DET KGL. DANSKE VIDENSKABERNES SELSKAB
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# SOME MARINE ALGAE FROM MAURITIUS

## III. RHODOPHYCEAE

PART 1

*PORPHYRIDIALES, BANGIALES, NEMALIONALES*

BY

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KØBENHAVN
I KOMMISSION HOS EJNAR MUNKSGAARD
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In the introduction to Part I of this publication, The *Chlorophyceae*, it was mentioned that copious collections of algae from the Mascarene Islands are found in the Muséum National d'Histoire Naturelle, Paris, and that Dr. FELDMANN had begun taking out a collection of Dr. JADIN's duplicates to be sent to me for examination, when the war broke out and made all postal communication impossible.

Meanwhile when the postal communication with Paris was reestablished last summer I wrote to Professor P. ALLORGE, Director of the Laboratoire de Cryptogamie, Paris, asking if it would be possible for him to send me the collection mentioned above. Professor ALLORGE was good enough soon to let me know that the collection would be sent to me through the intermediation of L'institut Allemand de Paris. Doctor G. HAMEL was so very kind as to take out the collection of algae and at the end of last year it arrived here safely.

The collection seems to be rather copious and is of much interest because Dr. JADIN has based his list of algae from the Mascarene Islands upon it. But several of the species are present only in a single small specimen, are often sterile, and some of them being collected by a native by name Daruty bear witness to be cast ashore specimens.

I am also much indebted to Professor R. PILGER, Botanisches Museum, Berlin-Dahlem who has most kindly sent me some very good material of *Dermonema amoena* Pilger.

From Naturhistoriska Riksmuseet, Botaniska Avdelningen, Stockholm, through the kind help of Dr. TH. ARVIDSSON, a collection of algæ from Mauritius has been lent me for examination.

Finally I owe thanks to Professor OTTO CHR. SCHMIDT, Botanisches Museum, Berlin-Dahlem for the loan of a collection of *Liagora*.

While the former two parts: I. *Chlorophyceae* and II. *Phaeophyceae* are for the most part based upon the collection of Dr. TH. MORTENSEN and Dr. R. E. VAUGHAN, this third part containing the beginning of the *Rhodophyceae* is not only due to the above-mentioned collections, but also to the rich collection of Dr. JADIN, quite recently received from Paris.

I should like here to acknowledge my indebtedness to Dr. O. HAGERUP of The Botanical Museum, Copenhagen who has not only been so kind as to make a series of microscopical sections of some algae for me but who has also drawn some of the figures in Chinese ink for reproduction.

# RHODOPHYCEAE

## A. BANGIOIDEAE

### I. Porphyridiales.

#### *Fam. 1. Porphyridiaceae.*

#### Asterocytis Gobi.

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

Hamel, Bangiales, p. 40 where literature is mentioned. — *Conferva ornata* C. Ag., Systema Alg., 1824, p. 104. *Asterocytis ramosa* Gobi in Arbeiten St. Petersb. Naturf. Gesellsch. X., p. 85, 1878.

Ramified specimens very like Hamel's fig. VII B drawn from an original specimen of C. Agardh were found upon *Chnoospora implexa*. The filaments had a breadth of about 12 μ and the cells were about 6—7 μ broad and had a well developed pyrenoid.

Mauritius: Tamarin Bay, "in pools behind reef", R. E. V. no. 293.
Geogr. Distr.: Atlantic coast of Europe and America, West Indies, Mediterranean Sea, Canary Islands, etc.

#### Goniotrichum Kütz.

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

Le Jolis, A., Alg. mar. Cherb., p. 103. Berthold, Bangiaceen, p. 26. Rosenvinge, Mar. Alg. Denm., p. 75. Børgesen, Mar. Alg. D. W. I., vol. II, p. 4, fig. 2. Hamel, Bangiales, p. 37.

The plant from Mauritius is rather slender, having a breadth of about 25 μ. The cells are about 9—11 μ broad and as is gener-

ally the case in this species have a rather variable shape, being often only half as long as broad. In a very few cases only have I found two cells side by side in the filament. The plant was found as an epiphyte upon *Sphacelaria tribuloides*.

Mauritius: Lagoon at Flic-en-Flacq, R. E. V. no. 250.
Geogr. Distr.: Seems to occur in most temperate and warm seas.

## II. Bangiales.

### *Fam. 1. Bangiaceae.*

### Erythrotrichia Aresch.

#### 1. Erythrotrichia carnea (Dillw.) J. Ag.

J. Agardh, Till Alg. Syst., III, 1883, p. 15. Rosenvinge, Mar. Alg. Denmark, 1909, p. 67, fig. 8. — *Conferva carnea* Dillw., Brit. Conf., 1809, pl. 84. *Conferva ceramicola* Lyngb., Hydrophyt. Dan., 1819, p. 144, tab. 48 D. For more synonyms comp. Rosenvinge, l. c.

The plant is found as an epiphyte upon various algæ. The filaments had a breadth of about 15 μ. Spore-formation was observed in several of the specimens.

Mauritius: Barachois, Ilôt Brocus, R. E. V. no. 204. Tamarin Bay, "in pools behind reef", R. E. V. no. 293.
Geogr. Distr.: Widely distributed in temperate and warm seas.

### Porphyra C. Ag.

#### 1. Porphyra tenera Kjellm.(?)

Kjellman, F. R., Japanska Arter af Slägtet Porphyra, 1897, p. 20, pl. 1, fig. 6; pl. 4, figs. 2—5; pl. 5, figs. 22—26. Yendo, Notes on Algæ new to Japan IV, p. 52—54. Okamura, Onda and Higashi, Preliminary notes on the development of the carpospores of Porphyra tenera Kjellm. Tseng, C. K., Economic seaweeds of Kvantung Province, S. China, 1935, p. 99, pl. fig. 2; Notes on some Chinese marine algae, 1938, p. 594.

The reason why I have put a ? after the specific name is that the question as to the real value of KJELLMAN's species seems not to have been at all satisfactorily settled yet in Japan. YENDO (l. c.) sharply critisized KJELLMAN's definition of this and other of his species, and is very much inclined to consider *P. tenera* as a mere form of *Porphyra leucosticta* Thur. TSENG, in his paper 1935, p. 99 called it *Porphyra tenera*; in a later paper (1938, p. 594) basing his examination upon Chinese material and referring to several publications in Japanese and especially to a paper by ONDA, Studies in the Japanese species of Porphyra (Journ. Fish. Expt. Sta., vol. 28, 1931) (in Japanese) he pointed out that *Porphyra tenera* in reality does not seem to be separable from *P. leucosticta*. But since ONDA, on the basis of some minor characters, prefers to keep up KJELLMAN's name for the Japanese species, he thinks it better to await further examination.

From Mauritius I have seen only a quite small specimen collected by JADIN who in his list mentions this species as *Porphyra umbilicalis* J. Ag. f. *purpurea*. The specimen agrees quite well with some specimens from Japan which YAMADA has sent me. The thallus is thin, a transverse section about 22 μ thick. Seen from the surface the cells are irregularly polygonal of shape and arranged without any order. KJELLMAN described this species as dioecious but, as pointed out by YENDO, it is monoecious. The thallus becomes fertile along the margin; the cystocarps contain 8 carpospores.

JADIN collected the plant in a very exposed locality.

Mauritius: Mahébourg, Septembre 1890, F. JADIN, no. 475.
Geogr. Distr.: Japan, China, India, most probably wide-spread.

# B. FLORIDEAE

## I. Nemalionales.

### *Fam. 1. Chantransiaceae.*

### Acrochaetium Nägl.

#### 1. Acrochaetium crassipes Børgs.

Børgesen, Mar. Alg. D. W. I., vol. II, 1915, p. 20, fig. 11. Some Indian Rhodophyceae, 1931, p. 2, fig. 1. — *Chantransia crassipes* Børgs., Some new or little known W. I. Florideae, 1909, p. 1, fig. 1.

var. *typica* Børgs., l. c. p. 20.

This variety is found in several of the collections of Dr. Vaughan. The basal cells had a breadth of about 8—10 μ. The hostplants were *Murrayella, Polysiphonia* and *Griffithsia Weber-van-Bosseae* Børgs.

var. *longiseta* Børgs., l. c. p. 2, figs. 12—13.

Specimens agreeing very well with my above-quoted figures were found fixed to an old specimen of *Acanthophora*. The basal cells had a breadth of 10 μ.

Mauritius: Ilôt Brocus, Aug. 1938, R. E. V. no. 191. Barkley Island, Aug. 1939, R. E. V. no. 338 (var. *longiseta*). Black River Bay, 9. Aug. 39, R. E. V. no. 282.

Geogr. Distr.: West Indies, India etc.

#### 2. Acrochaetium candelabrum nov. spec.

Thallus usque ad 400—500 μ altus. Spora germinans, ca. 13—14 μ longa et 8—9 μ lata, in texturam hospitis paululum penetrans, a superiore parte non immersa, filum erectum ramosum emittens.

Supra sporam ex cellulis basalibus filamenta duo opposita arcuatim suberecta oriuntur.

Filamenta, in inferiore parte ca. 7—8 μ lata, ad apicem versus gradatim attenuata ca. 2—3 μ lata, simplicia, aut ramis paucis instructa. Cellulae ca. 20—25 μ longae.

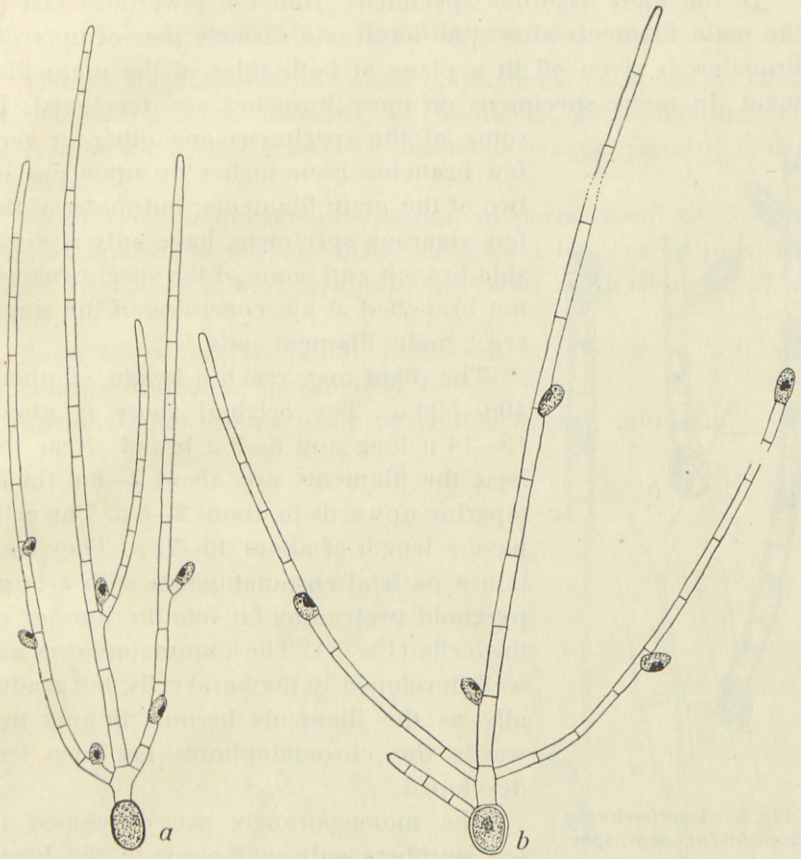



Fig. 1. *Acrochaetium candelabrum* nov. spec. Two specimens. (× 340).

Monosporangia sessilia, pauca et sparsa, interdum in summis filamentorum terminalia, ovato-ovalia, 10—11 μ longa et 7—8 μ lata.

Chromatophorum parietale, pyrenoide laterali instructum.

Mauritius: Tamarin Bay in *Sphacelaria furcigera* socialiter nidulans, R. E. V. no. 316.

This fine little species (Fig. 1) grows gregariously upon *Sphacelaria furcigera* in the epidermal wall of which the oblong somewhat oblique original spore is a little immersed (Fig. 2). When the spore germinates an erect filament is given out, sometimes a less vigorous adventitious filament also issues below it.

In the more vigorous specimens from the lowermost cell in the main filaments above the basal one a single pair of opposite branches is given off in a plane at both sides of the main filament. In many specimens no more branches are developed; in some of the specimens one other or very few branches issue higher up upon one or two of the main filaments; but many of the less vigorous specimens have only a single side-branch and some of the specimens are not branched at all, consisting of the single erect main filament only.

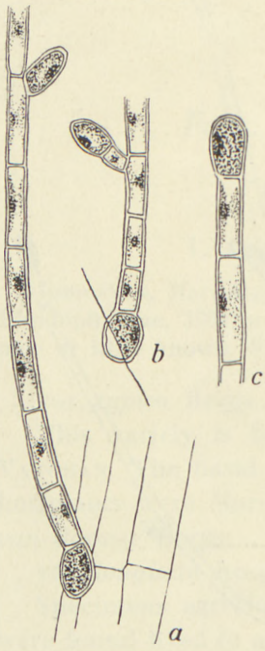



Fig. 2. *Acrochaetium candelabrum* nov. spec. *a*, *b*, bases of specimens; *c*, a terminally placed sporangium. (× 500).

The plant may reach a height of about 400—500 μ. The original spore is about 13—14 μ long and 8—9 μ broad. Near the base the filaments are about 7—8 μ thick, tapering upwards to about 2—3 μ. The cells have a length of about 20—25 μ. They contain a parietal chromatophore with a large pyrenoid protruding far into the interior of the cells (Fig. 2). The chromatophores are well developed in the basal cells, but gradually as the filaments become thinner upwards the chromatophores are also less developed.

The monosporangia are developed in few numbers only and occur in the lower part of the plant with the exception that now and then it happens that a sporangium terminates one of the erect filaments. The sporangia are obovate-oval, broadly rounded above or with a small apiculum; they are sessile, rarely pedicellate. Their length is about 10—11 μ and their breadth about 7—8 μ.

Because of its resemblance to a trifurcate candelabrum this species may show some likeness to the *Acrochaetium trifilum* (Buff.) Batters, 1902, p. 58; compare Hamel, Recherches 1927, p. 12, fig. 14a—d. But this species is a very small one, only 27—30 μ high, and consists only of very few cells.

### 3. Acrochaetium Mauritianum nov. spec.

Thallus in *Chaetomorpha aerea* epiphyticus, caespites densos, ca. 500—800 μ altos, formans, ex filamentis decumbentibus et repentibus ca. 5—6 μ crassis et filamentis erectis, ramosis compositus.

Fila erecta quoqueversum ramosa, in parte basali ca. 5—7 μ lata ad apicem versus attenuata, ca. 3—4 μ lata, ex cellulis ad basim ca. 15—18 μ longis, superne gradatim longioribus ca. 27 μ longis.

Rami sparsi aut secundati, recti, sub angulis acutis orti, ut plurimum simplices, sporangiferi.

Chromatophorum parietale pyrenoide laterali munitum.

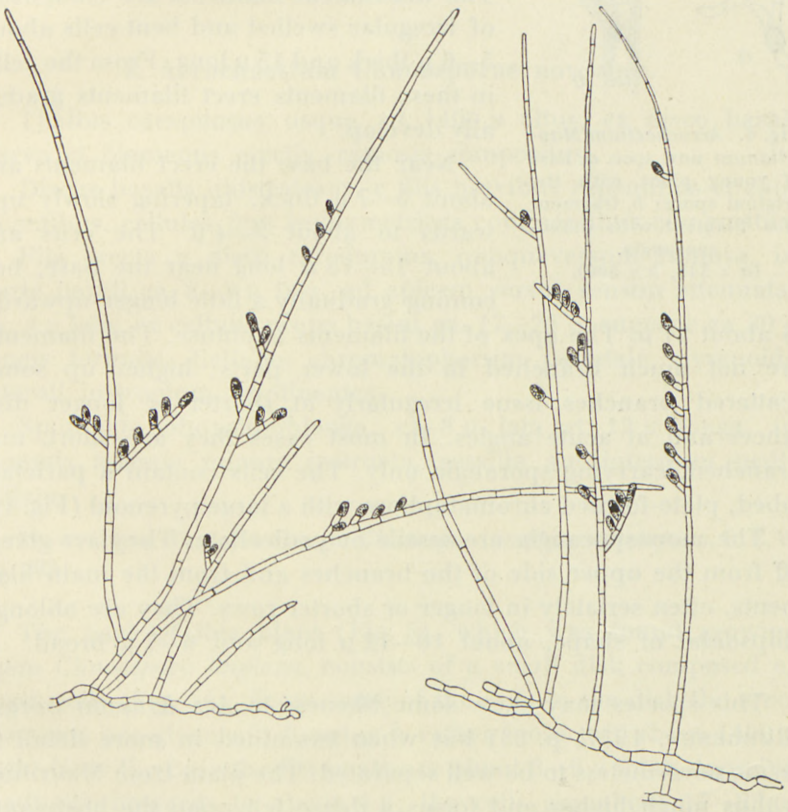


Fig. 3. *Acrochaetium Mauritianum* nov. spec. Parts of the thallus. (× 265).

Sporangia sessilia aut pedicellata, oblongo-ellipsoidea, ca. 10—12 µ longa et 6—7 µ lata.

Mauritius: Barachois, Ilôt Brocus, R. E. V. no. 204.

The plant (Fig. 3) grows gregariously upon *Chaetomorpha aerea*, forming a dense felt round the thallus of the host. It is composed of decumbent creeping filaments and straight erect branched filaments about 500—800 µ high.

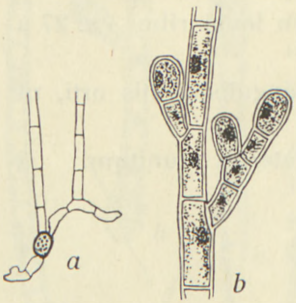



Fig. 4. *Acrochaetium Mauritianum* nov. spec. *a*, base of young plant with the original spore; *b*, fragment of a filament with monosporangia. (*a* × 340, *b* × 500).

From the upward-turned side of the germinating spore (Fig. 4 *a*) an erect filament is given out; and at the same time decumbent filaments begin to grow out, creeping along the surface of the host. The decumbent filaments are composed of irregular swelled and bent cells about 5—6 µ thick and 15 µ long. From the cells in these filaments erect filaments gradually develop.

Near the base the erect filaments are about 5—7 µ thick, tapering slowly upwards to about 3—4 µ. The cells are about 15—18 µ long near the base, becoming gradually a little longer upwards to about 27 µ. The apex of the filaments is obtuse. The filaments are not much branched in the lower parts; higher up some scattered branches issue irregularly at shorter or longer distances and at acute angles. In most cases they are short, unbranched, carrying sporangia only. The cells contain a parietal, lobed, plate-formed chromatophore with a large pyrenoid (Fig. 4).

The monosporangia are sessile or pedicellate. They are given off from the upper side of the branches and from the main filaments, often seriately in longer or shorter rows. They are oblong-ellipsoidal of shape, about 10—12 µ long and 6—7 µ broad.

This species may show some likeness to *Acr. Krusadii* Børgs. (Børgesen, 1937, p. 33) but when examined in more detail it seems nevertheless to be well separated. The plant from Mauritius is thus much higher and forms a dense felt upon the hostplant, while the Indian plant growing upon *Dictyota* only forms small

cushions. The cells in the creeping filaments of the Indian plant are much shorter. The filaments in the plant from Mauritius are slender and more erect, while these in the Indian plant are often curved. In the erect filaments of the Indian plant the cells are somewhat shorter than in the plant from Mauritius.

Also, the monosporangia are somewhat slender in the plant from Mauritius.

The plant from Mauritius may also be compared to the West Indian *Acr. caespitiforme* Børgs. (Børgesen 1920, p. 446, fig. 416), forming tufts upon *Padina Vickerssiae* Hoyt (= *P. Howeana* Børgs.) but in this plant the cells in the basal filaments are shorter, the ramification is more developed, and the sporangia are as a rule placed upon short branchlets, which is not the case in the plant from Mauritius.

### 4. Acrochaetium Chnoosporae nov. spec.

Thallus caespitosus usque ad 1400 μ altus, ex disco basali parvo et filamentis erectis, ramosis compositus.

Discus basalis unistratosus, e filis brevibus repentibus et confluentibus, cellulas fere isodiametricas continentibus compositus.

Fila erecta a disco egrediuntur, quoqueversum ramosa, in parte basali ca. 8—9 μ lata, ad apicem versus sensim attenuata, ca. 4 μ lata, ex cellulis prope basim ca. 17—25 μ, superne ca. 30 μ longis formata. Cellulae chromatophorum parietale, pyrenoide laterali instructum, continentes.

Sporangia obovato-oblonga, ca. 8 μ lata et 12 μ longa, in summis apiculo minore instructa, sessilia aut interdum pedicellata.

Mauritius: Tamarin Bay, in *Chnoospora implexa* epiphytica, R.E.V. no. 293.

The base of this plant (Fig. 5), which was found growing upon *Chnoospora implexa*, consists of a small disk composed of short cells (Fig. 5*b*). From some of the cells in the disk the erect filaments are given off, forming a rather loose tuft about 1400 μ high. Near the base the filaments are about 8—9 μ thick, tapering gradually upwards to about 4 μ; the cells are about 17—25 μ, the uppermost up to 30 μ long.

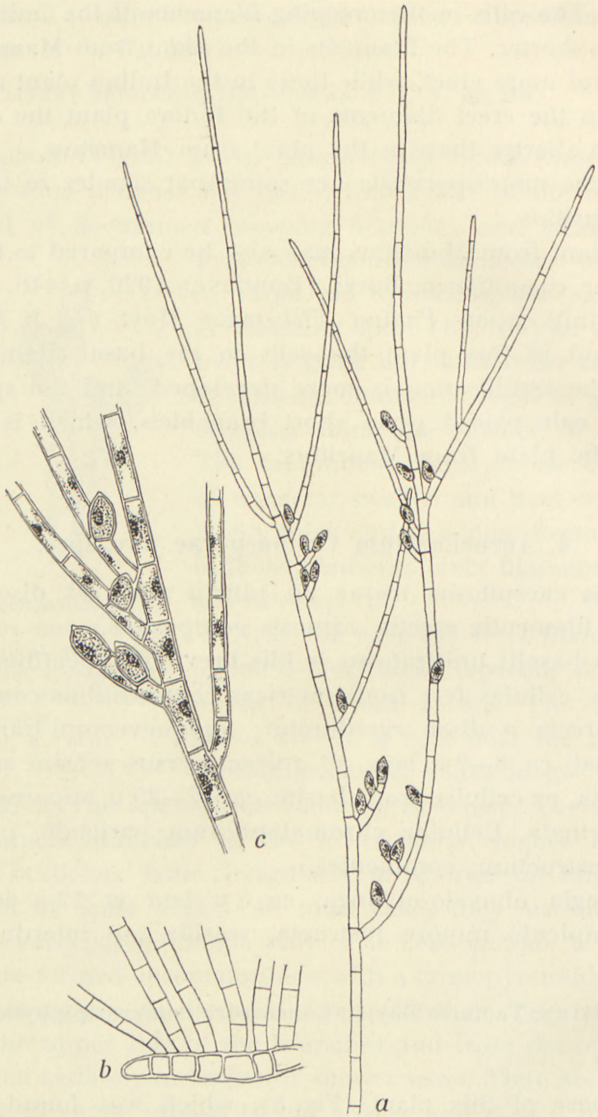



Fig. 5. *Acrochaetium Chnoosporae* nov. spec. *a*, part of the thallus; *b*, part of the base in transverse section; *c*, fragment of filaments with monosporangia. (*a* × 225, *b* and *c* × 500).

The lower parts of the filaments are unbranched; higher up branches are given out irregularly at shorter or longer intervals on all sides. The branches are of unequal strength; some are

quite short, some few nearly as vigorous as the mother filament and branch again. The upper, often rather long and thin, parts of the filaments are unbranched; their summits are obtuse. The branches issue at acute angles and carry monosporangia near their bases.

The monosporangia are obovate-oblong of shape, about 8 μ broad and 12 μ long; at their upper ends they have in most cases a well-marked apiculum (Fig. 5*c*). They are mostly sessile but sometimes also pedicellate.

The chromatophore is a lobed disk with a large pyrenoid (Fig. 5*c*).

The plant is surely nearly allied to *Acr. robustum* Børgs. (Børgesen 1915, p. 40) from the West Indies, but it is smaller in all respects, the cells being proportionally shorter; and I have not been able to ascertain the presence of the characteristic downward-directed process developed from the basal disk in *Acr. robustum*. In this species the sporangia are broadly rounded above, lacking the small apiculum found in *Acr. Chnoosporae*.

### 5. Acrochaetium subseriatum Børgs.

Børgesen, Some Indian Rhodophyceae, II, 1932, p. 118, figs. 6—7.

Upon *Griffithsia Weber-van-Bosseae* there occurred an *Acrochaetium* (Fig. 6) which I do not hesitate to refer to *Acr. subseriatum* described upon material from South-India. I have compared it with some preparations of the specimens from Tuticorin and found that the Indian specimens are perhaps a trifle larger than those from Mauritius, but so little that it is quite unessential. Nevertheless I give here a short description and a figure of the plant.

From the germinating spore short decumbent branchlets issue on all sides, which fix the plant to the host. In one specimen a rhizoid issued from the second basal cell in the erect main stem and when it came in contact with the surface of the *Griffithsia* it became attached to it (Fig. 6*a*).

In the very few specimens found, only a single erect shoot issued from the base; at a short distance from the base branches are given off irregularly on all sides.

The plant reaches a height of about 1 mm. Near the base the


Fig. 6. *Acrochaetium subseriatum* Børgs. *a*, a specimen with monosporangia. *b*, base of a young plant. (*a* × 200, *b* × 500).

main stem is about 8 μ thick; upwards the thallus decreases slowly, the uppermost ends being about 6 μ thick. The cells have a length of about 28 μ near the base, nearly keeping this length

upwards, the cells in the uppermost tips having a length of about 35 μ.

The branches are given out at acute angles and are directed upwards. The distance between the branches is rather irregular, and they issue sometimes unilaterally, sometimes on all sides, with various numbers of joints between them. They are unilaterally or more irregularly ramified.

Only monosporangia occurred. In most cases these are sessile, but now and then also pedicellate. They issue unilaterally one from each joint from the lower parts of the branches, more rarely higher up upon the filaments and on the upward-turned side of the branches. They are oblong-ovate of shape, about 12 μ long and 8 μ broad, with broadly rounded upper ends.

The chromatophore is a parietal lobed plate with a large greatly protruding pyrenoid.

Mauritius: Black River Bay, "in quiet lagoons", R. E. V. $^{9}/_{7}$ 39, no. 282.

Geogr. Distr.: India at Tuticorin.

## *Fam. 2. Helminthocladiaceae.*

### a. Nemalieae.

### Trichogloea Kütz.

#### 1. Trichogloea Requienii (Mont.) Kütz.

Kützing, Spec. Alg., p. 544. Zanardini, Pl. mar. rubr., p. 67, tab. V, fig. 1. J. Agardh, Epicrisis, p. 514. Schmitz und Hauptfleisch in Engl. u. Prantl, Natürl. Planzenfam. I, 2, 1897, p. 333, fig. 203 A—C. — *Batrachospermum Requienii* Mont. Quatrième Cent. de pl. cell. exot., 1843, no. 72, p. 355.

Of this species I have seen only a single specimen collected by Jadin. The specimen is about 16—17 cm high with several main branches forming a broad much ramified tuft; all the branches are nearly cylindrical, keeping the same breadth to near the top.

Jadin in his list calls it *Trichogloea lubrica* (Harv.) J. Ag. = *Liagora lubrica* Harv., Friendl. Isl. Alg. no. 46, being the other

of the two species known of this genus. I refer the plant from Mauritius to *Tr. Requienii* known from the Red Sea, but I must point out that I have had no material at all of this species to compare it with. But it seems to me that it agrees rather well with the description and figures of ZANARDINI, l. c. On the other hand, it deviates a good deal from HARVEY's above-mentioned species, of which we have a specimen in the Botanical Museum, and likewise from a specimen of *Helminthocladia Cassei* Crn. in MAZÉ et SCHRAMM's, Algues de la Guadeloupe, no. 728, which is considered to be the same as HARVEY's plant. In this species the branches taper much from base to top. And since, furthermore, several species known from the Red Sea have gradually been found to occur southwards also, down to the Mascarene Islands, this too speaks in favour of the occurrence of the species here.

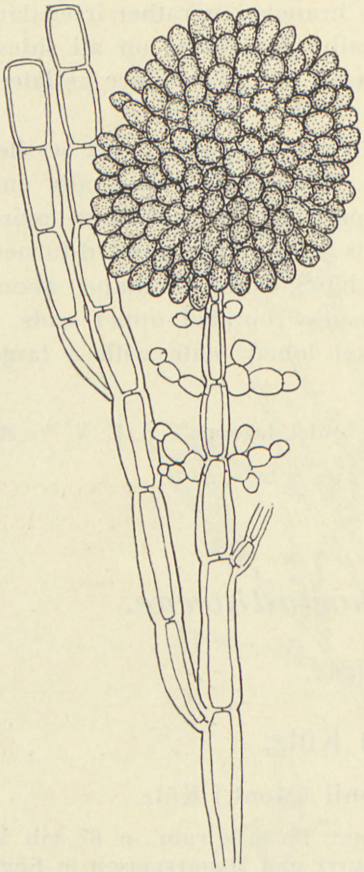


Fig. 7. *Trichogloea Requienii* (Mont.) Kütz. A gonimoblast and assimilating filaments. (× 220).

Its anatomical structure seems to be about the same as that of *Trichogloea lubrica* of which BUTTERS (1903, p. 11) has given a detailed description, pointing out that the structure of the gonimoblasts comes near to that of *Nemalion*, while its vegetative structure is nearest to that of *Liagora*.

The specimen showed abundantly fructification but was not so well suited for anatomical examination. The gonimoblasts (Fig. 7) are terminally placed upon the peripheric filaments. The cells in the stalk of the gonimoblasts become shorter upwards and short vertically placed branchlets issue from their upper

ends. The cells in the assimilating filaments are long, subcylindrical below, becoming shorter upwards, uppermost about double as long as broad, having a breadth of about 8—9 μ. No antheridia were present.

About its occurrence at the island JADIN writes: "Sur les récifs, balayés par le courant violent des lames, mais du côté intérieur regardant la lagune".

Mauritius: Flacq, Sept. 1890, JADIN, no. 458.
Geogr. Distr.: Red Sea, Malayan Archipelago.

## Nemalion Targ. Tozzetti.

### 1. Nemalion perpusillum nov. spec.

Frons cylindrica, teres, solida, gelatinoso-cartilaginea, nana, ca. $^1/_2$ cm alta et $^1/_2$ mm crassa, ad apices versus paululum attenuata, apicibus late obtusis, iterum fastigiata-subdichotoma, axillis suberectis, disco subplano basali ad saxa adfixa et ramis inter se saepe per discos adnatis, in saxis caespites densos formans.

Punctum vegetationis paululum immersum.

Frons ex duobus stratis composita. Medulla ex filamentis crassioribus, subdichotomis in directione longitudinali thalli percurrentibus ad peripheriam vertens filamenta sparsa emittentibus ex quibus stratum corticale oritur.

Stratum corticale ex filamentis assimilantibus iterum subditrichotome divisis, horizontaliter positis formatum. Filamenta assimilantia ex cellulis oblongis in parte basali majoribus, sursum gradatim minoribus, superne cellulis pyriformibus et majoribus stratum peripheriicum formantibus composita.

Ex filamentis assimilantibus fila tenuiora formata sunt inter filamenta assimilationis et eorum medullam in varias directiones percurrentia.

Antheridia in cellulis subsuperioribus filamentorum assimilantium evoluta caespites parvos subdensos formantia.

Mauritius: Savinia, Aug. 1939, R. E. V. no. 303, "in rock crevices, thallus deep brown".

The description of this small alga (Fig. 8) is based upon some very diminutive material preserved in formol in Dr. VAUGHAN's collection.

The plant is about a $^1/_2$ cm high. The thallus is terete, about $^1/_2$ mm thick, and keeps this size up to the broadly rounded

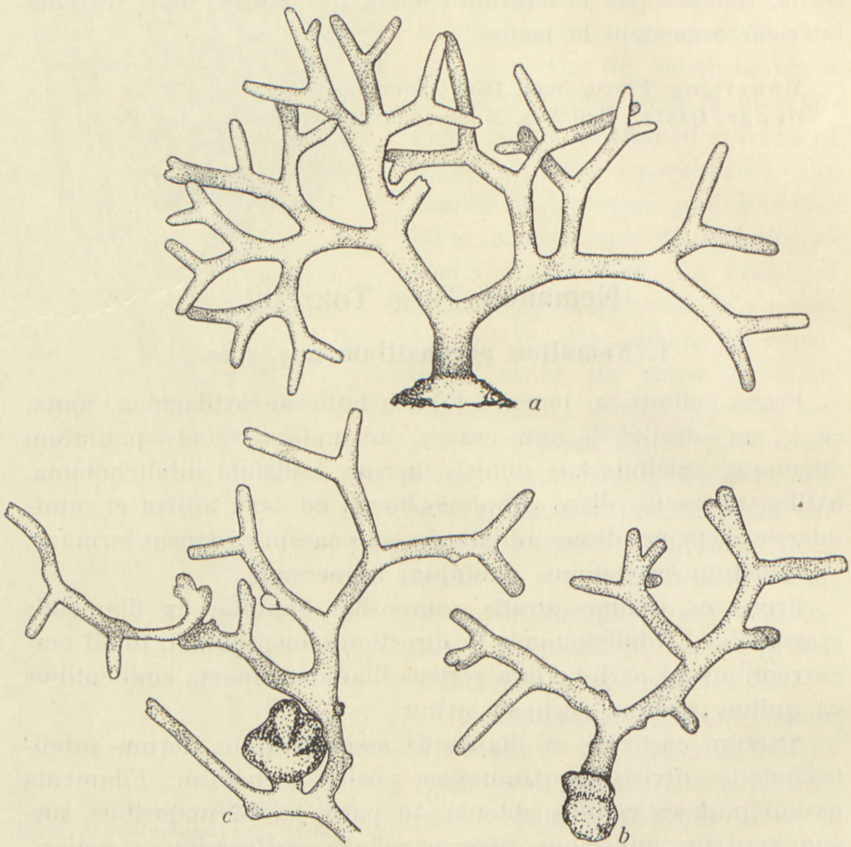



Fig. 8. *Nemalion perpusillum* nov. spec. *a*, *b*, two specimens; *c*, part of a specimen with an adhering part of another one. (× 9).

apical ends. The consistency of the thallus is slippery and tough, and it makes great resistance against pressure.

The thallus is furcated several times, the intervals between the furcations being about 2—4 mm. It is fixed to pieces of rocks by means of a flat disk composed of numerous coherent rhizoids, and as the thallus is capable of forming groups of rhizoids when-

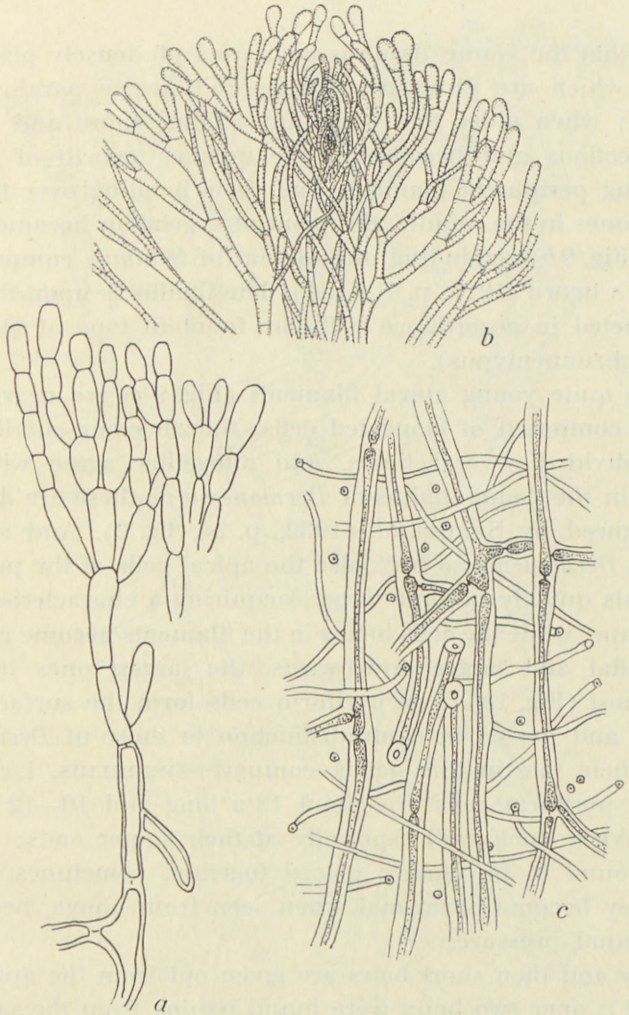



Fig. 9. *Nemalion perpusillum* nov. spec. *a*, longitudinal section of the apex; *b*, young filaments from the apex; *c*, filaments of the medulla. (*a*, *b* × 600; *c* × 350).

ever it comes in contact with the substratum the result is that the plant forms low cushions upon the rocks; also the tips of the thallus are often fused, compare Fig. 8*c*.

Upon superficial examination the structure of this small plant in several respects shows much likeness to *Dermonema*, but a more careful study recalls essential differences. This will be seen from the following description of its anatomical structure.

A longitudinal section of the apical tips of the thallus (Fig. 9*a*)

shows that the young tissue is composed of densely placed filaments which are directed upwards and nearly parallel in the middle; when older they gradually radiate more and more in all directions and because of the quicker growth of the surrounding peripheric filaments and their bending over the quite young ones in the middle, the point of vegetation becomes a little sunk (Fig. 9*b*) reminding one of that of *Scinaia*; compare SVEDELIUS's figure (1915, p. 7, fig. 1). The thallus is upon the whole constructed in accordance with the fountain type of OLTMANNS (Springbrunnentypus).

The quite young apical filaments (Fig. 9*a*) are nearly cylindrical, composed of elongated cells; they become subdichotomously divided several times, and altogether agree with those found in the young thallus of *Dermonema* as these are described and figured by SVEDELIUS (1939, p. 24, fig. 2). And as is the case in *Dermonema* so here also the apical cells of the peripheric filaments quickly become larger, acquiring a characteristic pear-like shape, while the cells below in the filaments become elongated ellipsoidal and larger downwards, the largest ones being the lowermost (Fig. 10). The pyriform cells form the surface of the thallus and persist in contradistinction to those of *Dermonema*; as to their fate in this genus compare SVEDELIUS, l. c., p. 25.

The pyriform cells are about 18 μ long and 10—12 μ broad and have a thick wall especially at their upper ends; they are often found to be closely placed together, sometimes so close that they become hexagonal when seen from above, because of the mutual pressure.

Now and then short hairs are given out from the apical cells (Fig. 11); once two hairs were found issuing from the same cell. They consist of a few, 2—3 cells and seem to be very like those SVEDELIUS has found in *Dermonema*, l. c. p. 26, fig. 6.

All round among the interstices between the assimilating filaments numerous thin rhizoid-like filaments run in all directions (Fig. 10). These filaments are given out from the cells of the assimilating filaments; compare Fig. 9*a* and Fig. 10 above. They are about 3 μ thick and now and then subdichotomously divided. They not only run all round among the assimilating filaments, but traverse the medullary tissue (Fig. 9*c*) and serve to keep the thallus together.

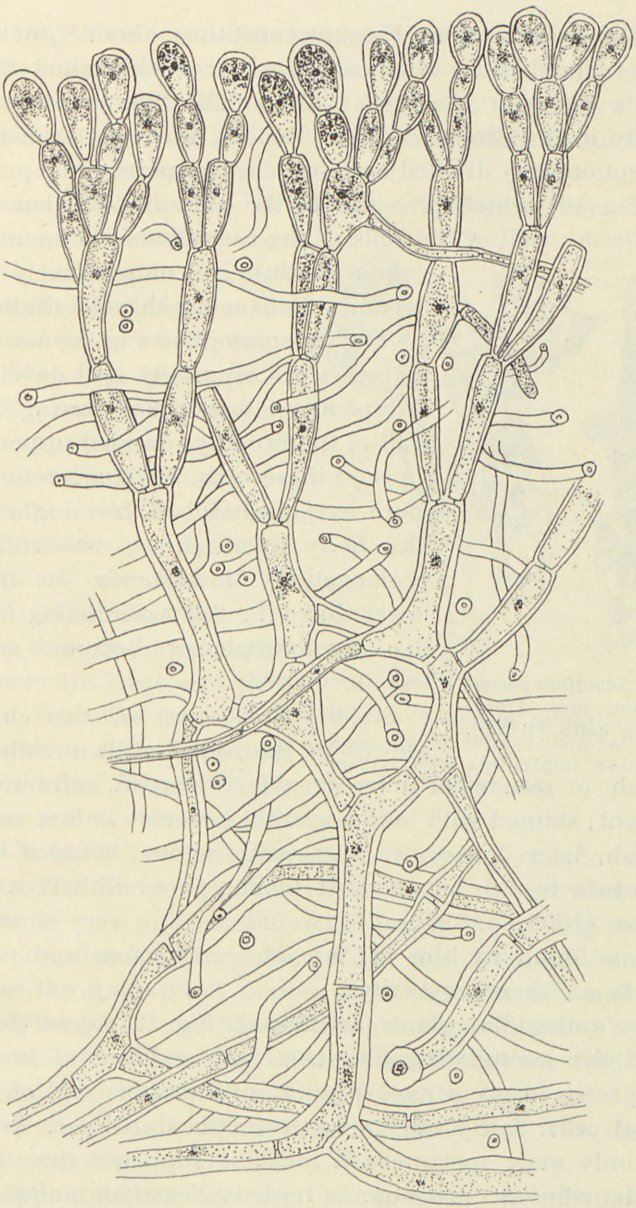


Fig. 10. *Nemalion perpusillum* nov. spec. Transverse section of the thallus showing the assimilating filaments issuing from the filaments of the medullæ. Among the assimilating filaments numerous thin rhizoid-like filaments are running. (× 600).

The medullary layer (Fig. 9*c*) constitutes about $^1/_3$ of the diameter of the thallus; it is composed of thick walled filaments having a diameter of about 8—12 μ. The filaments run nearly vertically in the direction of the thallus; now and then they are subdichotomously divided and branches issue from the peripheric ones (Fig. 10) which give rise to the assimilating filaments.

While the wall of the cells of the assimilating filaments in the young thallus is comparatively thin it becomes thicker in the old thallus.

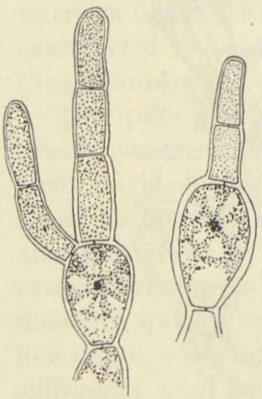


Fig. 11. *Nemalion perpusillum* nov. spec. Apical cells with hairs. (× 700).

The chromatophores in the assimilating filaments are especially well developed in the apical pyriform cells covering the inner wall of the broadly rounded upper half or more of these cells. They are reticulate or more irregularly lobed, forming a cupola-like body thick above, with ribbon-like prolongations downwards. In the cells lower down in the assimilating filaments the chromatophores become gradually less developed.

In the thick part of the chromatophores in the apical cells a rather large roundish, or somewhat more irregularly shaped, refractive body is present; stained with iodine-spirit it becomes at first yellowish-brownish, later it assumes a greenish colour. What it is I will not venture to say but it must be compared with Wolfe's description (1904, p. 610) of, it would seem, a very similar phenomenon found by him in *Nemalion multifidum* and which he thinks is a "vacuolar cavity".

Only antheridial plants are found. Fig. 12 shows the upper part of the assimilating filaments with antheridial branchlets. These are given off in most cases from the upper end of the subterminal cells, fairly often also from the third one. As I have found only male specimens it must be supposed that the plant from Mauritius is dioecious; as regards *Nemalion multifidum* this species, according to Rosenvinge (1909, p. 146), is mostly dioecious in Danish waters.

When compared with *Nemalion multifidum* (comp. Chester, Bot. Gaz., vol. 21, 1896, p. 340) *Nemalion perpusillum* must be

said to show differences in several respects and this applies not only to its much furcated thallus but also to the much firmer, tough consistency of its thallus originating from the many rhizoid-like filaments traversing not only the assimilating filaments but also the medullary layer.

But some other species of *Nemalion*, referred, correctly or not, to the genus *Nemalion*, show very much likeness to the plant from Mauritius for instance the small *N. pulvinatum* Grunow (in Holmes, Mar. Alg. Japan, 1896, p. 259). Not only is it about the same in appearance being repeatedly forked and forming low tufts upon the rocks, but its anatomical structure also agrees in many features with that of the plant from Mauritius. Thus the uppermost cells in the assimilating filaments are large and pyriform, and from the lower part of the assimilating filaments long, thin rhizoid-like filaments are given out which traverse the interstices between the assimilating filaments and run downward among the medullary filaments. And finally the growing point also seems to be a little sunk in this plant. According to Okamura's description (1909, p. 39, pl. IX, figs. 2—9) of *Nemalion pulvinatum* the antheridial bodies form "groups of small cells terminating the peripheral filaments", but when Okamura's figure is closely considered it seems to me to show that the antheridial bodies are lateral branchlets issuing from the upper cells in the assimilating filaments and thus agreeing fairly well with those of *Nemalion perpusillum*.

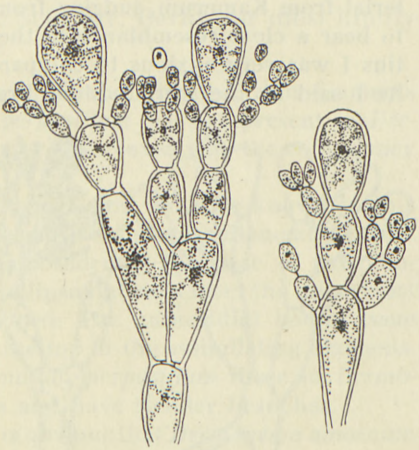


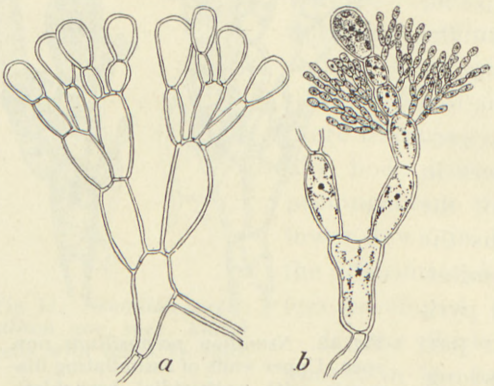
Fig. 12. *Nemalion perpusillum* nov. spec. Upper ends of assimilating filaments with antheridial branchlets. (× 700).

As it appears from this short comparison the plants show great agreement and for the present therefore it seems most natural to place the plant from Mauritius in the genus *Nemalion*, even if the female organs are as yet unknown.

This does not mean that these small forms, very different in

several respects from typical *Nemalion* forms not only by their much ramified thallus but also by their cartilaginous consistency originating from the much firmer structure, when they become better known may not very probably be separated generically from the genus *Nemalion*[1].

[1] As the *Dermonema amoenum* Pilger (1912, p. 299) described upon material from Kamerum, judging from the description and figures seemed to bear a close resemblance to the above-mentioned plant from Mauritius I was very auxious to compare some material of it with my plant. As I said in the introduction, Professor PILGER was kind enough at my request to send me some very good material so that I could make a comparison of the structure of both plants.




*Nemalion amoenum* (Pilger) Børgs. *a*, assimilating filament. *b*, assimilating with antheridial bodies. (× 300).

Already PILGER, when describing the plant, pointed out that in several respects it differed from *Dermonema* and as the female plant was unknown its reference to *Dermonema* was "immerhin etwas unsicher".

In this statement PILGER is surely quite right. But if PILGER nevertheless referred it to *Dermonema*, it must be taken into consideration that at that time we did not know the anatomical structure of *Dermonema*, and especially the peculiar development of the cortical layer, so well as we now know it from SVEDELIUS's detailed description (1939). As we now know *Dermonema* it must be admitted that it is entirely out of the question to refer PILGER's plant to that genus, even if its as yet unknown female organs should show some likeness to those of *Dermonema*.

When compared with the plant from Mauritius, it will be found that these two plants agree better, even if some differences are also present, the Kamerun plant being bigger and its consistency softer.

As to the anatomical structure of both plants, the apical tips in *Dermonema amoenum* are obtuse and no trace of a sunk growing point has been found but it must be pointed out that I have not been able to examine any really young tips, all of them being seemingly quite mature, having well developed antheridial bodies in the uppermost tips also.

The assimilating filaments are very much alike in both plants, and they have both large and pyriform peripheral calls (Fig. *a*).

## Liagora Lamouroux.

In Dr. JADIN's material I came across some apparently new species of *Liagora* which made a comparison with some species described by W. ZEH (1913, p. 268) upon material from Madagascar and Dar-es-Salaam very desirable. ZEH's material is kept in the Botanisches Museum, Berlin-Dahlem and I am much indebted to Professor OTTO CHR. SCHMIDT, Berlin for most kindly

But the numerous periclinal, or otherwise directed, thin filaments found so abundantly in *Nemalion perpusillum* are not present in *Dermonema amoenum* and this is of course the reason why the consistency of its tissue is so loose and soft.

As stated by PILGER antheridial specimens only are known in this plant; the antheridial bodies (Fig. *b*) consist of slender filaments divided several times di-trichotomously, composed near the base of subcylindrical, higher up somewhat shorter ellipsoidal cells from the uppermost of which the spermatia are developed. The antheridial bodies issue from the second or third cell from the top in the assimilating filaments. When compared with those of *Nemalion perpusillum* those in *Dermonema amoenum* form larger bushes and have slender branches.

As a result of this comparison it is obvious that *Dermonema amoenum* as regards its anatomical structure differs in some respects from *Nemalion perpusillum* and in a way agrees better than this with *Nemalion*. The final decision as to its real place can of course not be taken before its female organs are found; nevertheless I think that at present its right place is in the genus *Nemalion*, its name being thus ***Nemalion amoenum*** (Pilger) Børgs.

In this connection it seems to be of some interest that judging from a small dried specimen of *Nemalion amoenum* in my herbarium its outer habit is very like the original specimen of *Nemalion virens* J. Ag. (1847, p. 8) from St. Augustine, Mexico kept in the Botanical Museum, Copenhagen; it has also the same yellow or brownish-green colour as the Mexican species, but *Nemalion amoenum* is smaller and more gracile. And after an indeed rather superficial examination of the specimen of *Nemalion virens* the anatomical structure also seems to be very much the same in both plants. Thus in the Mexican plant the uppermost peripheral cells in the assimilating filaments are likewise pyriform; but the cells below these in the assimilating filaments are, however, much bigger than those in *Nemalion amoenum*, reaching a breadth of about 40—50 μ or more. No longitudinal periclinal filaments emerging from the cells of the assimilating filaments are found in the Mexican plant, either, and the consistency of its thallus is also very soft. I have not succeeded in finding fructiferous organs in the specimen of *Nemalion virens* found here.

sending me these species on loan on my request. ZEH's descriptions of the species are short but good enough; but they are without figures, and the want of these, especially of drawings of the shape of the assimilating filaments, makes it rather difficult to arrive at any safe result.

In his list of algae of Mauritius DICKIE (1875, p. 195) has described 4 new species of *Liagora* from the island. Two of these *Liagora lurida* and *L. crassa* are referred to *L. farinosa* Lamx. by HOWE (1920, p. 554). Regarding the first-mentioned species, of which I have seen a specimen, I cannot agree with HOWE and in the following list it is therefore considered as a separate species. Concerning the two remaining species: *Liagora galaxauroides* and *L. obtusa*, it is quite impossible to tell from the very poor descriptions what they are, and because of the war it is out of the question to see the specimens (they are in the Kew Herbarium, London). They must therefore be left out of consideration.

### 1. Liagora ceranoides Lamx.

LAMOUROUX, J., Hist. Polyp. corallig. flexib., 1816, p. 239. HOWE, Algae in BRITTON & MILLSPAUGH, The Bahama-Flora, 1920, p. 555. BØRGESEN, Mar. Alg. Can., 1927, p. 58. YAMADA, Spec. of Liagora from Japan, 1938, p. 20, pl. VI. — *Liagora pulverulenta* Ag., Sp. Alg., 1821, p. 396. BØRGESEN, Mar. Alg. D. W. I., vol. II, p. 80, figs. 87—92. — *Liagora leprosa* J. Ag., Alg. Liebm., 1847, p. 8.

Several specimens in JADIN's collection are referable to this species. If, as proposed by YAMADA l. c., one would distinguish as separate forms a var. *pulverulenta* and a var. *leprosa* both forms are present in the collection. JADIN classes both forms as separate species, and in addition *Liagora distenta* Lamx. is mentioned in his list, but according to a specimen from his collection which I have seen, this specimen is a female plant of *Liagora ceranoides*.

Mauritius: Baie de la Grande Rivière, Sept. 1890, JADIN no. 414. Port Louis, Sept. 1890, JADIN no. 414 bis. Flacq, July 1890, JADIN no. 250 and no. 304.

Geogr. Distr.: West Indies, Red Sea, India, Malayan Archipelago, Japan etc.

### 2. Liagora Jadinii nov. spec.

Frons caespitosa, 8 cm alta et ultra(?), teres, e basi sensim attenuata, in parte basali ca. $1^1/_2$, superne $^3/_4$ mm lata, plus minus irregulariter furcata, internodiis 4—5 mm longis.

Crusta calcarea satis continua, superficie in specimine exsiccata farinosa-subscabrida, superne longitudinaliter canaliculata.

Color thalli albidus, in apicibus ramorum rubicundus.

Stratum peripheric um ex filamentis assimilantibus dichotomis, cellulas oblongo-subcylindricas, in parte inferiore ca. 50 μ longas et 15—20 μ latas, ad apicem vertens gradatim minores, superiores pyriformes ca. 15 μ longas et 7 μ latas continentibus, formatum est.

Cellulae superiores pyriformes satis aggregatae supra superficiem crustae calcareae paululum conspicuae.

Rami carpogonici 15 μ lati ex 4 cellulis compositi. Gonimoblastae ex filamentis carposporiferis dense aggregatis formatae et filamentis sterilibus involucrum formantibus circumcinctae.

Mauritius: Without locality, F. Jadin 1892.

The only specimen I have seen of this species (Pl. I, fig. 2) form a dense tuft about 8 cm high. In the dried condition the branches are much intermingled and adhere to each other, indicating that the thallus has had a soft and mucilaginous consistency. Nevertheless the chalky incrustation is much developed close up to the summits of the filaments. The surface is rather uneven, longitudinally shrivelled, and of a farinose appearance. The colour of the dried specimen is whitish with the exception of the reddish tips. The thallus is rather irregularly furcated, the length of the joints is about 4—5 mm. The thallus is terete but in the dried condition a good deal compressed; above, the filaments are about $^3/_4$ mm thick; below, the thick stems have a breadth of about $1^1/_2$ mm.

The assimilating filaments (Fig. 13) are repeatedly divided several times and composed of oblong-subcylindrical cells, in the lower part about 50 μ long and 15—20 μ broad. Upwards the cells become gradually smaller. The uppermost have a characteristic pyriform shape, about 15 μ long and 7 μ broad. They are rather densely placed, forming the peripheric layer of the

thallus and just at the level of or a little above the surface of the chalky incrustation.

The medullary layer is composed of thick-walled filaments now and then divided and having a diameter of about 20—25 μ or more.

The carpogonial branches (Fig. 13 *a*) are formed laterally upon a cell in the middle of the assimilating filaments. It consists of

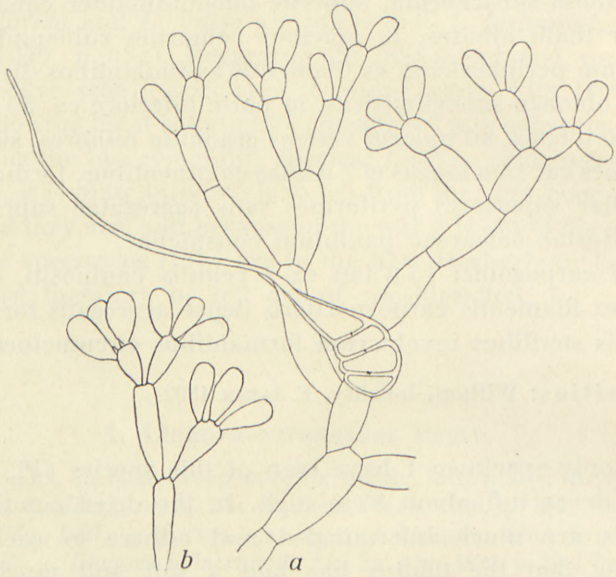



Fig. 13. *Liagora Jadinii* nov. spec. *a*, *b*, parts of assimilating filaments; *a*, with a carpogonial branch. (× 300).

4 cells and is somewhat curved. It is about 15 μ thick and about 40 μ long without the trichogyne, which is long, reaching up above the assimilating filaments.

The gonimoblasts, of which I have seen only very few, consist of a dense bundle of carposporic filaments surrounded by an involucrum of sterile filaments.

### 3. **Liagora rugosa** Zanardini.

Zanardini, J., Algae Novae, 1851, p. 36; Plant. Mar. Rubr., 1858, p. 65, tab. IV, fig. 2.

This species is mentioned in Jadin's list of algæ from Mauritius. I have been able to examine some quite small specimens from his collection.

They agree well with ZANARDINI's description and figures. They have a dense calcareous layer, whitish in the older parts of the thallus, brownish red in the younger parts and the surface is clearly annulated. But I have not seen any original specimen of ZANARDINI.

The assimilating filaments (Fig. 14*a*) are rather vigorously built, composed in their basal parts of elongated oblong cells,

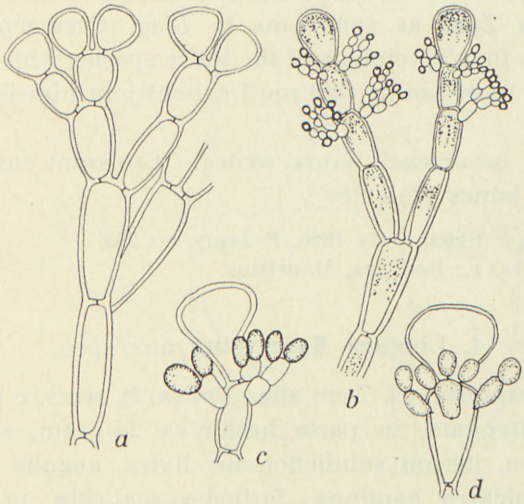



Fig. 14. *Liagora rugosa* Zanard. Parts of assimilating filaments. *b*, with antheridial bodies; *c*, *d*, tips of assimilating filaments with young antheridial bodies. (*a*, *b* × 300; *c*, *d* × 700).

the largest of these being about 12—13 μ broad; above these the following cells become smaller up to the uppermost broadly-pyriform ones which are about 13—15 μ thick. The last-mentioned cells protrude a little above the calcareous incrustation, adhere more or less to each other and form the surface of the thallus.

Antheridia only were found in these specimens. The antheridial bodies (Fig. 14*b*, *c*, *d*) form small clusters given out oppositely or verticillately from the uppermost cells in the assimilating filaments below the peripheric ones. They consist of branchsystems several times unilaterally divided, the uppermost of these being the mother cells of the spermatia.

No traces of female organs were met with in the specimens.

*Liagora Holstii* Zeh (1913, p. 272) of which I have seen an original specimen from Dar-es-Salaam, leg. HOLST no. 1276

belonging to the Botanisches Museum, Berlin, has assimilating filaments very like those of *Liagora rugosa*. But the thallus of *Liagora Holstii* is much more densely ramified; the filaments are very crooked and felted together; and its colour is greyish-green. The shape of the filaments and the structure as a whole of the thallus of *Liagora rugosa* comes near to *Liag. Caenomyce* Decsne, as pointed out by Mme Weber (1921, p. 202).

Yamada (1938, p. 6) refers *Liagora Holstii* Zeh and with a? *Liag. rugosa* Zan. as synonyms to *Liag. Caenomyce* Decsne. According to four specimens of the latter species which Professor Yamada has most kindly sent me I cannot join him in this interpretention.

About its occurrence Jadin writes: "Croissant sur les récifs, exposé aux lames violentes".

Mauritius: Flacq, July 1890, F. Jadin no. 293.
Geogr. Distr.: Red Sea, Mauritius.

### 4. Liagora Mauritiana nov. spec.

Frons caespitosa, ca. 7 cm alta et ultra(?), teres, e basi sensim paululum attenuata, in parte basali ca. $1^1/_2$ mm, superne ca. $^1/_2$ mm crassa, iterum subdichotome divisa, angulis acutis.

Crusta calcarea continua, farinaceo-scabrida, in specimine exsiccata superne plus minus evidenter canaliculata.

Color frondis canescente-rubescens. Stratum periphericum ex filamentis in parte basali paululum divisis cellulas subcylindricas continentibus constructum, superne irregulariter divisis cellulas breves oblique pyriformes aut rotunde-polygonatas et inter se implicatas continentibus formatum est.

Species monoica. Antheridia ad apices filamentorum assimilantium evoluta.

Rami carpogonii plus minus incurvi, ex 4 cellulis compositi, ca. 18 μ lati.

Gonimoblastae subsphaericae ex filis carposporiferis et involucro dilatato constructae.

Mauritius: Without locality, 1892, Herb. F. Jadin.

A single specimen only is found of this species (Pl. II, fig. 3); it forms a dense roundish tuft about 7 cm high. The filaments

are terete, below about $1^1/_2$ mm thick tapering slowly upwards to $^1/_2$ mm or less. They are irregularly divided, the length of the internodes between the furcations being rather variable, now less now more than 1 cm. In the dried specimen the filaments are often nearly parallel and stick together, indicating that in the

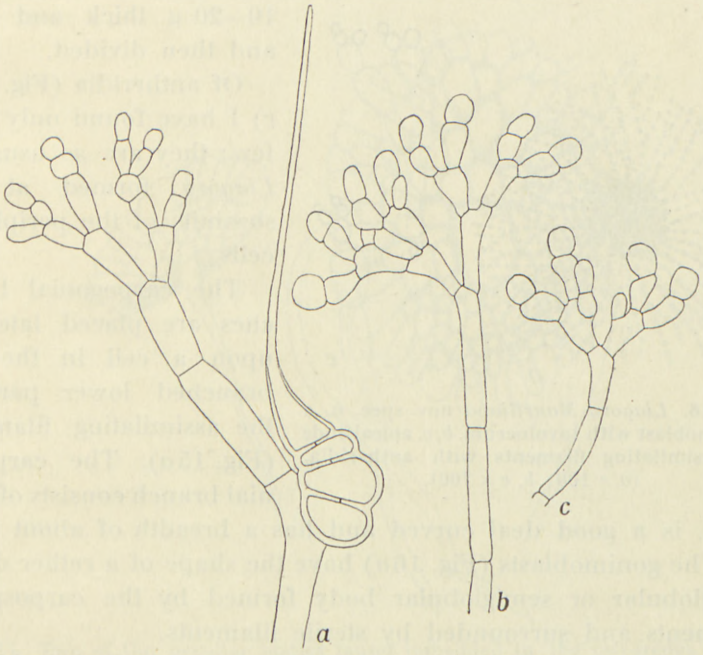



Fig. 15. *Liagora Mauritiana* nov. spec. *a*, *b*, *c*, parts of assimilating filaments, *a* with a carpogonial branch. (× 400).

living condition the thallus has probably had a soft and mucilaginous consistency.

The calcareous incrustation is rather strongly developed, forming a dense coating with a somewhat uneven farinose surface. The colour is greyish-red or dirty-red, more greyish in the upper parts. The red colour is due to the fact that the assimilating filaments protrude somewhat above the chalky incrustation.

In their lower part the assimilating filaments (Fig. 15) consist of thin, unbranched or very little branched filaments about 7—8 μ thick and composed of cells about 30—40 μ long. At their upper ends they are branched several times and broaden; the

cells here are short, irregularly-pearshaped; the uppermost peripheral ones are irregularly shaped, roundish or edged; they become mingled with the cells of the neighbouring filaments, thus forming a rather dense layer. The surface cells have a breadth of 6—7 μ.

The medullary layer consists of thick-walled filaments about 10—20 μ thick and now and then divided.

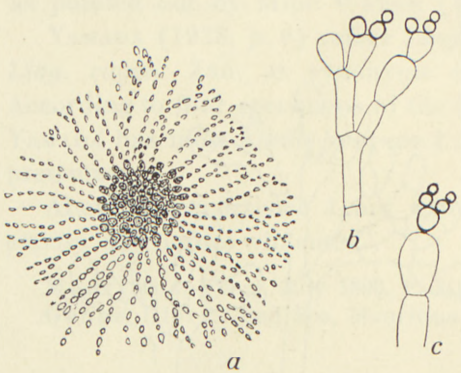



Fig. 16. *Liagora Mauritiana* nov. spec. *a*, a gonimoblast with involucrum. *b*, *c*, apical ends of assimilating filaments with antheridia. (*a* × 100; *b*, *c* × 700).

Of antheridia (Fig. 16*b*, *c*) I have found only very few; they are as usual in *Liagora* formed at the summits of the peripheric cells.

The carpogonial branches are placed laterally upon a cell in the unbranched lower part of the assimilating filaments (Fig. 15*a*). The carpogonial branch consists of four cells, is a good deal curved and has a breadth of about 18 μ.

The gonimoblasts (Fig. 16*a*) have the shape of a rather dense subglobular or semiglobular body formed by the carposporic filaments and surrounded by sterile filaments.

Dickie (1875, p. 195) mentions *Liag. coarctata* Zan. in his list of algae from Mauritius. This species has been described by Zanardini in Flora 1851, p. 36; and in Tab. Phycol., vol. 8, p. 43, pl. 90 II Kützing gives some figures of it. According to these figures Zanardini's species might bear some likeness to the above-described plant, but to clear up their possible identity an examination of Zanardini's plant would be necessary.

In this species some endophytic bodies were present similar to those Howe (1920, p. 1, pl. 1) and I (1920, p. 455, fig. 421) have found in several species of *Liagora* from the West Indies. While I considered these bodies as endophytes living in the slime and chalky incrustation of these algæ without any direct organic connection with *Liagora*, Howe regards them as organs belonging

to the *Liagora*, supposing "that these discs arise from gonidia, gemmae or aplanospores, derived from the terminal or subterminal cells of the assimilating filaments of the *Liagora*". In this interpretation HOWE accepts that of KÜTZING (1858, p. 43, tab. 90), who was the first to mention these bodies, which he supposed were developed from the assimilating filaments.

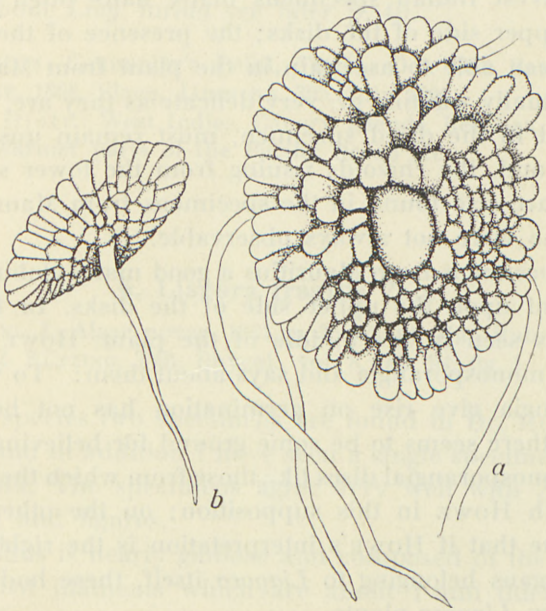



Fig. 17. Two of the peculiar bodies found imbedded in the calcareous incrustation among the assimilating filaments of *Liagora Mauritiana*. *a*, seen from above, *b*, from the side below; compare the text. (× 300).

Besides from the West Indies, the Red Sea, according to KÜTZING (l. c.), and now from Mauritius, these peculiar bodies are mentioned from the Malayan Archipelago by Mme WEBER (1921, p. 201). They do not seem to have by far the wide distribution that *Liagora* has; thus I did not find them at the Canary Islands (1927, p. 38), and YAMADA does not mention them in his monographic treatment of the genus *Liagora* in Japan (1938, p. 1). This seems to speak in favour of my view that they are a kind of facultative endophytes, having no organic connection with the host plant.

As to the plant from Mauritius (Fig. 17), the youngest specimens

I have found are very like those HOWE has shown in Figs. 11 and 12. The largest discs I have seen had a diameter of about 200—300 μ. Like those from the West Indies the specimens have a very dark red colour, which was well preserved even in the dried condition, and which forms a great contrast to the much paler colour of the surrounding assimilating filaments of *Liagora*.

In the West Indian specimens many hairs often protruded from the upper side of the disks; the presence of these hairs I have not been able to ascertain in the plant from Mauritius; if they are actually wanting or, very delicate as they are, may have disappeared in the dried specimen, must remain unsettled. On the other hand, the rhizoids issuing from the lower side of the specimens are also found in the specimens from Mauritius even though these were not always observable.

In the specimens from Mauritius a good many globular bodies were present upon the upper side of the disks. In Fig. 17*a* a large one is seen in the middle of the plant. HOWE considers these to be monosporangia and says about them: "To what these monosporangia give rise on germination has not been determined but there seems to be some ground for believing that they produce monosporangial discs like those from which they sprang". I agree with HOWE in this supposition; on the other hand; it seems to me that if HOWE's interpretation is the right one, and they are organs belonging to *Liagora* itself, these bodies should develop new *Liagora*-plants.

But to be able to clear up the real nature of these little bodies it seems necessary to examinate living material.

### 5. Liagora farinosa Lamx.

LAMOUROUX, J., Hist. Polyp. corallig. flex., 1816, p. 240. HOWE, Algae in Britten and Millspaugh, The Bahama Flora, 1920, p. 554. BØRGESEN, Mar. Alg. Canar. Isl., 1927, p. 59, figs. 32—33. YAMADA, Species of Liagora from Japan, 1938, p. 23, figs. 15—16. — *Liagora elongata* Zanard., Alg. novae etc. 1851, p. 35. BØRGESEN, Mar. Alg. D. W. I., vol. II, p. 67.

Several specimens of this species are found in the collections. Some fine well-prepared male and female specimens have been collected by Dr. MORTENSEN. In JADIN's list the plant is called *Liagora elongata* Zanard. In the collection of Naturhistoriska

Riksmuseet, Stockholm, a large female rather badly prepared specimen is found; it is determined as *Liagora pulverulenta* and has been collected by Colonel PIKE.

Two of DICKIE's new species, namely *Liag. crassa* and *Liag. lurida*, described upon material from Mauritius (DICKIE, 1875, p. 195) are, according to HOWE, (1920, p. 554) referable to this species; about *Liag. lurida* see later p. 40.

Mauritius: Cannonier's Point, Th. M., Oct. 1929. Barkley Island, Colonel PIKE, 1868. Flacq, JADIN no. 305, July 1890.

Geogr. Distr.: West Indies, Canary Islands, Red Sea, Malayan Archipelago, warmer parts of the Pacific Ocean etc.

### 6. Liagora fragilis Zan.

ZANARDINI, J., Algae novae, 1851, p. 36. Plant. Mar. Rubr., 1858, p. 64, tab. V, fig. 2. KÜTZING, Tab. Phycol., vol. 8, tab. 94, fig. 1.

Of this species two specimens are found in Dr. MORTENSEN's collection and in addition I have seen a single specimen collected by Dr. JADIN. The specimens agree very well with ZANARDINI's description and figures.

The thallus is nearly globose and composed of the dichotomously divided filaments which are about 1 mm thick near the base tapering gradually upwards to the very thin upper ends. From its base the much incrusted thallus has a continuous calcareous coating becoming gradually thinner upwards, the uppermost summits being free of chalk. The assimilating filaments are composed of long subcylindrical cells in the basal part and are not much divided; higher up they are several times divided and composed of somewhat broader, but shorter oval cells, about 7—8 μ broad.

In the apical ends of the filaments a few antheridial bodies were found; otherwise no fructiferous organs were met with.

Regarding its occurrence JADIN writes: "Très abondant sur les récifs, croissant en touffes roses d'un très joli effet".

Mauritius: Flat Island, Th. M., $^{17}/_{10}$ 29. Flacq, Sept. 1890, JADIN no. 474.

Geogr. Distr.: Red Sea, Mauritius, Malayan Archipelago.

### 7. Liagora cladonioides nov. spec.

Frons caespitosa, ca. 9 cm et ultra(?) alta, filiformis, teres, fere aequicrassa, ca. $^3/_4$—1 mm lata, laevis sed ubique transversim annulata, iterum di-trichotoma divisa, axillis acutis, articulis $^1/_2$—1 cm longis.

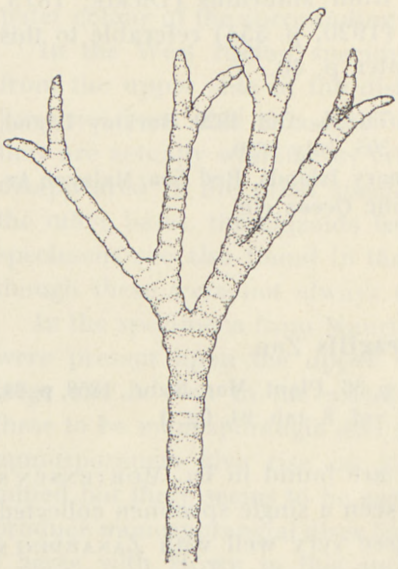


Fig. 18. *Liagora cladonioides* nov. spec. Fragment of the thallus showing the annulated surface. (× 8).

Crusta calcarea in specimine exsiccata plus minus longitudinaliter collabens, continua, apicibus ramorum breviter subacutis excepta.

Color frondis flavo-albidus, apicibus purpureis.

Axis centralis ex filamentis subcylindricis, ramosis, ca. 15 μ latis formatus est.

Stratum periphericum ex filamentis assimilantibus, iterum divisis, corymbiformibus compositum est.

Filamenta assimilantia ex cellulis in parte basali oblongo-subcylindricis, in media parte crassioribus, oblongo-pyriformibus, ca 50 μ latis, ad apicem versus gradatim minoribus, superioribus oblongis, ca. 15—18 μ longis et 7—10 μ latis constructa.

Species monoica. Rami carpogonii ex 3 cellulis compositi; cellula carpogonica conica in trichogynum longum producta.

Antheridia ad apices filorum assimilantium evoluta.

Mauritius: Without locality, Herb. Jadin.

The single specimen I have seen of this species (Plate II, fig. 4) characteristic by its annulated thallus (Fig. 18) forms an intricate tuft 9 cm high. It is rather regularly di- sometimes trichotomously furcated; the length of the joints between the divisions varies from $^1/_2$—1 cm.

The thallus is terete, $^3/_4$—1 mm thick, rarely more, tapering at the upper ends of the filaments to $^1/_2$ mm and less. The

plant has a vigorous continuous calcareous layer, above which the uppermost small peripheral cells of the assimilating filaments protrude. A transverse section of the thallus shows that the cal-

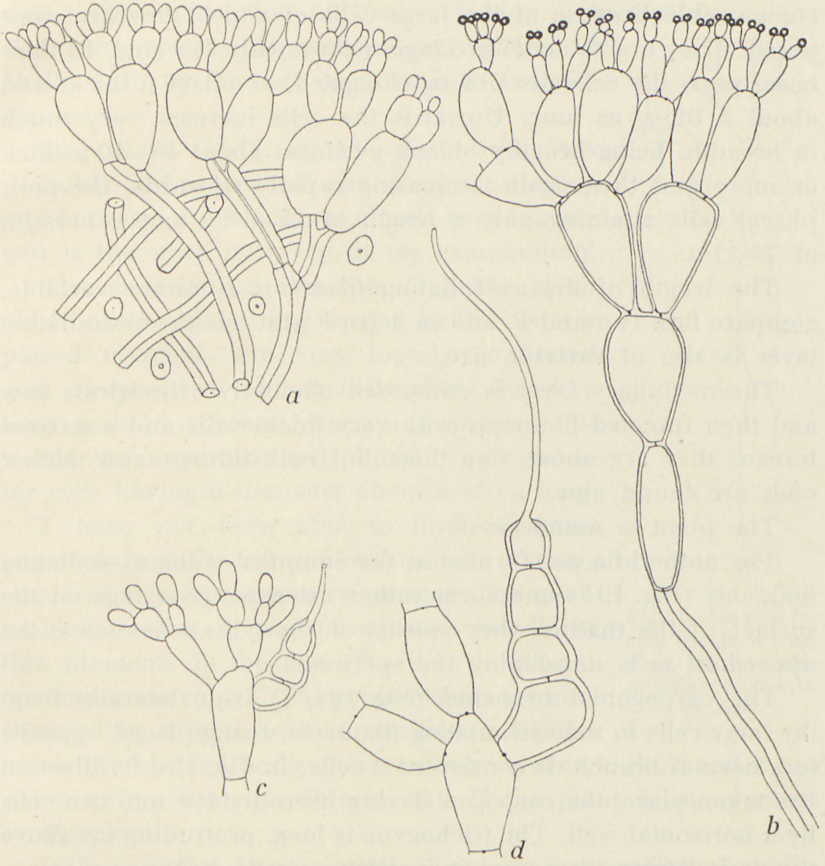



Fig. 19. *Liagora cladonioides* nov. spec. Parts of assimilating filaments. *a*, fragment of the thallus with short assimilating filaments; *b*, long assimilating filament with antheridial bodies; *c*, assimilating filament with young carpogonial branch; *d*, a fertilized carpogonial branch, the carpogonium is divided into two cells. (*a* × 250; *b*, *d* × 600; *c* × 300).

careous layer fills up the part of the assimilating filaments composed of the large cells. At the articulation the chalky incrustation is broken, and longitudinally it is also much shrivelled in the dried condition. The colour of the dried specimen is light yellow greyish with a rosy tinge.

The plant does not adhere to the paper, the thallus is rather stiff, and the dried specimen has much the same appearance as a *Cladonia*.

The assimilating filaments (Fig. 19) make the plant easily recognizable because of the large cells of which they are composed. They are as usual in *Liagora* repeatedly furcated. In their basal parts the cells are oblong-elongated, about 20 μ thick, and about 5 times as long. Upwards the cells increase very much in breadth, being broadly oblong-pyriform about 40—50 μ thick or more and then again decreasing rapidly upwards, the peripheral cells attaining only a length of 15—18 μ and a breadth of 7—11 μ.

The length of the assimilating filaments is rather variable, compare figs. 19*a* and *b*, and in accord with this the assimilating layer is also of variable size.

The medullary layer is composed of nearly cylindrical, now and then furcated filaments with very thick walls and a narrow lumen; they are about 15 μ thick but both thinner and thicker ones are found also.

The plant is monoecious.

The antheridia are formed at the summits of the assimilating filaments (Fig. 19*b*) and form rather extensive coverings on the surface of the thallus; they consist of short branchsystems, the uppermost cells developing the spermatia.

The carpogonial branches (Fig. 19*c*, *d*) issue laterally from the large cells in the assimilating filaments, being placed opposite to a normal branch. It consists of 3 cells; in Fig. 19*d* fertilization has taken place, the carpogon having been divided into two cells by a horizontal wall. The trichogyne is long, protruding up above the assimilating filaments; it is often spirally bent.

I have not seen any ripe gonimoblast.

### 8. **Liagora lurida** Dickie.

Dickie, G., Algae of Mauritius, 1875, p. 190.

Among the *Liagora* described in Dickie's list this species is also included. The very short description of it runs: "Fronde lurida, parce ramosa, ramis longe attenuatis, crusta calcarea fere nulla". That is all, but to this must be added that Dickie's list

is based upon a collection of algæ from Mauritius gathered by Colonel PIKE, and among the algæ which Dr. VAUGHAN has sent to me for determination is a specimen of *Liagora* collected by Col. PIKE. And as this specimen must be said to answer very well to the description of DICKIE, having a dead white colour and being practically without incrustation of chalk, I do not hesitate to refer it to DICKIE's species.

The plant (Pl. I, fig. 1) when living has probably had a very soft and slimy consistency and because of this adheres closely to the paper and is therefore not very fit for examination.

The assimilating filaments (Fig. 20) given out from the axial string formed by the densely placed filaments are very loosely connected and composed of oblong cells about 30—40 μ long and 12 μ broad, becoming shorter upwards, the uppermost peripheral nearly globular cells having a diameter about 8—10 μ long.

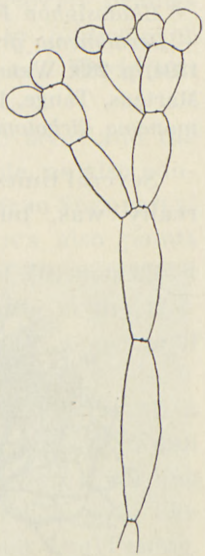


Fig. 20. *Liagora lurida* Dickie. A fragment of the assimilating filaments. (× 350).

I have not been able to find any carpogonial branch, but gonimoblasts in various stages of development were present. The gonimoblasts are composed of a dense bundle of thin filaments in the tips of which the carpospores are developed. The gonimoblasts are surrounded by a loose wall of ramified, bent filaments. Antheridial bodies I have not been able to find, and it has not therefore been possible to state if the plant is monoecious or dioecious.

Only very few *Liagora*-species have no incrustation of chalk; besides this species DE-TONI in Syll. Alg., vol. IV, p. 92 mentions *Liagora pectinata* Coll. and Herv. and *L. dubia* (Bory) Born.

Dr. HAMEL, Paris, has been kind enough to compare the plant with the collection of *Liagora* found in the Museum National but has not found any like it.

Mauritius: Colonel PIKE.
Geogr. Distr.: Endemic.

## b. Dermonemeae.

## Dermonema (Grev.) Harv.

### 1. Dermonema Frappieri (Mont. et Millard.) comb. nov.

*Cladosiphon Frappieri* Mont. et Millard., 1862, p. 20, pl. XXVI, fig. 1. — *Dermonema gracile* Schmitz in Heydrich, Beiträge Algenfl. Ost-Asien, 1894, p. 289. Weber-van Bosse, Alg. Siboga, p. 204. *Gymnophloea gracilis* Martens, Tange, 1866, p. 146. Kützing, Tab. Phycol., vol. 17, tab. 1. *Dermonema dichotomum* Harv., Alg. Ceyl. no. 93 (nomen nudum).

Several times I have wondered what the *Cladosiphon Frappieri* really was, but when I became better acquainted with the anatomical structure of *Dermonema gracile*, it became clear to me that the plant of Montagne and Millardet is in reality *Dermonema*.

Fig. 21. *Dermonema Frappieri* (Mont. et Millard.) Børgs. The original specimen. Natural size.

When the description and figures of these authors are considered, not only their description but especially their figures give quite a good picture of the plant. This applies not merely to the habit figure of the plant in natural size, but also the figures of the structure of the thallus really illustrate this quite well.

But even if I was left in no doubt as to the correctness of this observation, an examination of the authentic specimen was of course the best way to make sure, and so I asked Professor P. Allorge, Director of the Laboratoire de Cryptogamie, Paris, if it was possible to lend me a piece of the plant. On my request Dr. G. Hamel most kindly sent me the authentic specimen. A study of the plant convinced me that it was *Dermonema*. Fig. 21 shows a photo of the plant. This is quite like some specimens in Dr. Vaughan's collection.

That Montagne and Millardet's species has been unobserved

for so many years is perhaps to be wondered at, but partly the paper of MONTAGNE and MILLARDET is certainly very little known, partly it must be said to have been buried pretty well, having been referred to KÜTZING's rather unfortunate Phaeophycé-genus *Cladosiphon*. In DE-TONI, Sylloge Alg., it is also found in vol. III, *Phaeophyceae*, p. 417. DE-TONI says here that it scarcely belongs to *Cladosiphon* but should rather be referred to *Eudesme* or *Castagnea*; but he adds: "Ex icone depicta quasi Florideam partim decoloratam et virescentem crederes".

As to the peculiar development of the cortical layer and the anatomical structure of *Dermonema* upon the whole, as also concerning the development of the gonimoblasts I refer to SVEDELIUS' instructive paper (1939). In this paper SVEDELIUS also points out that in reference to the systematic position of *Dermonema* it may perhaps be doubtful whether it really belongs to the *Helminthocladiaceæ*, and he thinks that together with *Cumogloia* it should perhaps form a new separate family.

The few specimens from Mauritius I have seen have all a small, slender thallus only 3—4 cm high, thus attaining about half the size only of what the plant attains at Ceylon according to SVEDELIUS. Most probably the plant from Mauritius is like the delicate form which Mme WEBER mentions from Atja Tuning, New Guinea.

One of the specimens of Dr. VAUGHAN is female.

JADIN who in his list calls it *Dermonema dichotomum* Harv. writes about its occurrence: "Sur les récifs, ou sur des pointes rocheuses. Exposé aux lames violentes, croissant en touffes compactes".

Mauritius: Pointe aux Roches, R. E. V. no. 284 (no date). Flacq, June 1890, JADIN no. 212. Mahébourg, Sept. 1890, JADIN no. 451.

Geogr. Distr.: Ceylon, Formosa, New Guinea etc.

## *Fam. 3. Chaetangiaceae.*

### Actinotrichia Decsne.

#### 1. Actinotrichia fragilis (Forssk.) Børgs.

Børgesen, A revision of Forsskål's Algae, 1932, p. 6, pl. 1, fig. 4. — *Fucus fragilis* Forssk., Flora Ægypt.-Arab., 1775, p. 190. *Actinotrichia rigida* (Lamour.) Decsne, Sur les Corallines, 1842, p. 118.

Dr. Vaughan's collection contains a single specimen of this species.

For many years *Actinotrichia* has been known only in the sterile condition and because of the great resemblance of the anatomical structure of *Actinotrichia* to that of *Galaxaura* this genus was referred to *Galaxaura* for instance by Askenasy (1888, p. 32). But in the collections of the Siboga expedition Mme Weber succeeded (1921, p. 207) in finding fertile material, not only specimens with tetrasporangia but also sexual specimens, and by means of these she has published a very good figure of a transverse section of a cystocarp. As pointed out by Mme Weber, this shows that the construction of the cystocarp in *Actinotrichia* is quite different from that of *Galaxaura* and very much resembles that of *Scinaia* as we know the development of the cystocarps in this genus from Svedelius' minute description (1915, p. 23).

Quite recently Svedelius has made thorough cytological studies of the development of the cystocarps etc. in some species of *Galaxaura*. According to a preliminary report in Svensk Bot. Tidsskr., 1941, vol. 35, p. 100 Svedelius sums up his results as follows: the whole carpogonial branch system is used as the starting-point in the formation of the gonimoblasts and no special wall is developed round the gonimoblasts. *Galaxaura* is thus in conformity with another genus of the *Chaetangiaceæ*, namely *Chaetangium* (compare Margaret T. Martin, 1939, p. 115) in which the gonimoblasts have no wall, either, and these two genera should thus have no real cystocarps in contradiction to the other genera of the *Chaetangiaceae*: *Scinaia*, *Gloiophloea* and *Actinotrichia* in which a wall of sterile filaments surrounds the gonimoblasts.

*Actinotrichia* is mentioned in Dickie's list p. 196.

Mauritius: Black River Bay, "forms low cushions pink in colour", R. E. V. no. 288.

Geogr. Distr.: Red Sea, Indian and Pacific Oceans.

## Galaxaura Lamouroux.

Since Howe's important discovery (1917, p. 621 and 1918, p. 191) of the noteworthy dimorphism not only in the habit but also in the anatomical structure of the asexual and sexual phases of the same species which prevails in the genus *Galaxaura*, the determination of the species of this genus not only requires a large material but in fact makes a study of living plants in situ necessary to be able to make out the two connected forms of each species and thus arrive at a real knowledge of the species.

When Kjellman (1900) worked out his large detailed monograph of the genus *Galaxaura* the correlation of the sexual and asexual forms was unknown and the result therefore has been that in cases where he had the opportunity of examining both forms of the same species these have in his monograph been referred to two separate species. And to this must be added that Kjellman because of the scarce material he had access to in many cases has surely described as distinct species several forms which when more material is available will prove to belong together.

It must be a problem of the future to try to trace the two phases of each species and altogether the real limitation of the species; and in my later papers (see for instance 1927, p. 64 and 1939, p. 104) I have indeed made some attempts in this direction.

It seems regrettable therefore that Tanaka in his monographic paper on the genus *Galaxaura* in Japan (1936) has not tried to clear up as far as possible the correlation of the two phases of each species although he considers Howe's discovery very convincing, and he himself has also pointed out the dimorphism in some of the species.

In the very scarce material from Mauritius, a single or a couple of specimens of each form only, I have had for examination, 9 species in sensu Kjellman are found; 5 of these belong to groups comprising sexual forms and 4 to groups of asexual forms.

It is of course out of the question to clear up, by means of so little material, how these 9 species actually belong together; I shall merely make some suggestions on the subject at the end of the list of species.

## *Sectio I.* ***Rhodura*** Kjellm.

### 1. Galaxaura lapidescens (Sol.) Lamx.

Lamouroux, J. V., Hist. Polyp. corall. flexibl., 1816, p. 264. Kjellman, Galaxaura, p. 39—43. Børgesen, Mar. Alg. D. W. I., II, p. 95, figs. 102—104. — *Corallina lapidescens* Solander in Ellis and Solander, Nat. History etc. 1786, p. 112, pl. 21, fig. *g*.

In the material from Mauritius only one sample is found which comprises two specimens of a tetrasporic form belonging to this species. Regarding their appearance the specimens show a great likeness to the plant from the West Indies for which I (1916, p. 95, fig. 102) kept Solander's specific name *Galaxaura lapidescens* (Sol.) Lamx. When the specimens from Mauritius are compared with the form which Solander mentions (1786, p. 113) and has pictured in pl. 21, fig. *g* the resemblance to the Mauritius plant is indeed very striking.

The specimens are densely covered by the assimilating filaments, the thallus including the hairs being about 2 mm broad. One of the specimens is about 6 cm high, the other one about 5 cm. They are repeatedly irregularly furcated. The colour of the small specimen is a fine dark-red, while the larger one is more dirty reddish and this specimen is also rather overgrown with small *Corallinaceae* etc. Most probably the small specimen has grown in a more shaded place than the bigger one, and this is perhaps also the reason why the anatomical structure is a little different in the two specimens.

Fig. 22*a* shows a small part of a transverse section of the bigger specimen. The supporting cells from which the erect filaments originate are small, triangular-quadrangular in shape. From these one or two erect assimilating filaments are given off. The basal cell in these is oblong-ovoid, up to 80 μ long and

32—42 μ broad; the following cell is much smaller but still somewhat inflated in the middle, then the cells become cylindrical, keeping about the same breadth higher up in the filaments. These are about 20 μ thick and composed of about 20 cells; their length is about 33 μ and the cells have thick walls. In the smaller

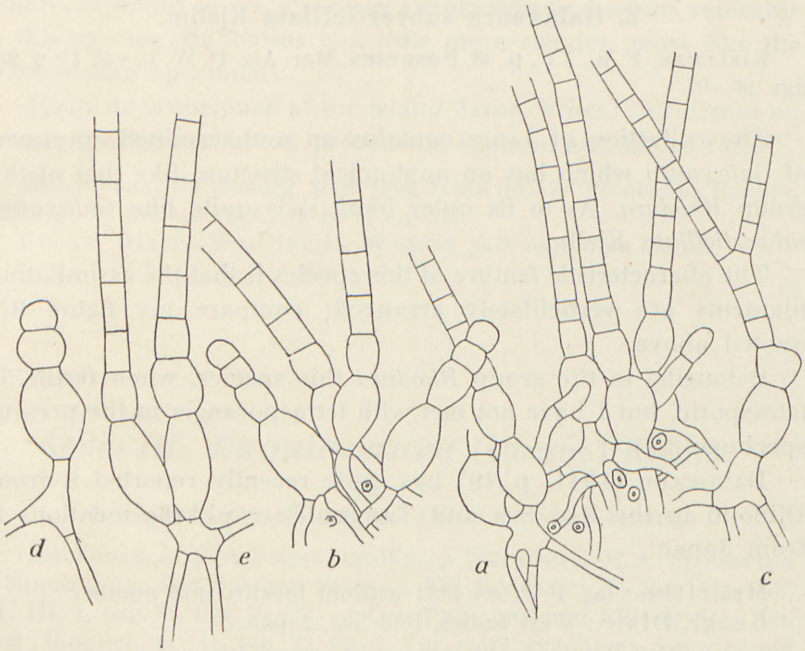



Fig. 22. *Galaxaura lapidescens* (Sol.) Lamx. *a*, *b*, *c*, parts of peripheral tissue with assimilating filaments of the large specimen. *d*, *e*, the same of the small specimen. (*a*, *c* × 220; *b*, *d*, *e*, × 300).

specimen (Fig. 22 *d*, *e*) the filaments were a little thinner, about 18 μ, and the cells a little longer, about 38 μ; the wall was thinner and they were composed of about 30 cells.

Besides the long assimilating filaments short ones are also present. In the bigger specimen the short filaments (Fig. 22 *b*) above the large basal cell have 2—3 cells becoming successively smaller upwards, while in the small specimen in most cases only two cells were present (Fig. 22 *d*). In the large specimen I only once found a ramified filament.

The medullary tissue is composed of thick-walled filaments about 8—10 μ thick, densely intermingled.

Mauritius: Pointe aux Sables, R. E. V., no. 354, Aug. 1939. Dr. VAUGHAN writes about its appearance: "Thallus usually deep purple or red". JADIN in his list mentions this species from Mauritius but I have not seen any of his specimens.

Geogr. Distr.: West Indies, Mauritius, etc.

### 2. Galaxaura subverticillata Kjellm.

KJELLMAN, F. R., l. c., p. 48. BØRGESEN, Mar. Alg. D. W. I., vol. II, p. 92, figs. 96—97.

The collection of JADIN contains an undetermined specimen of *Galaxaura* which has an anatomical structure like that of the group *Rhodura*. As to its outer habit it is quite like *Galaxaura subverticillata* Kjellm.

The characteristic feature of this species is that the assimilating filaments are verticillately arranged; compare my figure 97, quoted above.

Belonging to the group *Rhodura* this species, when fertile, is tetrasporic, but I have not met with tetrasporangia in the present specimen.

DANGEARD (1941, p. 49) has quite recently reported it from Djibouti in the Red Sea and TANAKA (l. c. p. 146) mentions it from Japan.

Mauritius: leg. F. JADIN 1892 without locality and number.

Geogr. Distr.: West Indies, Red Sea, Japan.

## *Sectio II.* ***Microthoë*** J. Ag.

### 3. Galaxaura rugosa (Soland.) Lamx.

LAMOUROUX, J. V., Hist. Polyp. corallig. flexib., 1816, p. 263. KÜTZING, Tab. Phycol., vol. 8, tab. 33, 1. AGARDH, J., Epicrisis, p. 528. KJELLMAN, Galaxaura, p. 55. BØRGESEN, F., Mar. Alg. D. W. I., vol. II, p. 100, figs. 105—107. — *Corallina rugosa* Solander in ELLIS and SOLANDER, The Natural History etc. 1786, p. 115, tab. 22, fig. 3.

This species is mentioned in JADIN's list and a specimen of his collection agrees perfectly well with a specimen in my her-

barium collected by HILDEBRANDT at Lasgori, Somali and determined by HAUCK (1886, p. 220). Compared with West Indian specimens the thallus of those from the Indian ocean is a little broader up to about $1^1/_2$ mm.

A piece of a less well prepared specimen most probably cast ashore, is found in Dr. VAUGHAN's collection and seems referable to this species. Its thallus is a little more slender, more like the West Indian specimens.

About its occurrence at the island JADIN writes: "Croissant en grosses touffes, comme la précédente exposée aux lames fortes".

Mauritius: Mahébourg, Sept. 1890, JADIN no. 474. Pointe aux Roches, "deep pools behind reef", R. E. V. no. 171.

Geogr. Distr.: West Indies, Western part of Indian Ocean.

## *Sectio III.* ***Eugalaxaura*** (Decsne) Kjellm.

### 4. Galaxaura oblongata (Ellis et Sol.) Lamx.

LAMOUROUX, J., Hist. Polyp. corallig., p. 262. HOWE, M. A. in BRITTON & MILLSPAUGH, The Bahama Flora, p. 559. BØRGESEN, F., Mar. Alg. Can. Isl., III, 1, pag. 71, figs. 39—41. — *Corallina oblongata* Ellis et Sol., Nat. Hist. Zoophyt., p. 114, tab. 22, fig. 1. For more synonyms compare my above-quoted paper.

Some few specimens in Dr. JADIN's collection, called in his list *G. dichotoma*, and some collected by Dr. VAUGHAN agree very well with specimens I have collected at the Canary Islands and referred to this species; compare the description and figures in my above-quoted paper.

The thallus of the plant from Mauritius had a breadth of up to about $1—1^1/_4$ mm, rarely $1^1/_2$ mm, and the length of the joints is as a rule about 7—8 mm. The thallus is clearly annulated. The specimens were female.

The peripheric cells are hexagonal-polygonal, having a diameter of about 12—15, rarely 18 μ, and the lowermost cells in the peripheric wall are subglobular to oval with a diameter of about 25 μ.

As already pointed out by me in 1931, p. 3, I find it impossible to separate *Galax. Schimperi* Decsne from the Red Sea from this species, as the dimensions and appearance of the thallus and the anatomical structure according to KJELLMAN's description and figures agree quite with the Canarian plant as well as with Indian specimens and those from Mauritius. The only difference I can find as to the latter is that this seems to be a little more calcified, and so more brittle than Indian (Dwarka) and Canarian specimens.

About its occurrence at the island JADIN writes: "Très abondant; croissant en grosses touffes roses sur des coraux ou sur le grosses coquilles, dans les lagunes. Recouvertes a marée basse".

Mauritius: Tamarin Bay, "on or near reef", R. E. V. no. 295. Flacq, Juin 1890, JADIN no. 407.

Geogr. Distr.: Mediterranean Sea, Canary Islands, Red Sea, West Indies, India etc.

### 5. Galaxaura cylindrica (Solander) Kjellm.

KJELLMAN, F. R., l. c., p. 64, pl. 8, figs. 34—42; pl. 20, fig. 53. — *Corallina cylindrica* Solander in ELLIS and SOLANDER, 1786, p. 114.

Some few specimens in Dr. JADIN's collection from Réunion (I have not seen any from Mauritius) called by him *Galaxaura dichotoma* Lamour. seem to me to agree so well with West Indian specimens that I have no hesitation in referring them to this species.

*Galaxaura cylindrica* is nearly related to *Galax. oblongata* but its joints are slender and more cylindrical, in the case of the specimens from Réunion about $^1/_2$ mm near their base, up to about $^3/_4$ mm or a little more at their upper end; and their length is about 6 mm. Also the colour of the plant from Réunion was the same characteristic greyish green as was found in the West Indian specimens.

Belonging to the group *Eugalaxaura* of KJELLMAN, the anatomical structure of this species is the same as in this group, which comprises sexual plants only.

Réunion: Saint-Gilles, Avril 1890, F. JADIN no. 115.

Geogr. Distr.: West Indies, Atlantic coast of South America, Canary Islands, Red Sea.

## 6. Galaxaura pilifera Kjellm.

KJELLMAN, Floridé-Slägtet Galaxaura, p. 65, tab. 9, figs. 4—12; tab. 20, fig. 8.

This species is described by KJELLMAN upon a female specimen gathered by Colonel PIKE at Mauritius. I am much indebted

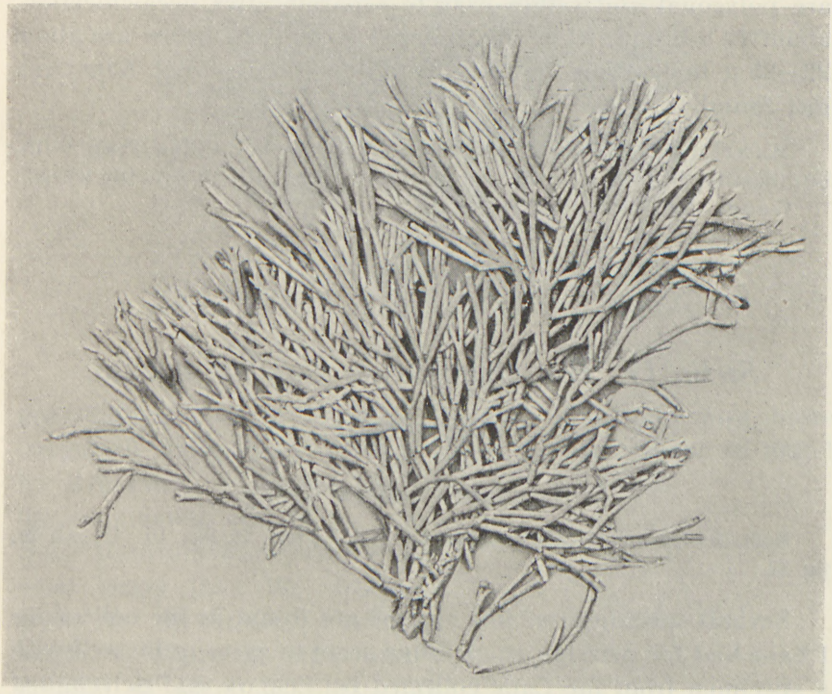


Fig. 23. *Galaxaura pilifera* Kjellm. 4/5 natural size.

to Dr. TH. ARWIDSSON, Riksmuseet, Stockholm, for having been allowed to see this specimen and having thus been able to compare a specimen in Dr. VAUGHAN's collection with the original specimen.

The specimen of Dr. VAUGHAN is a completely bleached plant, most probably cast ashore. It seems to agree fairly well with KJELLMAN's original specimens and his figures and description, with the exception that hairs are not present; most probably the hairs have dropped off or been torn away, at any rate annular

scars evidently originating from the hairs are found in the walls of many of the peripheral cells.

Fig. 23 shows a photo of the plant. It forms a roundish tuft about 9 cm high. The thallus is nearly cylindrical and annulated about 1 mm thick or a little more. It is repeatedly furcated and the joints reach a length from about $^1/_2$ cm in the lower part to about $1^1/_2$ cm in the upper parts of the frond. The surface cells are polygonal and rather easy to separate after decalcification, about 12 μ broad, while the rounded larger cells below are about 22—25 μ thick, thus in good accordance with what KJELLMAN has found.

Mauritius: Barkley Island, month of December, Colon. PIKE. Without locality, R. E. V. no. 14 in "pools near reef usually in running water".

Geogr. Distr.: Endemic.

## *Sectio IV. **Brachycladia*** Sonder, Kjellm.

### *Dissiminatae.

#### 7. Galaxaura tenera Kjellm.

KJELLMAN, Floridé-Slägtet Galaxaura, p. 77, tab. 14, figs. 10—19, tab. 20, fig. 32.

Several specimens of this species are found in the collections I have had for determination. They seem to agree quite well with a specimen from the Cape collected by ECKLON and determined by KJELLMAN; the specimen belongs to the Naturhistoriska Riksmuseet, Stockholm. The description of this species is based upon a specimen from Mombassa-Sansibar but KJELLMAN points out that the specimen from Cape only deviates slightly from that.

Fig. 24 shows the habit of the plant from Mauritius. The thallus is about $5^1/_2$ cm high and has a reddish-grey to olive-green colour with a dull or only very slightly shining surface. The lobes of the thallus are about $1^1/_2$—2 mm broad, irregularly subfurcated near the base with more acute angles, higher up with more open ones the internodes being about 5 mm long.

A transverse section of the thallus (Fig. 25) shows that the peripheric assimilating cells are of rather variable shape, often

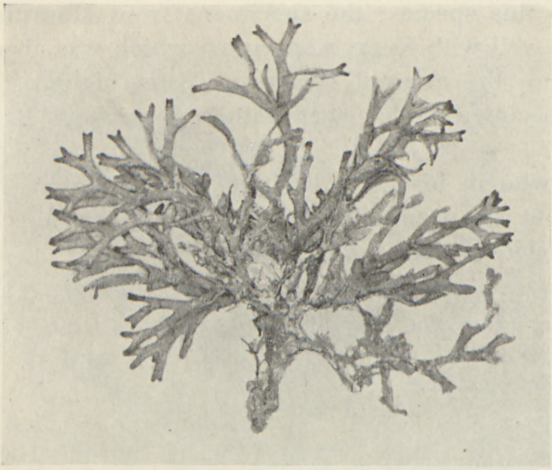


Fig. 24. *Galaxaura tenera* Kjellm. Natural size.

pearshaped, obovate or more oblong, sometimes also more irregularly oblique, having thus about the same shape as found by KJELLMAN; as to the size of the assimilating cells of the plant from Mauritius these were somewhat larger than the measures given by KJELLMAN, having a length of about 38—42 μ and a breadth of about 27—30 μ; but in the above-mentioned specimen from Cape in the Riksmuseum some assimilating filaments I have measured had a length of 38 μ and a breadth of 31 μ, being thus very like those in the specimens from Mauritius.

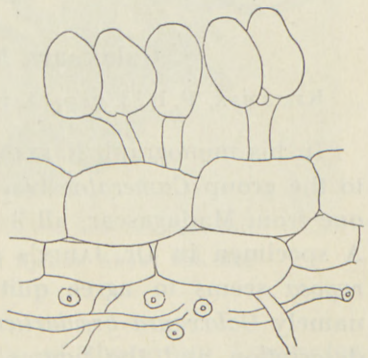


Fig. 25. *Galaxaura tenera* Kjellm. Transverse section of the peripheric tissue. (× 250).

The specimens from Mauritius were sterile but according to their anatomical structure they belong to the group *Brachycladia*, comprising tetrasporic plants;

most probably *Galax. veprecula* known from Madagascar is the sexual form of this species.

Kylin, 1938, p. 5, fig. 1 and pl. 1, fig. 2 refers a plant from Durban to this species; the specimens from Mauritius seem to agree very well with Kylin's specimen which was also somewhat smaller than the original specimen (8 cm high) of Kjellman. Kylin's specimen which was gathered in June had tetrasporangia.

Jadin, who in his list calls it *Galaxaura marginata* Schmitz, writes about its occurrence: "Abondant, croissant en touffes; souvent mêlées à *Liagora elongata*".

Mauritius: Isle Marianne, Oct. 1929, Th. M. Without locality, R. E. V. no. 35. Flacq, June 1890, Jadin no. 209. Baie de la Grande Rivière, July 1890, Jadin no. 239. Mahébourg, Sept. 1890, Jadin no. 473.

Geogr. Distr.: East Africa, Cape.

## *Sectio V.* ***Dichotomaria*** Decsne.

### *Cameratae.

### 8. Galaxaura breviarticulata Kjellm.

Kjellman, F. R., l. c. p. 84, pl. 18, figs. 1—13; pl. 20, fig. 51.

In his monograph Kjellman mentions 3 species as belonging to the group *Cameratae* two of which are from Port Natal and one from Madagascar, all 3 species based upon scarce material. A specimen in Dr. Jadin's collection determined as *Galaxaura rugosa* seems to agree quite well with one of these species, namely *Galaxaura breviarticulata* Kjellm. according to the short description and the figures especially the habit figure, pl. 20, fig. 51.

Fig. 26 shows a habit figure of the plant from Mauritius. The oval-elongated joints are 5—6 mm up to 8 mm and $1^1/_4$—$1^1/_2$ mm broad; when strongly compressed about 2 mm broad. The surface is smooth and dull. It is rather incrusted with chalk but

nevertheless not especially breakable. Its colour is greyish- to whitish-red. The plant forms a roundish much ramified tuft up to 9 cm high.

Fig. 26. *Galaxaura breviarticulata* Kjellm. About nat. size.

Its anatomy is that characteristic of the group *Cameratae*. Fig. 27 shows a piece of a transverse section of the epidermal layer; further I refer the reader to KJELLMAN's figures.

The specimens belonging to this group are all tetrasporic but the present specimen was sterile.

In his list JADIN calls it *G. rugosa* and writes about its occur-

rence: "Croissant en grosses touffes, comme la précédente exposée aux lames fortes".

Mauritius: Mahébourg, Sept. 1890, JADIN no. 474.
Geogr. Distr.: Port Natal.

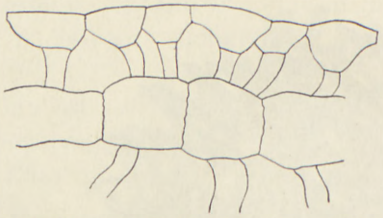


Fig. 27. *Galaxaura breviarticulata* Kjellm. Transverse section of the peripheric tissue. (× 250).

## **Spissæ.

### 9. Galaxaura corymbifera Kjellm.

KJELLMAN, Galaxaura, p. 87, tab. 19, figs. 21—27, tab. 20, fig. 50.

The reason why I refer a specimen collected by Dr. MORTENSEN and preserved in spirit to this species is not only that KJELLMAN's rather short description (the plant is described upon a "specimen unicum et mancum") seems to agree fairly well with the specimen from Mauritius but it is also because KÜTZING's figure of *Galaxaura oblongata*, to which KJELLMAN refers, shows great likeness to the plant from Mauritius. KÜTZING's figure in Tab. Phycol., vol. 8, pl. 35 is drawn from a plant from Port Natal.

The plant is much incrusted with chalk and very breakable; it collapses entirely after decalcification.

The size and shape of the joints is very variable. Near the base they are cylindrical-clavate, tapering somewhat towards the base, ca. $1^1/_4$—$1^1/_2$ cm long and ca. 2 mm broad. The following joints are cylindrical, about $2^1/_2$ mm broad and 1—2 cm or even more long; they are broadly rounded above and below at the articulations. Higher up in the thallus the joints get shorter, ellipsoidal-cylindrical, often with a somewhat waved surface; their length varies from about $^1/_2$—1 mm and likewise the breadth

from $1^1/_2$—$2^1/_2$ mm. The lower part of the thallus is furcated, higher up it is sometimes trifurcated, KJELLMAN says "umbellatim ramosa" but I have not seen more than 3 branches issuing from a single joint.

The surface cells are polygonal, ca. 20—25 μ broad and are easily separated after decalcification. The cells under the surface cells are roundish, c. 40 μ broad and likewise easy to separate.

Besides this species KJELLMAN has, in the group *Spissae*, *Galaxaura insignis* Kjellm. from Madagascar, but according to KJELLMAN's description this plant has a somewhat broader thallus.

Also rather near as to shape and the size of the joints is *Galaxaura obtusata* (Soland.) Lamx. (comp. TANAKA, 1936, p. 171, fig. 40) belonging likewise to the group *Spissae* and, first known from the West Indies, according to TANAKA distributed in the Pacific Ocean, Malay Archipelago, Polynesia and Australia. But the plant from Mauritius is much more incrusted with chalk and accordingly a much more breakable plant, and furthermore the peripheral cells are coherent in *Galaxaura obtusata*, whereas they are easy to separate after decalcification in the plant from Mauritius.

KYLIN (1938, p. 6, fig. 1F and Pl. 2, fig. 5) refers some specimens from Durban to this species; the plant from Mauritius seems to agree fairly well with KYLIN's figures.

Mauritius: Tombeau Bay, dredged at a depth of about 40 fathoms on sandy bottom with corals, 8th Oct. 29, TH. M.

Geogr. Distr.: Port Natal.

## Suggestions as to the supposed mutual connection of the species named in the list and based upon KJELLMAN'S monograph.

The first species mentioned in the list: *Galaxaura lapidescens* most probably, in conformity with HOWE's supposition concerning the West Indian species, has its sexual phase in *Galaxaura cylindrica* belonging to the group *Eugalaxaura* of KJELLMAN which is very different in habit. And as regards *Galaxaura oblongata*, a

species nearly related to *G. cylindrica* and to which species I have referred some specimens from Mauritius, HOWE supposes that it has its tetrasporic phase in *Galaxaura comans* Kjellm., a form very closely related to *G. lapidescens*. As to this supposition HOWE makes the following remarks, 1918, p. 197: "And just as the line of demarkation between *Galaxaura oblongata* and *G. cylindrica* seems a little uncertain and arbitrary, so also is the line of separation between *G. comans* and *G. lapidescens*". In this I quite agree with HOWE and would like to point out in this connection also that *Galaxaura pilifera* shows a great likeness to both *G. cylindrica* and *G. oblongata* so that its tetrasporic phase must most probably be looked for in a form coming near to *Galax. lapidescens* or *G. comans*.

The following species, *G. subverticillata*, likewise belonging to the tetrasporic group *Rhodura*, has surely, as in the West Indies, its sexual phase in *G. rugosa* with which species HOWE often found it growing in the West Indies. In their outer habit, for instance their size and the annular constrictions of the thallus these forms are very much alike, too.

The next species mentioned in the list is *Galaxaura tenera* which belongs to the group *Brachycladia* comprising asexual forms, the sexual forms of which according to HOWE are to be found in the group *Veprecula*. The characteristic species of the latter group is *G. veprecula*, and having been found at Madagascar, it must be presumed to occur also at Mauritius.

As to the two last-mentioned species in the list, namely *G. breviarticulata* and *G. corymbifera* belonging respectively to the tetrasporic group *Cameratae* and the sexual group *Spissae*, it was precisely upon members of these groups that HOWE (1916, p. 622) first arrived at the conclusion that the species of these groups actually represented the tetrasporic and the sexual forms respectively of each species. He came to this conclusion not only because the forms belonging to the same species are so very like in habit that they cannot be separated without microscopical examination, but also because both forms nearly always grow intermingled with each other.

## *Fam. IV.* ***Bonnemaisoniaceae.***

### Asparagopsis Mont.

**1. Asparagopsis taxiformis** (Delile) Collins and Hervey.

Collins and Hervey, Alg. Bermuda, 1917, p. 117. Børgesen, Mar. Alg. D. W. I., vol. II, 1918, p. 352, figs. 347—51. — *Fucus taxiformis* Delile, Flore d'Égypte, 1813, p. 151, pl. 57, fig. 2. C. Agardh, Spec. p. 368. *Asparagopsis Delilei* Mont., in Webb et Berthelot, Îles Canaries, vol. II, part 2, sectio 4, 1840; Addenda, p. XIV.

For more literature compare De-Toni, Syll. Alg., vol. IV, p. 771 and vol. VI, p. 367.

Dr. Vaughan's collection contains a small specimen preserved in formol. It is a female plant with young cystocarps.

I agree with Grunow who says in Alg. Fidschi, p. 46 about *Asparagopsis Sandfordiana* Harv.: "Scheint mir nicht genügend von *Asp. Delilei* verschieden zu sein".

Mauritius: Îlot Brocus, "washed into lagoon", R. E. V. no 218, 31. Dec. 38. It is mentioned from Mauritius in the lists of Dickie.

Geogr.: Distr.: Widely distributed in warm seas.

## List of Literature.


AGARDH, C., Systema Algarum. Lundae 1824.

— Species Algarum rite cognitae. Vol. I, 1821. Vol. II, 1828. Gryphiswaldiae.

AGARDH, J., Nya alger från Mexico. Öfversigt af Kungl. Vetenskaps-Akademiens Förhandlingar för den 13 Januari 1847.

— Species, genera et ordines algarum. Vol. II, 1851—63. Vol. III, Part 1. Epicrisis, 1876. Lund.

— Till Algernes Systematik. Sjette afdelningen. Lund 1890.

— Analecta Algologica. Continuatio III. Lundae 1896.

ARESCHOUG, J. E., Phyceae Capensis. Upsaliae 1851.

BATTERS, E. A. L., Catalogue of the British Marine Algae. Supplem. to the Journ. of Botany. London 1902.

BERTHOLD, G., Die Bangiaceen des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Eine Monographie. Fauna und Flora des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Herausg. v. d. Zoolog. Station von Neapel. VIII Monographie. Leipz. 1882.

BRITTON, N. L. and C. F. MILLSPAUGH, The Bahama Flora. New York 1920.

BUTTERS, FR. K., Observations on Trichogloea lubrica. Minnesota bot. Studies, Series 3. Minneapolis 1903.

BØRGESEN, F., Some new or little known West Indian Florideae. I, 1909. II, 1910. Botanisk Tidsskrift, vol. 30. København.

— The marine Algae of the Danish West Indies. Vol. II. Rhodophyceae. 1915—20. Copenhagen.

— Marine Algae from the Canary Islands, especially from Teneriffe and Gran Canaria. III. Rhodophyceae, Part 1. D. Kgl. Danske Vidensk. Selskab, Biol. Medd. VI, 6. København 1927.

— Some Indian Rhodophyceae, especially from the shores of the Presidency of Bombay, I—IV. Bulletin of Miscellaneous Information. Royal Botanic Gardens. Kew 1931—1934.

— A Revision of Forsskåls Algae mentioned in Flora Ægyptiaco-arabica and found in his Herbarium in the Botanical Museum of the University of Copenhagen. Dansk Bot. Arkiv, Vol. 8, Nr. 2, 1932.

— Contributions to a South Indian Marine Algal Flora, I—III. Journ. of the Indian Bot. Soc. Madras 1937—8.

COLLINS, FR. S. and A. B. HERVEY, The Algae of Bermuda. Proc. of the Amer. Academy of Arts and Sciences. Vol. 53. Boston 1917.

Dangeard, P., Algues de la Mer Rouge et de la Côte de Djibouti. Mémoires de la Soc. Linnéenne de Normandie. Nouv. Série. Sujets divers. 1. Vol. 1941.

Decaisne, J., Mémoire sur les Corallines ou Polypiers calcifères. Annales des Sciences Naturelles. II. Sér. Botanique. T. 18. Paris 1842.

De-Toni, J. B., Sylloge Algarum, Vol. IV. Florideae. 1897—1905. Patavii. Vol. VI. Florideae. 1924.

Dickie, G., On the Algae of Mauritius. Journal of the Linnean Society. Botany. Vol. XIV. London 1875.

Dillwyn, L. W., British Confervae or colored Figures and Descriptions of the British Plants referred by Botanists to the Genus Conferva. London 1809.

Ellis, J., and D. Solander, The Natural History of many curious and uncommon Zoophytes collected from various parts of the globe. London 1786.

Gardner, N. L., New Pacific Coast Marine Algae. I. University of California Publications in Botany. Vol. 6, Nr. 14. 1917. Berkeley.

Grunow, A., Algen der Fidschi-, Tonga- und Samoa-Inseln. Journ. de Mus. Godeffroy, Bd. 3. 1873—4.

Hamel, G., Bangiales. Floridées de France. Revue Algologique. Tome I. Paris 1924—5.

— Recherches sur les genres Acrochaetium Naeg. et Rhodochorton Naeg. Saint-Lo 1927.

Hauck, F., Die Meeresalgen Deutschlands und Oesterreichs. Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. Zweiter Bd. Leipz. 1885.

— Über einige von I. M. Hildebrandt im Rothen Meere und Indischen Ocean gesammelte Algen. Hedwigia 1886, 1887, 1888, 1889. Dresden.

Hering in Krauss, F., Pflanzen des Cap- und Natal-Landes, gesammelt und zusammengestellt von F. Krauss. Flora. 1846.

Heydrich, F., Beiträge zur Kenntniss der Algenflora von Ost-Asien. Hedwigia. Bd. 33. 1894. Dresden.

Holmes, E. M., New marine Algae from Japan. The Journal of the Linnean Society. Botany. Vol. 31. London 1895—7.

Howe, M. A., A note on the structural dimorphism of sexual and tetrasporic plants of Galaxaura obtusata. Bulletin of the Torrey Botanical Club. Vol. 43. New York 1916.

— Further notes on the structural dimorphism of sexual and tetrasporic plants in the genus Galaxaura. Brooklyn Botanic Garden. Memoirs. Vol. I. 1918. Brooklyn.

— Observations on monosporangial discs in the genus Liagora. Bull. Torrey Bot. Club. Vol. 47. 1920.

— Algae in Britton and Millspaugh, The Bahama Flora. New York 1920.

Jadin, F., Algues des Îles de la Réunion et de Maurice. Annales de Cryptogamie exotique. Tome VII. Paris 1934.

KJELLMAN, F. R., Japanska Arter af Slägtet Porphyra. Bihang till K. Svenska Vet.-Akad. Handlingar. Bd. 23, Afd. III, no. 4. Stockholm 1897.
— Om Floridé-Slägtet Galaxaura, dess Organografi och Systematik. Kungl. Svenska Vetenskaps-Akademiens Handlingar. Bd. 33. No. 1. Stockholm 1900.
KÜTZING, F. T., Tabulae Phycologicae. Bd. 1—19. Nordhausen 1845—69.
— Diagnosen und Bemerkungen zu neuen oder kritischen Algen. Bot. Zeit. 1847.
— Species Algarum. Lipsiae 1849.
KYLIN, H., Anatomie der Rhodophyceen. Handb. der Pflanzenanatomie, II. Abt., Bd. VI, 2. Teilband, Algen. Berlin 1937.
— Über eine marine Porphyridium-Art. Kungl. Fysiogr. Sällsk. i Lund Förhandlingar. Bd. 7. No. 10. 1937.
— Verzeichnis einiger Rhodophyceen von Südafrika. Lunds Univ. Årsskr. N. F. Avd. 2. Bd. 34. Nr. 8. 1938.
LAMOUROUX, J. V. F., Histoire des Polypiers coralligènes flexibles, vulgairement nommés Zoophytes. Caen 1816.
LE JOLIS, AUG., Liste des Algues Marines de Cherbourg. Paris—Cherbourg 1863.
LYNGBYE, H. L., Tentamen Hydrophytologiae Danicae. Hafniae 1819.
MAILLARD, L., Notes sur l'île de la Réunion. Botanique, Cryptogamie, Algues par C. MONTAGNE et M. MILLARDET. Paris 1862.
MARTENS, G., Die Tange. Die preussische Expedition nach Ost-Asien. Botanischer Theil. Berlin 1866.
MARTIN, MARGARET T., The structure and reproduction of Chaetangium saccatum (Lamour.) J. Ag. II. Female plants. The Journ. of the Linnean Soc. of London. Botany. Vol. LII. 1939. London.
MONTAGNE, C., Quatrième centurie de plantes cellulaires exotiques nouvelles. Ann. Sc. Naturelles. II. Sér. t. 20. Bot. Paris 1843.
OKAMURA, K., Icones of Japanese Algae. Vol. I—II, 1909—1912. Tokyo.
OKAMURA, ONDA and HIGASHI, Preliminary notes on the development of the carpospores of Porphyra tenera Kjellm. Botanical Magazine. Vol. 34. Tokyo 1920.
PAPENFUSS, G. F., Notes on South African Marine Algae 1. Botaniska Notiser 1940. Lund.
PILGER, R., Die Meeresalgen von Kamerun. Engler, Bot. Jahrb. Bd. 46. Leipzig 1911—12.
ROSENVINGE, L. KOLDERUP, The Marine Algae of Denmark. Part I. Rhodophyceae. D. Kgl. Danske Vidensk. Selskab, Skrifter, Naturv. og mathem. Afd. 7, VII, 1. København 1909.
SCHMITZ, FR., Marine Florideen von Deutsch-Ostafrika. Engler, Bot. Jahrb. Bd. 21. Leipz. 1896.
SUHR, I. N., Beiträge zur Algenkunde. Verhandlungen der Kaiserlichen Leopoldinisch-Carolinischen Akademie der Naturforscher. Bd. 18. 1stes Supplement. Breslau und Bonn 1841.
SVEDELIUS, N., Zytologisch-Entwicklungsgeschichtliche Studien über Scinaia Furcellata. Ein Beitrag zur Frage der Reduktionsteilung der

nicht tetrasporenbildenden Florideen. Nova Acta Regiae Soc. Scient. Upsaliensis. Ser. IV. Vol. 4, no. 4. 1915. Upsala.

Svedelius, N., Über den Bau und die Entwicklung der Spermatangiengruben bei der Florideengattung Galaxaura. Botaniska Notiser. Lund 1939.

— Anatomisch-entwicklungsgeschichtliche Studien über die Florideengattung Dermonema (Grev.) Harv. Botaniska Notiser 1939. Lund.

— Cystokarpieutvecklingen hos Galaxaura Diesingiana Zanard., en ny utvecklingstyp bland floridéerna. Svensk Botanisk Tidskrift. Bd. 35. 1941. Uppsala.

Tseng, C. K., Economic Seaweeds of Kwangtung Province, S. China. Lingnan Science Journal, Vol. 14, 1935. Canton, China.

— Notes on some Chinese Marine Algae, Lingnan Science Journal, Vol. 17. 1938.

Weber-van Bosse, A., Liste des Algues du Siboga. Siboga-Expeditie, LIX a, b, c, d. Leide 1913—28.

Wolfe, J. J., Cytological Studies on Nemalion. Annals of Botany. Vol. XVIII. London 1904.

Yamada, Y., The species of Liagora from Japan, Scientific Papers of the Institute of Algological Research. Vol. II, No. 1. Sapporo, Japan 1938.

Yendo, K., Notes on Algae new to Japan. I—VIII. The Botanical Magazine. Tokyo 1909—18.

Zanardini, J., Algae novae vel minus cognitae in mari rubro a Portiero collectae. Flora. Regensburg. 1851.

Zeh, W., Neue Arten der Gattung Liagora. Notizblatt des Königl. bot. Gartens und Museums zu Berlin. Bd. V (1908—12) p. 268. Leipz. 1913.

# INDEX OF SPECIES

together with some more important synonyms, the latter printed in italics.




Indleveret til Selskabet den 26. Februar 1942
Færdig fra Trykkeriet den 13. Juli 1942.

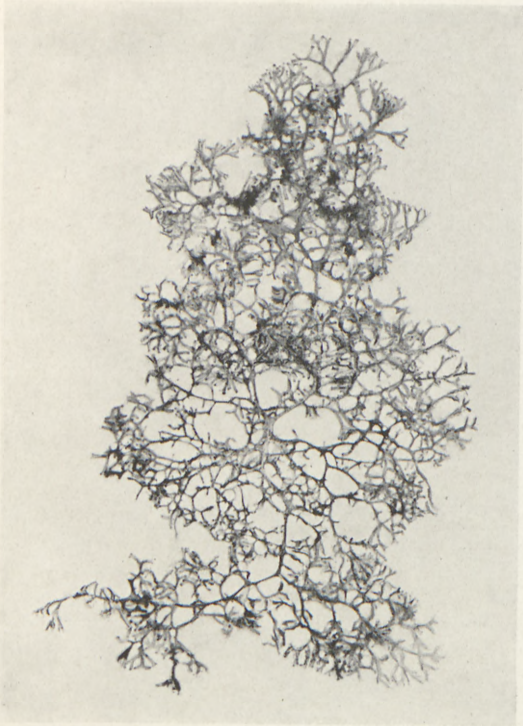


Fig. 1. *Liagora lurida* Dickie. ($^{9}/_{10}$ natural size).

Fig. 2. *Liagora Jadinii* Børgs. ($^{9}/_{10}$ natural size).

Fig. 3. *Liagora Mauritiana* Børgs. ($^9/_{10}$ natural size).

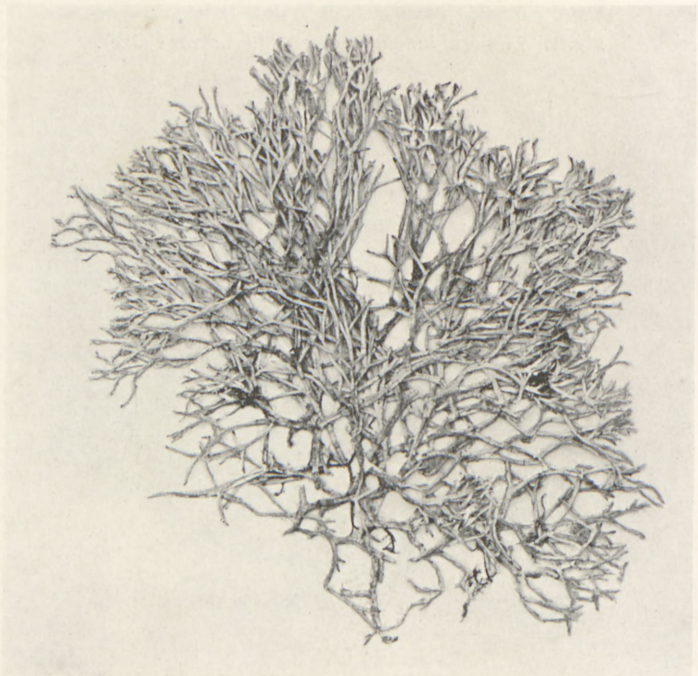


Fig. 4. *Liagora cladonioides* Børgs. ($^9/_{10}$ natural size).