Det Kgl. Danske Videnskabernes Selskab.
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ESPECIALLY FROM TENERIFFE AND GRAN CANARIA

III. RHODOPHYCEÆ

PART I

BANGIALES AND NEMALIONALES

BY

F. BØRGESEN

KØBENHAVN

HOVEDKOMMISSIONÆR: ANDR. FRED. HØST & SØN, KGL. HOF-BOGHANDEL

BIANCO LUNOS BOGTRYKKERI

1927

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This first part of the *Rhodophyceæ* of the Canary Islands comprises the *Bangiales* and the *Nemalionales.*

Of the 43 species mentioned in this paper, 7 species are endemic, 6 of which have been described here for the first time. 20 of the species found are common to these Islands and the West Indies or the Southern Atlantic coasts of North America. Of West Indian *Acrochætium* species described by me, I have found 3 species at the Islands, viz. *Acr. crassipes*, *Acr. gracile* and *Acr. occidentale*; as the Canarian form of the last mentioned species differs somewhat from the West Indian form it is described as a new variety. In addition, 3 other *Acrochætium* species are common to both sides of the Atlantic.

Of the 6 *Liagora* species found at the Canary Islands, two species are common to both groups of islands, one is a Mediterranean species, and three are described here as new ones. One of these, *Liagora canariensis*, is, however, related to the West Indian *Liagora valida.*

As to the four *Galaxaura* species mentioned in this paper, all of them occur also in the West Indies.

These examples must be enough to show that the great likeness between the algal flora of the Canary Islands on this side of the Atlantic and the West Indies and adjacent shores of America on the other side as already stated in the groups of *Chlorophyceæ* and *Phæophyceæ* is also striking in the groups of *Florideæ* mentioned here.

For the loan of type specimens or collections of Canarian algæ originating from earlier investigators I am much obliged to Dr. Achille Forti, Verona; Dr. G. Hamel, Muséum National d'Histoire Naturelle, Paris; Dr. M. A. Howe, Botanical Garden, New York; Dr. Otto Chr. Schmidt, Botanisches Museum, Dahlem bei Berlin; Professor René Viguier, Faculté des Sciences, Caen, and Professor É. de Wildeman, Musée botanique de l'État, Bruxelles.

Moreover Professor C. Sauvageau has permitted me to keep his collection from the Islands here. It has been of great help to me during my investigations.

The habit illustrations have for the most part been drawn by Mr. O. Hagerup, mag. scient.

The drawings of microscopic preparations have as a rule been made by me in pencil, afterwards Mr. Ove Rostrup has drawn them in Chinese ink for reproduction.

To the Trustees of the Carlsberg Foundation I am greatly indebted for a grant especially for the production of the drawings.

RHODOPHYCEÆ

A. Protoflorideæ.

I. Bangiales.

Fam. 1. Bangiaceæ.

Porphyra Agardh.

1. Porphyra leucosticta Thuret.

Thuret in Le Jolis, Alg. mar. Cherb., p. 100. Janczewski, Études anat. sur les Porphyra (Ann. sc. nat., V. Serie, t. 17, 1873, p. 241). Berthold, G., Die Bangiaceen des Golfes von Neapel, 1882. p. 24. Rosenvinge, L. Kolderup, Mar. Alg. Denm., p. 65.

Of this species M^lle^ Vickers has found a very small but fructifying and typical specimen.

The specimen is preserved in the Herbarium of M^lle^ Vickers in Bruxelles. I am much indebted to Professor É. de Wildeman for permission to see it.

It is fixed to a small *Gelidium* which again creeps upon *Corallina*.

Gran Canaria: Las Palmas (M^lle^ Vickers).
Geogr. Distrib. Atlantic coast of Europe, Mediterranean Sea.

Erythrotrichia Areschoug.

1. Erythrotrichia carnea (Dillw.) J. Agardh.

J. Agardh, Till Algernes System. III, p. 15.
Conferva carnea Dillw., Brit. Conf., pl. 84.

Conferva ceramicola Lyngb., Hydrophyt. Dan., p. 144, tab. 48 D.
Erythrotrichia ceramicola Aresch., Phyc. Scand. mar., p. 210.

As pointed out by Rosenvinge (Mar. Alg. Denm., p. 67), this species is attached to the host plants by means of a small disc formed by short rhizines developed from the basal cell only. The basal cell and the following lowermost cells in the filaments are comparatively long and thin, their breadth in the Canarian specimens being about 6—7 μ and the length about 25 μ. But the cells quickly get thicker upwards, their diameter reaching a length of about 16—20 μ. The length of the cells varies much being $^1/_2$—$1^1/_2$ that of the breadth. The cells are often constricted at the cross walls (comp. Fig. 1). In this figure the fine star-shaped chromatophore with the large pyrenoid is seen and, in two of the cells, the spore formation.

Fig. 1. *Erythrotrichia carnea* (Dillw.) J. Ag. Part of a filament with monospores. (About 375 : 1).

This plant is rather common as an epiphyte upon various algæ growing on or between *Cymodocea nodosa*, *Caulerpa prolifera* etc. in a sheltered bay in shallow water. It had monospores in March.

Gran Canaria: Playa de las Canteras.

Geogr. Distrib. Atlantic coast of Europe and North America, Mediterranean Sea, Morocco, West Indies, Indian Ocean, Easter Island.

2. Erythrotrichia obscura Berthold.

Berthold, G., Bangiaceen Neapel, p. 26, tab. I, fig. 19—25.
Hamel, G., Floridées de France, p. 289, fig. II, 2.

The description of Berthold is rather poor; it is said about the plant that it has a basal disc from which several

erect filaments arise up to a height of about 3 mm, that the cells are comparatively large and furthermore, in the upper end of the thallus, there are found sometimes two, rarely four cells in a row next to each other, and finally

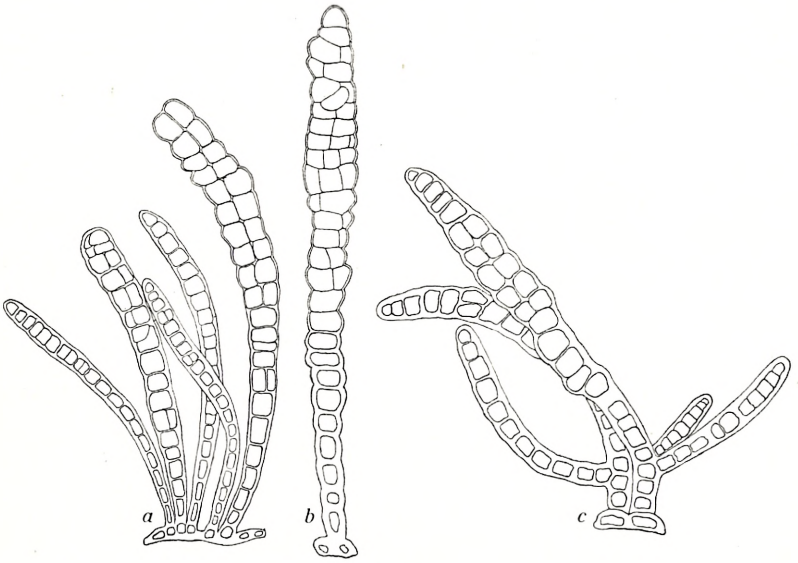


Fig. 2. *Erythrotrichia obscura* Berthold. *a*, *b*, unramified specimens from Christoballo; *c*, ramified specimens from Playa de Santa Catalina. (About 200 : 1).

the thallus near its base is sometimes divided into 2 or 3 branches.

As to the ramification, my specimens have shown no little difference. In one collection from the shore of Gran Canaria South of Las Palmas at Christoballo where it was growing upon *Dipterosiphonia dendritica* most of the specimens found were ramified. In another collection from the same locality, but found upon *Pterocladia*, nearly all the specimens were unramified (Fig. 2, *a*, *b*), very rarely a ramified specimen was found. In a collection from Playa de Santa Catalina North of Las Palmas many of the speci-

mens were ramified (Fig. 2, *c*). But as the plants in the collections in all other respects seem to agree very well, I refer them to this species.

The Canarian specimens have a well developed disc from which often grow up many erect filaments in different stages of development, from quite young ones formed only by a short single row of cells to fully developed filaments. These have at their base a single row of cells only; higher up the cells are divided by longitudinal walls into 2—4 or more cells, arranged as a rule in stories above each other with 2—4 cells in each story. By this cell-division, the filaments become clavate.

The cells are large, their diameter reaching a length of about 16—18 μ. As, especially in the upper part of the filaments, the cells protrude in the middle, the surface of the filaments undulates unevenly.

In the specimens examined I have found only monospores; in the usual way these are cut off from the mother cell by an oblique wall. In this species, Berthold has also found antheridia and carpogonia, and he has observed the fertilization.

The plant is found in rather exposed localities somewhat above low water mark.

Gran Canaria: Christoballo, Playa de Santa Catalina.
Geogr. Distrib. Mediterranean Sea.

3. Erythrotrichia investiens (Zanard.) Bornet.

Bornet, E., Alg. Schousboe, p. 60.

Bangia investiens Zanard., Notizie cell. mar. Ven., 1847 p. 68 (non vidi).

Bangia cæspitosa Reinsch, Contrib. Algol. et Fungol., p. 44, tab. 21, fig. 2.

Some specimens of this plant (Fig. 3) are found upon *Gelidium pusillum*.

The erect filaments arise from the basal disc; these are monosiphonous in the basal part. Higher up in the filaments the cells are divided by longitudinal walls into two cells. In these parts of the filaments their diameter is about 26 μ, while in the monosiphonous part of the filaments and in the young monosiphonous filaments the breadth is about 8 μ.

The monospores are formed in the usual way by an oblique or somewhat curved wall separating the spores from the mother cells.

It was found somewhat above low water mark in a rather sheltered place.

Gran Canaria: Playa de Santa Catalina.

Geogr. Distrib. Mediterranean Sea.

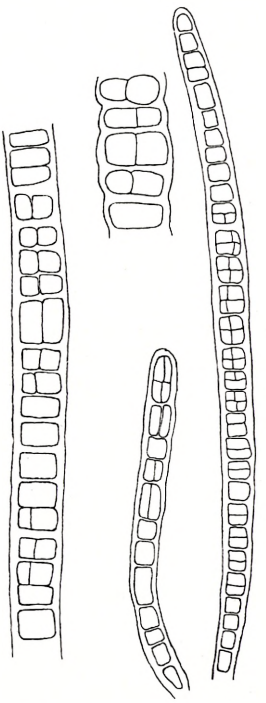


Fig. 3. *Erythrotrichia investiens* (Zanard.) Bornet. Parts of filaments in various stages of development. (About 275 and 375 : 1).

4. Erythrotrichia Boryana (Mont.) Berth.

Berthold, G., Bangiac. Neapel, p. 25. Hamel, Floridées de France, p. 427.

Porphyra Boryana Mont., Flore Algérie, p. 150, tab. XIII, fig. 2.

Only a few specimens of this plant have been found; they were growing in company with *Erythrotrichia obscura* upon *Pterocladia capillacea*.

Numerous densely placed erect fronds arise from a basal disc. In the basal part, these are monosiphonous, about

12 μ broad; but the cells soon divide, the result of which is a disc-shaped lamina-like thallus. The cells in these are arranged rather regularly in longitudinal and transverse rows. The cells are rather regularly quadratic with a diameter of about 16 μ.

Fig. 4. *Goniotrichum elegans* (Chauv.) Le Jolis. Cells with condensed cell-contents becoming free by the decomposition of the wall. (About 375 : 1).

Gran Canaria: Christoballo south of Las Palmas.

Geogr. Distrib. The southern Atlantic coast of Europe from South England. Mediterranean Sea.

Goniotrichum Kütz.

1. **Goniotrichum elegans** (Chauv.) Le Jolis.

Le Jolis, A., Alg. mar. Cherb., p. 103. Berthold, G., Bangiaceen, p. 26. Hauck, F., Meeresalgen, p. 518. Rosenvinge, L. K., Mar. Alg. Denm., p. 75.

Bangia elegans Chauvin, Mem. Soc. Linn. Norm., T. 6, 1838 (non vidi); Recherch. sur l'org. de plus. genr. d'Algues, Caen 1842, p. 33. Harvey, W., Phyc. Brit. pl. 246.

This plant seems to be a rather common epiphyte upon various algae and the leaves of *Cymodocea nodosa*, but I have nowhere found much of it.

The specimens are more or less ramified. The breadth of the thallus varies about 20 μ, the lumen of the cells being about 8 μ broad only. A large and much ramified specimen was 24 μ broad near its base, at the upper end of the branches 15 μ.

Fig. 4 shows what I think is the formation of the monospores. Schmitz has described the spore formation in "La Nuova Notarisia", 1894, p. 718 and in Engler und Prantl, "Nat. Pflanzenfam." I, 2, p. 314; as shown in the figure, the cells of the filaments get free by the decompo-

sition of the cell-membrane, the cell contents at the same time getting condensed.

Gran Canaria: Bahia del Confital, Playa de Santa Catalina in several places. Teneriffe: Orotava.

Geogr. Distrib. Europe, Mediterranean Sea, Morocco, West Indies, Easter Island, Dutch India.

Asterocytis Gobi.

1. **Asterocytis ornata** (Ag.) Hamel.

HAMEL, G., Floridées de France, II, p. 451.

Conferva ornata C. Ag., Syst. Alg., p. 104.

Asterocytis ramosa (Thwaites) Gobi in Arbeiten St. Petersb. Naturf. Ges., Bd. X, 1877, p. 85. WILLE, N., Algolog. Notiz., I—IV, p. 7, tab. 1, figs. 8—14. ROSENVINGE, L. KOLDERUP, Mar. Alg. Denm., p. 77. BØRGESEN, F., Mar. Alg. D. W. I., vol. II, p. 3.

Hormospora ramosa Thwaites in HARVEY, Phycologia Britannica, pl. 213.

Goniotrichum ramosum Hauck, Meeresalgen, p. 517.

This species has during resent years been called *A. ramosa* (Thwaites) Gobi, but HAMEL has examined an authentic specimen of *Micronema ornatum* C. Agardh mscr. in Herb. (= *Conferva ornata* C. Ag.) sent to BORNET by J. AGARDH and found it to be this species.

The plant was once found as an epiphyte upon *Corallina*. The specimens were small and not ramified. The diameter of the filaments reached a length of about 12—18 μ and the cells had a breadth of about 6 μ.

In some of the filaments the formation of akinetes took place. They were formed in agreement with WILLE's, ROSENVINGE's and my descriptions and figures. The akinetes are surrounded by a thick wall and were about 8—9 μ broad and 15—16 μ long.

The plant occurred in a rather exposed place, near

low water mark growing upon *Corallina*, intertwisted among other algæ.

Gran Canaria: Bahia del Confital.

Geogr. Distrib. Atlantic coast of Europe, Mediterranean Sea, Canary Islands, North America, West Indies.

B. Florideæ.

I. Nemalionales.

Fam. 1. Helminthocladiaceæ.

Subfam. 1. Chantransieæ.

Acrochætium Nägl.

1. Acrochætium crassipes Børgs.

Børgesen, F., Some new or little known West Indian Florideæ, (Bot. Tidsskr., 30. Bd., København, 1900); Mar. Alg. D. W. I., vol. II, p. 20.

Of this small plant I have seen but one specimen. It was fixed to *Acrochætium codicola* and was quite typically developed.

The accompanying figure (Fig. 5) shows the plant. It had a rather long unramified basal part and was then divided into two curved branches, carrying upon their upper side sessile or pedicellate sporangia; one of the branches ended in a hair. The basal cell was nearly 9 μ broad, the thallus tapering gradually upwards to about 5 μ.

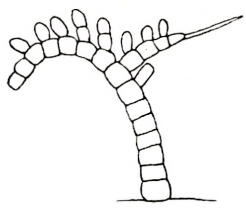


Fig. 5. *Acrochætium crassipes* Børgs. (About 400 : 1).

The following species, *Achrochætium parvulum*, differs essentially from this

species by its comparatively larger and more globular basal cell from which as a rule several branches are developed, while in *Acrochætium crassipes* a single or sometimes two filaments issue from it.

The species most nearly related to *A. crassipes* is *Acrochætium catenulatum* Howe[1]. Regarding the differences between these two plants compare HOWE's and my remarks respectively.

Teneriffe: Puerto Orotava.
Geogr. Distrib. West Indies.

2. Acrochætium parvulum (Kylin) Hoyt.

HOYT, W., Marine Algæ of Beaufort, 1920, p. 470, fig. 25.
Chantransia parvula Kylin in Bot. Studier tillägn. F. R. Kjellman, 1906, p. 124.
Chantransia hallandica γ parvula (Kylin) Rosenv., Mar. Alg. Denm., p. 97.

The Canarian specimens (Fig. 6) which I have found of this fine little plant seem to agree quite well with the description of KYLIN, the only difference being that the Canarian specimens seem in all respects to be a little smaller.

The plant is characterized by the presence of a rather large basal, globular, persistent cell which so far as I have been able to see is somewhat immersed in the wall of the host (*Cladophora crystallina*). The diameter of this cell varies from about 5 μ in the young small plants up to about 8 μ in the older more developed ones. From this cell a number of filaments (mostly 3—6) arise. The cells in these filaments are about 5—6 μ broad in their lower part, in the upper part often scarcely 4 μ. The cells are

[1] HOWE, M. A., The marine Algae of Peru in Memoirs Torrey Bot. Club, vol. XV, p. 84.

about $1^1/_2$ times as long as broad. At the ends of the filaments long hairs are present. In the most vigorous filaments short branchlets are sometimes developed in the basal part.

The oval-ovate sporangia are usually sessile, rarely pedicellate, frequently sporangia are placed oppositely upon the same joint. The sporangia are about 6 μ long and 4 μ

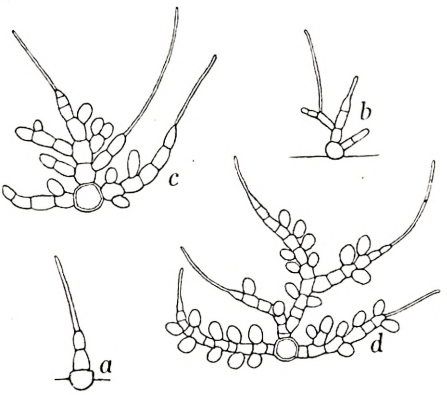


Fig. 6. *Acrochætium parvulum* (Kylin) Hoyt.
a. *b*, younger plants; *c*, *d*, more developed plants. (About 400 : 1).

broad. The chromatophore is a parietal dense plate filling out most of the cell; it contains a central pyrenoid.

Gran Canaria: Christoballo.

Geogr. Distrib. Scandinavia, Atlantic coast of North America (North Carolina).

3. Acrochætium virgatulum (Harvey) Bornet.

Bornet, E., Deux Chantr. corymbifera Thuret. p. XXII.

Callithamnion virgatulum Harvey, Phyc. Brit., pl. 313.

Callithamnion luxurians J. Ag., Spec. II, p. 14, according to Bornet, l. c.

Chantransia virgatula Thur. in Le Jolis, Liste p. 106.

Chantransia virgatula α *luxurians* (J. Ag.) L. K. Rosenvinge, Mar. Alg. Denm., p. 110.

While BORNET, after having examined an authentic specimen of *Callithamnion luxurians* J. Ag., considers it a form of *Acroch. virgatulum*, KYLIN in "Algenflora schwedische Westküste", p. 117 considers it a species. But ROSENVINGE,

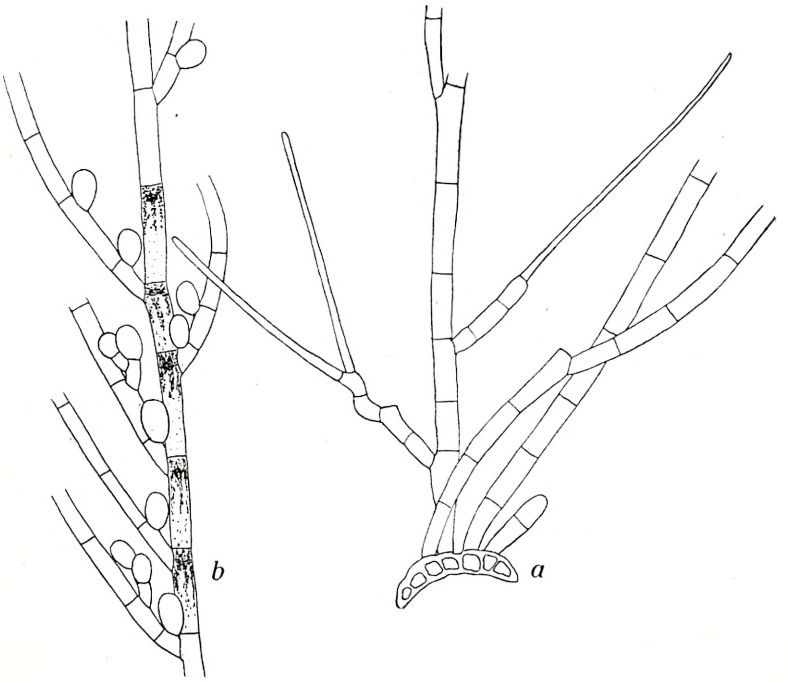


Fig. 7. *Acrochætium virgatulum* (Harv.) Bornet.
a, basal part of a plant; *b*, part of ramified branch with sporangia.
(*a*, about 270 : 1; *b*, about 225 : 1).

who has examined many specimens from the Danish waters and found it to be a very variable species, again refers it to *Acroch. virgatulum*,

The Canarian specimens seem to be in good accordance with the description of ROSENVINGE.

Fig. 7 *a* shows a basal part of a young plant. From the small disc several erect filaments of different ages grow up. The main filaments in the Canarian plant

are about 12—14 μ thick, and the sporangia about 20—23 μ long and 16 μ broad. A branch with sporangia and the characteristic hairs is pictured in Fig. 8.

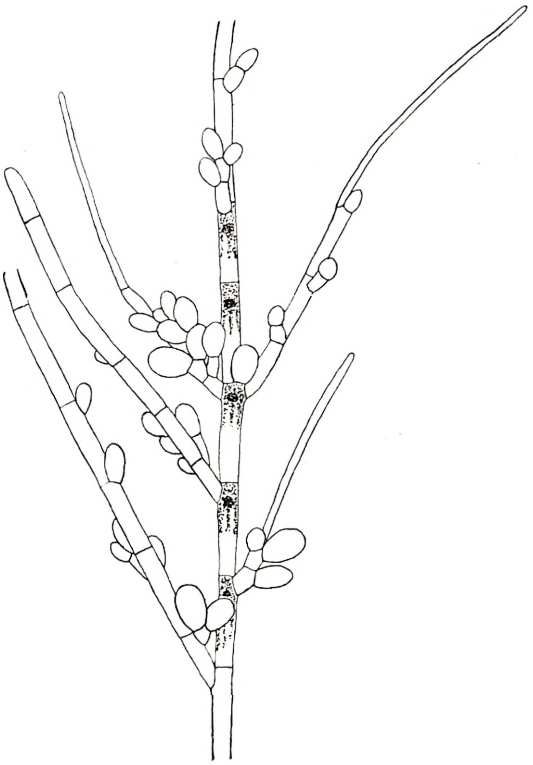


Fig. 8. *Acrochætium virgatulum* (Harv.) Bornet. Upper part of a plant with hairs and sporangia. (About 250 : 1).

The chromatophore is found in the upper end of the cell, it is more or less cucullate of shape, the central part containing the axil pyrenoid sending long prolongations downwards, shorter ones upwards (Fig. 7 *a*, 8).

The plant was found in a sheltered bay as an epiphyte upon *Caulerpa prolifera.*

Gran Canaria: Bahia del Confital.

Geogr. Distrib. Atlantic coast of Europe and North America.

4. Acrochætium canariense nov. spec.

Thallus cæspitosus ad 350 μ altus, e disco basali epiphytico et filis erectis sporangiferis compositus. Spora germinans in cellulas duas permagnas perdurantesque ca 10—12 μ longas et 8—9 μ latas divisa est; ex his cellulis nunc singula nunc dua fila, brevia, decumbentia et repentia, ramosa et plus minus confluentia, discum formantia gignuntur.

Fila erecta a basi plus minus ramosa, apicem versus paullulum attenuata e cellulis doliiformibus composita sunt. Cellulæ ca 8—10 μ latæ et ca 10—13 μ longæ chromatophorum cylindraceum parietale, pyrenoide centrali instructum continentes. Pili hyalini terminales adsunt.

Sporangia aut sessilia aut interdum pedicellata, uniseriata aut sparsa, raro opposita, ca 11—16 μ longa et 9—12 μ lata. Sporangia aut monosporangia, aut disporangia vel tetrasporangia cruciatim divisa sunt.

This interesting small plant is found as an epiphyte upon *Gelidium pusillum*.

The size and whole appearance of this species agrees with the form of *Acrochætium secundatum* I have figured in "Mar. Algæ of the Færöes", p. 350, fig. 51 and with the figure of KUCKUCK in OLTMANNS, "Morphologie der Algen", 1st edition, p. 650. But in one respect, namely the development and building up of the basal disc, the Canarian plant differs so essentially from the one found in the *Acrochætium secundatum* that I think it most appropriate to consider the Canarian plant as a new species.

The development of the disc in *Acrochætium secundatum*, first described by MURRAY and BARTON in Journ. Linn. Soc., Bot., vol. 28, p. 212, the note, pl. 37, fig. 5 and later by KYLIN, "Algenflora", p. 115, fig. 24 and ROSENVINGE,

"Mar. Alg. Denm.", p. 113, fig. 40 takes place as follows: the germinating spore is divided into three pericentral and

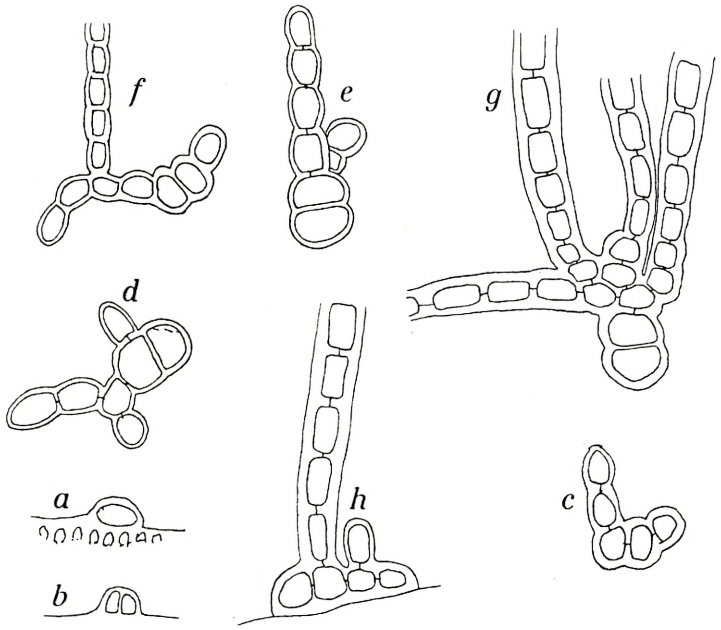


Fig. 9. *Acrochætium canariense* nov. spec. *a*, still undivided spore; *b*, the spore divided into two cells; *c*, an erect filament, composed of two cells, is given off from the one cell and a decumbent filament, still composed of a single cell, from the other. *d*, from one of the original cells is developed a short decumbent filament composed of two cells and from the first cell in this an erect filament consisting of two cells; furthermore an erect filament still consisting of a single cell is given off from the same original cell. *e*, from the one of the original cells a short decumbent filament and an erect one are issuing. *f*, decumbent filaments are given off from both of the original cells, the second cell in the one decumbent filament has produced an erect filament. *g*, base of a more developed plant; *h*, transverse section of a young base. (About 550 : 1).

one central, triangular cell from which the first erect filaments issue.

In the Canarian plant the development of the disc proceeds in a very different manner. The germinating spore

(Fig. 9 *a*) is here divided into two cells of nearly equal size (Fig. 9 *b*), and these cells, and this is the most important fact, are retained and always easy to recognize in the older plant by their size and the thick walls by which they are surrounded.

From these two cells the continued development now takes place in rather different ways in each plant. In some plants, and this seems to be the most common, a cell issues from only one of the original ones, and this cell again gives rise to a few cells which again are divided, the result being several quite short filaments creeping upon the host. The first erect shoot is often developed from the cell first given off from one of the original cells, and later on erect filaments gradually arise from nearly all the cells with the exception of the two originating from the divided spore. In plants having this development these two cells are placed eccentrically in the basal layer (comp. Fig. 9 *d*, *e*, *g*).

But in other plants a cell issues from both of the original cells, and in plants where this is the case we find the two original cells more or less centrally in the basal layer (comp. Fig. 9 *c*, *f*).

In most cases erect filaments do not seem to be given off from the original cells, but I have found plants in which erect filaments issue from these (Fig. 9 *e*, *h*). As far as I have been able to see, the basal layer consists only of a single layer of cells, and it forms a disc of cells, in older plants gradually growing together.

From the basal disc in older plants a good many erect filaments arise forming a dense tuft. The cells in the filaments swell a little in the middle, they are composed of cells about 9—10 μ thick and about $1^1/_4$ times as long.

In most of the specimens hairs occur (Fig. 10 *a*, *b*), but in some, hairs were not found.

The sporangia (Fig. 10) are placed more or less unilaterally upon the main filaments or upon the shorter branches issuing from these. The sporangia are either

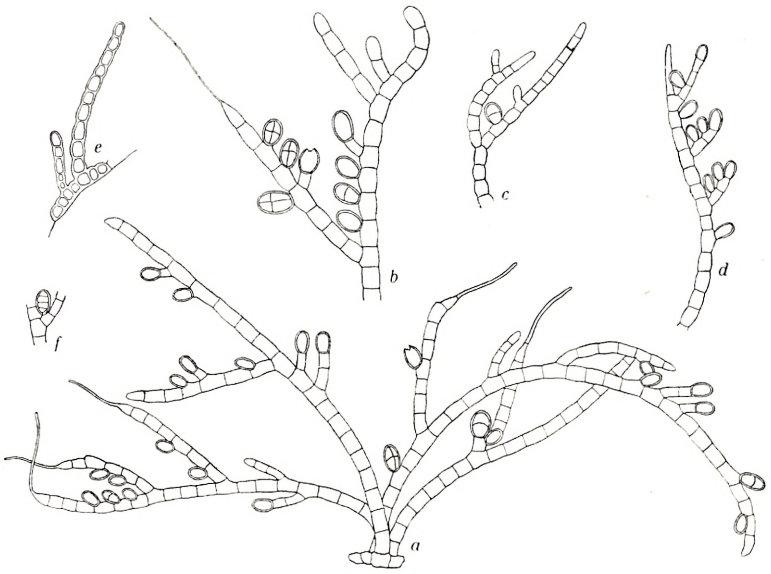


Fig. 10. *Acrochætium canariense* nov. spec. *a*, habit of a plant with sporangia; *c*, *e*, small plants; *b* and *d*, branches of plants with sporangia; *f*, a transversely divided sporangium. (*a*, about 250 : 1; *b*, 350 : 1; *c*, *d*, about 175 : 1; *e*, 225 : 1.

sessile or pedicellate. By far the greater part of the sporangia are monosporangia, but in many plants sporangia occurred which were divided into two spores or cruciately divided into four. A few more irregularly divided sporangia also occurred, and once I found a sporangium divided by horizontal walls into four spores (Fig. 10 *f*).

The sporangia were about 9—12 μ broad and 11—16 μ long, those divided into four spores are the larger ones.

The chromatophores (Fig. 11), with an axile pyrenoid

are placed in the upper ends of the cells sending down broader prolongations along the wall of the cell.

BORNET in his important paper: "Deux Chantransia corymbifera Thuret, Acrochætium et Chantransia", as is well known, gives a survey of the *Acrochætium*-species, basing this essentially upon the development of the basal part of these interesting small plants. If now we ask to which of BORNET's groups our plant belongs, it will soon be seen that in BORNET's grouping of species, we have not a group answering to our plant. It comes near to Sectio II by its persistent spore, but while this is divided into two cells in our plant, the germinating spore remains undivided in BORNET's group. Further, by the later development of a pseudoparenchymatous disc, our plant shows a likeness to Sectio VI of BORNET, but in this group the germinating spore becomes indistinct.

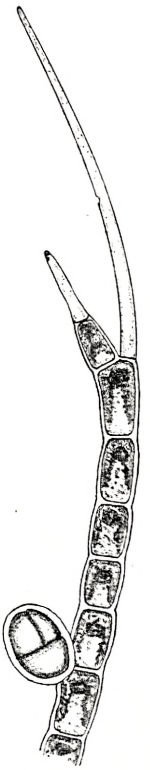


Fig. 11. *Acrochætium canariense* nov. spec. Upper end of a filament with hair, and a tetrasporangium. (Abt. 500 : 1).

By the fact that the germinating spore is divided into two cells, this species shows a likeness to *Acrochætium comptum* described by me in "The Mar. Alg. D. W. I.", p. 46, but the latter has no disc. And in "The Mar. Alg. of Denm." ROSENVINGE has described several species of *Acrochætium* in which the germinating spore is divided into two cells. Our plant especially seems to show a likeness to the *Chantransia polyblasta* Rosenv. and the *Chantransia humilis* Rosenv. l. c. pp. 115 and 118.

Gran Canaria: Playa de Santa Catalina.

5. Acrochætium Cymopoliæ nov. spec.

Thallus minutus, cæspitosus, e filamentis super vesiculam hospitis, *Cymopoliæ barbatæ*, repentibus et plus minus incrustatione calcarea eis immersis et e filamentis erectis simplicibus aut parce ramosis compositus.

Fila erecta sporangifera formata e cellulis plus minus doliiformibus, ca 5 μ latis, et 8 μ longis, chromatophorum cylindricum parietale, irregulariter lobatum, et pyrenoide centrali instructum continentia.

Pili breves, hyalini, terminales, ca 30 μ longi et $1^1/_2$ μ lati hic illic apparent.

Sporangia sessilia, monospora, solitaria, ovata, 9—10 μ longa et 5 μ lata.

Upon the upper ends of the facets of *Cymopolia barbata*, partly immersed in the chalky incrustation of this plant, a small *Acrochætium* (Fig. 12) was found, the basal filaments of which were creeping upon the surface of the facets and from these filaments, erect ones issue, often provided with hairs and bearing sporangia.

The original spore-cell from which the plant originated was not prominent.

As has been mentioned, the basal filaments creep upon the surface of the facets, and according to the way the plant is placed on these, the filaments either become more or less horizontally or more vertically arranged (compare Fig. 12). The filaments in the creeping filaments as far as I have seen remain mutually free, do not grow together, and are formed by cells a little swelled in the middle, about $1^1/_2$ times as long as they are broad, their breadth being about 5 μ.

From most of the cells in the basal filaments, an erect branch grows up. These are short, composed of few cells,

unramified or sometimes provided with short side-branches. The upper cell in the branch often ends in a short hair. The hairs are about 30 μ long and $1^1/_2$ μ broad and often a little swelled at the upper end.

The sporangia always seem to be sessile; they are oval-ovoid, about 9—10 μ long and 5 μ broad.

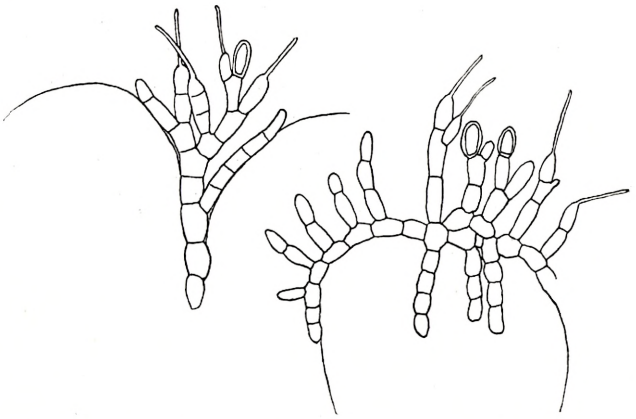


Fig. 12. *Acrochætium Cymopoliæ* Börgs. Two plants with sporangia and hairs growing upon the facets of *Cymopolia barbata*. (About 350 : 1).

The usually rather dense cromatophores have the shape of an irregularly lobed often cucullate disc arranged round the more or less centrally placed pyrenoid.

Gran Canaria: Playa de Santa Catalina.

6. Acrochætium gracile Børgs.

Børgesen, F., Mar. Alg. D. W. I., vol. II, Rhodophyceae, p. 26.

Upon *Gelidium pusillum* some specimens of a small *Acrochætium* occurred which I do not hesitate to refer to this species.

It forms tufts up to a height of about 700—800 μ (Fig. 13).

As far as I have been able to see the base of the plant (Fig. 14 *a*) is composed of creeping filaments most probably somewhat immersed in the tissue of the host, but on account of the toughness of the tissue of the host, it has been difficult to examine the base of the plant more exactly.

Fig. 13. *Acrochætium gracile* Børgs. Habit of a plant. (About 80 : 1).

The erect filaments arising from the creeping ones are about 4—6 μ thick near their base, decreasing slowly upwards to about 2.5 μ; the cells in the filaments are about 14—16 μ long. The more vigorous filaments are branched, the ramification being irregular on all sides. In the upper parts of the filaments, the sporangia-bearing branchlets, the pedicellate or sessile sporangia are found. They are commonly secundly arranged up along the filaments (Fig. 13). The sessile and pedicellate sporangia are the most common ones. The sessile sporangia are present especially in the upper parts of the filaments, but they are also found interspersed among the pedicellate ones. Each pedicel carries a single, sometimes two sporangia at its upper end. The length of the pedicel is about 8 μ and the breadth about 2.5 μ.

The sporangia-bearing branchlets (Fig. 14 *b*) generally consist of three cells, the lowermost of which each carries upon its upper side a sessile sporangium.

The monosporangia are ellipsoidal-cylindrical of shape, about 4—5 μ broad and 9—10—11,5 μ long.

The chromatophores have the shape of irregularly lobed plates or sometimes they are like lengthened parietal irregularly lobed ribbons. A relatively large, parietal pyrenoid is present, protruding so far into the narrow cell-lumen that often it looks as if it was centrally placed.

I have compared the Canarian specimens with my preparations of the West Indian plant and according to this comparison both plants seem to agree quite. To be sure, the size given by me for the sporangia of the West Indian plant is somewhat greater, but I have now measured several sporangia again and as a rule they are rarely more than 4 μ broad and 9—10 μ long.

The plant was gathered somewhat above low water mark in a rather sheltered place.

Gran Canaria: Playa de Santa Catalina.

Geogr. Distrib. West Indies (St. Thomas), Canary Islands.

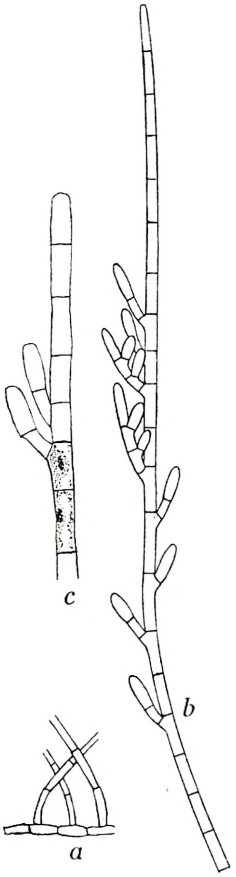


Fig. 14. *Acrochætium gracile* Børgs. *a*, part of the base; *b* and *c*, parts of filaments with sporangia. (*a*, about 300 : 1; *b*, about 375 : 1; *c*, about 500 : 1).

7. Acrochætium Daviesii (Dillw.) Nägeli.

Nägeli, C., Beitr. Morphol. Ceramiaceæ, 1861, p. 405. Bornet, E., Deux Chantransia corymbifera etc., p. XXII.

Conferva Daviesii Dillwyn, Brit. Conf., 1809, p. 73, pl. F.

Callithamnion Daviesii Harvey, Phyc. Brit., pl. 314; J. Agardh, Epicrisis. p. 8.

Chantransia Daviesii (Dillw.) Thuret in Le Jolis, Liste p. 106. Rosenvinge, L. K., Mar. Alg. Denm., p. 104.

Of this species I have once found a large tuft growing upon *Liagora canariensis*.

As pointed out in Rosenvinge's detailed description, this species is characterized by its thick-walled and short-

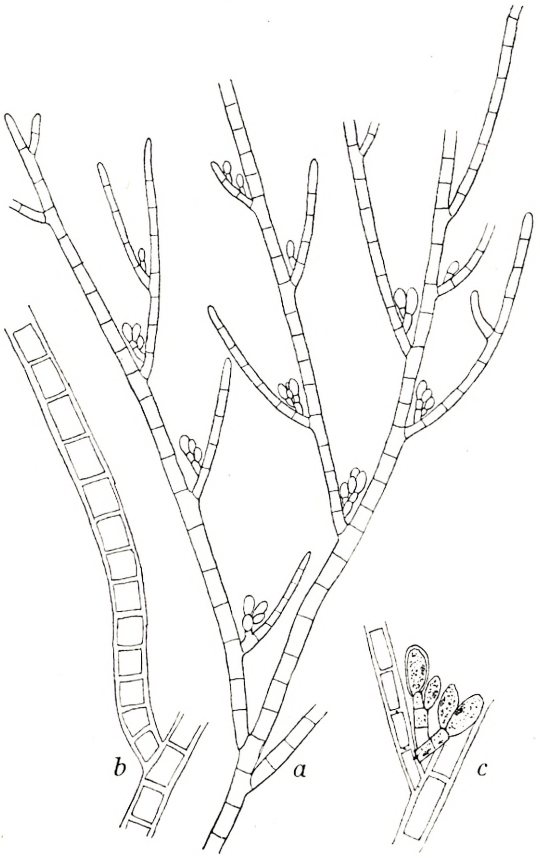


Fig. 15. *Acrochætium Daviesii* (Dillw.) Nägeli. *a*, part of the thallus with sporangia; *b*, part of the thallus with short cell; *c*, sporangia-bearing branchlets. (*a*, about 225 : 1; *b*, about 320 : 1; *c*, about 450 : 1).

celled filaments and the densely placed sporangia-bearing branchlets, found in the acute angles at the base of the branches. But as the Canarian plant in some respects

differs rather much from ROSENVINGE's description, I shall give a short description of the plant here.

The whole tuft apparently originated from a single large basal layer composed of filaments felted together. The robust erect filaments were up to about 16 μ at their base tapering slowly upwards to about 10—12 μ which was the size of most of the filaments. In the hair-like upper ends of the branches and branchlets, the breadth can go down to 4 μ. The most vigorous filaments thus seem to be a good deal broader than those of the Danish specimens. Further, the cells in the filaments are often rather short. Branches with such short cells as shown in Fig. 15 *b* occur now and then in the erect shoots, but I have found erect shoot systems composed almost only of such short cells.

But most of the erect shoots were like the one shown in Fig. 15 *a*, with cells about $1^1/_2$—2 times as long as they were broad, rarely more. Thus, as regards the length of the cells, the Canarian plant also differed rather much from the Danish one, in which ROSENVINGE found the cells to be 2—4 times as long as broad.

The wall of the cells is very thick, about 2 μ thick.

The cells contain a vigorous, rather dense, parietal, lobed chromatophore with a large parietal pyrenoid.

The characteristic placing of the sporangia upon small branchlets in the Canarian plant seems to agree quite well with ROSENVINGE's detailed description of the Danish plant.

The size of the sporangia was about 13—16 μ long and 8—10 μ broad, thus in good accordance with the dimensions of the sporangia in the Danish specimens.

The plant occurred in rock pools near low water mark in a very exposed locality.

Teneriffe: Orotava.
Geogr. Distrib. Atlantic coast of Europe and North America.

8. Acrochætium occidentale Børgs.

Børgesen, F., The Mar. Alg. D. W. I., p. 44, figs. 42—43.

var. *cæspitosa* nov. var.

A forma typica imprimis differt filamentis decumbentibus in incrustatione hospitis immersis, multo magis evolutis et filamenta erecta emittentibus cæspites densos formantia.

The Canarian plant was, like the West Indian one, found upon *Liagora farinosa* where it formed a rather dense felt over the whole thallus, reaching a height of about 1—1.5 mm.

The basal part of the plant is immersed in the chalky incrustation of the host. According to the division of Bornet, it belongs to the group of species which is characterized by the fact that the germinating spore is persistent.

When the spore germinates, an erect filament is given off from its upper side, while downwards a single, sometimes two rhizoidlike filaments issue from its basal part (Fig. 16).

The rhizoidlike filaments grow downwards along the assimilating filaments of the host; they are generally ramified, often forming a dense cluster round the filaments of the host, or they spread more freely round about between the adjacent filaments, hereby, in older plants, giving rise to a rather large system of branches, from which here and there erect filaments arise. The tufted growth of the plant is due to this way of growing.

The original spore is rather large, nearly globular, its diameter reaching a length of about 13—17 μ. The rhizoidlike filaments have a breadth of about 6—7 μ.

All the erect shoots originating from the creeping filaments want the basal cell; this is found only at the base of the first developed filament. In a few cases, for instance,

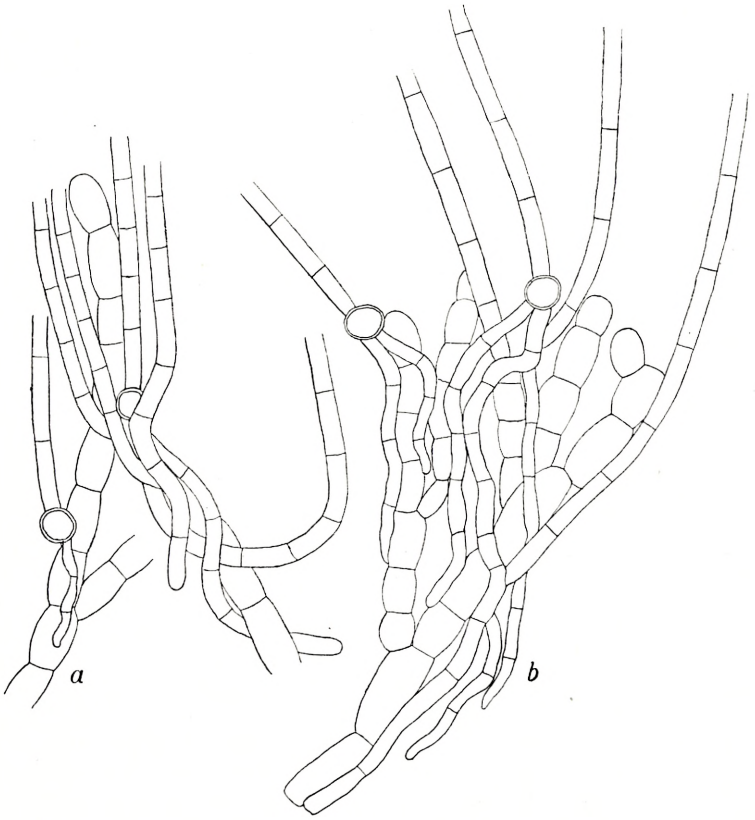


Fig. 16. *Acrochætium occidentale* Børgs. var. *cæspitosa* nov. var. Bases of plants fixed to the assimilating filaments of *Liagora farinosa*. (About 270 : 1).

if the first developed filament is damaged, it happens that a secondary branch is developed from the original spore.

The filaments growing upwards are straight, composed of cells about 7—11 μ thick, tapering upwards to about 4 μ; the length of the cells is about 3—4 times the

breadth, and longer still in the thinner upper parts of the filaments (Fig. 17).

The cells contain a parietal not much developed chromatophore placed in their upper end; in each chromato-

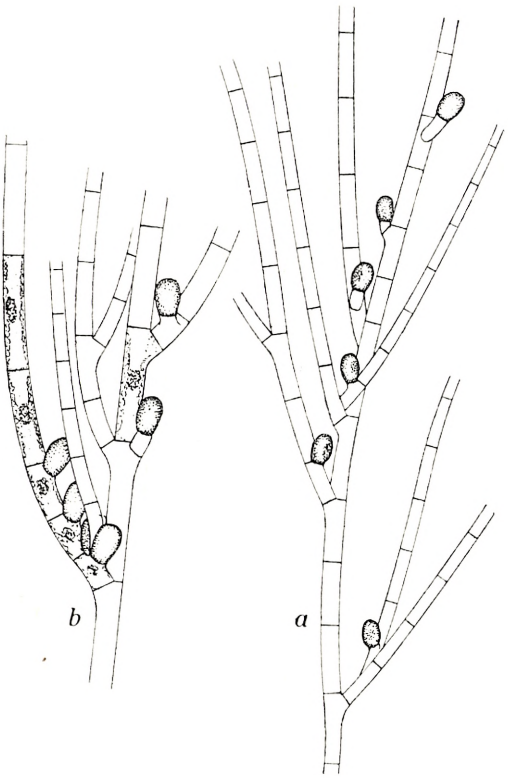


Fig. 17. *Acrochætium occidentale* Børgs. var. *cæspitosa* nov. var. Parts of the erect, ramified filaments with sporangia. (*a*, about 300 : 1; *b*, about 200 : 1).

phore a parietal pyrenoid is present. In the upper end of the filaments the chromatophores are less developed, the ends of the filaments getting hairlike and dying away gradually. The walls of the cells are thin, and the plant upon the whole rather flaccid.

The ramification is rich, branches being often given off from almost every cell in the main filament. The branches issue irregularly on all sides, in the upper part sometimes with a tendency to become opposite. The branches emerge at an acute angle from the mother filament (Fig. 17).

The monosporangia are broadly obovate-oval about 11—13 μ broad and 18—19 μ long. They are sessile or pedicellate, sometimes a branchlet bears two sporangia.

The sporangia occur in the lower parts of the branches on the upper side; as a rule 1—3 are found, rarely more.

It is true that the Canarian plant comes very near to the West Indian one, but it shows some important differences so I think it most appropriate to consider it as a variety of the latter. By its cæspitose growth, it differs essentially from the typical form as also by its much more developed basal system of endophytic creeping filaments from which gradually a great number of erect filaments arise, while in the West Indian plant, although I had but very little material at my disposal, I have as a rule found only a single, rarely two erect filaments issuing from the original persistent spore. Also the ramification of the erect filaments seems to be richer in the Canarian plant, just as it may happen that the sporangia are comparatively a little shorter and broader than in the West Indian plant. In this plant I also found the contents of a few sporangia divided into two spores, which I have not found in the Canarian specimens.

Also the *Acrochætium comptum* Børgs. from the West Indies in several respects shows some likeness to this species, but the original germinating spore is here divided into two cells by a horizontal wall, the sporangia are often pedicellate and occur in rather long series upon the upper side of the branches.

This plant is found in rather exposed places near low water mark, often forming quite a dense coating upon the host plant.

Gran Canaria: Bahia del Confital.
Geogr. Distrib. West Indies, Canary Islands.

9. Acrochætium Nemalionis (De Not.) Bornet.

Bornet, E., *Deux Chantransia corymbifera* Thur. *Acrochætium* et *Chantransia* (Bull. Soc. Bot. Fr., tome 51, 1904, p. XX).

Chantransia Nemalionis (De Not.) Ard. et Straf., Enum. Algh. Ligur., 1877, p. 167. Rosenvinge, L. Kolderup, Mar. Alg. Denm., p. 126.

Callithamnion Nemalionis De Not., Erbar. Crittogam. Ital., No. 952. Ardissone, Prospetto d. Ceram. italiche, 1867, p. 17, tav. 1, fig. 1—3.

Chantransia Saviana (Menegh.) Ardissone, Phycol. Mediter., 1883, p. 276 ex parte.

In her list of algæ from the Canary Islands M^lle^ Vickers at p. 302 mentions *Chantransia Saviana* Ardissone. She found it in Bahia del Confital upon *Liagora farinosa*, otherwise it has always been found upon *Nemalion*.

I have not found this plant myself but only the above mentioned variety of *Acrochætium occidentale* on the same host and in the same locality. Unfortunately M^lle^ Vickers's specimen does not seem to exist, at least it is not to be found in the Herbier du Jardin botanique de l'État, Bruxelles, according to kind information from Professor É. de Wildeman. But Bornet refers to the plant (l. c., p. XX), so M^lle^ Vickers's determination must be considered valid.

According to the division of Bornet, this *Acrochætium* belongs to the group in which the germinating spore becomes indistinct, contrary to the above described species, in which the original spore is persistent and easily observable.

Gran Canaria: Bahia del Confital (Mlle VICKERS).
Geogr. Distrib. Mediterranean Sea, Limfjord.

10. Acrochætium codicola nov. spec.

Thallus cæspitosus, permagnus, usque ad 3/4 cm. altus, e filis endophyticis ramosis et filis erectis ramosis sporangiferis formatus.

Fila endophytica inter utriculos hospitis immersa, e filis plus minus horizontalibus, repentibus, unde filamenta brevia deorsum oriuntur, composita.

Fila erecta in parte basali e cellulis 15—20 μ latis et 50—80 μ longis ad apicem versus angustata, e cellulis 10—11 μ latis composita; ramosa, ramis sparsis in superiori parte ramorum seriatis.

Chromatophorum parietale, lobatum, initio solidum postea in dua vel plura divisum. Monosporangia 27—31 μ longa, 18—21 μ lata, in superiori latere ramorum seriata, sessilia aut pedicellata, rarius in ramulis brevibus sedentia.

At the Islands, this large fine plant is a very common endophyte upon species of *Codium*, for instance *C. tomentosum*, *elongatum* and *adhærens*. Upon the host plants, it forms purple-red dense coverings up to a height of about 3/4 cm.

The basal part of this *Acrochætium* (Figs. 18 and 19 *a*) is composed of creeping filaments bending round along the walls of the utricles of the host. The filaments have sinuated walls, and they are more or less richly and irregularly ramified. They consist of cells about 28 μ thick and twice as long. Downwards from these, more or less horizontally expanded filaments, shorter or longer ones, issue like sinkers. These sinkers have a length of about 400 μ, and are often placed in bunches between the utricles

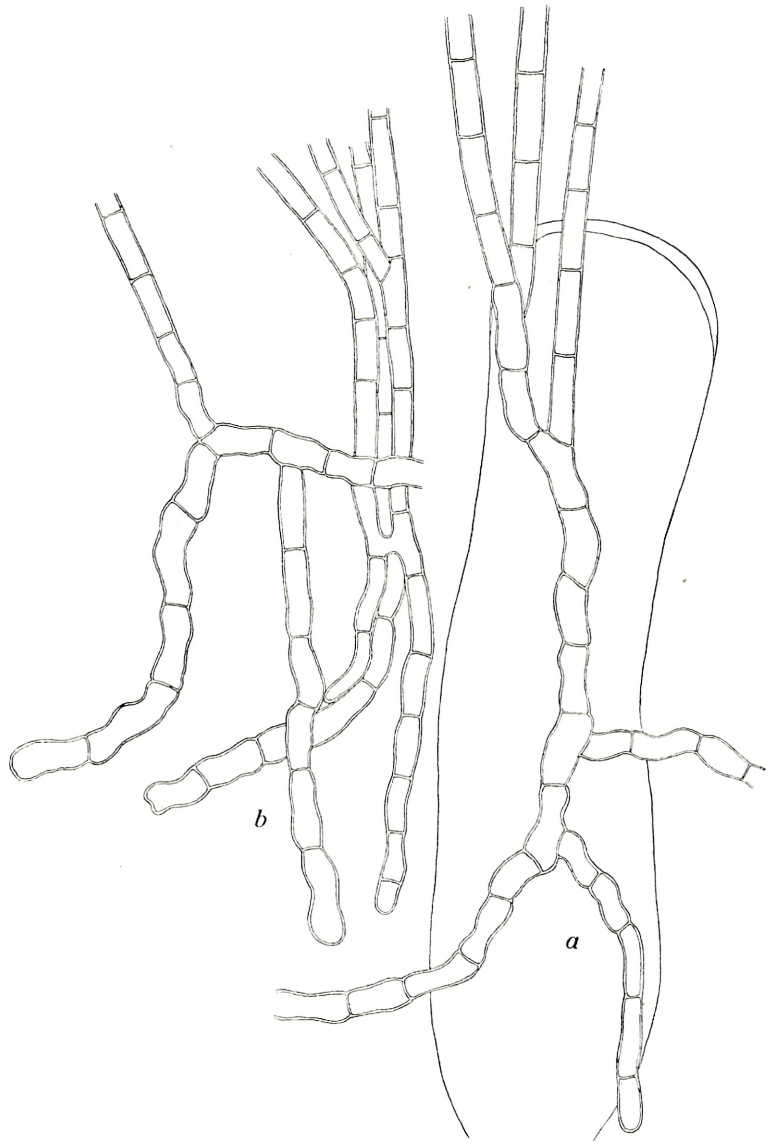


Fig. 18. *Acrochætium codicola* nov. spec. Bases of two plants. In *a* the immersed creeping filaments are drawn together by a utricle of the host plant. In *b* two of the sinkers are connected by fusion. (About 150 : 1).

of the host. The breadth of the cells in these sinkers often increases a little downwards, the lower cells having a diameter of about 32 μ; the lower end is broadly rounded. Once I found two of the sinkers connected by a fusion (Fig. 18 *b*).

From this vigorous basal part, the erect filaments are gradually developed. On reaching the surface of the host, they become cylindrical. The cells in the filaments have a diameter of about 15—20 μ, rarely more, and taper slowly upwards to the summit, where the breadth is about 10—11 μ, and in the less vigorous branches 7—8 μ only. The length of the cells as a rule varies from about 50—80 μ. The filaments are cylindrical, not constricted at the cross walls.

The filaments are rather richly ramified from near the base to the summit. The lowest branches are also branched like the mother filaments, the ramification getting poorer upwards and the top branches being unramified. The ramification is rather irregular, the branches being given off on all sides with shorter or longer intervals between the offsprings. The angles between the branches and the mother filaments are acute. In the upper part of the thallus, the ramification is more or less secund (Fig. 19 *b*).

In the young cell the vigorously developed parietal chromatophore (Fig. 20) is a very lobed plate, in the older cells it is gradually divided into two or several ribbon-like lobed discs. In the shorter cells, especially in the fructifying parts, the chromatophores contain but a single or two pyrenoids, in the larger cells several, 4—5 or more.

In the basal part of the branches on the upper side, the monosporangia (Fig. 19 *b*, *c*, *d*) are formed. These are sessile or pedicellate, one sporangium or pedicel issuing from each cell of the mother branch. The pedicels carry a single or very often two sporangia near the top, more

rarely the branchlets consist of more than one cell, this is the case in Fig. 19 *d*. The sporangia are oval, sometimes

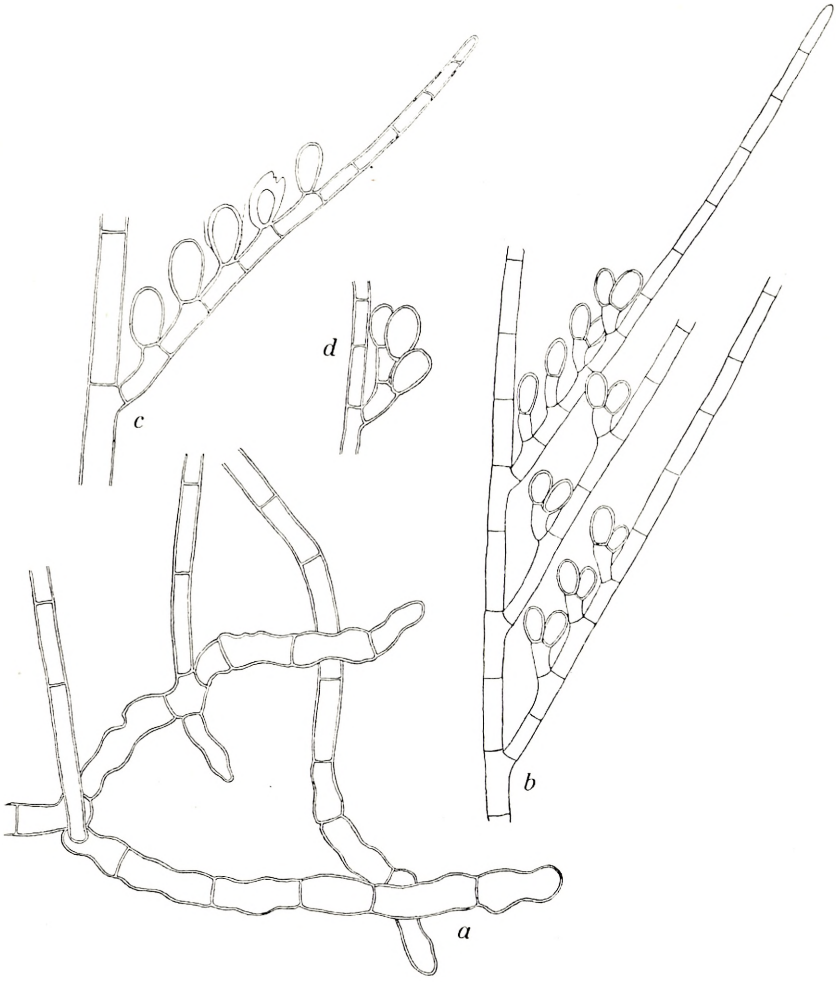


Fig. 19. *Acrochætium codicola* nov. spec. *a*, base of a plant; *b*, *c* parts of filaments with sporangia; *d*, a branchlet with two cells carrying sporangia. (*a*, *b*, about 150 : 1; *c*, about 225 : 1; *d*, about 200 : 1).

a little obovate of shape, up to about 27—30—31 μ long and 18—19—21 μ broad.

When a sporangium is emptied a new one is often formed instead of the old one (Fig. 19 *c*), and as this restoration may take place several times, we often find a series of sheaths or remnants of the walls of the former sporangia at the base of the sporangium. The pedicellate sporangia are the most common ones, the sessile sporangia occurring uppermost in the filaments (Fig. 19 *c*).

Tetrasporangia have not been observed.

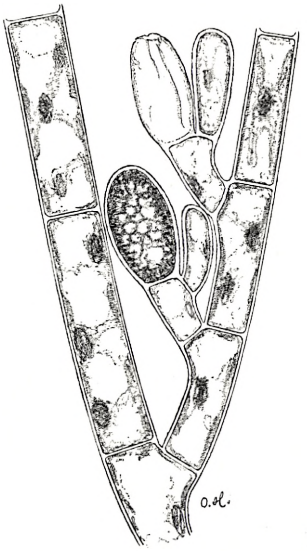


Fig. 20. *Acrochætium codicola*. Børgs. Small part of the thallus showing cells with chromatophores and pyrenoids and two branchlets with sporangia, one emptied. (About 450 : 1).

Of the species of *Acrochætium* described as occurring upon *Codium*, the *Acrochætium phacelorhizum* described by me in "Mar. Alg. D. W. I., vol. II p. 54 is no doubt much related to the Canarian plant. But in the West Indian plant, the downward growing filaments as a rule form dense clusters, and on account of this the erect filaments too are more densely gathered in tufts. The sporangia are all sessile, the cells contain a single chromatophore only with one pyrenoid, and in all respects the plant is much smaller, if we mention only the most essential differences.

The plant to which the Canarian species is most nearly related is perhaps the *Callithamnion Codii* Crouan = *Acrochætium Codii* Bornet. Bornet writes, l. c., about the basal part of this plant. "Au niveau de la surface du *Codium* les filaments se ramifient, s'entrelacent et s'émettent des pousses

déscendantes parallèles que constituent un faisceau serré s'enfonçant comme un clou dans la fronde de *Codium*". This description of the basal part may be said to remind one much of the Canarian species. But by means of some preparations of a plant from Swanage sent to Professor Rosenvinge by Mr. A. D. Cotton, Kew, and which is most probably like Crouan's plant, I have been able to convince myself that the plant in several points differs essentially from the Canarian plant. Professor Rosenvinge has also written down a short description of the plant which he has allowed me to see, and according to this the English plant differs from the Canarian one by the fact that the uppermost ends of the branches are very attenuated, subhyaline, and the chromatophores (two or more in each cell) contain only 1—2 pyrenoids, the sporangia are always pedicellate, and the ramification as a rule alternate, rarely opposite.

Acrochætium codicola seems to be a rather common endophyte upon various species of *Codium* at the Islands. It occurs near or somewhat above low water mark as well in very exposed as in more sheltered places.

Teneriffe: Orotava. Gran Canaria: Playa de Santa Catalina, Christoballo.

Subfam. 2. Nemalieæ.

Liagora Lamour.

In my West Indian Algal Flora, vol. II, Rhodophyceæ, p. 455—458, I have described and pictured some peculiar organisms commonly found in the assimilating tissue of the West Indian *Liagora*. Referring the reader to

HOWE's[1] and my descriptions of these structures, I only want to point out that I have searched in vain for them in the Canarian plants. While HOWE is most inclined to consider these organisms as derived from the upper cells in the assimilating filaments, I expressed as my view that they are most probably independent organisms. And the complete absence of them in the Canarian plants seems to support my view.

1. Liagora tetrasporifera nov. spec.

Frons cæspitosa, ca. 7—8 cm. alta, filiformis, teres, 0.5—0.7 mm. crassa, dichotome divisa; axillis, plus minus acutis, usque ad apices nudos distincta; crusta calcarea continua, superficie sublævi obducta. Color frondis in specimine exsiccata roseo-albidus.

Stratum periphericum ex filamentis dichotomis, plus minus irregulariter evolutis formatum est; cellulæ in parte basali subcylindricæ, 5—8 μ latæ, in media parte breviores et crassiores, ca. 8—10 μ latæ, ad apicem versus breviores et minores ca. 3 μ latæ. Rami carpogonii fere recti ex tribus cellulis compositi, ca. 10 μ lati.

Cystocarpia fere sphærica ex filis non carposporiferis sed tetrasporangiferis constructa.

Antheridia ad apices filorum assimilantium nascuntur.

Planta monoica est.

The specimens upon which I have described this species quite agree with some specimens gathered in the same locality by M^lle^ VICKERS and which she has called *Liagora viscida* (Forsk.) Ag. But after having compared the Canarian specimens with specimens of *Liagora viscida* from the Me-

[1] HOWE, M. A., Observations on monosporangial discs in the genus *Liagora*. (Bull. Torr. Bot. Club, vol. 47, 1920).

terranean Sea, it was soon clear to me that these differed so much in their anatomy and whole habit from *Liagora viscida* that they could not be referred to this species. And as I have not been able to find any other species to which they might be referred, I now describe them as a new species, and I am so much the more entitled to do this,

Fig. 21. *Liagora tetrasporifera* nov. spec. Habit of a plant. (About 1 : 1).

as the specimens in one respect show a great pecularity, namely the presence of tetrasporangia.

As to their outer appearance the Canarian specimens show much likeness to thinner forms of *Liagora valida*, but after microscopical examination it was clear that great differences separate them from this species.

The plant (Fig. 21) forms dense tufts upon the rocks. On account of the strong calcification, the thallus is rather stiff and breakable. The colour of the dried plant is whitish with a tinge of red, the young upper parts of the thallus are red. Examined through a lense the chalk incrustation is seen to contain numerous small roundish dark red dots

which in the specimens examined, as described below, originate from the tetrasporangial bodies.

The thallus is rather regularly dichotomously ramified, the angles between the branches being acute with the exception of the youngest uppermost ramifications, where it is rectangular.

The assimilating filaments (Fig. 22 *a*, 23 *b*, *c*) in the young

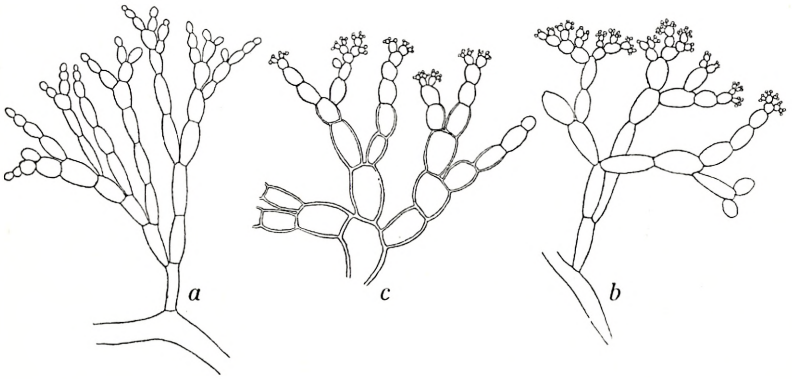


Fig. 22. *Liagora tetrasporifera* nov. spec. *a*, assimilating filaments; *b*, filaments with antheridia; *c*, part of filament with antheridia from a globular body (*a*, about 200 : 1, *b*, *c*, 350 : 1).

thallus in the basal part consist of long nearly cylindrical cells about 5—8 μ thick; upwards the cells become shorter and at the same time thicker, about 8—10 μ broad, and then decrease slowly towards their summits, where the cells are about 3 μ thick. The whole assimilating filament has the usual corymbiform shape as found in this genus, but the ramification is rather irregular, the branches issuing at the same height being of rather heterogeneous development.

Here and there from the summits of the young assimilating filaments long hairs arise (Fig. 23 *b*, *c*), these are clavate of shape having a broader part at the upper ends,

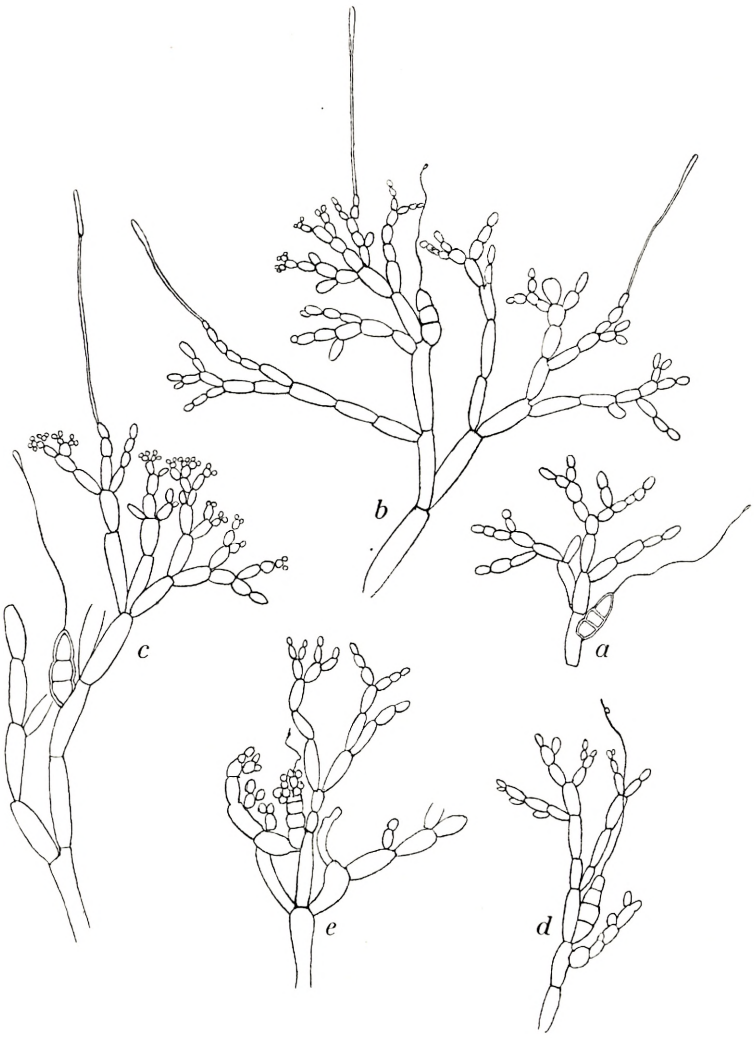


Fig. 23. *Liagora tetrasporifera* nov. spec. *a*, *b*, *c*, filaments with carpogonial branch, in *a* and *b* antheridia are also present; *d*, the carpogonium is divided into two cells, a spermatium is seen fixed to the trichogyne; *e*, the sporogenous filaments are begining to be developed from the carpogonium. (*a*, *b*, *c*, about 300 : 1; *d*, *e*, about 250 : 1).

which are filled with protoplasma. The assimilating filaments are quite imbedded in the incrustation.

The plant is monoecious, male and female organs occurring in the same plant. Besides these fructiferous organs I have, as mentioned above, found tetrasporangia in this species. The tetrasporangia occurred in the sexual plants.

The antheridia are developed at the ends of the assimilating filaments as quite small nearly spherical cells about 1—2 μ broad (Fig. 22 *b*, 23 *b*, *c*). Once I have also found the antheridia developed in stands, the filaments in these being crowded together and composed of larger thickwalled cells (Fig. 22 *c*).

The carpogonial branch issues from one of the cells in the middle of the assimilating filaments (Fig. 23 *a*, *b*, *c*). In all the specimens I have examined I have found that it consists of three cells only, and if this character is constant, the present species is easy to recognize in this respect, as in all other species, so far as I know, we have 4—5 cells in the carpogonial branch.

The carpogonial branch is rather straight, its breadth reaching up to about 10 μ.

After the fertilization (I have in a few cases seen spermatia fixed to the trichogyne) the carpogonium is divided by a horizontal wall into two cells (Fig. 23 *d*) as in my figure 79 (l. c.) of *Liagora pinnata*, and then the sporogenous filaments begin to grow out (Fig. 23 *a*) forming gradually a dense bundle of ramified filaments, surrounded by a sheath of sterile filaments issuing from cells near the cell upon which the carpogonial branch is placed. Thus the whole thing has quite the appearance of a cystocarp, but instead of developing carpospores at the end of the sporogenous filaments, tetrasporangia are formed here. Instead of remaining undivided, the end-cells are cruciately divided into four cells which get quite the appearance of tetrasporangia.

It is very peculiar that this plant thus seems quite to have given up forming carpospores. Fig. 24 shows a mature tetrasporangial body with tetrasporangia. As already mentioned, the tetrasporangia are cruciately divided, oval, rather small, about 19—20 μ long and 12—13 μ broad.

The discovery of tetrasporangia in this plant brings up the question where in the cyclus of development the

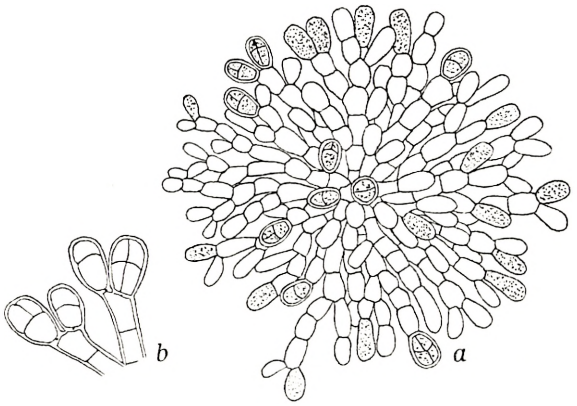


Fig. 24. *Liagora tetrasporifera* nov. spec. *a*, tetrasporangial stand with tetraspores. *b*, tetrasporangia (*a*, about 200 : 1; *b*, about 400 : 1).

nuclear reduction takes place. To settle this question a cytological examination is of course necessary, but for such an examination hardened material well adapted to the purpose is needed, and as my collection is preserved in ordinary spirit only, a nuclear investigation is excluded. We must therefore confine ourselves to suppositions only.

In a nearly related form of this group, in which the tetrasporangia have so far been searched for in vain, Svedelius, in his fine work on *Scinaia*[1], has discovered

[1] Svedelius, N., Zytologisch-Entwicklungsgeschichtliche Studien über *Scinaia furcellata* (Nova Acta Regiæ Soc. Scient. Upsaliensis. Ser. IV, Vol. 4, no. 4. Upsala 1915).

that the nuclear reduction takes place immediately after the fertilization, and KYLIN has shortly afterwards found the same to be the case in *Nemalion*[1] and *Batrachospermum*.[2] Regarding our plant the supposition is near at hand that the nuclear reduction may take place in accordance with what is the case in the above-mentioned forms viz. that the nuclear reduction may take place in the nucleus of the zygote immediately after the fertilization, and that thus, in other words, the formation of the tetrasporangia may be carried out without any nuclear reduction. And as now antheridia, carpogonia and tetrasporangia are present in the same individual, we may be entitled to consider our plant as a haplobiont.

However, it seems to me still more probable that the nuclear reduction in this plant does not take place immediately after the fertilization, but that it is not carried out until the formation of the tetrasporangia. While in *Scinaia*, as pointed out by SVEDELIUS p. 42, the diploid phase is confined to the nucleus of the zygote itself, in *Liagora tetrasporifera* the diploid phase should then be continued in the sporogenous filaments, until the formation of the tetrasporangia has taken place. In that case our plant must be designated as a diplobiont, even if the diploid phase does not come out into the light as an independent tetrasporic plant, which is the case in the normal diplobionts, but remains enclosed in the haploid sexual plant and is nourished by it.

If now a later cytological examination proves that the development really takes place in this way, our plant

[1] KYLIN, H. Über die Befruchtung und Reduktionsteilung bei *Nemalion multifidum* (Berichte d. deutsch. bot. Ges., Bd. 34, p. 257).

[2] KYLIN, H. Über die Entwicklungsgeschichte von *Batrachospermum moniliforme* (Ber. d. deutsch. bot. Ges., B. 35, 1917, p. 155).

may further be said to form in a fine way a connecting link between the haplobionts with only one life form viz. the haploid sexual plant, and the diplobionts on the other side with two alternating life forms: haploid sexual individuals and diploid tetrasporic ones. And besides our plant may be said to confirm the theory of Svedelius regarding the shifting of nuclear reduction. This Prof. Svedelius also suggested to me when answering the letter in which I told him of my discovery.

Finally the possibility that parthenogenesis may occur here is not excluded. To be sure I have in a few cases seen trichogynes to which were attached spermatia, but without any cytological examination we do not of course know if the fertilization really takes place. Parthenogenesis has been found by Kuckuck in *Platoma Bairdii*, and as pointed out by Rosenvinge[1] (whose conclusions about similar questions are of much interest with respect to *Liagora tetrasporifera*), the tetrasporangia in *Platoma Bairdii* must be developed without reduction, and the same might be the case in *Liagora tetrasporifera*.

As regards the presence of tetrasporangia in this genus the only statement I know is that of Schmitz in Engler und Prantl, "Nat. Pflanzenf." 1. Teil, Abt. 2, p. 334. As I wanted very much to see the original note about the matter, if such a one should exist, and have been looking in vain for it, I wrote to Professor Svedelius who has worked much with related forms, asking him if by chance he knew where the original note was to be found. Prof. Svedelius answered me most kindly that he knew no more about the matter than I, and that most probably the note about

[1] Rosenvinge, L. Kolderup, The marine Algæ of Denmark, Part II, 1917, p. 281.

the tetrasporangia was an original one. It runs as follows: "Sporangien ungenügend bekannt, angeblich an knotig verdickten Stellen der oberen Thalluszweige aus der Endzellen der Rindenfäden entwickelt und unregelmässig paarig geteilt." From this description I feel sure that the observation of SCHMITZ has nothing to do with the formation of tetrasporangia I have found. It is much more likely that SCHMITZ has come across some structures similar to those figured by HOWE in "Bull. Torrey Bot. Club", vol. 47, 1920, pl. 1, fig. 8.

PICCONE in "Crociera del Corsaro alle isole Madera e Canarie", 1884, p. 34 refers a plant collected by d'ALBERTIS at Arecife in the island Lanzarote to *Liagora viscida*. Dr. ACHILLE FORTI has been so kind as to send me a fine specimen of this plant, which like the specimens referred by M^lle^ VICKERS to *L. viscida*, belongs to *Liagora tetrasporifera*. The examination of this plant from PICCONE's Herbarium has been of special interest, as it turned out to be packed with tetrasporangia; they occurred in a quite similar way as described above in the cystocarps. The specimen was gathered "14—16 Agosto 1882" thus at quite another season than my specimens. The discovery of tetrasporangia in this old specimen seems to show that the formation of tetrasporangia does not depend upon any anomaly, but that it is undoubtedly quite a natural feature in this species.

The specimens examined were collected in the month of March.

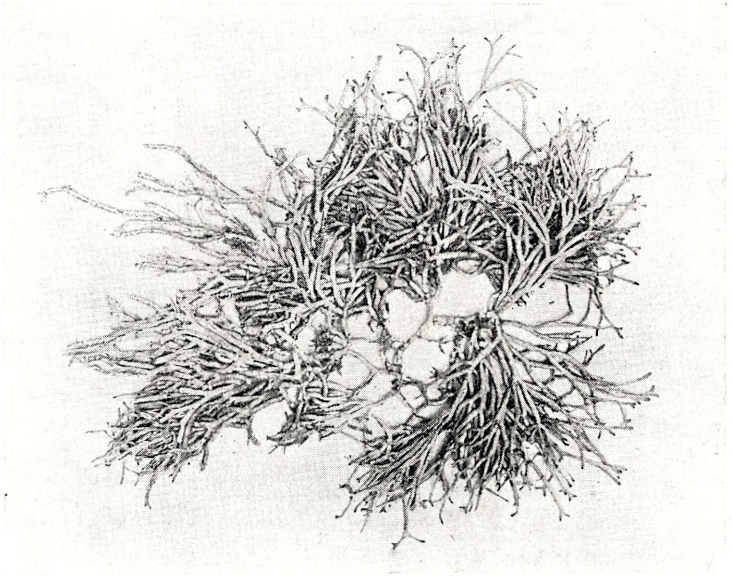
The plant was found in a very exposed place growing in crevices in the rocks near low water mark.

Gran Canaria: Bahia del Confital (VICKERS, !). Lanzarote: Arecife (D'ALBERTIS).

2. Liagora canariensis nov. spec.

Frons teres, dichotome divisa, axillis plus minus acutis, usque ad apices nudos crusta calcarea continua obducta, hirta, supremis partibus filorum assimilantium liberis.

Color frondis purpureus, ad basin versus albidus.



Kai Gram fot.

Fig. 25. *Liagora canariensis* nov. spec. A dried specimen (About 1 : 1).

Axis centralis ex filamentis cylindricis ramosis, c. 20 μ latis et ultra compositus est. Stratum periphericum ex filamentis dichotomis, cellulas in parte basali subcylindricas ad apicem versus breviores, ovatas-subcylindricas aut doliiformes continentibus, formatum est.

Species dioica. Rami carpogonii robusti, fere recti ex 5 cellulis compositi, ca. 13 μ lati; cellula carpogonica breviter conica, in trichogynum longum producta. Cystocarpia fere sphærica ex filis carposporiferis constructa, plus minus filamentis sterilibus involucrum formantibus circumcincta.

Antheridia ad apices filorum assimilantium evoluta.

This fine species (Fig. 25, 26) forms rather large rose-coloured tufts upon the rocks. The largest specimens I have gathered are about 10 cm. high. The thallus is terete, 1—1,25 mm. thick, rarely more, in the younger upper ends scarcely $^1/_2$ cm. thick. It is rather regularly di- sometimes trichotomously divided; the length of the joints between the divisions vary much from about $^1/_2$ cm. up to more than two cm. The plant is especially characterized by the fact that the assimilating filaments protrude somewhat above the surface of the incrustation (Fig. 27), giving the thallus a rose-coloured hue, on the other hand the lower parts of the thallus, where the ends of the assimilating filaments have fallen off, are whitish.

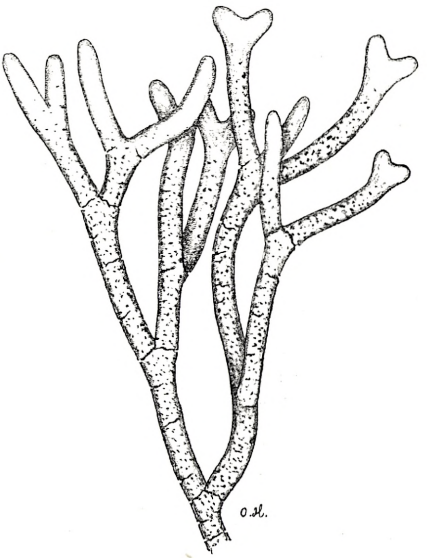


Fig. 26. *Liagora canariensis* nov. spec. Part of the thallus drawn after material in spirit. (About 4 : 1).

The chalky incrustation is strongly developed, forming a dense coating, the surface being finely pricked as if by a fine needle caused by the dropped summits of the assimilating filaments. Further, some larger dark-red dots caused by the fructiferous organs are present in the female plants. Because of the strong calcification the thallus remains terete also when dry, with the exception of the upper still incompletely incrusted summits which have shrivelled.

The younger parts of the thallus adhere strongly to the paper.

The assimilating filaments (Fig. 28 *a*, *b*) are repeatedly dichotomously ramified. In their basal parts the cells of these are oblong-cylindrical about 11—13 μ thick or more and about 6—8 times as long. Higher up the cells become gradually shorter, oval-subcylindrical, about 15—20 μ broad and then decreasing slowly upwards, the uppermost cells reaching a breadth of about 8—12 μ or less.

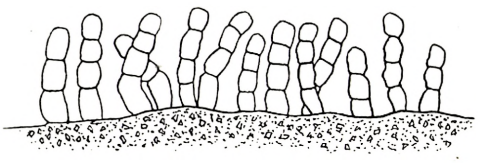


Fig. 27. *Liagora canariensis* nov. spec. Transverse section of the thallus showing the free ends of the assimilating filaments above the chalky incrustation. (About 300 : 1).

The medullary tissue is composed of long, cylindrical, repeatedly dichotomously ramified filaments varying much as to breadth, from quite thin up to 20 μ or more thick. All the specimens examined have proved dioecious, being either male or female plants, with the exception of one plant, predominantly female, in which a few scattered groups of antheridia also occurred.

The antheridia (Fig. 28 *c*) are formed in the summits of the assimilating filaments and form large extensive coverings on the surface of the plant. The ends of the assimilating filaments are repeatedly divided in smaller and still smaller globular cells, the uppermost of which are the spermatia.

Once I have also found the antheridia developed in the summits of filaments gathered in almost globular bodies (Fig. 28 *d*), the filaments of which are crowded together and composed of more thick-walled cells.

The carpogonial branch (Fig. 29 *a*, *b*) is formed laterally

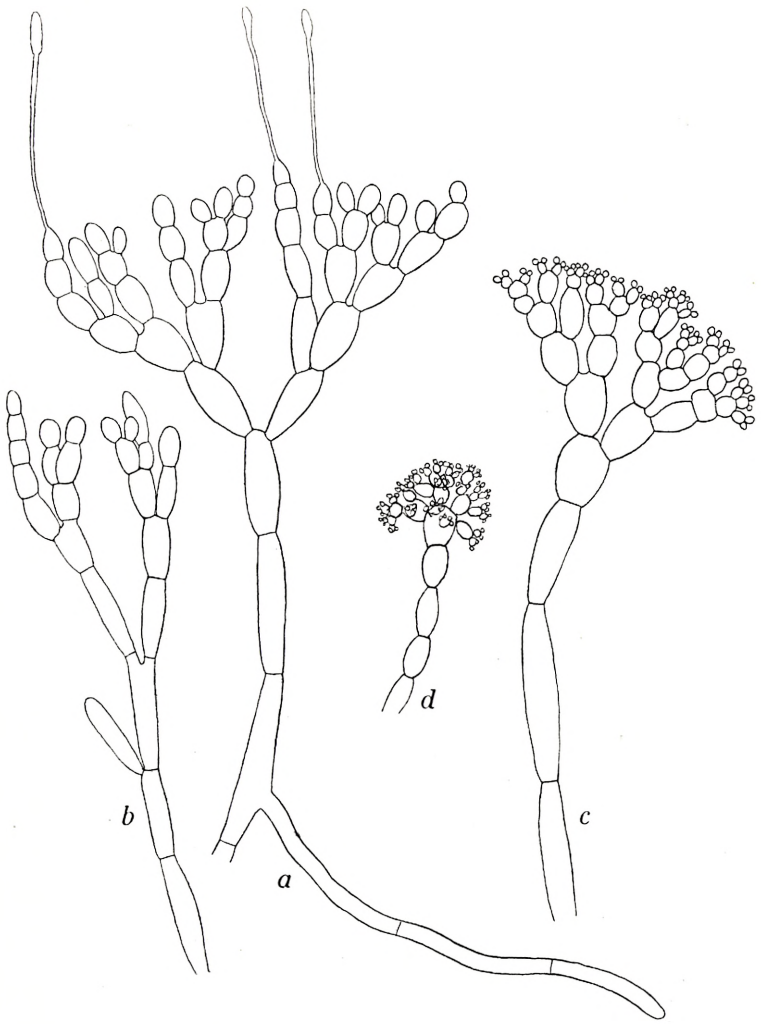


Fig. 28. *Liagora canariensis* nov. spec. *a*, *b*, assimilating filaments, *a* with hairs; *c*, *d*, filaments with antheridia (*a*, *b*, *d*, about 300 : 1; *c*, about 420 : 1).

upon the branches of the assimilating filaments and just so far from the periphery that the trichogyne is able to reach the surface. The carpogonial branch is composed of 5 cells, rarely 4, and with the exception of the upper and lower cell, these cells are about as long as they are broad

or a little shorter, the breadth being about 12—13 μ. Immediately after the fertilization, sometimes perhaps even before, the filaments surrounding the cystocarps begin to develop.

The cystocarps (Fig. 29 *c*) have the shape of dense glo-

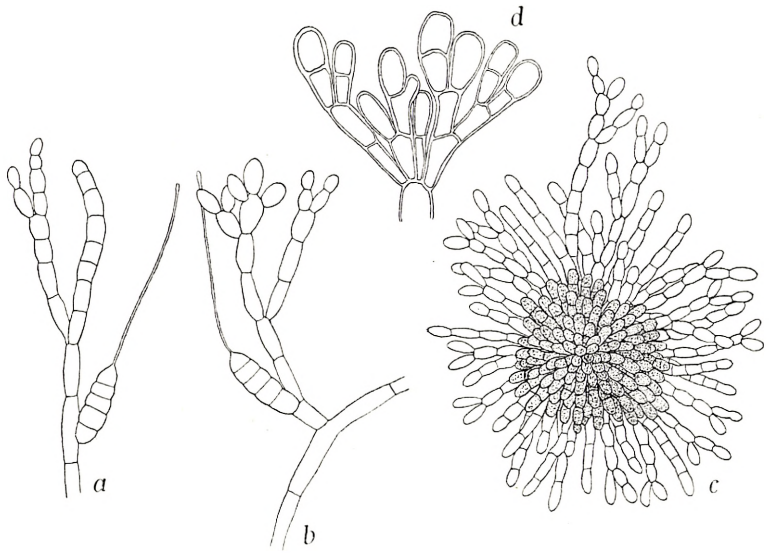


Fig. 29. *Liagora canariensis* nov. spec. *a*, *b*, filaments with carpogonial branches: *c*, a cystocarp; *d*, ends of sporogenous filaments with cystocarps. (*a*, *b*, about 250 : 1; *c*. about 150 : 1, *d*, about 450 : 1).

bular bodies formed by the much divided sporogenous filaments. At the ends of these the carpospores are gradually formed. The bundle of carposporic filaments is surrounded by a well developed involucrum of sterile filaments.

As to the outer appearance, this species shows some likeness to *Liagora valida* by its rather regularly dichotomously divided terete thallus with its rather strong calcification, but it differs essentially from *L. valida* by the protruding ends of the assimilating filaments above the incrustation giving the plant a rather deep red colour when dry.

As regards the anatomy, the upper cells in the assimilating filaments, when compared with the nearly spherical ones found in *Liagora valida*, are much more elongated, even reminding one somewhat of the nearly cylindrical ones found in *Liagora farinosa*. While the development of the antheridia according to my short description of their occurrence in *L. valida* (l. c. p. 72) seems to be very much alike in both plants, the carpogonial branch on the other hand shows some differences. In the *Liagora canariensis*, the carpogonial branch is nearly straight and about 12—13 μ broad, while in *Liagora valida* it is curved and about 18—20 μ broad or even more.

In "Crociera del Corsaro alle Isole Madera e Canarie" Piccone mentions, on p. 33, *Liagora decussata* Mont. from Santa Cruz, Gran Canaria. Of this plant I possess a specimen which Dr. Achille Forti has been so kind as to send me some years ago. I have now examined this specimen and found that it has nothing to do with *Liagora decussata*. At first I referred it to *Liagora valida*, but after having compared it with my specimens of the species described here, I take it to be a form of this plant.

The no doubt somewhat bleached specimen forms a small, about 4½ cm. high, dense tuft composed of the fairly regularly dichotomously ramified thallus which is about 1 mm. thick. The calcareous incrustation is highly developed and continuous, with the exception of the summits of the frond where the assimilating filaments protrude. In the older parts of the thallus the fructiferous organs are seen as red-brown dots in the calcareous layer.

Also the building up of the assimilating filaments seems to be in good accordance with this species, just as the very shrivelled carpogonial branches seem to agree with those in this species.

Dr. HOWE has been so kind as to send me a piece of a plant from Teneriffe, Orotava from the herbarium of the late FRANK COLLINS and determined by him as *Liagora valida*. This plant I, too, refer to this species.

Liagora canariensis was gathered in very exposed places, where it grew in crevices or low lying rock pools near low water mark.

Teneriffe: Orotava in various places round the Puerto; Santa Cruz (D'ALBERTIS).

3. **Liagora gymnarthron** nov. spec.

Frons cæspitosa, ad 15 cm. alta, filiformis, teres in parte basali ca. 2 mm. crassa, in superiori sæpe vix $^1/_2$—$^3/_4$ mm., subdichotome ramosa, ramulis inæqualiter evolutis, ca. 4—5 mm. longis, a basi sursum paulo crassioribus, subclavatis.

Crusta calcaria in specimine exsiccata, plus minus subscabrida, basi ramulorum excepta, quæ nuda est, continua.

Axis centralis ex filamentis subcylindricis, 10—20 μ latis compositus est.

Stratum periphericum compositum est ex filamentis dichotomis corymbiformibus, cellulas in parte basali oblongas, ad apicem versus oblonge ovales, supremas sæpe subpyriformes continentibus.

Rami carpogonii incurvi compositi ex 4 cellulis ca. 10 μ latis 3 cellulis basalibus brevioribus et cellula carpogonica majore conica in trichogynum longum producta; cystocarpia fere sphærica ex filis carposporiferis composita; involucrum parum evolutum est.

I am much indebted to Dr. OTTO CHR. SCHMIDT for the permission to examine a specimen of this plant belonging to the Herbarium of the Botanical Museum, Berlin.

It is determined as *Liagora decussata* Mont.?, but the label lacks the name of the collector as well as of the determiner.

It is a rather large specimen about 15—16 cm. high. The preparation of it is not of the best, and further it seems to have been washed ashore and to have been somewhat bleached by the sun.

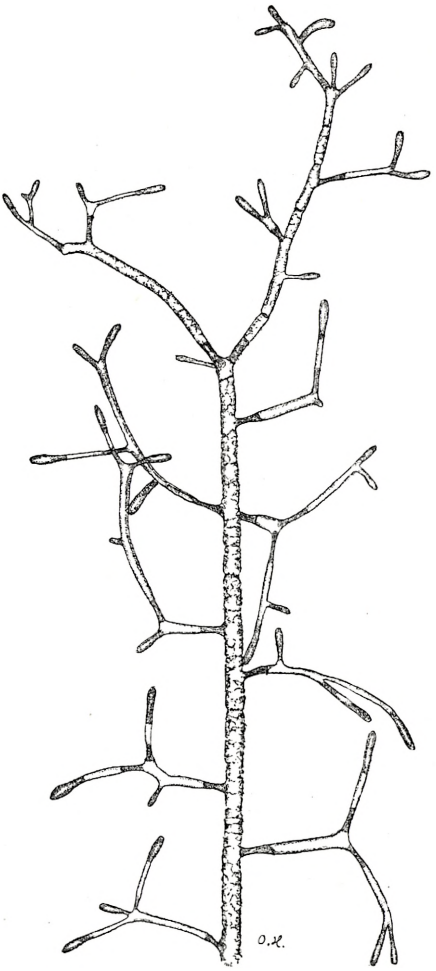


Fig. 30. *Liagora gymnarthron* nov. spec. Part of the thallus. (About 4 : 1).

Immediately at first sight, I was much in doubt whether it could really be *Liagora decussata* Mont., but after having steeped a small bit of it in water, so that its characteristic ramification was seen, it was clear that it had nothing to do with MONTAGNE's fine plant. *Liagora decussata* Mont., of which I have seen a specimen from Guadeloupe collected by MAZÉ and SCHRAMM, and further the plant published in "Phycotheca Bor.-Am." No. 89, is characterized by its monopodial ramification, its as a rule opposite branches being placed decussately above each other. In the present plant (Fig. 30) on the other hand, the ramification is mark-

edly pseudodichotomous and the branches are placed dispersedly upon the main branches on all sides. When the specimen has been referred to *L. decussata*, I think it is due to the fact that the branches as in *L. decussata* are attenuated and bare at their base, so that it happens that two branches may issue apparently oppositely, and further that the not incrusted summits of the branches have the same dark wine-red colour as found in *Liagora decussata*.

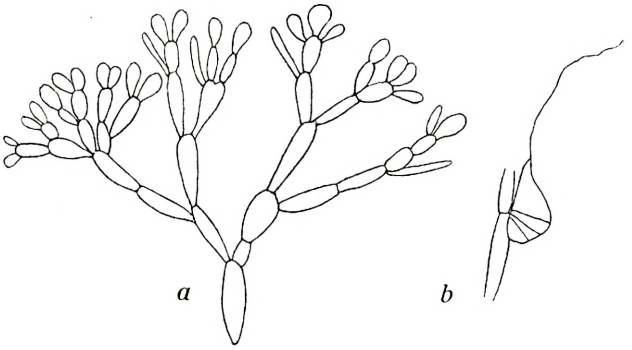


Fig. 31. *Liagora gymnarthron* nov. spec. *a*, part of an assimilating filament; *b*, carpogonial branch (About 450 : 1).

As I have been unable to identify this specimen with any species of *Liagora*, I describe it as a new species, although I do not very much like to base a description upon dried material only.

The thallus in the Canarian plant reaches a thickness of about 2 mm. in the main filaments, tapering in the branchlets down to about $^1/_2$ mm. The calcareous incrustation is rather vigorous, forming a dense cover with a rather even finely dotted surface, only the uppermost summits of the branches are not incrusted. In the older parts of the thallus the incrustation gets more uneven with numerous small depressions; at the base of the branchlets it is less developed and in the older parts of the thallus the

incrustation has fallen off leaving the nodes bare here. The branchlets are thin at their base, getting somewhat thicker upwards; when they have reached a length of up to $^1/_2$ cm. they are divided into two branches one of which is generally the most vigorous and is sometimes again divided, while the other one as a rule remains undivided. Besides, short proliferations are common. Now and then one of the branchlets grows more vigorously and becomes a main filament.

As to the anatomical building up of the thallus, after decalcification it is found to be built in conformity to the other species of this genus, that is, with a medullary layer from which the peripheral assimilating filaments arise. These (Fig. 31 *a*) are formed by repeatedly forked filaments composed of oblong cells, longer near the base, shorter upwards; the peripheral cells are oblong — ovate to pyriform and rather large, about 7 μ thick. The assimilating filaments show much likeness to those found in *Liagora valida*.

The medullary layer is composed of nearly cylindrical filaments, the thickest I have seen being about 20 μ but the larger stock of the filaments about 10—11 μ.

The specimen is a female plant. I have seen a few carpogonial branches (Fig. 31 *b*). These were composed of 4 cells, 3 rather short ones, and the carpogonium with the trichogyne. The carpogonial branch curves very much, reminding one considerably of those found in *Liagora valida*. The breadth of the carpogonial branch was about 10 μ. The cystocarps have the usual form composed of densely placed sporogenous filaments radiating to all sides from the middle; at the ends of the filaments the carpospores are formed. The involucrum is very poorly developed. I have not suc-

ceeded in finding any trace of antheridia as most probably the plant is dioecious.

As regards the locality it is said to be: "In littore magnæ Canariæ, inter Palmarum urbem et Isletam, 1856."

4. Liagora ceranoides Lamx.

Lamouroux, I., Hist. Polyp. corallig. flex., 1816, p. 239.

Liagora pulverulenta Ag., Spec. Alg., 1821, vol. I, p. 396. Børgesen, F., Mar. Alg. D. W. I., vol. II, p. 80.

Liagora leprosa J. Ag., Alg. Liebm., p. 8.

I am very much indebted to Professor Viguier, Caen for giving me the opportunity of comparing my specimens with Lamouroux's original plant and thus being able to state their identity with the plant of Lamouroux. His specimen originates from the former Danish Island St. Thomas in the West Indies, and the specimens I have collected there and which I have called *Liagora pulverulenta* also agree well with Lamouroux's specimen. However, having seen Lamouroux's plant earlier, Howe[1] has already taken up his name for *Liagora pulverulenta*, and he refers to *Liagora ceranoides* not only *Liagora pulverulenta* Ag., but also *Liagora leprosa* J. Ag., as to the maintaining of which species I have shown my great doubt in "Mar. Alg. D. W. I.", p. 84, and further *Liagora opposita* J. Ag. and *L. Pilgeriana* Zeh.

The specimens I have found seem to agree quite well with my description in "Mar. Alg. D. W. I.", p. 80.

The plant forms soft dense tufts upon the rocks. The thallus is rather regularly dichotomously divided. The colour may best be described as reddish with a mealy whitish cover. The assimilating filaments are about 250 μ long;

[1] Howe, M. A., Algæ in Britton and Millspough, The Bahama Flora, p. 555, 1920.

they are forked several times, and the cells in the lower part of the filaments are subcylindrical about 9—12 μ thick; upwards the cells get shorter and thicker, the uppermost being again smaller and nearly globular of shape. Like the West Indian specimens the uppermost cells often end in long hairs.

I have not succeeded in finding the carpogonial branch; on the other hand plants with cystocarps were found and also plants with antheridia.

Mlle VICKERS calls the plant *Liagora pulverulenta*. In her herbarium several fine specimens are found which quite agree with mine; they are all collected near Las Palmas.

Gran Canaria: Bahia del Confital (Mlle VICKERS, !).
Geogr. Distrib.: West Indies, Red Sea, Dutch India etc.

5. Liagora farinosa Lamx.

LAMOUROUX, I., Hist. Polyp. corallig. flex., 1816, p. 240.

Liagora elongata Zanard., Algæ novæ vel minus cognitæ in mari rubro a Portiero collectæ, Flora, 1851, p. 35. BØRGESEN, F., Mar. Alg. D. W. I., vol. II, p. 67.

Liagora Cheyneana Harv. In Trans. Irish Acad., vol. 22, 1854, p. 552.

Liagora corymbosa J. Ag., Analecta Algologica, Cont. 3, 1896, p. 104.

Thanks to the kindness of Professor VIGUIER, I have also been able to see the original specimen of this species, from the Red Sea, and thus I can state that not only the plant generally called *Liagora elongata*, for instance by me in "The Marine Algæ of the D. W. I.", p. 67, is like LAMOUROUX's plant, but also that the *Liagora Cheyneana* Harv., of which we have here in the Botanical Museum an original specimen, and the *Liagora corymbosa* J. Ag., which I have

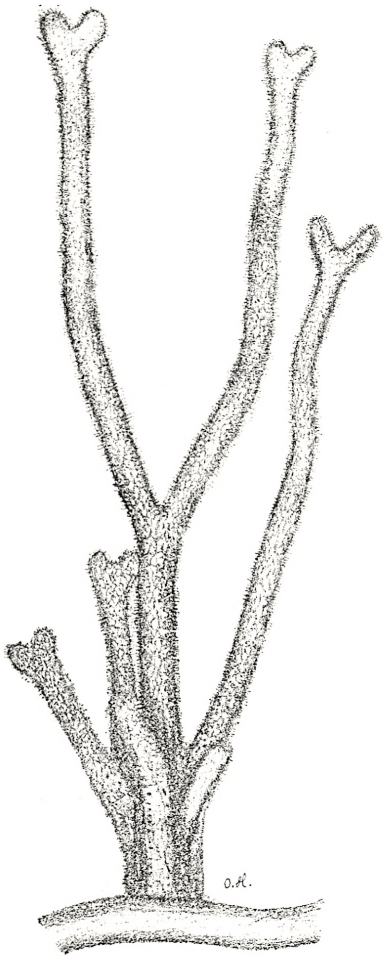


Fig. 32. *Liagora farinosa* Lamx. Part of young thallus growing upon a filament of *Galaxaura flagelliformis* (About 4 : 1).

declared both came very near to *Liagora elongata* (l. c., p. 70), are forms of this certainly rather variable plant, but nevertheless in its structure and whole building up a very characteristic species. Having seen the specimens of Lamouroux earlier, Howe [1] also now in the Bahama Flora, p. 554 considers not only the above mentioned forms but several others to be synonyms of this species.

The Canarian specimens agree very well with Lamouroux's plant, having the characteristic farinose surface of this species (Fig. 32). They are irregularly dichotomously ramified often with long intervals between the dichotomies.

The assimilating filaments (Fig. 33 *a*) are composed of nearly cylindrical cells only very little narrowed at their ends, about 20 μ thick and $1^1/_2$—3 times as long.

From the ends of these, vigorous clavate hairs are developed.

[1] Howe, l. c. p. 554, where several more synonyms are mentioned.

The carpogonial branch (Fig. 33 *b*, *c*, *d*) issues laterally upon branches in the basal part of the assimilating filaments, agreeing with the figure and the description of Madame WEBER ("Siboga-Algæ", part II, p. 201, fig. 62). As

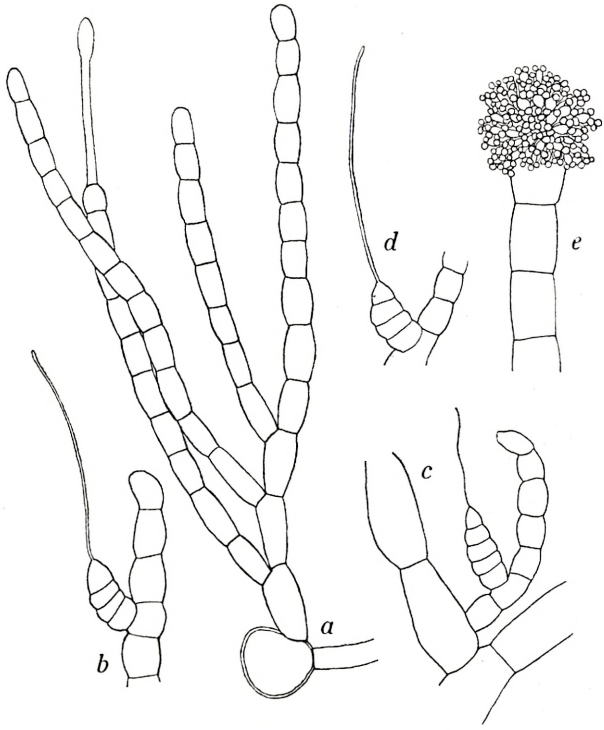


Fig. 33. *Liagora farinosa* Lamx. *a*, part of assimilating filament with a hair; *b*, *c*, *d*, carpogonial branches; *e*, antheridial stand (*a*, *b*, *c*, *d*, about 225 : 1; *e*. about 350 : 1).

in Madame WEBER's drawing, as a rule it is composed of four cells, but I have also found five cells. The cells in the carpogonial branch are about 15—20 μ broad. The antheridial stands (Fig. 33 *e*) had the nearly globular or subconical shape characteristic of this species. The plant is monoecious.

I have only found this plant twice; once as an epiphyte upon *Galaxaura flagelliformis* in a somewhat sheltered place, and once upon rocks in a crevice in a more exposed locality. It occurred somewhat below low water mark. Several small algæ were growing upon it, e. g. the *Acrochætium occidentale* var. *cæspitosa* described above.

M^lle^ Vickers has gathered some very fine and large specimens of this plant. They belong to the herbier du Jardin botanique de l'État, Bruxelles, and I am very much indebted to Professor É. de Wildeman for the permission to see them. The specimens which are determined by M^lle^ Vickers as *L. elongata* reach a height of up to 15 cm.

Gran Canaria: Castillo (M^lle^ Vickers), Bahia del Confital (M^lle^ Vickers, !).

Geogr. Distrib.: West Indies, Florida, Red Sea, Australia, Dutch India etc. Seems to occur in all warmer seas.

6. Liagora distenta (Mert.) Ag.

Agardh, C., Spec. Alg., p. 394.

Fucus distentus Mertens in Roth, Catalecta botanica, vol. III, 1806, p. 103, tab. II.

Liagora ramellosa Sonder in Kützing, Tab. Phycol., vol. VIII, p. 46, tab. 96.

Of this species I have seen fine specimens from the Islands collected by the late O. Gelert.

As to their appearance, the specimens were very much like the above quoted figure in Roth's "Catalecta", not having such short and dense clusters of branches as found in Kützing's figure of *L. ramellosa* drawn after a specimen from Teneriffe in Herb. Sonder. Bornet in "Algues de Schousboe", p. 264 mentions *Liagora ramellosa* Sonder as a species, but at the same time he points out that it is not "spécifiquement distinct du *Liagora distenta*".

The *Fucus canaliculariodes* Clemente, "Ensayo", Madrid 1807, p. 318, is a younger name for this species than that of MERTENS, and therefore not to be considered. *Fucus lichenoides* Desfontaines, "Flora Atlantica", vol. 2, anno sixto, p. 427, is certainly an older name, but the figures referred to are so bad that it cannot be said with certainty if we really have to do with this species.

Gran Canaria: Las Palmas (GELERT); Teneriffe: Orotava (LIEBETRUTH). Lanzarote: Arrecife (D'ALBERTIS), Isla de Lobos (BOLLE).

Geogr. Distrib.: From Cadiz to the Canary Islands, Mediterranean Sea.

Fam. 2. Chætangiaceæ.

Subfam. 1. Scinaieæ.

Scinaia Bivona.

1. Scinaia furcellata (Turner) Bivona.

BIVONA in l'Iride, Palermo 1822. J. AGARDH, Spec. Alg., vol. II, 2, p. 422; Epicrisis, p. 512. BORNET et THURET, Notes Algolog., Fasc. I, p. 18, pl. 16. SETCHELL, W., The Scinaia Assemblage, p. 90.

Ulva furcellata Turner in SCHRADER's Journ. f. die Botanik, vol. I, 2, 1891, p. 300, tab. I, A.

In her list M^lle^ VICKERS mentions that she has collected a small specimen of this species at low tide. Thanks to Professor É. DE WILDEMAN, Bruxelles, I have been able to see this specimen. It is a small cystocarpic plant scarcely more than $2^1/_2$ cm. high. The thallus is about 0.75—1.25 mm. broad, of a fine rose-colour and repeatedly dichotomously divided. The axis is obscure, and the cystocarps scattered and hardly visible with the naked eye. On account of the scarcity of the material a closer examination is precluded.

Gran Canaria: Playa de las Canteras (Mlle VICKERS).

Geogr. Distrib.: From Great Britain down to the Canary Islands; Mediterranean Sea.

Subfam. 2. Chætangieæ.

Galaxaura Lamouroux.

My collection of *Galaxaura* from the West Indies upon which I based my examination contained a good deal of forms, but not many specimens of each form; further, most of the collected specimens were sterile. It was therefore out of the question that I should, when working out my West Indian material, have the least suspicion as to how the different species mentioned in KJELLMAN's monograph belonged together, when HOWE's first note[1] about this interesting matter appeared in 1917, and his more detailed account[2] in the following year. In these papers, basing his view upon rich material and repeated examination of living plants, HOWE points out that all the forms placed together by KJELLMAN either in one group or in the other, in which he divides this genus, are either tetrasporic or sexual and that a tetrasporic plant of one of the groups has its corresponding sexual phase in one of the species of another group. HOWE gives much information concerning the groups and species which he thinks belong together. Of course we need cultural demonstration to settle the question definitely, but nevertheless HOWE's supposition seems very convincing.

When, during my stay at the Canary Islands, I again had an opportunity of collecting forms of this group, I

[1] HOWE, M. A., A note on the structural dimorphism of sexual and tetrasporic plants of *Galax. obtusata*. Bull. Torr. Bot. Club, vol. 43, 1917.

[2] HOWE, M. A., Further notes on the structural dimorphism of sexual and tetrasporic plants in the Genus *Galaxaura*. Brooklyn Bot. Garden Memoirs, vol. I, 1918.

took my chance and brought home a rather large collection of these plants. And as only one species with its two phases was present more commonly in the localities where I have collected my plants, the examination of this material had a special interest in showing that these two forms undoubtedly belonged together.

1. Galaxaura flagelliformis (Kjellm.) emend.

Tetrasporic form:

Galaxaura flagelliformis Kjellm., Floridé-Slægtet Galaxaura, p. 47. BØRGESEN, Mar. Alg. D. W. I., vol. II, p. 93.

Sexual form:

Galaxaura squalida Kjellm. l. c., p. 55, tab. 6, figs. 1—12, tab. 20, fig. 8. BØRGESEN, l. c., p. 102, figs. 108—111.

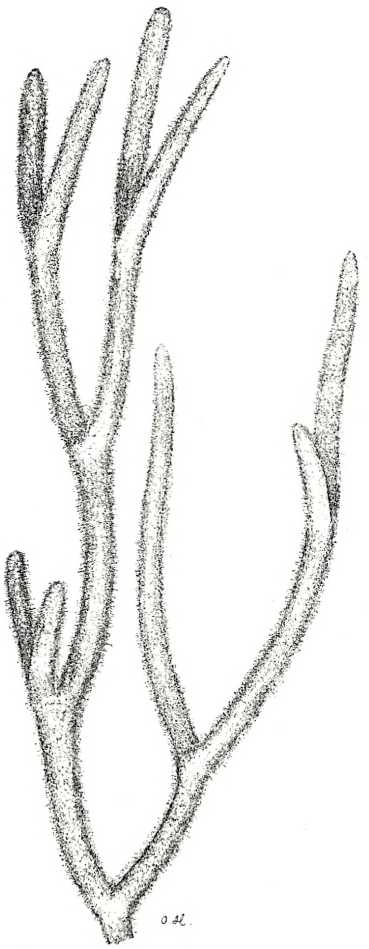


Fig. 34. *Galaxaura flagelliformis* (Kjellm.) emend. Tetrasporic form (= *G. flagelliformis* Kjellm.). About 3 : 1.

The species which is the most common at the Islands consists of a densely hairy always tetrasporic form (= *G. flagelliformis* Kjellm.) and a less hairy often almost glabrous, always sexual form (= *G. squalida* Kjellm.). As I shall point out below in a more detailed description, the two forms undoubtedly belong together, so I here combine them under the specific name of the plant first described by KJELLMAN.

The tetrasporic plant (Fig. 34) forms rather dense and very intricate tufts 6—10 cm. high or more, upon rocks. The thallus is terete and densely covered with red brown hairs that reach a length of up to 750 μ. It is di-trichotomously ramified, the joints of each dichotomy as a rule reaching different lengths; generally the length of the joints varies from $^1/_2$—$1^1/_2$ cm. or even more. But such long joints as are found in the West Indian form pictured by me (l. c. fig. 101), I have not found at the Canary Islands, but I beg the reader to remember that the West Indian form was from deep water.

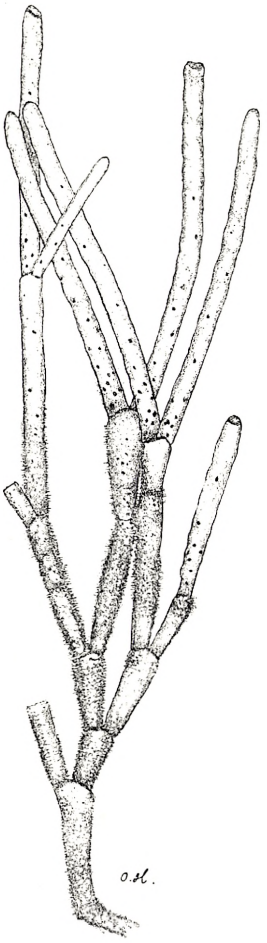


Fig. 35. *Galaxaura flagelliformis* (Kjellm.) emend. Sexual form (= *G. squalida* Kjellm.). A form with long joints. (About 3 : 1).

As regards the anatomy the medullary layer is composed of thick-walled, branched filaments woven together. The filaments consist of long cells with a diameter of about 15—20 μ. The basal cell of the assimilating filaments (Fig. 37) has a diameter of about 40—50 μ and is oblong globose. The short assimilating filaments consist of two or three cells, above the basal cell, and a little smaller than it. In the long assimilating filaments the cell above the basal one is a little swollen, then the cells become cylindrical being about $1^1/_2$—2 times longer than the breadth which is from 19 to 20 μ. The assimilating filaments are rather often provided with side bran-

ches. Tetrasporangia (Fig. 37) were found in many of the specimens. They are either terminally or laterally placed upon the assimilating filaments. Some of the tetrasporangia are pedicellate. The tetrasporangia are either oval or almost globose, about 35 μ long and 24 μ broad.

The sexual plant (Fig. 35, 36), though not quite as common, was often found growing together with the above described tetrasporic plant, and upon microscopical examination it showed the anatomical structure characteristic of the group *Microthoë*.

Various investigators have called the sexual form either *Galaxaura Decaisnei*[1] or *G. rugosa*. But the sexual plant is so like the West Indian *Galaxaura squalida* that I consider it identical with this plant.

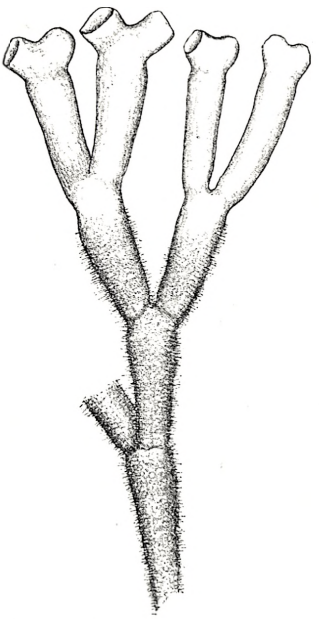


Fig. 36. *Galaxaura flagelliformis* (Kjellm.) emend. Sexual form (= *G. squalida* Kjellm.). A form with short joints. (About 3 : 1).

The outer appearance of the sexual plant varies rather. In some of the specimens the joints are short (Fig. 36) often not 1 cm. long, and the thallus about 2 mm. broad (in dried condition); in others (Fig. 35), very long joints up to 3 cm. are found, and the thallus is at the same time rarely more than $1^1/_2$ mm. broad. But

[1] *Galaxaura Decaisnei* is described by J. AGARDH upon specimens "from oceano atlantico calidiore". KJELLMAN, in "Galaxaura" p. 88, has examined the specimens in J. AGARDH's Herbarium and refers the species to the group *Spissæ*. According to J. AGARDH's description and KJELLMAN's fig. 48 (tab. 20) I think this plant is to be referred to *G. obtusata*.

these two extremities are connected by numerous intermediate links, and the variable development of the thallus is no doubt due to external conditions of life.

Also the presence of hairs, more or less numerous,

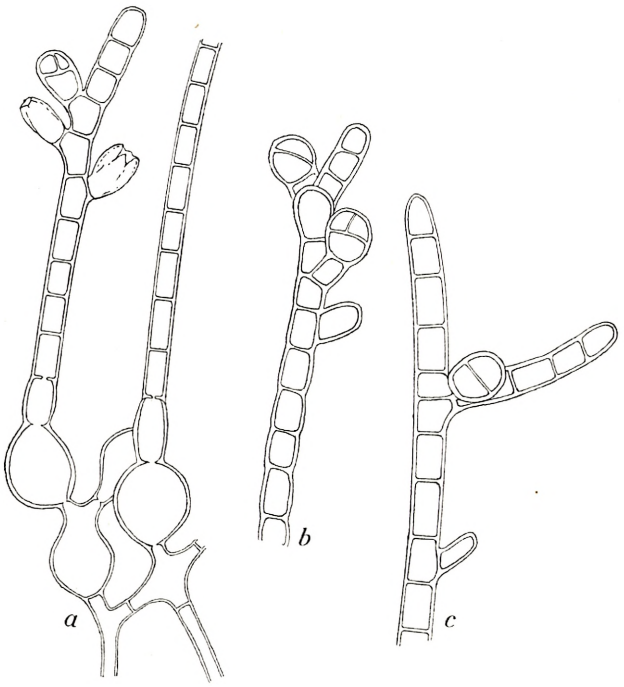


Fig. 37. *Galaxaura flagelliformis* (Kjellm.) emend. *a*, transverse section of the thallus with assimilating filaments and tetrasporangia (two emptied). *b*, *c*, ramified assimilating filaments with tetrasporangia. (About 225 : 1).

varies much in the different specimens. Some are nearly quite destitute of hairs these occurring only near the base of the plant while the upper parts of the thallus are quite glabrous. Of course these specimens show much likeness to *Galaxaura rugosa*. But they are not so markedly annulate or transversely rugose as in *G. rugosa*, the surface of the Canarian plant being often nearly quite smooth and even.

Other specimens are covered with hairs from their base up to near the summits, the younger uppermost parts of the thallus being glabrous. The most hairy plants are often those that have the longest joints.

As to the anatomy of the sexual plant (Fig. 38), it agrees well with my figures of the West Indian plant. The assi-

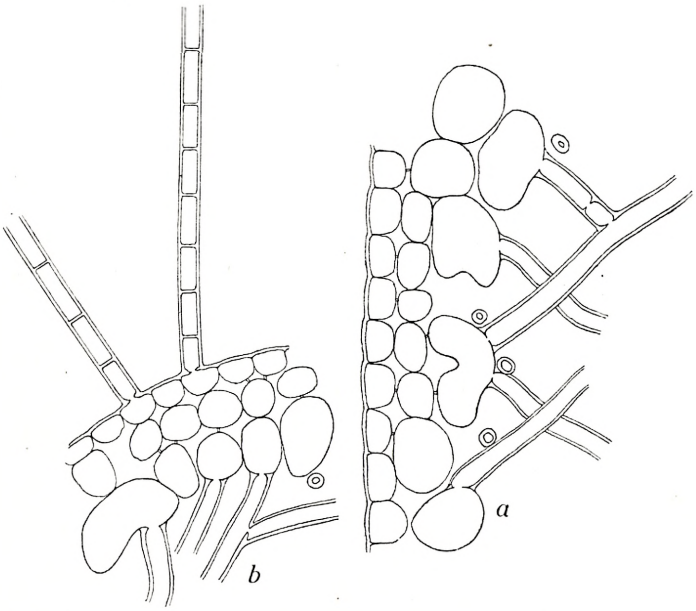


Fig. 38. *Galaxaura flagelliformis* (Kjellm.) emend. Transverse section of sexual plants. *a*, part of the thallus without assimilating filaments; *b*, part of the thallus with assimilating filaments. (*a*, about 300 : 1; *b*, about 200 : 1).

milating peripheral tissue is composed of short often di-trichotomously divided cell-rows. The innermost cells in these are the larger ones, being oblong-oval, often lobed in transverse section. The peripheral closely packed cells are the smaller ones. The medullary tissue is composed of thick-walled branched filaments woven together. Figure 38 *a* is from a smooth part of the thallus; Fig. 38 *b*, on the other hand, represents a hairy part of the thallus. The

assimilating filaments issue from the peripheral cells. They are about 19 μ broad, cylindrical and composed of cells about twice as long as broad.

As already mentioned above, I consider the two forms described as representing together the tetrasporic and sexual phase of the same plant. I base this upon the fact that both forms often grow together, being even found mixed together. And further, both forms are by far the most common ones compared with the other Canarian *Galaxaura* species which may all be designated as rare. In a quite convincing manner this seems to me to confirm the suggestion of Howe that *Galaxaura flagelliformis* should have its sexual component in *Galaxaura squalida*.

The *Galaxaura Descaisnei* mentioned by M^lle^ Vickers in her list of the Canarian algæ p. 302 is *G. squalida* according to a specimen of hers in my herbarium. And the same is the case with the fine collection of forms found in the herbarium of the Musée botanique de l'État, Bruxelles, which Prof. É. de Wildeman has been so kind as to let me see. Also a specimen of *Actinotrichia lapidescens* mentioned in M^lle^ Vicker's list was found in her herbarium and has turned out to be the tetrasporic form of this species.

And the *Galaxaura rugosa* mentioned by Piccone in "Crociera", p. 35, from "Santa Cruz di Teneriffe, agosto" is *G. squalida* according to a piece of the specimen which Dr. Ach. Forti has been so kind as to send me, and the same is most probably the case with the *G. rugosa* mentioned in the same paper, p. 55, as collected at Teneriffe by Liebetruth. I have not seen this specimen.

Further Dr. Achille Forti has sent me a piece of the *Galaxaura lapidescens* mentioned by Piccone, l. c. p. 35; it

is to be referred to *flagelliformis*, and PICCONE l. c. p. 55 mentions *G. lapidescens* as collected at the Islands by BOLLE and LIEBETRUTH. Thanks to Dr. ACHILLE FORTI I have seen a piece of BOLLE's specimen which BOLLE has called *Cladostephus spongiosus*. It is a sexual plant (= *G. squalida* Kjellm.), but unusually hairy. Finally Dr. ACHILLE FORTI has sent me a small piece of a *Galaxaura* collected by CHRIST at Orotava and determined as *G. lapidescens*. This, too, is referable to *Galaxaura flagelliformis*.

This species with its two phases occurs in rather sheltered places upon rocks and stones from near low water mark and downwards. At Orotava, Teneriffe, it was common in low lying rock pools, and at Gran Canaria I found it abundantly in the shallow area of water behind the reef in Bahia del Confital.

This species is no doubt common at the Islands and has been found there by many investigators.

Geogr. Distrib. Florida, West Indies, Canary Islands.

2. Galaxaura oblongata (Ellis and Solander) Lamx.

LAMOUROUX, J., Hist. Polyp. corall., p. 262.

Corallina oblongata Ellis et Solander, Nat. Hist. Zoophyt., p. 114, tab. 22, fig. 1.

Galaxaura adriatica Zan., Iconogr. Phycol. Adriat., vol. I, p. 91, tav. XXII. HAUCK, F., Meeresalgen, p. 66.

Galaxaura fragilis (Lamk.) Kütz., Spec. Alg., p. 530.

Dichotomaria fragilis Lamk., Hist. nat. des animaux sans vertèbres, t. II, 1816, p. 145 (HOWE in the Bahama Flora, p. 559 has already referred it to *Galax. oblongata*).

As I have pointed out in my West Indian Algal Flora (vol. II, pp. 88—89 and p. 97), the original specimens of ELLIS and SOLANDER seem no longer to exist, but fortunately the figures and descriptions in their work "The

natural history of many curious and uncommon Zoophytes", London 1786, concerning this and other species of *Galaxaura* are so good that there is no doubt as to the authors' meaning, and this I think may also be said with good reason about their *Corallina oblongata.*

On the other hand it is not with quite as good a reason that Lamouroux's name is added to the present specific name of the plant. His description is poor and cannot be said to fit this species particularly well, and to this comes that the specimen in his herbarium is not at all this species, but a form of *Galaxaura obtusata* with rather long joints.

At first I had much trouble as regards the right naming of my Canarian specimens. As was only natural, I began by referring them to *Galaxaura adriatica*, the Canarian plant agreeing well with Zanardini's and Hauck's description and also with the specimen of *Galaxaura adriatica* published in Hauck and Richter, "Phycoth. Univ.", no. 60, as well as with a specimen I have collected myself in the bay of Ajaccio, Corsica.

However, the similarity to specimens of *Galaxaura oblongata* from the West Indies was unmistakable.

As I have not much personal knowledge of this species, having found it only once in the former Danish West Indies (in my treatise I have called the plant *Galaxaura fragilis*) I wrote to Dr. Howe, New York, who, as is well known, has worked very much with this genus, and asked him about his opinion of the Canarian plant. In a letter of Jan. 5th 1927 Dr. Howe most kindly expressed his views in this way: "I know little or nothing of *G. adriatica* except from Zanardini's description and figures. The figures seem to agree very well with our plant. However, if I had

picked up your specimen in the West Indies, I should not have hesitated to refer it to *G. oblongata*".

Further, Dr. HOWE was so very kind as to send me some specimens of *Galaxaura oblongata* from various places in the West Indies, and as I have now compared them with my specimens, I do not hesitate to consider not only my

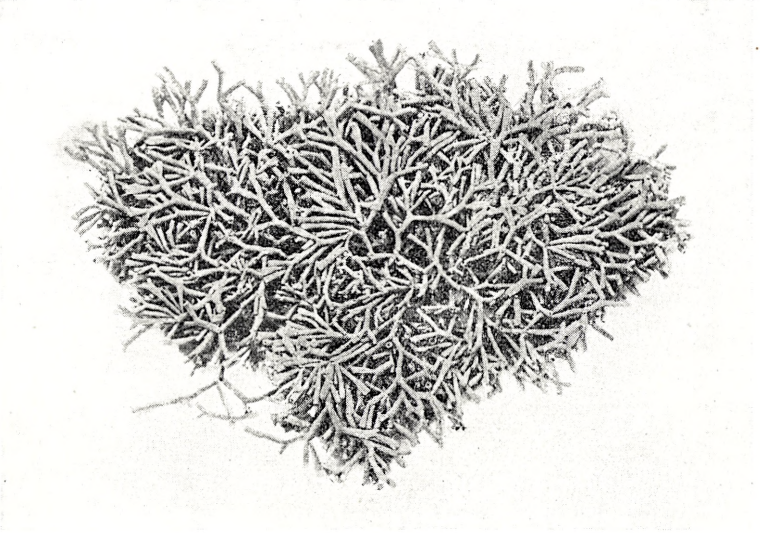


Fig. 39. *Galaxaura oblongata* (Ellis et Solander) Lamx. Habit of a plant. (About $^2/_3$: 1).

Canarian specimens, but also the Mediterranean *G. adriatica* as belonging to the same species as the West Indian plant, whose earlier name of *oblongata* must be kept, as the *Corallina oblongata* has been described by ELLIS and SOLANDER upon a West Indian plant.

After these introductory remarks as to the name of the plant I shall give a short description of the Canarian plant.

The plant forms dense roundish tufts about 6—8 cm. high upon the rocks (Fig. 39). The thallus is terete, with even or sometimes somewhat rugulose surface, repeatedly

di- or now and then trichotomously divided, and as the angles between the branches are often obtuse especially in the lower part of the thallus, the filaments are extended to all sides and very intricate. The joints are rarely more than $^1/_2$ cm. long. The breadth of the thallus varies from $^3/_4$ mm. up to about 1.25 mm.; in each specimen, the filaments keep nearly the same size, and we have thus specimens with a narrow thallus (Fig. 40 *a*) and others with a more robust thallus (Fig. 40 *b*), but between the different specimens an even transition is present. The colour of the dried plant is reddish grey. As regards the anatomy, this species belongs to the group *Eugalaxaura* in Kjellman's monograph and is therefore built up in conformity with the plants of this group.

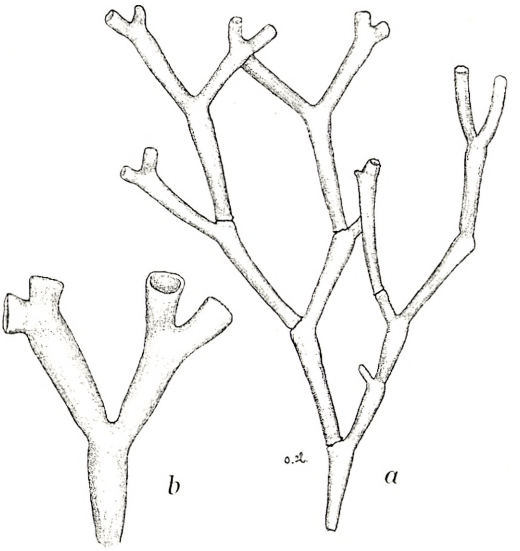


Fig. 40. *Galaxaura oblongata* (Ellis et Solander) Lamx. Part of the thallus. *a*, part of a slender form; *b*, part of a robust form. (About 4 : 1).

The peripheral assimilating very incrusted tissue (Fig. 41 *a*) is composed of short dichotomously divided filaments, the cells of which are larger innermost, subglobular of shape with a diameter of 20—30 μ, rarely more. Towards the periphery the cells grow smaller, the epidermal cells being the smallest ones; these are usually broader than long, and when seen from above roundish 4—6 gonal.,

their diameter varies from 10—18 μ. After decalcification it is easy to separate them. The medullary tissue is composed of dichotomously ramified thick-walled filaments intertwisted among each other, the intervals between the filaments are filled out with mucilage; their diameter is about 7—12 μ or more.

When the peripheral incrusted tissue has burst in the node, the outermost ends of the medullary filaments swell,

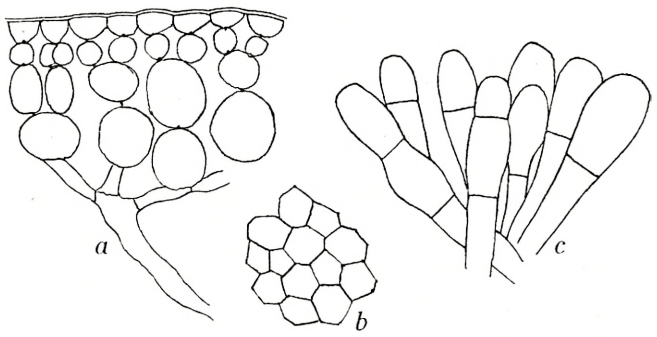


Fig. 41. *Galaxaura oblongata* (Ellis et Solander) Lamx. *a*, part of assimilating filaments; *b*, surface cells seen from above; *c*, swelled ends of medullary filaments. (*a*, about 200 : 1; *b*, *c*, about 300 : 1).

forming in this way a peripheral layer. The swelled ends reach a breadth of up to 16—24 μ (Fig. 41 *c*).

Of this plant I have found male and female specimens. The antheridial conceptacles consist of hollow cases, from the walls of which the antheridial stands grow up, the spermatia being formed at the ends of the thin filaments of which they are composed. The cystocarps are described and figured by SCHMITZ (ENGLER u. PRANTL, "Nat. Pflanzenf." p. 338, fig. 207 E.); they are built up in a very similar manner to the antheridial conceptacle, forming a hollow case, from the peripheral walls of which the much divided sporogenous filaments arise. In the summit of these, the

large cystocarps are formed; these are generally oval of form about 28—42 μ long and 23—25 μ broad.

Harvey-Gibson and Margery Knight [1] have found tetrasporangia in a specimen from the Red Sea. According to their observation "the tetragonidia are formed in the subepidermal layer, and the mother-cell contents divide in the tetrahedral manner into the four tetragonidia. As the gonidangia mature the superficial cell-layer disappears, forming the shallow depression seen on surface view". They also found tetraspores and cystocarps together in the same specimens and even in the same branch.

This observation seems nevertheless to be rather doubtful. According to my description all the specimens I have examined have been sexual either male or female, and this also quite agrees with the observation of Howe (in "Brooklyn Bot. Garden Memoirs", vol. 1, 1918, p. 197). According to this investigator, *G. oblongata* is supposed to have its tetrasporic phase in the, as to outer appearance very different, *G. comans* Kjellman, a plant which I have not succeeded in finding at the Canary Islands.

To this species I refer a specimen belonging to the Botanical Museum, Berlin. It was collected by A. Krause at Puerto (Orotava) at Teneriffe on the 2nd March 1893 and determined by Reinbold first as *cylindrica* and then as *fragilis*. There are two small specimens forming dense tufts about 3 cm. high. I am very much indebted to Dr. Otto Schmidt for the loan of the plant.

The *Galaxaura fragilis* Decsne var., mentioned in Piccone's list of Canary algæ, p. 55 as collected at the Islands

[1] Harvey-Gibson, R. I. and Margery Knight: Reports on the marine Biology of the Sudanese Red Sea. IX. Algæ (Journ. Linn. Soc., Bot., vol. XLI, p. 307).

by LIEBETRUTH is most probably this species. I have not seen the specimen.

This species was found in a very exposed locality growing on rocks in crevices near low-water mark. Fertile specimens were collected in the month of January.

Teneriffe: Orotava (Dr. A. KRAUSE, !), without locality (LIEBETRUTH), Santa Cruz (d'Albertis).

Geogr. Distrib. Mediterranean Sea, Red Sea, West Indies.

3. **Galaxaura cylindrica** (Solander) Lamouroux.

LAMOUROUX, J., Expos. méthod. p. 22. DECSNE, Class. des Algues et des Polyp. calcif., p. 103. KÜTZING, F., Spec. Alg., p. 530; Tab. Phycol., vol. VIII, tab. 31, fig. II. AGARDH, J., Epicrisis, p. 527. KJELLMAN, F., *Galaxaura*, p. 64.

Corallina cylindrica Ellis and Solander, Nat. Hist. Zoophytes, 1786, p. 114.

This plant I have only found once. It was growing in a crevice of the rock in a very exposed locality somewhat below low water mark. It formed a rather large, dense tuft about 9 cm. high.

The thallus is cylindrical about $^1/_2$—$^3/_4$ mm. broad, repeatedly di-trichotomously divided, and the angles between the branches are acute, the filaments being thus directed upward. Its colour is light red-greyish or greenish and its surface is rather smooth. The joints reach a length of about 1 cm.

It is by means of these external characters that this species is distinguished from the above mentioned; on the other hand it shows much likeness to it as regards its anatomical structure.

The medullary tissue is formed of thick walled filaments composed of long cylindrical cells about 7—8 μ thick or more. At the periphery these filaments bear the short,

dichotomously ramified assimilating filaments composed of nearly spherical or oval cells, the innermost about 20—22 μ broad, the next ones about 10—12 μ. The peripheral cells are broader than long, closely connected even after decalcification, their diameter reaching a length of about 8—12 μ.

Seen from above the peripheral cells are found to be composed of 5—6 gonal cells.

The few specimens I have gathered were all sterile; when fructifying *G. cylindrica* is always sexual, this plant having, as Howe (l. c. p. 196) supposes, its tetrasporic phase in *G. lapidescens*. I have not succeeded in finding any specimens of this plant at the Islands.

Galaxaura cylindrica has previously been mentioned from the Islands by Piccone, "Crociera", p. 34. Dr. Achille Forti has been so kind as to send me a small specimen. It had been gathered on the 10th of August.

Gran Canaria. Bahia del Confital. Teneriffe: Santa Cruz (d'Albertis).

Geogr. Distrib. Red Sea, West Indies, Atlantic coast of South America.

4. Galaxaura obtusata (Ellis et Solander) Lamx.

Lamouroux, J., Hist. Polyp. flex., 1816, p. 262[1].

Corallina obtusata Ellis et Solander, p. 113, tab. 22, fig. 2.

Galaxaura Decaisnei J. Ag., Spec. Alg., vol. III, 1, p. 526 (fide Howe, Bahama Flora, p. 559).

Galaxaura moniliformis Kjellman, Galaxaura, p. 83, pl. 17, fig. 15—30 (fide Howe, l. c.).

Of this species I have seen only a few specimens collected at the Islands by Sauvageau.

[1] According to the specimens in Lamouroux's Herbarium not only those called *Galaxaura obtusata* must be referred to this species, but also those called *oblongata* and *umbellata*. I am much obliged to Professor Viguier for permission to see these specimens of Lamouroux.

The specimens do not much resemble the figures of ELLIS and SOLANDER, as the length of the joints varies very much up to about 2 cm.; the breadth of the dried plant is about $3^1/_2$ mm.

But when the Canarian plant is compared with West Indian specimens of which Dr. HOWE has been so kind as to send me fine specimens, it will be seen that in these, too, the joints are often rather long.

As to the size and coherence of the superficial cells those of the Canarian specimens agree very well with the West Indian plant according to HOWE's description in the Bahama Flora, p. 558, as the cells in the Canarian plant have a diameter of about 40 μ or more, and furthermore are coherent after decalcification.

SAUVAGEAU referred his specimens to *Galaxaura oblongata* Lamour., cfr. "A Propos des Cystoseira", p. 52. About its colour SAUVAGEAU remarks: "D'un très beau rose dans l'eau".

The specimens I have examined had the structure of the "*Camaratæ*"-group of KJELLMAN, thus suggesting that the plant is a tetrasporic specimen[1]; but I have not seen any tetraspores.

Teneriffe: Orotava (SAUVAGEAU).
Geogr. Distrib. West Indies, Florida, Brazil, Canary Islands.

Fam. 3. Gelidiaceæ.

Caulacanthus Kütz.

1. Caulacanthus ustulatus Kütz.

KÜTZING, F., Phycol. gener., p. 395; Spec. Alg., p. 753; Tab. Phycol., vol. 18, tab. 8. J. AGARDH, Spec. Alg., vol. II, p. 433. BORNET et THURET, Not. algol., p. 55, pl. 19.

[1] Compare M. A. HOWE's papers quoted on page 64!

This small plant occurred abundantly upon stones and reefs South of Las Palmas.

When living, it formed a quite low, dense, moss-like cover of a yellow-brown colour. In dried condition the thallus is almost black.

The thallus is fastened to the substratum by means of very strong, short and broad, multicellular hapters.

In the specimens I have examined, I have found only tetraspores. According to Bornet et Thuret, l. c., the cystocarps occur much more rarely and only in less vigorous plants. The plant occurred in a rather exposed place and is laid dry for rather a long time at ebb-tide.

Gran Canaria: South of Las Palmas.

Geogr. Distrib. From the Gulf of Gascogne down to Senegal; Mediterranean Sea.

Gelidium Lamx.

1. **Gelidium crinale** (Turn.) Lamour.

Lamouroux in Bory, Diction. classique, vol. VII, 1825, p. 191.
Fucus crinalis Turner, Fuci, pl. 198.
Gelidium corneum, var. *crinale* Turn., Mont., l. c., p. 159.

This species has been gathered several times. Most of the specimens are small, rarely higher than 1—2 cm. and the breadth of the thallus about 200—250 μ.

The tetrasporangia are formed in the swelled upper ends of the filaments; in a gathering from Orotava several fructifying parts were present one above the other, the filaments thus getting a moniliform appearance.

I met with the plant in exposed places high up on the rocks, where it formed low coverings which were dry during ebb-tide.

Teneriffe: Orotava (SAUVAGEAU,!). Gran Canaria: Playa de Santa Catalina (M^lle VICKERS,!), Bahia del Confital (M^lle VICKERS). Without locality a specimen in Herb. MONTAGNE.

Geogr. Distrib. From the English coast to the Canary Islands, Mediterranean Sea, Red Sea, Atlantic coast of North America.

2. Gelidium intricatum Kütz.

KÜTZING, F., Spec. Algarum, p. 767. GRUNOW, A., Algen der Fidschi-, Tonga- und Samoa-Inseln, p. 40.

Acrocarpus intricatus Kütz., Tab. Phycol., vol. 18, tab. 35.

Fig. 42. *Gelidium intricatum* Kütz. Habit of a larger form. (About 8 : 1).

Grunow mentions l. c. that he has seen forms of this plant originating from the Canary Islands.

The specimens (Fig. 42) I refer to this plant form low, about 1—2 cm. high, very intricate tufts upon the rocks. The plant is fastened to the substratum by means of vigorous hapters formed by groups of rhizoids issuing from the thallus. The thallus of the plant is very irregularly ramified, and its breadth varies very much, from about 100—250 μ.

The diameter of the surface cells is about 8 μ long.

As pointed out by Grunow no doubt this plant comes near to *G. crinale.*

I have found plants with tetraspores.

The plant occurred near high water mark in a very exposed place and lower down in less exposed localities. It covers stones and cliffs densely[1].

Teneriffe: Orotava. Gran Canaria: Playa de Santa Catalina. South of Las Palmas near Christoballo.

Geogr. Distrib. According to Grunow the plant occurs in the Persian Bay, Batavia, North Australia, Tongatabu and Upolu, Valparaiso, Canarian Islands and Cape.

3. Gelidium spatulatum (Kütz.) Bornet.

Bornet, E., Alg. Schousboe, p. 268.

Acrocarpus spatulatus Kütz., Tab. Phycol., vol. 18, p. 13, tab. 36.

Of this plant (Fig. 43) I have found some specimens agreeing quite well with Kützing's figure. It has creeping filaments fastened to the substratum by means of short

[1] Interwisted in a tuft of *Gelidium intricatum* from Gran Canaria: Playa de Santa Catalina, I have found a few filaments of *Pylaiella fulvescens.* As mentioned in Part II, Phæophyceæ, p. 6, this species has been found once by M^lle^ Vickers and I am thus able to state the occurrence of this species at the Islands.

hapters. From the decumbent filaments, branched or unbranched filaments arise which in the upper end are flattened out like spatula.

As BORNET, l. c. has also pointed out, this plant is most probably nothing but a form of *G. crinale*.

The plant was found in exposed places on rocks somewhat above low water mark.

Teneriffe: Orotava (SAUVAGEAU,!). Gran Canaria: Playa de Santa Catalina near Castillo.

Geogr. Distrib. Mediterranean Sea.

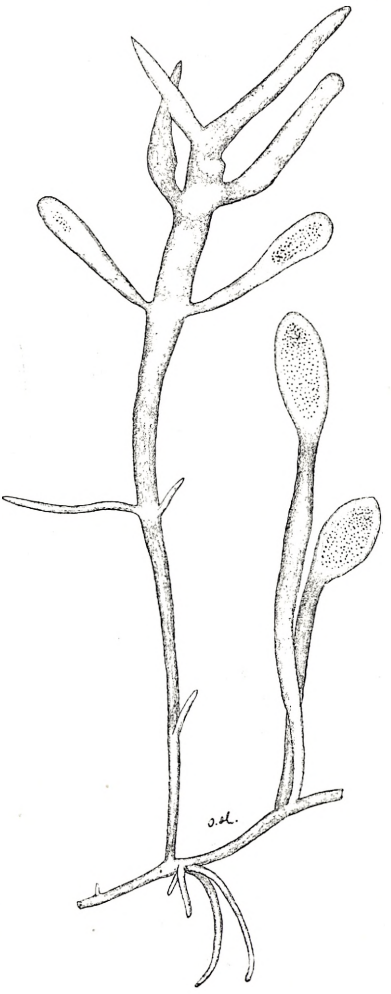


Fig. 43. *Gelidium spatulatum* (Kütz.) Bornet. Habit of plant. (About 12:1).

4. Gelidium pusillum (Stackh.) Le Jol.

LE JOLIS, A., Liste, p. 139. BORNET, E., Alg. de Schousboe, p. 268.

Fucus pusillus Stackh., Nereis, 1795, p. 17, tab. 6.

Acrocarpus pusillus Kütz., Tab. Phyc., vol. 18, tab. 37.

All the specimens I have referred to this species (Fig. 44) are dark red and when dry almost black. Most of them agree very well with KÜTZING's above cited figure which BORNET quotes in "Algues de Schousboe". In the basal creeping part the thallus is terete and higher up in the erect parts often leaflike.

The ramification is very irregular and proliferations are common. The tetrasporangia occur in the spatulate branchlets which are often narrowed several times.

Some of the specimens did not agree quite so well with Kützing's figure, as they showed some likeness to *G. pul-*

Fig. 44. *Gelidium pusillum* (Stackh.) Le Jol. Habit of plant. (About 8 : 1).

vinatum or *G. spatulatum*, small forms no doubt very nearly related and considered by many investigators as forms of the same species.

The var. *clavatum*, Lamx. mentioned by Montagne, l. c., p. 159 is surely a form of this plant.

Gran Canaria: South and North of Las Palmas near Christoballo and Castillo and other places, Boñadero (M^lle^ Vickers).

Geogr. Distrib. Atlantic and Mediterranean coast of Europe, Morocco, Japan, Australia, Easter Island.

5. Gelidium pulvinatum (Kütz.) Thur.

THURET in Herb. SCHOUSBOE; cf. BORNET, E., Alg. Schousboe, p. 108.

Acrocarpus pulvinatus Kütz., Spec. Alg., p. 762; Tab. Phycol., vol. 18, tab. 37.

In my material I have not found any form which seems to be referable to this plant, but SAUVAGEAU mentions this species in his list of Canarian species in "A propos des Cystoseira", p. 52.

SAUVAGEAU found it "sur les Patelles et les rochers".

Teneriffe: Orotava (SAUVAGEAU).

Geogr. Distrib. Atlantic coast of France and Portugal.

6. Gelidium corneum (Turner) Lamx.

LAMOUROUX, J., Essai Thalassioph., p. 41. BORNET, E., Algues Schousboe, p. 270.

Fucus corneus Turner, Fuci, tab. 257, fig. a.

The specimens I have referred to this species in most cases agree very well with TURNER's above quoted figure. They are repeatedly pinnate.

The tetrasporangia occur in the broad rounded spatulate ends of the branchlets.

The plant occurs upon rocks and stones and was especially common in dark ravines or under stones. In more exposed places it grows near high water mark.

It seems to be a common species at the Islands and has been found by most investigators.

Geogr. Distrib. Seems to be widespread.

7. Gelidium arbuscula Bory in herb.

Gelidium corneum var. *nereideum*? Lightf. (Fl. Scot.) in MONTAGNE, Iles Canaries, l. c., p. 158.

HAUCK and RICHTER, Phycotheca Universalis, no. 557 under the name of *Gelidium latifolium*

As I could not find any description of this fine plant I wrote to Dr. Hamel, Paris, and asked him if any description of the plant was to be found in Bory's Herbarium. Dr. Hamel most kindly informed me that no description existed, and at the same time he sent me some fragments of Bory's original specimen.

Having now compared these with my specimens I have convinced myself that they agree well with Bory's plant.

Fig. 45. *Gelidium arbuscula* Bory. A tuft of a small plant. (About $^4/_5$: 1).

And further it was clear to me that the plant published by Hauck and Richter in "Phycothea Universalis" no. 557 as *Gelidium latifolium* is this plant. Upon the whole it seems to be a rather common species at the Islands, Sauvageau has gathered a good many specimens of it, and M^lle^ Vickers mentions it in her list of algæ. And further, according to a specimen in Herb. Montagne, the *Gelidium corneum* var. *nereideum*, too, is this plant. Montagne gives the following diagnosis: "fronde plana, rigida tripinnata, pinnis horizontalibus dilatatis obtusissimis". And he adds:

"Elegantissima varietas, habitu prioris hypnoideo insignis a qua tamen substantia rigidiore diversa videtur".

Gelidium arbuscula (Fig. 45) is a rather large plant, which forms dense, red tufts upon the rocks between tide marks, growing below *Cystoseira Abies marina*. The tufts reach a height of up to 15 cm.

The thallus is flat, and the branches issue from the edges, but especially in older parts of the thallus branchlets occur, too, from the flat sides.

In the main filaments, the breadth of the thallus reaches up to about $1^1/_2$ mm. The ramification is repeatedly more or less regularly pinnate. The branches issue irregularly, sometimes with a tendency to be opposite. The length of the branches varies rather much, but as a rule the branches get shorter upwards. The uppermost branchlets are small, dwarfish, and in the sterile plant they consist of a midrib and a few pinnately placed side laps with acute ends (Fig. 46).

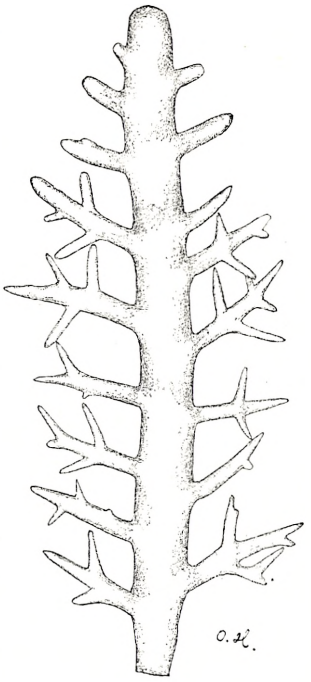


Fig. 46. *Gelidium arbuscula* Bory. Upper end of a branchlet with pinnules of a sterile plant. (About 12 : 1).

In the tetrasporic plant (Fig. 47) however, the last ramifications are like small oval short-stalked leaflets placed up along the margin of the thallus and carrying the tetrasporangia in the middle on the flat sides. These small leaflike thallus-parts are as a rule about 800—1000 μ long and 70 μ broad, but larger ones occur, and the tetra-

sporangia are also formed in the upper ends of the main filaments.

The plant occurs upon exposed cliffs. At Orotava it grows upon vertical, very exposed rocks (which has also

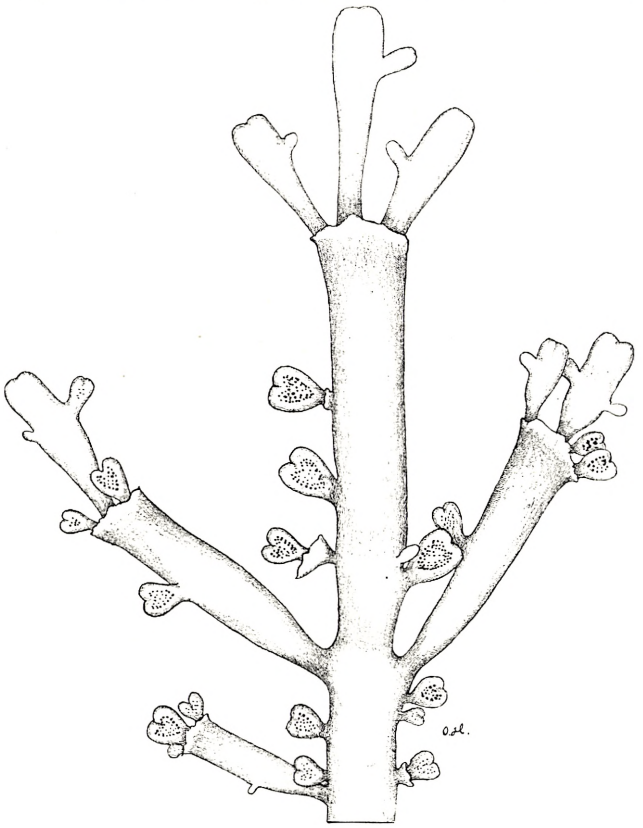


Fig. 47. *Gelidium arbuscula* Bory. Upper end of the thallus in a tetrasporic plant. (About 10 : 1).

been pointed out by Sauvageau in: "A propos des Cystoseira", p. 99) below *Cystoseira Abies-marina*, forming a fine red belt upon the rocks, while below it the dark red *Gelidium cartilagineum* forms another belt.

This species seems to be common at the Islands and has been found there by most investigators. Bory collected the plant

at the: "Rade de S^ta^ Cruz de Teneriffe, sur les rochers volcaniques".

Geogr. Distrib. Canary Islands.

8. Gelidium pectinatum Mont.

MONTAGNE, Fl. d'Algérie, p. 108, pl. X, fig. 1.

M^lle^ VICKERS has found (l. c. p. 303) a single small specimen of this species. Regarding the habitat she says: "Mêlé au *Fucus platycarpus* à mer presque haute". I have not seen her specimen.

Gran Canaria: Boñadero (M^lle^ VICKERS).

Geogr. Distrib. From south of France to Cadix, Mediterranean Sea.

9. Gelidium sesquipedale (Clem.) Thuret.

BORNET, E. et G. THURET, Notes algol., p. 61. BORNET, E., Alg. Schousboe, p. 271.

Fucus corneus var. *sesquipedalis* Clemente, Ensayo, p. 31 (non vidi). TURNER, Fuci. tab. 257, fig. f.

MONTAGNE (l. c. p. 158) mentions this species as found at Teneriffe; but the name of the collector is not mentioned.

In LYNGBYE's Herbarium in the Botanical Museum, Copenhagen, a well developed specimen of this plant from Teneriffe is present. Instead of the name of the collector is found only the letter B indicating most probably that it has been collected by BORY DE ST. VINCENT.

This species which has neither been gathered by M^lle^ VICKERS nor by SAUVAGEAU or by me is most probably rare at the Islands.

Teneriffe: Without locality (BORY DE ST. VINCENT?).

Geogr. Distrib. From the English coast southwards to the Canary Islands, Algiers.

10. Gelidium spinulosum (Ag.) J. Ag.

AGARDH, J., Spec. Alg., vol. II, p. 475. BORNET, E., Alg. de Schousboe, p. 272.

Spærococcus corneus var. *spinulosa* Ag., Spec. Alg., p. 283 (excl. syn.).

In "Iles Canaries", l. c. p. 158, MONTAGNE mentions this plant as found at the Islands, but Dr. HAMEL has been so kind as to inform me that no specimen having this name is to be found in Herb. MONTAGNE.

As to its occurrence at the Islands MONTAGNE writes: "Ad Isletam et Punto de Tedo[1] undis ad littora rejecta".

However, a specimen in Herb. MONTAGNE is called "*Gelidium asperum* (nob.). Rare. G^{de} Canarie". This plant shows much likeness to the *Gelidium microdon* Kütz., Tab. Phycol., vol. 18, tab. 64, about which BORNET, in "Algues de Schousboe", p. 272 says that it is nothing but a form of *G. spinulosum*. This specimen having been found at Gran Canaria cannot of course be the same as the one to which MONTAGNE refers in "Iles Canaries" as this has been found at Teneriffe.

Geogr. Distrib. Cadiz, Azores, Canary Islands, Cape.

11. Gelidium cartilagineum (L.) Gaill.

GAILLON, B., Résumé méthod. de classification des Thalassiophytes, 1828, p. 15.

Fucus cartilagineus L., Spec. plant., Edit. II, vol. II, p. 1630.

var. *Canariensis* Grun. in PICCONE, Crociera del Corsaro, p. 56.

I have not seen any original specimen of this variety, but to judge from GRUNOW's short description the specimens I have collected at the Canary Islands belong to this variety. A specimen collected by SCHIMPER "n. 215"

[1] Punta de Tedo must be a misprint for Punta de Teno, this is the westerly, very exposed promontory of Teneriffe.

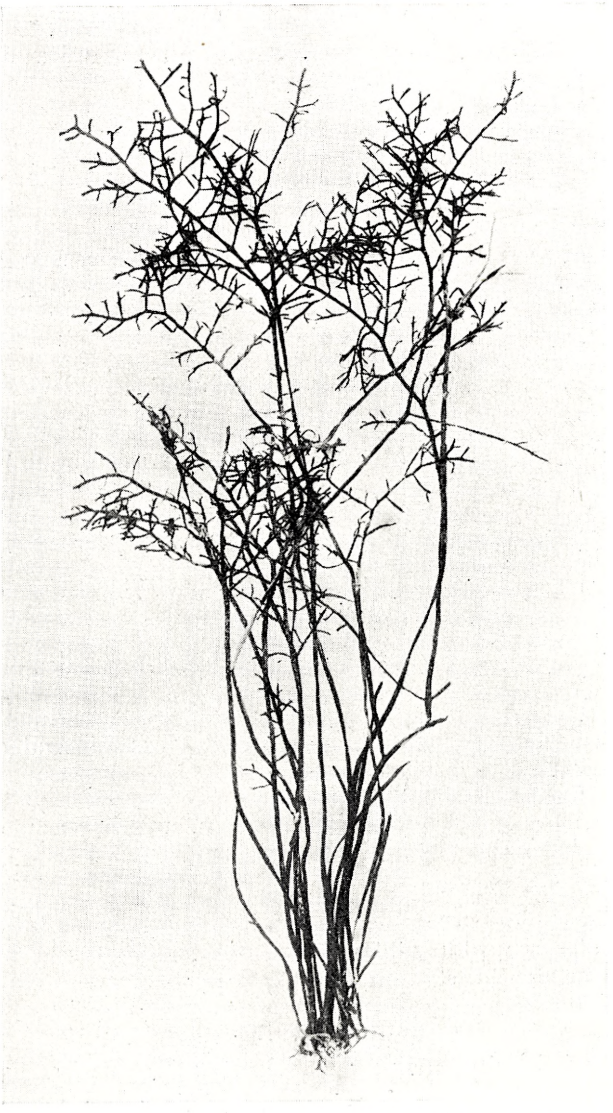


Fig. 48. *Gelidium cartilagineum* (L.) Gaill. A small tuft of a plant. (About $^4/_5$: 1).

which I got from the Botanical Museum, Berlin, was determined as var. *canariense* Grun. and is quite like my specimens.

Compared with typical plants from the Cape, the Canarian specimens (Fig. 48) have a more corymbiform, subfastigiate appearance, the ramification being much more irregular with branches of very varying length. On account of this the fine pinnate ramification of the typical form is lost, while the well developed main stems of the typical form are not so marked in the Canarian plant.

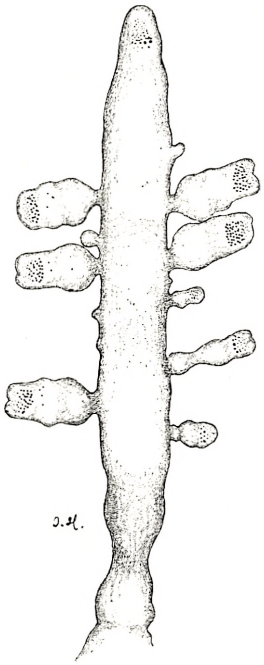


Fig. 49. *Gelidium cartilagineum* (L.) Gaill. Upper end of a branch with tetrasporic branchlets. (About 12 : 1).

In my material I have only seen specimens with tetrasporangia. They are formed near the summit of small flat branchlets on both sides of these. The branchlets are cordate of shape with a more or less elongated base (Fig. 49).

This species occurs in very exposed places somewhat above low water mark, often forming elegantly developed horizontally extended belts together with other species. Sauvageau in "A propos des Cystoseira" p. 99 gives the following striking description: "Le *Cystoseira Abies-marina* habite les rochers battus de la zone inférieure. Quand il croit sur une paroi verticale opposée à la mer, on observe toujours la succession suivante, si nette qu'on la distingue à distance: une bordure jaune, formée par lui, de 20—40 cm. de hauteur; immédiatement au-dessous, une autre bande

d'un beau rose violacé de *Gelidium arbuscula* Bory; au-dessous de celui-ci, et se prolongeant dans la partie non accessible et non visible, une plus large bande sombre, presque noire de *Gelidium cartilagineum* Gaill.".

Teneriffe: Orotava (SAUVAGEAU,!). As regards its occurrence at the Canary Islands MONTAGNE writes, l. c., p. 158: " Ad littora Canariensia a cl. BORYO lectum".

Geogr. Distrib. Philippine Islands, Madagascar, Cape, Brazil, Canary Islands etc.

Pterocladia J. Ag.

1. Pterocladia capillacea (Gmel.) Born.

BORNET, E., Notes algol., p. 57.

Fucus capillaceus Gmelin, Hist. Fuc., p. 146, tab. XV, fig. 1.

Gelidium corneum, var. *capillaceum* Gmel., MONTAGNE, "Iles Canaries", p. 158.

Of this species plants with tetraspores and cystocarps have been found.

It occurs on rocks somewhat below high water mark.

It is common in some places and has been found at the Islands by most investigators.

Geogr. Distrib. From Norway along the Atlantic coast of Europe to the Canary Islands, Mediterranean Sea.

Fam. 4. Wrangeliaceæ.

Wrangelia C. Ag.

1. Wrangelia Argus Mont.

MONTAGNE, C., Sylloge gener. specierumque Cryptogamarum, Paris 1856, p. 444. BØRGESEN, F., Mar. Alg. D. W. I., vol. II, p. 116.

Griffithsia Argus Mont. in WEBB et BERTHELOT, "Iles Canaries", vol. III, sect. III, p. 176, tab. 8, fig. 4.

Wrangelia plebeja J. Ag., Spec. Alg., vol. II, pars 3, p. 707; Epicrisis, p. 623.

The Canarian plant seems to agree entirely with the West Indian one. Nearly all the specimens were sterile. Only in one collection the plant had a few tetraspores, their shape and arrangement agreeing with figure 126 in my above quoted treatise.

The plant occurs near low water mark in very exposed places and seems to be rather common. It has been found at the Islands by most investigators. MONTAGNE writes about its occurrence: "Hancce formosissimam distinctissimamque speciem in rupe mari circumfluo præcincta, quam Roque del Gando vocant indigenæ, semel invenit et legit cl. DESPRÉAUX".

Geogr. Distrib. West Indies, Canary Islands, Indian Ocean.

2. Wrangelia penicillata C. Ag.

AGARDH, C., Spec. Alg., vol. II, p. 138. AGARDH, J., Spec. Alg., II, pars III, p. 708; Epicrisis, p. 623. Cfr. BØRGESEN, F., Mar. Alg. D. W. I., vol. II, p. 120, where more literature is quoted.

This species seems to be rare at the Islands. I have only found a few specimens in one locality. The specimens were tetrasporic and agreed well with the West Indian plant.

The plant occurred in a quite sheltered locality in shallow water as an epiphyte on *Cymodocea nodosa*.

Gran Canaria: Bahia del Confital in the innermost tranquil bay behind the Isleta.

Geogr. Distrib. Mediterranean Sea: the warmer parts of the European and American shores of the Atlantic Ocean.

INDEX OF SPECIES

together with more essential synonyms, the last mentioned printed in Italics.

Færdig fra Trykkeriet den 30. Juli 1927.

BIOLOGISKE MEDDELELSER

UDGIVNE AF

DET KGL. DANSKE VIDENSKABERNES SELSKAB

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2.	Müller, P. E.: Bidrag til de jydske Hedesletters Naturhistorie. Karup Hedeslette og beslægtede Dannelser. En pedologisk Undersøgelse. Med 1 Kort. Avec un résumé en français. 1924	8,25
3.	Lindhard, J.: On the Function of the Motor End-Plates in Skeletal Muscles. 1924	1,00
4.	Boas, J. E. V.: Die verwandtschaftliche Stellung der Gattung *Lithodes*. (Med 4 Tavler). 1924	2,35

Kr. Ø.

5. BÁRÐARSON, GUÐMUNDUR G.: A Stratigraphical Survey of the Pliocene Deposits at Tjörnes, in Northern Iceland. With two maps. 1925 ..... 9.75
6. ANKER, JEAN: Die Vererbung der Haarfarbe beim Dachshunde nebst Bemerkungen über die Vererbung der Haarform. 1925 2.25

5. BIND (KR. 19,25):

1. RAUNKIÆR, C.: Eremitageslettens Tjørne. Isoreagentstudier. I. 1925 ..... 2.50
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