

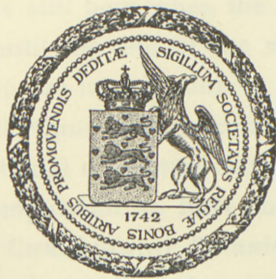
Det Kgl. Danske Videnskabernes Selskab.
Biologiske Meddelelser. **XVI**, 3.

SOME MARINE ALGAE FROM MAURITIUS

II. PHAEOPHYCEAE

BY

F. BØRGESEN



KØBENHAVN
EJNAR MUNKSGAARD

1941

Det Kongelige Videnskabskabernes Selskab.
Biologiske Meddelelser. XVI, 3.

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KØBENHAVN
Printed in Denmark.
Bianco Lunos Bogtrykkeri A/S.

In the introduction to the first part of this paper containing the *Chlorophyceae* I have already given information as to the material and its collectors, so I shall here merely mention that the essential portions of the material upon which the present part is based were collected partly by Dr. TH. MORTENSEN, Copenhagen, and partly by Dr. R. E. VAUGHAN. The latter has continued to send me parcels with algae and he has also taken a collection with him to England, when on leave there, but unfortunately the war has prevented me from getting it.

Thanks to Sir ARTHUR HILL, Director of the Royal Botanic Gardens, Kew, and to the keeper of the herbarium, Dr. A. D. COTTON I borrowed for study in Copenhagen the *Phaeophyceae* from Mauritius kept in the Kew Herbarium. This collection was still here when the war broke out and will remain here until the end of the war.

As mentioned in the introduction to part I, The *Chlorophyceae*, several collections of algae from Mauritius are found in the Muséum National d'Histoire Naturelle, Paris, but the war has made it impossible to have them sent.

Professor OTTO CHR. SCHMIDT, Botanisches Museum, Berlin, Dahlem, has most kindly informed me, that a collection of algae from Mauritius, made by the well-known Bohemian physician and traveller, Dr. F. W. SIEBER, is found in the Botanical Museum there, but as this collection has

not been kept separate and no list of the species is available, they were not able at present to send them.

Of former works dealing with the algae of Mauritius the most important have been mentioned in the introduction to the first part.

I am much indebted to Professor W. A. SETCHELL, Berkeley, Cal., who, with his usual kindness, has determined the specimens of *Sargassum* found in Dr. VAUGHAN'S collection. A number of 5 species were present in this collection and Professor SETCHELL has informed me that they were highly interesting, being rare and very little known species.

Otherwise with a few exceptions the war has prevented me from coming in contact with colleagues in foreign countries.

In the following list 38 species of *Phaeophyceae* are mentioned of which 13 are species of *Sargassum*. No doubt later investigations will increase the number a good deal. JADIN mentions 25 species in his list.

To the Trustees of the Carlsberg Foundation I am much indebted for a grant for continued algological researches.

PHAEOPHYCEAE

ISOGENERATAE.

I. Ectocarpales.

Fam. 1. *Ectocarpaceae*.

Ectocarpus Lyngb.

The material from Mauritius contains 6 species of *Ectocarpus*; two of these are described as new species.

According to our present knowledge the remaining 4 species appear to be widely spread in tropical seas. One of these *Ect. breviarticulatus* J. Ag. (= *Ect. spongiosus* Dickie and *Ect. hamatus* Crouan) is a characteristic and easily known species which was first described by J. AGARDH upon material from Mexico but has afterwards been found in many localities in the Indian and Pacific Ocean and the West Indies.

The 3 remaining species: *Ect. indicus* Sonder, *Ect. Mitchellae* Harv. and *Ect. irregularis* Kütz. have in the course of time caused much confusion especially because the description of two at least were at first poor and defective and an identification accordingly difficult. No wonder therefore that, when one of these plants was found far away from the original locality and when examined more carefully did not agree very well with the original description,

it was considered to be a distinct species. And what has added still more to the confusion is the fact that they often occur mingled together in the same tuft, and as their thalli are very alike and of nearly the same ramification they have sometimes been supposed to belong together, sporangia of rather distinct shape being in this way attributed to the plant. This applies especially to *Ect. indicus* Sonder which has long been a bone of contention, owing largely of course to the very defective diagnosis of SONDER. I, too, in earlier publications have felt rather inclined to give up this species, but all the same I have now come to the conclusion that *Ect. Duchassaingianus* Grunow is in reality the same species as that of SONDER; hence, though SONDER's description is bad and his species therefore ought to be rejected, while GRUNOW's is good, according to the rules of nomenclature, SONDER's specific name must replace that of GRUNOW. *Ect. Duchassaingianus* was first described by GRUNOW upon West Indian material but it has gradually become evident that it has a wide distribution in tropical seas.

Besides the above mentioned 4 *Ectocarpus* species *Ectocarpus terminalis* Kütz. or as it is now more correctly called *Hecatonema terminalis* (Kütz.) Kylin seems also to be widely spread in tropical seas.¹

But when compared with the very great number of *Ectocarpus* species found in northern seas the number of species occurring in tropical seas seems to be small, compare for instance: WEBER, A., *Algues Siboga*, 1928, p. 484 and OKAMURA, K., *The distribution of Marine Algae in Pacific Waters*, 1932 and OTTO CHR. SCHMIDT, *Verzeichnis der Meeresalgen von Neu-Guinea und dem westl. Oceanien*. 1928.

¹ This species is also found in India, for the plant I have called *Ectocarpus Enhali* (BØRGESEN, 1937, p. 8) is in reality this species.

1. *Ectocarpus Mitchellae* Harv.

HARVEY, W. H., *Nereis* Bor.-Am., 1851, p. 142, pl. XII G. BØRGESEN, *Mar. Alg. D. W. I.*, 1914, p. 162, figs. 129—130. SETCHELL and GARDNER, *Mar. Alg. Pacif. Coast*, Melanophyceae, 1925, p. 428. BØRGESEN, *Some Indian green and brown Algae*, I, 1930 p. 165, p. 8. FELDMANN, *Algues Côte des Albères*, I—III, 1937, p. 106. HAMEL, *Phéophycées de France*, 1931—39, p. XIV. BØRGESEN, *Iranian Gulf Algae*, 1939, p. 75, figs. 16—17. — *Ectocarpus virescens* Thur. in SAUVAGEAU, *Sur l'Ectocarpus virescens*, 1896, p. 17, figs. 1—7. BØRGESEN, *Mar. Alg. Canary Isl.*, II, 1926, p. 18, figs. 9—10. SVEDELIUS, *On the number of Chromosomes etc.*, 1928, p. 289, figs. 1—4. SAUVAGEAU, *Sur quelques Algues Phéosporées*, 1933, p. 67, figs. 15—16.

According to HAMEL's division of the genus *Ectocarpus* (HAMEL, 1939, p. 65 and 1939, p. X) this species belongs to the genus *Giffordia* Batters.

Several specimens in Dr. VAUGHAN's collection are referable to this species and as was the case in the Indian and Iranian material examined by me (BØRGESEN, 1930, p. 165; 1939, p. 75), plurilocular as well as unilocular sporangia are found, and I have also succeeded in finding a few antheridia.

SAUVAGEAU, in his valuable paper (1933, p. 65), where the plant is referred to as *Ect. virescens* Thur., mentions that he has found four kinds of sporangia in this species. For many years only mega- and meiosporangia (SAUVAGEAU, 1896, p. 17) were known, and although he continued to search SAUVAGEAU had never met with other kinds of sporangia, the spores of which SAUVAGEAU had found were able to germinate in cultures, spores of meiosporangia producing plants with meiosporangia, spores of megasporangia producing plants with megasporangia. And by cytological investigation of material sent him by SAUVAGEAU SVEDELIUS (1928, p. 296—300) found that the two kinds of plurilocular sporangia of *Ect. virescens* are cytologically similar, being

both haploid with a number of about 10 chromosomes. It was therefore suggested (see SVEDELIUS, p. 300) that *Ect. virescens* had lost its sexuality.

Then on "le 31 mars 1932" SAUVAGEAU was fortunate enough to find at Guéthary upon a fragment of *Codium tomentosum* a small plant which besides meiosporangia had unilocular sporangia; these occurred side by side on the same plant in agreement with those found by me in Indian and Iranian material. With these unilocular sporangia SAUVAGEAU established several cultures and in one of these he obtained plants with megasporangia as well as with antheridia. The antheridia have nearly the same shape as the megasporangia but their colour is paler and the loculi are quite small. SAUVAGEAU did not find out if fertilization took place. But as the spores in the following cultures developed successively some generations with antheridia and megasporangia similar to the first one without any alternation of generations, SAUVAGEAU concludes that the spores must have germinated parthenogenetically.

Since SAUVAGEAU's discovery of unilocular sporangia and antheridia in this plant no cytological examination of it has been made. But even if a fertilization of the spores of the megasporangia and the antheridia, as supposed by SAUVAGEAU, did not take place in the cultures, one is justified in supposing that under normal conditions such a fertilization would occur, and the result of this would be a diploid plant with unilocular sporangia in which the reduction division would take place.

This is briefly, according to SAUVAGEAU, our knowledge of the development of this plant, and SAUVAGEAU therefore suggests that *Ect. virescens*, which, because of the shape of its plurilocular sporangia, belongs to a group of spe-

cies¹ inhabiting warm seas, might be a species that had immigrated to more temperate seas and consequently had partly lost its old characters or partly acquired some new qualities. SAUVAGEAU says (1933, p. 79): "Par suite, on concevrait que ses organes reproducteurs eussent perdu ou eussent acquis, en voyage, certaines propriétés, comme nous voyons l'*Asparagopsis hamifera*, d'importation récente, se multiplier chez nous uniquement par parthénogénèse. Les autres espèces du groupe, qui sont restées cantonnées dans leur pays d'origine, et en particulier l'*Ect. Duchassaingianus* et l'*Ect. indicus* laisseraient probablement préciser la signification des différents reproducteurs, mieux que l'*Ect. virescens*."

After these introductory remarks I shall proceed to give a description of the specimens of this plant from Mauritius and begin with no. 300 in Dr. VAUGHAN'S collection. In the specimens of this number I have found meiosporangia, unilocular sporangia and further more a few antheridial sporangia.

¹ According to SAUVAGEAU (1896, p. 39) this group of species consists of the following 9 species: *Ect. Mitchellae* Harvey, *Ect. indicus* Sonder, *Ect. amicorum* Harv., *Ect. Duchassaingianus* Grunow and 5 species of CROUAN mentioned in MAZÉ et SCHRAMM, "Essai de classification des Algues de la Guadeloupe", 2^e édit., p. 109, but these 5 species are nomina nuda and must therefore be left out of consideration. To one of them *Ectoc. guadeloupensis* Crouan Mlle VICKERS has referred a plant of which she has published a figure in her "Phycologia Barbadosensis", pl. XVIII; but in my opinion this is referable to *Ect. Mitchellae*, being a form with short sporangia. Regarding the four first-mentioned species *Ect. virescens* Thur. is, as already previously pointed out by me, the same species as *Ect. Mitchellae* Harv. and being the oldest name (1851) HARVEY'S name has to be maintained. *Ect. indicus*, according to my interpretation of this species in this paper is like *Ect. Duchassaingianus* and seems to be a well-defined species; compare p. 16 in this paper. And finally *Ect. amicorum* is surely nothing but a form of *Ect. Mitchellae* with short sporangia; compare my remarks p. 15 in this paper.

The meiosporangia were the commonest. Fig. 1 *a* shows some of these sporangia having the common typical shape and size with a length of about 70—110 μ and a breadth of about 24—30 μ and the loculi about 5—7 μ high. The

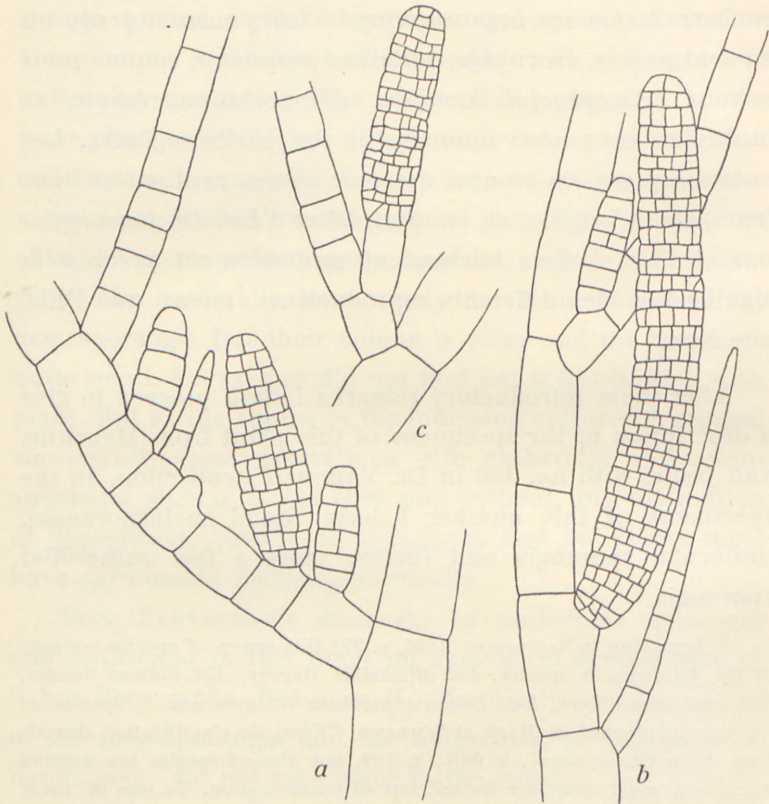


Fig. 1. *Ectoc. Mitchellae* Harv.

a, part of a typical form; *b*, a long sporangium; *c*, a pedicellate sporangium. ($\times 350$).

sporangia are nearly always sessile, SAUVAGEAU in his diagnosis of the species (1896, p. 38) also says "semper sessilibus"; nevertheless it may happen, even though it is rare, that a sporangium is pedicellate as Fig. 1 *c* shows. Sometimes, also, very long sporangia are found in plants in which

the sporangia are otherwise of normal size. Fig. 1 *b* shows such a sporangium the size of which is: length: $217\ \mu$, breadth: $27\ \mu$ and height of loculi: $5\text{--}6\ \mu$.

Furthermore, in this collection unilocular sporangia were present in abundance (Fig. 2). They were found in specimens in which meiosporangia also occurred. Both kind

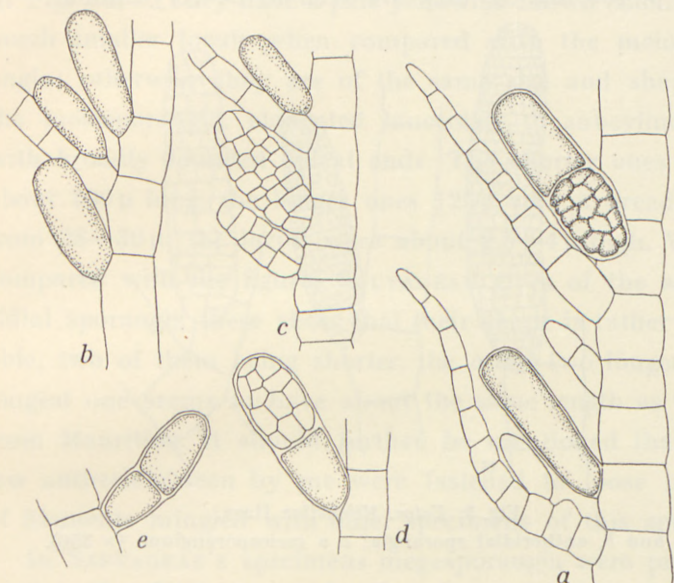


Fig. 2. *Ectoc. Mitchellae* Harv.

a, part of the thallus with unilocular sporangia, the lower part of the uppermost sporangium is plurilocular; *b*, unilocular sporangia, *c*, plurilocular and unilocular sporangia in the same filament; *d*, a sporangium the upper half plurilocular, the lower unilocular; *e*, a unilocular sporangium divided into two parts. ($\times 350$).

of sporangia are found side by side on the same filament (Fig. 2 *c*). In a few cases I have even found sporangia half of which were unilocular and the other half plurilocular (Fig. 2 *a*, *d*). Now and then a unilocular sporangium is also divided by a horizontal wall into two parts (Fig. 2 *e*). The shape and size of the unilocular sporangia agree quite well

with those found by SAUVAGEAU in plants from Guéthary; when compared with his figure the only difference seems to be that the sporangia in the plant from Mauritius are as a rule more cylindrical than the French ones. Their size was: length: 47—56 μ , breadth: 19—28 μ . When compared with my figures of those from Dwarka (BØRGESEN, 1930, p. 165, fig. 8), they are seen to be very similar.

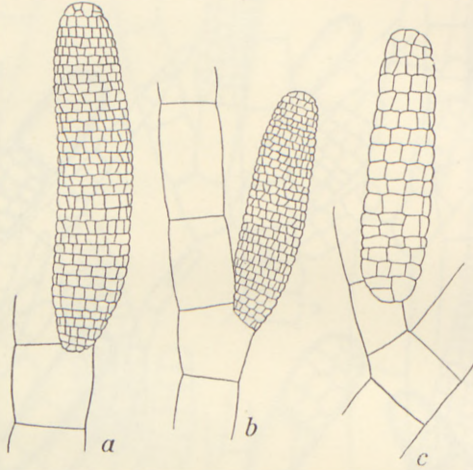


Fig. 3. *Ectoc. Mitchellae* Harv.

a and *b*, antheridial sporangia; *c*, a meiosporangium. ($\times 350$).

The phenomenon of unilocular and plurilocular sporangia occurring together in the same plant seems to be rather peculiar in the light of SVEDELIUS' observation that the meiosporangia are haploid, whereas the unilocular sporangia in conformity to what is otherwise the case must be presumed to be diploid; the plurilocular sporangia are then presumed to be diploid also. And since, as mentioned above, half a sporangium may be unilocular and the other half plurilocular, this interpretation must surely be the right one.

Instances of both kind of sporangia occurring in the same plant are also found in other species; concerning

Pylaiella littoralis see for instance DAMMANN, 1930, pp. 8—9, and MARGERIE KNIGHT, 1923, p. 355, fig. 12, and KYLIN has found that the same applies to *Ectocarpus siliculosus* (1933, p. 19).

Finally I have also succeeded in finding antheridia in this collection. Two of these antheridial sporangia are seen in Fig. 3 a, b. They have a pale yellowish-brown colour and much smaller loculi when compared with the meiosporangia; otherwise they are of the same size and shape as the meiosporangia, elongated lanceolate to subcylindrical with broadly rounded apical ends. The shorter ones were about 100μ long, the longer ones 125μ with a breadth of from $28-30\mu$; the loculi were about $2.5-4\mu$ high. When compared with the figures SAUVAGEAU gives of the antheridial sporangia these show that their shape is rather variable, two of them being shorter, the other two longer, the longest one seems to have about the same length as those from Mauritius. It should further be mentioned that the few antheridia seen by me were fastened to loose pieces of filaments mingled with other specimens of this species.

In SAUVAGEAU'S specimens megasporangia were present together with the antheridia, but in spite of much searching I have not succeeded in finding such in the material from Mauritius. According to SAUVAGEAU plants with megasporangia are upon the whole rare; while those with meiosporangia are common those with megasporangia have only been found in two places at Guéthary. Furthermore specimens with megasporangia have, as mentioned by SAUVAGEAU, been found twice at Las Palmas, Canary Islands, once by Mlle VICKERS and once by myself, and they are most probably rare there.

In another collection of Dr. VAUGHAN'S (no. 208) the specimens have unilocular as well as plurilocular sporangia

in great numbers, both occurring together in the same plant. The shape of the unilocular sporangia (Fig. 4 *a*) was somewhat broader, ovate-lanceolate, agreeing very well with SAUVAGEAU's drawings. The sporangia were 60—80 μ long and about 42 μ broad. But less broad more cylindrical sporangia were also present. Several of the meiosporangia were long.

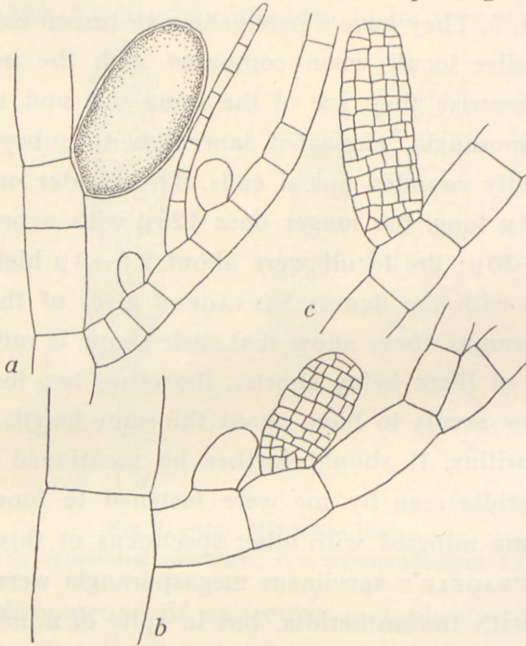


Fig. 4. *Ectocarpus Mitchellae* Harv.

a, piece of the thallus (no. 208) with a unilocular sporangium; *b*, part of a plant (no. 271) with short sporangia; *c*, a plurilocular sporangium of about normal size, from the same plant. ($\times 350$).

In a collection (no. 299) growing upon a piece of *Codium* plurilocular and unilocular sporangia were likewise found together on the same specimens. The plurilocular sporangia (all meiosporangia) had as a rule a length of 80 μ and a breadth of 28 μ but much longer sporangia were often found, for instance about 150 μ long, one being even

190 μ long. The unilocular sporangia were subcylindrical, ca. 70—80 μ long and 23—26 μ broad. In this collection, too, there occurred sporangia half of which were unilocular and the other half plurilocular (Fig. 5 a). Another peculiarity was that in several of the plurilocular sporangia the spores had begun to germinate. A specimen in the same collection had quite short plurilocular sporangia (Fig. 5 b).

In another collection (R. E. V. no. 271) the sporangia were like the above mentioned specimen, rather short, about 50 μ long only and 27 μ broad (Fig. 4 b), thus agreeing with those found by me in the Iranian Gulf which I called forma *brevicarpa* (1939, p. 76, figs.

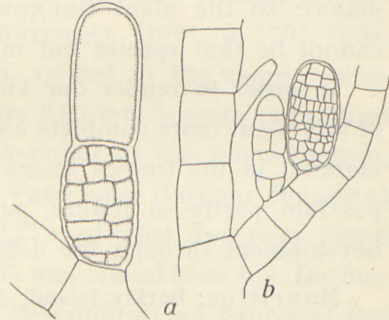


Fig. 5. *Ectoc. Mitchella* Harv.
 a, a sporangium plurilocular below, unilocular above. b, part of a plant with short plurilocular sporangia.
 (a, $\times 450$; b, $\times 350$).

16 and 17). While the sporangia in the material from Mauritius except for being short had the normal cylindrical form of this species in the Iranian material, some few sporangia of more irregular shape were met with, one even becoming broader upwards (l. c. fig. 16 c) and thus reminding one of *Ect. indicus*. As the loculi in some of these sporangia from the Iranian Gulf were rather small they might be antheridia which, according to SAUVAGEAU's figure (1933, Fig. 16), have a rather variable shape. In agreement with the Iranian plant I presume that the plant from Mauritius with short sporangia, too, is like *Ect. amicum* Harv., Friendl. Isl. Alg., no. 8, of which, I must admit, I have not seen any specimen, but about which GRUNOW (1874,

p. 24) writes: "scheint mir von *Ect. indicus* nur sehr schwach durch etwas kürzere Zoosporangien verschieden zu sein". And the reason why I take it for granted that the plant GRUNOW calls *Ect. indicus* is like *Ect. Mitchellae* and not like *Ect. indicus* SONDER as I interpret this species in this paper, is that GRUNOW himself has created *Ect. Duchassaingianus*; so the plant GRUNOW refers to SONDER'S species cannot be that species but must surely be *Ect. Mitchellae*.

In order to render our knowledge of the development of this plant more complete a detailed examination of living material in the tropics seems necessary; it would then be possible partly in nature, partly in cultures, to study its development through the different seasons of the year.

Mauritius: Barkly Island, Aug. 1839, R. E. V. no. 332. Point aux Roches, "on *Sargassum*", R. E. V. no. 271. Some other specimens of Dr. VAUGHAN, nos. 300, 299 and 208 without localities. Geogr. Distr.: Widely distributed in warm seas.

2. *Ectocarpus indicus* Sonder.

SONDER, in ZOLLINGER, Verz. der im Ind. Arch. ges. Pflanzen, 1854, p. 3, not seen, but SONDER'S diagnosis is reprinted by ASKENASY in "Alg. Gazelle", p. 19¹. WEBER, A., Algues Siboga, 1913, p. 129, fig. 34. — *Ect. Duchassaingianus*, Grunow, Alg. Novara, 1870, p. 45, tab. IV, fig. 1a, b, c. BØRGESEN, Mar. Alg. D. W. I., vol. I, 1914, p. 159, figs. 127—8. SETCHELL, W. A., American Samoa, 1924, p. 170, fig. 35.

Happening to find in a glass from Dr. VAUGHAN'S collection an *Ectocarpus* referable to *Ect. Duchassaingianus* Grun., agreeing with my description and figures of this species in Mar. Alg. D. W. I., vol. I, p. 159, I felt inclined to carry out a comparative investigation of this species and other related forms. Among these I took in consideration also

¹ The plant ASKENASY here refers to *Ect. indicus* is in my opinion not SONDER'S plant, but a form of *Ect. Mitchellae* with short sporangia.

the figure of *Ect. indicus* Sonder which Mme WEBER has drawn after SONDER's original specimen, and suddenly it struck me that this figure was most certainly drawn after a specimen of a plant identical with *Ect. Duchassaingianus*, not only the figure but also her description of it answering very well to this species. Accordingly I went through the literature and discovered that this was my opinion already in 1914 (p. 160) and later SETCHELL (1924, p. 170), independently of my observation, arrived at the same conclusion that Mme WEBER's figure 34 from SONDER's specimen is referable to *Ect. Duchassaingianus*. It was when examining a tuft of *Ectocarpus* from Pago Pago Harbour consisting of 4 different species (nos. 1137 a—d) that SETCHELL found that one of these (no. 1173 b) was referable to *Ect. Duchassaingianus*, agreeing with my description and figures of this species.

But while I quite agree with SETCHELL regarding this determination, I regret that I am not able to join him in his identification of another plant found in the same collection (no. 1173 a) which is referred to *Ect. indicus* Sonder. Because of SETCHELL's description, measures of sporangia and the good figure accompanying the description I feel sure in agreement with what I have previously suggested that this figure originates from a plant referable to *Ectocarpus Mitchellae* Harv. as at any rate now I look upon this species in accordance with my description and figures of it given above.

The arguments upon which SETCHELL bases his point of view concerning Mme WEBER's figure of SONDER's plant are as follows. SETCHELL presumes that SONDER's plant, like the tuft of *Ectocarpus* from Pago Pago Harbour, is composed of several species of *Ectocarpus*, and that SON-

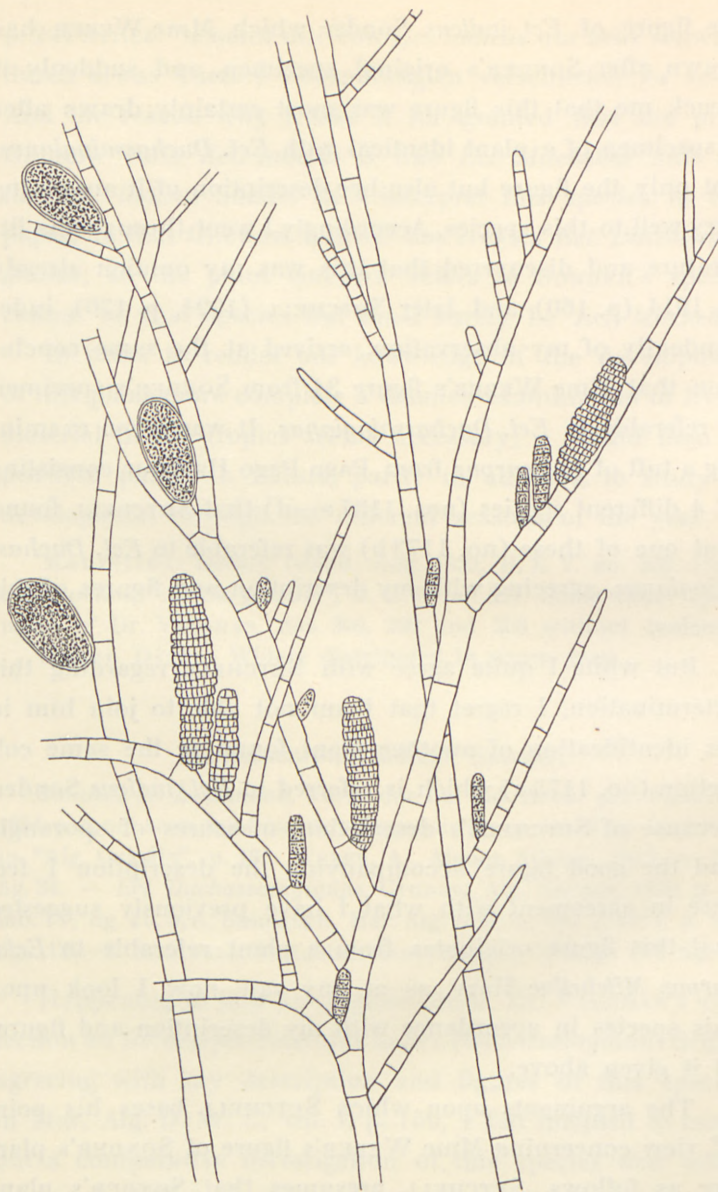


Fig. 6. *Ectocarpus indicus* Sonder.
Fragments of the thallus with plurilocular and unilocular sporangia.
($\times 175$).

DER's description is based upon one species in the tuft and Mme WEBER's figure upon another since SETCHELL does not think that her figure agrees very well with SONDER's description.

SETCHELL writes: "SONDER says, "bipollicaris vel ultra", but Mme WEBER's plant is, judging from her figure, not much over 0.333 to 0.25 of an inch (about 0.5 cm) high. In the second place, SONDER's description reads: "Filis decomposito-ramosissimis, ramis ramulisque alternis subsecundis". Mme WEBER's plant can not be called "decomposito-ramosissimis". It is thus its small size and its ramification which prevent SETCHELL from referring the plant Mme WEBER has drawn to SONDER's species, nevertheless it is referred to *Ect. Duchassaingianus* about which I say in my description of it that in the West Indies it forms tufts up to 4 cm high. And further, as regards its ramification, it is a very variable and often much ramified plant as is also pointed out in the description below of the specimens from Mauritius.

And there is one thing more I should like to point out in favour of my view. Mme WEBER says distinctly (1933, p. 131) that she has examined several authentic specimens of SONDER ("mais l'étude des échantillons authentiques de SONDER"). Would it not be strange that, if SONDER's specimens really consists of several species, she should not have met with some of the others? I therefore do not see any objection to the assumption that Mme WEBER's figure is like *Ect. indicus* Sonder.

And as we have now in Mme WEBER's figure of SONDER's authentic specimens a reliable representation of it, it seems to me most opportune to take this first published figure of SONDER's plant as a representation of his species.

Then we should also in a way be in accordance with Mme WEBER, even though the identity of SONDER's plant with *Ect. Duchassaingianus* did not occur to her.

Consequently GRUNOW's specific name from 1870, since SONDER's dates from 1855, has to be replaced by *Ect. indicus* Sonder. If this be done, this species, questionable for so many years, will no longer cause us trouble.

This species, as interpreted here, was at first described by SONDER upon material from Bima, where it was also later collected by Mme WEBER. GRUNOW described *Ect. Duchassaingianus* (1870, p. 45, pl. IV, fig. 1 a, b, c) upon material from Guadeloupe. Later I have found it in the former Danish West Indies, where it was a very common species.

Referring to my former description and figures (1915, p. 159) where the irregular ramification and the variable shape of the plurilocular sporangia are reported, I may mention here that in the material from Mauritius I have twice met with this species. In these two collections the plant was rather differently developed, most probably due to the external conditions of life. One of them (R. E. V. no. 332) forms a 3—4 cm high tuft composed of long and flabby very little ramified, loosely intermingled filaments with very few sporangia; some of these are drawn in figure 7 a, b, c. This plant has most probably lived in a sheltered locality with stagnant water. In the other collection (R. E. V. no. 287) the thallus of the plant, being an epiphyte upon *Acanthophora*, was small, only $\frac{3}{4}$ cm high; it was densely ramified with numerous dark brown plurilocular sporangia and also some unilocular sporangia (Fig. 6). This plant, I presume, has grown in a strong light and a more exposed locality.

The plurilocular sporangia of this species are rather irregularly shaped, often clavate becoming thicker upwards, or they may be more or less swelled in their middle, and their margin is uneven. They are mostly sessile but now and then stipitate, or they may be terminally placed upon

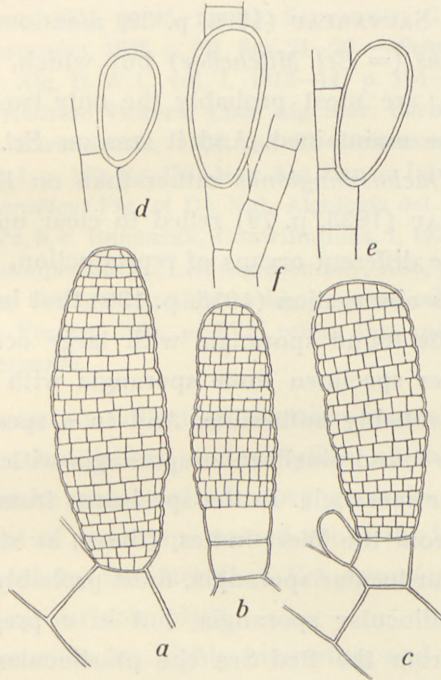


Fig. 7. *Ectocarpus indicus* Sonder.

a, b, c, three plurilocular sporangia, two of which are pedicellate. *d, e, f*, three unilocular sporangia. (*a, b, c*, $\times 450$; *d, e, f*, $\times 350$).

shorter or longer branches; but being a variable plant in some specimens, for instance that of which a part is shown in figure 6, no pedicellate sporangia were present, nor were the sporangia particularly clavate. The loculi in the plurilocular sporangia are about $5-6\mu$ high. The unilocular sporangia occurring together with the plurilocular ones in the same plant (Fig. 6) are obovate-pearshaped with thick

walls and rather large, the three sporangia pictured (Fig. 7 *d, e, f*) having a length of 90 μ , 120 μ and 133 μ respectively, while the breadth varied from 32 μ —57 μ ; their shape and size agree very well with those from the West Indies.

Ectoc. indicus belongs to the group of 9 species of *Ectocarpus* which SAUVAGEAU (1896, p. 39) mentions as related to *Ect. virescens* (= *Ect. Mitchellae*) but which, as said in the note p. 9, are most probably the only two species of the nine to be maintained. And it was on *Ect. indicus* including *Ect. Duchassaingianus* rather than on *Ect. virescens* that SAUVAGEAU (1933, p. 79) relied to clear up the signification of the different organs of reproduction, referring to Mme WEBER's observation (1913, p. 130) that in specimens from Bima she found sporangia with large oculi (7—8 μ) and in another specimen some sporangia with very small loculi most probably antheridia. And in a specimen from Kangeang she found plurilocular sporangia with large loculi and unilocular sporangia. In the specimens from Mauritius, as in those from the West Indies, I have, as stated above, found only plurilocular sporangia, most probably meiosporangia, and unilocular sporangia, but in a preparation of this species from the Red Sea the plurilocular sporangia had very small loculi about 3—4 μ high and therefore are surely antheridia. Megasporangia, on the other hand, I have looked for in vain in the material I have examined.

But, as already stated about *Ect. Mitchellae*, the examination of living material in connection with cultures is necessary to be able to clear up the life-history of these species.

Mauritius: Flic-en-Flacq, 31. Dec. 1938, R. E. V. no. 287. Barkly Island, R. E. V. no. 332.

Geogr. Distr.: West Indies, Red Sea, Malay Archipelago, American Samoa etc.

3. *Ectocarpus irregularis* Kütz.

KÜTZING, *Phycologia germanica*, 1845, p. 234; *Spec. Alg.* p. 454; *Tabul. Phycol.*, vol. V, 621. HAUCK, *Meeresalgen*, 1885, p. 328. BORNET, *Algues SCHOUSBOE*, 1892, p. 245. KUCKUCK in OLTMANN'S, *Morphologie*, 1922, vol. II, p. 9, fig. 294. BØRGESEN, *Mar. Alg. Canar. Isl.*, II, *Phaeophyceae*, 1926, p. 25, figs. 12—14. HAMEL, G., *Phéophycées de France*, *Ectocarpaceae*, 1931, p. 45, fig. 13. SAUVAGEAU, C., *Sur quelques Algues Phéosporées*, 1933, p. 101, figs. 24—26. — *Ectocarpus coniferus* Børgs., *Mar. Alg. D. W. I.*, vol. I, 1913—14, p. 164—9, figs. 131—32. *Ectocarpus Rallsiae* Vickers, *Liste Alg. mar. Barbade*, 1905, p. 59; *Phycologia Barbadosensis*, 1908, pl. 32. BØRGESEN, F., *Mar. Alg. D. W. I.*, vol. I, p. 169, fig. 133; *Mar. Alg. Canar. Isl.*, II, p. 23, fig. 11. *Ectocarpus arabicus* Fig. et De Not., *Algologia del Mar Rosso*, 1853, p. 169, fig. Va, b, c. BØRGESEN, *Contributions*, I, 1937, p. 5—8, fig. 1. *Ectocarpus coniger* Børgs., *List Alg. Bombay*, 1935, p. 31, figs. 14—16.

HAMEL in the introduction to his very valuable work: *Phéophycées de France*, 1939, p. XVII refers this species to his new genus *Feldmannia*.

Dr. VAUGHAN'S collection contains several specimens of this species but before a description of them is given I wish to make some introductory remarks in connection with the list of synonyms named above the length of which list is caused by the fact that *Ect. irregularis* has proved to be a very variable plant.

SAUVAGEAU in his highly interesting and valuable paper (1933, p. 101) has given a detailed description with instructive figures of various forms of *Ectocarpus irregularis* Kütz. based upon material from Biarritz and Guéthary. Of the specimens examined by SAUVAGEAU one plant, growing upon *Lithothamnion*, had the sporangia produced in short rows at the base of the branches, very like the West Indian *Ect. coniferus* described by me in 1913; and another form, the basal creeping filaments of which were immersed in *Codium adhaerens* had very large sporangia narrowed at their upper ends, completely like those found in *Ect. Rallsiae* Vickers

likewise from the West Indies. Because of his discovery of these forms SAUVAGEAU also makes comparisons with the West Indian species and as a result of his examination he concludes: "Ainsi, ces trois espèces . . . n'offrent entre elles que des différences légères. Ne connaissant les *Ect. Rallsiae* et *Ect. coniferus* que par les descriptions d'A. VICKERS et de BØRGESEN, je n'ai pas à prendre parti dans la question de leur indépendance spécifique". To this I wish to say that SAUVAGEAU's discoveries must be said to eliminate altogether all doubt as to the specific connection of these three species. When in 1913 I described *Ect. coniferus* the European *Ect. irregularis* was poorly known as KÜTZING's figure (l. c., tab. 62 I) is rather misleading and his description not much better. The most complete description from that time was BORNET's (1892, p. 245) but it is without figures and as said by himself to be based on badly preserved material. When I discovered the West Indian plant I therefore asked my regretted friend KUCKUCK for information about *Ect. irregularis*, knowing that at that time he was working at a monographic treatment of the genus *Ectocarpus*. KUCKUCK sent me for comparison a splendid drawing of this species, as far as I remember the original drawing of the figure later published in OLTMANN'S, "Morphologie", 1922, p. 9, fig. 294. On comparing this figure with the West Indian plant the near relationship of both plants was clear to me, but some differences were present. First of all, as shown in my figure 131 (BØRGESEN, 1914, p. 165), must be mentioned the characteristic unilateral arrangement of the sporangia in shorter or longer, often interrupted rows upon the upper side of the branches at their basal parts, whereas in KUCKUCK's figure the sporangia were placed solitarily and scattered up along the fila-

ment. But after SAUVAGEAU has succeeded in finding the same arrangement of the sporangia in the European plant this difference has been eliminated.

Regarding its geographical distribution *Ect. irregularis* was at this time known only from the Atlantic shores of Europe, from South England to the Golf de Gascogne and the Mediterranean Sea, a fact that also seemed rather important to me when creating the species, but later it has been found that *Ect. irregularis* has a very large area of distribution in warmer seas, in this and other respects forming a parallel to *Ect. Mitchellae* with which it often occurs intermingled. As it seems of interest in this connection to give some information about the distribution of this species I will briefly mention some dates here.

SAUVAGEAU (1933, p. 104) remarks: "L'*Ectocarpus irregularis* (ou une espèce affine) habite aussi l'Océanie." He refers to the plant from the Malayan Archipelago which Mme WEBER in "Liste", p. 131, figs. 35—36 mentions as *Ectocarpus spec.*, but which no doubt is *Ect. irregularis*.

And the plant from the island Vavau which ASKENASY in "Alg. Gazelle", 1888, p. 20, tab. V, figs. 1, 11, 14 calls *Ect. simpliciusculus* Ag. is most certainly a mixture of *Ect. irregularis* (Fig. 14), *Ect. Mitchellae* (Fig. 11) and *Ect. indicus* (Fig. 1) as I take these species. Likewise the plant from Deception Bay called by ASKENASY (1894, p. 8, pl. I, fig. 6 and pl. II, figs. 7 and 8) *Ect. indicus* is sure to be a mixture of *Ect. irregularis* and *Ect. Mitchellae*, the plant pictured in figs. 6 and 7 being referable to *Ect. Mitchellae*, whereas fig. 8 and most probably also fig. 9 on the same plate (determined as *Ect. simpliciusculus* var. *vitiensis*) are *Ect. irregularis*. It is more difficult to interpret what *Ect. indicus*, ASKENASY (1888, p. 19, pl. V, figs. 2, 10) is; but as ASKENASY says

about it that the sporangia are present in few numbers, and judging also from the figures, it seem likely that the material ASKENASY examined must have been young specimens of *Ect. Mitchellae*, the lowermost sporangium in fig. 10 being drawn with too pointed a summit.

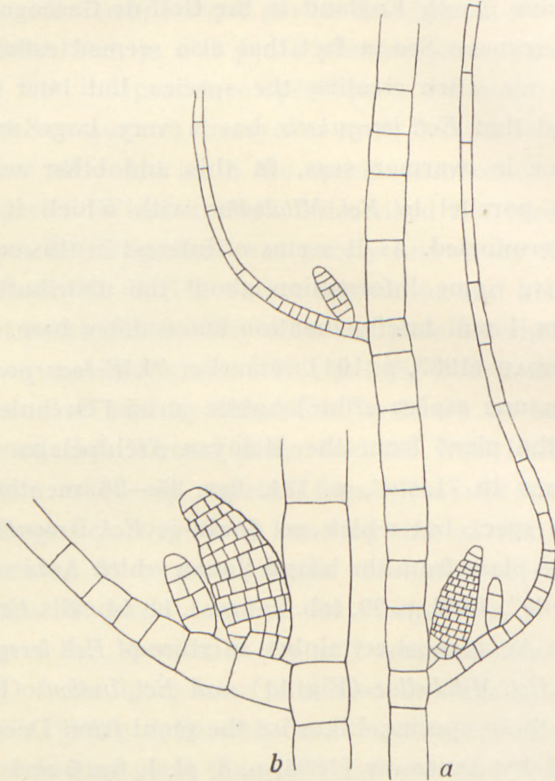


Fig. 8. *Ectocarpus irregularis* Kütz.
Parts of the thallus. (a, $\times 220$; b, $\times 350$).

Besides in the West Indies I have found *Ect. irregularis* at the Canary Islands; in my treatise (1926, p. 23 and p. 25) on these islands I called it *Ect. irregularis* and partly also *Ect. Rallsiae* because of the size of the sporangia which were often pedicellate, too.

Hence I do not hesitate to refer to this species the *Ectocarpus spec.* from Easter Island mentioned in my paper 1920, p. 257, fig. 8; the shape and size of the sporangium drawn in my figure agree very well with *Ect. irregularis*.

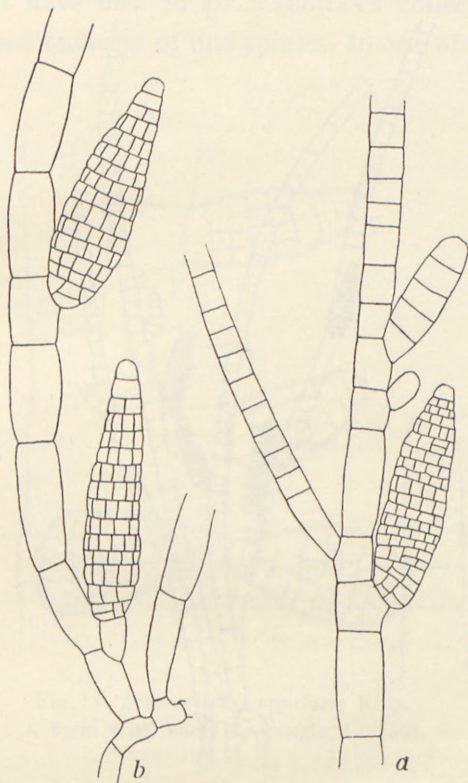


Fig. 9. *Ectocarpus irregularis* Kütz.

a, part of a filament higher up in the thallus; *b*, plurilocular sporangia from near the base of a plant. ($\times 350$).

Further it occurs in South India, where at first I referred it to *Ect. coniferus* (Contributions, I, 1937, p. 5) but later in a postscript in the same paper p. 7 to *Ect. arabicus* Figari et De Notaris. The authors described their species upon material from the Red Sea from where, thanks to

Dr. NASR (the University of Cairo), I have had the opportunity to examine well developed material and to ascertain that the plant from the Red Sea is in very good accordance with the West Indian plant, having often rather long rows



Fig. 10. *Ectocarpus irregularis* Kütz.
A young specimen. ($\times 80$).

of sporangia upon the up-turned sides of the branches. Unfortunately I had not yet at that time arrived at the conclusion that the West Indian and the European plants were the same, otherwise I should already then have referred the Indian plant and that from the Red Sea to *Ect. irregularis*. And according to my present conception of *Ect. irregu-*

laris, *Ect. coniger* which I described in 1935, p. 31 upon material from Bombay should rather be referred to *Ect. irregularis* as the characters upon which I based this species occur also in *Ect. irregularis*.

Finally I have now in Dr. VAUGHAN'S collection found well developed material of this species. In one of his gather-

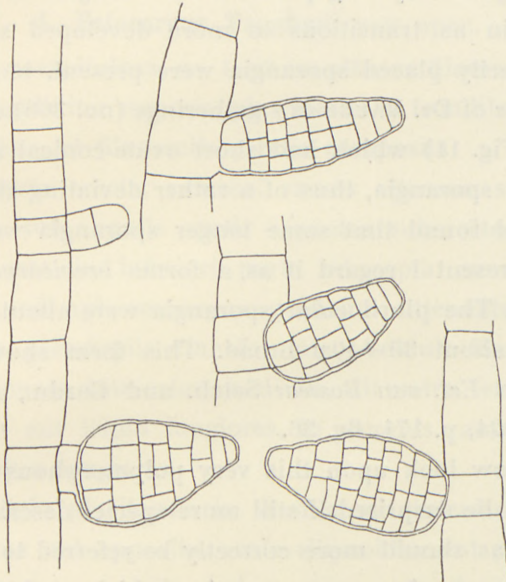


Fig. 11. *Ectocarpus irregularis* Kütz.
A form with short sporangia. ($\times 350$).

ings (no. 293) it was growing upon *Chnoospora implexa*. Fig. 8 shows parts of the plant with axillarily placed sporangia like SAUVAGEAU'S fig. 24; now and then the sporangia also occur scattered upon the main filaments (Fig. 9a). Some of the specimens upon *Chnoospora* were young (Fig. 10), agreeing well with SAUVAGEAU'S figures 25—26 of young plants found by him upon *Codium adhaerens*. From the basal filaments immersed in the cryptostomes of the host

plant erect, still unbranched, filaments protrude which, according to their age, have a zone of division lower or higher up in the filaments, and below this zone, often from near the base, several large elongated conical sporangia issue, reminding one of those of *Ectocarpus Rallsiae* (Fig. 9b). That these specimens, in spite of their deviating appearance, really were young plants of *Ect. irregularis* was easy to ascertain as transitions to more developed specimens with axillarily placed sporangia were present, too.

Another of Dr. VAUGHAN'S gatherings (no. 306) contained a plant (Fig. 11) which had short ovate-conical and often pedicellate sporangia, thus of a rather deviating shape; but after I had found that some longer sporangia were occasionally present I regard it as a forma *brevicarpa* of *Ect. irregularis*. The plurilocular sporangia were about 60—70 μ long and about 30—40 μ broad. This form shows much likeness to *Ect. van Bosseae* Setch. and Gardn., American Samoa, 1924, p. 171, fig. 36.

As I now look upon this very polymorphous species I should not be surprised if still more species described from tropical seas should more correctly be referred to this species. Of some of my own species which perhaps might come into consideration I may mention *Ect. filifer* and *Ect. thyrsoides* (BØRGESEN, Contributions, I, p. 10 and p. 12), both perhaps being only young specimens of *Ect. irregularis*. As both plants were growing upon *Liagora erecta* found in a very restricted locality it will surely be an easy matter to find more and better developed material upon which the question can be decided. And *Ect. cryptophilus* (BØRGESEN, 1931, p. 78) also may very well be a young stage of *Ect. irregularis*.

Mauritius: Tamarin Bay, "upon *Chnoospora implexa* in deep pools behind reef", R. E.V. no. 293; Savinia, Aug. 39, R. E.V. no. 306; Barkly Island, "on *Acanthophora*", R. E.V. no. 338.

Geogr. Distr.: From the English coast southwards to the Canary Islands, Northamerican coast, West Indies, Mediterranean Sea, Red Sea, Arabian Sea, Indian Ocean, Malayan Archipelago, Australia, Easter Island, Pacific Ocean.

4. *Ectocarpus Vaughani* nov. spec.

Frons caespitulosa, ca. 1—2 cm alta, ex filamentis repentibus, irregulariter ramosis, plus minus in frondibus hospitis nidulantibus, et filamentis erectis composita.

Filamenta erecta, ramosa, ramos alternos, sparsos vel oppositos, sub angulis acutis exeuntes, suberectos gerentia.

Filamenta in inferiori parte ad septa constricta, ca. $30\ \mu$ lata, ad apicem versus gradatim attenuata, ca. $15\ \mu$ lata et in pseudopila transformata. Articuli filamentorum per divisionem intercalarem divisi, diametro fere aequales vel duplo aut triplo longiores, in summis ramorum 5—6 plo vel ultra longiores.

Sporangia plurilocularia sessilia aut interdum pedicellata, sparsa aut opposita, ovato-ellipsoidea aut plus minus conico-elongata, apicibus plus minus rotundatis, $70\text{--}76\ \mu$ interdum ad $87\ \mu$ longa et $28\text{--}35\ \mu$ lata. Megasporangia vel meiosporangia vel antheridia praesentia sunt.

Mauritius: Flic-en-Flacq, on *Nemacystus decipiens*, "in shallow water near shore", 31 Dec. 1938, R. E.V. no. 252. Tamarin Bay, on *Chnoospora implexa*, "in pools behind reef". R. E.V., no. 293.

This fine little plant (Fig. 12) grows upon *Nemacystus decipiens* in the tissue of which its decumbent creeping basal filaments are more or less imbedded, and upon *Chnoospora implexa*.

It forms small tufts up to a height of about 1500 μ . The filaments of which the tuft is composed are ramified up

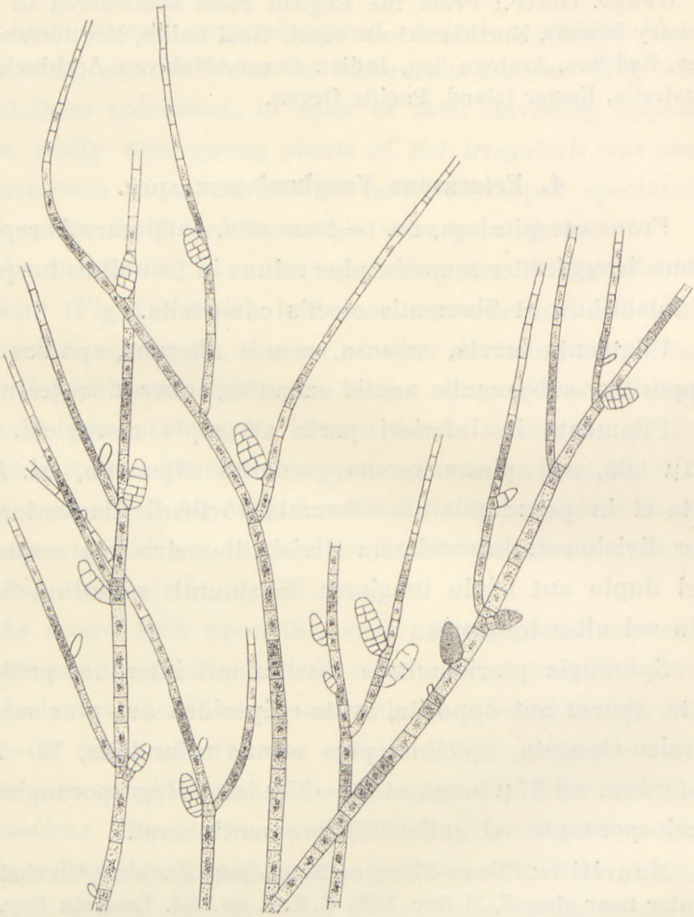


Fig. 12. *Ectocarpus Vaughani* nov. spec.

Some filaments of a tuft with megasporangia and antheridia. (\times ca. 100).

to $\frac{2}{3}$ of their height and carry sporangia; then follows a zone of division above which the filaments run out into long hair-like ends. Below the zone of division the cells in the filaments are divided intercalarily here and there,

and some short zones of division may be found, too. Because of this mode of division the length of the cells vary much.

The decumbent filaments (Fig. 13 *a*) are about 14—20 μ thick and composed of cells $1\frac{1}{2}$ —3 times as long. From these filaments the erect ones arise. These are slender at

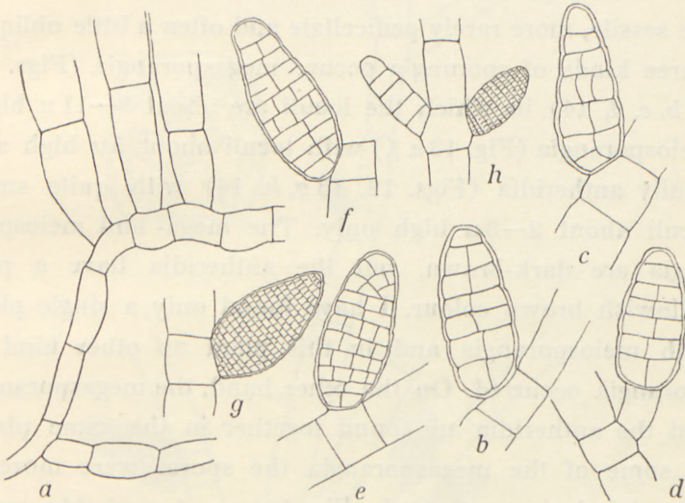


Fig. 13. *Ectocarpus Vaughani* nov. spec.

a, part of the base of a plant; *b, c, d*, megasporangia; *e, f*, meiosporangia; *g, h*, antheridia. ($\times 350$).

their bases, about 15—20 μ , but become quickly broader, the thicker part of the filaments reaching a diameter of about 30 μ , whereupon they taper slowly upwards, the hairlike ends being only about 15 μ broad. In the lower parts of the filaments these are a little narrowed at the transverse walls.

The ramification is irregular, the branches issuing either scattered or more or less unilaterally, now and then also two opposite branches are found; the sporangia likewise are given out scattered, oppositely, or a sporangium and a branch may be oppositely placed (Figs. 12, 13, 14).

The cells from which the branches and the sporangia issue are short. The chromatophores are roundish or more irregularly shaped discs (Fig. 14 b).

The plurilocular sporangia are ovate-conical to subcylindrical bodies about 70—76 μ long, the longest one observed was 87 μ long; their breadth lies between 28—35 μ . They are sessile, more rarely pedicellate and often a little oblique. Three kinds of sporangia occur: megasporangia (Figs. 12, 13 b, c, d, 14) in which the loculi are about 9—11 μ high, meiosporangia (Fig. 13 e, f,) with loculi about 5 μ high and finally antheridia (Figs. 12, 13 g, h, 14) with quite small loculi about 2—3 μ high only. The mega- and meiosporangia are dark-brown, but the antheridia have a pale yellowish brown colour. I have found only a single plant with meiosporangia and in this plant no other kind of sporangia occurred. On the other hand, the megasporangia and the antheridia are found together in the same plant. In some of the megasporangia the spores were more or less globularly contracted (Fig. 14) most probably ready for liberation. They remind one very much of those found in *Ect. Mitchellae* as described and figured by SAUVAGEAU 1896, p. 32—33, fig. 7 A.

Unilocular sporangia were looked for in vain.

The above description is based upon the specimens growing upon *Nemacystus decipiens*; those found upon *Chnoospora implexa* agree perfectly with those of *Nemacystus* with the exception that in these specimens only megasporangia occurred; this may be due to the plant having been gathered at another time of the year, but as the date is not mentioned this cannot be said with certainty.

This species comes near to *Ect. Padinae* (Buffh.) Sauvag. and related species, in which megasporangia, meiospor-

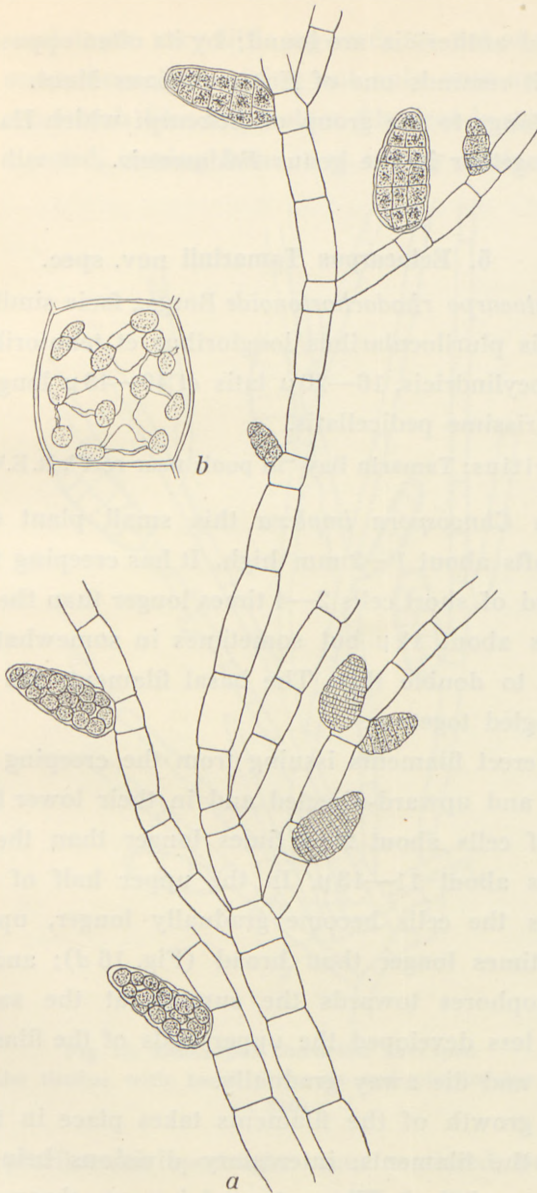


Fig. 14. *Ectocarpus Vaughani* nov. spec.

a, fragments of the thallus with antheridia and megasporangia, in some of these the spores have become roundish, probably ready for liberation;
b, a cell with chromatophores. (*a*, $\times 350$; *b*, \times ca. 800).

angia and antheridia are found; by its often opposite ramification it reminds one of *Ect. paradoxus* Mont.

It belongs to the group of *Ectocarpus* which HAMEL has placed together in the genus *Feldmannia*.

5. *Ectocarpus Tamarinii* nov. spec.

A *Ectocarpus rhodochortonoides* Børgs., facie simile, differt sporangiis plurilocularibus longioribus et tenuioribus, ovalibus-subcylindricis, 16—20 μ latis et 40—48 μ longis, sessilibus, rarissime pedicellatis.

Mauritius: Tamarin Bay "in pools near reef", R.E.V. no. 293.

Upon *Chnoospora implexa* this small plant (Fig. 15) forms tufts about 1—2 mm high. It has creeping filaments composed of short cells 2—4 times longer than the breadth which is about 12 μ but sometimes in somewhat inflated cells up to double this. The basal filaments are more or less mingled together.

The erect filaments issuing from the creeping ones are straight and upward-directed and in their lower half composed of cells about 2—4 times longer than the breadth which is about 11—13 μ . In the upper half of the erect filaments the cells become gradually longer, upmost up to ten times longer than broad (Fig. 16 *d*); and as the chromatophores towards the summit at the same time become less developed the upper ends of the filaments are hairlike and die away gradually.

The growth of the filaments takes place in the lower part of the filaments, intercalary divisions being carried out here and there. The not very vigorous chromatophores (Fig. 16 *e*) are irregularly ribbonlike or form shorter or longer plates with large openings. The filaments are cy-

lindrical and taper very little upwards or not at all. They are not much branched, giving out only now and then a side branch which like the mother filament is straight and upward-directed, issuing from it at a very acute angle.

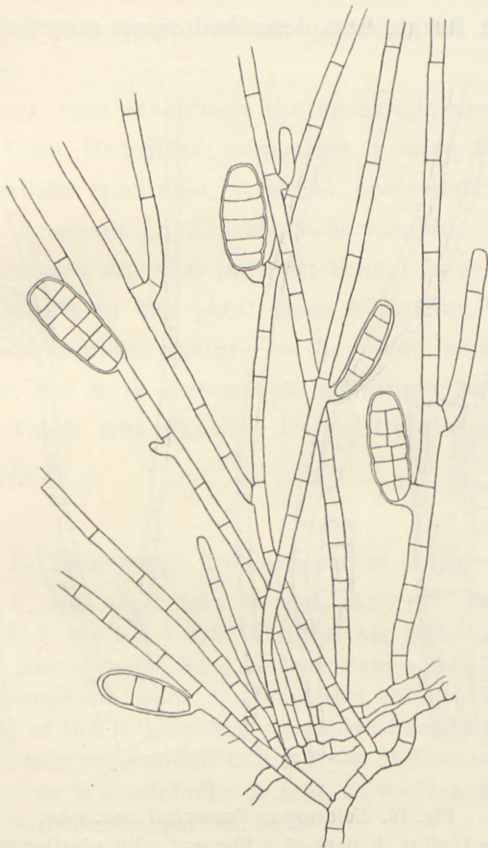


Fig. 15. *Ectocarpus Tamarinii* nov. spec.

Parts of the thallus with basal filaments and plurilocular sporangia.
($\times 350$).

The plurilocular sporangia occur scattered, but not in great numbers, in the lower part of the filaments. They are nearly always sessile, only a few times have I seen pedicellate sporangia (Fig. 16 *a, c*).

The sporangia are oval-subcylindrical in shape with broadly rounded bases and apices, about $16\text{--}20\ \mu$ broad and $40\text{--}48\ \mu$ long.

This small *Ectocarpus* is closely related to *Ect. rhodochortonoides* Børgs. first described upon material from the

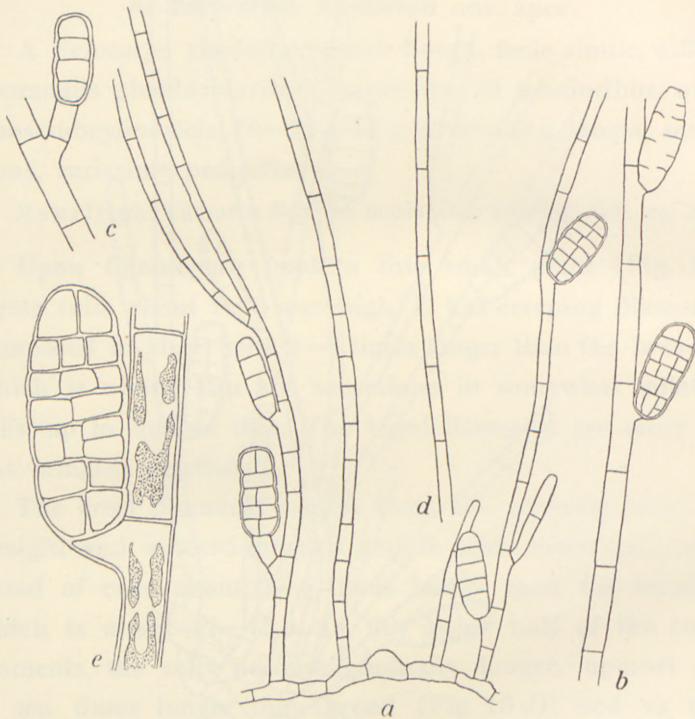


Fig. 16. *Ectocarpus Tamarinii* nov. spec.

a, part of the thallus, *b*, part of a filament with plurilocular sporangia, the uppermost emptied; *c*, a pedicellate sporangium; *d*, the uppermost nearly colourless hairlike ends of the filaments. *e*, a plurilocular sporangium. (*a* and *d*, \times ca. 250; *b* and *c*, \times 350; *e*, \times ca. 800).

West Indies (1914, p. 170), but later found also by me at the Canary Islands (1926, p. 9). The plant from the last-mentioned locality has, besides the typical short and broad plurilocular sporangia, also some more slender, ellipsoidal-

cylindrical sporangia (compare Fig. 6, l. c.). But even if some of these slender sporangia may resemble in shape the sporangia found in the plant from Mauritius I have, on the other hand, never in the last-mentioned plant found any of the typical broad sporangia of *Ect. rhodo-chortonoides*.

With very rare exceptions the sporangia are sessile in the plant from Mauritius; altogether I have found only 3—4 pedicellate sporangia, whereas pedicellate sporangia are rather common in *Ect. rhodo-chortonoides*. And some minor differences are also present; thus I have never met with any sheets in the plant from Mauritius, while this was a rather common feature in the plant from the Canary Islands, nor have I seen new sporangia replacing the old ones, which was likewise frequently the case in the Canarian plant.

6. *Ectocarpus breviarticulatus* J. Ag.

AGARDH, J., *Nya alger från Mexico*, 1847, p. 7. BØRGESSEN, F., *Mar. Alg. D. W. I.*, vol. I, p. 173, fig. 136; *Mar. Alg. from Easter Island*, p. 256, fig. 7. SETCHELL, W. A., *American Samoa*, p. 171, fig. 37. — *Ectocarpus spongiosus* Dickie, *Alg. Mauritius*, 1875, p. 191. E. S. BARTON, *Mar. Alg. of the Maldive and Laccadive Islands*, p. 479, pl. 13, figs. 9—13. *Ectocarpus hamatus* Cr. in MAZÉ et SCHRAMM, *Essai de classif. Algues de la Guadeloupe*, 2e Édit., 1870—77, p. 111. VICKERS, *Phycologia Barbadosensis*, part II, pl. 29.

The plant from Mauritius agrees quite well with the West Indian one. The filaments have a breadth of up to about 35 μ and the sporangia a length of 50—55 μ and a breadth of about 45 μ .

The plant has decumbent creeping filaments (Fig. 17) by which it is fastened to the substratum, most frequently rocks, but once it was also found as an epiphyte upon

Chnoospora fastigiata. According to Dr. VAUGHAN the plant forms light brown much entangled tufts about 3—5 cm high and occurs in exposed places dashed by the waves.

It is well known that KUCKUCK until his sudden death in the spring of 1918 was at work on the monograph on the *Phaeophyceae*, some parts of which W. NIENBURG has edited in "Fragmente einer Monographie der *Phaeosporeen*"; of the *Ectocarpaceae* KUCKUCK had made a series of splendid

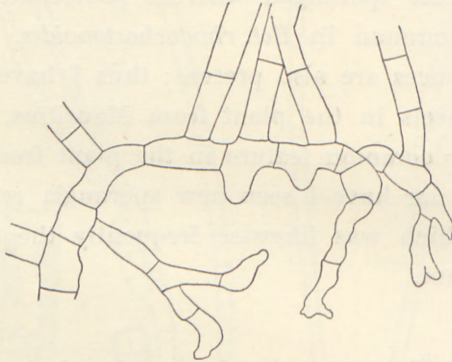


Fig. 17. *Ectocarpus breviararticulatus* J. Ag.
Basal part of a tuft. ($\times 250$).

drawings but the text was too fragmentary to be published in the "Fragmente". Accidentally among some old letters from KUCKUCK I have come across one, dated "Lichterfelde, Berlin 15. Dec. 1914". In this letter KUCKUCK writes: "Es wird Sie interessieren, dass ich jetzt bei *Ectocarpus breviararticulatus* auch unilok. Sporangien und Antheridien gefunden habe. Die bisher bekannten plurilokul. Sporangien können nur Oogonien sein."—As I have received well preserved material of this species from Dr. VAUGHAN I tried to find other sporangia than the well known megasporangia but without result.

Because of KUCKUCK's above-mentioned discovery this

species must, I think, be referable to HAMEL'S genus *Feldmannia*, although its habit should place it in the genus *Spongonema*.

Mauritius: Ilôt Brocus, "attached to rocks in flowing water R.E.V., no. 215, Aug. 1938. Pointe aux Roches, "Light brown tufts about 3.5 cm high, usually in rock crevices dashed by waves", R.E.V. no. 283, 11 Aug. 1939. Savinia, R.E.V., no. 306, Aug. 1939.

Geogr. Distr.: West Indies, Mexico, Easter Island, American Samoa, Madras, Japan, Mauritius, Laccadive Islands, Burmah, Seychelles; seems to be widely spread in warm seas.

II. Sphacelariales.

Fam. 1. *Sphacelariaceae*.

Sphacelaria Lyngb.

1. *Sphacelaria tribuloides* Menegh.

MENEGHINI, G., Lett. al Dott. CORINALDI, p. 2, no. 6; *Alge Italiane e Dalmatiche*, Fasc. IV, Padova 1843, p. 336. SAUVAGEAU, C., *Remarques sur les Sphacélariacées*, p. 123.

SAUVAGEAU, l. c. p. 131 mentions this species from Mauritius and in specimens gathered by Dr. VAUGHAN I have found propagula answering fairly well to those of *Sph. tribuloides*. SAUVAGEAU points out as a peculiarity of the plant from Mauritius that the propagula are sometimes opposite or, more rarely, placed opposite to a branch, and he has also found opposite branches. In one of Dr. VAUGHAN'S collection (no. 250) opposite branches occurred rather often. Fig. 18 c shows the bases of such a pair and a propagulum (Fig. 18 b) of the same plant. And Fig. 18 a

exhibits a pair of opposite propagula from another collection; as the shape of these propagula shows, these have somewhat longer corners, thus approaching *Sphacelaria rigida*.

Mauritius: Flic-en-Flacq growing upon *Turbinaria ornata*, R.E.V. no. 250; no. 297 (without locality).

Geogr. Distr.: Widely distributed in warm seas.

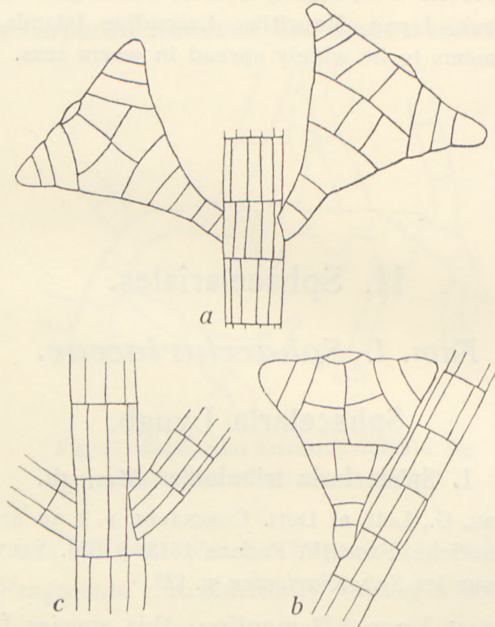


Fig. 18. *Sphacelaria tribuloides* Menegh.

a, two oppositely placed propagula; b, a propagulum; c, bases of two opposite branches. ($\times 220$).

2. *Sphacelaria rigida* Hering.

HERING in Flora, 1846, p. 213. KÜTZING, Spec. Alg., p. 465; Tab. Phycolog., vol. V, p. 26, tab. 90I.

The reason why I refer some few specimens found in the collections I have had for examination to this species and not to *Sphacelaria cornuta* Sauv. (1901, p. 132) is not only

because HERING described his species upon specimens from Port Natal but mostly because KÜTZING's figure quoted above (erroneously? the locality is stated to be "Roths Meer", whereas KÜTZING in Spec. Alg. gives "Natalbai" as the locality) must be said to give a good picture of the plant from Mauritius, while HERING's description on the other hand is not very instructive.

It seems rather strange that SAUVAGEAU when describing

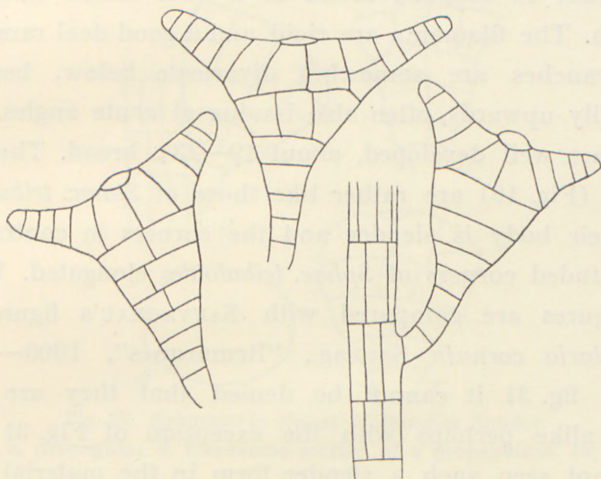


Fig. 19. *Sphacelaria rigida* Hering.
Three propagula. ($\times 220$).

Sphacelaria cornuta neither mentions HERING's species¹ nor KÜTZING's figure of it, and all the more so since SAUVAGEAU's species seems to come very near to *Sphacelaria rigida*, so near indeed that I am very much inclined to consider *Sphacelaria cornuta* Sauv. as identical with *Sphac. rigida* Her. But in order to obtain a final result it is of

¹ In the index to this work on the *Sphacelariaceae* SAUVAGEAU has a *Sphac. rigida* Grunow. It is mentioned on p. 124 and is included in the list of specimens examined by SAUVAGEAU and referred to *Sphac. tribuloides*.

course first of all necessary to examine authentic material of HERING's as well as of KÜTZING's plants, and furthermore to have more material than I have had.

The tufts of the plant from Mauritius are about $1\frac{1}{2}$ cm high. The bases are wanting and it cannot therefore be stated whether the plant is parasitic or not. The erect filaments in the plant from Mauritius are about $40-50\mu$ thick and taper upwards to about $23-35\mu$; the segments are about as long as broad or a little longer than the breadth. The filaments are rigid and a good deal ramified; the branches are somewhat divaricate below, bending gradually upwards, often also issuing at acute angles. The hairs are well developed, about $19-23\mu$ broad. The propagula (Fig. 19) are rather like those of *Sphac. tribuloides* but their body is slender and the corners in contrast to the rounded corners of *Sphac. tribuloides* elongated. When my figures are compared with SAUVAGEAU's figures of *Sphacelaria cornuta* Sauvag., "Remarques", 1900—1914, p. 133, fig. 31 it cannot be denied that they are very much alike perhaps with the exception of Fig. 31 F; I have not seen such a slender form in the material from Mauritius.

Sphac. taitensis Setch. (1926, p. 86, pl. 13, figs. 1—3) seems to be closely related to this species.

Further I should like to point out that REINKE in Beiträge, 1891, p. 8 refers *Sphac. rigida* HERING together with KÜTZING's figure in "Tabulae Phycol." to *Sphac. tribuloides*.

Mauritius: Port Louis Harbour, Col. PIKE, Dec. 69 (specimen in Hb. Kew.). R.E.V. no. 297 with no locality and dates.

Geogr. Distr.: Port Natal.

3. *Sphacelaria Novae Hollandiae* Sonder.

SONDER, G., *Nova Alg. gen. et spec.*, quas in itinere ad oras occid. Novae Hollandiae, collegit L. PREISS, 1845, p.50. SAUVAGEAU, C., *Remarques*, p. 137, fig. 33 and fig. 34A.

Dr. MORTENSEN has gathered a *Sphacelaria* which agrees very well with SAUVAGEAU's description of this species. The most characteristic feature of this species is that the corner cells in the propagula (Fig. 20) become divided by

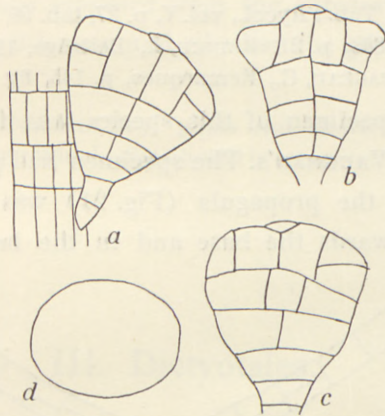


Fig. 20. *Sphacelaria Novae Hollandiae* Sonder.
a, b, c, propagula; d, transverse section of a propagulum. ($\times 220$).

a transverse wall into two cells placed one above the other; furthermore the propagula are more squarely formed and a transverse section of them roundish-oval (Fig. 20 d). Measured from the upper end of the stalk the body of the propagula is about 100μ long and about $80-85\mu$ broad and 68μ thick.

The specimens are about 1 cm high and the filaments near the base have a diameter of about 70μ , near the apical end it is about 50μ . The segments are generally shorter than the breadth and almost square, more rarely a little longer. The ramification is rather irregular and the branches

are often narrowed at their bases. The hairs are well-developed and about 15μ broad. The base was missing and no information as to the substratum can therefore be given.

Mauritius: Cannoniers Point, Th. M., Oct. 1929.

Geogr. Distr.: Australia, West Indies.

4. *Sphacelaria furcigera* Kütz.

KÜTZING, F., Tab. Phycol., vol. V, p. 27, tab. 90, fig. II, ASKENASY, E., "Gazelle", 1888, p. 21. REINKE, J., Beiträge, 1891, p. 14, pl. IV, figs. 5—13. SAUVAGEAU, C., Remarques, p. 145, fig. 35.

A single specimen of this species was found in a collection of Dr. VAUGHAN's. The specimen had propagula only. The stalk of the propagula (Fig. 21) was more or less attenuated towards the base and in the broader parts of

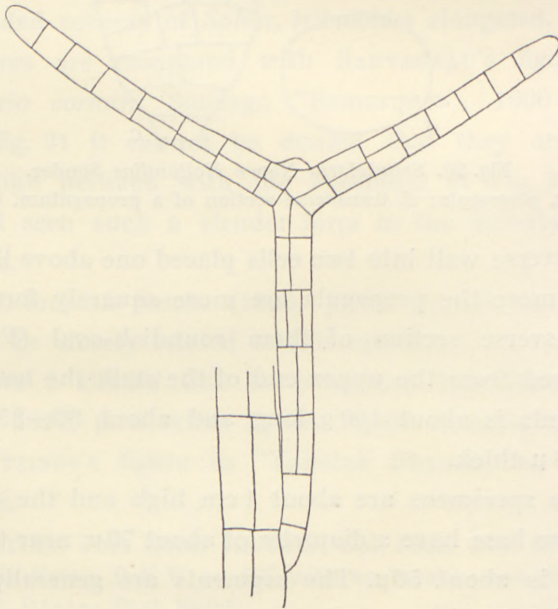


Fig. 21. *Sphacelaria furcigera* Kütz.
A propagulum. ($\times 220$).

the stalk and horns the segments are divided by a longitudinal wall, more rarely by two.

The erect filaments were about 40 μ broad at their bases and 30 μ near the apical ends, thus agreeing well with the size given by SAUVAGEAU for this species. The base in the specimen consists of decumbent filaments densely intermingled. It is strengthened by means of numerous rhizoids issuing from the lowermost part of the erect filaments. As the specimen was loosened from the substratum it cannot be stated what this was and whether the plant was partly endophytic.

Mauritius: Tamarin Bay, "pools near shore", R.E.V. no. 316.
Geogr. Distr.: Widely distributed in temperate and warm seas.

III. Dictyotales.

Fam. 1. *Dictyotaceae*.

Zonaria Draparn.

1. *Zonaria variegata* (Lamour.) Ag.

AGARDH, C., Synopsis Alg., 1817, p. XX. HOWE, M. A., Alg. Bahama, 1920, p. 594. BØRGESEN, Alg. Easter Isl., 1920, p. 266, fig. 14. SAUVAGEAU, Observations sur quelq. Dictyotacées, 1905, Extrait, p. 7. — *Dictyota variegata* Lamx., Nouv. Bull. Sci. Philom., 1, p. 331, 1809. *Gymnosorus variegatus* (Lamx.) J. Ag., Analecta algol., Contin. I, p. 11, 1894.

There are several specimens in the collections I have examined. According to Dr. VAUGHAN it forms "flat brown discs on shells and coral debris". Dr. MORTENSEN collected a specimen of it at a depth of 25 fathoms.

Mauritius: Between Gunner's Quoin and Flat Island, TH. M., 15 Oct. 29. Grand River and Ambre Island, Col. PIKE, 26 July 69 according to specimens in the Kew Herbarium. Tamarin Bay, R. E. V. no. 313. Aug. 1939.

Geogr. Distr.: Most warm seas.

Spathoglossum (Kütz.) J. Ag.

1. Spathoglossum asperum J. Ag.

AGARDH, J., *Analecta Algol.*, Cont. I, 1894, p. 36. BØRGESEN, F., *Alg. Bombay*, 1935, p. 35, pl. V; *Contrib. South Ind. Alg. Fl.*, II, 1937, p. 313.

Two specimens, the largest one about 20 cm high, are found in Dr. MORTENSEN's collection. Pl. I shows a photo of this specimen. The plant consists of several irregularly shaped and divided lobes from the margins of which proliferations (most common in the small specimen) are given off. Along the margins teethlike emergences, ca. 1—2 mm with irregular outlines are present; the cell walls in these are thicker and the cell-content a darker brown when compared with the lighter colour of the cells in the thallus itself. Seen from above the cells in the thallus are arranged in more or less regular rows; they are about rectangular or more irregularly polygonal. The diameter of the cells is about 45—60 μ long and their walls are rather thick. I have not been able to get any reliable transverse section of the thallus. Sporangia are present in great number, scattered over both sides of the thallus. Their diameter was about 100 μ long. The colour of the plant was dark brown.

When compared with the specimen figured in my paper (1935, p. 35, pl. V) the lobes of the thallus in the plant from MAURITIUS are proportionally broader more markedly

cuneate and the teeth along the margins are more developed. The specimens agree fairly well with some gathered by myself in South India (1937, p. 313) which I have been able to compare with specimens in the Herbarium of the British Museum, London.

The specimens were dredged by Dr. TH. MORTENSEN at a depth of 25 fathoms.

Mauritius: Between Gunners Quoin and Flat Island, 16 Oct. 1929. TH. M.

Geogr. Distr.: Ceylon, India.

Padina Adans.

1. *Padina gymnospora* (Kütz.) Vickers.

VICKERS, A., *Algues de la Barbade*, 1905, p. 58; *Phycologia Barbadosensis*, pl. VII. BØRGESEN, F., *Mar. Alg. D.W.I.*, vol. I, p. 202, figs. 155—6. — *Zonaria gymnospora* Kütz., *Tab. Phycol.*, vol. IX, tab. 71. *Padina australis* Hauck, *Alg. Hildebrandt*, 1887, p. 44. WEBER VAN BOSSE, A., *Liste des Algues Siboga*, I, p. 180, fig. 52.

Well prepared fruiting specimens of this species are found in the Kew Herbarium. The succession of the rows of hairs and sporangia is in agreement with what I have found in West Indian and Indian plants; compare my remarks 1930, p. 171 and my figure 155 a in the West Indian algal flora, p. 203.

Mauritius: Cannoniers Point, May 1858, DR. AYRES.

Geogr. Distr.: Malayan Archipelago, South India, Australia, West Indies etc.

2. *Padina Commersonii* Bory.

BORY, *Voyage de la Coquille*, 1828, p. 144, tab. 21, fig. 2. J. AGARDH, *Spec. Alg.*, vol. 1, p. 113. HAUCK in "*Hedwigia*", 1887, p. 42 and p. 44. WEBER VAN BOSSE, *Algues Siboga*, part 1, p. 178, fig. 51. BØRGESEN, *Some Indian Green and Brown Algae*, I, p. 170.

The few specimens found in the collections from Mauritius are not quite typical, a row of fructiferous organs being generally developed above every second row of hairs only. In this respect the specimens agree with HAUCK's description. The arrangement of hairs and fructiferous organs reminds one of that found in *Padina Sanctæ Crucis*, (BØRGESEN, 1914, p. 201, fig. 153) but in this species a well developed indusium is present.

In the lower part of the thallus in *Padina Commersonii* this is composed of three layers of cells, as mentioned in my paper quoted above.

HARVEY in "Algæ of Mauritius", p. 149 mentions *Padina Durvillæi* Bory from the island but the specimen of Mrs. TELFAIR found in the Kew Herbarium is *Padina Commersonii* and not *Padina Durvillæi*, which species according to Mme WEBER, ("Liste", 1913, p. 179), who has examined the original specimen of BORY in Muséum d'histoire naturelle, Paris, has concentric rows of sporangia but no hairs. JADIN in his list, p. 160, mentions *Padina Pavonia* as common at the island, but this determination is surely wrong; his plant might perhaps be *Padina tetrastratica* Hauck.

Mauritius: Black River Bay, leg. R. E. VAUGHAN no. 292. Without locality, leg. TELFAIR (Hb. Kew.).

Geogr. Distr.: Mauritius, Ceylon, Tonga Islands, Malayan Archipelago, Australia etc.

Dictyota Lamour.

1. *Dictyota divaricata* Lamour.

LAMOUREUX, Dictyonaire, p. 14. J. AGARDH, Till Alg. System., V, p. 101; *Analecta Algologica*, Continuatio I, p. 78. — *Dictyota Bartayresiana* var. *divaricata* J. Ag., Spec. Alg., I, p. 94. *Dictyota acutiloba* Kütz., Tab. Phycol., IX, pl. 29.

Some specimens are present in the Kew Herbarium which quite agree with KÜTZING's figure cited above. J. AGARDH also mentions Mauritius as a locality of this species and points out that the tips of the thallus are more obtuse in the specimens from Mauritius; this is in agreement with the specimens examined by me.

Mauritius: Grand River, Jan. 2, 1870, Colonel PIKE. Cannonier's Point. Oct. 29, TH. M. DR. VAUGHAN says about it that it is "very common"; specimens from Îlot Brocus (no. 216) and Cannonier's Point (no. 2) are found in his collection.

Geogr. Distr.: Warm Atlantic Ocean, Red Sea, Indian Ocean, Japan etc.

2. *Dictyota Bartayresiana* Lamour.

LAMOUREUX, Dictyonaire, n. 17. J. AGARDH, Spec. I, p. 94. KÜTZING, Tab. Phycol., vol. IX, tab. 16.

A specimen of this species is found in the Kew Herbarium. The species is mentioned both in DICKIE's and JADIN's lists.

Mauritius: Port Louis Harbour, 12. Dec. 1869, Colonel PIKE.

Geogr. Distr.: West Indies, Indian Ocean, Tropical Australia etc.

HETEROGENERATAE

A. HAPLOSTICHINEAE

I. Chordariales.

Fam. 1. Corynophloeaceae.

Myriactula O. Kuntze.

1. *Myriactula arabica* (Kütz.) Feldm.

FELDMANN, J., Algues mar. de la Côte des Albères, p. 136. BØRGESEN, Iranian Gulf Algae, p. 83, figs. 19—20. — *Phycophila arabica* Kütz., Tab. Phycol., vol. VIII, tab. 1, fig. 2. *Gonodia arabica* (Kütz.) Boergs., Mar. Alg. Arabian Sea, p. 22, fig. 4. HAMEL, G. Phéophycées de France, p. 136.

In the cryptostomes of *Chnoospora implexa* specimens of this species occurred mingled with the bases of *Ectocarpus irregularis*.

Mauritius: Tamarin Bay, R.E.V. no. 293, "in pools behind reef".
Geogr. Distr.: Arabian Sea, Iranian Gulf, Tanger, Guéthary.

Fam. 2. Chordariaceae.

Cladosiphon Kütz.

In his paper: "Sur le Castagnea Zosteræ Thur." SAUVAGEAU (1927, p. 369) has given an exhaustive account of the very intricate question as to the correct naming of this genus. For more detail I refer the reader to SAUVAGEAU's paper and here I shall confine myself to pointing out only that SAUVAGEAU was for the maintaining the hitherto most

commonly used generic name *Castagnea* Derb. et Sol. (1852, p. 56), in the diagnosis of which accompanied by figures these authors described and pictured the plurilocular sporangia of this genus. The generic name *Castagnea* has also as a rule been used in later years.

As KYLIN now in his very valuable monographic treatment of the *Chordariales* (1940, p. 26) has found it necessary to reject the generic name *Castagnea* and instead take up KÜTZING's somewhat older generic name *Cladosiphon* (1843, p. 329) I follow him in this though the diagnosis of KÜTZING is very poor and the plurilocular sporangia are not mentioned at all, the different shape of these organs, as first pointed out by THURET (in LE JOLIS, 1864, p. 84), being the essential characters to base the genera upon in this group.

In North America the genus *Aegira* Fries (1825, p. 342) based upon *Linkia Zosteræ* Lyngbye (1819, p. 194, pl. 66) = *Eudesme virescens* (Carm.) J. Ag. has recently been taken up. *Eudesme* and *Castagnea* have earlier often been looked upon as congeneric but as KYLIN considers *Eudesme* a genus by itself the generic name of FRIES can only replace *Eudesme*.

MISS PARKE (1933, p. 21), (and KYLIN (1940, p. 25) agrees with her), protests against the taking up of *Aegira* because only two of three specimens in LYNGBYE's herbarium are *Castagnea virescens*, but I cannot agree with her in this. For in most herbaria besides the typical specimens several more or less dubious specimens are nearly always found in the same cover. And furthermore the locality: "Kalvesund, Norvegiæ", of the undeterminable specimen not being mentioned among the localities of *Linkia Zosteræ* enumerated in the "Tentamen", it seems clear that LYNGBYE has attached no importance to this specimen.

1. *Cladosiphon Mauritianum* nov. spec.

Frons caespitosa, filiformis, tubulosa, permagna, ca. 30 cm alta et ultra(?) et $\frac{1}{4}$ — $1\frac{1}{2}$ mm crassa, fuscoflavescens, lubrica, irregulariter sinuosa et ramosissima, ramis sparsis elongatis ad basin et apicem attenuatis instructa. Rami iterum ramulosi, ramuli angulis plus minus rectis oriuntur, apicem versus ramella brevia, saepe curvata, gerentes.

Sporangia plurilocularia et unilocularia in eadem planta praesentia.

Sporangia plurilocularia in summis turgidis florum assimilationis periphericorum et unde clavatis formata aut in ramellis brevioribus subsecundis ibidem praesentia. (Pl. II).

Mauritius: Cannonier's Point, TH. M., 26. Oct. 1929.

In Dr. MORTENSEN'S collection some dried specimens of a brown alga (Pl. II) are present, the anatomical structure of which shows that they are referable to this genus.

From a small hold fast the very irregular and much ramified thallus grows up to a height of about 30 cm and probably more. The main filaments reach a diameter of about 2 mm, and from these branches are given off very irregularly, sometimes unilaterally, sometimes scattered at shorter or longer intervals, and these branches also carry short or long branchlets which at their upper ends are provided with 2—3 divaricate and curved ramuli. The thallus is upon the whole much curved and sinuate. At their basal ends the branches and branchlets are attenuated, quickly attaining their normal size upwards. The colour of the dried plant is reddish brown. As to the anatomical

structure of the plant from Mauritius this in most respects agrees quite well with Mme WEBER's description (1913, p. 139) of the plant called by her *Bactrophora nigrescens* = *Cladosiphon Sibogae* Kylin and with my description of the West Indian plant I called *Castagnea Zosteræ* = *Cladosiphon*

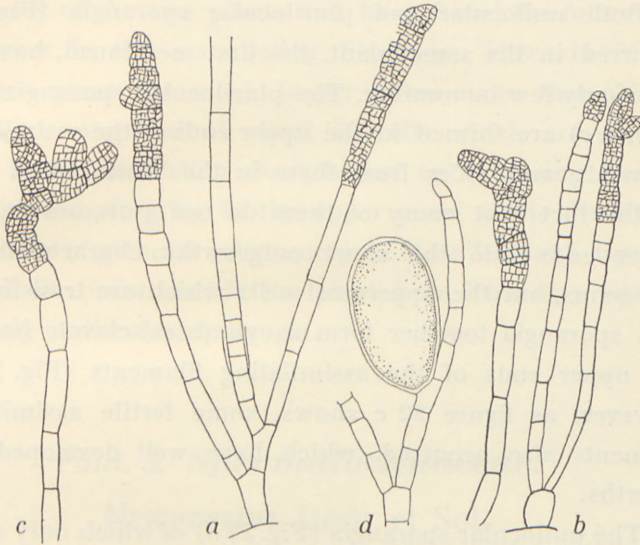


Fig. 22. *Cladosiphon Mauritianum* nov. spec.

a, b, c filaments with plurilocular sporangia; d, unilocular sporangium.
(\times ca. 350).

occidentalis Kylin, with the exception that Mme WEBER and I supposed each sympodium of the central filaments to be terminated by a hair, while as pointed out later by KUCKUCK (1929, p. 46 and 48) and now by KYLIN, in reality it ends in an assimilating filament, the hair, as KUCKUCK says, being "scheinbar terminal".

In its young parts the thallus of the plant from Mauritius is massive, when older it becomes hollow. The material was not fit for anatomical examination and it was out of the question to examine the summits of the filaments.

The assimilating filaments had a length of about 200 μ , consisting in their lower parts of long cylindrical cells about 8 μ thick, higher up the cells were shorter and broader, about 12 μ thick. The filaments are composed of about 13—15 cells.

Both unilocular and plurilocular sporangia (Fig. 22) occurred in the same plant, the first mentioned, however, were only few in number. The plurilocular sporangia (Fig. 22 *a, b, c*) are formed in the upper ends of the assimilating filaments and differ from these in the West Indian plant by the fact that many of them do not grow out at their upper ends into the short outgrowths characteristic of this genus, but the uppermost cells which are transformed into sporangia together form a cylindrical-clavate body at the upper ends of the assimilating filaments (Fig. 22 *a*); however, as figure 22 *c* shows, some fertile assimilating filaments also occurred, which have well developed outgrowths.

The unilocular sporangia (Fig. 22 *d*) of which only rather few are seen, are oblong obovate of shape, about 35—40 μ broad and 60—65 μ long.

When compared with the West Indian plant collected at St. Croix 1892 and referred by me (1914, p. 184, figs. 144—5) with reservation to *Castagnea Zosteræ* (Mohr) Thur. the habits of the two plants agree fairly well, but the plant from Mauritius is much larger with somewhat more marked main filaments, and the colour is darker brown.

As mentioned above, the anatomical structure also is rather like that of the West Indian plant but besides the somewhat different appearance of the plurilocular sporangia, the assimilating filaments are a little shorter in the West Indian plant, in most cases reaching only 160 μ .

As regards *Cladosiphon Sibogae* Kylin neither a description of its habit nor a photograph of the plant is found. But by means of a slide of a fragment of the plant from Thursday Island most kindly sent me in 1913 by Mme WEBER I have been able to compare the anatomical structures of the two plants and have found the following differences in the assimilating filaments. These in Mme WEBER's plant are much longer, often more than 300 μ long, and composed of about 20 cells which are ca. 7 μ broad below and rather short, higher up becoming gradually roundish, forming in the upper parts of the filaments a long row of globular cells; compare Mme WEBER's figures 42 and 43. Unfortunately the plant from Thursday Island had only unilocular sporangia.

Fam. 3. Spermatochnaceae.

Nemacystus Derb. et Sol.

1. *Nemacystus decipiens* (Sur.) Kuck.

KUCKUCK, P., Monographie, 1929, p. 68, figs. 92—3. BØRGESEN, Indian Green and Brown Algae, II, 1932, p. 65, fig. 7; Iranian Gulf Algae, 1939, p. 85. KYLIN, Chordariales, 1940, p. 46. — *Mesogloia decipiens* Suringar, Alg. jap., 1872, p. 75, pl. IV. *Cladosiphon decipiens* (Suring.) Okamura, Alg. Jap. Exsicc., no. 87; Icones Jap. Alg., vol. II, pl. 89.

Of this species two dried specimens and some filaments preserved in formol are present in Dr. MORTENSEN's and Dr. VAUGHAN's collections respectively. The dried specimens are fixed to a small piece of a seagrass, while no base is found in the plant in formol. The colour of the dried plant is yellowish brown, it is about 18 cm high and an irregularly and much ramified plant. In the specimens

preserved in formol hairs were scarce and found only in the young parts of the thallus, whereas they were more common in the dried specimens.

The assimilating filaments (Fig. 23) of the specimen in formol are rather short, up to about 150μ long or some-

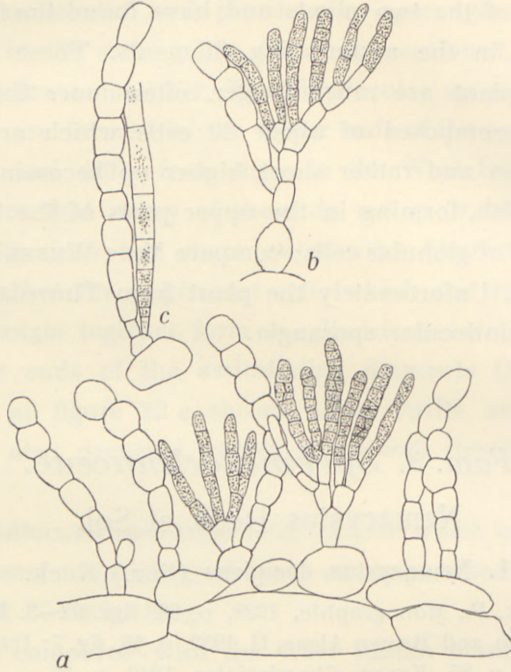


Fig. 23. *Nematicystus decipiens* (Sur.) Kuck.
Assimilating filaments; in *a* and *b* also plurilocular sporangia; in *c* a hair.
($\times 350$).

what longer; they are composed of about 10, rarely up to 15 cells, cylindrical below, more ellipsoidal upwards, the uppermost being subglobular with a diameter of about 16μ , rarely more. When young the thallus is massive, becoming hollow when older like OKAMURA's fig. 2. In the material in formol plurilocular sporangia are found. They form small dense branch-systems (Fig. 23 *a, b*) about 10μ

high with or without assimilating filaments at their bases. The sporangia are more or less unilaterally placed (Fig. 23 c). They are 7—8—9 μ thick and in most cases divided by horizontal walls into a single row of cells, but rather often, too, more or less vertical walls are present in the middle of the sporangium. Unilocular sporangia were not found in the plant in formol but in one of the dried specimens. They were oblong-obovate of shape, about 60 μ long and 40 μ broad.

When compared with the Japanese plant which, according to KUCKUCK's description and to his and OKAMURA's fine figures, must be said to be the best known species of *Nemacystus*, the habit of the plant from Mauritius agrees very well with OKAMURA's figure. In the anatomical structure some differences are present. Thus the Japanese plant has numerous hairs, and the assimilating filaments are longer in the Japanese plant and composed of more cells, about 20, and these are more elongated. KUCKUCK mentions the thallus in *N. decipiens* as being solid, but OKAMURA's drawing shows it to be hollow as in the plant from Mauritius. In the Japanese plant both unilocular and plurilocular sporangia occur in the same plant, whereas in the plant from Mauritius these organs were not found together in the specimens examined. The plurilocular sporangia of the Japanese plant agree with those in the plant from Mauritius, having now and then vertical or oblique walls, as shown in KUCKUCK's figure 93. Vertical walls are also present in *N. flexuosus*, according to KUCKUCK's figure 95; and KYLIN found them in *N. erythraeus*.

At Dwarka in the Arabian Sea, some years ago, I gathered a *Nemacystus* which I (1932, p. 65, fig. 7) referred to *N. decipiens*, pointing out that in some respects it differs from

the Japanese plant. Thus its thallus (Plate III) is thinner, only about $\frac{1}{4}$ - $\frac{1}{2}$ mm, and its colour is dark olive brown. And the plant form Dwarka occurred upon rocks and was laid dry several hours during low-tide, whereas OKAMURA describes it as an epiphyte upon *Sargassum* in Japan. The

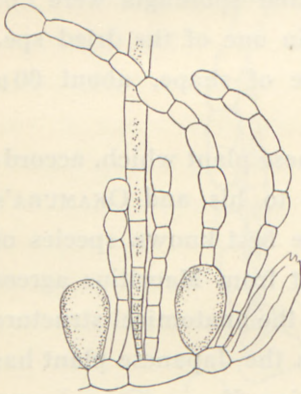


Fig. 24. *Nemacystus decipiens*
(Sur.) Kuck.

Assimilating filaments, unilocular sporangia (one emptied) and a hair. — From a specimen from the Iranian Gulf.

($\times 350$).

assimilating filaments of the plant from Dwarka when compared with those of the plant from Mauritius have nearly the same length and number of cells, but these are still more globose in the plant from Dwarka (compare my figure 7, 1932, p. 66) and the apical cells are larger, having often a diameter of 22μ . Hairs were abundant in the plant from Dwarka and only unilocular sporangia occurred, they were oblong-ovovate like those found by OKAMURA, while KUCKUCK found them teat-formed in a specimen

from Japan. As to the shape and size of the assimilating filaments the plant from Mauritius is so to speak, placed intermediately between the Japanese and the Indian plant.

I have also examined material of this species from the Bahrain Islands in the Iranian Gulf (Fig. 24). Here the plant was an epiphyte upon *Sargassum*. Its colour was yellowish brown and hairs were present in great numbers. The assimilating filaments resembled those in the Japanese plant with elongated but somewhat shorter cells. Only unilocular sporangia occurred; they were of the same shape and size as those in the Indian plant and that from Mauritius.

I have undertaken this comparison of the specimens in question because I have my doubts as to whether or not the plants from the various localities ought to be considered as independent species. This applies especially to the plant from Dwarka as the most deviating. In order to find out whether, for instance, the occurrence of both kinds of sporangia in the same plant or in separate individuals, or the substratum or other of the variations mentioned are of more constant value or not the examination of more material and observations in nature are necessary. Until details about these questions are obtained it seems more appropriate to consider the plants as variations of the same species: *Nemacystus decipiens*.

From South Africa KYLIN (1940, p. 48) has described *Nemacystus subsimplex* but this is a small plant, only a few cm high, simple or very little ramified, with a solid thallus and plurilocular sporangia, having a single row of loculi only.

Mauritius: Cannonier's Point, TH. M., 26. Oct. 1929. Flic-en-Flacq, R. E. V. no. 252.

Geogr. Distr.: Japan, Arabian Sea, Iranian Gulf.

B. POLYSTICHINEAE

I. Punctariales.

Fam. 1. *Encoeliaceae*.

Colpomenia Derb. et Sol.

1. *Colpomenia sinuosa* (Roth) Derb. et Sol.

DERBÈS, A. et A. SOLIER, Mém. sur... Physiologie des Algues, p. 11, pl. XXII, figs. 18-20. SAUNDERS, De Alton, Phycological Memoirs, 1898, p. 163-4. SETCHELL, W. A. and N. L. GARDNER, *Mela-*

nophyceae, 1925, p. 540—2. SAUVAGEAU, C., Sur le *Colpomenia sinuosa* Derb. et Sol., 1927, p. 309. BØRGESEN, F., Alg. Iranian Gulf, 1939, p. 89. — *Ulva sinuosa* Roth, Catal. bot., III, 1806, p. 326, pl. 12. *Stylophora vesicata* Harv., M. S., Algae of Mauritius, 1834, p. 149. For more literature compare DE-Toni, Syll. Alg., III, p. 489.

Several specimens, or perhaps more correctly pieces of specimens, are found in the Kew Herbarium. HARVEY, l. c., p. 149, when describing Mrs. TELFAIR'S specimens of this species, adds: "but it is much to be wished that more perfect specimens than those that have fallen under my observation, could be procured, that we might be enabled fully to describe it". The specimens seem to agree fairly well with forma *expansa* Saunders, l. c., p. 164, pl. 32, figs. 4—6.

And a single specimen in the Kew Herbarium gathered by Dr. AYRES agrees quite well with *Colpomenia tuberculata* Saunders, l. c., p. 164, pl. 32, figs. 1—3. SETCHELL and GARDNER have referred this plant as a forma *tuberculata* to *Colpomenia sinuosa*.

Mauritius: Cannonier's Point, Apr. 1858, Dr. AYRES. The specimens of Mrs. TELFAIR are without locality.

Geogr. Distr.: Widely distributed in warm seas.

Hydroclathrus Bory.

1. *Hydroclathrus clathratus* (Bory) Howe.

HOWE, Algae, in BRITTON & MILLSPAUGH. The Bahama Flora, 1920, p. 590. For more literature compare DE-TONI, Sylloge Algarum, III, p. 490.

According to JADIN l. c., p. 159, this plant is very common at the island.

Mauritius: Cannonier's Point, Oct. 1929, TH. M. Same locality, April 1858, Dr. AYRES in Hb. Kew.

Geogr. Distr.: Most tropical seas.

Chnoospora J. Ag.

1. *Chnoospora fastigiata* J. Ag.

J. AGARDH, Spec. Alg., vol. 1, p. 171. BARTON, E. S., On the fruit of *Chnoospora fastigiata* J. Ag. in Journ. Linn. Soc., 33, 1897—8, p. 50, pl. 28. BØRGENSEN, F., Mar. Algae from Easter Island, 1920, p. 263, figs. 11, 12.

Some specimens of this species referable to the var. *pacifica* J. Ag., KÜTZING, Tab. Phyc. vol. IX. pl. 86, fig. 1 are found in the Kew Herbarium.

Mauritius: Soufflem, July 31, 1869. Col. PIKE. In Dr. VAUGHAN'S collection some fine specimens of the same variety (no. 266) but without locality are present; about its appearance and occurrence at the island Dr. VAUGHAN writes: "Thallus light brown, common in rock crevices in exposed situations constantly washed by waves".

Geogr. Distr.: Pacific Ocean, Japan, Australia etc.

2. *Chnoospora implexa* (Her.) J. Ag.

AGARDH, J., Spec. Alg., vol. 1, p. 172. KÜTZING, Tab. Phyc., vol. IX, tab. 87. fig. 2. GRUNOW, A., Alg. Fidschi-, etc., 1874, p. 25. WEBER VAN BOSSE, A., Alg. Siboga, p. 137. — *Chnoospora pannosa* J. Ag., l. c., p. 172, GRUNOW, l. c., p. 25. KÜTZING, l. c., fig. 1. *Dicotyota obtusangula* Harv., Friendl. Isl. Alg., no. 40. KÜTZING, Tab. Phycol., vol. IX, tab. 28, fig. 2.

In J. AGARDH'S Spec. Alg., vol. I, p. 172 *Chnoospora implexa* (Hering) J. Ag. is referred to as "Species inquirendae" and all the same in DE-TONI, Syll. Alg., vol. III, *Fucoideae*, 1895, p. 466 a? is placed after the generic name. As late as 1925 SETCHELL and GARDNER in "*Melanophyceae*", p. 553 say that *Chn. implexa* Hering "is doubtful and may very possibly prove to be of quite a different genus". I have not been able to examine authentic material of HERING, but I have had well preserved material collected by Dr. VAUGHAN of a plant agreeing with KÜTZING'S figures, and

an examination of it has shown that the building up of the thallus agrees well with that of *Chn. fastigiata*, cryptostomes being spread all over the thallus. The material was sterile. The colour of the plant when alive was pale yellow.

In the Kew Herbarium several specimens of *Chnoospora* are found; some of these collected by Colonel PIKE are called *Chn. implexa*; some other specimens are determined as *Dictyota obtusangula* Harv. = *Chnoospora obtusangula* (Harv.) Sonder which with GRUNOW (l. c.) and Mme WEBER, "Algues Siboga", p. 137 I consider as a form of *Chnoospora implexa*.

Further, some fragmentary specimens collected by Dr. AYRES are found in the Kew Herbarium where they are referred to *Chn. pannosa* J. Ag. But in my opinion these specimens are nothing but small and badly developed specimens of *Chn. implexa*. In this connection I wish to point out that I have examined a specimen that seems to be a cotype specimen of *Chnoospora pannosa* found in the Botanical Museum, Copenhagen. On the label of the specimen is written: "ins. Sandwich, Hb. BINDER", thus it is from the same locality as the specimen upon which J. AGARDH based *Chn. pannosa*. This specimen is determined as *Chn. implexa* J. Ag., it consists of intricate filaments of different algae, most of them being *Dictyota divaricata*, some *Chnoospora implexa* and some filaments of *Hypnea* and *Chondria*.

In continuation of this I further wish to mention what SETCHELL and GARDNER write about *Chn. pannosa* in Mar. alg. of the pacif. coast of North America, III. *Melanophyceae*, p. 553: "It seems likely that *C. pannosa* J. AGARDH, from Hawaii, is simply a pannose growth form of *C. pacifica*".

Mauritius: Tamarin Bay, R.E.V. no. 293. Cannonier's Point, May 1858, Dr. AYRES. Barkley Isl., Jan. 1870, Colonel PIKE. Rochetois, July 22, 1870, Colonel PIKE.

Geogr. Distr.: Red Sea, Malayan Archipelago, Japan etc.

Rosenvingea Boergs.

1. *Rosenvingea intricata* (J. Ag.) Boergs.

BØRGESEN, Mar. Alg. D.W.I., vol. I, p. 182. — *Asperococcus intricatus* J. Ag., Nya alger från Mexico, 1847, p. 137; Spec. Alg., vol. 1, 1848, p. 77. *Encoelium intricatum* Kütz., Spec. Alg., p. 551; Tab. Phycol., vol. 9, tab. 5.

A small specimen is found in the collection of the Kew Herbarium.

Mauritius: Cassis, Colonel PIKE, 1869 in Herb. Kew.

Geogr. Distr.: Vera Cruz, Samoa, Australia, India, etc.

CYCLOSPOREAE

I. Fucales.

Fam. 1. *Sargassaceae*.

Turbinaria Lamour.

1. *Turbinaria ornata* J. Ag.

J. AGARDH, Spec. Alg., I, p. 266. BARTON, E. S., Syst. Struct. Account of *Turbinaria*, p. 219. — *Fucus turbinatus*, var. *ornatus* Turner, Fuci, vol. I, p. 50, tab. 24, figs. c, d.

Several specimens are found in the collections examined by me.

Mauritius: Cannonier's Point, R.E.V. no. 186, August 5th 1933: "In shallow water behind reef, common in many localities". From the same locality there are specimens in the Kew Herbarium

collected by Dr. AYRES as well as some specimens without locality gathered by Mrs. TELFAIR and Colonel PIKE.

Geogr. Distr.: Widely distributed in the Indian Ocean and the adjacent parts of the Pacific Ocean.

Sargassum C. Ag.

The following list comprises 13 species of *Sargassum*, 6 of these have been collected by Dr. VAUGHAN and as stated in the introduction, the well known specialist of *Sargassum* Professor W. A. SETCHELL, Berkeley, Cal. has most kindly determined these species. He has informed me that they are all rare species and of great interest. In the list these species are marked by an asterisk.

The remaining species are found in the Kew Herbarium and are determined partly by HARVEY, partly by DICKIE. I have revised HARVEY'S and DICKIE'S determinations after GRUNOW'S "Additamenta ad cognitionem *Sargassorum*" and the species in the list are likewise arranged according to GRUNOW'S treatise.

1. *Sargassum heterophyllum* (Turn.) Ag.

AGARDH, C., Spec. Alg., vol. 1, p. 21. AGARDH, J., Spec. Alg., vol. 1, p. 296; Spec. Sarg. Austral., p. 66. GRUNOW, Additamenta, no. 40, p. 354. — *Fucus heterophyllus* Turn., Hist. Fuc., II, p. 62, t. 92. *Blossevillea heterophylla* Kütz., Spec. Alg., p. 630; Tab. Phyc., vol. X, tab. 86.

To this species DICKIE has referred two small specimens from Mauritius. I have been able to compare them with a specimen from South Africa collected by ECKLON ("ad oras Kafrorum") found in the Botanical Museum, Copenhagen. Their aspect shows some likeness to ECKLON'S specimen but considered in more detail some differences are

present; thus the leaves in the Mauritius plant have well developed cryptostomes in two rows along the midrib, whereas there are not very many in ECKLON'S specimen in which the leaves had also a much darker colour and the teeth were less developed. Nor does KÜTZING, in his figure quoted above, draw any cryptostomes. No vesicles are present either in ECKLON'S specimen or in the specimens from Mauritius.

Mauritius: Without locality, Colonel PIKE. Flacq, F. JADIN. Geogr. Distr.: South Africa.

2. **Sargassum obovatum* Harv. var. *Robillardii* Grunow.

GRUNOW, A. Additamenta, no. 92, p. 392.

SETCHELL writes about the specimen: "This is one of the species or forms which occur on the east coast of Africa and in the Red Sea, which make for trouble. Its prominent cryptostomata are characteristic. The receptacles are very slightly developed in yours, but on the whole I think that the species and variety are better referred as I am doing for the present, since the leaves are altogether too thin and the whole habit is too slender for *S. crassifolium* J. Ag."

I have not seen any specimens of the species itself. This species is described by HARVEY, l. c., p. 148 upon specimens collected by Mrs. TELFAIR at Mauritius. In the collection of the Kew Herbarium no specimen of this species was found. It is also mentioned in JADIN'S list, p. 159.

Mauritius: Cap Malheureux, Mrs. TELFAIR. Point aux Roches, "on the reef and in pools behind the reef", R. E. V. no. 291.

Geogr. Distr.: Mascarene Islands.

3. *Sargassum duplicatum* J. Ag.

AGARDH, J., Spec. Sarg. Austr., p. 90. GRUNOW, Additamenta, no. 93, p. 392. — *Sargassum ilicifolium* var. *duplicatum* J. Ag., Spec. Alg., p. 318. *S. cristaeifolium* Harvey, Alg. TELFAIR, 1834, p. 147.

A fine specimen of Mrs. TELFAIR'S upon which HARVEY described the species is found in the Kew Herbarium.

Mauritius: Cap Malheureux, Mrs. TELFAIR.

Geogr. Distr.: Mascarene Islands, Indian and Pacific Oceans.

4. *Sargassum myriocystum* J. Ag.

AGARDH, J., Spec. Alg., vol. I, p. 314; Spec. Sarg. Austr., p. 99. GRUNOW, Additamenta, no. 134, p. 440.

DICKIE refers a specimen in Herb. Kew to this species. I have not had any material with which to compare it.

Mauritius: Without locality, Colon. PIKE.

Geogr. Distr.: Indian Ocean.

5. *Sargassum polycystum* C. Ag. var. *onusta* J. Ag.

AGARDH, J., Spec. Alg., vol. I, p. 311. GRUNOW, Additamenta, no. 138, p. 445. — *Sargassum onustum* Harv., Alg. TELFAIR, p. 147.

Several specimens gathered by Mrs. TELFAIR at Mauritius are found in the Kew Herb. This species is also mentioned from Mauritius in JADIN'S list, p. 160.

Mauritius: Cap Malheureux, Mrs. TELFAIR. Flacq, Sept. 1890, F. JADIN.

Geogr. Distr.: Indian Ocean.

6. **Sargassum granuliferum* C. Ag.

AGARDH, C., Spec. alg., p. 31; Icon. alg. ined., pl. XI. AGARDH, J., Spec. alg., p. 309; Spec. Sargass. Austr., p. 118. Kützing, Tab. Phyc., XI, tab. 16, I. GRUNOW, Additamenta, no. 142, p. 447. Setchell, Hong Kong Seaweeds, V, p. 7, 1936.

SETCHELL writes about it (Pl. IV): "Your specimens have very little fruit and would perhaps be referred by some to another species of the general graniferous group. The

leaves, however, seem to be without costa. I think that *S. spinifex* is only a denser form of the present species and this name is the older. You will note that in my paper on "Hong Kong Seaweeds", Part V, I have discussed the situation. The species of these granuliferous *Sargassa* are very difficult to determine, since from such experience as I have had, leaves, receptacles, etc., as well as the amount of papillae on the axes, vary very much and often in the same specimen".

Mauritius: Cannonier's Point, "in shallow water behind reef", R. E. V. no. 187.

Geogr. Distr.: Indian and Pacific Oceans.

7. **Sargassum densifolium* Zan.

ZANARDINI, Pl. mar. rubr., 1858, p. 32, no. 24. GRUNOW, Addita-
menta, no. 166, p. 24.

Two specimens, no. 188 and no. 190, are found in Dr. VAUGHAN'S collections.

About no. 188 (Pl. V.) SETCHELL remarks: "This, I think, is only a denser form of *S. latifolium* (Turn.) C. Ag., or it may be a form of *S. aquifolium* (Turn.) C. Ag. It is unfortunately sterile but it seems to differ from both the TURNER plants as well as from *S. ilicifolium* (Turn.) C. Ag. by more finely dentate leaves. This, however, varies in your specimens, and this number might be placed under any of these names, since there is no fruit. I have seen no specimens of ZANARDINI'S species."

And about no. 190 SETCHELL says: "This is a more densely leaved specimen and one which comes nearer to ZANARDINI'S description than your no. 188. It also is sterile".

Mauritius: Cannonier's Point, "in shallow water behind reef", R. E. V., nos. 188 and 190.

Geogr. Distr.: Red Sea, Indian Ocean, Iranian Gulf etc.

8. *Sargassum bacciferum* (Turn.) C. Ag.

Forma *capillifolia* Kütz., Tab. Phycolog., vol. XI, p. 4, tab. 12, fig. II. GRUNOW, A., Additamenta, no. 183, p. 36.

Two specimens are found in the Kew Herbarium, referred by DICKIE to this form. The leaves are very long, up to 7 cm, very narrow and with very few teeth along the margins. I have not seen apiculate vesicles, as GRUNOW says it sometimes has.

Mauritius: Without locality, Colonel PIKE.

Geogr. Distr.: Indian and Pacific Oceans.

9. **Sargassum Portierianum* Zan.

ZANARDINI, Pl. mar. rubr., 1858, p. 24, no. 10. GRUNOW, Additamenta, p. 145, no. 193.

About a specimen in Dr. VAUGHAN's collection no. 148 (Pl. VI) Professor SETCHELL writes as follows: "Your specimen has no vesicles but clearly belongs to the *S. cymosum* group. It might be mistaken for *S. lendigerum*, but is not the plant of LINNAEUS. You will find notes on the latter species in my "Report on the *Sargassums* of the Templeton Crocker Expedition of the California Academy of Sciences", 1932 (1937, p. 133). Your plant is a very interesting one but has been identified mostly through the description of ZANARDINI and the relationships which I have been trying to work out between the *cymosum-lendigerum* groups."

And about another specimen in the collection, no. 267, Professor SETCHELL remarks: "No. 267 seems to me to be referable to *Sargassum Portierianum* Zan. f. *lendigerioides*. The form name is of my own coining, since your specimens look so much like *S. lendigerum* (L.) Ag., but do not agree sufficiently with that species to be referred to it. I

have this form from so far south as Natal and can confess to you that I do not know exactly what to do with it. It is clearly of the *S. cymosum* Ag. group but is very different from the typical Brazilian forms of that species. It is also very much like *S. lendigerum*, but the cryptostomata are almost absent and the basal portions have the primary axes very short, instead of long as in that species. I may be entirely wrong in referring it as a form to the species of ZANARDINI but in some ways it seems to resemble the descriptions of the forms of that species, and GRUNOW has placed the species in his rather extensive and somewhat variegated list of the cymosum forms, species, etc. You marked this specimen a duplicate, so I am sending you half of it to compare with no. 148, which I think is the same but of which I have no specimen here to make comparison, It may possibly rank as a distinct and unnamed species."

Mauritius: Point au Roches, 7. Febr. 39, R. E. V. no 267; same locality, 3. Apr. 31, R. E. V. no. 148.

Geogr. Distr.: Red Sea, Mombassa.

10. *Sargassum Scopula* Grun.

GRUNOW, *Additamenta*, no. 205, p. 158.

This species has been described by GRUNOW upon specimens from Mauritius collected by ROBILLARD. No specimens have been present in the collections I have seen from the island. It is mentioned in JADIN's list p. 160.

Mauritius: Flacq, June 1890, F. JADIN.

Geogr. Distr.: Mauritius.

11. **Sargassum Merrifieldii* J. Ag.

AGARDH, J., *Sargass. Austr.*, 1889, p. 115, pl. XXX, fig. IV. GRUNOW, A., *Additamenta*, no. 209, p. 159.

About no. 191 a (Pl. VII) in Dr. VAUGHAN'S collection Professor SETCHELL says as follows: "A very interesting plant, agreeing fairly well with a fragment named by GRUNOW which is in our collection. It is closely related to *S. polyporum* Mont. Probably also to *S. leptopodium* J. Ag., and in the group with *S. polyphyllum* J. Ag. and *S. torvum* J. Ag. All of these have the leaves occasionally furcate. Some of them have more or less graniferous axes. The receptacles are at the bases of your specimens. You will find further notes in my "Hong Kong Seaweeds", no. V, under *S. polyporum*." About another specimen of Dr. VAUGHAN'S collection. no. 132, Prof. SETCHELL writes: "A less representative specimen than any of those under 191a".

Mauritius: Cannonier's Point, 5. Aug. 33, "in shallow water behind reef", R. E. V. no. 191. Port Louis Harbour, leg. G. ANTELME, 10 feet, 15. Jan. 31, R. E. V. no. 132.

Geogr. Distr.: Australia, Adelaide, Melbourne.

12. *Sargassum subrepandum* (Forssk.) Ag.

AGARDH, C., Spec. Alg., vol. 1, p. 8. AGARDH, J., Spec. Alg., vol. 1, p. 319; Spec. Sarg. Austr., p. 95. GRUNOW, A., Additamenta, no. 121, p. 422. — *Fucus subrepandus* Forssk., Fl. Aegyp.-Arab., p. 192.

The Kew Herbarium contains some specimens collected by Colonel PIKE which DICKIE has referred to this species, The specimens seem to agree rather well with KÜTZING'S figure in Tabulae Phycologicae, vol. XI, pl. 11, I, at any rate the leaves have nearly the same shape and dentation and the numerous cryptostomes are arranged in the same way. But compared with a specimen of FORSSKÅL'S the likeness is not so great, the leaves in FORSSKÅL'S plant being smaller, the number of cryptostomes likewise, and the leaves are sinuated and nearly entire. But according to GRUNOW there are many varieties of this polymorphous

species, and the plant from Mauritius might very well be one of these.

Mauritius: Colonel PIKE. Flacq, Sept. 1890, F. JADIN.
Geogr. Distr.: Red Sea.

13. **Sargassum paniculatum* J. Ag.

AGARDH, J., Spec. Alg., p. 315; Spec. Sargass. Austr., p. 122, tab. XII, figs. 1—3. GRUNOW, A., Additamenta, p. 177, no. 228.

About the specimens (a part of one of these is found on Pl. VIII) of Dr. VAUGHAN Professor SETCHELL writes as follows: "Seemingly very excellent specimens of this, of which I have only a scrap named by GRUNOW. I would like very much to get a specimen of this."

Three fine specimens are found in Dr. VAUGHAN'S collection.

Mauritius: Cannonier's Point, 5. Aug. 88, "in shallow water behind reef", R. E. V. no. 189.

Geogr. Distr.: Indian Ocean.

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Indleveret til Selskabet den 19. Februar 1941.
Færdig fra Trykkeriet den 26. Maj 1941.

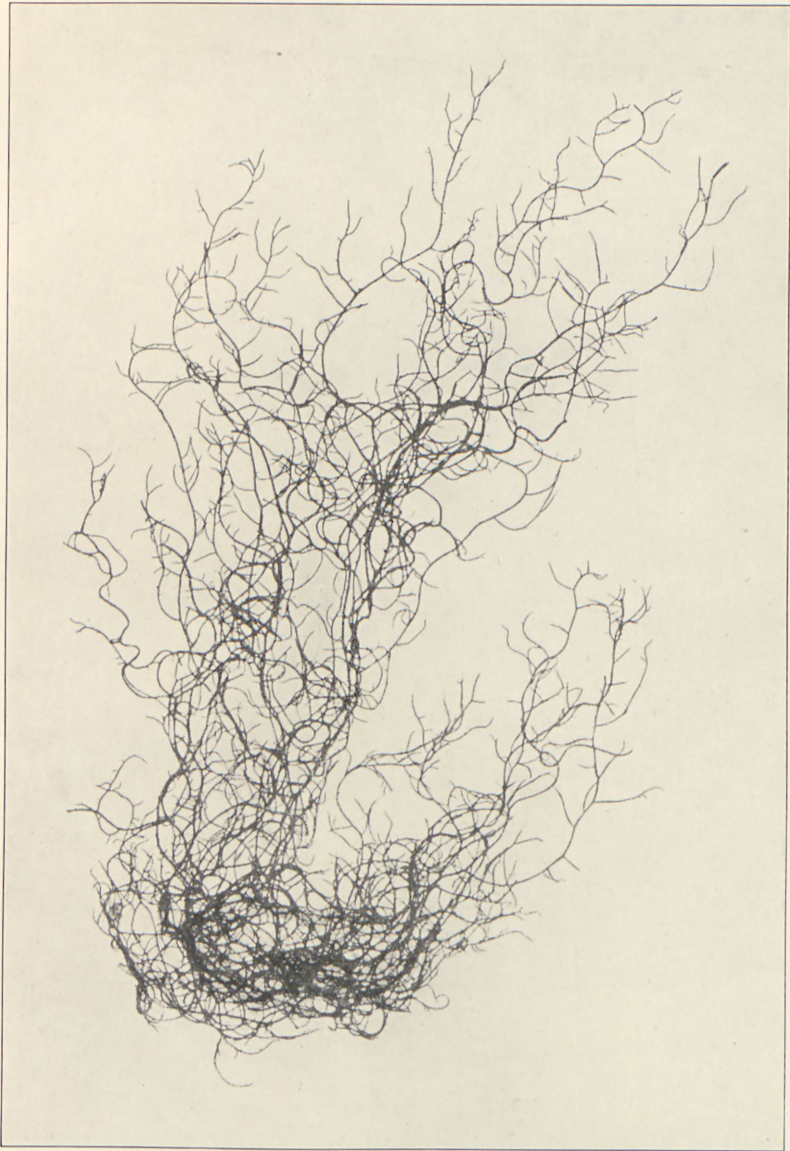
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Spathoglossum asperum J. Ag. ($\frac{2}{3}$ natural size).



Cladosiphon Mauritianum Børgs. (About $\frac{1}{2}$ natural size).



Nemacystus decipiens (Sur.) Kuck. From Dwarka (India). (Natural size).



Sargassum granuliferum C. Ag. (About $\frac{2}{3}$ natural size).



Sargassum densifolium Zan. Above a specimen with large vesicles (no. 188).
Below a specimen with small vesicles (no. 190). ($\frac{1}{2}$ natural size).



Sargassum Portierianum Zan. ($\frac{3}{5}$ natural size).



Sargassum Merrifieldii J. Ag. ($\frac{1}{2}$ natural size).



Sargassum paniculatum J. Ag. (About $\frac{1}{2}$ natural size).