Some Chlorophyceæ from the Danish West Indies. II.

By

F. Børgesen.

Valonia Ginn.

Valonia ventricosa J. Ag.

J. Agardh, Till Algernes Systematik. VIII. Siphoneæ. p. 96.

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

In "Hydrophytologia Danica", Lyngbye p. 72 mentions these specimens: "Ad insulas Færöenses non nisi parvæ evadunt, sed exemplaria vidi in herbario cel. Vahlii, ex insula St. Crucis, allata, quæ ovum columbinum magnitudine exsuperant". Lyngbye referred this species to his *Gastridium ovale* (= *Halicystis ovalis* Aresch.) and C. Agardh in "Species", p. 431, also refers the specimens from St. Croix mentioned by Lyngbye to *Valonia ovalis* and as belonging to this species it is also found in later authors until J. Agardh described it as above quoted.

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

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

It is most often egg-shaped or nearly globular, but sometimes also pyriform or more irregular. It is fastened to the substratum by means of numerous small rhizoids growing out at the basal end of the plant (fig. 1 *b*) from the small lentiform cells occurring here in great number.

The rhizoids are unicellular and end with a small, richly ramified, often coral-like disc (fig. 1 *c*, *d*). Both the small lentiform cells and the rhizoids are richly provided with stores of food.

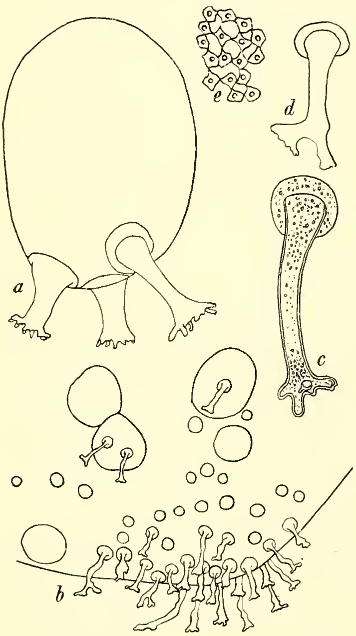

Fig. 1. *Valonia ventricosa* J. Ag. *a*, a young plant (50:1). *b*, basal end of an older plant with numerous small lentiform cells with rhizoids crowded at the base; to the left one and above four large lentiform cells, two of these again with small lentiform cells and rhizoids. *c* and *d*, rhizoids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

Besides the small lentiform cells, whose diameter is about 250 μ and which are crowded together at the basal end of the plant, we find in the periphery of these crowds some larger lentiform cells. About these Kuckuck l. c. p. 42 writes: "Ausserdem werden freilich nur ganz vereinzelt zwischen den kleinen auch einige grosse Uhrglaszellen angelegt, die zu kleinen Tochterblasen auswachsen können. Diese wenig in die Augen fallenden Zweigblasen haben hier die Aufgabe, die Hauptblase auf ihrer Unterlage zu stützen und besser festzulagen". Also in my specimens I have found some few of these cells grown out to small daugther cells which again were provided with a single or a few small lentiform cells with rhizoids. How far these cells are able to grow out to large cells like the mother cell I cannot tell; I have not been able to find any fertilized cells and do not know, therefore, how far the mother cells after fertilization die away or not, but most probably this is the case and then the cells in question are perhaps able to grow out to new plants.

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

In the wall-plasma we find the plate-formed chromatophores; they are irregularly polygonal with more or less elongated corners and forming in this way a net-work (fig. 1 *e*). A rather large pyrenoid is found in each chromatophore, as pointed out both by Murray and Kuckuck. Below the chromatophores we find the numerous, rather regularly distributed nuclei.

All the specimens I have collected and examined were in a vegetative state as above mentioned; the fructification most probably takes place at another season than when I have collected in the West Indies (Dec.—April). But among the rhizoids of a few specimens I have found some quite young plants with only one or a few rhizoids (fig. 1 *a*) and these I think originate from germinated zoospores.

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

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

Valonia macrophysa Kütz.

Kützing, Phycologia generalis, p. 307, Species Algarum, p. 507, Tabulæ phycol., vol. 6, tab. 87, fig. 3. J. Agardh, Till Algernes Systematik, VIII, p. 97. Kuckuck, Über den Bau und die Fortpflanzung von Halicystis Aresch. und Valonia Ginn. in Bot. Zeit., 1907.

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

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

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

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

Valonia utricularis (Roth) Ag.

C. Agardh, Species Algarum, vol. 1, p. 431. J. Agardh, Till Algernes Systematik, VIII, p. 98. P. Kuckuck, Über den Bau und die Fortpflanzung von Halicystis Aresch. und Valonia Ginn. (Bot. Zeit. 1907).

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

forma *typica* Kuck. l. c.

forma *crustacea* Kuck. l. c.

The forms I have referred to this species seem to agree very well with those described by Kuckuck, l. c. In the forms which occur on exposed places, the small lens-shaped cells were present in great number. They occurred not only in the basal part of those cells by which the plant is fastened to the substratum, but also in other parts of the cells, especially in the furrow where the cells meet each other. Here we often find a dense row of these small cells on both sides of the wall and as these small lenticular cells often bear short rhizoids which attach themselves to the neighbour cell they contribute to the firmness of the cell-complex, making it more resistant to the beating of the waves.

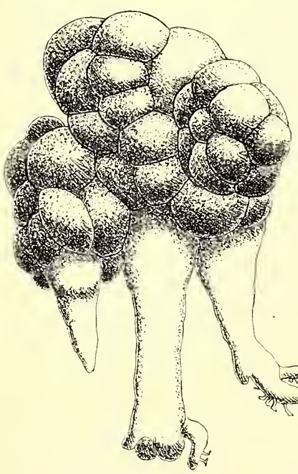

Fig. 2.
Valonia utricularis (Roth) Ag.
forma *crustacea* Kuck.
(about 6 : 1).

Fig. 2 shows a plant of the form I have referred to var. *crustacea* and fig. 3 a little part of it more magnified. The arrangement of the lens-cells and the manner in which the rhizoids, growing out from the small cells, attach themselves to the neighbouring cells reminds one in a striking way of *Dictyosphæria favulosa*, a plant I also consider very nearly related to *Valonia*, as will be mentioned later on.

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

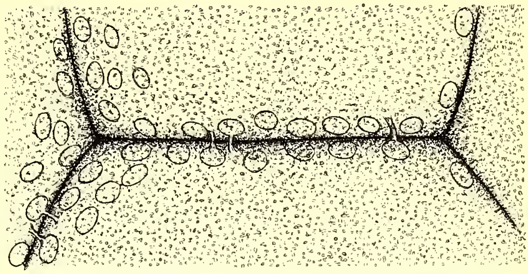

Fig. 3. *Valonia utricularis* (Roth) Ag., f. *crustacea* Kuck.
A little part of the plant pictured in fig. 2. It shows the arrangement of the small lentiform cell along the walls of the cells. (70 : 1).

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

The species is common at the shores of the islands.

Valonia Ægagropila C. Ag.

C. Agardh, Species Algarum, p. 429. J. Agardh, Till Algernes Systematik, VIII, Siphoneæ, p. 99. Kützing, Spec. Algarum, p. 507; Tab. Phycol. vol. 6, tab. 87; fig. 1. P. Kuckuck, Über den Bau und die Fortpflanzung von Halicystis Aresch. und Valonia Ginn. (Bot. Zeit. 1907).

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

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

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

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

St. Croix. At the shore of Great Pond on the south coast.

St. Thomas. In the sea West of Water Island.

Dictyosphæria Dcsne.

In a small but very valuable note[1]) for the understanding of the classification of *Dictyosphæria* M^me^ Weber van Bosse has pointed out that what has hitherto been referred to *D. favulosa* comprises 3 species, namely besides *D. favulosa* the two new species *Dict. intermedia* Web. van Bosse and *D. Versluysi* Web. van Bosse. According to the description of M^me^ Weber van Bosse *D. favulosa* has always a hollow thallus and lacks the peculiar needles in the interior of the cells, *D. Versluysi* is distinguished by having these and a massive thallus, and finally *D. intermedia* is characterized by having a massive thallus in the young stage and no needles. In the introduction M^me^ Weber furthermore points out that, on account of these facts, the description of *D. favulosa* by modern authors is wrong and promises in her list of the Siboga algæ later to give a description of its development and growth. I regret that I have been in advance of M^me^ Weber with my examination: in excuse I may urge that I had nearly finished the examination of my material before I became acquainted with M^me^ Weber's note, not expecting to find so very much of interest to me in it, treating as it does of Asiatic algæ. It was therefore all the more interesting to find that, as far as can be judged from the short diagnoses given by M^me^ Weber, I have obtained not only a form answering to *D. Versluysi* but very seemingly also one coming near to *D. intermedia*.

Before entering upon a description of the species found and of the development of the thallus, which I have been able to follow in *D. favulosa*, I must first give an account of the different and contradictory interpretations found in algological literature.

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[1]) Weber van Bosse, A., Note sur le genre *Dictyosphaeria* Dec. "Nuova Notarisia", Serie XVI, 1905.

Harvey in "Nereis", III, p. 50, has given the first more detailed and in several regards good description of our plant. Of his description I may here reprint the following:

"Fronds at first globose, like tubers, heaped together, hollow and empty or filled with seawater, attached to the rock and to each other by a few short, rooting processes; at length irregularly torn, and then forming expanded, cartilaginous, or skinlike coarsely reticulated membranes. The membrane is wholly composed of a single layer of large, globose, or by mutual compression hexagonal cells, which closely cohere by their sides, leaving the convex ends of cell free, and these form the surface of the membrane, which when dry resembles a piece of fish skin, or a miniature honeycomb. When the cells have been separated, each is seen to be marked at the line of junction by a double row of circular discs. In full grown cells the primordial utricle is easily separable from the outer cell-wall, and contains a green, granular endochrome; from which, by cell-division, four new cells are formed, and thus the frond extends by repeated quadrisection of its component cells".

This description shows that Harvey refers essentially to *D. favulosa* but when he has "seen hairlike processes issue from it (the cell-wall) internally" this shows that he has had to do with another species also.

J. Agardh in "Till Algernes Systematik", VIII, p. 113 gives a long discussion of *Dictyosphœria* but he does not carry us much farther than Harvey, as also pointed out by Murray.

In 1888 Askenasy in "Forschungsreise S. M. S. «Gazelle»", IV. Theil, Botanik, p. 8 gives a rather detailed description of *Dictyosphœria favulosa*. According to Askenasy the plant consists of rather large cells which join each other by plane walls, except at their upper and lower-most part where they leave open a small space, this being in transverse section cuneate and filled with small cells. Askenasy also discusses the cell-division: "Man findet aber auch hier und da solche Zellen von mehr kugliger Gestalt, die bis zu 5 mm Durchmesser besitzen. In diesen letzteren erfolgt die Theilung des Inhaltes und die Ausbildung neuer Zellen, was ich ganz sicher ermitteln konnte, da ich am Rande eines Thallus eine Reihe solcher übermassig grossen Zellen antraf, von denen einige noch ungetheilt, andere bereits getheilt waren (vgl. Taf. II, fig. 2). Bei der Theilung zerfällt die Zellen in zwei bis drei Schichten übereinander liegenden Zellen, die genau so gebaut sind wie die des erwachsenen Thallus; nur sind sie mit verhältnissmässig dünnen Wänden versehen. Auch die Zwischenzellen sind bereits vorhanden, wenigstens die oberste Reihe derselben. Die unteren 2—3 Reihen scheinen etwas später gebildet zu werden. Näheres über den Verlauf der Theilung kann ich nicht angeben, da ich keine Zwischenzustände antraf; immer zeigte sich der ganze Komplex von Tochterzellen innerhalb der grossen Zellen als vollständig fertig ausgebildet, woraus zu schliessen ist, das die Theilung des Plasmas und die Ausbildung der Zellwände rasch und in allen Zellen ziemlich gleichzeitig stattfindet. Eine regelmässige Viertheilung wie sie bei Harvey a. a. O. abgebildet ist, habe ich nirgends gefunden".

The description of Askenasy is not quite clear. When it is said that "die jüngsten Exemplare endlich sind vollständig geschlossene Säcke" and the needle-formed processes are not mentioned, this seems to allude to *Dict. favulosa* but when on the other hand several layers of cells are produced by the cell division this is not in agreement with this species.

In 1892 we again find *Dictyosphæria* mentioned, by Murray in "Phycological Memoirs", part 1, pag. 16. His description of what he calls *D. favulosa* shows that it in any case comprises one other species also. Without knowing the above-mentioned description of Askenasy, Murray first mentions the young plants and thereupon gives a description of the "mysterious discs. These proved to be tenacula emitted from and attached to the cells, and binding the mass together", and he compares them with the tenacula found in *Struvea*, *Spongocladia*, *Microdictyon*, *Boodlea* &c. As to the cell division Murray writes: "With regard to the cell division into four, some of the Ferguson specimens (fig. 1c, upper part) show what I take to be an appearance of the kind described by Harvey and Agardh, but I am not altogether convinced that the explanation of the matter is so simple. On this point I hesitate to put forward an alternative view for the present".

Murray also gives Schmitz' interpretation of the development of the thallus in our plant. I give it here in its whole length: "Die jüngeren Pflanzen von *D. favulosa* sind massive Zellkörper von unregelmässig kugeliger Gestalt, oberseits mehr oder weniger abgeflacht, unterseits etwas verdickt und mit schmaler Insertionsfläche angewachsen. Diese massiven Zellkörper sind grosszellig; die grossen Zellen aber sind angeordnet in unregelmässige verzweigte

Zellreihen, die von der Insertionsstelle aus aufwärts fächerförmig auseinander laufen. Der ganze Zellkörper aber stellt ein congenital verwachsenes Verzweigungssystem einer grosszelligen *Cladophora* (z. B. *Cl. prolifera*) oder einer kleinzelligen *Valonia* (z. B. *V. Cladophora* Kütz.) dar, ein Verzweigungssystem, dessen Gliederzellen vielfach secundär querverkettet sind durch ganz kleine Hapter-Zellchen (wie solche ja bei Siphonocladaceen vielfach vorkommen). Nachträchlich erfolgt dann in dem stärker verbreiterten Pflanzenkörper unterhalb der obersten Zellenlage der Oberseite die Bildung eines mehr oder minder ausgedehnten horizontalen Spalte, wodurch eine Deckschicht von dem Thallus-körper sich abhebt. Dann reisst die abgehobene Deckschicht in der Mitte unregelmässig auf und reisst von hier aus in wechselnder Weise ein, während sie gleichzeitig unter Flächen-Wachstum sich ausdehnt und in verschiedenartigster Weise sich ausbreitet. Eine "Viertheilung" der Zellen erfolgt bei diesem Flächen-Wachstum der aufgerissenen Deckschicht aber nicht. Die Lappen der aufgerissenen Deckschicht können dann in mannigfaltigster Weise weitersprossen, häufig auch proliferirenden Sprossungen den Ursprung geben. Fortpflanzungsorgane habe ich nicht beobachtet". Schmitz' description is scarcely based upon *Dictyosphæria favulosa* but rather most probably upon a species with massive thallus which would better suit "ein congenital verwachsenes Verzweigungssystem einer grosszelligen *Cladophora* oder einer kleinzelligen *Valonia*".

Furthermore in the same year we also find *Dictyosphæria* mentioned by Heydrich in "Berichte der deutschen bot. Gesellsch.", Bd. X, p. 466. His description and figures shows that he has been working with a form with massive thallus, most probably with *D. Versluysi.*

Oltmanns in "Morphologie und Biologie der Algen", p. 260 follows the view of Schmitz, referring our genus to the Cladophoraceæ. On the other hand, Wille (1897) in Engler and Prantl, "Chlorophyceæ", refers our plant to the Valoniaceæ and here he has also placed it in the "Nachträge" 1910, where he gives some few additions to the description of the genus essentially based upon the investigations of Miss Crosby in "Minnesota Bot. Studies", 3. Series, Part 1, 1903, p. 61. Miss Crosby "compares the plant body to a primitive, irregular, sessile, branched system, homologous to the elongated branched system of *Struvea.* Each cell may be considered a sessile detached branch, which coheres by haptera, not by incrustation". The development of the plant is described in this way: "In younger solid plants the cells are of equal size. Soon those in the center enlarge and through the growth of outer cells become torn and disorganized. The hollow thus formed enlarges by the same process. The thallus lacks cohesion, gained by interlacing branches in *Struvea*, and is bound together by a membrane; this now splits in all directions causing the thallus to rupture". Miss Crosby gives a detailed description of the needles in the interior of the cells, of the hapters etc.

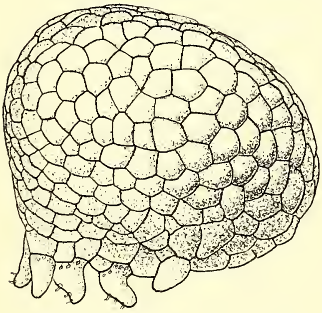

Fig. 4. A young plant of *Dictyosphæria favulosa* (Ag.) Decsne.
Its thallus is hollow and consists of a single layer of cells. (About 6 : 1).

Her description seems essentially to be based upon *D. Versluysi* but she seems also to have had specimens of *D. favulosa*.

Finally I may yet add that in "Icones of Japanese Algæ", vol. 1 (1907—9), pl. XL, fig. 13—24, Okamura gives some illustrations of our plant. Judging from his figures it seems to be evident that he has had in hand the true *Dict. favulosa*.

After this survey of the different interpretations in the botanical literature with regard to the development of the thallus of this genus I shall now give a description of what I have found in my material.

Dictyosphæria favulosa (Ag.) Decsne.

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

Valonia favulosa Ag., Species Algarum, 1, p. 432.

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

As already pointed out by Harvey the young specimens are globose (Fig. 4), later on irregularly torn, forming expanded cartilaginous membranes.

In its first beginning the thallus consists of a single cell (fig. 5 *d*); this can have a very variable shape, often very irregular, being sometimes somewhat cylindric, sometimes oviform. The basal part of the cell has often a longer or shorter root-like prolongation (fig. 5 *c*, *e*), upon the lowermost end and sides of which we find a great number of small unicellular rhizoids which grow out, one from each of the numerous small cells occurring here very similar to those found in *Valonia*. Also higher up on the cell we often find many of these small cells arranged as a rule in rows (fig. 5 *d*), some of them also more scattered. How far the origin of these

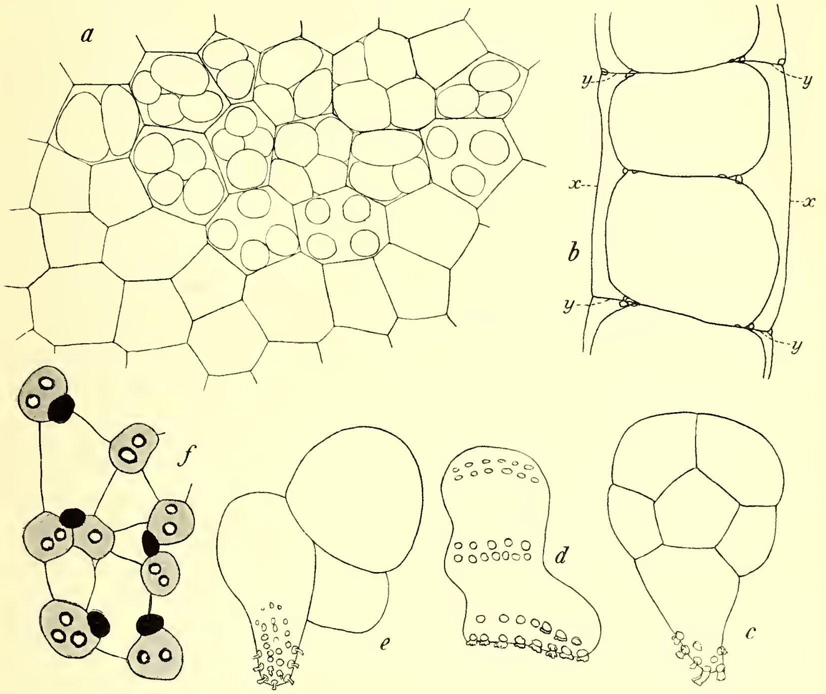

Fig. 5. *Dictyosphæria favulosa* (Ag.) Decsne.
a. part of a thallus with cells in division in different stages of development (6 : 1), *b.* transverse section of thallus with cell newly divided (compare text) (20 : 1), *c. d. e.* young plants (10 : 1), *f.* chromatophores with pyrenoids and nuclei (250 : 1).

young plants are due to zoospores is difficult to say, most probably they are not; in the abundant material I have collected not a trace of zoospore-formation has been found and this has never been found by other investigators. Much seems to suggest that these young individuals are due to cells loosened from the thallus of other specimens. This seems also to be indicated by the fact, that the cells themselves are often densely covered by Melobesieæ and other epiphytes. Perhaps some of them also can have their origin from aplanospores, about which more later on.

As mentioned above the young plants are unicellular but a few were found consisting of a few cells (see fig. 5 *e*). Most probably the 3 cells in this figure have been torn from an old plant at once.

In the upper end of the young plant a cell division now takes place, resulting in a number of cells arranged more or less regularly (fig. 5 *c*). In this stage of development our plant has some likeness with a small *Valonia* but when Schmitz also compares it to a *Cladophora* I may point out, that I have never found any specimen resembling that genus. How the cell division takes place in the quite young plant (see fig. 5 *c*) I have not succeeded in finding out, but I have no hesitation in assuming that it is accomplished quite in the same way as I have found it in older specimens.

Here the cell division was performed in the following way. In some of the cells we find that the whole cell contents with chromatophores, nuclei etc. have been aggregated into a number of spherical clumps from three to six or even more, but most commonly three to four (fig. 5 *a* and 6 *a*). At first these spherical bodies fill up far from the whole lumen of the mother cell but after becoming surrounded with a membrane they begin to increase (fig. 6 *b*), growing closer together and at the same time becoming arranged in the same plane as the other cells in the plant, which as already described by Harvey consists of a single layer of cells only. When the cells are grown quite together (fig. 6 *c*) filling up the whole lumen of the mother cell they assume its form, growing polygonal, and along their uppermost and lowermost edges appear the small hapters which very regularly and alternately (fig. 6 *f*) fasten the neighbouring cells together.

Fig. 5 *b* shows a transverse section of a part of a thallus in which the cells have just been divided in this way. We see that the wall of the mother-cell (marked *x* in the figure) covers over the young cells and, further, we find that at each two—three or four cells the cross walls of the mother cells (marked *y* in the figure) run in between the daughter cells. On the exposed outerside or on the upperside of the flat old thallus the wall of the old cells seems soon to be torn off; on the other hand, in thallus still in the form of hollow sacs we often find several layers of old membrane covering the sheltered innerside.

This cell-division does not take place simultaneously in all cells of the thallus; we often find, on the contrary, that it is only a group of cells here and there which is divided, sometimes also a single cell only has been divided. Fig. 5 *a* shows a part of an old thallus with divided and not divided cells.

I have mentioned above that the young unicellular specimens might perhaps have their origin from aplanospores. I think it very

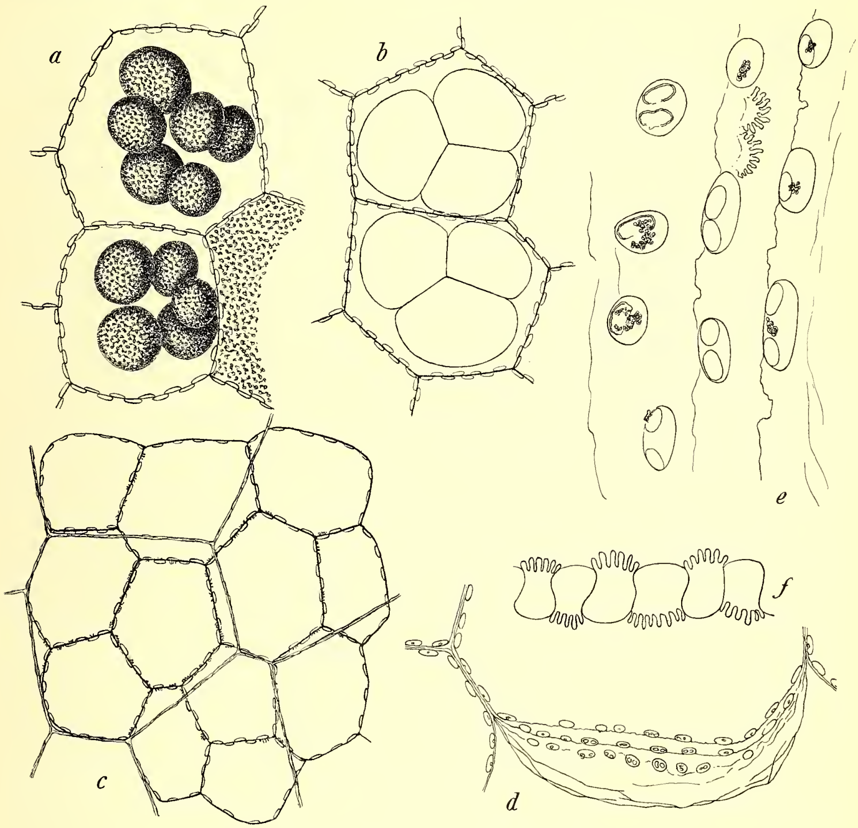

Fig. 6. *Dictyosphæria favulosa* (Ag.) Decsne.
a. b. c. different stages of cell-division, in *a* the cell contents have been contracted to balls, in *b* the young cells fill up nearly the lumen of the mother-cell, in *c* the young cells are quite developed, the walls of the mother cells are seen over the young cells (10 : 1). *d.* wall of a cell torn loose from the neighbour-cell showing arrangement of hapteræ (25 : 1). *e.* small part of *d* more magnified; in the small cells chromatophores are seen; the oval rings upon them are the bases of the hapteræ, in one place the ends of the hapters broken of from the neighbour-cell are seen (100 : 1). *f.* hapters between two cells seen from above showing their alternating arrangement (150 : 1).

likely namely, that the above-mentioned balls, formed by the cell division, may occasionally become free and be able to grow.

In the quite young small plants the thallus is massive (fig. 5 *c*) but by cell-division the cell layer in the periphery will grow larger and larger, first making the thallus sack-shaped (fig. 4) and at last it will be torn and disc-shaped. These old disc-shaped specimens can be very large; I have collected specimens with a diameter of about 12 cm.

As to the hapteræ found along the edges of the cells, these all grow out from quite small cells which are very similar to the small lentiform cells found in *Valonia*[1]). These small cells are arranged in series (most often 3) along the edges of the large ones (fig. 6 *d*) and very regularly, alternately opposite each other in such a way that the hapteræ growing out from the small cells attach themselves to the wall of the neighbour cell just in the intervals between the small cells on it (fig. 6 *e*, *f*). In this way the large cells are very firmly fixed together. The small cells are, when seen from above, oval oblong sometimes also quite circular. One to two hapteræ grow out from them (fig. *d*, *e*).

The small cells also occur abundantly upon the sack-like outgrowth from cells at the base of the plant (fig. 4, 5 *c*, *d*, *e*). Where their walls come near to the substratum the small cells are present in great number and from them rhizoids grow out and attach the plant. Here the arrangement of the small cells is more irregular.

With regard to the wall-plasma, we find, as also pointed out by Askenasy and Miss Crosby, the numerous rather large roundish-polygonal chromatophores of the wall plasma becoming connected with thin prolongations forming in this way a more or less open net-work (fig. 5 *f*). In the chromatophore one—three large pyrenoids are present. Near to the one side of the chromatophores the numerous oblong, rather large nuclei are met with.

In the small cells also some few chromatophores with pyrenoids occur (fig. 6 *e*), furthermore also a single nucleus or in the larger oblong cells even two. That chromatophores occur in the small cells is also mentioned by Heydrich l. c. p. 468. The outer wall shows cross-wise striations.

As already mentioned above, I consider Harvey's description of *Dictyosphæria favulosa* to be in several respects very good, this especially applying to his description of the appearance and habit of the plant. As to the cell division, "the repeated quadrisection

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

of its component cells", I think that Harvey has most probably observed some older stages of divided cells and as often only four cells are the result of the division (cfr. my fig. 5 *a*) he has made it a quadrisection.

As to Askenasy's description of the cell division, the cells being divided into two—three layers of cells, this as already mentioned seems to allude to a species different from *Dict. favulosa.* And when Askenasy tells us further, that the space over and under the cross wall between the large cells is filled with small cells, this also is not quite correct, this space being filled up with the hapteræ growing out from the small cells.

As to Schmitz' opinion that our plant can be compared with a *Cladophora* with large cells I may point out, as already mentioned above, that I have never found a trace of such a likeness; on the other hand, young plants yet massive can be very like a *Valonia.* Our plant may also be referred to the Valoniaceæ and not to the Cladophoraceæ, as Oltmanns does on the authority of Schmitz. And when Miss Crosby compares our plant with a *Struvea* this is quite as misleading as when Schmitz compares it with a *Cladophora.*

I consider *Dictyosphæria favulosa* as very nearly related to *Valonia*; the form of *Valonia utricularis* (Roth) Ag. I have figured (fig. 3) shows a striking likeness, also having along the edges of the cells a row of small lentiform cells from which rhizoids grow out and fix themselves to the neighbouring cells. I therefore quite agree with Murray, who considers our plant as "one of the simplest forms of valonioid organism", when he gives the following description of it: "In *Dictyosphæria favulosa* we have simply an aggregate of similar cells not forming a definite frond, but cohering in an unbranched mass, this colony of units being held together solely by tenacula".

The remarkable method of cell division, the cell contents being transformed to a number of balls, reminds one very much of the process of cell division in *Siphonocladus tropicus* as described by me. And the cell division of *Struvea* as described in this paper is also very similar, and likewise that found in the apex of the stalk of *Chamædoris.*

Upon the whole, this "ball-cell-division", reminding so very much on the free cell-division, has shown itself characteristic of many Valoniaceæ.

Dictyosphæria favulosa occurs in shallow water and often on rather exposed coasts, growing on coral reefs where it is constantly under the influence of the waves. Here the specimens are not so very large, seldom more than 4—5 cms in diameter and are most often sack-shaped. But, furthermore, it is found abundantly in deep water down to a depth of about 40 meters. Here in the quieter surroundings and in the moderate light it often forms large flat expansions, some of the specimens reaching in diameter 12 cm.

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

D. van Bosseæ nov. spec.

Judging from the rather short diagnosis in M^me^ Weber van Bosse's note I had at first referred my form to *D. Versluysi*, but after having seen an original specimen of this species which M^me^ Weber has been so very kind as to lend me, I think it is more convenient to consider my plant as a different species even if it shows a great likeness with M^me^ Weber's species.

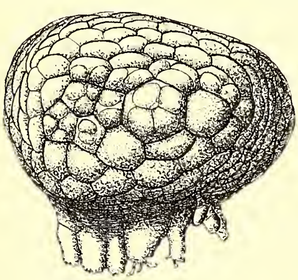

Fig. 7.
Dictyosphæria van Bosseæ n. sp.
Young plant. About (6 : 1).

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

The cells are about half the size of those in *D. favulosa*, being on an average about 500 μ in diameter, but varying, many cells being much smaller, others reaching up to 700—800 μ in diameter. Between the cells rather large intercellular openings often occur in which the hapteræ grow rather long.

Herewith a short Latin diagnosis:

Frons irregulariter rotundato-hemisphærica, solida, nunquam cava, cellulis processibus acutis in pariete interiori instructis, rotundato-polygonatis, mediocribus, ca. 500 μ latis.

As to its mode of growth the cell division seems to take place in a similar way to that found in *D. favulosa.* In any case the three small cells found in the larger one in fig. 8 *a* may be supposed to have a similar origin and also in the small plant (fig. 7) we see something very similar, but I have only found very few cells in this stage of development and quite young stages not at all. Besides, I am very much inclined to think, that the cells are also able to divide in a very similar way to that found in *Valonia*, as now and then on the cell walls of sectioned plants I have found some smaller roundish or oval cells, reminding one somewhat of the lens-shaped cells

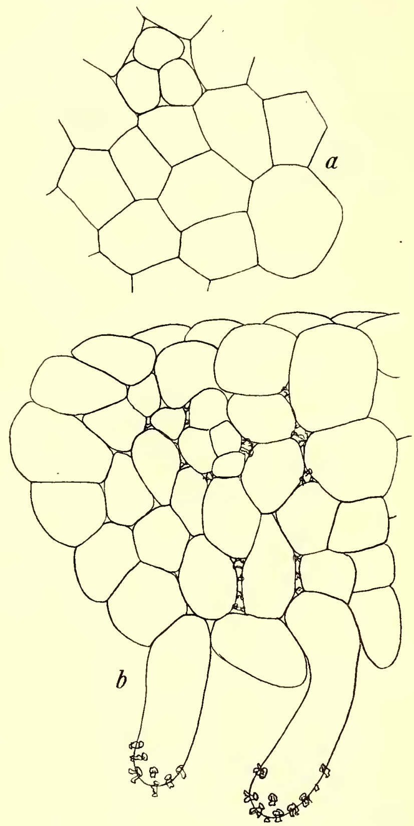

Fig. 8.
Dictyosphæria van Bosseæ n. sp.
a. part of the thallus seen from above, the cell above has been divided in three cells. *b*. transverse section of a young plant showing the massive thallus. In the interwalls between the cells the hapteræ are seen (10:1).

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

of *Valonia.* If this is the case, Schmitz' description of the evolution of the thallus can agree better with the real condition in this plant.

Whilst, as mentioned above, I have not succeeded in finding any trace of zoospore-formation in *D. favulosa*, I have been so fortunate as to find a specimen of *D. van Bosseæ*, whose cells without any doubt were about to form zoospores (Fig. 9).

Whilst in the normal vegetative cells the chromatophores with pyrenoids and nuclei form a net-work in the wall-plasma, in those in question the cell contents were aggregated into irregularly formed bodies consisting of a larger broad plate with or without

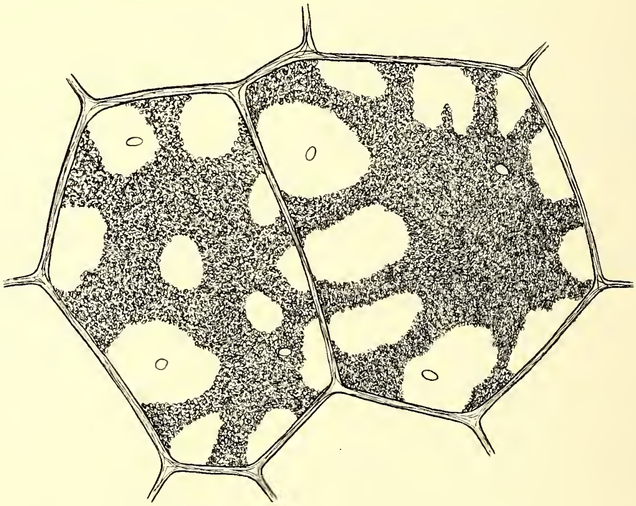

Fig. 9. *Dictyosphæria van Bosseæ* n. sp.
Cells in zoospore-formation. (ca. 20 : 1).

holes in the middle of the cell, from which narrower prolongations ran down along the sides of the cells, giving them a very characteristic appearance. And that it really is the formation of the zoospores we have to do with was furthermore made evident by the fact, that in the cell wall of some of the cells 2—4 holes were found, through which the zoospores could escape.

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

This species is found in rather exposed localities in shallow water growing on rocks where it was constantly under the influence of the waves.

St. Croix: Cane Bay, Sandy Point.

D. intermedia Weber van Bosse.

A. Weber van Bosse, l. c. p. 143.

It is very doubtful, if this species really occurs on the shores of the Danish West India Islands. I have only found a single small specimen of the size of a large pea. It was massive but lacked the needle-shaped processes in the interior of the cells. In these characters it was in good agreement with the description of M^me^ Weber, but, as mentioned above, in *D. van Bosseæ* sometimes cells occur without needles and as our plant, apart from the want of these, seems otherwise to be very like it in all regards it is very possible that it is only a needle-less form of the above-mentioned species.

The single specimen found was collected together with some specimens of *D. van Bosseæ* in shallow water at Cane Bay, St. Croix.

Ernodesmis[1]) nov. gen.

Thallus ramosus, stipitatus, stipes rhizoideis ramosis substrato adfixus, claviformis, in parte basali transverse annulatus, apice obtuso, 5—10 ramos claviformes strictos gerens, qui ipsi in apice obtuso leviter incrassato ramulorum claviformium fasciculis instructi sunt; sic ramificatio pluries regulariter redintegratur.

Omnes rami totius plantæ pariete convexo basali ab inferiori cellula discreti unaque cellula formati sunt. Rami præsertim in parte superiori plantæ in zoosporangia poris pluribus aperta transformati.

Ernodesmis verticillata (Kütz.) nob.

Valonia verticillata Kütz., Species Algarum, p. 508, Tab. phycol, vol. VI, tab. 88. J. Agardh, Till Algernes Systematik, VIII, p. 100. P. Kuckuck, Über den Bau und die Forpflanzung von Halicystis Aresch. und Valonia Ginn. (in Bot. Zeit., 1907).

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

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

[1]) From ἔρνος = a branch and δεσμίς = a bundle.

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

Before pointing out the ways in which it shows likeness with and differences from the above-mentioned genera, I shall give a description of the plant. As is the case with so many related forms our plant when young consists of a single clavate cell forming the basal stalk of the older plant. This at its base is fixed to the ground by irregularly ramified and septated rhizoids (fig. 11 *a*). The wall of the cells in the rhizoids is thick and much starch is found in the cells. Also the wall in the stalk itself, in any case in older plants, is rather thick in its lower part and here some annular corrugations occur, most strongly developed lowermost (fig. 11 *a*), leaving only a small passage open in the middle of the cell.

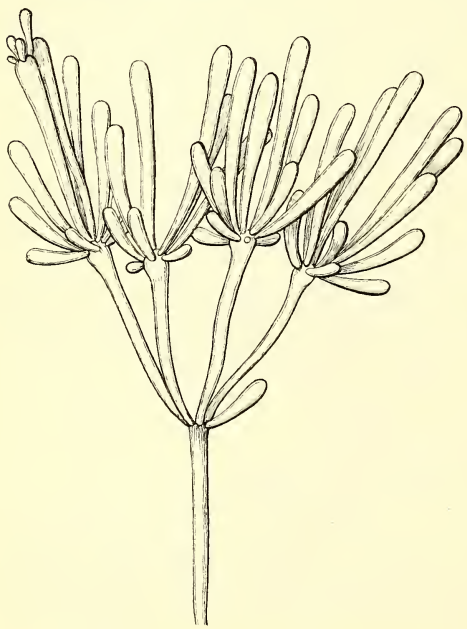

Fig. 10. *Ernodesmis verticillata* (Kütz.). Part of a plant. About 4:1.

In its broadly rounded, sometimes even a little swollen, uppermost end the clavate stalk bears a bundle of branches up to a dozen or more (fig. 10). These branches are quite like the mother-cell, clavate, thinnest at their base. Here, in any case when they grow older, we find a single swelling (fig. 11 *b, c*). The branches are separated by an often somewhat concave wall from the mother cell. In their upper end these branches again are ramified quite in the same way and this very regular ramification takes place several times, with the result that the plant gets a nice candelabrum-like appearance (fig. 10).

So far as I have been able to follow the development in my material, the formation of the branches takes place in the following way; first much cell plasma with chromatophores and nuclei accumulate at the point where a branch will grow out. The accumulation is separated from the mother-cell by a membrane and then begins to grow out like a cupola outgrowth. This becomes more and more prolonged and gradually assumes the shape of the mother-cell. The branches in each bundle are established successively, so that branches in different stages of development are found in the young bundle and even in the older a young branch occurs now and then (compare fig. 10).

Some small, short, thick rhizoid-like organs grew often out from the lower side of the above-mentioned swellings at the base of the branches in the older part of the thallus; they grow downwards and when they meet the wall of the cell below they attach themselves very firmly to it and serve to strengthen the plant (fig. 11 *c*, 12 *b*). These organs remind one very much of the clamps, as Murray and Boodle (in Annals of Botany, vol. 2, p. 276) call them and which they have found in *Struvea ramosa*. Often only one or two of these clamps are found but sometimes a whole ring of them are developed quite near each other (fig. 11 *c*).

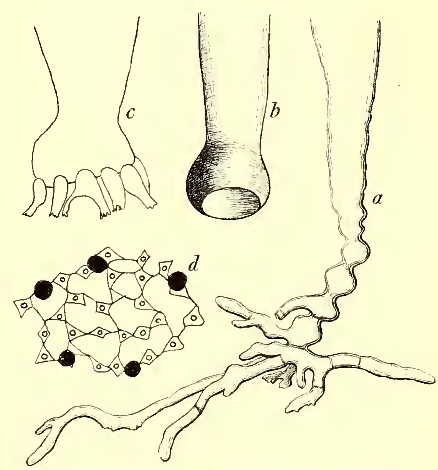

Fig. 11. *Ernodesmis verticillata* (Kütz.) *a*. base of the plant (8 : 1). *b*. basal end of a branch (12 : 1). *c*. do. with a ring of clamps (12 : 1). *d*. chromatophores with pyrenoids and nuclei (300 : 1).

Furthermore, in some specimens but far from common some longer rhizoid-like appendices grow out from the swelling (fig. 12 *c*, *d*). These appendices are so far as I have seen not separated by a wall from the mother cell, in contrast to the above-mentioned clamps where a wall is present. Kuckuck who has examined a dried specimen collected by the late M^lle^ Vickers at Barbadoes has also found them. He writes l. c. p. 187: "Dagegen zeigten die Sprossenden im unteren Teile des Büschels Gruppen von locker stehenden Rhizinen, die aus der oberen stumpfen Kuppe des Sprosses zwischen und neben den Tochtersprossen abzweigen". I think that these organs may also serve to strengthen the plant, just as these and the clamps can help to attach loose fragments of the plant to the bottom again.

The cell-wall in the older part of the thallus is rather thick, thinner in the younger; it is nicely striated in an irregularly undulating way. The cell-plasma contains numerous plate-shaped small chromatophores of irregular polygonal outline with the corners running out into shorter or longer, thin prolongations connected in a reticular way (fig. 11 *d*). In the middle of the chromatophore a rather large pyrenoid is present. Underneath the chromatophores we find the numerous nuclei in regular arrangement.

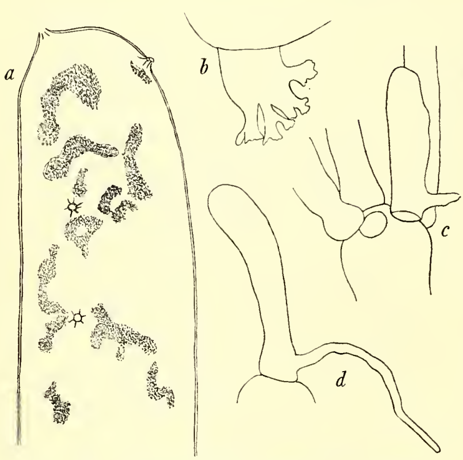

Fig. 12. *Ernodesmis verticillata* (Kütz.). *a.* the upper end of a branch transformed to zoosporangium (25:1). *b.* a single clamp (20:1). *c.* the top of a branch with small branches, one of these with a rhizoid-like appendix, in the middle the annular cicatrix from a branch torn off (8:1). *d.* branch with a rhizoid-like appendix (8:1).

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

Fructiferous cells occurred rather often in my collections. The whole cell is transformed into a sporangium (fig. 12 *a*) and the zoospores escape through numerous holes formed in the cell wall in exactly the same way as I have described for *Siphonocladus tropicus*[1]). Quite in accordance with this species the holes protrude a little and have radiating striations. Also the cell plasma with chromatophores and nuclei is contracted to an irregular network or to more irregular clumps, from which the zoospores are

[1]) Børgesen, F., Contributions à la connaisance du genre *Siphonocladus* Schmitz. (Oversigt over det kgl. danske Videnskab. Selsk. Forhandl. 1905).

formed in good accordance with other algæ e. g. *Bryopsis*, *Valonia* etc. As to the last mentioned genus Kuckuck in his paper above-quoted has given a detailed description of the formation of the zoospores based upon the study of living material.

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

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

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

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

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

This species, which has already been gathered at St. Croix by West who called it *Conferva diaphana* and of which well-kept specimens are still preserved in Vahl's Herbarium in the Botanical Museum, Copenhagen, has been described by Kützing upon specimens also from this island. It is rather common here, occurring

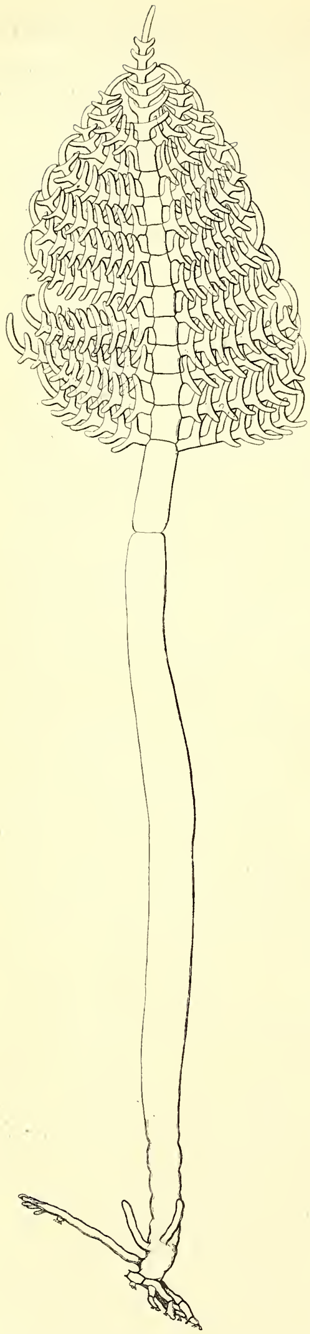

Fig. 13. *Struvea elegans* n. sp. (ca. 3:1).

both in shallow and deeper water down to a depth of about 5 fathoms. It is found both in more open but especially in sheltered localities in the shallow areas of sea behind the coral reefs. Here it often occurs loose in the form of *ægagropila*-like clumps.

It was found with sporangia in January—March.

St. Croix: Off Frederiksted, Lt. Princess, the harbour of Christianssted, Long Reef, Casavagarden.

Struvea Sond.

S. elegans nov. spec.

Struvea, stipite cylindrico, simplici, in basi transverse annulato, superne levi, flabello ovato-subpyramidali coronato; ramis flabelli oppositis distiche, plerumque quater pinnatis, apicibus ramorum plerorumque hapteris brevibus unicellularibus cellulis proximis adfixis, ramificatione in planta juvenili accuratissima, in adultiori minus regulari; cellula basali rachidis cellulis superioribus 3-plo longiori.

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

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

From the creeping filaments grows the erect part of the thallus, the stalk crowned with the frond. From its earliest stage of development the stalk consists of a single, nearly cylindric cell. At its base, at least in more mature specimens, we find a few, 6—8 annular corrugations though not very deep (fig. 13). When the stalk has reached nearly the normal height of the plant it divides into a number of cells. The forming of these cells is said by J. Agardh (l. c. p, 108), who founds his description on that of Harvey[1]), to be due to an apical cell, but this is not right, judging from what I have found in my material. I have observed the cell division in the frond of a young plant, of which fig. 14 *c* shows the uppermost halfpart. We see here that the side branches and the apical cell first grow out to a considerable length and then the cell contents in each branch are divided simultaneously into a number of smaller parts of nearly the same size, with exception of the apical cell in each branch, which is longer. Each of these smaller parts becomes surrounded by a membrane. The figure shows that the branches nearest the top are yet undivided. Somewhat lower down, where the division of

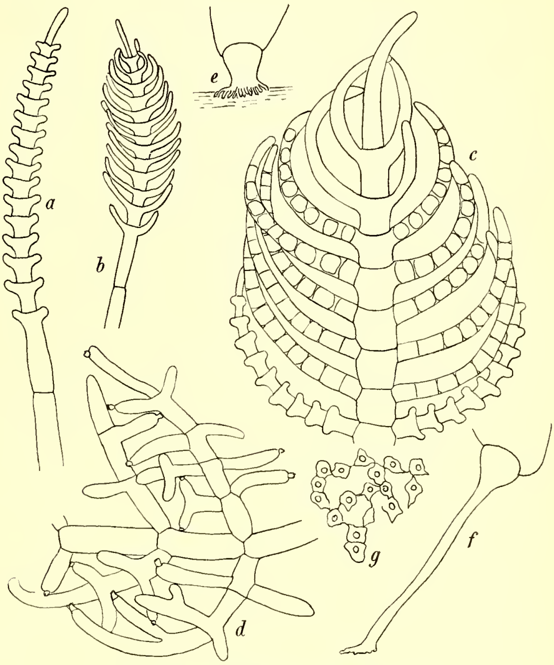

Fig. 14. *Struvea elegans* n. sp.
a. b. c. tops of young stalks shoving development of the frond and *c* the cell division also, the uppermost branches in this figure and the topcell are yet undivided, then branches occur where the cell contents are aggregated in clumps and lower down again the cell-division has been completed and in the lowest pair of branches side branches begin to grow out. *d.* part of older thallus. *e. f.* hapteræ. *g.* chromatophores. (*a. b.* about 3 : 1, *c.* 6 : 1, *d.* 10 : 1, *e. f.* 70 : 1, *g.* 300 : 1).

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

the contents has recently begun, we find that the single parts of the contents are separated from each other by a rather large open space, larger perhaps owing to the influence of the alcohol than in the living plant. These parts are surrounded by a membrane and then, as we see lower down, where the cell division is in a more advanced stage of development, they grow quite near each other and are no longer separated. The apical cell is also divided later on in this way. When these cell parts or cells, as we may now call them, have reached a certain degree of maturity they all with exception of the top cell begin to grow out in their uppermost end into two opposite branches lying in the same plane as the whole frond (see the lowermost branches in fig. 14 *c*). These new branches again grow out to a certain length and then they divide quite in the same way and so on. In fig. 14 *a* we see the uppermost part of a young stalk in about the same stage of development as the last-mentioned side branches in fig. 14 *c*; and fig. 14 *b* shows a more advanced stage, where the side branches have grown much longer but are yet undivided. In my material I have not succeeded in finding the first beginning of the cell division in the stalk, this at first being a long cylindrical cell with no walls at all, but I have no doubt that this is performed quite in the same way as mentioned above with regard to the side-branches.

This method of cell division reminds one very much of that described above in *Dictyosphæria* and of that found in *Siphonocladus tropicus* as I have described it l. c. and Dr. Rosenvinge has also directed my attention to that found in the formation of the zoosporangium of *Vaucheria* (cfr. Götz in "Flora", vol. 83, 1897, p. 93 and the literature quoted here).

The ramification of the branches can take place several times; in an old frond I have found branches of the 4th order. While the branching is very regular in the young specimens, as the figure shows, the ramification in the older leaves is more anomalous, branches of the highest order being not formed everywhere (fig. 14 *d*).

At the same time as the side branches of first order have begun to divide, the top cells of each branch develop at their apices rhizoid-like organs of attachment which Murray and Boodle have called "tenacula". These consist of a little cell (fig. 14 *e*) ending in a broader, irregularly lobed disc, by means of which the top cell of each of the inward bent branches fastens itself to the cell-wall of the branch nearest above. Most of the apices of the top cells touch the branches above even before the tenaculum has grown out and this need only be quite short, but sometimes it happens that it does not succeed in coming into close connection with another branch and then it can grow rather long like a rhizoid (fig. 14 *f*). To begin with it is only the top cell of each branch which fixes itself in this way, forming a kind of edge along the side of the frond, but later on in the older frond nearly all the side branches of the second, third and higher order are provided with tenacula at the top and fastened to other branches (fig. 14 *d*). In this way, in good accordance with what is well-known in other *Struvea*-species, all the branches, loose at first, form a connected whole. Sometimes, but more seldom, I have found two tenacula growing out from the same top of the cell.

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

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

As to the wall plasma and its contents this is very like what we find in *Valonia.* The chromatophores (fig. 14 *g*) are plate-shaped, of irregular polygonal form, often with elongated angles forming in this way a net-work. In each chromatophore a rather large pyrenoid is nearly always present. Behind the chromatophores we find the numerous nuclei rather regularly distributed.

The whole plant with stem and frond together reaches a height of about 10 cm, the length of the frond may measure up to 4 cm and the breadth $2^1/_2$ cm. The stalk is normally unbranched but a single specimen was found having a side-branch also crowned with a frond.

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

Struvea elegans was dredged in deep water only, down to about 40 meters. It occurs at several places in the Sound between St. Thomas and St. Jan, further near Thatch Cay at St. Thomas where it was collected by Dr. Th. Mortensen and off America Hill on the north side of St. Jan.

S. anastomosans (Harv.) Piccone.

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

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

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

At first the young plant consists of a nearly cylindric cell, tapering somewhat at both ends, the stalk of the full grown plant. Below it is fastened to the substratum by means of irregularly ramified and septate rhizoids in which starch is accumulated (fig. 15 *d*). The stipe has quite even walls and has no annular constriction at its base. It is often ramified (fig. 15 *d*).

When the stalk has reached a certain degree of development the cell contents are densely accumulated in the top of the cell and then divided into a number of cells (fig. 15 *a*). This division takes place so far I have been able to see quite in the same manner as in the above-mentioned species. In spite of the fact, that I have had a fairly large material I have nevertheless only found very few cells in the first stages of development, most pro-

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

bably because the division of the cell contents takes place very quickly. One of the youngest stages I have seen is shown in fig. 15 *a*. We see here that 5 cells are formed, a larger cell below which is always found here at the base of the frond and 4 smaller cells above it.

Fig. 15 *b* shows a somewhat more advanced stage of development, the side-branches of first order here beginning to grow out from the cells in the stalk. This mode of growth is quite in accordance with that in the above-mentioned species and on the whole the ramification takes place in the same way as in *Struvea elegans*, only not quite so regularly.

As to the cell contents the plate-shaped irregular polygonal chromatophores (fig. 15 *f*) form a network in the wall plasma. In each chromatophore a large pyrenoid is present and under the chromatophores the numerous nuclei are arranged rather regularly.

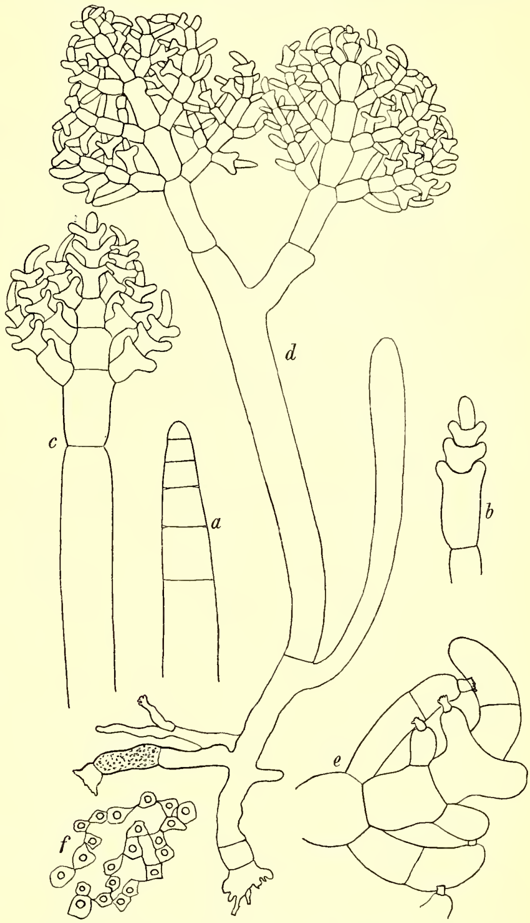

Fig. 15. *Struvea anastomosans* (Harv.) Piccone. *a*, and *b*. tops of young stalks showing development of the frond. *c*. somewhat more developed frond. *d*. plant prepared out from a tuft, with rhizoids and ramified stalk so common in this species; below to the right a young stalk is growing out. *e*. parts of the frond showing the mode of attachment by means of tenacula. *f*. chromatophores with pyrenoids. (*a*. *b*. *c*. *d*., about 6 : 1; *e*, 20 : 1; *f*. 250 : 1).

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

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

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

St. Croix: Christianssteds harbour.

Chamædoris Mont.

C. Peniculum (Sol.) O. K.

Corallina Peniculum Solander in Ellis, The Natural History of many curious and uncommon Zoophytes collected from various parts of the globe, London 1786. p. 127, tab. 7, fig. 5—8, tab. 25, fig. 1.

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

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

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

Scopularia annulata Chauvin, Recherches sur l'organisation, la fructification et la classification de plusieurs genres d'Algues. Caen 1842 (9. Nov.).

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

At its base (Fig. 16) the stem is fastened to the substratum by irregularly branched and septate rhizoids which penetrate often rather deeply into the loose limestone, upon which especially I have found the plant growing. In the cells of the rhizoids starch is richly present. The uppermost rhizoids growing out from the stalk are more rhizome-like, creeping as they do on the surface of the substratum, and from these new stems grow up often in great number. Owing to this mode of growth the plant also grows gregariously often in large tufts. How far all the individuals in a tuft have their origin from this mode of propagation I cannot say; many of the plants in a tuft were so loosely connected and so easily separated that one may doubt their origin in this way, but the connection between the single plants can of course early decay. If we consider the fig. 16 we find, that each of the young plants is separated by a cell wall in the rhizome-like filament from the next young plant, each in this way receiving a piece of the rhizome from which rhizoids grow out downwards. Most probably the young plants are easily separated at these walls and in this way become separate individuals.

The quite young stem has thin walls and no constrictions, but these begin at an early stage to be developed from the base, progressing upwards. When the stem has reached a height of about 4—5 cms it will be quite annularly constricted with exception of the uppermost part. Then the formation of the cup-shaped head will take its beginning (fig. 17 *a*, *b*, *c*, *d*). First, much of the cell-content accumulates in the top of the cell and the obtuse apex elongates, becoming conical. Then the cell contents here divide simultaneously into two or most often three (fig. 17 *a*) separate parts, the largest lowest, the smallest at the top. Each of these parts becoming surrounded with a membrane grow again closely together, the plant in this way now consisting of a very large cell in the stem and three (seldom only two) smaller at its top. These cells and the uppermost end of the stem swell somewhat and after reaching a certain thickness a whorl of some small warty outgrowths emerge at their uppermost end (fig. 17 *b*). These small warty outgrowths are the beginning of the filaments of which the head is composed. In the lowest of these four (seldom three) whorls of filaments we find a number of about 20, in those higher up fewer, from the uppermost small

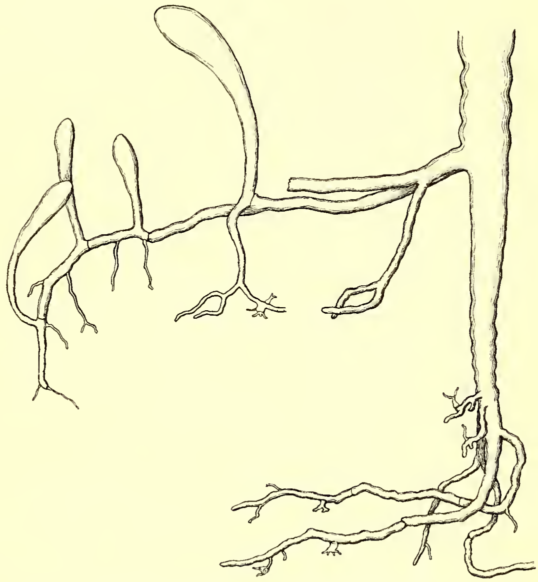

Fig.16. Base of *Chamædoris Peniculum* (Sol.) O.K. Young stems growing up from the rhizome-like filament to the left. (about 3:1).

cell only 3 or 4 filaments growing out. Near their base a wall is formed in the filaments. These filaments grow longer (fig. 17 *c*) and divide very regularly many times pseudodichotomously having a wall just over each side-branch (fig. 17 *e*). Fig. 17 *f*, *g* show the ramification as it takes place in a young filament. We find that

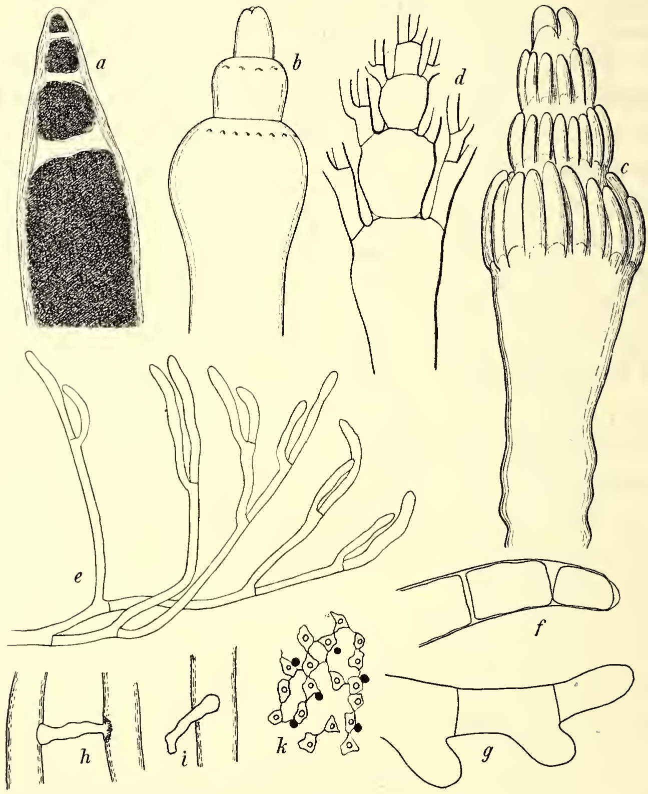

Fig. 17. *Chamædoris Peniculum* (Sol.) O. K.
a. *b*. *c*. tops of young plants in different stages of development, in *a* the cell contents have newly been divided, in *b* the young cells have swollen, the ring of warty øutgrowths showing the first beginning of the filaments in the head, in *c* the warty outgrowths have grown longer. *d*. shows a longitudinal section through a somewhat older specimen in which the filaments have begun to be divided. *e*. part of the filaments. *f*. and *g*. young filaments showing the mode of cell division. *h*. and *i*. rhizoid-like hapteræ growing out from the filaments *k*. chromatophores with pyrenoids and nuclei. (*a*. *b*. *c*. *d*. *e*. about 10:1, *f*. *g*. *h* *i*. 25;1, *k*. 250:1).

also here as in the stem the protoplasm first divides into some smaller parts (fig. 17 *f*) which surround themselves with a membrane and grow together again and then a side-branch grows out from the uppermost end of each of the parts in which the filaments have been divided (fig. 17 *g*). The branched filaments are felted together and the coherence is moreover increased by means of some small, short, rhizoids growing out here and there from the filaments and attaching themselves very strongly to the neighbouring filaments (fig. 17 *h*, *i*).

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

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

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

As to the cell contents, we find in the wall-plasma the irregularly polygonal plate-shaped chromatophores, forming by means of their prolonged corners a rather dense network in the young parts of the thallus (fig. 17 *k*), in the older the chromatophores are of a more elongated form and more openly placed. In the middle of the chromatophore a pyrenoid is present. Below the chromatophores the numerous nuclei occur distributed rather regularly.

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

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