts of the thallus long unicellular hairs are given off from a great number of the peripheral cells forming a dense coating round the filaments (Fig. 362 *a*). These filaments are cylindrical—subclavate, being a little thicker in the upper end; they are about 200 μ long and 6—7 μ broad. They have very thin walls and are filled with protoplasma in the upper end.

In this plant tetrasporangia are the only known organs of reproduction. They occur in the upper apices of the pinnules which become swelled and conical in shape. They are formed here in great numbers in the peripheral tissue. The tetrasporangia are oblong, rather small, about 50 μ long and 27 μ broad; they are cruciately divided.

In a recently published list of algæ from Bermuda, Howe*) has replaced this plant in the genus *Gelidium*, and he bases his opinion on the fact that *Gelidium cartilagineum*, which in several respects shows likeness to the present species, is allowed to remain in the genus. As pointed out by M^me^ Weber, it is especially the non-existence of the hyphæ in the middle of the thallus and the great resemblance of the stichidia of this genus to those of other species of *Gelidiopsis* which makes it most natural to place our plant in the genus *Gelidiopsis*.

Tetrasporangia were found in specimens gathered in the months of January and February.

This plant has originally been described upon specimens from St. Croix which Vahl received from Rector West, and these specimens are still in the Botanical Museum, Copenhagen.

It is a very common species at this island, growing upon coral reefs etc. in shallow water. At St. Thomas and St. Jan I have not gathered it with the exception of quite a small fragment dredged in the sea near the east end of the first mentioned island.

Geogr. Distrib.: Seems to occur in all warm seas.

Subfam. 2. Gracilarieæ.

Gracilaria J. Ag.

I regret to say that, in the determination of several of the species of this polymorphic genus, I have not always arrived

*) In N. L. Britton, Flora of Bermuda, New York 1918, p. 514.

at a definite conclusion, but to attain this result a monographic examination of a rich material af a large number of species is necessary in order to determine how the plants vary under different conditions.

How useful the examination of a large number of specimens is, Collins and Hervey, in their work: "The Algæ of Bermuda", have shown, when they had the opportunity of examining a large collection of specimens which had previously been referred to the three species *Gr. Wrightii*, *Poitei* and *cornea*. They arrived at the conclusion that they „can find no line of demarcation between the three species mentioned". They therefore refer all of them to one and the same species: *Gr. Wrightii*.

Some of the ten species recorded in the following list have been recorded from the islands by former investigators. Of several of these species I have found only very few specimens or such about which I feel a great doubt. This applies for instance to what is called *Gr. compressa*. I greatly doubt whether the few specimens I have referred to this species really belong to the European species and it is the same in the case of some dried specimens from St. Croix determined by J. Agardh and kept in the Botanical Museum, Copenhagen.

1. **Gracilaria confervoides** (L.) Grev.

Greville, R. K., Alg. Brit., p. 123. Harvey, Phycol. Brit., pl. 65. J. Agardh, Spec. Alg., vol. II, p. 587, Epicr. p. 413. Thuret et Bornet, Études phycologiques, p. 80, pl. XL.

For more references see De Toni, Sylloge Alg., vol. IV, Sect. II, p. 431.

The specimens referred to this species have a tissue of very large cells in the middle of the thallus, often more than 1 mm in diameter. The walls of the cells are very thin. This tissue is surrounded by a cortical layer one or two cells thick. When dry, the thallus quite collapses.

Plants with cystocarps were gathered in the month of January.

This species occurs in shallow water and in sheltered places. It often grows in localities with a sandy bottom sprinkled with stones to which the alga is attached.

St. Croix: Christianssted's harbour and lagoon; Lt. Princess, Green Cay; Longford.

Geogr. Distrib.: Warmer Atlantic coast of Europe, Morocco, Mediterranean Sea, West Indies, Cape, The Philippine Islands etc.

2. Gracilaria ferox J. Ag.

Agardh, J., Spec. Alg., vol. II, p. 592: Epicr., p. 414.

A few not very typical specimens may, I think, be referred to this species. The ramification and whole habit of this plant shows some likeness to *Gr. cervicornis*, but this last species has a compressed thallus. The branches are subdichotomously ramified, the ramuli short with acute apex, in the upper part of the thallus often aculeate.

From a transverse section of the thallus it appears that the cells in the middle are large, growing smaller outwards. They have thin walls. The cortical layer is thin, one to two layers thick.

The plant was once gathered on rocks near the shore in a rather exposed place, and once in the open sea at a depth of about 5 fathoms. According to J. Agardh it has previously been found at St. Croix, and in the Botanical Museum, Copenhagen, a specimen collected at this island by Ørsted, is present.

St. Croix: White Bay, off Frederikssted.

Geogr. Distrib.: West Indies, Pernambucco.

3. Gracilaria compressa (Ag.) Grev.

Greville, R. K., Algæ Brit., 1830, p. 125. Harvey, Phycol. Brit., pl. 205. J. Agardh, Spec. Alg., vol. II, p. 593; Epicr., p. 417.

Sphærococcus compressus Ag., Spec. Alg., p. 308; System., p. 233. Kützing, Fr., Spec. Alg., p. 774; Tab. Phycol., vol. 18, pl. 78.

Comp. for more synonyms De-Toni, Sylloge Alg., vol. IV, Sect. II, p. 438.

Only a few not very typical specimens may, I think, be referred to this species. Compared with *Gracilaria confervoides* they especially differ on account of their somewhat thicker thallus and of the smaller cells in the interior of the filaments, their diameter reaching only a length of about 300 μ. The cells have thin walls. The cortical layer is thin, composed only of one or two layers of cells. The thallus is of a soft consistence and collapses in drying.

According to J. Agardh (l. c.) this species has been found

at St. Thomas and in the Herbarium of the Botanical Museum, Copenhagen, some specimens, determined by J. Agardh, are kept; they are collected by Ørsted near Christianssted at a depth of about 5 meters.

St. Croix: Coakley Bay.

Geogr. Distrb.: The warmer Altantic coast of Europe, Mediterranean Sea, West Indies, Mexico.

4. Gracilaria caudata J. Ag.

Agardh, J., Spec. Alg., vol. II, p. 598; Epicrisis, p. 420.

The specimens referred to this species are, when dry, of a corneous-cartilaginous consistence. The main branches are ramified on all sides, upwards with shorter ramuli, the upper ends of the branches being bare.

From a transverse section the cells in the interior of the filaments are seen to be nearly of the same size as those in *Gr. compressa*, their diameter reaching a length of about 300 μ. But their walls are thicker, and the cells decrease more evenly outwards and pass evenly into the rather thick cortical layer (Fig. 363).

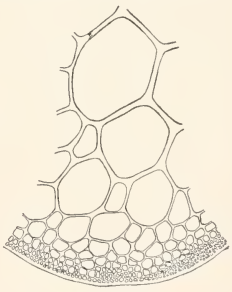

Fig. 363. *Gracilaria caudata* J. Ag. Part of a transverse section (About 60:1).

As I have had no authentic specimens at my disposal I do not feel convinced that my determination is right. In referring my specimens to this species I rely on the cartilaginous consistence of the thallus, only slightly collapsed when dry, and upon the anatomical structure.

Tetrasporic plants were found in the month of February.

It occurs in shallow water in more sheltered places and in the open sea at a depth of about 10 meters.

St. Croix: The harbour of Christianssted and Christianssted's Lagoon, Green Cay, off Frederikssted. According to J. Agardh this species has previously been found at St. Croix.

Geogr. Distrib.: West Indies, Mexico.

5. Gracilaria cylindrica nov. spec.

Gracilaria Blodgetti Borgs., Some new or little known West Indian Florideæ (Bot. Tidsskrift, vol. 30, 1909, p. 18).

Frons usque ad 22 cm longa, e callo parvo, discoideo adsurgens, caule ad basin tenuiori, mox crassiori, terete, cylindrico, ca. 1½—2 mm crasso, carnoso, exsiccatione collapso.

Fig. 364. *Gracilaria cylindrica* nov. spec. Habit of a plant. (About ⅘ natural size).

Rami sparsi, irregulariter undique orti, ad basin tenuiores, celeriter crassiores, teretes, cylindrici, apice late rotundati. Rami sæpe simplices, interdum ramosi, ramulos parvos in superiori parte gerentes.

Tetrasporangia sparsa, in cortice immersa. Cystocarpia verrucosa in superficie plantæ sparsa.

After renewed examination and after having seen a specimen of *Gracilaria Blodgettii* Harv. it is evident to me that the plant, to which I previously have given this name, cannot be referred to this species, but must be regarded as a new species for which I propose the name *Gr. cylindrica*, referring to the nearly cylindrical thallus, which is only interrupted by the narrowings at the base of the branches (Fig. 364).

The plant reaches a height of about 22 cm. It is fastened to the substratum by means of a small disc. The main stem, being quite thin at its outgrowth from the disc, soon reaches the normal thickness of the thallus, about 1½—2 mm and this thickness it keeps throughout. The branches are issued on all sides. The ramification is rather irregular with shorter or longer distance between the branches.

These are altogether a replica of the main stem. At their outgrowth from this they are quite thin, but rapidly obtain the normal size of the thallus keeping this through their whole length (often more than 10 cm) to their obtuse apex. The branches are mostly unbranched, but now and then they issue a

few branches of quite the same shape as their own; sometimes it may happen that such a branch is given off from the blunt apex of the mother branch.

The plant has a fine, clear-rose colour; it is somewhat diaphanous, of a fleshy succulent consistency. When dry it collapses completely, and it adheres mostly very well to the paper. A transverse section (Fig. 365 *c*) shows that the greater part of the tissue consists of large, transparent and thin-walled cells; outwards these become smaller and they are surrounded by a cortical layer consisting of one or two layers of rather small, thick-walled cells. Seen from the surface the cortical cells are irregularly polygonal (Fig. 365 *B*).

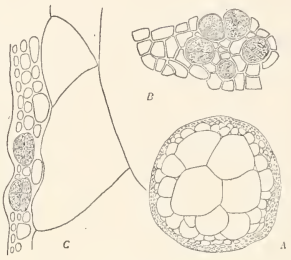

Fig. 365. *Gracilaria cylindrica* nov. spec.
A, transverse section of the thallus (about 8:1); *B*, surface of the thallus with tetraspores; *C*, transverse section of epidermal layer with tetraspores.
(*B* and *C* about 80:1).

In the tetrasporic plant the tetrasporangia occur scattered or in small irregular groups in the cortical layer (Figs. 365 *B*, *C*). The tetrasporangia are roundish of shape, their diameter reaching a length of about 40 μ.

The female plant bears the warty, dark-red cystocarps scattered over the surface.

The plant does not seem to approach any known *Gracilaria*. From *Gracilaria Blodgetti* it differs especially by the scarcer ramification and the obtuse apices of the branches.

The plant was found with tetraspores and cystocarps in the month of March. It was dredged in deep water about 10—15 fathoms.

The *Callithamnion cordatum* is a common and characteristic epiphyte upon this *Gracilaria*.

St. Jan.: Found in many places in the sound between this island and St. Thomas; and in the sea to the north of America Hill.

6. Gracilaria usneoides (Mert.) J. Ag.

J. Agardh, Spec. Alg., vol. II, p. 595; Epicrisis, p. 415.
Fucus usneoides Mert. mscr.
Sphærococcus usneoides Ag., Spec. Alg., p. 333.

This species has, according to J. Agardh, been found at St. Croix by Ørsted and in the Botanical Museum, Copenhagen, some fragments of Ørsted's plant are kept. These seem to show some likeness to *Gr. Wrightii*, but they are more densely ramified and the thallus collapses when it is dry.

Near Buck Island at St. Croix I have dredged a few specimens at a depth of about 5 fathoms which perhaps are referable to this species: they show much likeness to *Gracilaria Wrightii*, but the thallus is softer, the cells have thinner walls and they collapse therefore when dry.

Geogr. Distrib.: Brazil, West Indies.

7. Gracilaria Wrightii (Turn.) J. Ag., emend. Collins et Herv.

Collins and Hervey, Algæ of Bermuda, 1917, p. 109. J. Agardh, Spec. Alg., vol. II, p. 599 including *Gr. Poitei* (Lam.) J. Agardh, ibid. p. 596 and *Gr. cornea* J. Agardh, ibid., p. 598.

The specimens referred to this species are all coarse, thick plants of cartilaginous consistence. They are ramified very irregularly in every direction.

A transverse section of the thallus shows that it consists of a parenchymatic tissue of roundish, not very large cells, largest in the middle (about 180 μ broad) decreasing evenly towards the periphery. The walls of the cells are rather thick and often undulated, especially in the case of the small cells found between the larger ones. Towards the periphery the cells decrease, being about 20—30 μ thick. A longitudinal section, on the other hand, shows that the cells are rather long, about 170 μ, and have thick and sinuated walls. The cortical layer consists of short dichotomously ramified filaments composed of small oval cells; at the periphery a rather thick cuticula is found.

Specimens with tetrasporangia occurred in January and February.

The plant was found in shallow water in rather protected places.

St. Croix: White Bay, Lime Tree Bay. Some old specimens from the island are kept in the Herbarium of the Botanical Museum, Copenhagen.

Geogr. Distrib.: West Indies, Red Sea.

8. Gracilaria lacinulata (Vahl).

Fucus lacinulatus Vahl, Endeel kryptogamiske Planter fra St. Croix (1799) in Skrivter af Naturhistorie-Selskabet, 5. Bd., 2. Hefte, Kiøbenhavn 1802.

Gracilaria multipartita (Clem.) J. Ag., Alg. Mediterr., 1842, p. 151; Spec. Alg., vol. II, p. 600; Epicr., p. 423. Harvey, Phycol. Brit., pl. XV; Nereis Bor.-Am., p. 107.

Sphærococcus multipartitus Ag., Spec. Alg., p. 247.

Fucus multipartitus Clemente, Ensajo, Madrid 1807, p. 311 (non vidi).

For more synonyms compare De-Toni, Sylloge Alg., vol. IV, Sect. II, p. 447.

We are obliged, I think, to take up Vahl's name for this plant. His description is clear and striking and cannot be misunderstood, even if the specimens, upon which he founded his description, cannot be identified with certainty at any rate at the present moment. This is of course a regrettable drawback. There is in the Herbarium of the Botanical Museum, Copenhagen, several old specimens (called *Fucus lacinulatus*) from the Danish islands which surely have been seen by Vahl, but none of these bear his handwriting.

And that the specific name of Vahl has been used for this plant is shown, too, by the careful drawing of this plant reproduced here (Fig. 366). It is found in a book containing drawings of several algæ originating from Professor Fr. Weber in Kiel and later presented to the Botanical Library, Copenhagen by his royal Highness Prince Christian.

Among the rather few specimens, which I have gathered myself, forms are found which approach partly to the var. *granatea* (Turn.) J. Ag. (= *Fucus*

Nr. 366. *Gracilaria lacinulata* (Vahl). Compare the text.

granateus Turner, Fuci, pl. 215), and partly to the var. *æruginosa* (Turn.) J. Ag. (= *Fucus æruginosus* Turner, Fuci, pl. 147). Besides I have some few specimens approaching the var. *polycarpa* (Grev.) J. Ag. and some others most likely referable to the var. *angustissima* Harv. These last mentioned specimens are quite terete at their base, but in the upper part the thallus is a little flattened being at the same time more or less bi-trifurcate. Some of these specimens were lying loose upon the bottom.

Gracilaria lacinulata occurs in shallow water near the shore, partly in sheltered places, partly in more exposed.

St. Croix: Longford, Christianssted's harbour, White Bay, Salt River, Buck Island.

Geogr. Distrib.: Warmer Atlantic coast of Europe and America, Mediterranean Sea.

9. Gracilaria dentata J. Ag.

Agardh, J., Spec. Alg., vol. II, p. 603; Epicr., p. 424.
Sphærococcus oligacanthus Kütz., Tab. Phycol., vol. XVIII, pl. 87.
Sphærococcus rangiferinus Kütz., ibd. pl. 86.

The specimens found seem to agree very well with J. Agardh's description. They have a thicker, more firm and cartilaginous thallus than that of *Gracilaria lacinulata*. The thallus is several times bi-tripartite, in the upper end flabellate. Along the margin the specimens are more or less dentate. Some of the specimens lack the dents. These bear a close resemblance to some specimens in my collection from Jamaica, gathered some years ago at this island by Mr. O. Hansen and determined by the late Major Reinbold to be a form intermediate to the var. *polycarpa* of *Gr. lacinulata*.

Transverse sections of the thallus show that the cells in the present plant are much smaller than those of *Gr. lacinulata*, about 200 μ lat. The cells become smaller outwards and are surrounded by the cortical layer which consists of a few layers of cells, oval of shape.

The *Fucus denticulatus* of Vahl (in Skrivter af Naturhistorie-Selskabet, 5te Bind, 2. Hefte, p. 45) is most probably this species. But as his diagnosis is rather short and as I have seen no specimens from Vahl's time, I do not think it right to reestablish his specific name.

Plants with tetraspores were found in the month of February.

It has been gathered in shallow water near the shore in rather exposed places.

St. Croix: White Bay, Long Reef, Lt. Princess.
Geogr. Distrib.: West Indies.

10. **Gracilaria cervicornis** (Turner) J. Ag.

Agardh, J., Spec. Alg., vol. II, p. 604; Epicr., p. 425.
Fucus cervicornis Turner, Fuci, pl. 121.
For more synonyms comp. De-Toni, Sylloge, vol. IV, Sect. II, p. 452.

I have not myself gathered this species at the islands, but according to J. Agardh it has previously been found at St. Croix. And some old specimens from St. Croix are kept in the Herbarium of the Botanical Museum, Copenhagen. Some of these are most probably collected by Rector West and sent to Vahl; but being without his signature, this question cannot be settled.

It seems to me that the description of *Fucus versicolor* given by Vahl in the year 1802 in „Skrivter fra Naturh.-Selskabet", vol. 5, part 2, p. 44 on the whole answers to this species, but when the „dentibus" are said to be "obtusissimis" it does not correspond with this plant.

Geogr. Distrib.: West Indies, Mexico, Brazil.

Subfam. 3. Hypneeæ.

Hypnea Lamouroux.

Collins and Hervey point out in the "Algæ of Bermuda", p. 112—13 that the species of *Hypnea* are generally so poorly defined that any exact determination is mostly excluded.

The representatives of the genus *Hypnea* seem to be very variable plants, varying much according to their different growing places. Several of the species described are most probably nothing else but forms of the same plant.

1. **Hypnea musciformis** (Wulf.) Lamour.

Lamouroux, Essai Thalassioph., p. 43. Kützing, Fr., Spec. Alg., p. 758; Tab. Phycol., vol. 18, tab. 19. J. Agardh, Spec. Alg., vol. II, p. 442; Epicr., p. 561.

Fucus musciformis Wulf. in Jacquin, Collectanea, III, p. 154, tab. 14, fig. 3 (non vidi). Esper, Icones Fuc., tab. 93. Turner, Fuci, tab. 127.

For more synonyms compare De-Toni, Sylloge Alg., vol. IV. Sect. II, p. 472.

This is a common species along the shores of the islands. It occurs in shallow water and mostly in more sheltered places, but it is also found in somewhat exposed localities.

Fig. 367. *Hypnea cornuta* (Lamour.) J. Ag. Part of a plant. (About 3:1).

In the last mentioned places where the light, too, was strong some specimens were gathered which were covered quite densely with long, unicellular, hyaline hairs. These hairs serve most probably as a protection against strong light*) being present in so many littoral algæ and non existing or less developed in those from deep water. That the hairs, on the other hand, also may serve as absorbing organs of nutriments, is very likely**).

Hypnea musciformis is often an epiphyte upon larger algæ and occurs commonly entangled among other algæ to which it fixes itself by means of the tendrils.

Specimens with tetrasporangia were found in the month of February.

St. Croix: Christianssted's harbour, Christianssted's Lagoon, Lt. Princess, White Bay, Casavagarden etc. St. Thomas: Store Nordsidebugt. St. Jan: Coral Bay, Cruz Bay.

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

2. **Hypnea cornuta** (Lamour.) J. Ag.

J. Agardh, Spec. Alg., vol. II, p. 449; Epicr. p. 563.
Gigartina cornuta Lamour. mscr.
Chondroclonium cornutum Kütz., Spec. Alg., p. 741.

*) Vide Berthold, G., Beiträge zur Morphologie und Physiologie der Meeresalgen. Pringsh. Jahrb. f. wiss. Bot., Bd. 13, 1882 p. 675.

**) Rosenvinge, L. Kolderup: Remarks on the hyaline unicellular hairs of the Florideæ (Biol. Arbejder tilegnede Eug. Warming, København 1911).

The plant (Fig. 367) is characterized by the small, stellate, spiny branchlets found scattered upon the filaments. They have 3—5 rays and are peltately fixed to the branches. Tendrils are now and then present, but not upon all specimens. The plant forms rather large, richly ramified bushes up to about 20 cm high.

A transverse section (Fig. 368) of the thallus shows rather large cells in the middle, smaller towards the periphery. The cortical layer consists of a single layer of cells which have a very thick cuticula often 25—30 μ thick. A longitudinal section shows that the cells in the middle are about 3—4 times longer than broad.

The *Acrochætium Hypneæ* described on page 51 of this volume is found upon this plant in whose thick cuticula its basal part is immersed.

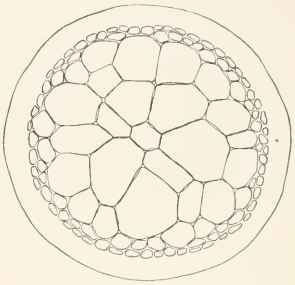

Fig. 368. *Hypnea cornuta* (Lamour.) J. Ag. Transverse section of the thallus. (About 100:1).

This species has been found a few times in sheltered places in shallow water.

St. Thomas: in the harbour of Charlotte Amalia; St. Croix: near Christianssted. Ørsted has gathered it as St. Thomas.

Geogr. Distrib.: West Indies, Guinea, Japan etc

3. **Hypnea cervicornis** J. Ag.

J. Agardh, Spec. Alg., vol. II, p. 451; Epicrisis, p. 546.
Hypnea spinella Kütz., Tab. Phycolog., vol. 18, tab. 26.

The specimens referred to this species form roundish bushes composed of numerous, much branched filaments. No main branches are present, all the branches being of nearly the same size and mostly rather thin. The ramification is very irregular, the branchlets longer or shorter with acute apices. Frequently the upper ends of the filaments get an antler-like appearance being often curved and their branchlets decreasing in length towards the top.

Some of my specimens might perhaps quite as well be referred to *Hypnea divaricata* Grev. of which some specimens from

St. Croix and St. Thomas, collected by ØRSTED and determined by J. AGARDH, are kept in the Herbarium of the Botanical Museum, Copenhagen. I have specimens which are quite identical with these. They seem to be like a more densely branched form of the present one.

It seems to me very likely that the specimens I have referred to this species are only forms from more protected places, and those referred to the following species, *Hypnea spinella*, nothing else but forms from more exposed places.

This species occurs in more protected places in shallow water, but it has also been dredged in deep sea at a depth of about 30 meters. It was found with tetrasporangia and cystocarps in the months of February and March.

It is a common species along the shores of the islands.
Geogr. Distrib.: Seems to occur in most warmer seas.

4. Hypnea spinella (Ag.) Kütz.

KÜTZING, Spec. Alg., p. 759. J. AGARDH, Spec. Alg., vol. II, p. 453; Epicrisis, p. 565.

Sphærococcus spinellus Ag., Spec. Alg., p. 323; Systema, p. 237.

This plant forms small compact tufts upon rocks.

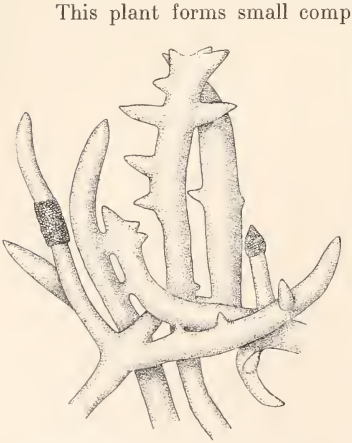

Fig. 369. *Hypnea spinella* (Ag.) Kütz. Part of a plant with anastomosing branches and fertile parts with tetrasporangia (about 10:1).

The plant is very irregularly ramified (Fig. 369); the branches are issued in all directions, in some cases with larger distance between them, in others several branches are crowded together. Some of the branches grow out to main filaments, most of them become small, short, spinelike branchlets of variable length.

These much branched filaments are felted between each others and further often anastomosing to each others by means of rhizoids breaking out everywhere from the thallus (Fig. 369).

The tetrasporangia are formed in the branchlets. The fertile part of these is thicker than the sterile one. The quite short branchlets become fertile in their whole length, the longer in their upper end; sometimes a fertile zone is found in the middle part of a branch (Fig. 369).

The plant grows in shallow water near the shore in somewhat exposed places where the waves often dash the rocks constantly. It seems to me rather probable that this plant is only but a dwarfish form of the preceding species adapted to the conditions of life of the more exposed localities.

The plant has been found with tetraspores in the months of December and January and with cystocarps in the month of February.

St. Croix: White Bay; St. Thomas: In several places near Charlotte Amalia. St. Jan: Cruz Bay.

Geogr. Distrib.: West Indies.

Fam. 2. *Rhodymeniaceæ.*

Subfam. 1. Gloiocladieæ.

Gloiocladia J. Ag.

1. Gloiocladia spec.

Only a single sterile plant has been found. It forms a small roundish tuft, about 3 cm high and has, when dry, a beautiful rosy colour. The thallus is flat, repeatedly forked, its divisions being about 3 mm broad; it seems to be somewhat twisted. The upper ends of the thallus are more or less emarginate with obtuse corners.

A transverse section of the thallus shows that it is composed of two different cell-tissues (Fig. 370 *a*, *b*).

In the middle of the thallus a layer of very large transparent cells are found; these are about 180 μ thick and often more than 400 μ long. Seen from above these cells have more or less undulated walls and are mostly one and a half to twice as long as broad (Fig. 370 *c*). For the most part this tissue consists of a single layer of cells, but a few times I have found the large cells divided into a number of smaller cells (compare Fig. 370 *a*).

The epidermal layer consists, in the parts nearest to the large

cells in the middle, of irregularly shaped, tri-polygonal cells with elongated corners; from these cells short, several times forked, moniliform filaments emerge, these being composed of small oval cells (Fig. 370 *a*, *b*). The cells in the filaments are about 6—7 μ thick.

The consistency of the thallus is very gelatinous.

I have referred this doubful plant to *Gloiocladia* as it, to a great extent, bears a close resemblance to this genus. Of *Gloio-*

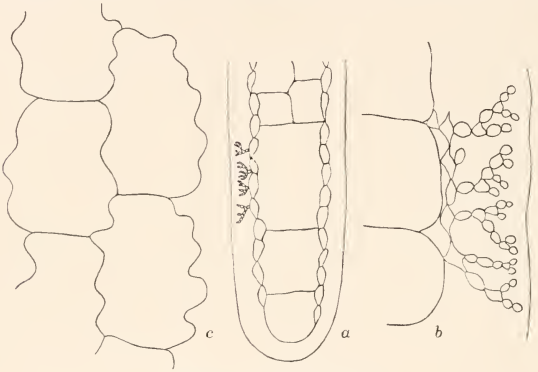

Fig. 370. *Gloiocladia* spec.
a, transverse section of the thallus (about 80:1); *b*, part of the same more magnified (about 300:1); *c*, cells from the middle of the thallus seen from above (about 300:1).

cladia a single representative, *G. furcata* from the Mediterranean Sea, is known up to the present time (compare Zanardini, Iconographia Phyc. Adriat., vol. I, p. 13, pl. 4 A). When compared with this plant the West Indian one differs nevertheless in several respects. Thus it must be pointed out that its thallus is broader and flat throughout its whole length and the upper ends of the thallus are obtuse.

As to the anatomical structure the most essential difference between the two plants is that while the tissue in the interior of the thallus in my plant consists mostly of a single layer only, in the Mediterranean plant with its thicker thallus this tissue is composed of several layers.

Hence, it is most probable, we have to do with a new spe-

cies which is a West Indian representative of this genus, but, having had so very little and quite sterile material at my disposal, I prefer to leave it unnamed.

The plant was dredged in deep sea at a depht of about 15 fathoms.

St. Jan: off Annaberg.

Subfam. 2. Rhodymenieæ.

Rhodymenia Grev., J. Ag.

1. Rhodymenia occidentalis nov. sp.

Frons plana, membranacea, 25 cm longa et ultra, crebre dichotomo-furcata, subflabellata, furcationibus angustioribus, laciniis ca. 4 mm latis, margine nuda, interdum prolifera, summis late rotundatis, basi subterete-stipitata.

Frons ex duobus stratis composita, cellulis exterioribus corticalibus minutis, interioribus ad medium versus gradatim majoribus, rotundatis-polygonatis.

Organa fructificationis ignota.

The plant is fastened to the substratum by means of a disc from which proliferations often arise. The thallus is flat, membranaceous. It is narrow near the base, but scarcely quite terete; upwards it is evenly broadened out until it reaches its normal breadth, about 4 mm. The thallus is repeatedly forked; in the

Fig. 371. *Rhodymenia occidentalis* nov. spec. Part of a plant. (About $^2/_3$).

basal part the distance between the furcations is shorter than upwards. At each furcation the thallus is much narrowed being often here only 1 mm broad.

Besides this normal ramification proliferations are now and then issued from the margin of the thallus especially near the narrowings. The thallus is slightly sinuated. The apex of the thallus is broadly rounded.

From a transverse section is seen that the thallus consists of cells which are largest in the middle (about 150 μ thick) and

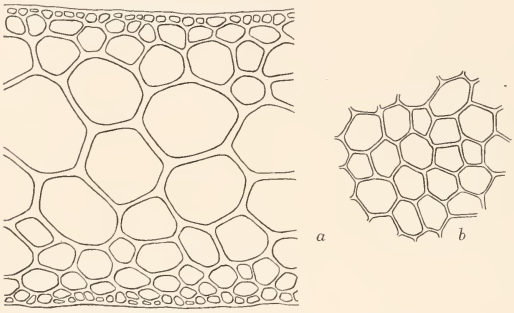

Fig. 372. *Rhodymenia occidentalis* nov. spec.
a, transverse section of the thallus (about 125:1); *b*, part of the cortical layer seen from above (about 350:1).

decreasing evenly outwards (Fig. 372, *a*). All the cells have very thick walls. This parenchymatic tissue is surrounded by a cortical layer composed of a single layer of cells; in transverse section these are roundish polygonal, seen from above polygonal (Fig. 372 *b*).

Neither tetraspores nor other organs of reproduction were found in the material.

Considering its entire structure it seems to me that the plant agrees very closely with *Rhodymenia*, but, if its organs of reproduction should be found, it is, of course, not impossible that it may turn out to be, for instance, a *Gracilaria*.

As to species of *Rhodymenia* with which our plant may be compared, *Rh. flabellifolia* (Bory) Mont. (= *Sphærococcus tenui-*

folius Kütz., Tab. phycol., vol. 18, pl. 93), *Rh. linearis* J. Ag., *Rh. ligulata* Zanard. etc. may be pointed out.

The plant was found at a depth of about 10—15 fathoms of water. It was growing, apparently rather abundantly, in the sound between St. Thomas and St. Jan as a component of the very rich algal vegetation found here.

St. Jan: Found in several places in the sound between this island and St. Thomas: off Cruz Bay, near Great St. James, off Hermitage, off Annaberg.

Coelothrix nov. gen.

Frons rigida, filiformis, ex numerosis filamentis arcte conjunctis orta, tubulosa, in interiori parte cava, irregulariter ramosa, ramis sparsis, interdum secundis et inter se conglomeratis, interdum anastomosantibus cæspites densos formantibus.

Frons ex duobus stratis composita, exteriori cortice unistrato, cellulis minoribus densis, interiori cellulis gradatim majoribus, rotundatis-polygoniis, cavitatem versus glandes sparsas gerentibus.

Tetrasporangia apici inflato ramorum inhabita.

1. Coelothrix irregularis (Harv.)

Cordylecladia? irregularis Harv., Nereis Bor.-Am., part II, p. 156.

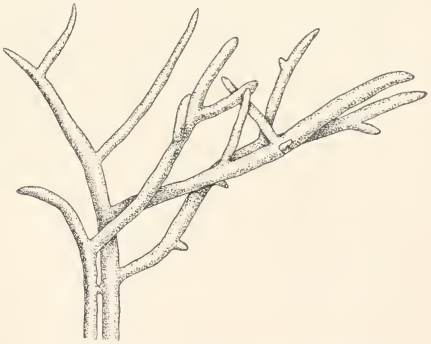

Fig. 373. *Coelothrix irregularis* (Harv.). Part of a plant. Below two branches with anastomose. (About 4:1).

When Harvey referred this plant to the genus *Cordylecladia* he put, no doubt correctly, a query behind the name as the structure of this plant differs greatly from that of the type species: *Cordylecladia erecta*, a transverse section of which being very like that of *Gracilaria*. Considering the structure of the thallus, especially since this is hollow as already pointed out by Harvey, and the glands found upon the cells facing the

cavity, the plant seems to me to be much closer related to, for instance, *Chrysymenia* and *Chylocladia*, even if it cannot in a natural way be referred to any of these genera. On account of this I propose to consider it as a representative of a new genus.

I have not found this plant myself and my description is therefore, unfortunately, rather poor, having had but some old dried specimens, preserved in the Botanical Museum, Copenhagen, at my disposal. But the plant seems to stand drying rather

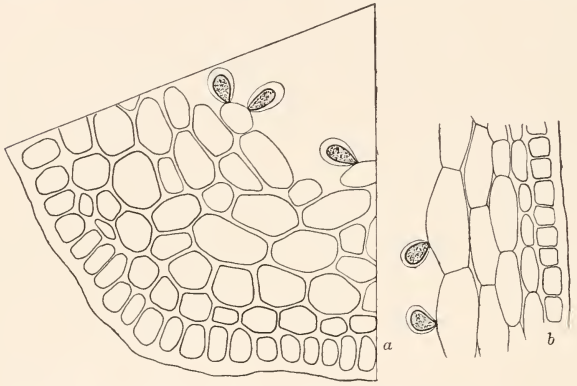

Fig. 374. *Coelothrix irregularis* (Harv.).
a, transverse section of the thallus (about 275:1);
b, longitudinal section (about 200:1).

well and, after having been steeped in water, to reassume fairly well its original appearance.

The plant (Fig. 373) forms low cushions composed of the rather rigid and very irregularly branched filaments felted together; they are fastened to the substratum by means of numerous groups of rhizoids, these being able to break out everywhere from the thallus. By means of such rhizoids the filaments in the cushions, too, are mutually connected; a group of surface cells grow out rhizoid-like from both filaments and anastomose in a way very similar to that in *Wurdemannia* (comp. Fig. 360).

The ramification is very irregular the branches being issued, with shorter or longer intervals on all sides, sometimes with a tendency to be second.

The growing point in the apex of the thallus consists of numerous filaments packed together and with diverging apices.

A transverse section (Fig. 374 *a*) of the thallus shows at the periphery a single row of oblong cells placed densely together; these cells are about 28 μ long and 16 μ broad. Next to this layer a parenchymatic tissue follows whose cells are roundish and gradually increase towards the cavity being at the same time somewhat looser connected. The innermost cells protrude more or less freely into the cavity and carry now and then glands (Fig. 374 *a*)

A longitudinal section (Fig. 374 *b*) shows that the peripheral cells are nearly square; the cells of the parenchymatic tissue are rather long, about 2—3 times as long as broad.

The specimens examined were sterile; I thought in one of the specimens to have found tetrasporangia, but a more thorough examination showed that these originated from a *Hypnea* whose filaments were densely interwoven between those of *Coelothrix*. But Collins*) mentions having found tetraspores, and Howe**), too, mentions such ones. According to him "the tetrasporangia occur on pod-like enlargements of the ends of certain branchlets". Collins also mentions having found cystocarps; these "are spherical and external on the branches". A more detailed description of these organs would be highly desirable.

In "The Algæ of Bermuda" Collins and Hervey name the plant *Cordylecladia rigens*, referring it to the *Chylocladia rigens* J. Ag. (= *Sphærococcus rigens* C. Ag.). Howe, l. c., p. 516 points out that "the type of *Sphærococcus rigens* Ag. is a Japanese plant different in structure from the Bermudian and West Indian."

The specimens preserved in the Botanical Museum, Copenhagen, are partly "ex ins. St. Crucis, misit Palle Bang", partly from "St. Jan., Dr. Ravn." They are labelled *Sphærococcus durus* Ag. var.

Geogr. Distrib.: Florida, Bermuda, Jamaica.

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*) Collins, Fr. S., The Algae of Jamaica (Proceed. Am. Acad. of Arts and Sciences, vol. 307, 1901, p. 255).

**) Howe in Britton, Flora of Bermuda, 1908, p. 516).

Chrysymenia J. Ag.

In some introductory remarks to a former paper of mine*) concerning this genus I have pointed out that the bursting of the thallus, as described by Schmitz and Hauptfleisch, and the peculiar way in which, according to these authors, the gland-cells in the cavities of the *Chrysymenias* are supposed to come into existence does not hold good in case of a more thorough examination. In a paper of the late Prof. Kuckuck**), whose early death is sincerely to be regretted, this prominent investigator

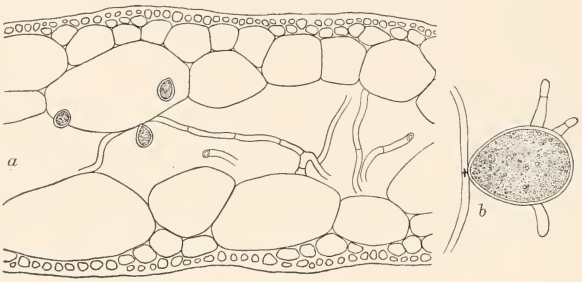

Fig. 375. *Chrysymenia Agardhii* Harv.
a, transverse section of the thallus (about 80:1);
b, gland-cell with filaments (about 350:1).

quite agrees with me regarding the development of the cavities and glands of the *Chrysymenias*.

In the same paper I also mentioned that the shape of the gland-cells and their arrangement upon the innerside of the large wall cells seem to be of much specific value.

1. Chrysymenia Agardhii Harv.

Harvey, W. H., Nereis Bor.-Americana, Part. IV, p. 189, tab. XXX A. Agardh, J., Epicrisis, p. 322. Børgesen, F., Some new or little known West Indian Florideæ, II. (Bot. Tidsskr., vol. 30, 1910).

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*) Børgesen F., Some new or little known West Indian Florideæ, II (Botanisk Tidsskrift, vol. 30, 1910, p. 181).

**) Kuckuck, P., Beiträge zur Kenntnis der Meeresalgen, 13, Untersuchungen über Chrysymenia (Wiss. Meeresuntersuchungen. Neue Folge, V. Bd., Abt. Helgoland, Oldenburg, 1912).

A few specimens of this plant have been found. They are fixed to the substratum by means of a small disc, having a cuneate rapidly expanded base which is afterwards divided into several lobes. These lobes bear along their margin several smaller ramifications, in my specimens they are of an elongated oblong shape tapering towards both ends.

The thallus is flat, compressed, in places nearly compact, but here and there smaller or larger openings are present between the innermost large cells (Fig. 375 *a*). These cells are

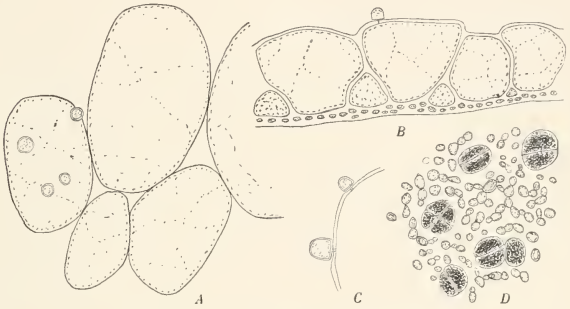

Fig. 376. *Chrysymenia Agardhii* Harv.
A, wall of frond seen from innerside; the cell to the left with glands (70:1); *B*, transverse section of the wall; the cell in the middle with a gland (70:1); *C*, part of a cell with glands (170:1); *D*, tetrasporangia in the cortical layer (170:1).

oblong to oval of shape when seen from the surface (Fig. 376 *A*), in transverse section irregularly polygonal (Fig. 376 *B*). The surface consists of a dense layer of small cortical cells covering the underlying large cells completely.

On their innerside, facing the cavities in the interior of the thallus, one of the large cells bears here and there a few (2—4 seldom more) scattered gland-cells (Fig. 375 *a*, 376 *A*). These are globular to obovate.

Furthermore hyphæ-like filaments grow out in all directions from the innerside of the large wall cells filling up the cavities more or less (Fig. 375 *a*). These filaments have transverse walls and are sometimes ramified. The cells in the filaments are nearly cylindrical, about 20 μ thick and five to eight times as long. Such

filaments are sometimes issued from the gland-cells too (Fig. 375 *b*).

Only tetrasporic plants occurred. The tetrasporangia are developed in the cortical layer (Fig. 376 *D*). They are cruciately divided and rather small, about 27 μ broad. They occurred in the month of March.

This species has been found in deep water only (about 12—16 fathoms).

St. Jan: Off Cruz Bay and near Great St. James; off America Hill where it was collected by Dr. Th, Mortensen and myself.

Geogr. Distrib.: Florida.

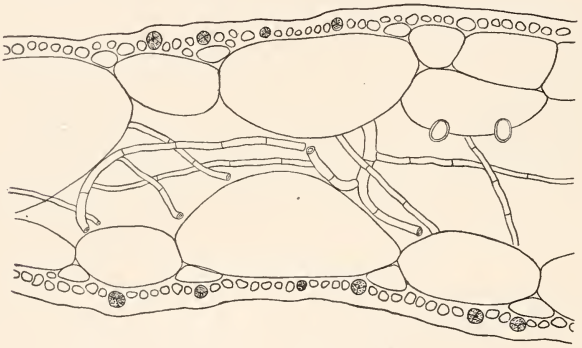

Fig. 377. *Chrysymenia planifrons* (Melv.) J. Ag.
Part of a transverse section of the thallus with tetrasporangia (about 80:1).

2. **Chrysymenia planifrons** (Melv.) J. Ag.

J. Agardh, Epicr. p. 319.

Chrysymenia Agardhii var. *planifrons* Melville, Notes on the Algæ of South Carolina and Florida (Journ. of Botany, vol. XIII, 1875, p. 263).

A fragment of a *Chrysymenia* with flat thallus is, most probably, referable to this species. It originates from a tetrasporic, and rather old plant.

A transverse section (Fig. 377) of the thallus bears a close resemblance to that of *Chrysymenia Agardhii*. In the middle it is more or less hollow and the cavities are more or less filled up with numerous hyphæ issued abundantly from the large wall

cells. The gland-cells are placed in the same way, having nearly the same shape as in *Chrysymenia Agardhii*. Also in this plant hyphæ were found growing out from the gland-cells.

It cannot be denied that this plant, on the whole, comes very near to *Chrysymenia Agardhii* and that Melville is right in considering it as a variety only of this species. The only difference between the two forms seems to be that the thallus in *Chrysymenia planifrons* is not divided, being very broad.

The plant was gathered in the month of March. It was dredged in rather deep water, about 30 meters.

St. Jan: Off Cruz Bay.

Geogr. Distrib.: Florida.

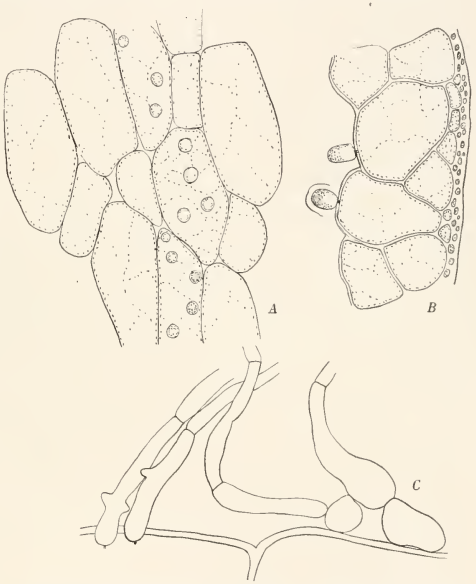

Fig. 378. *Chrysymenia ventricosa* (Lamour.) J. Ag. *A*, large cells facing the cavity of the thallus, those in the middle with glands (70:1); *B*, transverse section of the wall with two glands (70:1); *C*, transverse section of an older part of the thallus showing hyphæ-like filaments growing out from the innerside of the large cells (125:1).

3. Chrysymenia ventricosa (Lamour.) J. Ag.

J. Agardh, Alg. Medit., 1842, p. 106; Spec. Alg. vol. II, p. 213; Epicrisis, p. 323. F. Børgesen, Some new or little known W. I. Florideæ, II, 1910, p. 183, fig. 3. Kuckuck, Untersuch. über Chrysymenia (Beiträge zur Kenntnis der Meeresalgen, 13, p. 218, pl. XIII, figs. 16—21).

Dumontia ventricosa Lamour., Essai Thalassiophyt., 1813, p. 45, tab. 10, fig. 6.

Halymenia ventricosa Ag., Spec. p. 212. Kützing, Tab. Phycol., vol. 16, tab. 86.

Halymenia pinnulata Ag., Aufzählung etc. (Flora X, 1827, p. 645).
Chrysymenia pinnulata J. Ag., Alg. Mediter., p. 106; Spec. Alg., II, p. 212; Epicr., p. 323. Zanardini, Iconogr. Adriat., I, p. 151, pl. 36 A.

The wall of this rather large plant consists of several cell-layers; innermost, towards the cavity in the interior of the frond, the cells are large, becoming smaller outwards (Fig. 378 *B*). The cortical layer consists of larger cells innermost, smaller at the periphery; it is beautifully figured by Kuckuck (l. c., p. 219, pl. XIII, fig. 17) who, on the other hand, found the cortical layer composed of short moniliform filaments consisting of small roundish cells. This was not so marked in the West Indian specimens except in the tetrasporic plant.

Here and there, on the innerside of the large cells facing the cavity in the interior of the thallus, a single one of these cells or a few consecutive ones bear glands (Fig. 378 *A*). These glands are as a rule placed immediately upon the membrane of the large cells, more rarely I have found a few of the glands placed upon a small roundish cell while the remaining glands were placed immediately upon the wall of the large cell. In specimens from the Mediterranean Sea Kuckuck mentions that he also now and then has found such a small cell between the gland cell and the large cell (compare his fig. 19, pl. XIII). The glands seem always to be solitary, but several occur on each cell. The glands are oblong-roundish when seen from the side (Fig. 378 *B*).

Fig. 379. *Chrysymenia ventricosa* (Lamour.) J. Ag. Tetrasporangia in the cortical layer (250:1).

Further, in the older part of the thallus (comp. my remarks l. c., p. 181) we find hyphæ-like filaments growing out from the innerside of the large wall cells (Fig. 378 *C*). These filaments are irregularly bent, often swollen in their lowermost part, nearly cylindrical in their upper part consisting of cells about 16 μ thick and 6—12 times as long. The filaments are now and then ramified, Kuckuck has found similar hyphæ in the Mediterranean plant. A few times small nearly globular glands occurred upon the filamemts.

The tetrasporangia are produced in the cortical layer and occur scattered over the whole thallus. They are about 20 μ broad and cruciately divided (Fig. 379). Kuckuck gives (l. c., p. 223) a transverse section of the wall with tetrasporangia.

The cystocarps are likewise found scattered over the surface of the thallus; they are hemispherical prominent and have an apical porus. Tetrasporangia and cystocarps occurred in the month of March.

At the islands this species has been found in deep sea only (about 12—15 fathoms); according to Berthold*) and Kuckuck (l. c., p. 218—19) it occurs too in shallow water in the Mediterranean Sea. But it is also found there in deeper water, and Rodriguez**) found it even at a depth of 130 m at the Baleares.

Fig. 380. *Chrysymenia Enteromorpha* Harv. (about natural size).

St. Jan: In many places in the sound between this island and St. Thomas and in the sea to the north of St. Jan.

Geogr. Distrib.: Mediterranean Sea, Morocco.

4. Chrysymenia Enteromorpha Harvey.

Harvey, Nereis Bor.-Americana, Part II, p. 187. F. Børgesen, W. I. Florideæ, II, p. 185. J. Agardh, Epicrisis, p. 325.

Of this fine plant (Fig. 380) I have found a few specimens in deep water. They reached a length of more than ten cms (in the biggest specimen collected the basal part was absent). As described by Harvey, the plant, to begin with, consists of a single saccate oblong frond, two—three cms. long which at its base tapers into a short stalk ending in a small disc, by means of which the plant is fastened to the substratum. From this primary sac similar, often narrower and longer, secondary sacs are issued in all directions, and these are again ramified in the same way and so on

*) Berthold, G., Über die Vertheilung der Algen in Golf von Neapel etc., p. 526.

**) Rodriguez, J., Algas de las Baleares, p. 254.

(Fig. 381). At their base the sacs taper considerebly to an almost acute point, while their summits are broadly rounded. The sacs are nearly cylindrical, sometimes somewhat flattened.

The wall is rather thin. It consists of a single layer of large cells which, above their transverse walls, are covered by a layer of cortical cells (Fig. 381 *E*). These are largest just over the transverse walls of the large cells growing smaller from here, leaving the middle of the large cells uncovered. Seen from above this arrangement gives the membrane a very fine, reticular appearance.

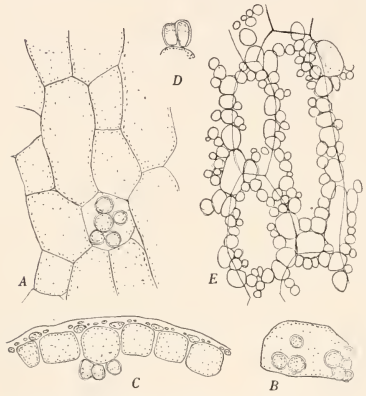

Fig. 381. *Chrysymenia Enteromorpha* Harv. *A*, wall-cells facing the cavity, the one near the middle with a group of glands (70:1); *B*, a cell with glands (70:1); *C*, transverse section of the wall, one of the cells with glands (70:1); *D*, glands (70:1); *E*, part of the wall seen from above (compare the text) (125:1).

A transverse section shows the wall-cells to be roundish-rectangular (Fig. 381 *C*); seen from above they are irregularly polygonal or oblong, two—three times as long as they are broad (Fig. 381, *A*).

On the innerside facing the cavity one of the large cells bears now and then glands (Fig. 381 *A*, *C*). These are obovate-oval to pyriform, when seen from the side, and of rather variable size. They occur scattered or in small groups upon the surface of the mother-cell (Fig. 381 *B*). A number of ten or more can be found upon the same cell.

At the constrictions between the sacs there is a tissue consisting in the middle of very large cells covered by smaller ones (Fig. 382 a). From the large cells some small ones forming shorter chains protrude into the cavity of the vesicles. In the upper end of these cell-chains glands sometimes are found. Similar short chains of cells have been observed by Kuckuck in *Chrysymenia microphysa*.

Plants with tetraspores did not occur in my material. But

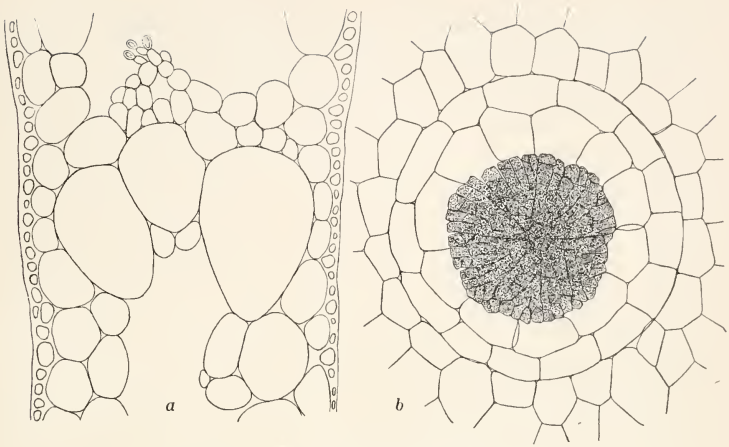

Fig. 382. *Chrysymenia Enteromorpha* Harv.
a, transverse section of the constriction between the sacs (about 80:1);
b, a cystocarp seen from above (about 80:1).

in the "Phycotheca Bor.-Am.", No. 386, a tetrasporic specimen from Key West is found. The tetraspores are scattered over the whole surface of the thallus in the cortical layer and are cruciately divided.

Of a female plant a fragment only was gathered. The cystocarps are scattered over the surface of the thallus; they are hemispherical prominent and provided with an apical porus. Fig. 383 shows a longitudinal section through the middle of a nearly ripened cystocarp; in the middle the placental branch is seen from which the gonimoblasts are formed. Seen from above the cystocarps form spherical bodies (Fig. 382 *b*).

Fig. 383. *Chrysymenia Enteromorpha* Harv. Longitudinal section through the middle of a cystocarp (about 70:1).

This plant was dredged

in deep water (about 12—15 fathoms). Cystocarps were found in the month of March.

St. Jan: Off Cruz Bay, off America Hill.
Geogr. Distrib.: Key West.

5. Chrysymenia pyriformis Børgs.

F. Børgesen, W. I. Florideæ, II, p. 187 (Botanisk Tidsskr. vol. 30, 1910, p. 187).

The plant (Fig. 384) reaches a height of about $4^1/_2$ cm (the largest specimen collected, the smaller ones were about two cm only). It is fastened to the substratum, stones, shells etc., by means of a rather large, flat disc; from this disc, one or more, erect shoots grow up. The stem of these erect shoots is terete and solid. It bears the swollen, hollow and short shoots (Fig. 385). The shape of these is obovate-pyriform reaching a length of about 8 mm and a breadth of 5 mm.

Fig. 384. *Chrysymenia pyriformis* Børgs. About natural size.

The plant is, when living, somewhat translucent. The colour is red with a yellow-brown tinge. With the exception of the stem, which is firmer, it is of a rather soft and slimy consistency and adheres strongly to the paper.

As to the anatomy of the thallus, we find the wall of the vesicles consisting of a layer of large cells (Fig. 386 *A*) which on their outer side are covered more or less completely by a layer of small cells (Fig. 386 *B*). Seen from the surface the innermost large cells show themselves to be roundish polygonal (Fig. 386 *B*, *C*). Above the transverse walls of the large cells, where some more space is left on account of the somewhat curved surface of these cells, we find a row of roundish cells and from these again smaller and smaller roundish cells grow horizontally out over the surface of the large wall-cells (Fig. 386 *B*). In younger vesicles

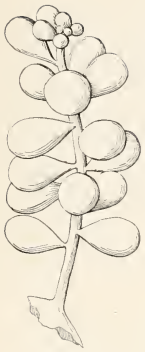

Fig. 385. *Chrysymenia pyriformis* Borgs. A little magnified (about $1^1/_4$:1).

this cortical layer leaves a space free over the middle of the large cells, while in older vesicles the cortical cells very often cover them completely. The wall of the vesicles is about 90 μ thick. The cavity in the interior is filled with mucilage.

A transverse section of the solid stem (Fig. 387) shows great likeness to that of *Chrysymenia microphysa* Hauck as drawn by Kuckuck (l. c., p. 210). The cells are largest in the middle, decreasing gradually towards the periphery.

On the inner side of the large cells, facing the cavity in the interior of the vesicles, we find here and there groups of gland-cells (Fig. 386 *A*, *C*). These are pear-shaped, occurring from two to about eight together in a bunch. Sometimes, too, a solitary gland-cell is present. The cells bearing the gland-cells are mostly smaller than the surrounding cells.

Only sterile plants have been gathered.

Compared with *Chrysymenia microphysa* Hauck — of which we have a detailed description since I described this species by the late Prof. Kuckuck — our plant differs essentially by its larger size, larger and differently shaped vesicles of which the Mediterranean plant mostly bears but a single terminal one upon each stem. Furthermore, glands are not found in the Mediterranean plant. Of the hitherto known *Chrysymenia*-species in the West Indian waters this plant comes, as I have already

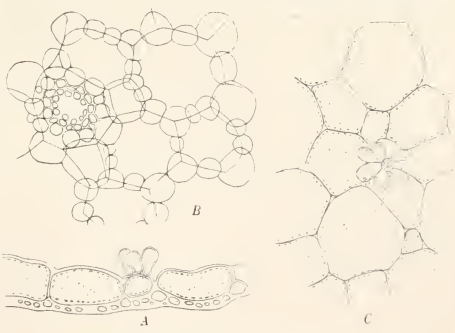

Fig. 386. *Chrysymenia pyriformis* Borgs. *A*, transverse section of the wall, in the middle a cell with glands (70:1). *B*, part of the wall seen from the surface (70:1). *C*, large cells of the wall facing the cavity, one of the cells with glands (70:1).

pointed out, nearest to *Chrysymenia Uvaria*. But among other characters, e. g. the small size of the thallus in comparison with that of *Chr. Uvaria*, it is easily distinguished from this species by the pear-shaped vesicles, in *Chr. Uvaria* nearly spherical, and by the fact that the vesicles are larger in *Chr. pyriformis*. In the anatomical characters also, for instance in the shape and occurrence of the glands, a great difference may be seen when comparing the descriptions and figures of both species.

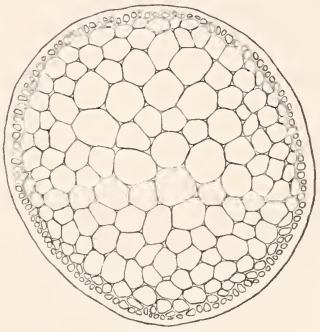

Fig. 387.
Chrysymenia pyriformis Borgs.
Transverse section of the stem.
(About 65:1)

This species was dredged in deep water only, at about 15—16 fathoms.

Found in the sea to the north of St. Jan: off. America Hill west of Thatch Island.

Geogr. Distrib.: Found at the Bermuda Isles by Collins.

6. Chrysymenia Uvaria (L.) J. Ag.

J. Agardh, Algæ maris Mediterranei et Adriatici, p. 106; Epicrisis, p. 324; Florideernes Morphologi, tab. XVI, figs. 20—22. Harvey, Nereis Bor.-Americana, Part II, p. 191, pl. XX, B, figs. 1—3. Børgesen, F., W. I. Florideæ, II, p. 189. Kuckuck, P., Untersuchungen über Chrysymenia (Beitr. z. Kentn. d. Meeresalgen, 13, p. 214, pl. 13, figs. 14—15).

Fucus Uvarius L., Syst. Nat., 1767, II, p. 714.

Gastroclonium uvaria Kütz., Spec. Alg., p. 865; Tab. Phycol., vol. XV, tab. 97.

As pointed out by Kuckuck, the West Indian plants attain a much larger size than those found in the Mediterranean Sea. Several of my specimens reach a height of up to 20 cms. The American specimens are proportionally more slender than those from the Mediterranean Sea, and the distance between the vesicles is mostly larger.

As to the anatomy, the wall of the vesicles consists inwardly towards the cavity of larger cells, and of smaller outwardly (Fig. 388 *A*). The cortical layer is dense (Fig. 388 *C*); covering the underlying large cells completely. The large cells are, when

seen from above, polygonal (Fig. 388 *B*), in transverse section roundish-oblong.

Towards the cavity in the interior of the vesicles the large cells (about a third part of them) bear here and there gland-cells, which are rather regularly distributed (Fig. 388 *B*). They are nearly always solitary, a single one in the middle of each cell; a few times I have found two, but distinct glands, upon the same cell. The glands are nearly spherical. According to KUCKUCK the glands do not occur in the Mediterranean plants or are at any rate very rare.

In a specimen from Ajaccio, Corsica, which I gathered there in November 1897, I found glands rather abundantly; they were larger than those of the West Indian form, of oval to oblong shape, and occurred singly, but mostly quite near the cross-walls of the large cells.

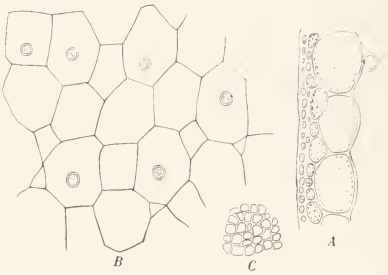

Fig. 388. *Chrysymenia Uvaria* (L.) J. Ag. *A*, transverse section of the wall, the uppermost of the large cells facing the cavity with a gland (70:1); *B*, large cells, facing the cavity. some of these with glands (70:1); *C*, part of the cortical layer seen from above (150:1).

Transverse sections and longitudinal sections of the massive stem of the West Indian plant seem quite to agree with KUCKUCK's description.

The above mentioned differences, regarding not only the external appearance of both plants but also their anatomy, show that the American plant does not exactly agree with the Mediterranean. I propose to call the American plant var. *occidentalis*, the differences between them not being of such importance that a specific distinction seems necessary.

All my material was sterile, but KUCKUCK gives fine illustrations of a part of a tetrasporic plant and of a transverse section of a cystocarp.

At the islands the plant was found in deep water only, at a depth of about 12—15 fathoms, while in the Mediterranean sea it is also found in shallow water.

St. Jan: In the sound between this island and St. Thomas and in the sea to the north of this island.

Geogr. Distrib.: West Indies, Morocco, Mediterranean Sea, Canary Islands.

Coelarthrum Børgs.

1. Coelarthrum Albertisii (Piccone) Børgs.

Børgesen, F., some new or little known West Indian Florideæ, II (Bot. Tidsskr., vol. 30, p. 189, 1910).

Chylocladia Albertisii Piccone, Crociera del "Corsaro" alle Isole Madera e Canarie del Capitano Enrico d'Albertis, p. 37, tab., fig. 3—5, 1884.

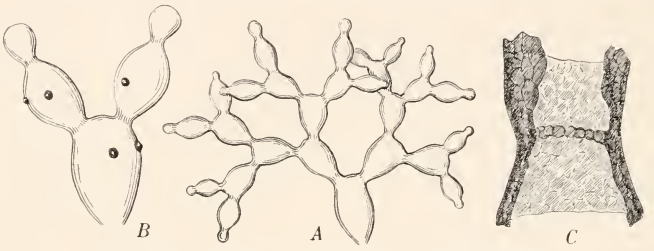

Fig. 389. *Coelarthrum Albertisii* (Piccone) Børgs.
A, part of a plant (about natural size); *B*, part of a female plant (about 2:1); *C*, transverse section showing the diaphragm between the joints (10:1).

As mentioned in my former paper this plant was at first found at the Canary Isles by Piccone and described by him as *Chylocladia Albertisii*. Referring to my above quoted paper with regard to my reasons for considering this plant a representative of a new genus, I shall here restrict myself to a short description of the plant.

Coelarthrum Albertisii forms small bushes about 4—5 cm high. The thallus is nearly terete, articulate, hollow, repeatedly dichotomously ramified (Fig. 389 *A*). The joints are largest in the basal part, in my specimens oblong obovate of shape, about 1 cm long and $^1/_2$ cm broad; upwards the joints become gradually smaller and nearly spherical. Between the joints diaphragms are present dividing the cavity in the interior into as many compartments as there are joints (Fig. 389 *C*, 390 *A*).

The membrane consists of a layer of rather large cells oblong—rectangular when seen from the surface (Fig. 390 *D*, *E*), more roundish-quadrangular in transverse section (Fig. 390 *A*, *B*, *C*.)

Towards the surface these cells are covered by a cortical layer, this consists of oval—roundish cells forming a more or less dense cover. Above the cross-walls of the cells, where these,

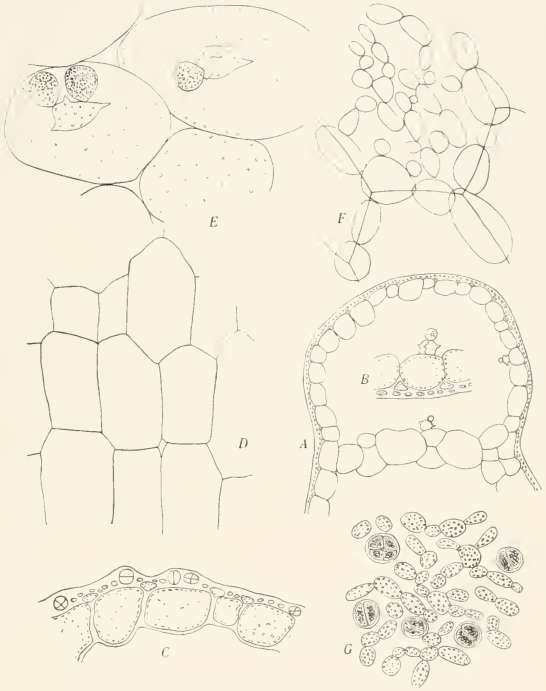

Fig. 390. *Coelarthrum Albertisii* (Piccone) Borgs.
A, transverse section of a joint at the apex of the thallus (about 10:1); *B*, *C*, transverse sections of the wall, *B* with a gland, *C* with tetraspores (70:1); *D*, large cells of the wall seen from the inner side (70:1); *E*, do. with glands (150:1); *F*, the wall seen from the surface showing also the underlying cells (150:1); *G*, part of the cortical layer with tetraspores (150:1).

because of their roundish shape, leave some space open, some larger cells are found (Fig. 390 *F*) and from these larger cells smaller ones are given off growing out over the surface of the large wall-cells.

The diaphragms consist of a single or two layers of cells ac-

cording to the dimensions of the cells. Here and there, towards the cavity in the interior of the thallus, some of the cells in the membrane and diaphragms bear some smaller, irregularly stellate cells provided with shorter or longer prolongations (Figs. 390 *A*, *B*, *C*). Some of the prolongations of these cells are connected with the adjacent cell as seen in Fig. 391.

Upon the stellate cells one or, more rarely two nearly globular or short pyriform glands occur (Figs. 390 *E*, 391).

I have found only tetrasporic plants. The tetrasporangia

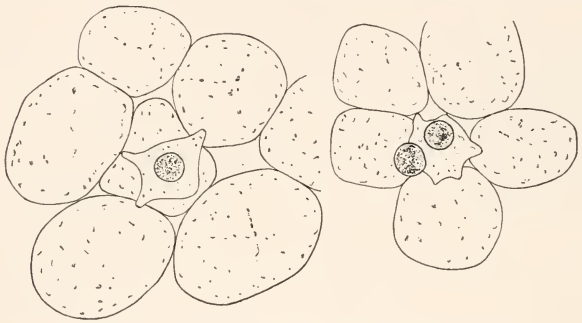

Fig. 391. *Coelarthrum Albertisii* (Piccone) Borgs.
Membrane-cells from the inner side with stellate cells and glands.
(About 275:1).

are formed in the cortical layer and are cruciately divided (Fig. 390 *G*). Their diameter reaches a length of about 25 μ. The tetrasporic plants were gathered in the month of March.

The cystocarps occur, according to a specimen from Guadeloupe collected by Schramm, scattered over the thallus (Fig. 389 *B*); they are hemispherically prominent and provided with a small apical porus.

At the islands this plant has been dredged only once in the sea to the north of St. Jan: off America Hill west of Tortola. I discovered it in a collection of several living algæ which Dr. Th. Mortensen, visiting the islands for zoological investigation, most kindly sent to me. It was dredged in deep water (about 15 fathoms) in rather open sea.

Geogr. Distrib.: Canary Islands, Guadeloupe, Bermuda.

Champia Desv.

1. Champia parvula (Ag.) Harv.

Harvey, W. H., Nereis Bor.-Am., part II, p. 76. J. Agardh, Epicrisis, p. 303. Farlow, W. G., The marine Algæ of New England, p. 156, pl. XV, figs. 2—5. De-Toni, G. B., Il genere Champia Desv. (Memorie d. Pont. Accad. del Nuovi Lincei, vol. XVII, Roma 1900, p. 11).

Chondria parvula Ag., Systema, p. 207.

Gastridium parvulum Grev., Alg. Brit., p. 119.

Chylocladia parvula Hook., Brit. Flora, II, p. 298. Harvey, Phycolog. Brit., tab. 210.

Lomentaria parvula Kütz., Spec. alg. p. 864; Tab. Phycol., vol. XV, tab. 87; J. Agardh, Spec. Alg. II, p. 729.

Fucus kaliformis, γ *nanus* Turner, Fuci, p. 61.

For more synonyms compare De-Toni, Sylloge Alg., vol. IV, part II, p. 558.

Many investigators have been engaged upon the examination of this plant; I mention below the chief authors and their papers.

Berthold[1]) in his useful treatise has given some short notes on this alga, but Debray[2]) and Bigelow[3]) were the first to give a more detailed description of the structure of it. Their papers were worked out quite independently of each other at about the same time. A few years later, in 1890, Debray published a "2me Mémoire", Sur la structure et le développement des Chylocladia, Champia et Lomentaria[4]) in which he amplifies his former paper. Later on Davis[5]) has given a detailed description of the development of the frond of *Champia* from the carpospore, and in the same year Hauptfleisch[6]) gives, besides a short description of the vegetative structure of

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[1]) Berthold, G., Beiträge zur Morphologie und Physiologie der Meeresalgen. (Jahrb. für wissensch. Botanik, Bd. 13, 1882, p. 686).

[2]) Debray, F., Recherch. sur la structure et le développement du thalle des Chylocladia, Champia et Lomentaria (Bullet. scient. départem. du Nord, 2° série, No. 718, Paris).

[3]) Bigelow, R. P., On the structure of the frond in Champia parvula Harv. (Proceed. Amer. Acad. of Arts & Sciences, 1887, p. 111).

[4]) In Bulletin Scientifique de la France et de la Belgique, tome 22, 1890).

[5]) Davis, B. M., Development of the frond of Champia parvula, Harv. from the carpospore (Annals of Botany, vol. 6, 1892, p. 339).

[6]) Hauptfleisch, P., Die Fruchtentwickelung der Gattungen Chylocladia, Champia und Lomentaria (Flora, vol. 75, 1892, p. 307).

the plant, a description of the development of the cystocarp. And finally, in 1896, DAVIS[1]) published a paper in which he gives a very detailed description of the development of the cystocarp in *Champia parvula*.

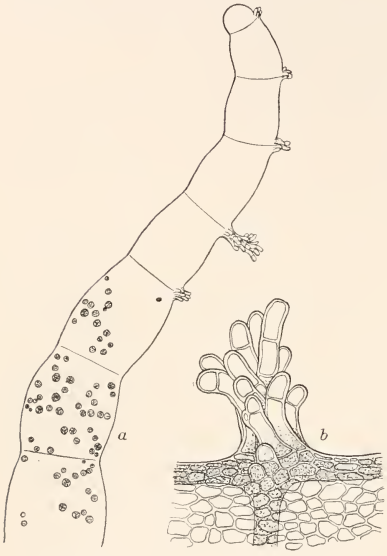

Fig. 392. *Champia parvula* (Ag.) Harv. *a*, part of a creeping filament with rhizoids and tetrasporangia (about 22:1); *b*, one of the bundle of rhizoids more magnified (about 60:1)

Referring to these examinations with regard to the structure and development of the plant, I shall only mention here that I have often found the plant creeping on the leaves of *Thalassia* as well as on larger algæ, for instance, *Udotea Flabellum* or *Halimeda*. The filaments are more or less decumbent and, from the nodes on that side of the filaments facing the hostplants, groups of surface cells grow out forming short hapters by means of which the plant attaches itself to the substratum (Fig. 392).

The tetraspores are formed in the peripheral layer in broad belts comprising several joints, generally rather close to the apex of branches (Fig. 392).

The antheridial stands (Fig. 393) form small roundish patches which often cover several coherent joints rather densely; sometimes the whole upper part of a branch is covered. DAVIS has l. c., 1896, pl. VII, fig. 1 figured a part of a male plant in which these often large zones of antheridial stands are seen.

A few young female plant have also been found; the cysto-

[1]) DAVIS, B. M., Development of the cystocarp of Champia parvula (Bot. Gazette, vol. 21, 1896, p. 109).

carps occur scattered, solitary or a few together upon the same joint. Davis has l. c. described their development.

This plant was found with tetraspores in the months January to March and with antheridia and cystocarps once in February.

It occurred in shallow water both in sheltered and in more exposed localities and in deep water down to a depth of about 20 fathoms. In deep water and in sheltered localities, for instance in lagoons, the plant is slender and the joints rather long, in more exposed places it is more robust with short joints.

St. Croix: Christianssted's Lagoon, Christianssted's Harbour, off Frederikssted, Krause's Lagoon. St. Jan: Off America Hill, off Ramshead.

Geogr. Distrib.: Warmer parts of the North-atlantic European and American coasts, Mediterranean Sea.

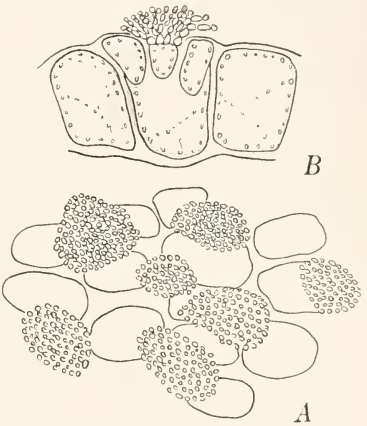

Fig. 393. *Champia parvula* (Ag.) Harv. *A*, part of the wall seen from above and *B*, transverse section of the wall of a male plant (350:1).

2. Champia salicornoides Harvey.

Harvey, W. H., Nereis Bor.-Am., p. 76, tab. XIX B. Agardh, J., Epicrisis, p. 305.

This species bears a rather close resemblance to *Champia parvula* not only with regard to its outer habit, but also in its anatomy. Bigelow has pointed this out in his paper quoted above on p. 118. But *Champia salicornoides* is a much bigger plant and when examined more thoroughly, some anatomical differences also become apparent.

The peripheral wall of the frond consists of a single layer of cells, seen from above rectangular—polygonal, about $1^1/_2$ to 2 times as long as broad; in transverse section the cells are nearly square-shaped. The cells have a rather thick peripheral wall which swells greatly in water. The diaphragms between the joints of the thallus consists of a single layer of cells of irregular, polygonal

shape when seen from above (Fig. 394 *A*), more rectangular in transverse section (Fig. 394 *B*).

On the inner side of the wall we find the vertical filaments (Fig. 394 *B*, *D*). These are often in quite close connection with the wall-cells, sometimes even somewhat immersed in their thick membrane (Fig. 394 *C*). The filaments run from the apex of the branches to the bottom and pass through the diaphragms (Fig. 394 *A*, *B*). The cells of the filaments are about 16 μ thick and

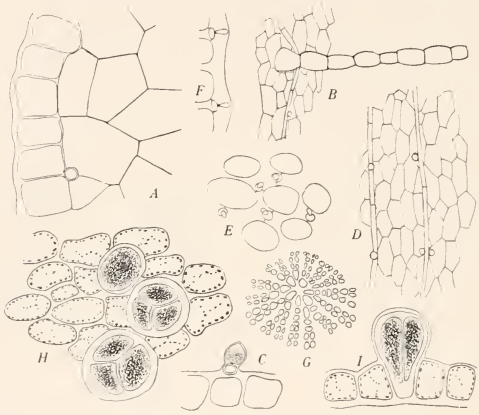

Fig. 394. *Champia saticornoides* Harv.
A, transverse section of the wall (to the left), to the right part of the diaphragm seen from above (50:1); *B*, transverse section of the diaphragm, to the left with a part of the wall (30:1); *C*, transverse section of the wall and a filament with a gland (50:1); *D*, the wall seen from the inner side with filaments (30:1); *E*, wall-cells with glands seen from above (150:1); *F*, part of the same in transverse section (150:1); *G*, apex of a branch seen from above (150:1); *H*, part of the wall with tetraspores (50:1); *I*, tetraspore in transverse section (50:1).

about ten times as long. They bear one, or sometimes, two opposite gland-cells placed about the middle of the cell. The glands are nearly spherical or somewhat ovate (Fig. 394 *C*). As a rule the filaments are not ramified, but once a side-branch was found connecting the filament with one of the adjacent filaments.

Among the larger wall-cells some smaller ones, rather regularly distributed, are generally present (Fig. 394 *E*); like the large cells the small ones, too, are connected by means of pores with the

adjacent cells. These small cells are mostly rather flat and from their upper (outer) side a small oblong cell merges vertically into the thick peripheral wall (Fig. 394 *F*). These cells are formed very early together with the other large cells and are already observable in the quite young parts of the thallus, and they are easily recognizable by means of their homogenous and more refractive contents. When treated with Chlor-Zinc-Iodine they are coloured yellow like the large wall cells and treated with Hæmatoxylin they assume also nearly the same tinge of colour as these. Most probably, as I have already pointed out in my above quoted paper, we have to do with a kind of gland-cells from which is secreted the mucilage in which the living plant, as far as I remember, is mostly imbedded.

The apical growth of the plant seems to agree fairly well with that of *Champia parvula* as described by Bigelow.

As I have pointed out already in my paper mentioned above I cannot agree with Bigelow when he says that "the branches in *Champia salicornoides* do not come off at the nodes, but may spring from any part of the internodes"; in my specimens the branches always issue at the diaphragms.

The tetrasporangia are formed in the wall in the following manner. A small cell is cut off now and then from one of the larger cells. This becomes to a great extent filled with contents and gradually increasing in size becomes the mother cell of the tetrasporangium. The tetrasporangia occur scattered over the whole surface of the branches; a transverse section shows that more than half their length emerges into the cavity of the joints.

The cystocarps are rather prominent, urn-shaped and occur scattered over the surface of the thallus.

Among the dried specimens a single male plant was found. The antheridial stands are very like those in *Champia parvula* and occur over the whole surface of the plant.

Farlow and later on De-Toni in his paper: "Il genere Champia Desv." have considered this species only as a variety of *Champia parvula.* As mentioned above *Champia salicornoides* certainly is closely related to *Champia parvula.* But *Champia salicornoides* is a much larger plant, and the arrangement of the tetrasporangia is not the same and some anatomical differences are also present, for instance there are several more vertical filaments in this

species than in *Champia parvula*, and the filaments have more cells in each joint than in *Ch. parvula.*

Plants with tetraspores and cystocarps were found in the month of March; antheridia in January. It was gathered mostly in deep water (about 14—15 fathoms), once in shallow water near the shore in a rather protected place.

Found at St. Jan. in several places in the sound between this island and St. Thomas, near Mary Bluff (by Dr. Th. Mortensen), off America Hill, Coral Bay.

Geogr. Distrib.: Florida.

List of the *Chlorophyceæ, Phæophyceæ* and *Rhodophyceæ* found at the islands together with addenda and corrections.

Chlorophyceæ.

1. **Enteromorpha flexuosa** (Wulf.) J. Ag.
2. — **chætomorphoides** Borgs.
3. — **lingulata** J. Ag.
4. — **plumosa** Kütz.
5. — **clathrata** (Roth) Greville.
6. **Ulva Lactuca** L.
7. — **fasciata** Delile.
8. **Blastophysa rhizopus** Rke.

Besides the plant I previously found growing in *Nemalion Schrammi* I have now found it, once more, rather abundantly in *Dictyota indica*, where it occurred in the epidermal cell-layer together with *Phæophila Floridearum* and *Endoderma*.

Seen from above the cells are oval to oblong, but still many of them are of a very irregular shape (Fig. 395 *a*). The cells contain a great number af roundish or polygonal chromatophores, a pyrenoid being present in the middle of some of those. The cells are about 100 μ long and 50 μ broad.

Sometimes the cells lie quite closely together, sometimes with some distance between, being then connected with a shorter or longer tube (comp. Fig. 395 *a*, *b*); this is about 8—10 μ thick.

The hairs occur upon the external side of the cells in groups of about two to six; the hairs are about 3 μ thick.

Fig. 395 *c*, *d* shows tranverse sections of the epidermal cell-layer of *Dictyota* in between which the *Blastophysa* is seen immersed;

Fig. 395. *Blastophysa rhizopus* Rke.
a, seen from above. *b*, plant from near the margin of *Dictyota*.
c and *d*, transverse sections.
(About 200 : 1).

in the one figure two cells are seen lying below the epidermal cells of the *Dictyota*, in the other figure a single thicker cell is seen between the cells of the *Dictyota*.

The *Dictyota* was dredged in a depht of about 10 meters.

St. Croix: off Frederikssted.

9. Phæophila Floridearum Hauck.

Hauck, F., Verzeichnis der im Golfe von Triest gesammelten Meeresalgen (Oesterr. bot. Zeitschr., 1876, pp. 56,7). Huber, I., Contributions à la connaissance des Chaetophorées épiphytes et endophytes (Ann. sc. nat., 7. sér., bot., t. 16, p. 326, pl. XVI).

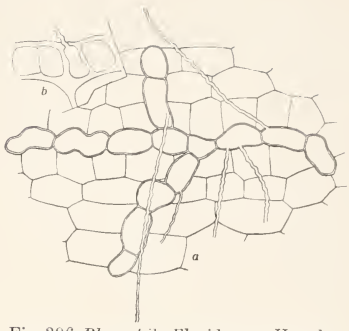

Fig. 396. *Phæophila Floridearum* Hauck. *a*, seen from above. *b*, transverse section. (About 200:1).

This plant has been found several times as an endophyte in different *Florideæ*, for instance in *Liagora pinnata*, *Laurencia Poitei*, *Griffithsia globifera* and *Champia parvula*.

Furthermore I have found this plant growing in the epidermal layer of *Dictyota indica* (Fig. 396). The cells reached a length of about 50 μ and a breadth of about 25 μ. The hairs are about 4 μ thick. The figure shows partly a piece of the plant together with the epidermal cell-layer of the host, partly a transverse section of the *Phæophila* immersed in the epidermal layer of the *Dictyota*.

St. Croix: off Frederikssted, Long Point, near Buck Island.

Geogr. Distrib.: Mediterranean Sea, Atlantic coast of Europe.

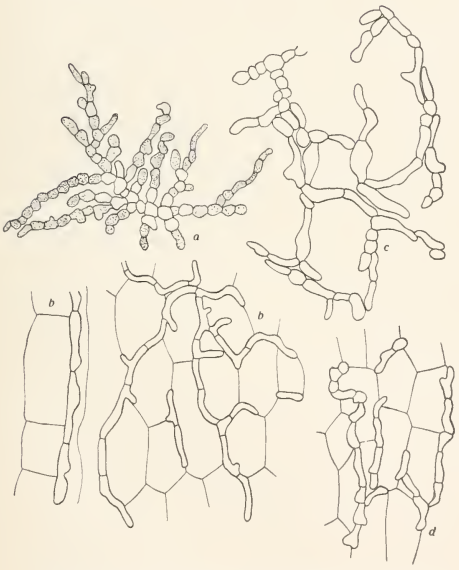

Fig. 397. *Endoderma viride* (Reinke) Lagerheim. *a*, plant from *Chrysymenia Agardhii*. *b*, from *Champia salicornoides*. *c*, from *Chrysymenia Enteromorpha*. *d*, from *Champia parvula*. (*a*, *b*, about 200:1; *c*, *d*, about 150:1.)

10. **Endoderma viride** (Reinke) Lagerh.

Once more I have found this plant upon *Chrysymenia Agardhii*. Several of the specimens had zoospores, a smaller or larger part of the cells in the middle of the plant being emptied. The Fig. 397 *a* shows such a plant. It was gathered in the month of January, and the host plant was dredged in deep water about 30 meter, at St. Jan: off America Hill.

In several other plants I have found forms of *Endoderma* which I think are referable to this species, even if they mutually show differences both as to the shape of the cells and as to their way of growing in the various host plants.

In a specimen of *Champia salicornoides* an *Endoderma* was found of which the Fig. 397 *b* shows a small piece. As is seen from the figure it forms a network composed of the jointed branching filaments which follow the outlines of the large wall cells of the host plant in a way very similar to that found in forma *Nitophylli* Cotton[1]). If we compare Cotton's figure 1 with my figure the likeness seems very striking. The diameter of the cells is about 3—6, the thickest cells reaching a breadth of up to 10 μ. The cells were crammed with starch, and the shape of the chromatophore was not recognizable. This plant was dredged in deep water about 15 fathoms in the Sound between St. Jan and St. Thomas: near Great St. James.

A very similar form was found in *Champia parvula*. Fig. 397 d shows a small piece of this *Endoderma*. The cells are a little shorter here, but the breadth of the cells are nearly the same as in the case of the form found in *Champia salicornoides*. It was dredged off Frederikssted, St. Croix, in a depth of about 10 meters.

In the epidermis of *Chrysymenia Enteromorpha* an other form (Fig. 397 *c*) was found which I think also can be referred to *End. viride*. It grows in a way similar to that of the above mentioned form following the outlines of the large membrane cells. It is a somewhat larger plant, its cells being from 6 to 14 μ broad. The shape of the cells is more irregular than in the former plant. In many of the cells the formation of zoospores was present and several cells were emptied of their contents. It was dredged off Cruz Bay, St. Jan, in a depth of about 12 fathoms.

[1]) Cotton, A. D., On some endophytic Algæ (Journ. of the Linnean Soc., Bot., vol. 37, 1906, p. 288, pl. 12).

Further, in the thick membrane of *Hypnea cornuta* an *Endoderma* occurred whose cells were subcylindrical or sometimes more irregular with small elevations. As large cells are not present in the cortical layer of the *Hypnea* the endophyte creeps everywhere at random, forming an irregular network by means of its filaments which are ramified on both sides. The cells were about 5—7 μ thick and up to 40 μ long. The *Hypnea* was found in the harbour of Charlotte Amalia, St. Thomas.

Fig. 398. *Endoderma viride* (Rke.) Lagerh. from the epidermis of *Dictyota indica*. (About 175:1.)

Furthermore an *Endoderma* (Fig. 398) was found in the epidermis of *Dictyota indica*. It is freely dendritically ramified with branches issuing from both sides of the filaments and spreading widely in the host, following mostly the way above the vertical walls of its peripheral cells. The cells of this *Endoderma* have more or less sinuate walls and reach a length of up to 30 μ and a breadth of up to 15 μ. The cells are filled with granular contents, rich in starch. In the cells one or two pyrenoids are present. This form was dredged off Frederikssted, St. Croix in a depth of about 10 fathoms.

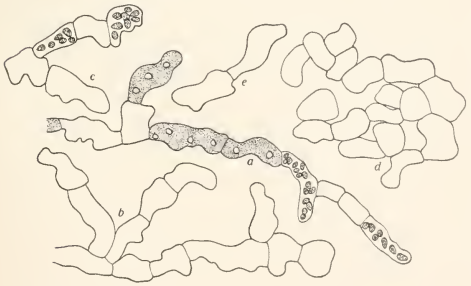

Fig. 399. *Endoderma viride* (Rke) Lagerh. Forma. Comp. text. (About 260:1.)

A very similar *Endoderma* was found in *Spyridia filamentosa* gathered at the shore of Green Cay Estate, St. Croix.

In an old *Caulerpa* another *Endoderma* was found of which the accompanying Fig. 399 shows some

filaments. As it is seen from the figure the irregularly branched filaments are composed of cells of rather varying shape. Near the apex of the filaments the cells are subcylindrical, but they soon obtain a very irregular shape often with several outgrowths and narrowings in between. In older parts of the plant the filaments are packed so closely together that they form an almost pseudoparenchymatous tissue (comp. Fig. 399 *d*). The cells are 8—11—14 μ sometimes up to 20 μ broad, and two to four times as long. They have a large parietal chromatophore with a few pyrenoids (1—3). All the cells may be transformed into zoosporangia. The zoospores escape by means of a hole in the cell-wall. I refer this *Endoderma*, as a forma *major*, to *E. viride*.

The *Caulerpa* was gathered in Christianssted's Lagoon, St. Croix.

11. **Endoderma vagans** nov. spec.

Thallus endophyticus, in membranis hospitis (*Griffithsiæ globiferæ*) valde circumvagabundus, e filamentis repentibus, articulatis, irregulariter ramosis compositus; cellulæ subcylindricæ, 5—13 μ latæ, diametro 2—4 plo vel ultro longiores, in media parte sæpe tumorem unilateralem vel rarius cellulam parvam gerentes; chromatophora parietalia, pyrenoideis pluribus instructa.

Zoosporæ numerosæ in cellulis vegetativis ortæ.

In the thick peripheral membrane of *Griffithsia globifera* a highly ramified *Endoderma* was found which I consider the representative of a new species (Fig. 400). In the specimen of *Griffithsia*, in which it was discovered, it was found in abundance and formed a reticular plate all round the cell of the host. In dried material the *Endoderma* had a clear green colour. Its cells are of very varying dimensions from 5 to 13 μ thick or more, and from 18 to more than 50 μ long. The shape of the cells is much varying, too; in most cases the cells are nearly cylindrical, or they may have an elevation on the one side, more seldom two opposite, one on each side. From this elevation a new branch frequently originates, but it may happen, that it is cut off by a wall, thus remaining as a small cell (Fig. 400 *a*).

The cells contain a large disc-formed chromatophore, covering nearly the whole lumen of the cell; in the chromatophore several pyrenoids (about 5—7) are present (Fig. 400 *c*, *d*). The

cells contain a great deal of starch and are coloured quite black by Iodine. A single nucleus is present in each cell.

In some of the cells zoospores were present (Fig. 400 *e*). The whole cell with its elevation is transformed into a sporangium. The zoospores are about 2 μ broad and 4 μ long with acute anterior end and broadly rounded dorsal end. They are formed in a number of about 15 in each cell, somewhat varying according to its size. The zoospores escape by means of a short channel

Fig. 400. *Endoderma vagans* nov. spec. Compare text.
(*a*, about 150:1, *b* and *e*, about 250:1, *c* and *d*, about 500:1.)

through the membrane of the host plant which is formed by the elevation of the cell. The cilia were not visible.

There is still to be added that now and then the contents of the small cells mentioned above were divided into several small narrow bodies lying above each other up to a number of 5—6 or more (Fig. 400 *c* and *d*). They were filled with starch, becoming very dark when coloured by Iodine. What their function was I cannot tell, having not been able to follow their development, for which purpose living material is necessary.

The *Griffithsia*, in which this plant occurred, was dredged in a depth of about five fathoms in the month of January.

St. Croix: Near Buck Island.

12. **Endoderma ventriculosum** nov. spec.

Endoderma endophyticum in membranis hospitis (*Chrysymeniæ Agardhii*) maculas largas formans; thallus e filamentis articulatis, longis, irregulariter subdistiche ramosis, undulatis compositus; rami angulo fere recto e filo materno oriuntur.

Cellulæ longæ, subcylindricæ, crassitudine variabili, in parte media inflatæ, 4—20 μ latæ, sæpe 70 μ longæ, chromatophorum parietalem, pyrenoideis instructum continentes. Sporangia non visa.

Fig. 401. *Endoderma ventriculosum* nov. spec. *a*, plant seen from above. *b*, transverse section through the host-plant with the endophyte. (*a*. about 150:1, *b*, 200:1.)

In the thick peripheral membrane of *Chrysymenia Agardhii* an endophytic, widely spreading plant (Fig. 401) of a very characteristic appearance was found, forming patches of great extensions in the host plant. This plant I think referable to the genus *Endoderma* as a new species.

In dried material the *Endoderma* was easily recognizable owing to its green coloured chromatophores, filling out the whole cell homogenuously. And, as to material preserved in alcohol, the plant in this case, too, when put into water and Iodine, was easily recognizable, the whole contents of the cells being coloured nearly black on account of the starch contained in the cells.

The plant consists of long cells of very irregular shape forming together highly ramified filaments. The apical cells are subcylindrical with obtuse summits and more or less undulated walls, but soon the cells swell in the middle, this swelling occupying nearly a third part of their whole length. Because of these swellings and, on the whole because of the very varying diameter of the cells, these being now thinner, now thicker and the undu-

lating shape of the cells, the filaments get a serpentine-like appearance.

The cylindrical part of the cells is about 4 μ thick, the swelled part often more than 20 μ. The cells reach a length of more than 70 μ.

The branches are mostly given off from the swelled parts of the cells, and it may happen that 3 to 4 branches issue from one and the same cell, this then becoming swelled and often very irregularly shaped through nearly its whole length. The ramification is rather irregular, but nevertheless a certain method is present, because a main filament is, as a rule, distinguishable, and from this branches are given off at about right angles on both sides. In this way the plant forms a reticular tissue with larger and smaller meshes all over the surface of the host.

The shape of the chromatophore was not to be seen with certainty in the material, but seems to be a parietal plate. There are several large pyrenoids in each cell; the cells contain much starch.

The *Chrysymenia*, in which it occurred, was dredged in about 15 fathoms of water.

St. Jan: off America Hill.

13. **Ulvella Lens** Crouan.
14. **Pringsheimia scutata** Reinke.
15. — (?) **Udoteæ** Børgs.
16. **Gomontia polyrhiza** (Lagerh.) Bornet et Flah.
17. **Chætomorpha clavata** (Ag.) Kütz.
18. — **antennina** (Bory) Kütz.
19. — **crassa** (Ag.) Kütz.
20. — **ærea** (Dillw.) Kütz.
21. — **brachygona** Harv.

Besides the above mentioned (vol. I, p. 18) detached form of this species I have found several fixed forms all characterized by proportionally short cells, but of rather varying diameter in the filaments; but, nevertheless, as it seems, closely connected. How far these forms are rightly referred to *Chætomorpha brachygona* I dare not say. A study upon living material of these forms, which in several respects bear a close resemblance to *Urospora*, would be highly interesting and instructive.

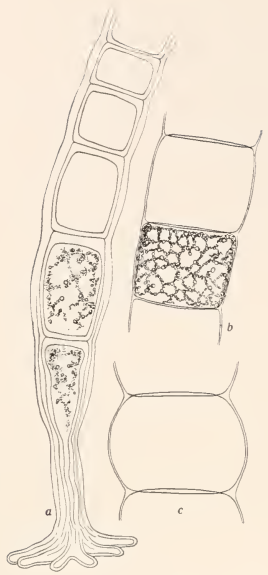

Fig. 402. *Chætomorpha brachygona* Harv. *a*, base of a plant. *b* and *c*, parts of the filament. (About 150:1.)

The figure 402 shows one of these forms. It is fixed to the rocks by means of a vigorous basal disc; the basal cell is long with thick and lamellated wall; it increases in size and is formed by the lowermost cells of the filament gradually growing downwards into the cell below, a well known fact described by Rosenvinge[1]). The cells in the filament varies in length from about half their diameter to about as long as broad; they are rarely longer, but it happens that cells occur about twice as long as broad. In this specimen the upper end of the basal cell is 67 μ broad; the vegetative cell in the filament are about 85 μ broad and the emptied zoosporangia up to 150 μ broad. But I may point out that the breadth of the filaments is very varying, even in the same filament; for instance was a filament in some parts 45 μ thick only, in others 95 μ, and thinner and thicker parts were found in between each other.

Another form is shown in Fig 403 *a*, *b*, *c*. This has also a vigorous basal disc formed by the through growing of the lowermost cells. The cells in the vegetative part of the filament are nearly as long as broad, shortly

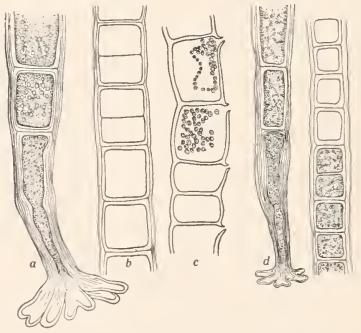

Fig. 403. *Chætomorpha brachygona* Harv. Two forms. Comp. text. (About 150:1.)

[1]) In »Botanisk Tidsskrift«, vol. 18, p. 65, 1892—93.

after division only half their length. The zoosporangia, have nearly the same shape, though often a little swelled in the middle. In this form the upper end of the basal cell is about 40 μ broad; the vegetative part of the filaments is 65 μ broad, and the sporangia 70 μ broad.

Parts of a very similar form is figured in Fig. 403 *d*, *e*. The vegetative cells in this plant reached a breadth of about 50 μ.

Finally in Fig. 404 *a*, *b* and *c*, *d* two more narrow forms are figured. Their vegetative cells vary in thickness from 35—45 μ. With the exception of those quite close to the base the cells in these forms are very short, often reaching not half their breadth.

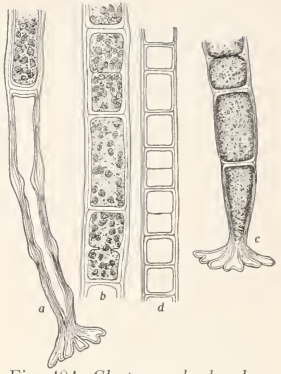

Fig. 404. *Chætomorpha brachygona* Harv. Two forms. Compare text. (About 200:1).

The specimens here described and figured are only to be considered as samples. Between them specimens may be found connecting them all gradually as to shape and size of the cells.

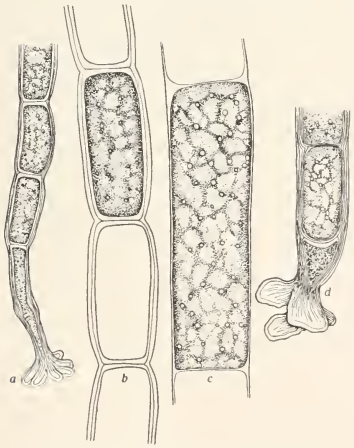

Fig. 405. *Chætomorpha gracilis* Kütz. *a*, *b*, *c*, parts of a filament. *d*, base of another plant. (About 150:1.)

These forms were all growing together in an exposed locality and found in company with *Enteromorpha plumosa*, *Pylaiella fulvescens* and the below mentioned *Rhizocloniums*.

St. Jan: Christiansfort on steep rocks facing the open sea at about high water mark or a little above.

22. **Chætomorpha gracilis** Kütz.

Besides the detached form mentioned in vol. I, p. 19 I have moreover found a fixed

form which I think referable to this species (Fig. 405). It was growing together with the above mentioned *Chætomorpha* forms.

It is fixed to the rocks etc. by means of a larger or shorter basal cell formed by throughgrowing of the lowermost cells. The cells in the vegetative part of the filaments are about 70—80 μ thick and two to four times as long. The zoosporangia are often a little swelled in their middle, about 85 μ thick and two to three times as long.

St. Jan: Christiansfort.

Rhizoclonium Kütz.

Upon steep rocks in an exposed place near high water mark or a little above some *Rhizoclonium* forms were found showing several peculiarities. They occured as parts of an interesting association of algæ, answering to the North-Atlantic *Bangia-Urospora* Association of the Færöes[1]) or the *Bangia-Urospora-Ulothrix* Association of Clare Island[2]). The members of the tropical association were: a small *Enteromorpha plumosa*, *Pylaiella fulvescens* and several species of *Chætomorpha* and *Rhizoclonium*.

Fig. 406. *Rhizoclonium Kochianum* Kütz. Different forms with bases of two plants. (About 260:1.)

It is a well known fact that the genus *Rhizoclonium* is especially characterized by the presence of lateral rhizoids occurring more or less abundantly, though sometimes nearly or quite wanting, and by the absence of the original basal end-rhizoid, this having been found a few times only.

In the present forms (compare figs. 406 and 407) all the many specimens examined had no lateral rhizoids at all and in most

[1]) Börgesen, F., The Algæ-vegetation of the Færöese coasts (Botany of the Færöes, Part III, 1905, p. 719).

[2]) Cotton, A. D., Marine Algæ, Clare Island Survey 15, p. 30. (Proceedings Royal Irish Acad., vol. 31, 1912).

of the specimens the original basal rhizoids were present, the plants being fixed by means of them to the rocks. Most probably the end-rhizoid had been cut off during the gathering in the specimens in which it was absent.

The basal rhizoid (comp. Fig. 406 and 407) is below broadened out to a small disc with irregular coralliform outline, and the base on the whole becomes gradually strengthened by means of throughgrowing of the lowermost cells in the filament down into the basal cell in a way similar to that known so well in *Chætomorpha*. This throughgrowing can take place in three to four of the basal cells, the lowermost cell in this way becoming rather long.

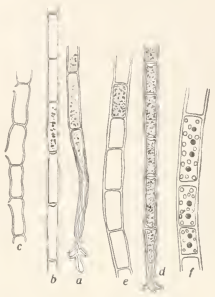

Fig. 407. *Rhizoclonium Kerneri* Stockm. Two forms with the original bases. (*a*—*e*, about 260:1; *f*. about 500:1.)

As already mentioned the original basal rhizoid in *Rhizoclonium* is very rarely found. Regarding *Rhizoclonium Kerneri* Stockm. Wille in "Studien über Chlorophyceen", VII, p. 41 writes, as follows, concerning the basal rhizoid: »Beim Keimen der Zoosporen bildet sich ein basales Endrhizoid (Taf. IV, Fig. 166—68); aber da sich die Fäden durch intercalare Teilungen und zufällige Zerreissungen sehr stark vermehren, so findet man Fäden mit Endrhizoid sehr selten. Inwiefern die Fäden ursprünglich festsitzen, kann ich nicht mit Sicherheit ausmachen, vielleicht darf die eigentümliche starke Verdickung an dem abgebildeten Rhizoid (Taf. IV, Fig. 168) als eine abnorme Entwickelung gedeutet werden, indem sie keine Gelegenheit gehabt hatte sich zu befestigen, da dieses Exemplar nur loose zwichen den übrigen Fäden hing«. Regarding the presence of basal rhizoids in my specimens no doubt is possible. They were vigorously developed and present in all the specimens. As the plants have no other rhizoids to fix themselves with they would immediately have been washed away by the waves, if they had not been fixed by the basal rhizoids.

The filaments increase by means of intercalary divisions of the cells, these being divided when they have reached a certain length.

The cells contain a very irregularly shaped chromatophore of a reticular spongy appearance with smaller and larger openings. Often it fills up the whole lumen of the cell so densely that it is impossible to see its shape. In the chromatophores a large number of pyrenoids are present, distributed regularly in the cells. The cells contain, according to their size, one to four nuclei.

With Iodine and Chlor-Zinc-Iodine the chromatophores are coloured black showing that much starch is present. With the last mentioned chemical the walls of the cells do not show the cellulose reaction, the wall, just as when treated with Iodine alone, getting a light yellow tinge.

In the upper end of the filaments the cells gradually are transformed into zoosporangia; the zoospores escape through an opening in the wall of the cells. In accordance with the description of WILLE this opening occurs a little above or below the middle of the cell, and the place, where it will come into existence, is beforehand marked by an outgrowth of the wall.

To point out any differences between these affixed forms of *Rhizoclonium*, as are described above, and *Chætomorpha* seems nearly impossible, and STOCKMAYER, too, has already mentioned this difficulty in his monograph of the genus *Rhizoclonium*, and that in spite of the fact that he did not know such forms fixed by the original end-rhizoid. Should I try to mention some differences between such forms of *Rhizoclonium*, as are mentioned above, and *Chætomorpha* I think the most essential differences are, besides the lesser dimension of the filaments, that the filaments of *Rhizoclonium* are mostly quite cylindrical, in *Chætomorpha* mostly moniliform, that the cells of *Rhizoclonium* are mostly proportionally longer and have thicker walls than those of *Chætomorpha*, that now and then in the filaments of *Rhizoclonium* a thickening of the wall is found round above the cross-wall between the cells (comp. Fig. 406 *h*) while in *Chætomorpha* the filaments are narrowed here. Characteristic of *Rhizoclonium* is also a kneelike bending (comp. STOCKMAYER, fig. 4, pag. 576) found now and then in the filaments. On the whole the appearance of a *Rhizoclonium* filament is rather like a *Conferva*, but the structure of the wall is quite different. Regarding the chromatophore its reticular structure is more easily seen in *Chætomorpha* than in *Rhizoclonium* in which the dense clumsy-spongy structure mostly makes it very indistinct.

The above mentioned non-colouring of the wall of *Rhizoclonium* with Chlor-Zinc-Iodine is of no use as a means of distinction, as the wall of *Chætomorpha*, too, does not show the common reaction of cellulose.

Finally I agree absolutely with Stockmayer when he recommends to study these plant upon living material.

Among the fixed forms I think the two forms mentioned below may be distinguished.

23. **Rhizoclonium Kochianum** Kütz.

Fig. 406 *a*, *b*, *c*, shows a form in which the cells are from nearly as long as broad up to $2^1/_2$ times as long; their diameter varies from 13 to 20 μ in length.

The zoosporangia are a little thicker, about 25 μ.

Another form is figured in Fig. 406 *d*, *e*, *f*, *g*. It is a little thicker than the above described plant, its vegetative cells reaching a breadth of about 20 μ, the length of the cells up to 62 μ. The zoosporangia are about 35 μ thick.

St. Jan: Christiansfort.

24. **Rhizoclonium Kerneri** Stockm.

Some other of the fixed forms I prefer to refer to this species which is characterized by its somewhat longer cells.

Fig. 407 *a*, *b*, *c* shows one form whose vegetative cells are about 10 μ thick and 40 μ long. It is fixed to the rocks by a long rhizoid formed by throughgrowing of three cells.

The zoosporangia are often a little narrowed in their middle, about 13 μ thick.

Another form with somewhat shorter cells is figured in Fig. 407 *d*, *e*. The vegetative cells are about 12 μ broad and two to four times as long.

St. Jan: Christiansfort.

25. **Cladophora uncinata** Børgs.
26. — **corallicola** Børgs.
27. — **fuliginosa** Kütz.
28. — **utriculosa** Kütz.

Kützing, Phycologia generalis, p. 269; Species Alg., p. 393; Tabulæ Phycologicæ, vol. 3, tab. 94, fig. 1. Hauck, Meeresalgen. p. 454.

A small tuft of this plant was found in termingled between several other algæ. The cells in the basal part were about 150 μ thick and up to ten times as long, upwards gradually shorter and thinner, the cells in the upper ramuli being only about 70 μ thick and a few times longer.

Found in shallow water, near the shore in a rather unprotected place.

St. Croix: Coakley Bay.

29. **Cladophora fascicularis** (Mert.) Kütz.
30. — **crispula** Vickers.
31. — **heteronema** (Ag.) Kütz.
32. **Anadyomene stellata** (Wulf.) Ag.
33. **Microdictyon umbilicatum** (Vell.) Zanard.
34. **Valonia ventricosa** J. Ag.
35. — **macrophysa** Kütz.
36. — **utricularis** (Roth) Ag.
37. — **Ægagropila** C. Ag.
38. **Dictyosphæria favulosa** (Ag.) Decsne.
39. — **van Bosseæ** Børgs.
40. **Cladophoropsis membranacea** (Ag.) Børgs.
41. **Boodlea Siamensis** Reinb.
42. **Struvea elegans** Børgs.
43. **Struvea anastomosans** (Harv.) Piccone.
44. **Chamædoris Peniculum** (Sol.) O. Kuntze.
45. **Siphonocladus tropicus** (Crouan) J. Ag.
46. **Ernodesmis verticillata** (Kütz.) Børgs.
47. **Neomeris annulata** Dickie.
48. **Batophora Oerstedi** J. Ag.
49. **Acetabularia Caliculus** Quoi et Gaimard.
50. — **crenulata** Lamx.
51. **Acicularia Schenckii** (Möb.) Solms.
52. **Avrainvillea nigricans** Decsne.
53. — **Mazei** Murray & Boodle.
54. — **Geppii** Børgs.
55. — **asarifolia** Børgs.
56. **Rhipilia tomentosa** Kütz
57. **Cladocephalus luteofuscus** (Crouan) Børgs.
58. **Penicillus capitatus** Lamarck.

forma *typica*.

— *laxa*.

59. **Penicillus Lamourouxii** Decaisne.
60. — **pyriformis** A. and E. S. Gepp.
forma *typica*.
— *explanata*.
61. — **dumetosus** Blainville.
62. **Udotea conglutinata** (Ell. et Sol.) Lamx.
63. — **cyathiformis** Decsne.
64. — **spinulosa** Howe.
65. — **occidentalis** A. and E. S. Gepp.
66. — **verticillosa** A. and E. S. Gepp.
67. — **Flabellum** (Ell. et Sol.) Howe.
68. **Halimeda Tuna** (Ell. et Sol.) Lamx.
— var. *typica* Barton.
— var. *platydisca* (Decsne) Barton.
69. — **discoidea** Decsne.
var. *typica* Børgs.

In the text p. 106 after the word *typica* a"," through misprint has fallen out. I regret the mistake having herewith seemingly referred this variety to Dr. Howe. Comp. Dr. Howe's remark regarding this matter in "Torreya", vol. 15, 1915 p. 48.

var. *platyloba* Børgs.
70. **Halimeda Opuntia** (L.) Lamx.
71. — **gracilis** Harv.
var. *opuntioides* Børgs.
72. — **incrassata** (Ell. et Sol.) Lamx.
var. *typica* Barton.
f. *gracilis* Børgs.
var. *monilis* (Ell. et Sol.) Barton.
f. *robusta* Børgs.
f. *cylindrica* Borgs.
var. *simulans* (Howe) Børgs.
73. **Codium difforme** Kütz.
74. — **tomentosum** (Huds.) Stackh.
75. — **isthmocladum** Vickers.
76. — **elongatum** C. Ag.
77. **Bryopsis Duchassaingii** J. Ag.

78. **Bryopsis plumosa** (Huds.) Ag.
var. *pennata* (Lamx.).
var. *secunda* Harv.
var. *Leprieurii* (Kütz.).

79. **Caulerpa fastigiata** Mont.

Besides the locality mentioned above this plant has been found among several other algæ on the reef between the Hurricane Island and St. Thomas.

80. **Caulerpa Vickersiæ** Børgs.

Being dedicated to the late M^lle^ *Vickers* the specific name for this plant ought to be *Vickersiæ* and not *Vickersii*.

81. **Caulerpa verticillata** J. Ag.
f. *typica* Børgs.
f. *charoides* (Harv.) Web. v. Bosse.

82. — **Webbiana** Mont.
f. *disticha* Web. v. Bosse.

83. — **prolifera** (Forsk.) Lamx.
f. *obovata* J. Ag.
f. *zosterifolia* Børgs.

84. — **crassifolia** (Ag.) J. Ag.
f. *typica* (Web. v. Bosse) Børgs.
f. *mexicana* (Sonder) J. Ag.

85. — **taxifolia** (Vahl) Ag.

86. — **sertularioides** (Gmel.) Howe.
f. *typica* Børgs.
f. *brevipes* (J. Ag.) Svedelius.
f. *longiseta* (J. Ag.) Svedelius.
f. *Farlowii* (Web. v. Bosse) Børgs.

87. — **Ashmeadi** Harv.

88. — **cupressoides** (Vahl) Ag., Web. v. Bosse emend.
var. *mamillosa* (Mont.) Web. v. Bosse.
var. *typica* Web. v. Bosse.
var. *plumarioides* Børgs.
var. *flabellata* Børgs.
var. *elegans* (Crouan) Web. v. Bosse.

89. — **racemosa** (Forsk.) Web. v. Bosse.
var. *clavifera* (Turner) Web. v. Bosse.
f. *reducta* Børgs.

var. *uvifera* (Turner) J. Ag.
var. *occidentalis* (J. Ag.) Børgs.
var. *lætevirens* (Mont.) Web. v. Bosse.
var. *Lamourouxii* (Turner) Web. v. Bosse.

90. **Vaucheria dichotoma** (L.) Ag.

Phæophyceæ.

Pylaiella (Bory) Kjellmann.

Subgen. **Bachelotia** Bornet.

1. **Pylaiella fulvescens** (Schousb.) Bornet.

Bornet, Ed., Note sur l'Ectocarpus (Pylaiella) fulvescens Thuret (Revue générale bot., tome 1, 1889, p. 5, pl. 1); Les Algues de P.-K.-A. Schousboe (Mémoires ... Cherbourg, t. XXVIII, 1892, p. 247). Sauvageau, C., Note sur l'Ectocarpus (Pylaiella) fulvescens Thuret (Journ. de Botanique, 1896, p. 47).

Conferva fulvescens Schousboe mscr.; Icon. ined., t. 115 in Herb. Thuret.

Ectocarpus fulvescens Thuret in Algæ Schousb. no's 109—110.

This peculiar plant has been found twice in two different collections intermingled with other algæ.

As is well known from Bornet's and, more recently, from Sauvageau's descriptions of this plant it has creeping filaments fixed to the rocks by short haptera; from these creeping filaments the erect ones arise. In the material gathered I have found small fragments of the creeping filaments, but an abundance of the erect filaments, these having been cut over when collected. In most of the erect filaments an intercalary growing zone was found in about their middle. In this zone the cells are dark coloured, the chromatophores filling up nearly the whole lumen of the cells; these are all short being divided as soon as they reach a length corresponding to their breadth or even earlier.

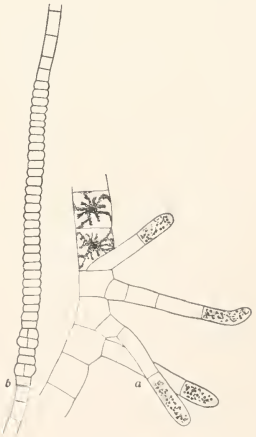

Fig. 408. *Pylaiella fulvescens* (Schousb.) Bornet. *a*, part of a filament with rhizoids. *b*, part of a filament with sporangia. *a*, about 150:1; *b*, 70:1.)

From this growing zone the cells gradually increase in length towards both ends. The filaments are about 35 μ thick and the cells reach a length of up to 90 μ. The peripheral walls are about 2 μ thick.

In some of the filaments rhizoid-like short branchlets were found (408 *a*). These seem to be able to grow out from all vegetative cells; in one filament, for instance, they were growing out from both ends of the filament. Another filament was much curved in the one end and from nearly all the cells here short branchlets were issued from the convex side of the filament. According to

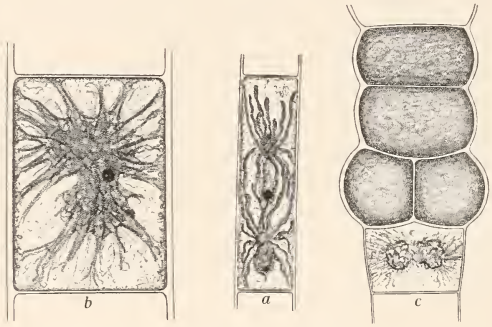

Fig. 409. *Pylaiella fulvescens* (Schousb.) Bornet.
a, *b*, cells with chloroplasts and nuclei. *c*, parts of a fertile filament.
(About 350:1.)

Sauvageau this takes place in the upper ends of the erect filaments, these by means of these branchlets, »crampons« becoming often fixed also in the upper end. The branchlets may attain to a considerable length; they have more or less sinuate walls. They are about 16 μ thick, their cells being about four times longer than broad.

The cells contain a beautiful and very characteristic chromatophore, closely reminding of the one in *Zygnema* (Figs. 408 *a*, 409). The chromatophore is stellate; from a dense centre long, thin prolongations protrude in all directions towards the wall of the cells, here often being broadened out to small roundish or oval discs lying closely against the wall. Two stars of chromatophore are present in each cell; in the longer cells the distance

between the two chromatophores is often rather considerable these being connected by a broader or slender strand of protoplasm. In the shorter cells the chromatophores gradually approach forming apparently in the young and newly divided cells but a single stellate chromatophore.

As pointed out by Sauvageau, too, the comparatively small nucleus is found in the strand of protoplasm between the two chromatophores (comp. Fig. 409 *a*, *b*.)

In one of the filaments nearly ripe sporangia were present. The sporangia have thick walls (Fig. 409 *c*); they are somewhat broader than the vegetative cells, about 50 μ broad, but often not half as long, about 20 μ. In the upper end a few of the cells were divided into two sporangia each. In the fertile filament found, 35 sporangia were present in the row (Fig. 408 *g*).

None of the sporangia present were ripe or emptied, but the disposition of the very large zoospores, characteristic of this plant, was clearly seen.

According to the above description the West Indian plant seems in all essentials to agree with the one from Morocco and the South of France, described by Bornet and Sauvageau.

It was found with sporangia in the month of March.

It was once gathered on rocks near the surface of the sea between other small algæ, e. g. *Chætomorpha*, *Enteromorpha* and *Myxophyceæ* in a rather exposed place where the waves constantly dash the rocks. Another time it was found in a more protected, lagoon-like locality intermingled with a tuft of *Hypnea cervicornis*.

St. Thomas: near Charlotte Amalia in the Harbour. St. Jan: Cruz Bay.

Geogr. Distrib.: Morocco, south of France and Spain.

2. **Ectocarpus Duchassaingianus** Grun.
3. — **Mitchellæ** Harv.
4. — **coniferus** Børgs.
5. — **Rallsiæ** Vickers.
6. — **rhodochortonoides** Børgs.

In the diagnosis p. 170 the diameter of the filaments is, on account of a misprint, stated to be 21 μ; it is 11 μ as is found in the text, p. 171, but this length of the diameter is found only

in the basal part of the filaments and in the more vigorous ones, higher up in the filaments and in the less vigorous the diameter descreases to about 7 μ.

The chromatophores are not very developed; each consists of a few irregularly bent and ramified narrow ribbons in each cells.

7. **Ectocarpus variabilis** Vickers.

Vickers, A., Liste des algues de la Barbade (Ann. sc. nat. Bot., sér., 9, t. 5, 1905, p. 59); Phycol. Barbadensis, pl. XXXI.

Upon some old leaves of *Thalassia testudinum* a small creeping *Ectocarpus* was found forming small low tufts upon it. This plant I think referable to the above mentioned species of the late Mlle. Vickers. In one respect, to be sure namely the length of the cells, it differed somewhat from her figure in which the cells are drawn very short, mostly not twice their breadth, but in the diagnosis of the species the length is said to be three times the breadth which agrees better with my plant.

Fig. 410. *Ectocarpus variabliis* Vickers. (About 250:1.)

The plant, of which a piece is shown in Fig. 410, has creeping basal filaments from which the erect ones arise. These have a diameter of about 9—12 μ in their lower part decreasing gradually upwards to about 7 μ. In the lower part the cells are about 22—30—40 μ long, higher up they become slowly longer, in the upper ends of the filaments reaching a length of more than 60 μ. The upper ends are not hairlike, the apical cells have roundish summit, ending now and then in a sporangium.

A marked growing zone is not found.

In each cell several irregularly bent, narrow ribbon-like, chromatophores are present.

The plurilocular sporangia are sessile or pedicellate, of rather variable size and shape, lanceolate to oblong with broadly rounded summit; about 60 μ long and 27 μ broad.

The plant was found in a lagoon-like locality in the harbour of St. Thomas.

Geogr. Distrib.: Barbadoes.

8. **Ectocarpus breviarticulatus** J. Ag.

9. — **elachistæformis** Heydr.

Of this plant I have come across some more material, and I am able to make some additions to my former description, vol. I, p. 174.

In its basal part not only horizontal filaments are present, as shown in Fig. 137 *a*, but also more or less vertical short ones (Fig. 411 *a*). These are growing down in the tissue of the host. They are mostly rather thick, about 20 μ thick and composed of short cells in which chromatophores are present.

The upper cells of the assimilating filaments are often nearly colourless, but their summits are mostly obtuse. The uppermost cells reach a length of about 70 *μ*.

Upon the assimilating filaments from near their base and rather high up, short plurilocular sporangia occurred (411 *b*). These are mostly short, proportionally thick and sessile, they are about 12 *μ* broad and 25—35 up to 70 *μ* long.

The common plurilocular sporangia, found at the base of the plant, often reached a length of more than 170 *μ*.

In one plant a supposed unilocular sporangium was found (Fig. 411 *b*). It was ovate of shape, placed terminally upon a short stalk composed of short cells. The sporangium was 50 *μ* long and 28 μ broad; the cells in the stalk 11 μ broad.

Fig. 411.
Ectocarpus elachistæformis Heydr. *a*, part of the base of a plant. *b*, part of plant with unilocular sporangium and plurilocular sporangia up along the assimilating filament.
(*a*, about 200:1; *b*, 150:1.)

Ascocyclus Magnus.

10. **Ascocyclus Hypneæ** nov. spec.

Fila basalia endophytica inter cellulas externas hospitis, *Hypneæ musciformis*, repentia, ex cellulis brevibus composita;

hæc pilos, ascocystos et sporangia erecta extra hospitem surgentia gignunt.

Ascocysti clavati, ca. 65 μ longi et 10—16 μ lati. Pili longi; articuli eorum in parte basali breves, ca. 6 μ lati, in superiori parte longi, ca. 180 μ et crassiores, ca. 16 μ lati. Sporangia plurilocularia ex pediculis brevibus surgentia, oblonga-fusiformia, ca. 16—26 μ lata et 65 μ longa.

Upon a specimen of *Hypnea musciformis* a small, partly endophytic brown alga was found which I think can be referred to the genus *Ascocyclus*, having those bodies, named ascocysts by *Sauvageau* (Myrionemaceæ, p. 9), charateristic of the genus«

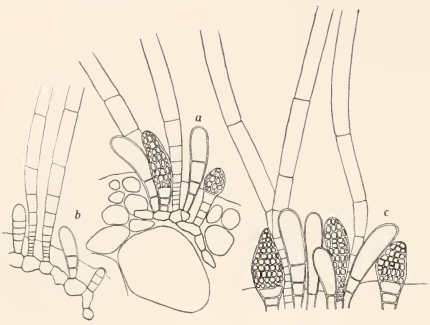

Fig. 412. *Ascocyclus Hypneæ* nov. spec. *a*, *b*, *c*, parts of the plant. (About 150:1.)

The base of the plant (Fig. 412 *a*, *b*) consists of filaments creeping among the peripheral cells of the *Hypnea*. The cells in these filaments are rather irregularly shaped, often swollen in their middle. They reach a breadth of about 7—8 μ. From these cells arise: 1) the ascocysts, 2) the hairs and 3) the sporangia. Characteristic for all three organs is that they are rather thin at their start from the creeping filaments, but gradually, as they approach the periphery of the host plant, they become thicker (comp. Fig. 412).

The ascocysts are clavate in shape; from a slender base they increase gradually upwards until near their apices which are broadly rounded. They are about 65 μ long and their diameter reaches a length of about 10—16 μ. They may arise directly from a cell in the creeping filament or have a few short cells at their base. They have thick walls and their contents seem rather homogenuous and of a dark brown colour in spite of the plant having been preserved in alcohol.

The hairs have a growth zone near their base; here the cells

are quite short and filled with chromatophores; higher up the cells gradually grow longer and become nearly destitute of chromatophores; in the upper parts of the hairs the cells reach a length of about 180 μ. In the basal part the hairs are thin, their diameter reaching a length of about 6 μ only; higher up the hairs grow thicker to about 16 μ. The cells of the hairs are barrel-shaped cylindrical, being a little narrowed at the cross-walls.

The plurilocular sporangia are oblong to spindleshaped, about 16—26 μ broad and 65 μ long. They have a short stalk consisting of a single or a few cells.

Owing to its partly endophytic way of growing and to the fact that the basal filaments do not form a disc this plant differs from the hitherto described species of this genus and ought perhaps rather to be referred to a new genus. Nevertheless I have preferred to refer it to the genus *Ascocyclus*, having not seen much of it.

The *Hypnea* upon which this plant was found was gathered in the month of January near the shore in shallow water.

St. Croix: Lime Tree Bay.

Fam. ***Myriotrichiaceæ.***

Myriotrichia Harv.

11. **Myriotrichia occidentalis** nov. spec.

Frons ex filis basalibus repentibus, ramosis et filis erectis composita.

Filamenta basalia ex cellulis, 20 μ longis et 10 μ latis composita, ramis aut oppositis aut alternis et unilateralibus instructa.

Ex cellulis basalibus aut pili, aut fila brevia, aut rarius sporangia plurilocularia aut filamenta principalia oriuntur.

Pili ca. 12 μ lati ex cellulis hyalinis valde elongatis orti.

Fila brevia, ca. 150 μ alta et 12 μ lata, ex cellulis ca. 6 composita, apice obtuso, rarius ramosa.

Fila principalia monosiphonia, ca. 1 mm longa, 18—24 μ lata; hæc ex cellulis sparsis (»nodis«) fila brevia, simplicia aut ramosa, opposite aut subverticillate orta gerunt.

Sporangia plurilocularia, aut sessilia aut pedicellata, 50—100 μ longa et 12—30 μ lata ex seriebus pluribus loculorum composita.

The plant (Fig. 413) forms small, low tufts upon the host plant, *Dictyota indica*, from which the longer main filaments protrude.

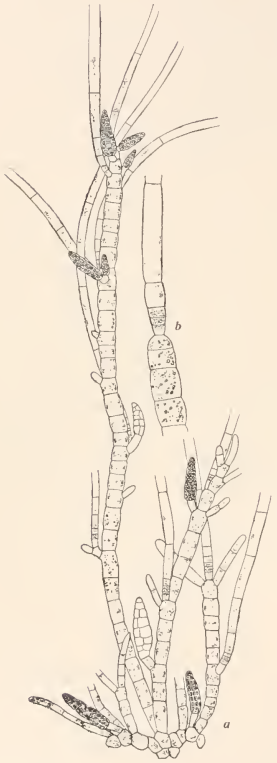

Fig. 413. *Myriotrichia occidentalis* nov. spec. *a* part of a, plant with sporangia (someones emptied). *b*, apex of a filament with terminal hair. (*a*. about 150:1; *b*, about 250:1.)

The base (Fig. 414 *a*) of the plant consists of freely ramified filaments creeping upon the surface of the host and fixed to it by means of quite short, small rhizoids (Fig. 414 *b*). The filaments have apical growth and the branches are given off from the distal end of the cells at both sides, now alternating, now opposite or sometimes, too, unilateral. The filaments are mutually free. The cells in the basal filaments contain well developed chromatophores; the cells are about 10 μ broad and 20 μ long.

From the cells of this base the different erect organs are given off, namely: short branchlets, hairs, long main filaments and more rarely plurilocular sporangia (comp. Fig. 413 *a* and 414 *a*, *b*). The short branchlets are commonly unbranched, nearly cylindrical with obtuse apex, composed of about six cells reaching a height of about 150 μ and a breadth of 12 μ, more rarely ramified.

The hairs have one or two basal cells of which the lowermost is the longest; above these cells the growth zone follows. Upwards in the hairs the cells rapidly increase in length, being very long in the upper end. The hairs are about 12 μ thick.

The few plurilocular sporangia found growing out from the basal filaments had, at their base, a single or a few sterile cells, about 8—9 μ broad. The sporangia are elongated-spindle-shaped, about 80 μ long and 20 μ broad.

Of the long main filaments I have found only a few; one of the longest, reaching a length of about 1 mm, is figured in Fig. 413. The breadth of the main filaments is about 18—24 μ; they are composed of cells of rather variable length from shorter than the length to about their double length. The filaments found by me have all been monosiphonous throughout, longitudinal walls being not present at all. But having seen so few erect filaments

Fig. 414. *Myriotrichia occidentalis* nov. spec.
a and *b*, parts of the basal filaments seen from above and from the side.
c, part of a main filament with hairs, branchlets and sporangia.
(*a*, about 260:1. *b* and *c*, about 150:1.)

it is of course possible that such may occur in more developed specimens. As pointed out by Kuckuck[1]) the growth of the main filaments takes place by means of intercalary division of the cells (comp. Fig. 413 and 414 *c*), but this division is restricted mostly to the middle and upper end of the filaments. The top of the filaments end in a terminal hair (comp. Fig. 413 *b* and *a* the branch to the right).

The erect main filaments are provided with side-organs of

[1]) Kuckuck, P., Die Gattung Myriotrichia Harvey. Beiträge zur Kenntnis der Meeresalgen, 6, 1899, p. 59.

three kinds: short branchlets, hairs and sporangia. They are mostly arranged in a tier-like manner issuing several from the same cell, each tier being separated by a row of bare cells.

The branchlets are short, often spinelike, undivided or provided with hairs. Two opposite branchlets are mostly given off from each point. In the upper, more richly developed part of the erect shoots the branchlets grow larger, become ramified and bear often several plurilocular sporangia and hairs.

The hairs are like those issued from the basal filaments; they have a longer cell at their base, then the growing zone follows above which the cells quickly grow long and colourless. In the lower part of the erect shoots they are given off immediately from the main filament, higher up, as mentioned above, mostly from the branchlets.

The plurilocular sporangia are rarely sessile, mostly pedicellate or placed upon the branchlets. They are spindleshaped about 50—100 μ long and 12—20—30 μ broad.

Unilocular sporangia were not found.

Considering the species of *Myriotrichia* hitherto described this plant seems to be most closely related to *Myriotrichia repens*, this species having for the most part monosiphonous filaments, and the dimensions of the cells and the development of the erect filaments being rather like the West Indian plant. But the West Indian plant differs nevertheless essentially from *Myriotrichia repens* in the very different development of the basal filaments, and in the fact that the filaments, as far as hitherto found, always are monosiphonous, the knot-cells (Knoten of KUCKUCK) being not even divided and in the development of the plurilocular sporangia, these having two or more rows of loculi in each.

Our plant seems to show some likeness, too, to the certainly very imperfectly known species *Myr. canariensis* Kütz., but this species has rather many longitudinal walls in the main filaments, and the plurilocular sporangia seem, according to KÜTZING's figure and as pointed out by KUCKUCK, to be very like those found in *M. clavæformis*.

The *Dictyota indica* upon which this species was found was dredged in the month of February in the open sea at a depth of about ten meters.

St. Croix: off Frederikssted.

12. **Colpomenia sinuosa** (Roth) Derb. et Sol.
13. **Hydroclathrus cancellatus** Bory.
14. **Rosenvingea Sanctæ Crucis** Børgs.

In the description of this plant (vol. I, p. 178) the locality and occurrence has been omitted. It was found in shallow water near the shore in a sheltered place this being protected from the open sea by coral reefs. It was attached to small stones. It was gathered in the month of January.

St. Croix: Longford.

15. **Castagnea Zosteræ** (Mohr) Thur.

16. **Myrionema vulgare** Thur.

Thuret, G., in Le Jolis, Liste des algues mar. de Cherbourg, p. 82. Sauvageau, C., Sur quelques Myrionémacées (Ann. sc. nat., Bot., Sér. 8, Tome 5, 1897, p. 185).

Upon an old *Sargassum*, together with many other epiphytic and partly endophytic algæ, a *Myrionema* also occurred which I think referable to *M. vulgare*.

Fig. 415 *a* shows a part of the basal disc; it consists of creeping filaments whose cells are from 5 to 7 μ thick. And fig. 415 *b* shows plurilocular sporangia from the older parts of the plant; the sporangia are about 7 μ thick. The hairs have a rather long sheath at their base; they are about 7—8 μ thick.

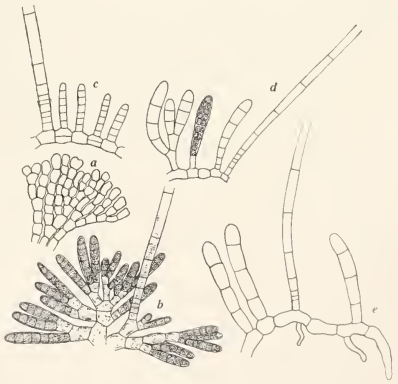

Fig. 415. *Myrionema vulgare* Thur. *a*, *b*, *c*, parts of a plant from St. Thomas. *d*, part of a plant from St. Croix. *e*, part of a plant from St. Jan. (*a*, *b*, *c*, *d*, about 275:1. *e*, about 200:1.)

This plant was found in the harbour of St. Thomas.

A very similar plant was found upon *Chætomorpha antennina* gathered at »Northside«, St. Croix in a very exposed place (Fig. 415 *d*).

Further upon an old *Dasya* a tuft of a somewhat more robust form was found (Fig. 415 *e*).

The base of this plant was very like the Fig. 2*A* of Sauvageau, l. c., p. 31. The cells in the filament are about 8—10 μ thick.

Hairs occur rather abundantly; they have a growing zone at their base with a slightly developed sheath and are about 7—8 μ thick. The erect assimilating filaments consist of about 4 cells; their diameter reaches a length of about 11 μ. Of plurilocular sporangia only a few unripe have been found. This plant was dredged in about ten fathoms of water in the sound between St. Thomas and St. Jan: off Cruz Bay.

Geogr. Distrib.: The European and American shores of the Atlantic Ocean, Mediterranean Sea.

17. **Ralfsia expansa** J. Ag.
18. **Lithoderma** spec.
19. **Aglaozonia Canariensis** Sauvag.
20. **Sphacelaria tribuloides** Menegh.
21. — **furcigera** Kütz.
22. **Zonaria variegata** (Lamx.) Mert.
23. — **lobata** Ag.
24. **Padina Sanctæ Crucis** Børgs.
25. — **gymnospora** (Kütz.) Vickers.
26. — **Howeana** nov. nom.

Syn.: *Padina variegata* Hauck et auctores. Hauck, F., Ueber einige von I. M. Hildebrandt im Rothen Meere und Indischen Ocean gesammelte Algen (Hedwigia, vol. 26, 1887, p. 41). Vickers, A., Phycologia Barbadensis, part II, pl. VIII. Börgesen, F., The marine Algæ of the Danish West Indies, vol. I, p. 205. Collins, Fr. S. and Hervey, A. B., The Algæ of Bermuda, v. 87.

Zonaria variegata Kütz., Tab. Phyc., vol. IX, pl. 73, fig. 2.

In a review of the parts of my paper dealing with the green and brown algæ Dr. Howe[1]) points out that when both *Zonaria variegata* and *Padina variegata* are derived from Lamouroux's *Dictyota variegata* this practice cannot be kept up according to the rules of nomenclature.

Dr. Howe writes: »This practice, which did not originate with Börgesen, seems to rest upon the assumption that the original *Dictyota variegata* of Lamouroux was a mixture of two

[1]) In »Torreya«, vol. 15, 1915, p. 46.

species, representing two genera of the same family, and that, in spite of the confusion entailed, this specific name was available and valid in each of these two related genera, — a practice that is possibly permissible under the »Vienna Rules« but is distinctly forbidden by the »American Code«. In this particular case, the present reviewer has enjoyed the privilege of seeing the specimens of *Dictyota variegata* Lamour. in LAMOUROUX's herbarium at Caen and finds that they agree with the figures published by LAMOUROUX in showing only a *Zonaria* (the *Gymnosorus variegatus* of J. AGARDH), so that the name »*Padina variegata* (Lamx.) Hauck«, employed by BÖRGESEN would seem to be vulnerable on the ground of historical fact as well as on the ground of nomenclature theory.«

To this I wish to remark that, when working out my paper, I had no access to the original specimens of LAMOUROUX, the examination of which was the necessary starting point for an eventual change of name for one of the plants in question, the figure of LAMOUROUX being such, that even if it shows perhaps most likeness to *Zonaria variegata* this, nevertheless, cannot be stated with absolute certainty. Therefore I followed the practice of HAUCK. But now, when Dr. HOWE has examined the original specimens of LAMOUROUX, the case is different. The plant, named *Padina variegata* uptill now, must be given a new specific name and in honour of Dr. HOWE, who has solved the question, I propose to call it *Padina Howeana.*

27. **Dictyota Bartayresiana** Lamx.
28. — **linearis** (Ag.) Grev.
29. — **volubilis** Kütz.
30. — **pardalis** Kütz.
31. — **Indica** Sonder.
32. — **ciliata** J. Ag.
33. — **crenulata** J. Ag.
34. — **dentata** Lamx.
35. **Dilophus alternans** J. Ag.
36. — **Guineensis** (Kütz.) J. Ag.
37. **Dictyopteris delicatula** Lamx.
38. — **plagiogramma** (Mont.) Vickers.
39. — **Justii** Lamx.

Dictyerpa Collins.

40. **Dictyerpa Jamaicensis** Collins.

Collins, F. S.; The algæ of Jamaica (Proceed. Americ. Acad. of Arts and Sciences, vol. 37, 1901, p. 251).

Some small specimens have been found which I think referable to this plant. They were collected in a rather exposed place upon the small reef near the entrance to the harbour of St. Thomas. They form small, low tufts, most probably growing in narrow crevices in the rocks over which the waves constantly dashed. They are fixed to the substratum by means of numerous rhizoids breaking out in groups everywhere on the thallus.

The thallus consists of thin slender filaments about 300 to 600 μ thick or more, which, in transverse section, are roundish or oval. The ramification is very irregular, being di, tri- to polychotomous. The internodes are of variable length; they are thinnest at their base and increase gradually upwards. The young group of rhizoids are covered by the cuticula forming an indusium which bursts later on. The rhizoids are about 27 μ thick, being divided into cells more than four times longer. They are irregularly bent and nearly destitute of contents.

The thallus increases by means of a large nearly hemispherical apical cell from which segments are cut off in all directions.

From a transverse section is seen that the thallus consists of a cortical layer of small, nearly quadrangular cells with considerable contents and a medullary layer of larger colourless cells being irregularly polygonal or often nearly rectangular; the walls of these cells are more or less undulated. A longitudinal section shows these cells to be about twice as long as broad.

Regeneration seems to take place very easily, I have several times seen a group of young branches grow out from the thallus when it has been broken.

As in the case of the plant from Jamaica this, too, was quite sterile.

Regarding this plant Svedelius in Engler u. Prantl, Nat. Pflanzenfam., Nachtr. zu 1. Theil, Abt. 2, p. 188 writes: Die Gattung *Dictyerpa* ist höchst wahrscheinlich nichts anderes als eine freiliegende, trotzdem aber weiterlebende Form einer normalerweise auf Steinen wachsenden *Dictyota*, die durch die

freiliegende Lebensweise ein Aussehen und einen cylindrischen Bau bekommen hat, ganz wie z. B. freiliegende kleine *Fucus*-Formen. Daraus erklärt sich auch ihre Sterilität«. Most probably SVEDELIUS is right in this supposition. To be sure my plant was not detached, but fixed to rocks. Nevertheless there is a possibility that we may have to do with a form, the development of which has been retarded because of unfortunate, external conditions of life. It might perhaps belong to *Padina*, the basal part of which in the young state is terete.

Found in crevices in the small reef near the entrance to the Harbour of St. Thomas.

Geogr. Distrib.: Jamaica.

41. **Turbinaria trialata** Kütz.
42. **Sargassum vulgare** C. Ag.
    — var. *typica.*
    — var. *foliosum* (Lamx.) J. Ag.
43. — **lendigerum** (L.) Kütz.
44. — **platycarpum** Mont.
45. — **Hystrix** J. Ag.[1])

Rhodophyceæ.

1. **Asterocytis ramosa** (Thwaites) Gobi.
2. **Goniotrichum elegans** (Chauv.) Le Jolis.
3. — **Humphreyi** Collins.

As already pointed out in a corrective note to the Part II, 1916, of the *Rhodophyceæ*, the plant which I, on p. 10, have referred to *Bangiopsis subsimplex* is not this plant, but a form of COLLINS'

[1]) *Sargassum natans* (L.) Meyen and *Sargassum fluitans* Borgs. both treated in length in my paper: "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, No. 32), and the last species described in vol. I. of the present work p. 222, are both floating, pelagic forms, the most common species of the Sargasso Sea. Now and then both forms are washed ashore at the islands, but having never been found attached there, they do not belong to the flora of the islands and are therefo re not mentioned in the list.

Goniotrichum Humphreyi, described in Collins, Holden and Setchell, Phycotheca Bor.-Am., No. 421 and in Collins, The Algæ of Jamaica (Proc. Amer. Acad., vol. 37, 1901, p. 251).

4. **Erythrotrichia carnea** (Dillw.) J. Ag.
5. **Erythrocladia subintegra** Rosenv.
6. **Acrochætium Sargassi** Børgs.
7. — **crassipes** Børgs.
8. — **pulchellum** Børgs.
9. — **netrocarpum** Børgs.
10. — **gracile** Børgs.
11. — **cæspitiforme** nov. spec.

Thallus parvus, gracillimus cæspitosus usque ad 700 μ altus in *Padina Howeana* epiphyticus. Pars basalis e filis repentibus plus minus lateraliter confluentibus composita. Cellulæ subbreves, 8 μ longæ et 5 μ latæ.

Fila erecta quoquoversum ramosa, ad apicem versus attenuata; ramis sparsis nonnumquam secundatis aut irregulariter ortis. Cellulis in inferiori parte filorum ca. 5 μ latis et 12 μ longis, in superiori ca. 2,5μ latis; in ramis paulo minoribus, inferioribus 3—4 μ latis, superioribus ca. 2 μ latis.

Rami recti, sub angulis acutis surgentes; in inferiori parte eorum ramuli breves sporangia gerentes.

Sporangia pedicellata aut raro sessilia, 11—12 μ longa et 6 μ lata.

Chromatophorum parietale irregulariter lobatum aut perforatum pyrenoide laterali munitum.

Upon a young *Padina Howeana* an *Acrochætium* was found which I think must be regarded as a new species (Fig. 416). It comes, undoubtedly, in several respects rather near to the *Acr. gracile* described above on p. 26, but differs from this species in its ramification and in the deviating arrangement of the sporangia.

The plant forms small roundish tufts formed by the densely placed and very ramified filaments. It grows with preference along the edges of the *Padina* and the basal filaments run along it. The base (Fig. 416 *a*), in which the original spore is not visible, consists of filaments creeping upon the surface of the host. These filaments merge more or less together, forming an often large,

more or less coherent disc. The cells in the basal filaments are about 5 μ broad and 8 μ long.

From nearly all the cells of these filaments erect ones arise. These are ramified from rather near the base; the branches are given off in all directions, but very irregularly, often several above each other at the same side. And the distance between the branches, too, is very variable; in some cases a row of cells of the main filaments carry a branch, in other several bare cells are present between those bearing branches (Fig. 416 *b*). The branches are straight and given off at acute angles. The main filaments are at the base about 5 μ thick and the cells 12 μ long; upwards they taper slowly to about 2,5μ. The branches are proportionally smaller, 3—4 μ at their base, about 2 μ at their summit.

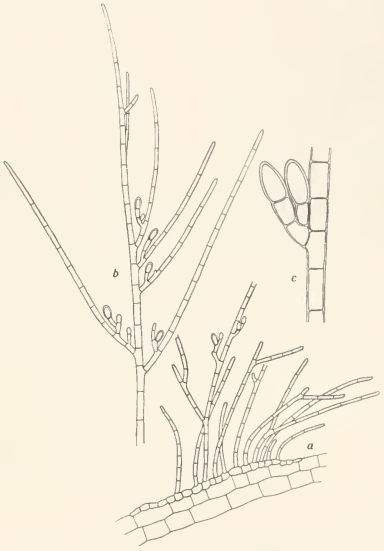

Fig. 416. *Acrochætium cæspitiforme* nov. spec. *a*, basal part of the plant. *b*, upper part of a filament. *c*, branchlet with sporangia. (*a*, about 200:1; *b*, about 260:1; *c*, about 600:1).

The sporangia are linear-oblong, 11—12 μ long and about 6 μ broad. They occur upon short branchlets at the base of the branches (Fig. 416 *b*, *c*). The sporangia are mostly pedicellate, rarely sessile. In the upper end of the main filaments these, too, carry branchlets with sporangia.

The chromatophore is an irregularly lobed or perforated, parietal plate, covering most of the cell and including a lateral pyrenoid.

The most important differences between this species and *Acr. gracile* are, that in *Acr. gracile* the erect filaments are very

slightly ramified or not at all, while in *Acrochætium cæspitiformis* the ramification is considerable; further, the sporangia in *Acr. gracile*, owing to the scanty ramification, are placed up along the main filaments, while in *Acr. cæspitiformе* they are found at the base of the branches.

The plant was gathered at the end of February in shallow water near the shore.

St. Croix: Salt River.

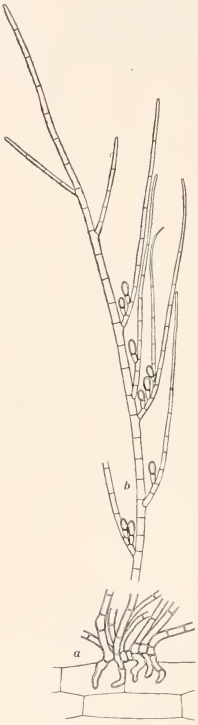

Fig. 417. *Acrochætium* spec. *a*, base of the plant. *b*, part of erect filament. (*a*, about 200:1; *b*, about 150:1).

12. **Acrochætium globosum** Børgs.
13. — **Sancti Thomæ** Børgs.
14. — **seriatum** Børgs.
15. — **flexuosum** Vickers.

16. **Acrochætium** spec.

Upon a young *Padina Howeana* a few plants of an *Acrochætium* were found, showing apparently some likeness to *Acr. flexuosum*. Having had so little material of it at my disposal, I prefer to leave it unnamed.

It forms tufts up to more than one mm.; one specimens was about 1200 μ high.

The base consists of short, creeping filaments (Fig. 417 *a*); these are irregularly bent, in the middle of the basal layer interwoven and merging together, but with free ends. The cells in the basal filaments are about 8 μ thick and 11 μ long.

The erect filaments (Fig. 417 *b*) arising from the basal filaments are from 10—13 μ thick and the cells about 35 μ long. Upwards the main filaments do not taper much: until at about 8—11 μ.

The filaments are very ramified; from near the base they carry branches given off irregularly at all sides with longer and shorter rows of bare cells in between, and often with some tendency to secund arangement. The branches are given off at acute angles; they seremto be rather rigid and are a little curved. They are somewhat thinner than the main filaments, at their base about 9 μ, tapering to about 5 to 6 μ at their apex.

The chromatophore is a parietal plate with a large lateral pyrenoid, protruding far into the lumen of the cell.

The sporangia occur at the base of the branches; in the specimens found one, two, or, more rarely, three upon each branch, The sporangia are pedicellate or more rarely the uppermost sessile. The sporangia are oval in shape; they have a thick wall especially at their upper end. They are about 21 μ long and 13 μ broad.

From this plant *Acr. flexuosum* Vickers chiefly differs in its thinner filaments and by the presence of ramuli, upon which the sporangia are placed.

Our plant ought also to be compared with *Acr. Daviesii* (Dillw.) Nägl. showing in its short, thick-walled cells and whole ramification great likeness to this species. But it differs in an essential way especially by the lack of the repeatedly ramified branchlets.

The plant was gathered in shallow water at the end of February.

St. Croix: Salt River.

17. **Acrochætium unipes** Børgs.

18. — **opetigenum** Børgs.

19. **Acrochætium robustum** Børgs.

When I described this plant I had not come across young specimens. In fig. 418 the basal parts of two young plants are figured; in these the basal discs are not yet developed. From these figures it seems quite clear, that the germinating spore during its growth produces downwards the process which penetrates into the tissue of the host. The process has an acute base and thick walls. It is not separated from the original germinating spore by any wall. The process is the only endophytic part of the plant; the original spore and the small disc gradually developed round it are epiphytic.

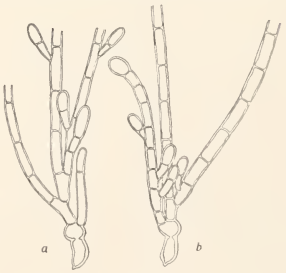

Fig. 418. *Acrochætium robustum* Borgs. Bases of two young plants. (About 250:1).

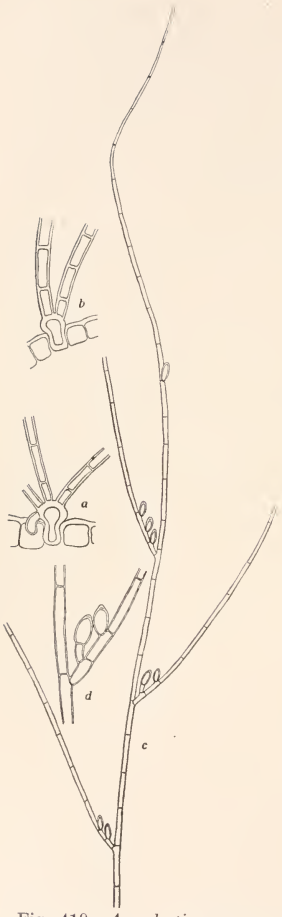

Fig. 419. *Acrochætium* spec. *a* and *b*, basal parts of plants. *c*, upper part of a filament. *d*, small part of the same, more magnified. (*a*, *b*, *d*, about 200:1; *c*, about 140:1).

20. **Acrochætium** spec.

Howe anf Hoyt[1]) in 1916 described an *Acrochætium affine* which is closely related to Collins' *Acr. Hoytii*, described in "Rhodora", 1908, p. 134 and to the two species *Acr. robustum* and *unipes* described by me. They made a thorough comparison between their new species and Collins' and my plants and arrived at the conclusion that: "there seems to be no compelling reason for the association of our plant with any one of the three names mentioned rather than with any other of the three."

Growing rather abundantly upon a *Dictyota*, which I have determined to be *Dictyota indica*, I have once more found an *Acrochætium* (Fig. 419) which is closely related to the above-mentioned species, but which, nevertheless, when more carefully examined, shows differences from all four species.

As is characteristic of these species the germinating spore of the plant now found produces a more or less obtuse process penetrating into the peripheral layer of the host, reaching a length of about 28 μ (Fig. 419 *a*, *b*); the spore itself remains lying upon the wall of the host; its diameter reaches a maximum of about 16 μ.

[1]) Howe, M. A. and W. D. Hoyt, Notes on some marine Algæ from the vicinity of Beaufort, North Carolina (Memoirs of the New York Bot. Garden, 6, 1916).

From the spore a few cells are gradually developed in all directions; by more or less growing together they form in older, vigorous plants a small disc. From the spore and from the surrounding cells erect filaments are given off. These are mostly not ramified near their base, higher up branches are given off in all directions.

At the base the filaments are 8—10—12 μ broad, tapering slowly upwards, the apices reaching a breadth of about 4—6 μ only. The filaments reach a height of about 3 mm. The cells contain a parietal, slightly developed chromatophore with a lateral pyrenoid protruding far into the cells. The chromatophore is mostly developed in the basal part of the plant, upwards less so. The branches are given off at acute angles in all direction from the main filaments which are for the most part easily observable; the branches are similar to the main filaments, thicker below, thinner upwards. At their base from the distal end of the lowermost cells the sporangia are issued (Fig. 419 *c*). These are sessile or pedicellate, in some specimens about half of all the sporangia are pedicellate. The sporangia have a little thickening of the wall in their upper end (Fig. 419 *d*). They are about 11—12 μ broad and 21 μ long. Other fructiferous organs were not found.

If we now compare this plant with the above-mentioned four related species and begin with *Acr. unipes* we find, that this species differs firstly by the fact that generally a single erect filament is issued from each spore; now and then an accessoric branch may be present, but this is no doubt mostly due to the fact that the primary branch has been damaged; comp. my fig. 33 *b*. The sporangia seem always to be sessile in *Acr. unipes*, and they are more scattered placed upon the branches; furthermore the sporangia are proportionally a little broader in *Acr. unipes*, namely about 12 μ broad and 20 μ long, and their apex is more obtuse with no such marked thickening above in the wall.

According to Howe's and Hoyt's description *Acr. affine* differs from our plant on account of the 1—4 erect filaments issuing from the primary basal cell, "often subdichotomous or subtrichotomous at the distal end of the first cell"; furthermore by the presence of terminal hairs. Cystocarps and antheridia were found in this plant.

And *Acr. robustum* differs from the above described form

by its much more robust habit, forming a dense tuft composed in older plants of many more filaments arising from the basal disc. The erect filaments are furthermore divided from near their base. The chromatophore is vigorously developed, forming irregularly shaped plates. The filaments are 7—10 μ thick, tapering very slightly from the base upwards, their upper ends being 5—6 μ thick with obtuse apices and with well developed chromatophores, even in the upper cells. The sporangia are smaller, about 9 μ broad and 15 μ long.

Finally *Acr. Hoytii*, according to the description by Collins and additional remarks by Howe and Hoyt, l. c., p. 119, differs from our plant by its, on the whole, smaller dimensions, by its differing ramification, — the erect filament being much ramified below, rarer above, — and by its smaller sporangia 6 × 15 μ.

The *Acrochætium* spec. was found at a depth of about ten meters.

St. Croix: off Frederikssted.

21. **Acrochætium bisporum** Børgs.
22. — **occidentale** Børgs.
23. — **comptum** Børgs.
24. — **Avrainvilleæ** Børgs.
25. — **hormorhizum** Børgs.
26. — **Hypneæ** Børgs.
27. — **repens** Børgs.

The host plant in which this species was found was *Hypnea musciformis*.

Creeping with its basal part in the thick membrane of *Griffithsia globifera* an *Acrochætium* was found which I prefer to consider as a form of this species, until more material can be examined.

The plant (Fig. 420) has long, irregularly ramified, endophytic filaments creeping throughout the thick membrane of the host (Fig. 420 *a*). Now and then from these basal filaments erect ones are given off. The cells of the basal filaments are subcylindrical to oval being thickest in their middle, the filaments by this getting a more or less moniliform appearance; the cells reach a breadth of up to 11 μ and are two to three times as long. They have a parietal chromatophore with a parietal pyrenoid. I have not

been able to discover the original germinating spore and the plant may therefore be referred to group III of Bornet[1]).

The erect filaments have at their base rather short cells; higher up these grow gradually longer, the filaments at the same time becoming thinner. At the base of the filaments the cells are about 8 μ, in their middle about 5 μ, the upper ends about 2 μ only. The cells contain a parietal chromatophore and a parietal pyrenoid; upwards in the filaments the chromatophore becomes less developed and is quite or nearly absent in the uppermost thin cells.

The filaments are scantily ramified bearing short branches at all sides; just as in the case of the main axes of the erect filaments the main axes of the branches are thickest below with short cells, having longer and thin cells above.

Fig. 420. *Acrochætium repens* Børgs. *a*, endophytic, basal filaments. *b*, erect filament with sporangia. (About 175:1).

Upon the lowermost cells of the branches the sporangia occur, placed mostly two together upon a short pedicel (Fig. 420 *b*). The sporangia are about 8 μ broad and 12 μ long.

It is evident from this description that the plant shows great likeness to the one found in *Hypnea musciformis*. Nevertheless some differences are present. For instance the erect filaments grow taller and therefore proportionally more slender than those

[1]) Bornet, Ed., Deux *Chantransia corymbifera* Thuret. *Acrochaetium* et *Chantransia* (Bull. Soc. bot. France, Tome 51, 1904, p. XX).

of the typical *Acr. repens*. As to the occurrence of the sporangia a difference, too, seems to be present as the pedicels, bearing the sporangia in *Acr. repens*, are often placed directly upon the main filament, while in the plant upon *Griffithsia* these, in the scanty material found, are always placed upon the lowermost cells of the side-branches.

By its large, widely spreading system of endophytic filaments our plant, too, reminds very much of *Acr. Nemalionis* (De Not.) Bornet, but it is, nevertheless, very different when compared with Rosenvinges[1]) exhaustive description, the *Acr. Nemalionis* being a much taller, more robust and much more ramified plant.

The *Griffithsia* in which this plant was growing was dredged in about 5 fathoms of water in the month of January.

St. Croix: Near Buck Island.

28. **Acrochætium phacelorhizum** Børgs.

29. **Acrochætium Collinsianum** Børgs.

Syn. *Acrochætium Liagoræ* Børgs., p. 57.

In the year of 1914 Mme Weber in the Marine Algæ of "The Percy Sladen Trust Expedition"[2]) has described a *Chantransia Liagoræ* found on *Liagora Hawaiiana*. The *Acrochætium* (*Chantransia*) *Liagoræ*, which I described a year later in the first part of this volume, must therefore have another name, and I propose to call it *Acr. Collinsianum* in honour of the well known American phycologist, Mr. Franc S. Collins, who has contributed largely not only to our knowledge of the American *Acrochætium* species, but to our knowledge of American algal flora in its entirety. I deeply regret to say that it will not only be in honour of Frank S. Collins, but also in memory of him. Because, after the MS. had left my hands and gone to the printers, Dr. Howe informed me by letter that Collins, the enthusiastic algologist, had suddenly died. His death is a great loss to science, but I also feel it as a deep personal one, having corresponded with F. S. Collins during many years.

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[1]) Rosenvinge, L. Kolderup, The marine algæ of Denmark, Part I, Rhodophyceæ, p. 126.

[2]) In The Transactions of the Linnean Society of London; 2. ser. Zoology, vol. 16, part. 3, London 1914.

30. **Acrochætium ernothrix** Børgs.
31. **Nemalion Schrammi** (Crn.) Børgs.
32. — **longicolle** Børgs.

33. **Liagora elongata** Zanard.

In the "Algæ of Bermuda", p. 99, Collins and Hervey refer *Liagora corymbosa* J. Ag. to *Liagora elongata* Zanardini, pointing out that it is impossible to separate them from each other. The single dried specimens found I have with much doubt (comp. p. 70) referred to *L. corymbosa* J. Ag. as I found its anatomical structure agreeing closely with that of *L. elongata*. I therefore now prefer to consider it as a form of *Liagora elongata*, in accordance with the opinion of Collins and Hervey.

34. **Liagora valida** Harv.
35. — **pinnata** Harv.
36. — **megagyna** Børgs.
37. — **pulverulenta** C. Ag.

Appendix to Liagora.

Before I leave the genus *Liagora* I wish to mention here some remarkable organisms, which I found in several of the species, when working out my material of this genus, and from which the drawings here reproduced were made at the time (Fig. 421). When I found these bodies, I was inclined to consider them as a kind of endophytes living in the mucous layer of *Liagora*. But feeling very uncertain what to do with them, I wrote to Dr. Howe wishing to hear if he also had met with them. Dr. Howe wrote to me that he, too, had found these bodies in several species of *Liagora* and that he, too, felt rather uncertain what to do with them. At first he was on the point of describing them as representing a new genus of uncertain family, but later after having made more thorough examination he arrived at the conclusion "that these discs seemed to spring from terminal or subterminal cells of the assimilatory filaments of the *Liagora*, usually after rejuvenescence of the cell". Dr. Howe told me that he had written a paper describing the discs and their supposed origin, but that he had put it aside feeling not so sure of the matter as he would like to be, before putting it into print.

Dr. Howe's interesting paper[1]) has now appeared, and though I am not able to give any better explanation as to these peculiar bodies, I nevertheless wish to give here a short description being able in some respects to make a few additions to the description by Dr. Howe.

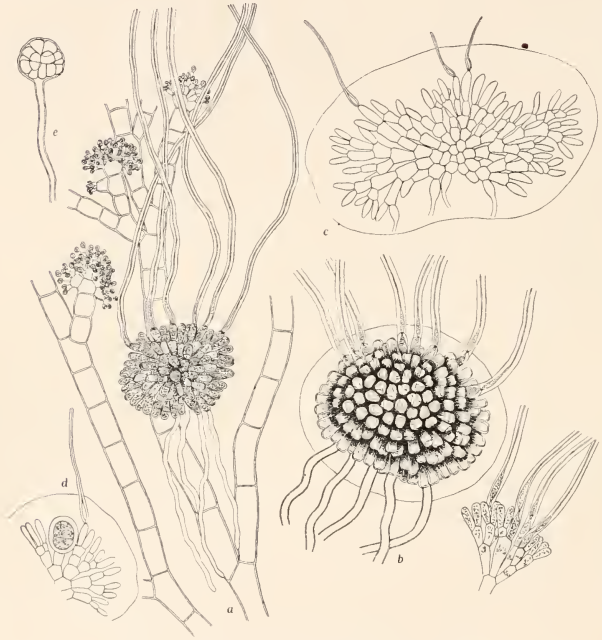

Fig. 421. Endophytic organisms in *Liagora*.
a, a body fixed to the filaments of *Liagora*. *b*, another specimen more magnified. *c*, transverse section. *d*, part of a specimen with sporangium. *e*, a young specimen. *f*, part of a crushed specimen.
(*a*, about 300:1; *b*, *f*, about 500:1; *c*, *d*. *e*, about 275:1.)

These bodies I have found, in common with Howe, in several species of *Liagora*, but especially abundantly in *Liagora elongata* and therefore I restrict my description to those from this species (Fig. 421).

[1]) M. A. Howe, Observations on Monosporangial Discs in the Genus Liagora. (Bull. Torrey Bot. Club, 47, 1920).

The shape of the bodies, when fully developed, is like a subglobular thick disc, their diameter reaching a maximum of about 200 μ or possibly a little more. From the flattened upper side of these discs long hairs arise and from the opposite under side long rhizoids are given off (Fig. 421 *a*, *b*). The hairs are very long; they have a well developed pore at their base, granular contents, especially in their lower part, and thick walls. At their base they are about 7—10 μ thick growing thinner upwards. The rhizoids have no granular contents; their walls are thin. They are about 5 μ thick. The rhizoids run down along the assimilating filaments of the *Liagora* or spread freely in the mucilage of the host plant (Fig. 421 *a*). Both hairs and rhizoids are often present in great number, 10—12 or even more. The surface of the bodies consists of the more or less free obtuse ends of the peripheral cells. They are surrounded by a thicker or thinner mucous layer.

From a transverse section (Fig. 421 *c*) it is seen that the disc is composed in the middle of a parenchymatic tissue formed of thin-walled, roundish-polygonal cells. These are arranged in filaments radiating towards the periphery and are subdi-trichotomously ramified several times. The growth takes place in the peripheral cells, these are long, thin and, as mentioned above, more or less free.

In one of the transverse sections sporangia were found (Fig. 421). These are formed from the peripheral cells and are oval in shape. One of these was divided by means of a transverse wall into two spores; the whole sporangium was sourrounded by a thick transparent wall commonly found round the tetraspores. Howe has in his specimens found only monosporangia, and similar bodies (comp. Howe's figures) I, too, have often seen in mine.

Regarding the chromatophores Howe says that they seem similar to those of *Liagora* but those of the discs are more red. In my specimens the chromatophores appear to be a few parietal plates.

Finally I must add that these bodies are found in all states of development from quite small to larger ones.

The function of these little bodies has yet to be made clear. In his paper Dr Howe tries to make it evident that they originate from the *Liagora* itself. He says" The truth seems to be that these discs arise from gonidia, gemmæ or aplanospores, derived

from the terminal or subterminal cells of the assimalitory filaments of the *Liagora*, as was the view of KÜTZING[1]) in regard to similar structures in *Liagora Turneri*". And HOWE describes and gives figures of this continuity, but he points out himself that the observed evidences of direct continuity were not so numerous as he might wish.

I have not in my material been able to find any organic continuity between this organism and the host-plant, and I am therefore most inclined to consider it as an independent plant. As is already pointed out by Dr. HOWE it seems both easier and more probable to consider these bodies as independent endophytic structures.

Finally I can only wish, just as Dr. HOWE does, that some one, who has access to suitable living material, would be able to solve the question by means of a thorough examination.

38. **Scinaia complanata** (Collins) Cotton.

Galaxaura Lamouroux.

When I worked out my material of this genus I, of course, founded my determinations on the rather recently published comprehensive monograph by KJELLMAN.

The material I have collected of this genus was rather poor, these plants being not very attractive, and rather slow and difficult to dry and taking up much space in the bottles. Nevertheless through KJELLMAN's work I arrived at the conclusion that eleven species were present at the islands.

But I want to point out that the determination of the species from the work of KJELLMAN is not without difficulty. Many of his species are surely based upon scanty material and are often at the best only varieties or forms of the same plant.

The highly interesting and instructive examinations by Dr. HOWE[2]) have amply proved that this is the case. The fact is that this well known American investigator has arrived at the con-

[1]) KÜTZING, F., Tab. phycologicæ, vol. VIII, pl. 90.

[2]) HOWE, M. A., in Brooklyn Botanic Garden Memoirs, vol. I, 1918, p. 191.

clusion that, in spite of the very different anatomical features found in the different forms and upon which KJELLMAN based his grouping of the species, KJELLMAN's "species" of one of the groups nevertheless represent, in all probability the tetrasporic or sexual form of another "species" referred to another group.

For instance the species of the sectio "*Vepreculæ*" of KJELLMAN represent the sexual plants, and those of the sectio "Brachycladia" the tetrasporic plants of corresponding species. And the group *Rhodura* is made up of tetrasporic plants whose corresponding male and female plants are to be found in the groups *Microthoë* and *Eugalaxaura* of KJELLMAN.

How different the two corresponding forms of the same plant are, is best seen by comparing some of my figures of the anatomical structure as given above. Nobody would imagine taht the *Galaxaura occidentalis*, as it is described and figured on pag. 110—11, could belong to the same species as *G. marginata*, the anatomical structure of which is shown in Fig. 116.

According to HOWE the forms found in the West Indies might be grouped in this way:

39. **Galaxaura marginata** (Sol.) Lamx.
(sexual form: *G. occidentalis* Børgs.).
40. **Galaxaura squalida** Kjellm.
(tetrasporic form: *G. flagelliformis* Kjellm.).
41. **Galaxaura rugosa** (Solander) Lamx.
(tetrasporic form: *G. subverticillata* Kjellm.).
42. **Galaxaura cylindrica** (Solander) Kjellm.
(tetrasporic form: *G. lapidescens* (Sol.) Lamx.
43. **Galaxaura oblongata** (Ell. et Sol.) Lamx. according to Howe, the right name for *G. fragilis* (Lamarck.) Kjellm.
(tetrasporic form: *G. comans* Kjellm.).

44. **Gelidium corneum** (Huds.) Lamour.
45. **Wrangelia Argus** Mont.
46. — **bicuspidata** Børgs.
47. — **penicillata** C. Ag.
48. **Halymenia Floresia** (Clem.) Ag.
49. **Grateloupia filicina** (Wulf.) Ag.
50. — **dichotoma** J. Ag.
51. — **cuneifolia** J. Ag.

Cryptonemia J. Ag.

52. **Cryptonemia crenulata J. Ag.**

J. Agardh, Nya alger från Mexico (Öfvers. k. Vet.-Akad. Forh. 1847, p. 11, the note); Spec. Alg., vol. II, p. 225; Epicrisis, p. 163. Harvey, W. H., Nereis Bor.-Am., part II, p. 184. Kützing, F., Tab. Phycol., vol. 19, tab. 31.

Pyllophora crenulata J. Ag., In Hist. Alg. Symbolæ (Linnæa, vol. 15, 1841, p. 18).

Areschoug, J. E., Icones algarum, 1847, p. 1, tab. II. Kützing, Spec. Alg., p. 791.

Phyllophora denticulata Kütz., Tab. Phycol., vol. 19, tab. 77.

Two small collections have been found. One of them was dredged in deep water and consists of small plants growing epiphytic upon a piece of coral. The plants have a small basal disc and a very short stipe from which the thallus quickly broadens out, the broadest part being somewhat over $^1/_2$ cm. broad. It is several times subdichotomously ramified. The margin is somewhat sinuate and irregularly dentate.

The other specimen was most probably growing in shallow water. It is a larger plant with much broader thallus, more than one cm. broad, and more proliferous and, on the whole, very irregularly ramified. The margin is sinuate with larger and smaller teeths.

Both specimens were sterile.

St. Croix: near White Bay. St. Jan: near Rams Head (ca. 20 fathoms). Geogr. Distrib.: West Indies, Brazil.

53. **Contarinia Magdæ** Web. v. Bosse.
54. **Cruoriopsis** spec.
55. **Peyssonnelia armorica** (Crn.).
56. — **Dubyi** Crn.
57. — **Boergesenii** Web. v. Bosse.
58. — **Nordstedtii** Web. v. Bosse.
59. — **simulans** Web. v. Bosse.
60. — **conchicola** Picc. et Grun.?
61. — **polymorpha** (Zan.) Schm.?
62. — **rubra** (Grev.) J. Ag.
63. **Hildenbrandia prototypus** Nardo.
64. **Lithothamnion mesomorphum** Foslie.
65. — **sejunctum** Foslie.

66. **Lithothamnion ruptile** Foslie.
67. — **occidentale** Foslie.
68. **Lithophyllum accretum** (Fosl. et Howe) Lem.
69. — **caribaeum** Fosl.
70. — **erosum** Fosl.
71. — **intermedium** Fosl.
72. — **daedalum** Fosl. et Howe.
73. — **strictum** (Fosl.) Lem.
    var. *nana* Fosl. et Howe.
74. — **absimile** Fosl. et Howe.
75. — (?) **propinquum** (Fosl.)
76. — **prototypum** Fosl.
77. **Melobesia farinosa** Lamx.
78. — **Chamaedoris** Fosl. et Howe.
79. — **atlantica** (Fosl.) Lem.
80. — **affinis** (Fosl.) Lem.
81. **Porolithon mamillare** (Harv.) Lem.
    var. *occidentalis* Fosl.
82. — **Boergesenii** (Fosl.) Lem.
83. — **pachydermum** Fosl.
84. **Amphiroa rigida** Lamx.
85. — **fragilissima** (L.) Lamx.
86. **Corallina cubensis** (Mont.) Kütz.
87. **Jania pumila** Lamx.
88. — **adhaerens** Lamx.
89. — **decussato-dichotoma** Yendo.
90. — **capillacea** Harv.
91. — spec.

92. **Spermothamnion investiens** (Crouan) Vickers.
    var. *cidaricola* Børgs.

Besides the var. *cidaricola* (comp. p. 200), which covers the spikes of *Eucidaris tribuloides* quite densely, I have come across a closely related form which in a similar way may densely cover the stems of *Chamædoris Peniculum* to which it is fastened firmly by means of the numerous short rhizoids given off from the basal creeping filaments (Fig. 422 *a*). The rhizoids are unicellular, ending in a broad disc with coralliform outline. The creeping filaments are upto 35 μ thick.

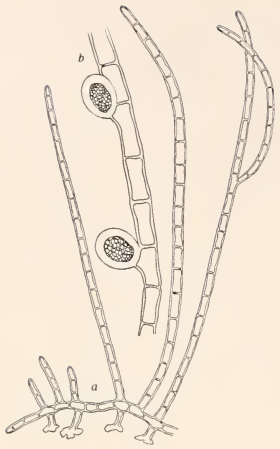

Fig. 422. *Spermothamnion investiens* (Crouan) Vickers. *a*, part of a plant. *b*, part of a filament with sporangia. (*a*, about 70: 1; *b*, about 140: 1.)

From the creeping filaments the erect ones arise. These are mostly simple, bearing now and then — for the most part in their upper end — one or more branches but never many. The erect filaments are nearly cylindrical; they are 24—27—31 μ thick. The length of the cells about 70– 80 μ.

A few tetrasporangia were found (Fig. 422 *b*). They were sessile, roundish-subreniform in shape with a thick periferal wall, about 45 μ broad and 50 μ long. The sporangia occurred upon the main filament.

The plant was gathered near the shore in a rather exposed rocky locality; it had tetrasporangia in the month of January.

St. Croix: White Bay.

93. **Griffithsia globifera** (Harv.) J. Ag.

94. **Griffithsia tenuis** Ag.

C. Agardh, Spec. Alg., vol. II, p. 131. J. Agardh, Spec. Alg. vol. II, p. 84; Epicrisis, p. 70. Collins and Hervey, Alg. Bermuda, p. 135, pl. VI, figs. 38—39.

Griffithsia thyrsigera Askenasy, Forschungsreise "Gazelle", IV Theil, Bot., p. 36, pl. IX, figs. 1 and 4.

Callithamnion tenue Harvey, Nereis Bor.-Am., part III, p. 130.

Creeping upon some larger algæ I have found some well developed tetrasporic specimens of this plant (Fig. 423).

As pointed out by Collins and Hervey the *Griffithsia thyrsigera* Askenasy and *Callithamnion tenue* of Harvey do belong to this species. Regarding Askenasy's description of the tetrasporic plant, some differences are certainly present, but this is, as indicated by Collins and Hervey, most probably due to the more luxuriant development of the West Indian plant.

Griffithsia tenuis forms very loose tufts composed of the irregularly ramified filaments. It is fixed to the host plant by means of vigorous rhizoids breaking out from the decumbent creeping

part of the filaments (Fig. 423 *a*). The rhizoids are unicellular, having in their basal end a flat roundish, coralliform disc. The rhizoids are given off mostly in the basal proximal ends of the cells near the cross walls (Fig. 423 *a*), but now and then, too, a rhizoid (mostly smaller) is issued in the upper (distal) end of the adjacent cell.

The ramification is not very abundant; being mostly restricted to a few branches in the older parts of the thallus, the upper ends of the filaments often being undivided. As pointed out by Askenasy a peculiarity is to be noted regarding the issue of the branches, these not being given off at the distal end of the cells, as is ordinarily the case in related forms, but near the basal wall of the cells (Fig. 423 *a*).

The cells are nearly cylindrical or a little thicker at both ends; about 200 μ thick and 4—6 times as long. The wall is thick in the older parts of the thallus. Near the apex of the filaments the young cells become gradually shorter and a little swollen at their upper end.

Round the upper end of the young cells is early formed a dense ring composed of several rows of hairs. These are di-trichotomously ramified and are soon shed, long before the cell has reached its normal size.

The tetrasporangia (Fig. 423 *b*) are formed upon shorter or longer, pyriform to clavate, unicellular pedicels, one upon each of these. They form a dense ring at the upper ends of the cells, a little above that of the hairs or scars of these. Askenasy found about ten only in each

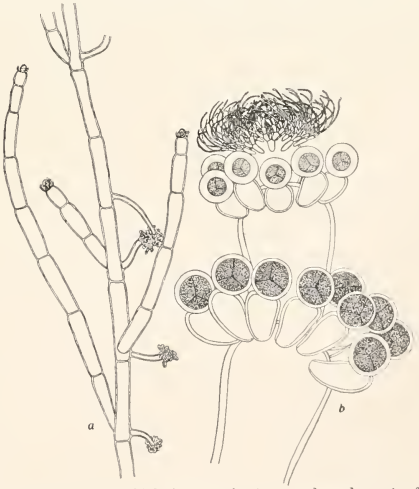

Fig. 423. *Griffithsia tenuis* Ag. *a*, basal part of a plant. *b*, apex of filament with tetrasporangia. (*a*, about 17:1 *b*, about 85:1).

ring; in the West Indian plant, as pointed out by Collins and Hervey, too, about 15 are often present. Mostly each filament bears two to three whorls, but sometimes more than six whorls are successively developed. The diameter of the mature tetrasporangia is about 100 μ.

The antheridial stands are described and figured by Askenasy; they are formed terminally upon short pedicels of one to three cells (comp. Collins and Hervey, The Algæ of Bermuda, p. 135). The cystocarps seem to be insufficiently known. Askenasy describes, but in a very fragmentary manner, one found by him and Collins and Hervey only say that "they are characteristic of *Griffithsia*".

The plant was gathered with tetraspores in the month of January. It was found in shallow water near the shore in a rather sheltered place behind the protecting coral reef.

St. Croix: Lime Tree Bay.

Geogr. Distrib.: Mediterranean Sea, West Indies, New Guinea, Bermuda etc.

95. **Griffithsia barbata** (Engl. Bot.) Ag.

C. Agardh, Spec. Alg., vol. II, p. 132. J. Agardh, Spec. Alg., vol. II, p. 80; Epicrisis, p. 64. Kützing, Spec. Alg., p. 660; Tabul. Phycol., vol. XII, tab. 24. Harvey, Phycologia Britannica, tab. 287.

Conferva barbata Smith, Engl. Botany, tab. 1814.

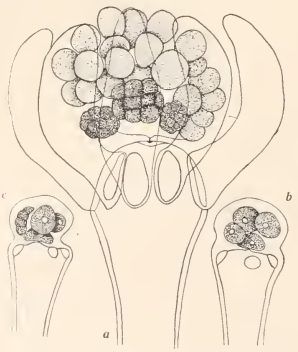

Fig. 424. *Griffithsia barbata* (Smith) Ag. *a*, a nearly ripe cystocarp. *b* and *c*, a procarp seen from two opposite sides. (*a*, about 175:1; *b* and *c*, about 150:1.)

Of this plant I have twice come across a few filaments of female plants. In the one collection, found between some different algæ gathered at Lt. Princess, St. Croix, a young procarp was present. It is a well known fact that the procarp in this species is developed terminally upon a short branchlet composed of a single joint. The Fig. 424 *b*, *c* shows a young procarp seen from two different sides. From this it is seen that the basal central cell bears two pericentral

cells and furthermore the carpogonial branch. If this is normally the case then the difference from *Gr. globifera* is great; in that species likewise only a single carpogonial branch is present,the carpogonial branch in *Gr. globifera* being, as described by Lewis[1]), formed from the second or third peripheral cell.

The cystocarps are surrounded by an involucrum composed of about eight cells, growing out from the upper end of the terminal joint cell. These cells are long and curved over the cystocarp (Fig. 424 *a*). According to Zanardini[2]) and Hauck[3]) the rays of the involucrum are either undivided or consist of two to three cells.

The vegetative cells were about 100 μ broad and four to five times as long.

The plants were collected in the month of February and March, the one in shallow water near the shore, the other in a depth of about 30 meters.

The *Griffithsia* spec., mentioned above on pag. 208, belongs most probably to this species.

St. Croix: Lt. Princess; St. Jan: off Cruz Bay in the sound between this island and St. Thomas.

Geogr. Distrib.: Mediterranean Sea, warmer parts of the Atlantic European coast.

96. **Mesothamnion caribaeum** Børgs.

97. **Callithamnion cordatum** Børgs.

98. — **byssoides** Arn.

99. — spec.

100. **Seirospora occidentalis** Børgs.

101. **Antithamnion Butleriæ** Collins.

Collins, Fr. S., The Algæ of Jamaica (Proceed. of the Amer. Acad. of Arts and Scienc., vol. XXXVII, 1901, p. 258).

Some small fragments (Fig. 425) of this delicate plant were found creeping upon *Lophosiphonia obscura.* These seem to accord with the description given by Collins. The main filament reaches a breadth of up to 30 μ, its cells a length of about four time the breadth. The wall is thick. In the lowermost part of

[1]) Lewis, The Life History of Griffithsia Bornetiana (Annals of Bot., vol. 23, 1909, p. 657).

[2]) Zanardini, Iconogr. Phycol. Med.-Adriat. II, p. 39, pl. 50.

[3]) Hauck, Die Meeresalgen Deutschl. und Oesterreichs, p. 91.

the filaments the opposite branches are issued nearest the basal (proximal) wall of the cells in a way similar to that found in *Griffithsia tenuis* (Fig 425 *c*); higher up in the thallus, on the other hand, the branches issue always a little below the upper cross-wall of the cells (Fig 425 *a*, *b*)

In the basal part of the thallus some of the cells are naked or bear only a single short ramulus, but soon each cell bears two opposite branches, which, when the thallus reaches its highest development, first gradually develop ramuli from their lower side and later from their upper side also. The rachis of the pinna consists of about 10 cells, the ramuli on the lower side seldom of more than 3 to 4 cells, those on the upperside of 2 to 3. The length of the whole pinna is about 500 μ.

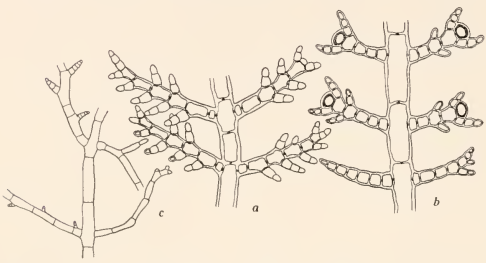

Fig. 425. *Antithamnion Butleriæ* Collins. *a* and *b*. parts of the thallus with glands. *c*, part of the thallus near the base. (*a*, *b*, about 175:1; *c*, about 60:1.)

The uppermost cell in the rachis of the pinnæ is often transformed into a gland-cell (Fig 425 *b*). This gland-cell is short and broad with roundish summit and has the usual transparent, homogenous contents. Now and then, too, the end cell of the ramuli are transformed into a gland-cell (Fig. 425 *a*). The specimens found were sterile.

Found once in shallow water near the shore.

St. Croix: White Bay.
Geogr. Distrib.: Jamaica, Barbadoes.

102. **Antithamnion antillanum** Børgs.
103. — spec.
104. **Crouania attenuata** (Bonnem.) J. Ag.

105. **Spyridia filamentosa** (Wulf.) Harv.

After having finished my description of this plant (p. 233) I have come across an antheridial plant. The antheridial stands

are formed near the base of the ramuli covering densely several cells. The antheridial stands were first observed by FARLOW who in "The Marine Algæ of New England", p. 140, pl. X, fig. 1 has described and figured them.

Tetrasporangia, cystocarps and antheridia were found in the months January to March.

106. **Spyridia clavata** Kütz.
107. — **aculeata** (Schimp.) Kütz.
var. *typica.*
var. *disticha* Børgs.
f. *inermis* Børgs.
108. **Centroceras clavulatum** (Ag.) Kütz.
109. **Ceramium fastigiatum** (Roth) Harv.
110. — **strictum** Grev. et Harv.
111. — **transversale** Coll. et Herv.
112. — **nitens** (Ag.) J. Ag.
113. **Laurencia Poitei** (Lamx.) Howe.
114. — **papillosa** (Forsk.) Grev.
115. — **obtusa** (Huds.) Lamx.
var. *gelatinosa* (Desf.) J. Ag.
116. — **implicata** J. Ag.
117. — **chondrioides** Børgs.
118. — **cervicornis** Harv.

119. **Chondria polyrhiza** Coll. et Herv.

The first time I examined this plant I had only a dried specimen at my disposal, now I have come across some more material, some of it preserved in alcohol.

In this material the group of rhizoids were not so very abundant, being mostly restricted to the basal parts of the filaments or to filaments becoming decumbent or approaching other algæ etc. to which they could fix themselves.

A transverse section shows that the thallus is terete (Fig. 426 *b*), and that the cells have very thin walls. The small central cell is surrounded by four to six large pericentral cells; at the periphery these have, for the most part, some smaller cells, the whole being encircled by a thin cortical layer of quite small cells.

The branches have rather broad bases (Fig. 426 *a*), these

being but slightly narrowed or not at all; upwards the narrowing of the branches is, for the most part, slight and gradual until rather suddenly, near the summit, they start tapering rapidly into the acute apex.

As described by Collins and Hervey the tetrasporangia are formed in the upper ends of the branches (Fig. 426 *a*); the fructiferous part is swollen being often about twice the breadth of the sterile, slender part.

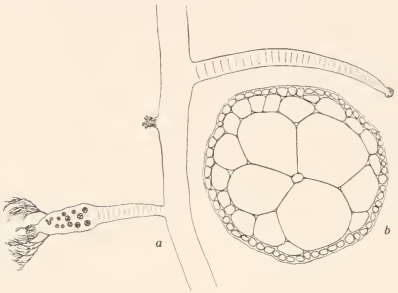

Fig. 426. *Chondria polyrhiza* Collins and Hervey. *a*, part of thallus with a group of rhizoids and a tetrasporic branch. *b*, transverse section of the thallus. (*a*, about 17:1; *b*, about 60:1.)

In several respects, for instance, as to its whole appearance, this plant shows great likeness to the *Laurencia chondrioides* described by me, but on closer examination several differences will soon be observed, for instance, the acute apex of the thallus, the pericentral cells easily seen through the cortical layer, the different shape of the branches especially the tetrasporic ones and the highly deviating transverse section.

Found with tetraspores in the month of March.

The specimens were gathered in the same locality as those formerly examined.

St. Jan: off Cruz Bay.

120. **Chondria atropurpurea** Harv.
121. — **littoralis** Harv.
122. — **dasyphylla** (Woodw.) Ag.
123. **Acanthophora spicifera** (Vahl) Børgs.
124. — **muscoides** (L.) Bory.
125. **Polysiphonia havanensis** Mont.
126. — spec.
127. — **variegata.** (Ag.) Zan.
128. — **sphærocarpa** Børgs.
129. — **macrocarpa** Harv.
130. — **ferulacea** Suhr, J. Ag.

131. **Digenea simplex** (Wulf.) Ag.

In a collection consisting of various algæ I have come across the male plant of this species. The antheridial stands have previously been known only from a figure in KÜTZING's "Tabulæ Phycologicæ", vol. 15, pl. 28, fig. m. Concerning this figure FALKENBERG in his monograph of the *Rhodomelaceæ* writes p. 160: "Die Antheridien habe ich zwar nicht selbst gesehen, aber die Abbildung KÜTZING's lässt wohl kaum eine andere Deutung zu, als dass es sich bei *Digenia* in der That um flache, ovale Antheridien handelt, die am oberen Ende der Sprosse gehäuft stehen. Ich wäre eher geneigt, die Abbildung auf misverstandene eingekrümmte Blätter zu deuten, wenn ich nicht bei *Bryothamnion* analoge flache Antheridien gefunden hätte".

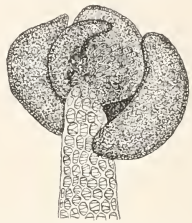

Fig. 427. *Digenea simplex* (Wulf.) Ag. Summit of the thallus with antheridial stands. (About 80: 1.)

The male plants recently discovered by me prove that KÜTZING has had such a plant at his disposal. The antheridial stands are, when fully developed, discoid bodies of oblique reniform shape; their entire surface is covered by the antheridia.

A whole trichoblast is used to the formation of the antheridial stand just as in the case of *Bryothamnion* according to FALKENBERG's description (l. c., p. 175), and its development takes place in a very similar way. From an apical cell with two sides segments are cut off alternately at both sides. These segments or branches remain together, increasing gradually in length and at the same time dividing into smaller cells; and this process is carried on until the above mentioned flat bodies are formed.

The antheridial plant was found in the month of January in shallow water near the shore.

St. Croix: Lt. Princess.

132. **Bryothamnion triquetrum** (Gmel.) Howe.

133. — **Seaforthii** (Turn.) Kütz.

134. **Herposiphonia secunda** (Ag.) Falkenb.

As pointed out in my previous description of *Herposiphonia*. I was most inclined to consider the two species *H. tenella* and

H. secunda as nothing else but two forms of the same plant. This opinion I founded on the fact that the supposed different ramification, being the only real difference between them, would not be proof against a thorough examination of more extensive material, and this point of view, that the ramification in itself is not a sufficient character of distinction, I still maintain, at any rate, to a certain degree.

Nevertheless, I have now come to the conclusion that we have to do with two different species, my conclusion being based on the fact that I have succeded in finding two very different types of antheridial plants, so different that they necessarily must be regarded as belonging to two distinct species. Had these two different types shown diverse forms of ramification we might perhaps by means of this have been able to refer plants with other fructiferous organs, tetraspores and cystocarps to their respective species. But this was not the case, both plants being ramified with some differences in a rather peculiar way which seems to be characteristic of the male plants.

Fig. 428. *Herposiphonia secunda* (Ag.) Falkenb. *a*, transverse section of antheridial stand. *b*, apex of branchlets with antheridial stands in different stages of development. *c*. part of a male plant. (*a*, *b*, about 200:1; *c* about 50:1.)

If we now leave out of consideration the ramification as a character of distinction between the two species and look upon the other differences between them mentioned in the descriptions we find that the most essential one is that *H. tenella* is a more slender plant than *secunda*. Taking this into consideration I now refer the most robust form of the antheridial plants found to *Herposiphonia secunda*, the other to *H. tenella*[1]).

[1]) The third West Indian form, *H. Pecten-veneris* (Harv.) Falkenb. is, I think, nothing else but a form with recurved branchlets and summits of branches.

Before entering upon a description of both plants I wish to point out that both were found growing together upon the same host plant, *Dictyota indica*, in the open sea at a depth of about ten meters. Consequently they were both growing under exactly the same external conditions, these no doubt highly influencing the habit of these plants. They were gathered in the month of February.

So far as I know the antheridial stands of *Herposiphonia* are on the whole known only from the rather imperfect note by Falkenberg in his monograph, l. c., p. 308.

The antheridial stands in the plant referred to *H. secunda* are formed by the trichoblasts in the upper end of the branchlets (Fig. 428). A whole trichoblast is used to each antheridial stand. They show great likeness to those found in *Polysiphonia*, for instance to those in *Polysiphonia ferulacea*, comp. my fig. 278.

When fully developed the antheridial stands consist of a basal stalk composed (mostly) of two cells, a shorter basal one and a longer above it (Fig. 428); they are both without chromatophores and have very thick walls. The lowermost cell is about 20 μ high, that above from 40 μ to 60 μ long and about 60 μ thick; the peripheral wall is about 8 μ thick. Then follows the fructiferous, polysiphonous part covered all over with the antheridia. It is subcylindrical, about 70 μ thick below, 55 μ above and about 180 μ long. In the specimens I have examined it consists of 4 to 5 segments, the central cells being clearly visible in the middle (Fig. 428 *a*). From the middle of the central cells smaller cells are given off; these are di-tri-tetrachotomously ramified several times in a candelabrum-like manner. The outmost cells are the antheridia.

The whole antheridial stand ends in a terminal sterile cell, about 50 μ long, subpyramidal in shape and like the cells in the stalk with no chromatophores and with very thick wall.

Fig. 428 *b* shows in the middle a young stage of the antheridial stand. From this it is seen that the antheridial part of it consists of short segments becoming gradually polysiphonous.

In the male plants found, the development of the branches and branchlets is much reduced. In some of the plants no trace of branches are found at all, in others these are only very rudi-

mentarily developed; and the branchlets are developed in a very restricted number.

The most common form of ramification found in the male plant is that drawn in the diagram (Fig. 429) and also clearly seen in the Fig. 428 *c* namely, after a segment with a branchlet issuing, as it seems, from the dorsal median line, follows one with a rudimentary branch alternately on the right or left side of the stem, but always on the opposite side of the stem as the foregoing, then three bare segments, then one with a branchlet and one with a branch and so on. In another specimen in which no branches at all were developed I found generally three bare segments between each with a branchlet, once only two bare segments. The branchlets seem all to be issued from the dorsal median line of the main branch, not being arranged in zig-zag form as is commonly the case.

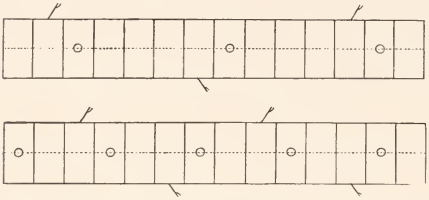

Fig. 429. Scheme of the ramification as found in the male plants of *Herposiphonia secunda* (uppermost) and in *Herposiphonia tenella* (lowermost). (The apical end at the left).

This varying arrangement of branchlets and branches, differing much from that commonly found in *Herposiphonia*, seems to support my view that no systematic value can be attached to it.

So far I have seen, both the main filaments and branchlets of this form have eight pericentral cells. The branchlets are about 80 μ thick.

Of the forms mentioned in my description on p. 286 I now think it best to refer the plants figured in Figs. 288 and 289 to *H. secunda*, these having short segments and being on the whole rather robust.

135. **Herposiphonia tenella** (C. Ag.) Nägl.

The male specimens referred to this plant have more slender antheridial stands than those of *H. secunda* (Fig. 430). Commonly the whole stand together with basal cells and apex reaches a length of about 150 μ (the fructiferous part alone 125 μ) and a breadth of about 40 μ; the largest antheridial stand found on the whole was 240 μ long and 55 μ broad.

Beginning from the base, the stalk consists in the normally developed antheridial stands of two cells (Fig 430 *b*); the lowermost about 12 μ long and 20 μ broad is nearly immersed in the tissue of the branchlet, the uppermost about 12—16 μ long and 24 μ broad has rather thick walls. The antheridial part is nearly cylindrical; it is terminated by a sterile part. This consists in the different specimens of a varying number of short cells, two to five, or sometimes it terminates in a longer trichothallic prolongation (Fig 430 *a*). A few times I have found ramified antheridial stands where, in two cases, a smaller fructiferous branch issued from the second cell in the stalk (comp. Fig. 430 *a*), and in another stand three cells were developed in the stalk, and from the uppermost of these cells a well developed, ramified, trichoblastic, sterile branch issued (Fig. 430 *c*). This shows that in this species there is a tendency not to use the whole trichoblast in the formation of the antheridial stands, this feature, as mentioned above, being in most cases confined to a few sterile cells in the upper end of the antheridial stands, in others to a shorter or longer hairlike prolongation, rarely to a whole ramified trichoblastic branchlet. The whole antheridial stand is generally much curved in this species in contradistinction to the straight ones in *H. secunda*. And while the antheridial stands, rarely more than four, are crowded together in the upper end of the branchlets in *H. secunda*, these, in *H. tenella* (up to a number of ten upon

Fig. 430. *Herposiphonia tenella* (Ag.) Nägl. *a*, part of a male plant. *b*, transverse section of antheridial stand. *c*, apex of branchlet with antheridial stand from the third basal cell of which a sterile well developed trichoblastic branch is given off. (*a*. about 50:1; *b* and *c*, about 200:1.)

the same branchlet) are found scattered along the branchlet often one from each segment with the exception of the lowermost. A great number of segments, 10—12 or more, are present in the fructiferous part of this plant, the central cells of which are easily observable (Fig. 430 *b*); in *H. secunda*, as mentioned above, only four to five are present.

Fig. 431. *Herposiphonia* spec. *a* and *b*, plants with cystocarps (compare the text). *c*, part of tetrasporic plant. (*a* and *b*, about 22:1; *c*, about 50:1.)

As to the ramification of the main stem I have generally found a single bare segment between those with branchlets and branches, as shown in the diagram (Fig. 429). But modification is often present, compare e. g. Fig. 430 *a* where two bare segments are found in one case.

In this form in the main stem, nine pericentral cells were present, in the erect branchlets seven only. The diameter of the branchlets was about 50 μ.

In a collection af various algæ from shallow water gathered at the shore of Water Island at St. Thomas, plants with cystocarps were found. How far these plants really belong to *H. tenella* I dare not say with certainty. The ramification, at any rate, was the common one answering to the diagram of it given by Falkenberg, l. c. p. 303.

As described by Falkenberg, l. c., p. 309, pl. 3, fig. 10 the procarps are formed in the trichoblasts in the upper end of the branchlets. The branchlets, which bear the cystocarps, become

more robust, having much shorter and broader segments than those of the vegetative branchlets in the same plant. The ripe cystocarps are frequently placed in the upper end of the branchlets (comp. Fig. 431 *a*), but not always. Often the branchlets, bearing the cystocarp, get renewed growth, attaining a considerable length and in this way giving rise to a new branchlet (comp. Fig. 431 *a*), these being composed of about the same number of segments as the common branchlets and in their upper end terminated by trichoblasts.

And this development may be carried on still further. I have found several specimens in which the branchlet growing out below the cystocarp gets indefinite growth like the main filaments; branchlets grow out from its dorsal side and it may develop into a normally built main axis (Fig. 431 *b*). While in my specimens the above mentioned three different cases occurred, Falkenberg in his specimens has only found one form: a branchlet growing out below the cystocarp. Falkenberg accounts for this peculiar phenomenon by the increased supply of nutrition to the cystocarps, which also benefits the branchlets and favours the growth.

The cystocarps are urceolate with a rather long neck and a wide opening; they are about 300 μ broad and 400 μ long.

The plant was found with cystocarps in the month of January.

A slender form with tetraspores (Fig. 431 *c*) was once dredged in deep water. The branchlets in this form are very long; at their base about six sterile segments were present followed by one to six fructiferous segments and finally a long sterile upper end composed of about twenty long, but slender segments tapering slowly upwards. The ramification of this plant was the same as the cystocarpic plants, mentioned above.

This plant was found at a depth of about 30 meters in the month of March in the sound between St. Jan and St. Thomas: off Cruz Bay.

136. **Dipterosiphonia dendritica** (Ag.) Falkenb.

137. **Lophosiphonia obscura** (Ag.) Falkenb.

138. **Lophosiphonia cristata** Falkenb.

In my previous examination of this plant I had only sterile material at my disposal, now I have come across specimens with cystocarps and tetraspores.

As always in the case of the Fam. of the *Rhodomelaceæ* it is from the second joint of the young trichoblasts that the procarp originates. The lowermost joint of the trichoblast becomes polysiphonous, too, while the upper end of the trichoblast soon dies away.

Fig. 432 *a* shows a quite young procarp. Fig. 432 *b* a more advanced stage at the moment of fecundation. We see here the four-celled carpogonial branch from which the long thin trichogyne (specimens have been found in which the trichogyne has twice

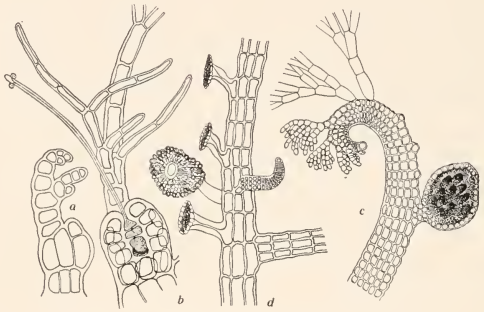

Fig. 432. *Lophosiphonia cristata* Falkenb.
a, quite young procarp. *b*, more developed procarp in the stade of fertilization. *c*, upper end of erect filament with cystocarp. *d*, part of basal creeping filaments with rhizoids ending in large roundish discs.
(*a* and *b*, about 260:1; *c*, about 150:1; *d*, about 60:1.)

the length of the one drawn in the figure) protrudes; two spermatia are fixed to its upper end. The fully developed cystocarp (Fig. 432 *c*) is oblique urceolate with a rather broad opening in its upper end. It is about 200 μ long and 170 μ broad.

The tetrasporangia have been found by Falkenberg and I refer to his description (l. c., p. 500). The tetrasporangia are formed one in each segment in the upper end of the erect filaments and in adventitious short branchlets, of which several were present in the specimens found. They are spirally arranged.

The specimens with cystocarps and tetraspores were found in the month of January. Together with *Herposiphonia tenella*, *Laurencia* and blue-green algæ it formed low dense crusts upon the rocky shore of Water Island at St. Thomas.

139. **Bostrychia tenella** (Vahl) J. Ag.
140. **Lophocladia trichoclados** (Mert., C. Ag.) Schmitz.
141. **Wrightiella Tumanowiczii** (Gatty) Schmitz.
142. **Murrayella periclados** (Ag.) Schmitz.
143. **Dasya pedicellata** Ag.
144. — **mollis** Harv.
145. — **caraibica** Børgs.
146. — **ocellata** (Gratel.) Harv.
147. — **corymbifera** J. Ag.
148. **Heterosiphonia Wurdemanni** (Bail.) Falkenb.
var. *typica* Børgs.
var. *laxa* Børgs.
149. **Dictyurus occidentalis** J. Ag.
150. **Falkenbergia Hillebrandii** (Born.) Falkenb.
151. **Cottoniella arcuata** Børgs.

Shortly after the publication of part V of this treatise, in which I described this plant, I got a letter from Dr. Howe of New York in which he most kindly called my attention to a plant which he some years ago had described and referred to the genus *Sarcomenia*, namely *S. filamentosa* Howe[1]). I regret very much that I have overlooked it, as it seems to come very near to the plant I have found.

Fortunately I do not think that the mischance I have had in overlooking Dr. Howe's plant will have any influence on my new genus. If we, namely, consider the species hitherto referred to the genus *Sarcomenia* we will soon find out that these are very heterogeneous, and this fact has also been pointed out by Grunow[2]), Agardh[3]) and recently by Howe, l. c. Concerning this matter I wish to quote here what Howe writes; l. c., p. 572: "*Sarcomenia filamentosa* does not appear to be very closely related to any of the described species of this chiefly Australian genus. The only other species to which monosiphonous filaments are attributed are, so far as we can discover, the Australian species *Sarcomenia tenera* (Harv.) J. Ag., *S. dolichocystidea* J. Ag., *S. opposita* J. Ag. and *S. secundata* J. Ag., but these are all much

[1]) Howe, M. A., Phycological Studies, II. (Bull. Torrey Bot. Club, 32, 1905, p. 571, pl. 27 and pl. 29, figs. 1—11).
[2]) Grunow, A., Algæ in Reise der Oester. Fregatte Novara, 1870, p. 93.
[3]) Agardh, J., Analecta Algologica, Cont. 5, 1899, p. 130.

coarser plants with Dasyoid or Cliftonioid rather than Polysiphonioid habit, and the origin and arrangement of the branchlets and monosiphonous filaments are more or less different in all of these. In its delicate Polysiphonioid habit, *S. filamentosa* is nearer the group which includes *S. miniata* (Ag.) J. Ag. (the type of which we have seen in Herb. AGARDH), *S. intermedia* Grunow, and *S. mutabilis* (Harv.) J. Ag., but these differ not only in absence of monosiphonous filaments, but also in cortex characters, etc.; in *S. mutabilis*, also, the branches have a marginal or submarginal instead of mid-central origin.

The apparent incongruity of referring delicate plants of the miniata type to a genus originally based upon the fleshy membranous *Sarcomenia delesserioides* has already been remarked by GRUNOW and discussed at length by J. AGARDH. In placing the above-described new species in *Sarcomenia*, we accept, for the present, the current conception of the limits of the genus".

This shows that HOWE had some doubts when he referred his plant to this genus which already has so many different components making it yet more heterogeneous. A division of it seems therefore rather desirable, a beginning being now made by classing the genus *Cottoniella* as a representative of the two American species, *Cottoniella filamentosa* and *C. arcuata.*

In his above mentioned letter Dr. HOWE suggested that the two plants might perhaps be identical. However, according to the description by HOWE this does not seem to be the case, as several differences are present. With reference to those we may first point out that the monosiphonous filaments in my plant are arranged in zig-zag formation in two rows, as against one row in HOWE's. The upper ends of the branches in *C. filamentosa* do not seem to be archshaped like those in *C. arcuata.* And I have never found in mine similar flattened parts of the filament. as shown in fig. 2 or cross sections (3 or 4) in HOWE's figures. Nor have I found such a well developed cortex as is shown in HOWE's fig. 9, whilst the oldest and thickest filaments in my plant looked like my fig. 336 *b.* On the whole my plant seems to be a much more delicate plant than that of HOWE. Therefore I think we have to do with two different forms.

When I described the plant I placed it, though with much doubt, in the Fam. *Rhodomelaceæ* among "genera incertæ sedis",

my plant upon the whole showing so much likeness to a *Polysiphonia*. Now, of course, it has found its right place among the *Delesseriaceæ*. Its way of forming the cortex, the development of which I was not able to find out from my material, but which is easily seen in Howe's plant, exactly shows its relation to this family.

152. **Tænioma perpusillum** J. Ag.

153. **Caloglossa Leprieurii** (Mont.) J. Ag.

154. **Delesseria tenuifolia** Harv.

155. **Martensia Pavonia** J. Ag.

156. **Asparagopsis taxiformis** (Delile) Coll. et Herv.

Conolly has in "Flora", Bd. 103, 1911, Heft 2, given a description of the Australian species *Asparagopsis armata* which ought to be compared with that of *Asparagopsis taxiformis* given above.

157. **Gigartina acicularis** (Wulf.) Lamx.

Hypneocolax nov. gen.

Thallus parasiticus, minutus, subhemisphæricus, processibus brevibus undique projectis, verrucæformis aut semistellariæformis parte basali nutrici adfixus et cum hospite arcte coalescens. Structura parenchymatica, cellulis plus minus seriatis radiatim flabellatis; interiores majores, exteriores minores corticemque formant. Sporangia in cellulis externis formata in duas sporas divisa. Antheridia in summo filorum breviorum creata, dense congesta totam fere superficiem plantæ occupantia. Cystocarpia sparsa in singulis plantis pluria in processibus formata, semiglobosa poro terminali non instructa.

158. **Hypneocolax stellaris** nov. spec.

Thallus ca. $^3/_4$ mm latus. Cuticula crassa, 20—25 μ lata. Sporangia in cortice formata in duas sporas divisa, long. 30 μ; lat. 16—22 μ. Cystocarpia globosa pluria in eadem planta praesentia, carposporas numerosas continentia; latitudo eorum 20—22 μ.

Upon a specimen of *Hypnea musciformis* some small wartlike or sometimes more stellate bodies were found (Fig. 433),

having shorter processes with broad bases and acute or more roundish apices everywhere, except at the side facing the host plant. As soon as I observed them I supposed that I had to do with a parasitic *Floridean* and after having found, not only plants with neutral spores, but also antheridial and female plants, this seemed quite clear and was also amply proved by closer examination.

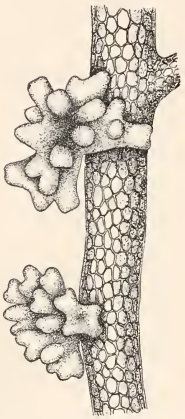

Fig. 433. *Hypneocolax stellaris* nov. spec. Two plants fixed to the host plant. (About 8:1.)

The parasite occurs in all parts of the host plant, upon young thin filaments as well as upon thicker main filaments; I have especially found many of them upon the tendrils of the *Hypnea*. The specimens attain the size of a pinhead, their diameter having a length of up to $^3/_4$ mm.

As the material has been preserved in alcohol I am unable to tell anything about the colour of the plant.

From a transverse section (Fig. 434, *a*, *b*, *c*) through the host and parasite is seen that their growing together is very intimate, the parasite having a very hyperplastic effect upon the tissue of the host. Thus the epidermal layer of the *Hypnea* is quite disorganized, its cells becoming in such a way transformed and intermingled among the cells of the parasite that it is generally quite impossible to say, where the one ends and the other begins. The parasite does not penetrate to any great extent into the tissue of the host. I have never found any of its filaments between the large cells in the medullary tissue of the *Hypnea*.

The figure 434 *b* shows a part of a transverse section of *Hypnea*, and the parasite. We see some of the large cells belonging to the central body of the *Hypnea*, but the very regular cortical layer of this plant is much damaged; perhaps two or three of the largest roundish cells are from this tissue, but this cannot be stated with certainty. And after having stained the transverse section in HOFFMANN's violet, dissolved in glycerine and water it is easily seen that the cells of the parasite and those of the *Hypnea* are connected by pores quite in the same manner as de-

scribed by Richards for *Choreocolax Polysiphoniæ*[1]) and thereby showing that we have to do with a real parasite.

From the transverse section is seen that the cells nearest to the host plant generally are the smallest, but they grow gradually larger. The cells in the middle of the tissue are roundish-polygo-

Fig. 434. *Hypneocolax stellaris* nov. spec.
a, transverse section of parasite and host. *b*. part of the same more magnified. *c*, longitudinal section of apex. *d*, laminated membrane. (*a*, about 40:1; *b* and *d*, about 250:1; *c*, about 100:1).

nal, rather irregular in shape with rather thick walls forming a parenchymatic tissue. The cells are more or less filled with rather large, roundish to oval grains of starchs. The cells of the parenchymatic tissue are usually arranged rather distinctly in rows. Towards the periphery the cells gradually become smaller and are distinctly arranged in rows, forming short filaments. The end

[1]) Richards, H. M., On the structure and development of *Choreocolax Polysiphoniæ*, Reinsch. (Proceed. Americ. Acad. of Arts and Sciences, vol. 26, 1891, p. 46).

cells are elongated and when they have reached a certain size they may be divided into two cells by a longitudinal wall, and thereafter the basal ends of the cells are cut off by transverse walls (comp. Fig. 434 *c*, *d*).

The whole plant is at the periphery surrounded by a very thick cuticula about 20—25 μ thick. It is obviously lamellated like *Lobocolax*, as described by Howe[1]) (Fig. 434 *d*).

The apex of the projections is composed of a great number of filaments packed together and diverging in all directions.

In some of the specimens I have found some large cavities; I think that these originate from lobes which have grown together, because the thick cuticula, too, was partly present upon the wall of these.

Most of the specimens examined were sterile; I have found only four with neutral spores, one with antheridia and five with carpospores.

The neutral spores (Fig. 435 *a*) are formed in the cortical layer in such a way that after the division of the terminal cells by a longitudinal wall, as described above, one of the cells becomes the mother-cell of the sporangia. This cell becomes filled with dense contents and increases gradually in size. It is then divided by a transverse wall into two spores. I have never found the sporangia divided into more spores than two, and, as most of the sporangia seemed quite mature, I feel convinced that no further division takes place. The sporangia are about 30 μ long and 16—22 μ broad. They are formed over the whole surface of the plant.

In the male specimen found, the antheridial stands occur in extended patches covering nearly the whole surface of the plant. The epidermal cells are divided several times into thin filaments composed of small roundish cells, the uppermost cells of which become transformed into the antheridia and are gradually rounded off and get loose (Fig. 435 *b*).

The female plants found all had quite or nearly ripe carpospores. The trichogyne or the carpogonial branch have not been found at all, and I have therefore not been able to follow the development of the cystocarps. But, nevertheless, I think I have

[1]) Howe, M. A., The Marine Algæ of Peru (Memoirs of the Torrey Bot. Club, vol. XV, 1914, p. 90).

seen sufficient to be able to refer the plant to its systematic place, this without doubt being among the *Gigartinaceæ*, as the development of the cystocarp seems to proceed along similar lines as in the case of *Harveyella* and *Choreocolax*, though with some differences.

To judge from the youngest stages found the sporogenous filaments grow out, after fertilization, from the central cell in all directions between the rather loose parenchymatic tissue and send off here and there short ramified filaments from which the carpospores are formed. Gradually, as the carpospores increase in size and number, the cells of the parenchymatic tissue are squeezed together in such a way that a small globular space is formed which is filled with the carpospores (Fig. 435 *c*). These are roundish-triangular in shape. Their diameter reaches a length of about 20—22 μ. Near the base of the cavity I have seen a large multilobed cell most probably being the auxiliary cell after the fusing with the sterile cells. I have not found any carpostome, the spores most probably becoming free by dissolving or bursting of the wall. Several cystocarps are present in each plant; they are formed in the processes, these getting a hemispherical shape.

Fig. 435. *Hypneocolax stellaris* nov. spec. *a*, part of transverse section with sporangia. *b*, transverse section of male plant. *c*, transverse section of a cystocarp. (*a*, about 175:1; *b*, about 200:1; *c*, about 150:1.)

Compared with *Choreocolax* and *Harveyella*, as these are known from the descriptions by Sturch[1]) and by Richards[2]), my plant

[1]) In Annals of Botany, vol. 13, 1899, p. 83.

[2]) Richards, H. M., On the structure and development of *Choreocolax Polysiphoniæ* (Proceed. Amer. Arts and Sciences, vol. 26, 1891, p. 46).

differs from *Choreocolax* by the clusters of carpospores formed by the sporogenous filaments, while in *Choreocolax* a single, but very large spore is produced at each place; it further differs by the lack of any carpostome. *Harveyella* differs from our plant by the fact that the cystocarps form large extended bodies over the surface of the plant, and are not confined to small roundish bodies as in my plant. From both genera my plant differs by the sporangia being divided into two spores only.

The plant was gathered in shallow water near the shore in a sheltered locality.

It had tetraspores, cystocarps and antheridia in the month of January.

St. Croix: Lime Tree Bay at the south shore of the island.

159. **Gymnogongrus tenuis** J. Ag.
160. **Kallymenia perforata** J. Ag.
161. **Catenella Opuntia** (G. et W.) Grev.
162. **Agardhiella tenera** (J. Ag.) Schmitz.
163. **Rhabdonia ramosissima** (Harv.) J. Ag.
164. **Eucheuma isiforme** (Ag.) J. Ag.
165. **Wurdemannia setacea** Harv.
166. **Gelidiopsis rigida** (Vahl) Web. v. Bosse.
167. **Gracilaria confervoides** (L.) Grev.
168. — **ferox** J. Ag.
169. — **compressa** (Ag.) Grev.
170. — **caudata** J. Ag.
171. — **cylindrica** Børgs.
172. — **usneoides** (Mert.) J. Ag.
173. — **Wrightii** (Turn.) J. Ag.
174. — **lacinulata** (Vahl) Børgs.
175. — **dentata** J. Ag.
176. — **cervicornis** (Turner) J. Ag.
177. **Hypnea musciformis** (Wulf.) Lamour.
178. — **cornuta** (Lamour.) J. Ag.
179. — **cervicornis** J. Ag.
180. — **spinella** (Ag.) Kütz.
181. **Gloiocladia** spec.
182. **Rhodymenia occidentalis** Børgs.
183. **Coelothrix irregularis** (Harv.) Børgs.

184. **Chrysymenia Agardhii** Harv.
185. — **planifrons** (Melv.) J. Ag.
186. — **ventricosa** (Lamour.) J. Ag.
187. — **Enteromorpha** Harv.
188. — **pyriformis** Børgs.
189. — **Uvaria** (L.) J. Ag.
var. *occidentalis* Børgs.
190. **Coelarthrum Albertisii** (Piccone) Børgs.
191. **Champia parvula** (Ag.) Harv.
192. — **salicornoides** Harv.

General remarks.

Definition of Species.

It is a well-known fact that some species show wide variation while others are almost constant and do not offer any difficulty as to classification.

Whilst the classification favoured by some writers tends to the formation of many small species in spite of the fact that intermediate forms occur between them, others prefer to group into more comprehensive species those forms which are linked together by intermediate stages. It appears to me that the middle course is here the most convenient. When I have considered myself able to prove the existence of such intermediate forms I have thought it best to refer them to the species with which they have most in common.

But in order to finally decide the matter an extensive material is necessary. When the material at hand contains only few specimens it is safer to classify into separate species; they can always, when more material is at disposal, be united later, if necessary.

To take an instance from the West Indian algæ, I have pointed out that *Caulerpa cupressoides* is a very variable plant, the forms of which are very diverse, but nevertheless these are all referable to the same species, as the variations seem to be due to the environment and are connected with intermediate forms.

Halimeda incrassata is another example. Howe divides this species into several smaller ones, while I, having found intermediate stages between the different forms, prefer to consider them as belonging to the same species.

It seems to me that we get a much better idea of the mutual relationship of the different forms, by connecting those which are obviously related, into larger species, than by dividing them up in a greater number of small ones.

This last renders it difficult to form a clear conception of their mutual affinities and equally difficult to compare the geographical conditions of the different floras.

Some remarks concerning the algal vegetation at the islands.

In the introductory remarks to my monograph of the West Indian *Caulerpas* I have mentioned the external conditions under which the algæ upon the whole live, and I can therefore refer the reader to what I then wrote as to the nature and situation of the coast and sea-bottom and to the fact that there is practically no tide at the islands in question.

But, as I have not dealt with the temperature of the sea, I may give here some figures which I owe to the kindness of Capt. Speerschneider of the Meteorological Institute, Copenhagen.

The numbers show the mean temperature for each month of the surface water in the sea at St. Thomas.

January	25,5	July	28,3
February	24,8	August	27,7
March	24,9	September	27,2[1])
April	25,6	Oktober	27,8
May	27,2	November	27,0
June	28,4	December	26,4

I regret that I am not in a position to give much information as to the algal vegetation and the associations etc. of which it is composed. I had planned to go to the islands in 1915 for the

[1]) For September a single observation only was made.

purpose of studying the algal vegetation, as during my earlier visits I had mostly been occupied with the flora, but the outbreak of the war suddenly put an end to my preparations for the journey.

When an algologist who is only familiar with the algal vegetation of our Northern seas — dependent upon a rocky coast or other firm substratum for its existence — for the first time comes in contact with the tropical algal vegetation, he cannot fail to be immensely struck with the extraordinary richness and variety of form of the tropical algal flora which flourishes on a loose and yielding sea-bottom and is formed of types which are altogether absent from the Northern seas. I briefly dealt with this matter for the first time in 1898 in the book written by Prof. Ove Paulsen and myself (Om Vegetationen paa de dansk-vestindiske Øer, Kjøbenhavn 1898, p. 4; also in Botan. Tidsskr. Vol. 22). Since then I have gone into the matter in more detail in later papers[1]) and therefore I shall not deal further with it here.

Another really just as strange occurrence of algæ in the West Indies is the vegetation which is fastened to the roots of the mangrove (*Rhizophora mangle*). The algæ find the rather uneven surface of the roots a favourable place to fasten themselves, and the fact that the water can circulate freely round the roots also contributes to favour this habitat. Consequently the result is that those mangrove roots which grow in the water, where it is salt and not stagnant, are overgrown by a vigorous and often very luxuriant algal vegetation. I have also mentioned this interesting vegetation in an earlier paper, namely in the above quoted volume published on the occasion of Professor Warming's seventieth birthday.

Upon the coral reefs and upon the larger and smaller blocks broken off from these we find near the surface of the sea and in shallow water several *Caulerpa*-forms covering the blocks and

[1]) Borgesen, F., A contribution to the knowledge of the marine Alga vegetation on the coasts of the Danish West-Indian Islands (Bot. Tidsskrift, vol. 23, 1900). An ecological and systematic account of the Caulerpas of the Danish West Indies (Kgl. danske Vidensk. Selsk. Skrifter, 7. Række, Naturv.-mathem. Afd. IV, 5, 1907). The algal vegetation of the lagoons in the Danish West Indies. (Biologiske Arbejder tilegnede Eug. Warming, den 3. Nov. 1911, København).

stones more or less abundantly[1]). In additions to *Caulerpa* many other algæ are characteristic of such localities; of the *Chlorophyceæ* we find for instance *Dictyosphæria favulosa* and *D. van Bosseæ*, *Valonia ventricosa*, *V. utricularis* and *V. macrophysa* all forming smaller or larger crust-like bodies, also *Cladophoropsis membranacea* occurs fixed as well as detached forming *Ægagropila*-like bodies upon the bottom. And these are joined with *Chamædoris annulata*, *Halimeda Opuntia* and *H. incrassata*, *Penicillus* and many others. Of *Phæophyceæ* we most frequently find several *Padina*- and *Dictyota*-species, tufts of *Ectocarpus*, *Colpomenia* and *Hydroclathrus* etc. and finally many *Rhodophyceæ*, of which the most characteristic are *Gelidiopsis rigida*, *Bryothamnion triangulare*, *Digenea simplex*, *Laurencia papillosa*, *Hypnea*- and *Spyridia*-forms, *Galaxaura*, *Amphiroa fragilissima* and other corallinaceous algæ, *Centroceras* and many other species, all forming larger or smaller tufts often intermingled between each other.

Upon the very exposed rocky coast of the northwest side of St. Croix several algæ occur so high above the sea-level that they are moistened only by the spray. Uppermost were found several *Myxophyceæ* and small tufts of *Laurencia obtusa* and *L. papillosa*, of *Dilophus guineensis*, *Dictyota ciliata* and *Padina gymnospora*. Amongst these, scattered tufts of *Chætomorpha antennina* were found in abundance and lower down *Polysiphonia ferulacea*, *Centroceras clavulatum* and *Ectocarpus breviarticulatus*. Extensive patches are formed by *Aglaozonia canariensis*, which covers the very uneven rocks with its fleshy — cartilaginous red-brown thallus; now and then *Ralfsia expansa* and *Lithothamnion*, too, form smaller or larger crusts. This association can perhaps be compared with that of *Callithamnion arbuscula* at the Færöes, the tropical association like the northern one living in such exposed places upon steep rocks where it is exposed to the whole force of the sea, and some of the tropical algæ, too, being able to retain the water like small sponges.

Another characteristic association of algæ, corresponding to the *Bangia—Urospora*-association of the Færöes was found in rather exposed places upon the steep rocky coast at Cruz Bay,

[1]) Borgesen, F., An ecolog. and system. account of the *Caulerpas*, l. c. p. 346.

St. Jan. The components of the West Indian algal communtiy consisted of *Enteromorpha plumosa*, *Chætomorpha* and *Rhizoclonium*-species, *Pylaiella fulvescens* etc., all thread-like algæ.

In crevices in rocks and in small caves, especially in rather shady places, several small algæ are able to grow a little above the surface of the sea, so they may become rather dry when the sea is calm. In such places in Store Nordside Bay (Magens Bay), St. Thomas, a vegetation was found uppermost composed of *Bostrychia tenella*, together with several *Myxophyceæ*, *Chætomorpha antennina*, *Ch. brachygona* and other forms, *Struvea delicatula*, *Hypnea spinella*, *Centroceras clavulatum*, *Sphacelaria tribuloides* and *furcigera*, *Tænioma perpusillum*, *Wrangelia Argus*, *Enteromorpha plumosa*, *Polysiphonia ferulacea*, *Ectocarpus* etc. But the great number of these species are yet, for the most time, covered by the sea, living quite near the surface. The rocks washed by the spray from the sea were covered by crusts of various Lichens[1]) and below *Ralfsia expansa* and *Lithothamnion* were found intermingled with the Lichens.

Upon stones and shells in somewhat exposed places crust-like algæ are often found in shallow water, for instance *Ralfsia expansa*, *Hildenbrandia prototypus*, *Peyssonnelia* etc. And upon stones scattered on sandy bottom in more sheltered places in shallow water *Agardhiella tenera*, *Castagnea Zosteræ*, *Rosenvingea Sanctæ Crucis*, *Ectocarpus*, *Hypnea musciformis*, *Spyridia filamentosa*, *Grateloupia* etc. grow in larger and smaller tufts.

Upon rocky and stony coasts often in bays, but also in rather exposed localities *Sargassum* and *Turbinaria* form together an often luxuriant vegetation, exactly corresponding with the Fucaceous vegetation of the Northern seas.

A characteristic algal vegetation occurs on piers and rocks, over which the waves are rolling, for instance in the inner harbour of St. Thomas where the water was much polluted. The most

[1]) According to the determination of Wainio, I collected here: *Parmelia lusitana* Nyl. var. *decipiens* Wain., *Pertusaria prætervisa* Wain., *Placodium Boergesenii* Wain., var. *squamosa areolata* Wain., *Placodium diplacium* (Ach.) Wain.; *Physcia integrata* Nyl., *Physcia picta* (Sw.) Nyl.; *Rinodina pyxinoides* Wain.; *Buellia conspirans* Nyl., *Buellia orcularia* Wain.; *Heppia Bolanderi* (Tuck.) Wain.; *Collema acarosporoides* Wain.; *Synalissa lichinella* Wain.; *Pyrenopsis negans* Wain.; *Psorotichia Boergesenii* Wain.

prominent components of this vegetation are *Grateloupia dichotoma* and *Gr. cuneifolia*, *Enteromorpha lingulata*, *Ulva Lactuca*, *Gymnogongrus tenuis*, *Bryopsis plumosa*, *Hypnea cervicornis* and *musciformis*, *Spyridia filamentosa* and *Sp. clavata* etc.

In deeper water at a depth of about 5 fathoms near Buck Island at St. Croix a rich vegetation of various algæ was present; among the most characteristic were *Griffithsia globifera*, *Liagora pinnata*, *Wrangelia penicillata*, *Laurencia Poitei* and *L. obtusa*, *Hypnea cervicornis*, *Gracilaria lacinulata*, *Digenea simplex*, *Amphiroa fragilissima*, *Dilophus Guineensis*, *Dictyota ciliata* and *D. volubilis*, *Zonaria variegata*, *Udotea Flabellum*, *Penicillus Lamourouxii*, *Caulerpa cupressoides*, *Neomeris annulata* and several others

In a similar depth off Frederikssted, St. Croix, was found: *Penicillus capitatus* and *P. pyriformis*, *Udotea Flabellum* and *U. conglutinata*, *Dictyota indica*, *D. volubilis* and *D. linearis*, *Amphiroa fragilissima*, *Jania cubensis*, several *Galaxaura*-species *Cladophora crispula*, *Champia parvula*, *Spyridia filamentosa* and *Sp. clavata*, *Digenea simplex* and many others.

In the sea at St. Thomas west of Water Island in a depth of about 10—15 fathoms a vegetation composed mostly of *Chlorophyceæ* and among these especially representatives of *Codiaceæ* were found. Of this family were present here: *Penicillus capitatus*, *P. pyriformis* and *P. Lamourouxii*, *Udotea cyathiformis*, *U. verticillosa* and *U. Flabellum*, *Avrainvillea nigricans*, *A. Mazei*, *A. asarifolia*, *Halimeda Tuna* forma *platydisca*, *H. incrassata* and *Cladocephalus luteofuscus*. Of other algæ: *Caulerpa prolifera*, *C. crassifolia*, *C. cupressoides* var. *flabellata* etc. *Dictyosphæria favulosa*, *Valonia ventricosa*, *Microdictyon umbilicatum*, *Anadyomene stellata*, *Callithamnion* spec., *Cottoniella*, *Dictyurus occidentalis*, *Gracilaria lacinulata*, *Zonaria variegata* and several others.

But the richest flora of all was found in the sound between St. Thomas and St. Jan in a depth from about 10 to 20 fathoms.

Here was found: *Dasya elegans*, *D. ramosissima* and *D. caraibica*, *Lophocladia trichoclados*, *Wrightiella Tumanowiczii*, *Wrangelia bicuspidata* and *W. penicillata*, *Delesseria tennifolia*, *Asparagopsis taxiformis*, *Gracilaria cylindrica* with *Callithamnion cordatum*, *Rhodymenia occidentalis*, *Rhabdonia ramosissima*, *Griffithsia globifera*, *Callymenia perforata*, *Bryothamnion Seaforthii*, *Galax-*

aura, *Chrysymenia ventricosa*, *Chr. Enteromorpha*, *Chr. Agardhii*, *Chondria dasyphylla*, *Champia salicornoides* and *Ch. parvula*, *Mesothamnion caribæum* etc.

Of the *Chlorophyceæ* the most striking forms were *Caulerpa Ashmeadi*, *C. crassifolia*, *C. prolifera*, *C. clavifera*, *C. cupressoides* var. *flabellata*, *C. Webbiana*, *Struvea elegans*, *Rhipilia tomentosa*, *Chamædoris annulata*, *Udotea cyathiformis*, *U. verticillosa*, *U. Flabellum* and *U. spinulosa*, *Valonia ventricosa*, *Penicillus pyriformis*, *Avrainvillea nigricans*, *Avr. asarifolia*, *Halimeda discoidea* var. *platyloba*, *Anadyomene stellata*, *Acicularia Schenckii*, *Dictyosphæria favulosa*, *Codium tomentosum* and *C. isthmocladum* and several others.

In the strait north of St. Jan between Tortola the algal vegetation had another composition. Here *Chrysymenia Uvaria* was often found in large quantities.

Some remarks on the geographical position of the West Indian algal flora.

We see from the investigation now concluded, concerning the algæ found round those West Indian islands which formerly belonged to Denmark, that we have dealt with 90 species of *Chlorophyceæ*, 45 of *Phæophyceæ* and 192 of *Rhodophyceæ*, this last mentioned being therefore by far the largest group. Compared with the very high number of 788 species, which Murray has included in his "Catalogue of the marine algæ of the West Indian region"[1]), 327, the total number found by me, is certainly not a large number. But we must remember that the *Myxophyceæ* are included in Murray's list and moreover, as he himself admits, a large number of the West Indian species in his catalogue are doubtful ones, so this large number will certainly get much reduced on critical examination.

If we now will try to make a comparison between the West Indian algal flora, as known from the islands in question, and other algal floras, a comparison with other West Indian floras is, of course, the most obvious one. But this I have not done here, as, with the exception of the Bermuda Isles and in lesser degree.

[1]) In Journal of Botany, 1888—89.

Barbadoes, Jamaica and Guadeloupe, the West Indian region is still rather poorly investigated and a comparison is therefore not very satisfactory and besides I consider such a local comparison but of minor interest.

On the other hand, a comparison between the West Indian algal flora on the one side of the Atlantic Ocean and that of the Atlantic-Mediterranean area on the other side of the ocean, and a comparison between the West Indian algal flora on the one side of the American Continent and the flora of the Indo-Pacific Oceans on the other side of the Continent would be of great interest.

A priori, one would be absolutely inclined to think that the similarity between the two last mentioned floras must be very small or non existent as the American Continent reaches towards the North as well as towards the South into cold seas which makes any mixing of the algal floras from the warm parts of the two oceans impossible. However, we shall soon see that the similarity between these areas is even remarkably great.

In the table below a survey is given on the distribution of the West Indian algæ in the other areas.

Total number af species found	Species found in the West Indies and surrounding seas only	Species hitherto only found at the islands in question	West Indian species also found in the Mediterranean Sea and adjacent parts of the Atlantic.	West Indian species also found in the Indo-Pacific Ocean
Chlorophyceæ: 90 . . .	33	11	35	46
Phæophyceæ: 45 . . .	20	5	14	18
Rhodophyceæ: 192 . . .	108	46	63	47
In all: 327 . . .	161	62	112	111

It is seen from this table that of the 327 West Indian species 161 have hitherto been found in the West Indies and on the adjacent American shores of the Atlantic ocean. Of these 161 species 62 have hitherto been found at the shores of the former Danish West-Indies, but it is to be expected that most of these species will also be found later in other parts of the West Indian region when this is more thoroughly examined. Several species from these islands have already been found at the Bermudas, according to Collins

and Hervey's newly published work on the algal flora of these islands.

Of the remaining 166 West Indian species, 112 species are also found in the Mediterranean and at the warmer Atlantic coasts of Europe and Africa and 111 are likewise found in the Indo-Pacific ocean. Practically speaking the same number of species is therefore common to both of the areas in question, and the West Indian algal flora may therefore be said to be equally related to both the different areas. If we look at the *Chlorophyceæ* alone we shall meanwhile find that they occupy a somewhat different position; of this group 90 species are found at the islands and of these species 46, that is more than the half, are common to the Indo-Pacific, while only 35 are found both in the West Indies and in the Mediterranean and adjacent region of the Atlantic. With regard to the *Phæophyceæ* the corresponding numbers are 18 and 14. On the other hand the West Indian representives of the *Rhodophyceæ* are more closely related to the Mediterranean-Atlantic flora (63 species common to both) than to the Indo-Pacific ocean (only 47 species in common).

From the above we have seen that the West Indian algal flora does resemble in an almost equal degree the flora of the Indo-Pacific ocean and that of the Mediterranean Sea and adjacent warm parts of the European and African Atlantic coasts — in the case of the *Chlorophyceæ* the resemblance being even far greater — and that in spite of the fact that the two areas are apparently so distinctly separated.

Murray was the first to point out this striking similarity. In his paper; "A comparison of the marine floras of the warm Atlantic, Indian Ocean, and the Cape of Good Hope"[1]) he has compared these areas thoroughly. As to those of the Indo-Pacific ocean and the West Indian he writes: "We have here two tropical marine floras cut off from each other by a permanent continental area, and communicating only via the Cape". And he tries to explain in the following way how this great similarity has arisen: "That these floras have been periodically mingled at the epochs of warmer climate at the Cape seems a reasonable conclusion with regard to a group of such antiquity as the Algæ". That some species by passing the Cape may have been able to

[1]) In Phycological Memoirs edited by George Murray, Part II, 1893.

migrate this distance is, of course, not impossible, but in order to explain the great similarity between the West Indian and the Indo-Pacific algal flora his explanation is not sufficient. It is well known that, owing to geological reasons, the supposition has been adopted that the Pacific Ocean and the Atlantic have been in direct communication through Central America as late as in the Tertiary Period. But if this is the case the algal floras of both oceans have then had the opportunity of easy communication.

Regarding the geographical distribution of the *Caulerpas*, SVEDELIUS[1]) has adopted this explanation as the most natural one. In comparing the 21 species of *Caulerpas found* by him at the shores of Ceylon with those found in the West Indies, SVEDELIUS discovered that no less than twelve (according to his definition of species), were common to both areas. SVEDELIUS writes: "It is very remarkable that the tropical algal district in the Atlantic is almost confined to the West Indies. This probably depends on the eastern coast of South America, just as the western coast of Africa — as MURRAY points out, not offering suitable habitats for algal growth. But then one can scarcely assume that, even if warmer water washed the south coasts of South America and especially of Africa, a more luxuriant algal vegetation should have been harboured then than is the case to-day, seeing how little suited they are said to be for algal growths of any kind. I therefore think that the communication and the relationship between the floral districts of the Indian-Pacific Ocean and the West Indies can be more naturally explained in another way, i. e., that these districts once had direct communication over the districts where now the Central or South American continent separates the two great oceans".

Of the 11 species of *Caulerpa* found at the West Indian Islands examined by me, 9 are also found in the Indo-Pacific Ocean, and if it might be proved that *Caulerpa ambigua* Okamura is like my *Caulerpa Vickersiæ* no less than 10 are common to both areas, the *Caulerpa Ashmeadi*, being the only specific West Indian species found, having a rather restricted distribution. And just the fact that, which I have mentioned above, it is the *Chlorophyceæ*, and among them especially such old genera as *Caulerpa*,

[1]) SVEDELIUS, N., Ecological and systematic Studies of the Ceylon Species of Caulerpa (Ceylon Marine Biological Reports, Nr. 4).

Dictyosphæria, *Valonia* and *Codium*, that have most species in common in both oceans, while the *Rhodophyceæ* being surely of more recent origin, show less correspondance, seems to strengthen the supposition that the great number of species common to both oceans is due to this earlier communication between the two oceans.

In this connection it is also of interest to mention Ostenfeld's[1]) conclusion regarding the marine phanerogamic plants. Of these, 6 species which are surely the representatives of very old types, occur in the West Indies and 4 of these are closely related to four corresponding forms occurring in the Indo-Pacific ocean, and this great resemblance is, according to Ostenfeld, only to be understood by the species having migrated through the Tertiary Central American strait into the Caribean Sea and, after having been shut in here, they have developed into the species which we now find in the West Indies.

In just the same way, in fact, resemblances between zoological groups have been accounted for.

The result of the above-mentioned comparison can therefore briefly be summed up thus: The algal flora of the West Indian islands in question shows a strikingly great resemblance to that of the Indo-Pacific ocean. This applies especially to certain, undoubtedly very old, groups of *Chlorophyceæ*. The *Rhodophyceæ*, on the other hand, show less resemblance to those from the Indo-Pacific Ocean, being more closely related to the algal flora occurring in the Mediterranean-Atlantic territory.

The great similarity between those two algal floras: the West Indian and the Indo-Pacific, which in our days are so distinctly separated, has its natural explanation in a prehistoric old connection between the two oceans.

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[1]) Ostenfeld, C. H., On the geographical distribution of the Seagrasses (Proc. Roy. Soc. Victoria, 27, (N. S.), Part II, 1914, p. 179).
Ostenfeld, C. H., Havgræssernes Udbredelse i Verdenshavene, „Naturen", 1917.

Concluding Remarks.

During the war the Danish Government found itself compelled to sell to America our small, but beautiful Danish West Indian Islands. In spite of the opposition of a large part of the Danish people, and the protest, not only of many eminent men of science, but also of many prominent commercial and naval men, the Dannebrog, after having waved over the islands for two and one half centuries, was lowered for ever in 1917. The United States took over the islands in the year 1917, that is, long before the publication of the later sections of this work, so the title of these later sections is in this respect misleading.

It was in 1892 that, I as a young man, visited our West Indian Islands for the first time, and among other things began to collect and examine the marine algæ along the coasts of the islands encouraged by Prof. Warming[1]) who just at that time visited the islands. I, of course, chose these islands because they were Danish, and because I thought it our duty to study their nature. I little thought to have the grief of seeing Denmark lose the islands; this has not only been a personal loss, but also a considerable loss for the Danish Natural Science. I want in this connection to mention the fact which Dr. Th. Mortensen and I[2]) have already pointed out, that the sea round the islands is full of incomparable treasures, for the Zoologist especially, on account of the great depth of the sea just off the coast, and the botanist will scarcely be able to find a more diverse algal vegetation than the one which I have found in the sound between St. Jan and St. Thomas and, in fact, in all the adjoining waters of these islands. The sea has nearest to them a depth of about 10 to 20 fathoms and a very rich vegetation consisting of the most interesting types of algæ covers the sea bottom. A biological station, near Cruz Bay, St. Jan, for example would always be able to supply the students with the

[1]) Professor Warming, who has always shown the greatest devotion to the interests of his country, has continually emphasized the young botanists' duty to investigate the distant parts of our kingdom. It was through his initative that the botanical survey of the Færöes was started, and the "Botany of the Færöes" was published as a result. And when this survey was concluded, an investigation, on similar lines, of the botany of Iceland was initiated, and as a result of this a couple of volumes have already appeared.

[2]) Mortensen, Th. og F. Börgesen, En biologisk Station i Dansk Vestindien. „Atlanten", vol. I, 1904, p. 89.

most varied material. At this place one can dredge the bottom again and again and continually find interesting forms, without even being troubled by corals which often in the West Indies, near St. Croix for instance, renders dredging difficult.

In the introduction to the *Chlorophyceæ* I have given a short account of earlier collectors of algæ, but omitted to mention there that the "Challenger" expedition also visited St. Thomas and made dredgings and that some of the many *Codiaceæ*, which have been found just at this island, were dredged by that expedition.

Also several naval officers on the Danish men of war, which in the course of time were stationed at the islands, have made many collections there, and though these collections have a haphazard character and, of course, generally consist of algæ which have drifted ashore or those from the littoral zone, we have, nevertheless, to thank many of these collectors for the specimens on which many of our first descriptions have been based. Indeed not a few of the West Indian Algæ were first described upon specimens from the Danish Isles.

While collecting material my procedure has always been to sort the gathered material immediately on my return in such a way that of each species collected some specimens were dried and others laid in alcohol, and my determinations and examinations are chiefly based upon the last mentioned material. If I therefore, with regard to the new forms, had to speak about "type-specimens", in the way that word is especially used in America, mine are mostly to be found in bottles and in my preparations.

Before concluding I should like to thank all those who in different ways have helped me with my work. Besides those I already have mentioned in the introduction to the sections treating of the green and the brown algæ, I should like to convey my warmest thanks to the specialists who have assisted me in working out certain groups, particularly Mme Paul Lemoine of Paris who worked out the *Melobesieæ*, and Mme Weber-van Bosse in Eerbeck who was so kind as to give a description of my collections of *Rhizophyllidaceæ* and *Squamariaceæ*. My thanks are also due to Dr. Henning E. Petersen who, by his great knowledge of the group *Ceramieæ*, was the best able to deal with this group.

I should also like to thank the American algologist Dr. M. A. Howe who sent me large collections of West Indian algæ, which have been of great use to me for purposes of comparison, concerning many doubtful forms.

Then I owe a debt of gratitude to the late Prof. W. G. Farlow for his valuable assistance and for the interest he always showed in my work, and to the late F. S. Collins, who sent me much valuable material of West Indian algæ, and through his extensive knowledge of the American algal flora supplied me with much useful information.

Moreover I am highly indebted to Prof. C. Lindman of the Riksmuseum, Stockholm, and Prof. N. Svedelius of the Botanical Museum, Upsala, for the loan of algæ to compare with my collections. Likewise I am sincerely grateful to the Professors Murbeck and Nordstedt for their courtesy in giving me access to Agardh's Herbarium in Lund.

Finally I seize the opportunity to thank my colleague, Prof. Rosenvinge, to whom I owe much important information and who, as editor of Dansk Botanisk Arkiv, has assisted with the reading of the proof-sheets.

Mr. Ove Rostrup has helped me with most of the drawings, and my best thanks are due to him for the trouble he has taken.

Then I should like to thank most cordially Mr. A. D. Cotton of Kew, who has done me the great service of reading my proof-sheets, by which those errors, which easily arise when a foreigner has to write a language not his own, have been as far as possible put right.

Finally I want especially to thank the Trustees of the Carlsberg Foundation, not only for the continued grant for the reproduction of the many drawings, but particularly for the special grant for the printing of the last part which otherwise must have waited, owing to the high cost of printing at present.

With this I take leave of those beautiful small islands where so many of my thoughts and so much of my work have been centred for so many years, and the parting is the more painful since the tie, which bound the islands to my native land, has been severed.

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