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MARINE ALGAE FROM KARACHI

PART I CHLOROPHYCEAE

Contents

FOREWORD

The publication of a handbook on Indian Marine Algae needs no apology, as no such work exists today. The only papers of importance on this subject are those of Dr. F. Boergesen of Copenhagen who came to India during 1927-28 at the invitation of the Bombay University. He made collections at Bombay and Dwarka and has contributed several systematic accounts of these from time to time. He has also published some papers on the marine algae from South India sent to him. A few other stray papers on this subject have also been published by some Indian workers. No regular and detailed systematic study of the marine flora of any particular region, however, has been attempted before, and the author of these pages, Dr. Anand, has not only studied the marine plants from the Karachi coast purely from taxonomic stand point,, but also from the ecological point of view. The latter aspect of study has altogether been neglected in this country. Dr. Anand, by his ecological and taxonomic studies in the algal flora of the British Chalk Cliffs, has proved himself a very competent person for such work. He and his students have made a vast collection of marine plants from the Karachi coast at different seasons of the year and collected the ecological data presented in this book. Only the Green Algae *(Chlorophyceae)* have been dealt with, which form Part I, of the Marine Algae from Karachi. Part II of the Marine Algae comprising the Red Algae *(Rhodophyreae)* is

nearing completion and will be published soon. It is proposed to extend this investigation to other places along the Indian coast, when the study of Karachi marine flora is completed.

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Introduction

In India, very little attention has so far been paid to the study of marine algae. There are practically no data available defining the ecological position of the species or their relation to tide flow. There are only a few papers by Boergesen on some algae from Dwarka, Okha Port, Bombay, Madras and Karachi. Even then the field of study of this important branch of algae remains vast and largely unexplored. Karachi has a very luxuriant marine algal vegetation. Moreover, this is the most easily accessible place along the sea shore from Lahore, of all the other places in India. These considerations have lead to the selection of this place for a comprehensive ecological and taxonomic study of its algal flora. As this work will take several years to be completed, it is proposed to give out short contributions every now and then. The present paper contains the first instalment of the results so far obtained. Any ecological work necessitates the study of the systematics of the group, hence the need of this paper. Although collections have been made from various localities such as the rocky ledge at Manora, the buoys, piers and wharves near Manora and the Kemari harbour, sea beaches at Sandspit and Baba Island and the water channels in the adjoining salt-marshes, it is proposed to limit the detailed ecological study in the beginning to the rocky ledge only. By limiting the investigation to a small area in this way a more accurate knowledge of the vegetation and of the conditions influencing its distribution could be obtained.

The rocky ledge lies in the north-west side of Manora islands (PI. I, Fig. i). It is about 5—6 furlong long and 1 furlong wide. Here the shore is all rocky with a large number of tide pools of different depths and having a sandy or stony bottom. It is totally submerged under water at the time of high tide, but when the water recedes, although most of the water flows out through small channels in between the rocks, a certain amount is always left in the rock pools, thus allowing plants which, as a rule, cannot tolerate

exposure to drought and are confined to greater depths, to survive at higher levels. The rocks are of varying heights so that some of these, although lying near the low tide mark, become exposed at their summits as soon as the tide begins to recede. The surface of the rocks is smooth or rough. The latter condition is probably, to a certain extent, due to erosion by barnacles, which are seen attached in extremely large numbers to these rocks. Certain rocks may be slightly tilted forming shallow cave-like sheltered localities. In between the rocks there are long, flat stretches of areas covered with a thick layer of mud. Most of the rocks in these areas and in certain rock pools are silt-covered.

Collections from the rocky-ledge have been limited to the littoral region between the high-tide and low-tide-marks. A suitable time for collection is when there is low tide, or if possible, one should move as the tide recedes keeping at the receding water edge. For the collection of drift algae a rising tide will be more suitable, since then the algae will be borne in closest to the water edge. In this collection one usually finds a number of deep water plants, which could otherwise only be obtained by dredging. Collections are either dried and preserved as herbarium specimens or preserved in solution formed by dissolving 4 cc of 40% formaline in 96 cc of the sea water.

The travelling expenses for collections were met out of a grant from the Sanatana Dharma College Society, Lahore, which is here gratefully acknowledged.

Preliminary Survey of the Algal Vegetation from the Ecological Point of View

The vegetation at the rocky ledge is very luxuriant and can be divided into belts of different colours, determined by that of the dominant species in each belt and recognisable from a considerable distance. This marked zonation of algae on closer observation, however, is seen to be disturbed by the numerous rock pools, as one would expect, because these enable the plants that would otherwise occur at greater depths, due to intolerance for longer periods of drought, to persist near the high-water mark. The following belts are recognised on the rocky ledge as you go from the high-water towards the low-water mark: —

(1) *Phormidimn-Pleurocapsa-Calothrix-belt.* This belt has a width of about i—2 metres. The component algae form a greyish stratum on the surface of the rocks. The presence of these rocks at the extreme limit of high-water mark shows that the algae on them are able to withstand desiccation for sufficiently long periods. Similar strata formed by these algae are found on the summits of larger rocks, scattered all along the shore, even as far as the low-water mark, as these become exposed at once as soon as the tide begins to recede. This belt is fairly conspicuous during winter when the stratum forms a more or less thick mat, while in April it cannot be so easily distinguished. The dominant algae right at the extreme limit are *Pleurocapsa* and *Calothrix*. Species of *Phormidium* form blue-green strata at sightly moister localities. On loose pebbles with smooth surface, that are carried to and fro at high tide, plants like *Pseudulvella* form small, rounded, light-green crusts. *Entermorpha compressa* is commonly found on stones totally submerged in the rock pools in this belt. At the margins of these rock pools are light-brown patches of colonial diatomes.

(2) The *Ulva-Enterotnorpha-be\L* This belt is about 10 metres wide and displays a bright-green colour. The dominant forms are *Ulva indica* and *Enteromorpha compressa* forma *complanata*. *Ulva indica* forms dense pure tufts on silt-covered rocks and stones along the side of rock pools and submerged

under water in them. It persists at all seasons of the year but is most conspicuous in winter. It is neither tolerant of too much exposure nor too much shelter. In sheltered localities it no longer remains dominant but is replaced by small yellowish-red cushions of *Gelidium* and light-green tufts of *Enteromorpha compressa.* A few plants of *Viva indica* may be seen as epiphytes on these cushions.

The rock pools in this belt mostly contain drift algae, the commonest being *Hypnea musiformis,* which forms very much entangled masses of purple-red colour, twining round almost every other plant near it by the swollen crozier hooked, branched fronds, and *Chrysmenia Uvaria* forma *luxurians* with large, scarlet-red fronds, densely covered with small rounded vesicles. Other plants commonly associated with them are *Coelarthrum opuntia, Gracelaria* sp., species of *Codium, Agardhiella robusta* and solitary fronds of *Caulerpa taxifolia.* At the margins of the rock pools are brown patches of *Ectocarpus* and *Pylaiella* associated with *Enteromorpha.* At the time of collection the *Enteromorpha*-plants were richly covered with diatomes giving them a brownish-green colour. In very much sheltered crevices are yellowish-red cushions of *Gelidium.*

(3) *Colpomenia* simosfl-belt. This belt is dominated by *Colpomenia sinosa* forma *tuberculata* and is the most conspicuous along the rocky ledge. This is due to the fact that the plants grow in such large masses as to give a distinct brown colouration to the belt which extends all along the mid-tide zone. The plants form large round dark-brown, tuberculate masses attached to the rocks by small rounded discs or by the entire basal surface. In between these clusters are thick, dark-green mats formed by mud-binding species like *Cladophoropsis,* and *Cladophora.* These algae are also dominant on extensive flat stretches of mud-covered areas in this belt. *Microcoleus chthonoplastes* is locally abundant in these areas.

The rock pools in this belt are deeper, have a luxuriant vegetation and the plants are relatively more developed. This is probably due to the fact that the component algae in these pools remain submerged under water for longer periods and are also protected from direct insolation and consequently higher temperatures by the surrounding rocks. In April their growth is very poor and stunted. *Sargassum tenerrimum* and *Cystoseira* sp. are

dominant in pools with rocky bottoms while those with sandy bottom have *Padina tetrastromatica, Chaetomorpha prostrata, Cladophoropsis memberanacea, Acetabularia Mobii* and *Bryopsis* spp. among the most common plants. *Caulerpa racemosa* associated with *C. peltata* form large tufts on completely submerged silt-covered stones. Most of these plants are covered with numerous epiphytes the commonest being *Champia compressa, Jania* sp., *Enteromorpha compressa, Viva indica, Melobesia* and diatomes. Along the margins where there is a good deal of shelter small patches of reddish colour are occasionally found dominated by *Gelidium* sp. and *Polysiphonia platycarpa,* intermingled with *Bryopsis* and *Enteromorpha.* Dark-pink encrusting patches of *Lithothamnion* are very common on animal shells.

(4) *Gelidium-Polysiphonia-Ceramium-belt.* This is the last visible belt on the littoral region and extends right upto the low-water mark. The dominant plants are *Gelidium* sp., *Polysiphonia platycarpa* and *Ceramium* sp. *Ceramium* is locally dominant in sheltered localities near the low-water mark and in rock pools with sandy bottom where it is usually intermingled with *Bryopsis,* the two binding a good deal of mud.

The following communities have been recognised at the rocky ledge: —

(1) *Pleurocopsa-Phormidium-Calothrix-community.* This is the chief community comprising the uppermost belt along the high water-mark.

(2) *Viva* ṁdi'cfl-community (PI. II, Fig. 3). This community is dominated by the bright-green plants of *Viva indica.* The thalli are small with a highly frilled margin collecting a lot of sand particles in between the folds. The community persists at all seasons of the year but is most conspicuous in winter. *Viva* is abundantly associated with *Enteromorpha compressa.*

(3) *Colpomenia* s̈nosa-community (PI. II, Fig. 4). This community which is dominated by *Colpomenia sinosa* forma *tuberculata* is the most conspicuous and extensive community on the rocky ledge. In winter the plȧnts are very well developed and have a light-brown colour while in April the growth is very stunted and poor, the plants are usually in a shrivelled condition and have a dark-brown colour. This is probably due to higher temperature and greater exposure to drought. Where the stones become covered by

a thick layer of mud, *Colpomenia* becomes associated with *Cladophoropsis zoolingerii* and *C. membranacea.* In shaded localities *Colpomenia* has other serious rivals in *Gelidium* and *Ceramium.*

(4) *Sargassum-Cystoseira-community* (PL I, Fig. 2). This community is confined to the deeper rock pools in the *Colpomenia sinosa-be\t.* The dominant plants are *Sargassum tenerrimum* and *Cystoseira* sp. During winter the plants are very highly developed forming very bushy growth of dark-brown colour. *Champia, Jania* and *Melobesia* are the commonest epiphytes. *Sargassum* is practically absent from these rock pools during April, while only very small, stunted plants of *Cystoseira* are occasionally found without many epiphytes. The plants are firmly fixed to the stones at the bottom by well developed rounded discs.

(5) *Chaetomorpha-Acetabularia-community.* This community is confined to deeper rock pools with sandy bottom. *Chaetomorpha prostrata* is the dominant plant forming a more or less compact mat by the intertwining of the filaments. The filaments are quite rigid, possess a bluish-green colour, become declined as soon as they are formed, get entangled with each other or among other algae and are much coiled and contorted. They are firmly fixed to the soil by means of long slender rhizoids. The much coiled and contorted prostrate filaments and the presence of a large number of branched rhizoids help the plants in binding the sandy substratum on which they grow. *Acetabularia Mobii* is locally abundant at places, forming small blue-green patches. Rarely associated with *Chaetomorpha* and *Acetabularia* are *Chaetomorpha torta, Cladophoropsis membranacea, Cladophora magdalenae* and *Struvea delicatula.*

(6) *Pylaiella-Enteromorpha-community.* It is a shade-loving community, favouring frequent submergence, distributed on shaded silt-covered stones along the margin of the rock pools or in water when it is very shallow and not more than 10 cm deep. *Pylaiella litoralis* is the dominant plant forming delicate tufts of brownish colour. Abundantly associated with *Pylaiella* is *Enteromorpha intestinalis* forma *tubulosa.* In extremely shaded localities *Gelidium, Polysiphonia* and *Ectocarpus* are also present side by side with the dominant plants.

(7) *Caulerpa racemosa-community* (PL III, Fig. 5). This community which is dominated by *Caulerpa racemosa* is confined to silt-covered stones totally submerged under water in the rock

pools in the *Colpomenia sinosa-beit.* Rarely *Caulerpa peltata* is also present.

(8) *Cladophoropsis zoolingeri-community.* This community is dominated by *Cladophoropsis zoolingeri,* forming dark-green matted tufts on mud-covered stones in between the *Colpomenia sinosa* clusters and flat stretches of mud-covered areas in the mid-tide zone. It is highly mud-binding community, the mats often becoming more than two centimetres thick. The filaments are frequently clamped to each other by means of haptera. *Chaetomorpha prostrata* is frequently intermingled with *Cladophoropsis, Cladophora magdelenae* and *Struvea* are also rarely present.

(9) *Padina tetrastromatica-community* (PL III, Fig. 7). This community dominated by *Padina tetrastromatica* occurs in rather shallow rock pools with sandy-bottom, extending from the mid-tide to the high-water mark along the rocky ledge. The beautiful fan-like light-brown plants stand erect in the rock pools anchored below in the sand. Pure dense growths of *Padina* are as a rule present but wherever the water is slightly deeper species of *Cystoseira* and *Sargassum* may occur. This community exists throughout the year.

(10) *Gelidium-Polysiphonia-community.* This is the dominant community in the *Gelidium-Polysiphonia-Ceramium-belt.* Though restricted to the low-water mark, it may extend to higher levels also along the rocky ledge but always remains confined to very shaded and moist localities. *Gelidium* sp. is the dominant alga of the community. It forms either red or pinkish-yellow, low, about one centimetre high, cushions on rough surfaced rocks richly covered with barnacles. The plants are very firmly attached by means of rhizoids given off from the prostrate branches. In the tide pools abundantly intermingled with *Gelidium* are *Polysiphonia* and *Ceramium.* In shallow rock pools with sandy bottom *Bryopsis* and *Ceramium* are locally abundant.

(11) *Codium elongatum-comm\\i\\ty.* This community is confined to the rocks at the low-water mark. *Codium elongatum,* the dominant plant of the community, forms large, dark-green, dichotomously branched hanging festoons which as a rule remain submerged under water or are constantly splashed by the waves. The plants are firmly fixed to the rocks or animal shells. Due to constant buffeting by the waves portions of the plants get detached

and are carried to higher levels by the high tide. Most of the plants are richly covered with pinkish phosphorescent clusters of *Champia compressa.*

(12) *Hypnea-Chrysmenia-community* (PI. Ill, Fig. 6). This is a drift algae community and is invariably dominated by *Hypnea musiformis* and *Chrysmenia Uvaria.* All the algae comprising this community are inhabitants of deeper waters, which become detached and are cast ashore during high tide. As a rule the upper part of the plants is only present but occasionally complete plants still attached to a portion of the rock on which they grow are also met with. Abundantly associated with the dominant plants of the community are, *Gracilaria* sp., *Agardhiella robusta, Codium elongatutn* and *Sargassum tenerrimum.* Frequently we come across *Gracilaria cortica, Laurencia, Cystoseira* and solitary fronds of *Caulerpa taxifolia. Coelarthrum opuntia* is only occasionally found. *Erythrocladia subintegra* is epiphytic on *Cystoseira.*

The algae growing on the buoys are firmly fixed to them, forming large hanging festoons, just below the water surface. Although different plants dominate the algal vegetation on different buoys, but they are all intolerant of drought and are thus invariably submerged. On some of the buoys a certain degree of zonation is recognised, the upper belt being formed by the green algae and the lower by the red ones. The floating wharves in the Kemari harbour also bear very luxuriant vegetation, the component algae being occasionally submerged and constantly splashed by the waves. The algal communities present on the buoys and wharves are: —

(1) *Ulva fasciata-community.* This community which is dominated by the bright-green plants of *Ulva fasciata* is confined to buoys near the break-water, forming a green band about 20 cm. wide, all round the buoys. The plants are firmly attached to the buoys by a basal disc, the segments are very much elongated, attaining a length of 35-40 cm. At the uppermost limit of the band *Ulva* is commonly associated with *Enteromorpha prolifera* and dwarf plants of *Ulva lactuca.* Below the band of *Ulva* there is rich growth of some Polyzoa colonies intermingled with small violet patches of *Champia.*

(2) *Ulva-Enteromorpha-community.* This community which is very prominent on the buoys is dominated by *Ulva lactuca* and *Enteromorpha prolifera.* The former forms grass-green coloured

attached, foliaceous, orbicular patches all round the buoys, while the latter forms thin wefts of entangled filaments of light-green colour. *Enteromorpha intestinalis* and *Cladophora Fritschii* are also occasionally met with. This community is present on most of the buoys and persists throughout the year.

(3) *Clodophora Fitschii-community.* This community which is dominated by *Cladophora Fritschii* is very well developed upon buoys and wharves. The plants form dense, twisted, flaccid, hanging festoon like tufts of olive-green or brownish-green colour. On some of the plants there is an abundant growth of epiphytic diatomes. The ramuli of these plants are usually thicker and more fasiculated than those without the epiphytes. *Enteromorpha prolifera, E. compressa* and *Cladophora Fritschii* var. *Kemariensis, C. fascicularis sue* occasionally associated with the dominant species.

(4) *Acanthophora Delilei-community.* This community is usually present on the buoys and grows below the green algae communities. *Acanthophora Delilei* is the dominant species, forming cylindrical, much branched bushy tufts of violet red colour which in certain cases may become dark red. A species of *Cladophora* having somewhat tough filaments is occasionally associated with *Acanthophora.*

(5) *Chaetomorpha media-community.* This community is very common on the wharves in the Kemari harbour. *Chaetomorpha media,* the dominant plant of the community, bears dark-green, unbranched filaments, upto 10 cm. high, attached to the substratum by branched intertwining basal rhizoids given off from the wedge shaped elongated basal cell. *Erythrocladia subintegra* is a common epiphyte covering large areas of the host plant. At deeper levels *Chaetomorpha* is frequently associated with *E. compressa* and *Polysiphonia platycarpa.*

Two communities formed by floating algae are usually met with in Kemari harbour, Baba island and the channels in the salt-marshes.

(1) *Enteromorpha intestinalis-community. Enteromorpha intestinalis* forma *flagelliformis,* the dominant plant of the community, forms large entangled masses of green or pale-green colour floating in Kemari harbour and in Baba island. It persists throughout the year.

(2) ***Enteromorpha prolifera-community.*** **This community is most conspicuous in the channels in the salt-marshes, covering large areas and forming a thick carpet of light-green or yellowish-green colour.** ***Enteromorpha prolijera*** **is the dominant species. Rarely associated with it are** ***Enteromorpha intestinalis*** **and fragments of** ***Viva lactuca.*** **The community is tolerant of frequent exposures and therefore extends to the adjoining muddy areas along the channels.**

Systematic List

ULOTRICHALES

FAM. ULVACEAE

Genus. **Enteromorpha*** *Link.*

Plants tubular, small or attaining a very big size, slender but often ample ; simple, proliferous or branched, branches showing uniseriate filamentous tips ; at first attached, sometimes later free-floating ; hold-fast formed by the downward growth of the cells in this region ; cells parenchymatously arranged, in distinct longitudinal rows in the younger stages and in some species even in the adult condition ; inner and outer membranes often thickened ; chromatophores single, may completely or partly fill the cell ; with generally one pyrenoid ; zoospores, four to sixteen formed in each cell, sexual by biciliate iso- or anisogametes, formed in different thalli ; the zyogote germinating without meiosis.

(1) Enteromorpha compressa (Linn.) Grev. var. **typica** forma **complanata** (Chapman). Fig. 1A.

Dominant on rocks in the *Ulva-Enteromorpho-belt* at the high water-mark, rocky-ledge, Manora.

Plants attached, bright-green, tubular or more or less compressed, dilated towards the apex, tapering below, giving several branches from the gradually contracted stalk-like base, branches similar to the main frond ; fronds upto 1.5 cm. high ; cells small, 10"13 mi in diameter, rounded or subquaderate, without any definite arrangement in the adult plants, walls not thickened, contents completely filling the cell, with one pyrenoid.

***The identification of the species of *Enteromofpha* has been effected with the help of a key by V. J. Chapman, Green Algae of North America by Collins and Marine Algae of the Pacific Coast of North America by Setchell and Gardner.**

(2) Enteromorpha intestinalis Kuetz. forma **flagelliforrais** Chapman Fig. 15, PI. IV. Fig. 8.

Fronds floating in large entagled masses of greenish or pale-green colour in the Kemari harbour and along the beach at Baba island.

Thallus simple or branched ; branches arising in tufts usually from the base, similar to the main axis ; fronds filiform, inflated at intervals to give it an intestine-like appearance, flattened at the top, margin crisped, texture soft ; plants at first attached by

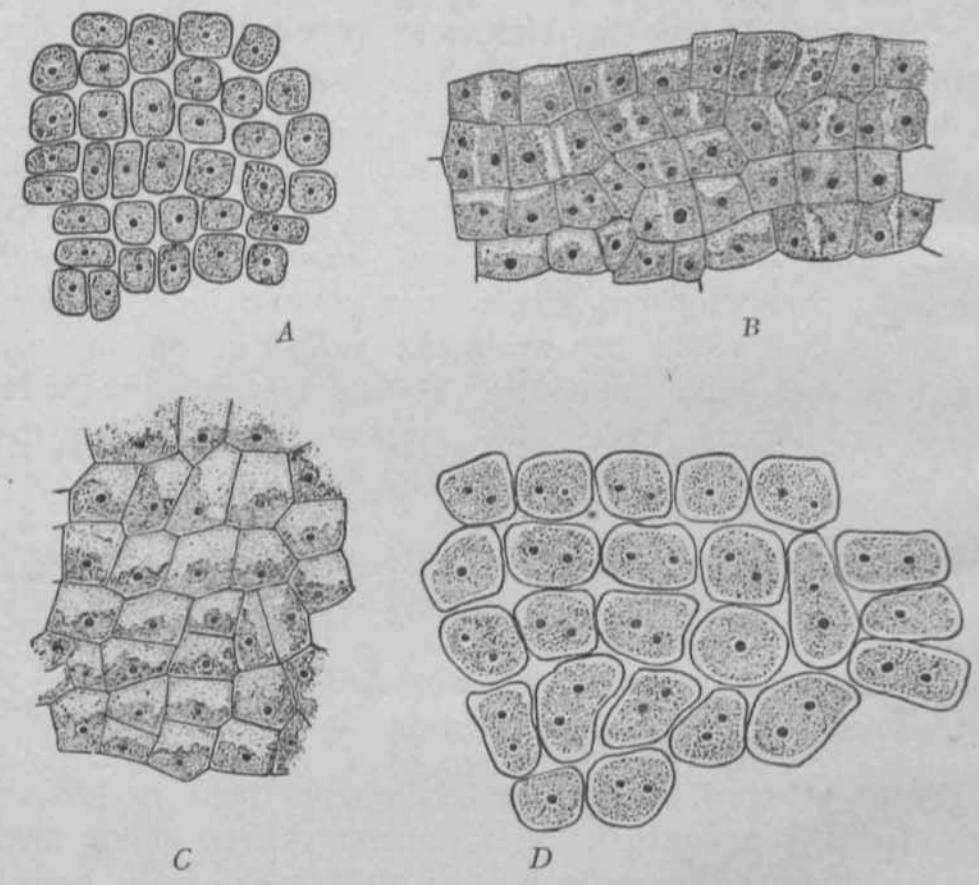


FIG. 1. *E*
meat and structure, x 385. *A, E. cotupressa* var. *typica* forma ***COtnplanata*** *; B, E. intestinalis* form *flagelhj<>r>>tis ; C, E. intestt-nalis* forma *cornucopiae ; D, E. intestinalis* forma *tubulosa.*

basal rhizoidal portion, later on free-floating, 4-10 cm. high, 2-7 mm. wide ; cells in surface view rectangular or squarish, 17.6-30.8 *fi* long, 12-15 ju. broad, inner membrane 8.0 *11* thick, outer 2.2 *fx* ; cells in younger parts only arranged in definite rows ; chloroplasts completely filling the cell ; the plant adheres to paper on drying nnd its green colour fades with age and preservation.

(3) Enteromorpha intcstinalis Kuetz. var. cornucopiae Kuetz. Fig. 1C.

Abundanty found attached to buoys in the Kemari harbour intermingled with species of *Cladophora.*

Fronds dwarf, 2-5 mm. in diameter ; only a few filaments acquire the characteristic form of the species while most of them are tubular with a few constrictions here and there ; rarely they are flat and ribbon-like ; filaments usually simple or slightly branched at the base ; cells 10-16 *[i* in diameter, without any definite arrangement in longitudinal rows ; chloroplast completely filling the cell with a single pyrenoid. The plant adheres to paper on drying.

(4) **Enteromorpha intestinalis** Kuetz. forma **tubulosa** Chapmȧn. Fig. ID.

Fronds in tufts of light-green colour along margins of rock pools and upon exposed rocks in the *Ulva-Enteromorpha-belt* at the rocky ledge, Manora, Karachi.

Fronds dwarf, slender tubular or compressed, filiform, profusely branched at the base, main frond and branches further bearing spine-like proliferations ; plants 1-3 cm. high, 50-500 /1 broad, attached by small flattened or elongated basal portion ; cells in surface view square or slightly rectangular, 10-15 /x in diameter, arranged in definite rows in the younger parts only, chloroplast filling the cell each having one to two pyrenoids ; plants adhere to paper on drying.

(5) Enteromorpha prolifera Ag. Fig. 2A.

COLLINS, *Green Algae North America,* 1928, *p. 122.*

Abundant in the salt-marshes adjoining the Kemari harbour, where the filaments lie prostrate forming either a thin weft or more usually a thicker carpet. In the channels it forms huge floating masses of light-green colour. None of the specimens was collected from this locality in the attached condition. This plant is also abundant on some of the buoys in the sea along Manora. The plants are firmly attached by their basal rhizoids, and form dense hanging tufts along the water surface. The plants here are short and broad while those in the salt-marshes are slender and very much larger.

Filaments show a great variety of form and are either simple or richly proliferous. The diameter varies from 100-800 /A. The proliferations are, as a rule, of uniform diameter throughout their length and sometimes only one cell thick. It is only rarely that the branches are proliferous in their own turn when they

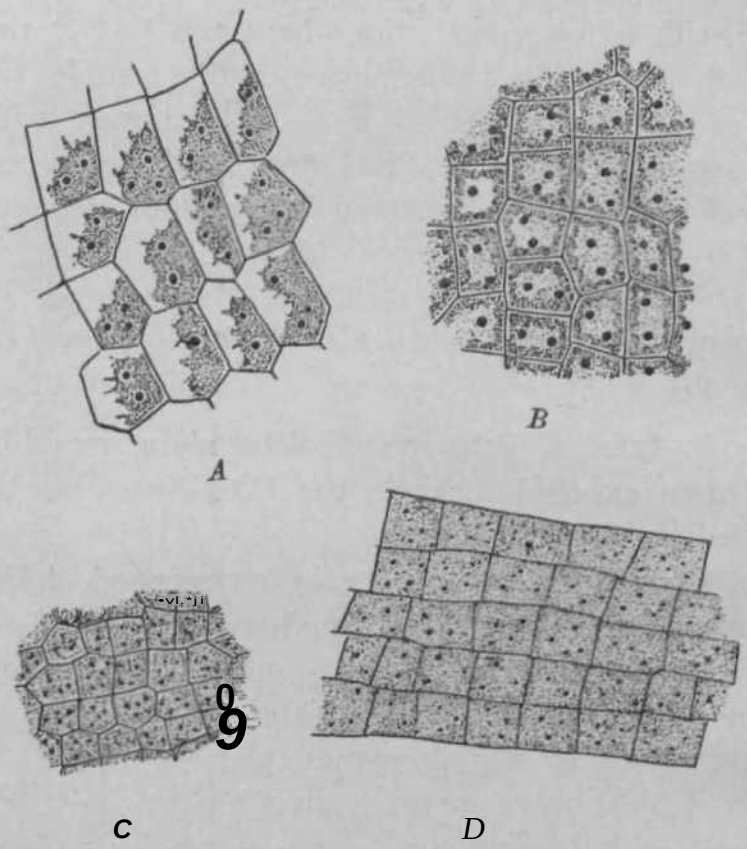


FIG. 2. *Enteromorplta:* Surface view, showing cell arrangement and structure, x 385. *A, E. prolifera ; B, E. prolifera* forma *capitlaris; C, E. minima ; D, E. lubulosa.*

bear short, spine-like proliferations. Cells more or less rectangular in surface view, 13-19 ju. long, arranged in longitudinal rows ; chloroplast completely fills the cell and contains one or more pyrenoids.

(6) **Enteromorpha prolifera** Ag. forma capillaris Chapman, Fig. *2B*

Commonly found either attached to floating wooden wharves in the Kemari harbour and buoys near Manora, or as huge, floating entangled masses of light-green colour near Baba island and in the channels in the salt-marshes.

Thallus tubular or compressed with abundant proliferous branches ; branches usually simple or may further branch, varying in length and diameter ; plants upto a metre or more in length and usually 150-700 JU. broad ; proliferations dilating at the apex ; cell in surface view square, 10-30.2 /A in diameter, arranged in distinct rows, clear in the younger parts but less so in the older ones ; membrane thin, cells in transverse section 17.6 *p.* long, 15 /x broad, chloroplast filling the cell, each with a single pyrenoid ; plants adhere to paper on drying.

(7) Enteromorpha minima Nacg. Fig. 2C.
COLLINS, ***Green Algae North America,* 1928, *p. 121.***

Dominant as a pale green mat at the high-water level, on cement-concrete embankments at Manora ; zoospores in December.

Fronds dwarf, 1-2 cm. long, tubular or slightly compressed, soft and delicate, dilating towards the apex, simple or rarely branched ; branches arising from the margin ; cells squarish in surface view, 7-8 JU. in diameter (rarely upto 10 /x), arranged in no definite order ; wall on the inner and outer faces about equally thick.

(8) **Enteromorpha tubulosa** Kuetz. Fig. 2D.
SETCHELL **and** GARDNER, ***Marine Algae of the Pacific Coast of North America,* 1920, *p. 2*56.**

Occasionally intermingeld with *E. prolifera* forma *capillaris* on floating wooden wharves in the Kemari harbour.

Fronds simple or with short proliferations near the base ; unifomly thickened, 700 /x wide ; cells squarish or slightly elongated, 13-16 ^ in diameter, arranged in longitudinal series throughout ; walls equally thickened on both sides, chromatophore filling the outer end of the cell.

Genus **Ulva** Linnaeus

Fronds flat, leaf-like, parenchymatous, attached to the substratum by more or less marked attaching discs ; cells placed with their long axes at right angles to the surface of the thallus, arranged in two layers in close contact with each other ; each cell with a single parietal chloroplast having a single pyrenoid ; reproduction by quadriflagellate zoospores and bi-flagellate gametes.

(9) **Ulva fasciata** Delile. Fig. 3A, PI. IV, Fig 9

FLORA EGYPTE, **1813,** ***p. 153,*** **pi. 58, fig. 5 ; J.** AGARDH, ***Till Algernes Systematik ^dxe aAfd. VI, Ulvaceae, p. 174.,*** **1883 ; A.** VICKERS, ***Phycologia Bar bade sis,*** **1908, PI. II;** COLLINS, ***Green Algae of North America,*** **1909,** ***p. 216*** **;** BOEKGESEN, ***The Marine Algae of Danish West Indies,*** **Vol. I, J9I3-I4.** ***P-*** **#•**

Abundantly hanging in masses of green colour from side of the buoys, dredges and wooden wharves in Kemari Harbour. Plants always submerged just below the surface of water, firmly attached to the substratum by strong basal discs throughout their life.

Fronds 10-30 cm. high, attached by a circular or oblong basal disc, 2-4 mm. in diameter, divided into more or less distinct segments, each 1-3 cm. wide with an undulate margin ; in the upper and lower region of the segments the thallus is differently thickened along the midrib and the margin. In T. S. from the upper region of the segments the thickness of the margin is 50-60 /A and at the midrib 70-90 ^ while from the basal portion the thickness at the margin in 60-90 ^ and at the midrib 110-115 ^ , cells in the surface view are polygonal with rounded angles, 18-22 //. in diameter, rarely 16 ^ ; in vertical section the cells are slightly elongated, the chloroplast filiing the outer half of the cells only. Plants adhere to paper on drying and the colour fades with age and preservation.

(10) **Ulva fasciata** Delile forma **taeniata** Setch.

PI. V, Fig. 10.

In this form the fronds are divided into distinct lobes which are slender and elongated, with a crisped margin. At the base? the segments are toothed.

(11) Ulva lactuca Linnaeus. Fig. 3fi.

BOERGESEN, ***Marine Algae Danish West Indies,*** **Vol. I, 1913-14 ,** TAYLOR, ***Marine Algae North-Eastern Coast of North America,*** **1937 ;** SETCHELL **and** GARDNER, ***Marine Algae Parific Coast of North America,*** **Vol. II, 1920.**

Found growing in masses of green colour on buoys in the Kemari harbour.

Plants attached, always submerged, foliaceous and orbicular, attached by basal disc, 2-4 mm. in diameter ; stipe inconspicuous,

apparently absent ; thallus much broad than long, 4-8 cm. high, 5-10 cm. broad, rounded, seldom lanceolate, often somewhat lobed, undulate or ruffled margin, small holes may be present ; cells in surface view polygonal, closely placed, 13-15 ju in diameter ; thick-

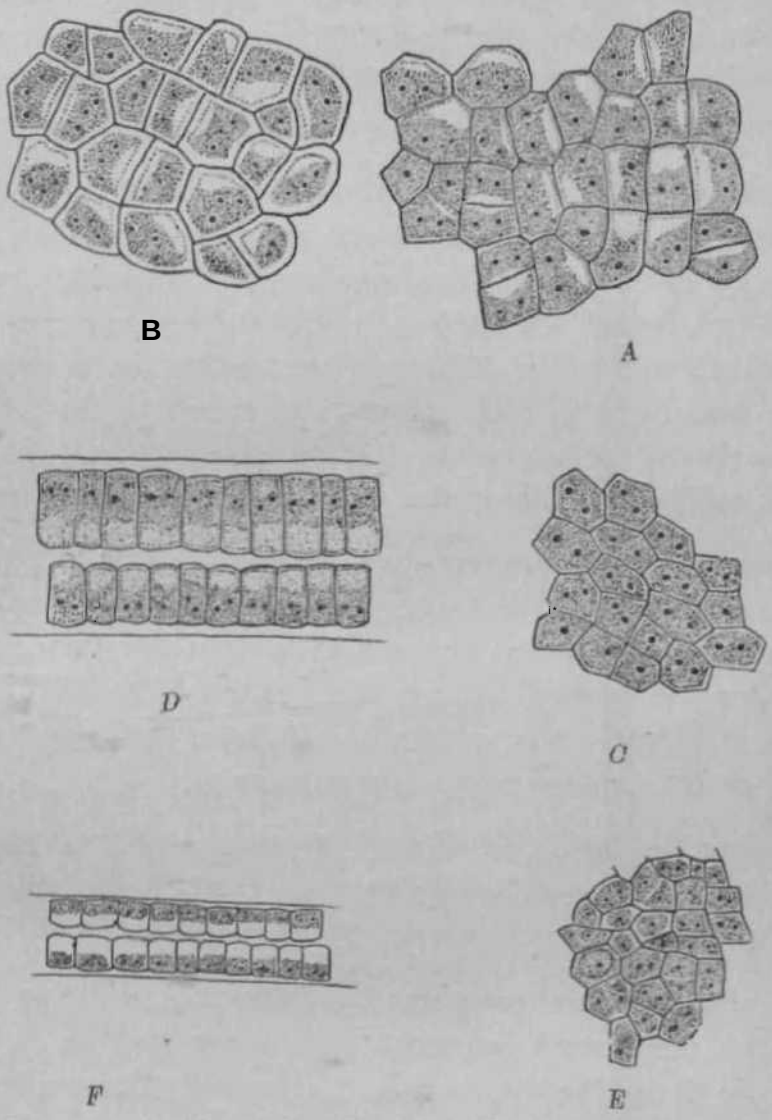


FIG. 3. *A. Viva fasciata ; B, Viva lactuca,* surface views showing cell arrangement and structure, x 385 ; *C—F, IHva indica* sp. nov. ; C. Surface view of larger form ; />, Sectional view **larger** form ; *E,* Surface view smaller form ; **;•', Sectional** view smaller form, x **130.**

ness of the lobes is different at different regions ; at **the** margin 4°"45 *ft* thick, midrib 60-65 /t '> cells in vertical section square to **rectangular,'** *i$*$_{iJL}$ in diameter at the margin and 13-15 /i broad and 20 *fi* long at the middle. Plants adhere to paper on drying and their grass-green colour fades with preservation and age.

(12) Ulva indica sp. nov. Fig. 3C-F, PL **II,** Fig. 3

Dominant in the *Ulva-Enteromorpha-be\t,* on the rocky ledge, Manora, forming a dense mat on the silt-covered stones along the margins of the rock pools. It may also extend into the *Colpomenia sinosa-belt* in the mid-tide zone where it occurs with Co//>omem'fl-clusters or as an epiphyte on *Sargassum tennerimum* in the rock pools.

Fronds small, bright-green, about i cm. high, .8-1.5 cm. broad, orbicular, soft, tufted, margin very wavy and frill-like giving the plant a composite-flower-like appearance, retaining lot of sand particles in between the folds ; frond suddenly narrows down into a distinct though short hollow stipe, ending in a more or less rounded disc by which the plant is attached to the substratum ; cells squarish or polygonal in surface view, 15-25 ^ in diameter, contents completely filling the cell, each with one pyrenoid.

It seems that there are two different forms of this species present at Manora. The larger form has thicker fronds 75-85 //. thick, cells are polygonal or squarish in surface view, upto 30 \i in diameter ; in vertical section the length of the cells in the two layers is different, cells in the upper layer are upto 40 /A long while those in the lower one are upto 30 *p.* •

The smaller form has thinner fronds, 35-40 *y,* thick ; cells in the surface view usually polygonal, 15-18 *p.* in diameter ; in vertical section cells are squarish, 15-18 ^ in diameter.

The smaller form resembles *U. californica* Wille in the thickness of the membrane, presence of a stipe and its habitat, but differs from it in the characteristic composite-flower-like form of the thallus, hollow stipe and the smaller size of the plants which are seldom more than 1 cm. high. The larger form, however, differs from *U. californica* in the greater thickness of the membrane, different sized cells in the two layers of the thallus, hollow stipe, bright-green colour and soft consistency.

This species is characterised by the small size of the plants, bright-green colour, soft consistency, .8-1.5 cm. in diameter, highly ruffled, frill-like margin giving the plant a composite-flower-like appearance, and different sized cells in the two layers of the thallus.

CLADOPHORALES

FAM. CLADOPHORACEAE

Genus Chaetomorpha Kuetz.

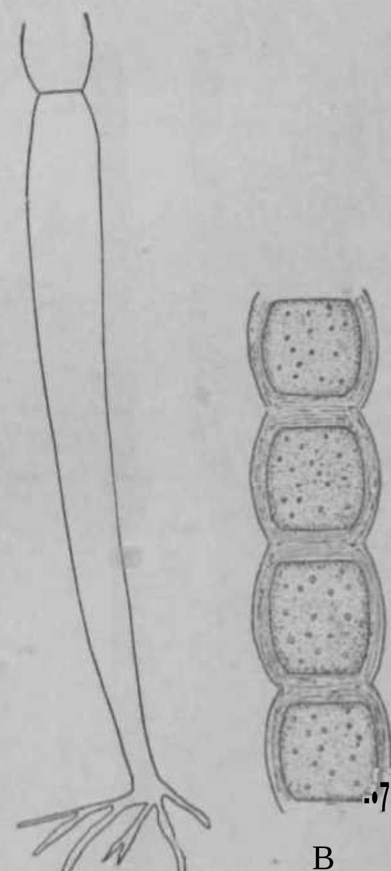
Plants filamentous, unbranched, attached by a long tapering basal holdfast cell ending in branched rhizoids ; cells with firm, often heavy, lamellose walls; chromatophore a parietal band, more or less perforate, with numerous pyrenoids ; reproduction by quadricilliate zoospores and by bicilliate isogametes ; mostly marine.

(13) Chaetomorpha media (Ag.) Kuetz. Fig. 4A,B.

BOERGESEN, *J. I, B. S..* V.,1. XI. 193^ *PP- 5H* **Cou.«s,** *Green Algae of North America,* 1928 *pp. 224* ; SETCHELL and GARDNER, *The Marine Algae of the Pacific Coast of North America,* Vol. II. 1920, *p. 203.*

Rarely growing on floating wooden wharves in Kemari harbour, Karachi, forming tufts of dark green colour.

Filaments tufted, unbranched, 4-10 cm. long, erect, rigid and stiff below, somewhat soft and flexuous above ; basal cell very much elongated, swollen at the apex, 550^ broad and narrow at the base, 205/1 broad, 10-12 times as long as broad at its maximum thickness, giving long, slender, intertwining rhizoids, containing thick chloroplast rich in pyrenoids ; other cells of the filament 400-500 jn broad, usually as long as broad, rarely 2-2^ times as long, uppermost cells barrel shaped, more long than broad ; cell wall thick, upto 60 *fl*, lamellate.



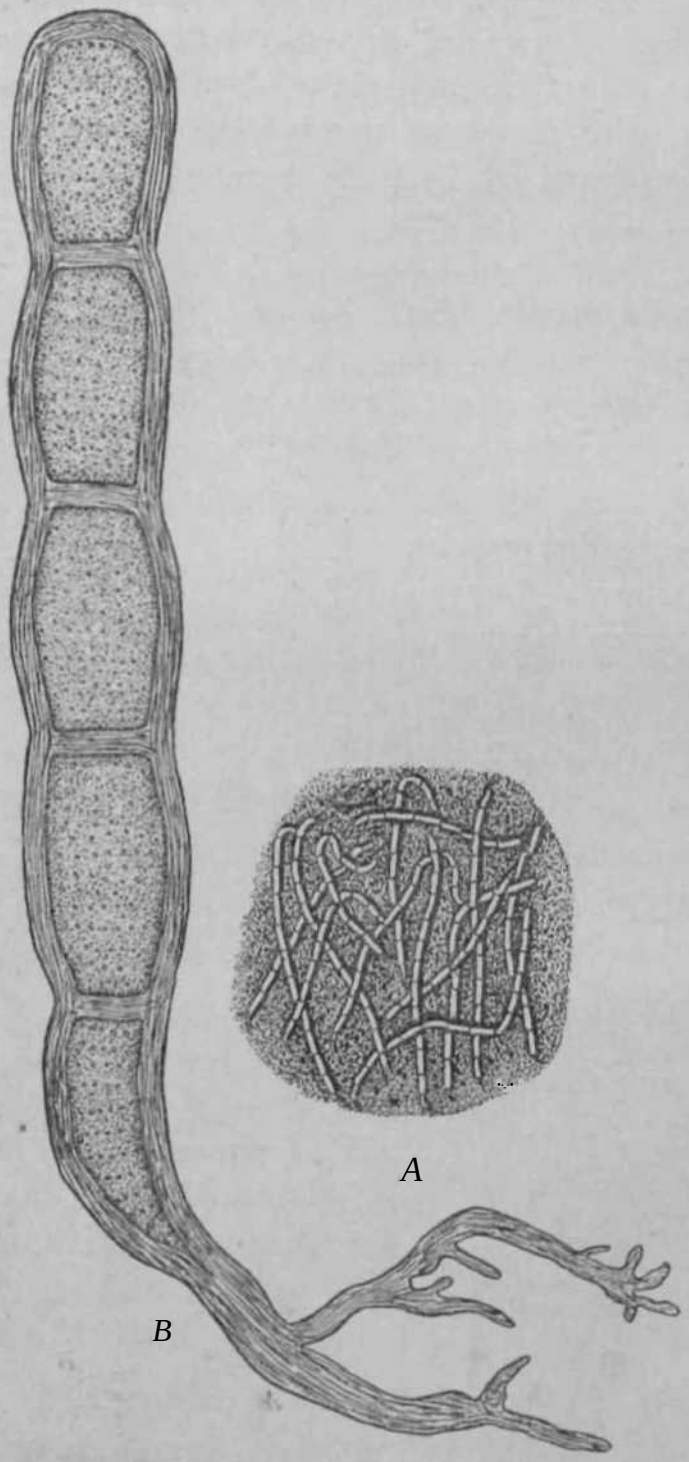
A B

Chaetomorpha media. A. Basal ... B. ... of the filament, x 32.

The plants are usually covered over by epiphytes, the commonest being *Erythrocladia subintegra.* Plants very much adhere to paper on drying.

(14) Chaetomorpha prostrata sp. nov. Figs. 5A, B; 6

Abundant in the sandy bottom rock pools in the *Coipomenia sinosa*___and *Gelidium-Polysiphonia-Cerafnium-bells,* on the rocky ledge, Manora, more or less throughout the year.



I'lu. 5. *Chaetomorpha prostrata* sp. *nov.* *A,* Small **portion** of **the** compact mat formed by -the **intertwining filaments binding** lot of sand; fj. Short unbranched **filament** with the slightly elongated basal rhizoidal cell, x 32.

Plants form a more or less compact mat, about i cm. thick, by the intertwining of the filaments. The filaments become declined as soon as they are formed, get entangled with each other or among other algae and are much coiled and contorted. They are quite rigid, not collapsing on removal from water and possess bluish green colour. The thickness of the filament varies, the slender ones being upto 300 ju. in **diameter,** while the thicker ones may be upto 900 *p.* (rarely 1 mm.) ; cells I-I£ times as long as broad, nearly uniform throughout and distinctly moniliform. The walls are very **thick,** 60-100 JU and high

lamellate. The filaments are firmly fixed to the soil by means of long slender branched rhizoids, given off from certain cells. These rhizoids are very much branched at their tips and firmly clasp any other filament or any rhizoid of a filament that comes in their way, so that it is quite difficult to tease out a single filament from the thick mat without breaking it. Occasionally erect filaments **have** been observed fixed to the substratum by elongated, tapering rhizoidal basal cell. In these the other cells do not bear any rhizoids.

This species resembles *C. torta* (Farlow) McClatchie in the declined filaments, forming entangled, coiled and contorted masses, size of the cells and bluish-green colour but diliers from it in the smaller size of the filaments, which lie prostrate and firmly anchored by means rhizoids given off from certain cells.

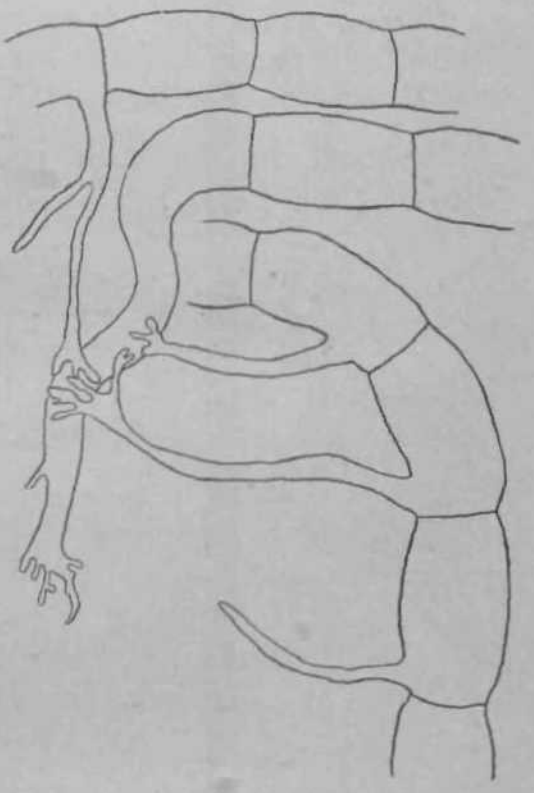


FIG. 6. *Chaetomorpha prostrala* sp. nov.: Rhizoids from **three different** plants clasping each other iirmly, **x 20.**

This species, particularly the plants with slender iiUirnents, resembles very much *Rhizoclonium grande* Boergesen described by him from Bombay. '. however, differ from him in putting it under *Rhizoclonium.* This species has been put under *Chaetomorpha* because of the coarse filaments, not collapsing on removal from water, large slightly barrel shaped cells highly thickened **lamellate** wall and occasional presence of erect or prostrate unbranched filaments attached to the substratum by the **tapering** basal rhizoidal cell. In my opinion the presence of rhizoids given off from certain cells is an adaptation to the conditions of growth. This particular species grows on loose and shifting sand at the bottom of the rock pools and the formation of rhizoids helps in binding this sand into a compact substratum.

The prostrate, coiled and contorted nature of the filaments also is helpful in his process.

This species is characterised by thick, rigid, slightly moniliform, prostrate filaments, coiled, contorted and entangled to form a thick, compact mat, firmly fixed to the substratum by means of rhizoids given of by certain cells ; basal cell not very much elongated ; other cells 300-900 ju thick, I-I£ times as long as broad, with highly thickened lamellate walls.

(15) Chaetomorpha torta (Fallow) McClatchie. Fig. 7.

COLLINS, *Marine Algae North America,* Second Supplementary papers '028, *p. 77* ; SETCHELL and GARDNER, *Marine Algae Pacific Coast of* ***Worth*** *America,* 1920, *p. 205.*

Frequent in the rock pools with sandy bottom in the *Colpomemenia sinosa*-belt associated with *Acetabularia Mobti.*

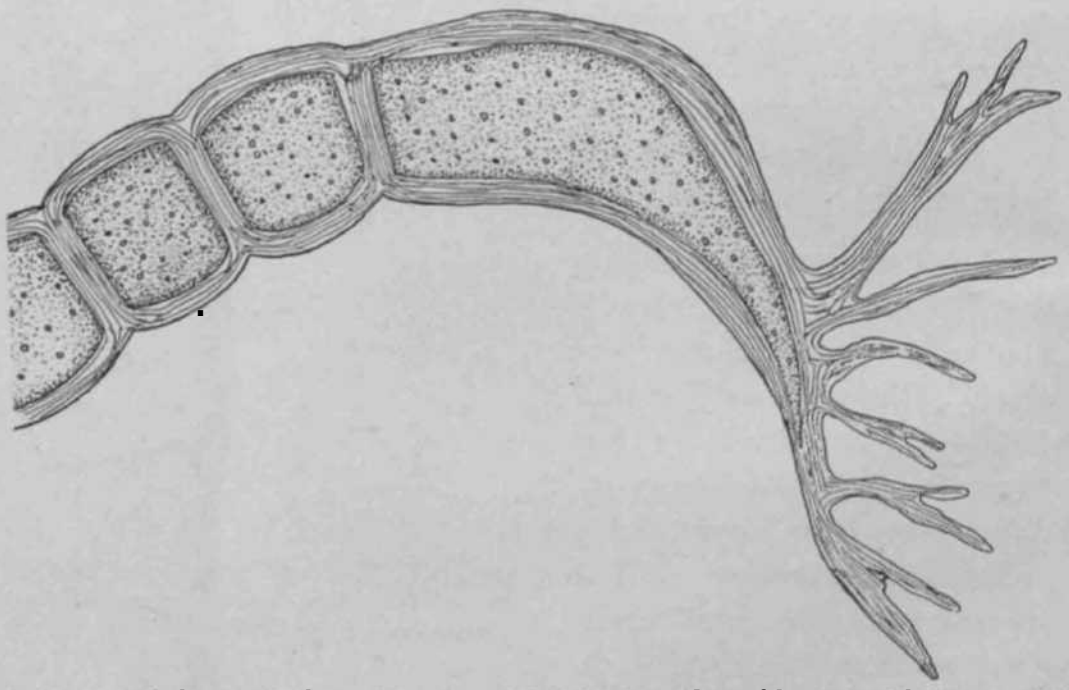


FIG. 7. *Chaetomorpha torta:* **Portion** <>*i* **the** filament showing tin slightly **elongated,** declined, basal rhizoidal cell.

Filaments rigid, attached by a basal rhizoidal cell, only 2-3 times as long as broad ; declined near the base, coiled, upto 5 cm. long, 400-600 in diameter ; cells as long as broad ; colour bluish-green ; rhizoids slender, branched.

The plants never attain a very big size and always remain attached to the substratum.

(16) **Chaetomorpha linum** (Muel) Kuetz.

KUETZ., ***Phyc. Germ. p. 204 ; Conferva hnum*** **Boerg.,** ***Marine Algae Arabian Sea,*** **1934.**

Plants forming entangled masses among other algae. Specimens about 150-200 ^ thick ; length of the cells from about **i** the breadth upto 4-5 times as long.

This is one of the previous records from Karachi.

Genus **Rhizoclonium** Kuetz.

Plants filamentous, unbranched or sparingly branched, with a few to many rhizoidal branchlets composed of one to few segments, cells long, with one to several nuclei and a single reticulate, parietal chloroplast, with numerous pyrenoids ; multiplication by fragmentation ; reproduction by biflagellate zoospores or by akinetes.

(17) **Rhizoclonium tortuosum** Kuetz.

KUETZING, ***Phyc. Germ.,*** **1845,** ***p. 20$*** **;** COLLINS, ***Green Algae North America,*** **1928,** ***p. 248*****;** SETCHELL **and** GARDNER, ***The Marine Algae of Ike Pacific Coast of North America,*** **1920,** ***p. 185.***

Occasionally associated with *Enteromorpka compressa* in the *Ulva-Enteromorpha-be\t* on the rocky ledge, Manora, forming dark-green entangled masses.

Filaments curled, 45-60 ^ in diameter, cells 8 times as long as broad ; cell walls not very thick and lamellose.

It differs from the type in having very much elongated cells.

(18) **Rhizoclonium kochianum** Kuetz.

KUETZING, ***Phyc. Germ.,*** **1845,** ***P- 206 ;*** BOERGESEN, ***Marine Algae Danish West Indies,*** **Vol. 1/** ***p. ig,*** **fig. 7 ;** COLLINS, ***Green Algae North America,*** **1928,** ***p. 240.***

Frequently intermingled in an *Enteromorpha-mat* on wet, muddy banks along the channels in the salt marshes adjoining the Kemari harbour.

Filaments pale-yellow ; cells 12-15 *jx* broad, about twice as long as broad ; rhizoids rare. This species has been described by Boergesen from Bombay, Kolaba.

(19) Rhizoclonium implexum (Dillw.) Kuetz. Fig. 8A,
COLLINS, *Green Algae North America,* 1928, */>. 2j.g* ; SETCHELL and GARDNER, *Marine Algae Pacific Coast North America,* 1920, *p. 183,*

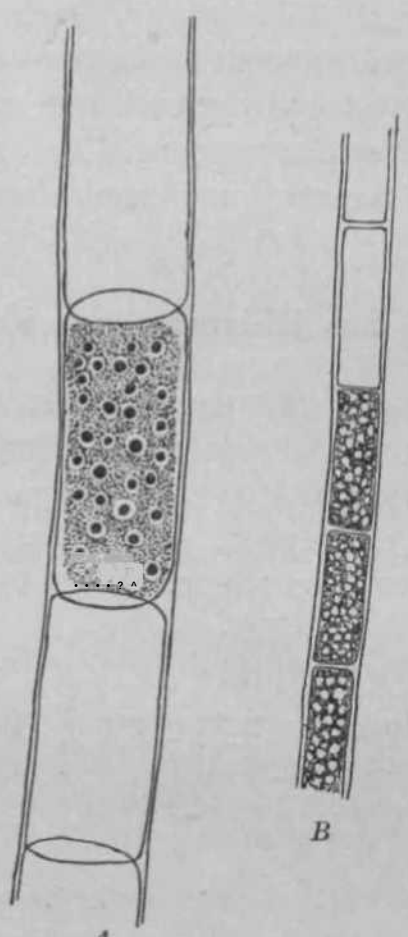


FIG. 8, v4, *Rhizoclonium implexum,* x 350 *; B, R. Kerneri,* x 35°.

Usually intermingled with *Enteromorpha compressa* at **the** high-water mark.

Filaments light or yellowish-green, flaccid, 35-45 *p* broad, 1-2 times as long as broad ; rhizoids absent.

(20) **Rhizoclonium Kerneri** Stockm. Fig. *8B.*
COLLINS, *Green Algae North America,* 1928, *p. 24.0 ;* SEACHELL and GARDNER, *Marine Algae Pacific Coast North America,* 1920, *p.* 185.

Usually associated with *Enteromorpha compressa* along the margins of rock pools or frequently submerged under water, in the *Ulva-Enteromorpka-be\t.*

Filaments yellowish-green, very slender, 12-14 u thick, 3-5 times as long as broad, devoid of rhizoids.

Genus **Cladophora** Kuetz.

Plants filamentous, sparingly to repeatedly branched ; branching lateral but often appearing dichotomous ; growth in length chiefly by the division of the apical cell ; cells multinucleate, chloroplast as a rule reticulate, with many pyrenoids, or in the form of numerous discs ; cell wall thin or thick, in older a1ls lamellose ; reproduction by 4-ciliated zoospores and by bicilaU-gametes.

(21) **Cladophora Fritschii** sp nov. Fig. *9A-B* ; 10A-£, I'l. V, Fig. **11 and PI.** VI, Fig. 12.

Very common on buoys and wooden wharves in the Kemari harbour, forming dense twisted rope-like hanging festoons of brownish-green colour.

Plants 1^-30 cm. high, anchored by small basal discs formed by the intertwining of the numerous branched rhizoids given of from the basal cell ; plants soft, flaccid, profusely branched ending in smaller or larger tufts of terminal ramuli. The branching in the basal region is alternate, rarely opposite, while in the upper it is <li polychotomous. The tufts of the terminal fasciculate ramuli are thinner and longer in the lower region, while they are thicker and shorter in the upper region ; in the upper thicker tufts the ramuli arise from each articulation, while in the lower ones they may have a few cells in between the suecessive ramuli. Branching in both the lower and upper tufts is di-polychotomous, the ultimate branches bearing, usually on the inner side, 1-3 **celled** slightly curved ramuli. Cells of the main axis 200-300 ^ broad, 10-12 times as long as broad, usually much broadened at the

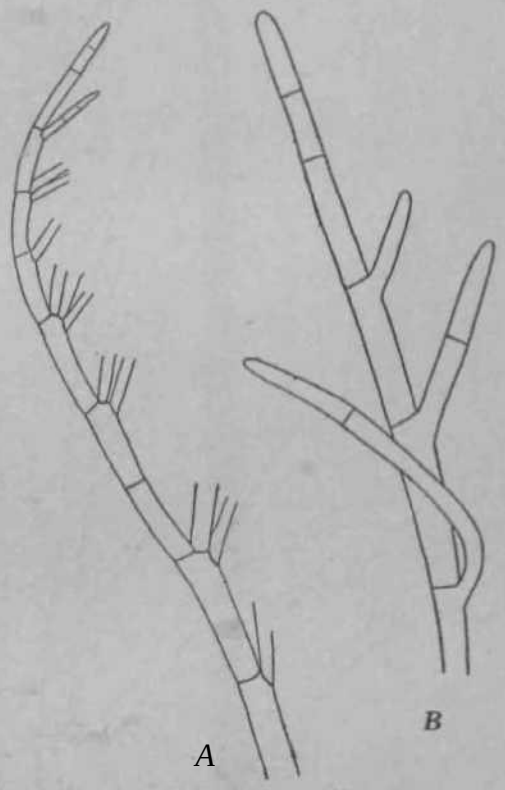


FIG. 9. *Cladophora Fritschii* sp. nov.: A, Part of the main filarnent From lower clusters, * 24 ; upper emi of a filament ramuli, K "** 4 pp ultimate

upper end bearing 3-6 branches. In the lower tufts of ramuli cells of the main axis are 150-200^ broad, 3-5 times as long as

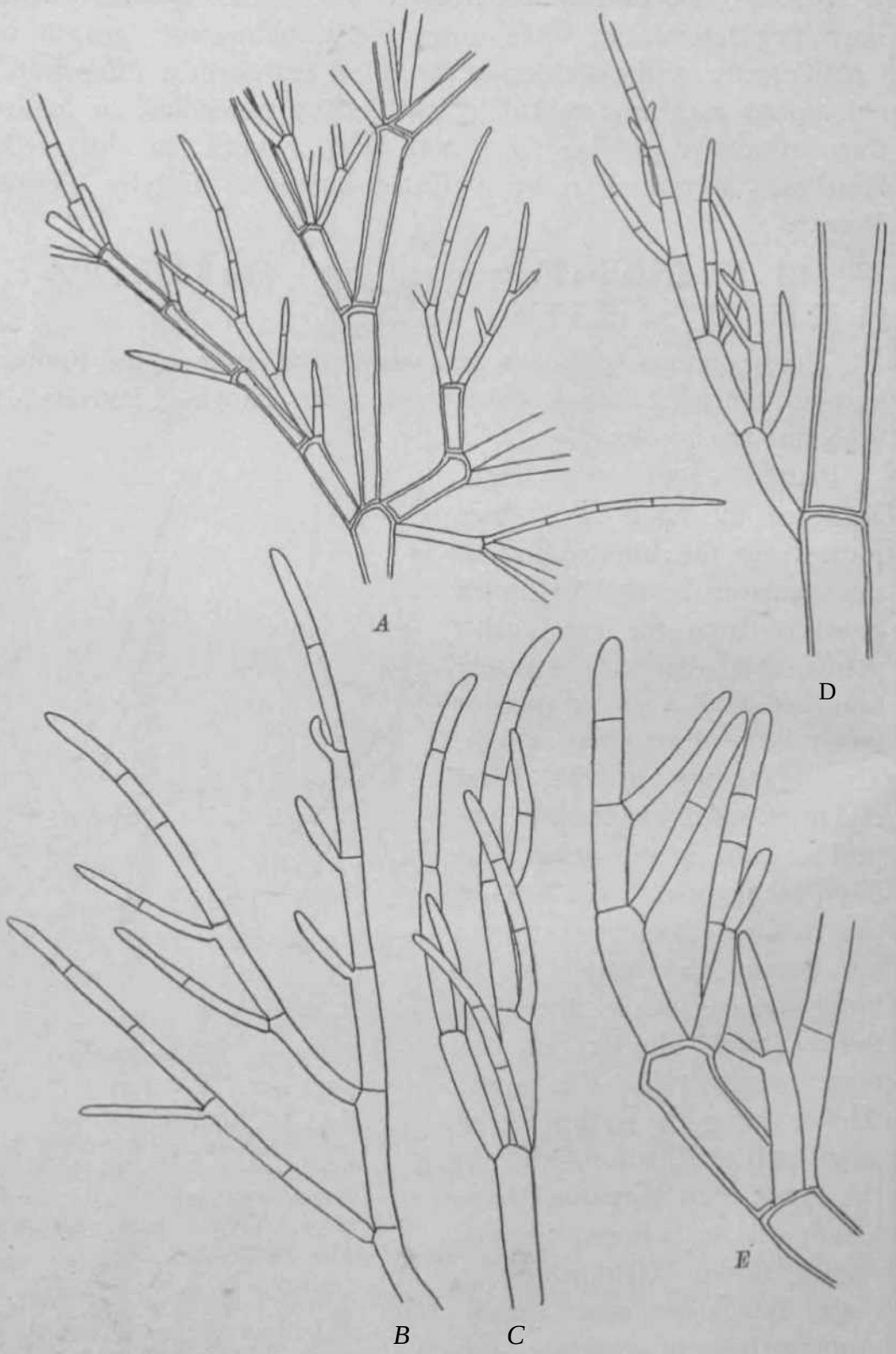


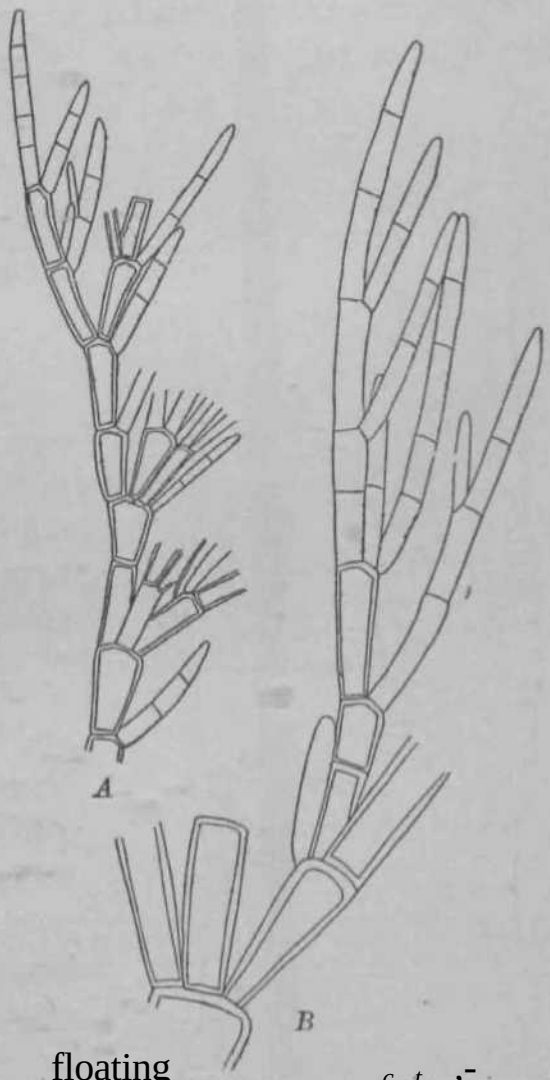
FIG. IO. *Cladopharu* ***FritschH*** sp. nov.: *A.* part of the upper luft of ramuli, x 35 ; *B-C.* ultimate ramuli from the same, x 55 ; *D.* part of a principal filament with **a small** tuft of a ramuli, x 35 ; *E.* part of **the** very small, thick tufts, **with short** and erect ultimate ramuli, x 55.

broad ; while those of the ultimate ramuli are 60-80 f broad, 4-6 times as long as broad, with more or less rounded apices. In the upper tufts of ramuli, cells of the main axis are 90-100 » broad 7-9 times as long as broad, and those of the **ultimate** ramuh 28 35 u broad, 5-8 times as long as broad, with acute apices. The ramulUn these tufts are more conspicuously curved than those in the lower tufts and also show a slight constriction at the point of origin. Rarely very short, thick tufts are present with di-polychotomous branching. Ultimate branches in these tufts are short and erect, cells 50-60 „ broad, **1J-3** times as long as broad. Most of the ramuli in the upper tufts at the time of collection were full of zoospores, escaping by an opening at the upper end of each cell just below the septum. **Plants** firmly adhere to paper on dryiiig.

This species is markedly characterised by the brownish-green colour, soft and flaccid substance, lower thinner and upper thicker tufts of ramuli with di-polychotomous branching, ultimate branches bearing one to three celled sightly curved ramuli, usually on the inner aside ; ramuli in the upper tufts slightly constricted at the base ; cells of the main filament 200-300/1 broad, 10-12 times as long as broad ; plants adhere to papper on drying.

(221 **Cladophora Fritschii** var. **Kemariensis** var. nov Fig **11.**

Very common on buoys near Manora, and floating wooden wharves in the Kemari harbour, forming dense, lossely tufted, hanging festoons.



FIG, 11. *Cladophora Fnlschtt* var. *Kemariensis* Sp. et var. nov.: *A*, Part of a tuft of ramuli, x 24 ; *B*. Upper end of the same with ultimate ramuli, x 38.

Plants erect, 10-15 cm- high, attached to the **substratum** by small rounded basal disc ; soft and flaccid ; cells of the main filament 216-270 ^ thick ; 10-13 times as long as broad, with strongly lamellate walls ; in the lower part the branching is rather irregular ; branches end in small tufts of ramuli, in which every cell of the main filament is di-polychotomously branched ; one of the branches is usually reduced and is often only 2-3 celled, ultimate ramuli 60-80 ^ in diameter, 4-6 times as long as broad, with blunt or slightly acute apices.

This variety differs from the type in smaller size of the plants, light olive-green colour and no differentiation of upper and lower tufts of ramuli. A very characteristic feature is the presence of reduced, 2-3 celled branches at each di-polychotomous division in the tufts of ramuli.

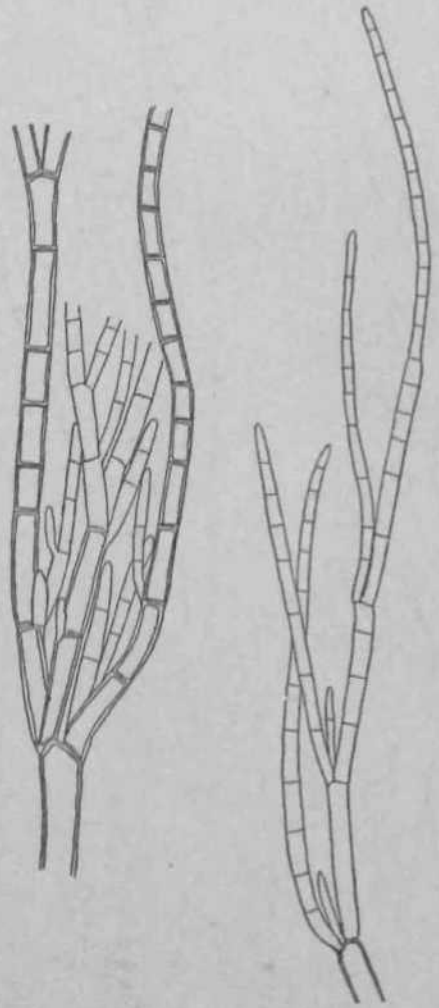


FIG. 12. *Cladophora fascicularis: A,* part of the main iilament. *x* 19 ; />'. upper end of the filament with ramuli, x 19.

(23) Cladophora fascicularis (Mert.) Kuetz. Fig. *12A-B.*

COLLINS, *Green Algae North America,* 1928, *p.* 265.

Abundant on buoys and wooden wharves in Kemari harbour, intermingled with *Clodophora Fritsckii,* forming twisted rope-like, hanging festoons of olive-green colour.

Fronds upto 40 cm. high, soft and flaccid ; cells of the main filaments 250-300 *fi* in diameter, 4-6 times as long as broad ; cell **walls** highly lamellate ; main filaments bear at short intervals very loosely built, fascicle-like tufts, of very long, simple or sparsely branched ramuli each consisting of 10-is cells : cell of the ramuli 80-100 *a* in diameter, 2-3 times as long as broad.

This plant differs from the type in having very loosely built **fesciculate** ramuli, which are not densely pectinately arranged and in the presence of very long, unbranched ultimate ramuli. It resembles *C. monumentalis* Boergs. in the olive-green colour and loosely built fascicles. Whether on the basis of these characters it should be regarded as a distinct species is problematic.

(24) Cladophora Magdalenae Harv. Fig. 13.

COLLINS, *Green Algae North America,* 1928, *p. 26S* ; TAYLOR, *Marine Algae of North Eastern Coast of North America.* 1937. *P- ^{2}>*

Plants frequently forming prostrate mats of light-green colour in shallow rock pools in *Colpomenia* simosfl-belt, associated with *Acetabularia Mobii.*

Filaments creeping with several erect branches, nearly I cm. high, irregularly branched ; branches bear inwardly curved ramuli, sometimes given off unilaterally ; cells of the main axis 80-120 *fi* broad, 4-5 times as long as broad (rarely 6-8 times) ; ramuli given off from every articulation, cells 30-35 \i broad, 3-5 times as long as broad ; colour brownish-green, cell wall not lamellate.

The plants from Karachi differ from those described by Collins in the size of the cells of the main axis which reaches 120 *fi* and **the** smaller size of the plants which is seldom more than 1 cm.

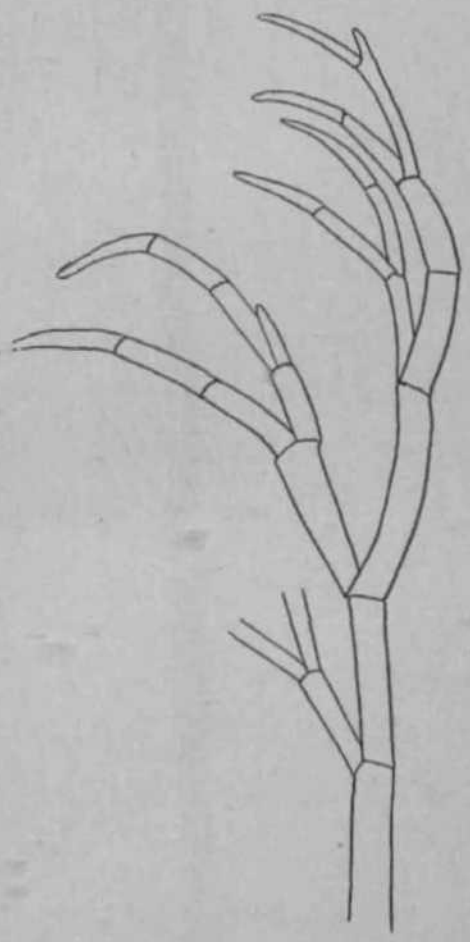


FIG. 13. *Cladophora magdaleno ;* A branch with ramuli, x 48.

(25) Cladophora (Hutchinsiae?) (Dillw.) Kuctz. Fig. 14.

HARVEY, *Phyc. Britannica.* Vol. IV, pi. CXXIV ; COLLINS, *Green Algae North Ainericaj* 1928, *p. 213.*

Intermingled with *Enteromorpha* on a wooden wharve near Baba island.

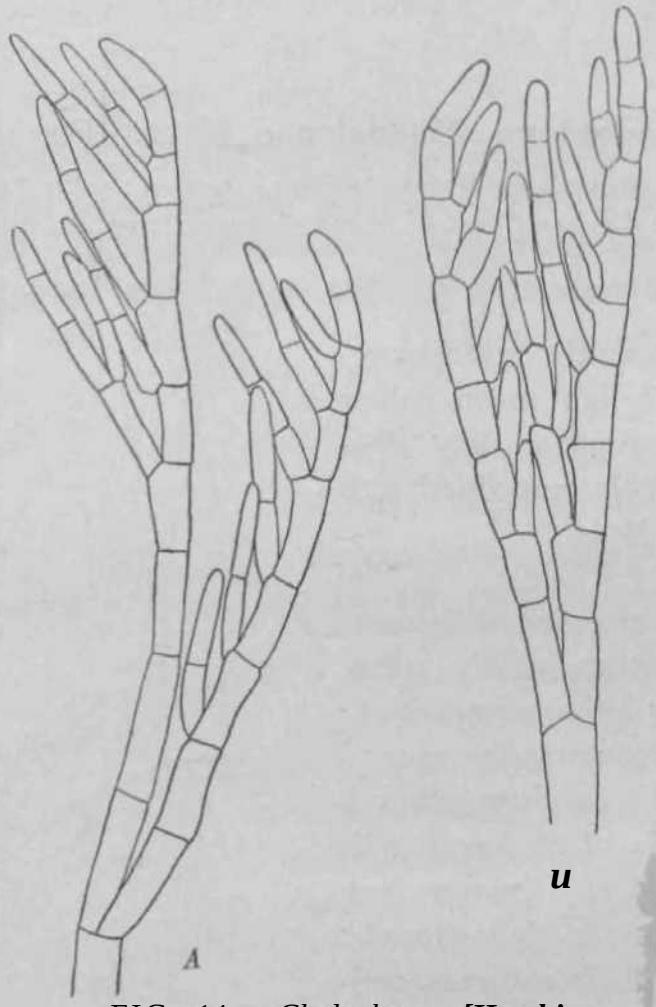


FIG. 14. *Cladophura **[Hutchinsia}):** A—B,* Branches with ramuli, x 27.

Plants glaucous green ; filaments 150-300 *fi* in diameter ; flrxuous, sparingly branched ; ramuli few, 1-2 celled, secund, with blunt apices ; cells 2-4 rimes as long as broad.

As very little material of this plant was available, I haive provisionally put it under *C. Hutchinsiae*, from which it differs in the small size of the plants and absence of constrictions at the base of the ramuli.

CHAETOPHORALES

FAM. CHAETOPHORACEAE

Genus **Endodcrma** Lagerheim.

Fronds microscopic, epiphytic or endophytic on other algae ; filaments irregularly branched ; cells with parietal chromatophores. with one or more pyrenoids ; reproduction by 2-4 ciliated zoospores.

(26) **Endoderma viridc** (Reinke) Lagerheim.
COLLINS, ***Green Algae North America,* 1928, *p. 109.***

Commonly found as an endophyte in *Ceramium* and *Polysiphonia* in the *Gelidium-Polysiphonia-Ceramium-belt* on the roftky ledge.

Filaments usually much branched ; cells 3-8 ^ broad, 1-6 times as long as broad ; often irregularly swollen and contorted, with one pyrenoid.

(27) **Endoderma Wittrockii** (Wille) Lagerh. Fig. 15A.
COLLINS, ***Green Algae North America,* 1928, *p. 199.***

Common as an endophyte on *Ectocarpus* in the *Acetabularia*-Stfrauea-community.

Filaments simple or irregularly branched ; cells 10-12 /1 in diameter, i-rj times as long as broad ; pyrenoids one in each cell.

Genue **Entocladia** Reinke.

Plants microscopic, growing within the cell membranes of other algae, composed ot irregularly branched filaments, coalescing* in the centre to form a single layered disc ; growth mostly by the division of the terminal cell ; parietal chromatophore, with one or more pyrenoids ; reproduction by 2-4 ciliated zoospores.

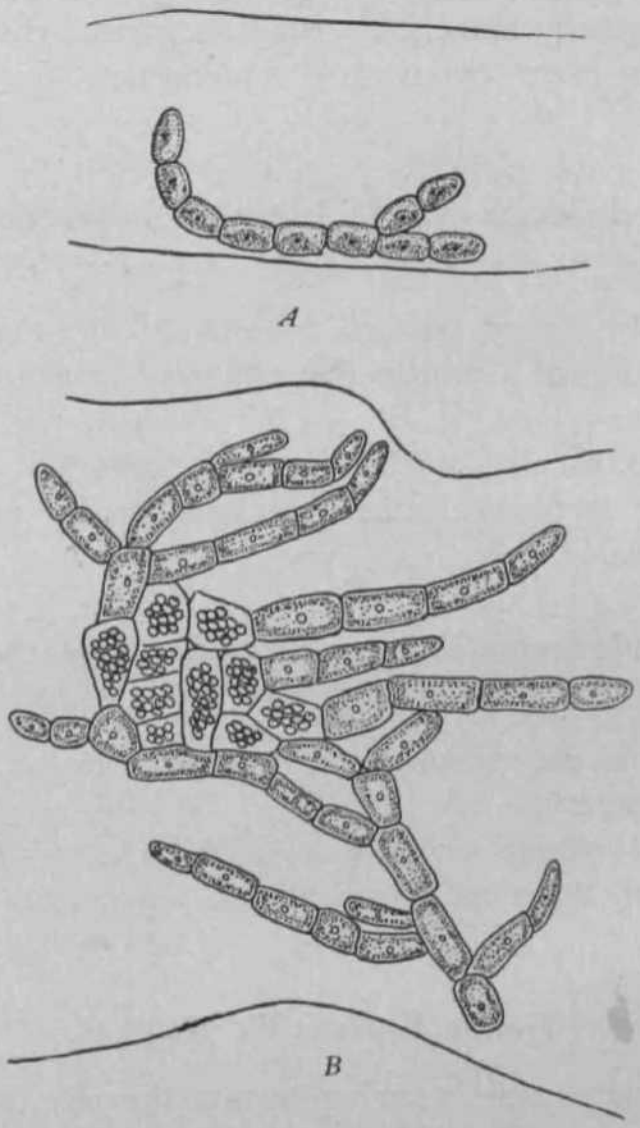
(28) **Entocladia Polysiphoniae** sp. nov. Fig. 155.

Commonly creeping under the cell membrane of *Polysiphonia* from the *Gelidium-Polysiphonia-Ceramium-beli.*

Thallus yellowish-green or light-green, without any haire ; filaments branched, branches closely coalescent to form

a

continuous layer in the centre of the mass, leaving a few marginal filaments ; cells of the filaments 8-n *p* in diameter, 2-3 times as long, terminal cells slender and more or less conical ; cells of the central plate irregularly polygonal, usually 10-15 /*• ''n diameter.



Fro. 15. *A, Endoderma wittrockii x* 203 ;
B, Entocladia Polysiphonics sp. nov. x 350.

Many reproductive bodies have been observed in each cell of the central portion, but the nature of these, their method of escape and subsequent behaviour has not been observed.

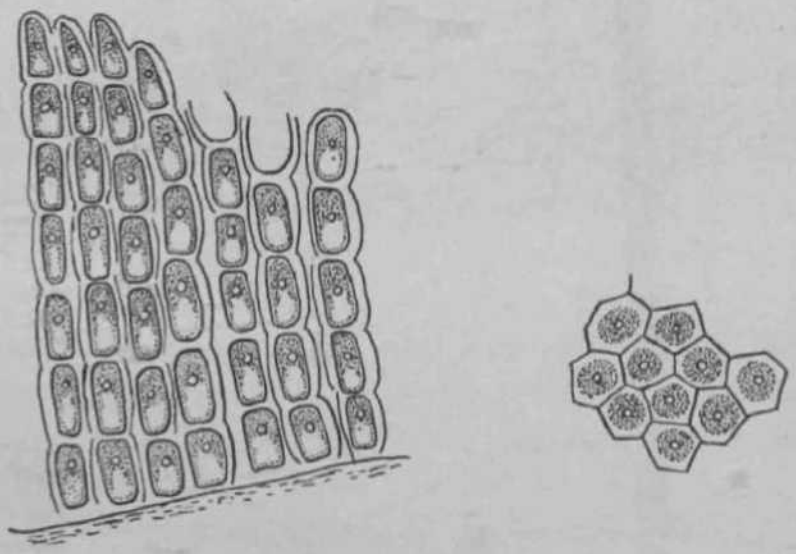
This species resembles *Epicladia Flusirae* Reinke in the presence of a central pseudoparenchymatous disc but differs from it in the dimensions of the cells and the endophytic habit of growth. It has been provisionally put with *Entocladia* on account of its endophytic habit of growth.

Genus **Pseudulvella** Will.

Thallus forming small, rounded discs, composed of closely placed radiating filaments, becoming pluristratose in the centre ; tells uninucleate, single chromatophore containing one pyrenoid ; reproduction by 4-ciliated zoospores.

(29) # **Pseudulvella sp.** Fig. **16**

Abundant on smoth surface pebbles in rock pools in the *Viva-Enleromorpha-be\t,* near **the** high-water mark, forming dark-green rounded discs.



B *A*

FIG. 16. *Pseudulvella* sp. *A,* Surface view of the stratum, x 1012 ; *B,* section of the same, showing erect filaments with terminal empty cells, x 1012.

Cells 4-6 ^ broad, 2-2^ time? as long as broad, arranged in compact vertical rows in the centre, each row of 6-7 cells ; apical cell usually conical tapering upwards ; single chloroplast with a single pyrenoid ; cells in the surface view polygonal with more or **less** rounded contents.

Although no swarmers have been observed, but **the** presence *o* empty terminal cells with terminal openings indicate that th.ese might be concerned in their formation and dispersal.

SIPHONALES

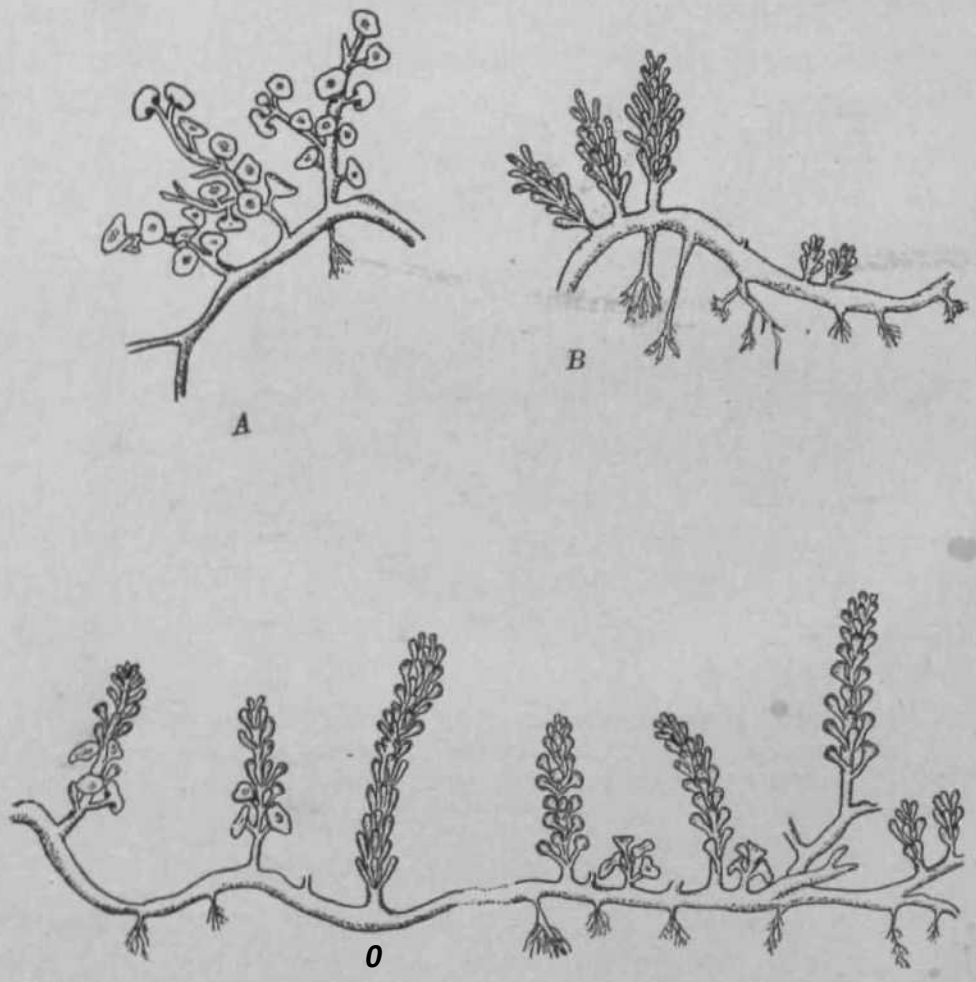
FAM. CAULERPACEAE

Genus Caulerpa Lamour.

Fronds composed of creeping rhizome-like stem, giving out filamentous rhizoids below and erect fronds above, showing a great degree of vegetative variation ; fronds may be simple to elaborately branched ; propagation by bits of rhizomes which can develop into complete plants.

(30) Caulerpa peltata (Turn.) Lamour. Fig. *17A.*

BOERGESEN, /. /. *B. S.*, Vol. XI, 1932.



Fio. *J7< A, Caulerpa peltata; B—C, Caulerpa racemosa ; B,* A portion of the same **resembling** *C. laetivirens ; C.* A stolon bearing **different** types **od camuli.**

Occasional in shallow rock pools on silt-covered stones, in the *Coipomenia sinosa-be\t,* at the rocky ledge, Manora.

Plants nearly I cm. high, light-green bearing rhizoids belo>v and rrect assimalators above ; assimilators bear simple, p>eltate,

disc-shaped ramuli arranged in a spiral manner, each slightly turned upwards ; discs 5-6 mm. in diameter of plants collected in winter, and 2-3 mm. (rarely 4-5 mm.) in those collected in April.

In general characters and the size of the discs this plant resembles the form described by Boergesen from Bombay, but I have not so far observed the curious assimilators described by him.

(31) **Caulerpa racemosa** (Frosk) Weber-van-Bosse. Fig. 17B-C.

Frequent in shallow rock pools in the *Colpomenia sinosa*-belt, on the rocky ledge, Manora. This plant was not found during April. The plants are erect, completely submerged under water, attached at the base to silt-covered stones.

The plants agree in all the general characters with C. *racemosa* but at the same time combine the characters of a number of described forms of *Caulerpa.*

Boergesen has separated var. *occidentalis* from var. *Chemintzia* by the fact that in the former the uppermost swollen part of the ramuli are convex while in the latter they arc more or less disc-shaped or even concave. He also distinguishes this form from *C. laetivirens* by the suddenly swollen apices of the ramuli as compared to the cylindrical or evenly thickened ones in the latter. In C. *peltaia* the ramuli are peltate and disc-shaped.

The present form combines all these characters in the same individual. The same assimilator may bear ramuli with convex, concave or disc-shaped apices and on the same stolon some assimilators may bear uniformly thickened ramuli. On some of the assimilators have also been observed a few typical peltate ramuli resembling *C. peltata.* Some of the shorter assimilators are wholly covered with peltate ramuli. From this it seems possible, as various other authors have already pointed out that a clear sharp line cannot be drawn between the various species. It has frequently happened that species have been founded on specimens showing markedly different characters, while later investigations have brought to light plants with fronds of both types growing from the same stem. Inorder to definitely clear the position of the various species an intensive ecological work in nature and cultural work in the laboratory is needed.

(32) Caulerpa taxifolia (Vohl.) Agardh. PI. VI. Fig. 13

BOERGESEN, ***Marine Algae of Danish West Indies,*** **191J-14,** ***pp. 132*** **.** COLLINS, ***Green Algae of North America,*** **1928,** ***p.*** **334.**

Common in deeper rock pools, attached to silt-covered, totally submerged stones, in the *Colpomenia sinosa-belt,* forming huge, erect tufts, at the rocky ledge, Manora. Also collected along with the drift algae from the sandy beach, Manora.

Plants somewhat rigid, 10 cm. high, with naked creeping stolon ; assimilators plane, lanceolate, linear, pinnate ; pinnules sickle-shaped, always opposite and distinctly constricted at the base, ending in a short mucro, 4-7 mm. long, 1-1-J- mm. broad. Plants imperfectly adhere to paper on drying.

(33) Caulerpa scalpelliforms (R. Brown) Web. v. Bosse. f. **typica** Web. **v. B.**

WEBER VAN BOSSE, ***Monographie des Caulerpes, p. 286.***

Assimilators placed alternately on both sides of the thallus, very cuneate in shape tapering towards the apex ; angles between the lobes acute ; along the upper rounded part of the lobes a row **of acute processes is present.**

This form has not so far been observed by me although it has been previously reported from Manora, Karachi.

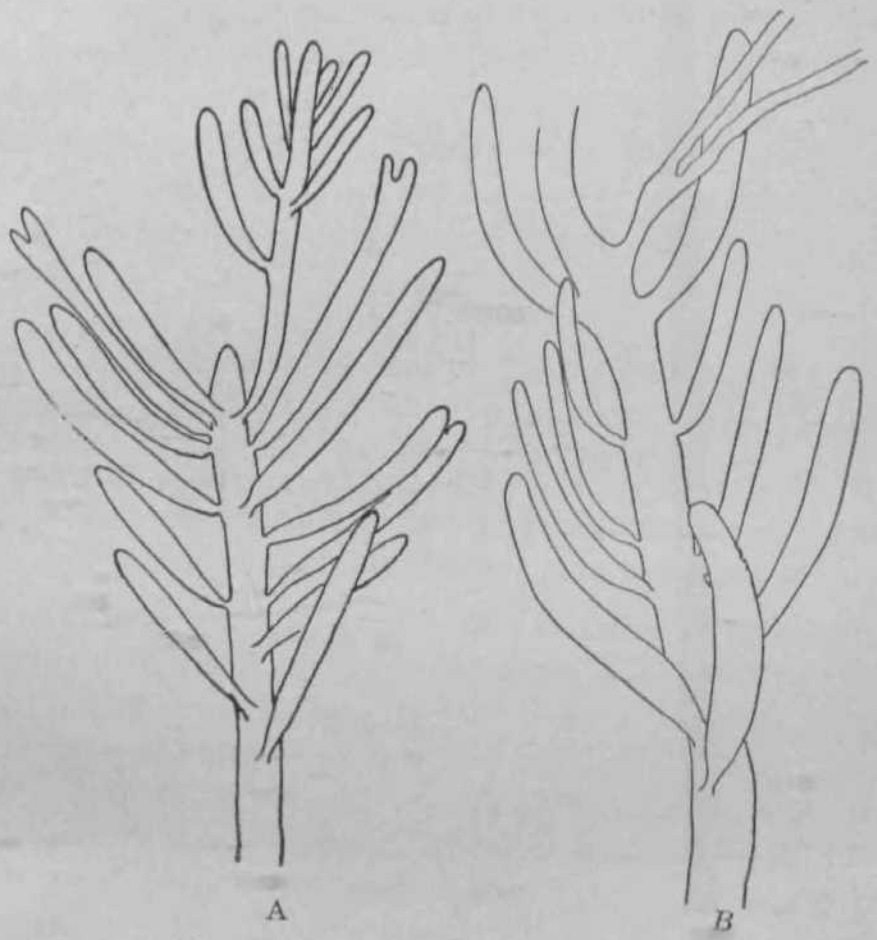
Genus Bryopsis Lamour.

Plants erect, tufted, much branched, coenocytic ; numerous disc-shaped chromatophores, each with a single pyrenoid ; plants fixed to the substratum by rhizoids given off by the main axis, bearing erect branches more or less pyramidally or uni- *ot* bilaterally arranged ; reproduction by biciliate gametes of two kinds formed in the pinnules.

(34) Bryopsis **corymbosa** J. Ag. Fig. *ISA* and *B.*

DB 'I **ONI,** *Sylloge* ***Algarvm,*** **Vol.** I.

Abundant in the sandy bottom rock pools in the *Celidium-Polysipkonia-Ceramium-he\t,* forming browish-green or olive-green *SymplocaAWmi* fascicles.



FlO. 18. *A. liryopsis corymbosa,* x 75 ; *B.* showing **a** branch forming a rhizoid, x 50.

Fronds upto 2 cm. high, soft, sparsely branched, branches given **ofl** in no definite order and densely clustered at the apex ; no sharp distinction **between** the lesser branches and the pinnules ftat clothe th-m on all sides ; the latter themselves being frequently more or less branched or forked ; pinnules lone and slender, gradually attenuate at the apices, slightly constricted at the base.

Rarely in some plants any one of the branches may become elongated, colourless and end in a rhizoid.

(35) Bryopsis pennata Lamour. var. **minor** J. Ag. Fig. 19.

Dii TONI, *Sylloge Algarum,* Vol. **I,** *p.* 431.

Commonly intermingled with *Bryopsis corymbosa.*

FIG. **19.** ***Bryupsis*** *f>m-* ***nata*** v;ir. ***minor'***. **A** portion **of the frond, x 3a.**

Plants erect, 1-3 cm. high, yellowish-green or olive-green ; sparsely branched, ultimate branches forming linear-lanceolate plumes, with distichous pinnules gradually narrowed towards the slightly constricted base, grading rather evenly from the longest at the base of the branch to the initials at the apex.

FAM. DASYCLADACEAE

Genus **Acetabularia** Lamour.

Plants consisting of a stalk attached to the substratum by a branched rhizoid-like base, and with a terminal cap-like whorl with rays either free or joined by calcium ; each ray bearing on its upper surface near the base a prominence, the prominences forming a ring, the corona superior, with scars corresponding to deciduous tufts of hairs borne by them. A corresponding corona, the inferior corona, may be present below the rays. Reproduction by aplanospores formed in the rays, the membrane of the spores free from lime ; the aplanospores give out zoogametes which by conjugation form a zygote which germinates to give the new plant.

(36) **Acetabularia Mobii** Solms-Labauch. Fig. 20A-C

Solms-Labauch, *Monograph of Acetabularieae. Trans. Linean Soc,* Second Series, Vol. 5, Bot., London, 1895-1901.

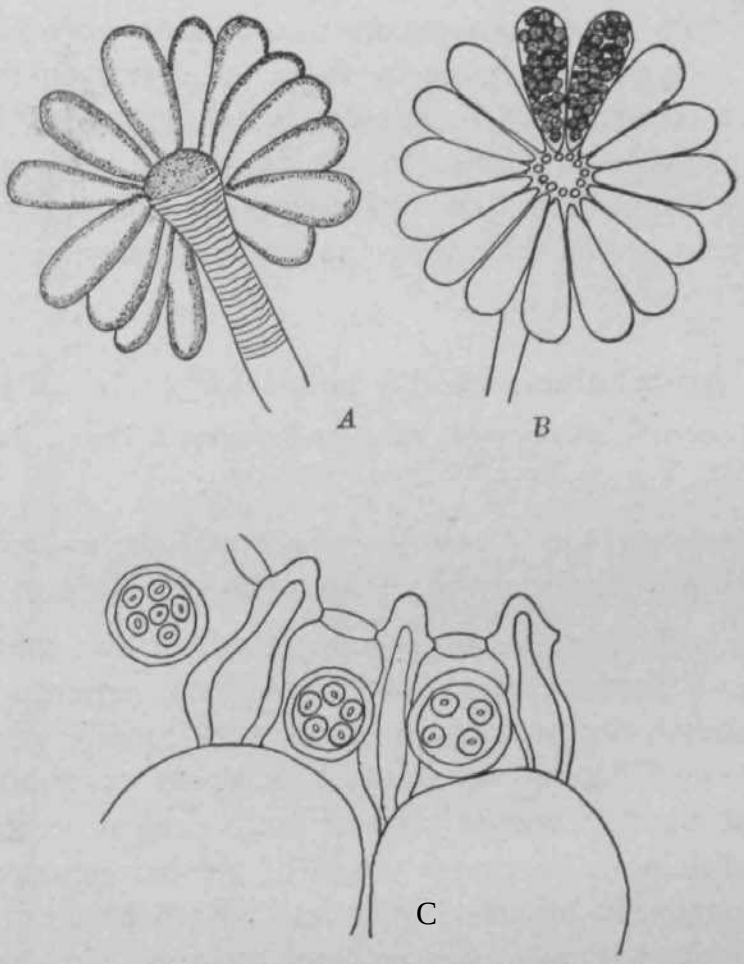
Dominant in the *Chaetotnorpha-Acetabularia-community* in deeper rock pools on the rocky ledge, Manora, Karachi.

Plants with short stalks, rugose ; terminal disc rounded, flat, 3-5 mm. in diameter ; rays 15-16 (rarely 18), vesicular, obovoid, approximately twice as long as broad, with rounded ends, which are not calcified, lateral walls united by strong calcification in the majority of plants ; corona superior only present, coronal knobs with roundish apex bearing a whorl of 4-6 hair scars (rarely 3), hair tufts copiously branched but short. Each fertile ray containing 50-62 rounded aplanospores, each 90-120 ^ in diameter.

This beautiful plant has been referred to this species because of the presence of only the superior corona, the coronal segments being knob-shaped with rounded upper surface and a circular tfroup of numerous hair scars.

The plants always remain small, the height varying from [2]-5~7-o mm. The stalk is rugose, gradually tappering towards the base ending in a very branched rhizoid which penetrates into the substratum and firmly fastens the plant there. In order to dig out the complete plant, the surrounding stone has to be either dissolved in some acid or mechanically crushed by a pair of forceps. The stalk ends in a rounded flat disc, 3-5 mm. in

diameter of 15-18 rays, united together by strong calcification oi the side walls. Solms-Labauch puts the union together of the rays by strong calcification as a classification character, but in my collections, however, the plants show a great deal of variation in this character. Majority of the plants, which are, as a rule, very small, never more than 3 mm. high, show a strong calcification,



Fie. 20. *Acetabularia Mobii: A,* ventral view disc, x 18 ; *B,* Dorsal view disc, **the** rays **containing** aplanospore, x *11 ;* C, Corona Superior with hair scars, x 506.

in others which are usually upto 7 mm. high, the rays are quitr separate from each other and in a few cases a ray or two are seen to be bent upwards or downwards, while in still others they are united in bundles, each bundle of three or four rays. Occasionally there are plants with rays quite free from each other arising from the central disc partly overlapping each other.

, Rarely there are two discs present, one above the other but without any intervening hair tufts.

Each ray is 400-600 ^ broad at the apex, 100-150 /x at the base, and 2-2 J times as long as its maximum breadth, apices of the rays have broadly rounded corners.

The segments of the corona superior are knob-shaped, 700-800 *ix* in diameter with rounded upper surface, bearing a circular group of 4-6 hair scars. In some cases only 3 scars are present.

Solms-Labauch differentiates this species from *A. polyphysoides* Howe by the radially elongated coronal segments in the latter with an elliptical group of numerous hair scars. Collins, however, does not mention this character for *A. polyphysoides* and only says that the coronal segments bear numerous hair scars.

Hairs present on the coronal segments, 30-35 *n* broad, 4-5 times as long, repeatedly branched, branches 17-20 JU broad, 4-5 times as long, ultimate branches becoming very narrow, 8-12 *n* broad.

Fertile rays are strongly calcified, each containing 50-62 iiplanospores, each spore 90-120 ^ in diameter.

FAM. CODIACEAE

Genus **Codium** Stackhouse.

Thallus firmly anchored to the substratum by a basal disc ; in transverse section the thallus is seen to be composed of a central medulla of narrow, interwoven, forked threads and a peripheral cortex of large club-shaped vesicles densely grouped at the same level to form a palisade layer ; chloroplasts aggregated beneath the outer surface of each cortical vesicle ; sporangia one °r more on each vesicle, each opening by an apical pore.

(37) **Codium elongatum** Agardh. Fig 21A.

PI. VI, Fig. 14.

BOERGESEN, ***J. I. B.*** **S., Vol. IX, 1930, />. 759 ;** ***Marine Algae of Danish West Indies,*** **Vol. I, 1913-14,** ***p. 116;*** **COLLINS,** ***Green Algae from North America,*** **1920,** ***p. 172.***

Common in deeper rock pools, the plants firmly attached by their basal discs, and floating out into the water or hanging down from the rocks at the low tide mark on the rocky ledge, Manora. Also collected along with the drift algae at Sandspit.

ft

Plants dark-green in colour often much elongated 10-30 cm. high, 3-5 mm. in diameter, regularly dichotomous, firmly attached to the rocks by basal disc ; younger divisions of the thai-Ins terete while older ones frequently compressed and slightly expanded beneath furcations ; utricles obovate, clavate giving 1-4 coenocytic filaments at the base, 220-540 *fi* broad (rarely upto 700 /A), 3-4 times as long ; sporangia one or more on each utricle, sometimes the utricles bear scars of pre-viously borne sporangia ; stalked, lanceolate, pointed at the apex, 100-150 /* broad, 370-400 *11* long, opening by. an apical pore. Plants par-tially adhere to paper on drying. *Champia compressa* is a very common epiphyte on these plants **forming** dark-red shining clusters. Fronds are also richly covered with diatomes.

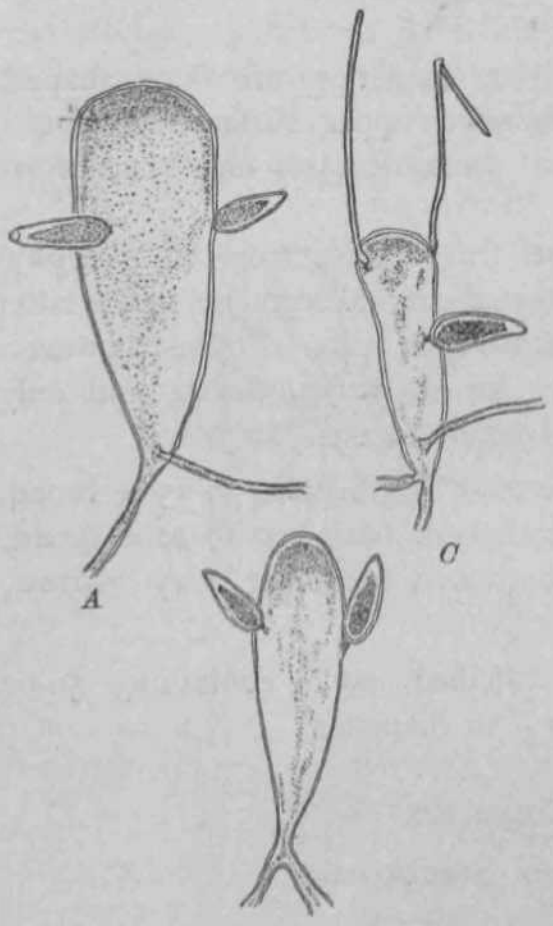


FIG. *21. Codium*: Utricles with sporangia, x 175 ; *A, C. elongatum* ; B_t C. *Coronation ; C, C. latum.*

This plant differs from that described by Collins, in the size of the utricles which may be upto 700 broad (rarely more) and 3-4 times as long.

(38) **Codium coronatum** Setch. Fig. 2LB.

BOERGESEN, /. /. *B.* S., Vol. XVI, 1937, />. *$.*

Only one specimen of this plant has so far been collected amongst the drift algae from the rocky ledge, Manora, Karachi.

Plant easily recognisable by its characteristic irregularly shaped, coxcomb-like thallus, flat nearly 2 cm. broad ; utricles **clavate,** 160-200 *fi* broad, 4-5 times as long, contents restricted to the upper swollen portion, **gametangia** one or more, borne laterally on each utricle, fusiform, stalked, 85-200 *n* broad, 235-250 *n* long, each with an apical pore.

(39) Codium **latum** Sur. Figs. *21C* 22.

SETCHELL and GARDNER, *Marine Algae Pacific Coast of North America,* 1920, *p. 175,* PI. 15, fig. 6.

Common on rocks and shells of barnacles near low tide mark, forming felt-like masses of erect, often dichotomously branched fronds, anchored firmly by small basal discs.

Lower portion of the frond is more or less cylindrical, while the upper is abruptly flattened, di-trichotomously branched and blunt at the apices ; utricles clavate, 180-270 *p* broad, 700-780 ju long, cylindrical when young, hearing one or two long hairs just below **the** tip ; gametangia borne laterally on utricles, 150-175 *p.* broad, 350-400 ju l°ng» usually the contents dividing transversely into two.

FIG. 22, *Codium latum,* x i.

Genus Udotea Lamour.

Fronds arising from a mass of creeping colourless rhizoids, stipe erect, terminating in a brush-like tuft, or in a flabelli-form more or less distinctly zonate lamina ; consisting of continuous filaments, with numerous short branches, attached to each other by short processes and sometimes developing laterally into a more or less definite cortex ^calcification as a rule complete.

(40) **Udotea indica** A & E S. Gepp.

V & E. S. GEPP, 77M *Codiaceae of the Siboga* ***Expedition, p.*** *ut.* 8- U-M. 50-53 ; BOERGKSEN, *four.* ***Ind.*** *Bot. Sac,* Vol. IX, 1930, *Pp. 160-161.*

This plant has been recorded from Karachi by Mr. and Mrs. **Gepp,** I have, however, not so far found it in my collection. Boergesen has described it from Dwarka but according to him his plants are much bigger, about double the size of the specimens from Karachi.

FAM. VALONIACEAE

Genus **Siphonocladus.**

Plants small erect, attached to the substratum by a well-branched thick-walled rhizoid with or without septa ; primary vesicle bears a number of constrictions at the base ; sooner or later becomes divided into a large number of irregularly arranged cells of unequal size ; branches arise from these segments which either remain undivided or become multicellular and bears branches in **turn.**

(41) **Siphonocladus** sp.

Commonly intermingled with *Cladophoropsis Zoolingen* on flat stretches of mud-covered areas in the *Colpomenia sinosa*-belt. Only young plants of this genus have so far been observed.

Genus **Valoniopsis Boergesen.**

Thallus forming low dense tufts on rocks ; branched, branches given off in a basipetal manner, cut off from the main filaments by septa, apparently opposite ; haptera may be developed from the base of the filament or at the end of any of the branches.

(42) **Valoniopsis pachynema (Martens) Boergs.**

BOERGESEN, ***Some Marine Algae from the Northern part of the Arabian Sea,*** **Det. Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser, XI, 6,** ***pp. 10-13.***

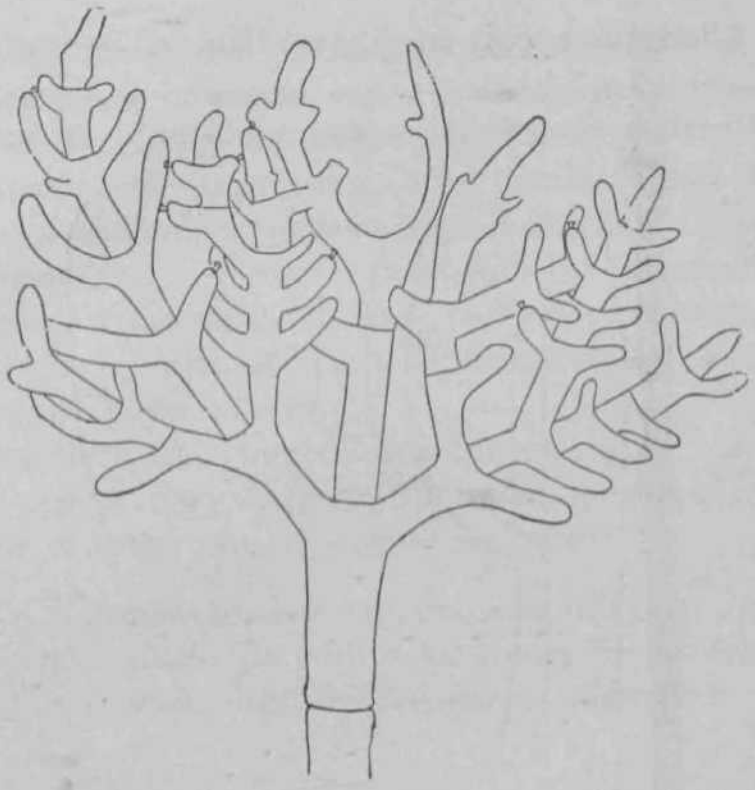
I have not so far observed this species although it has been described by Boergesen from Karachi and Ceylon.

Genus **Struvea Sonder.**

Fronds attached to the substratum by branched rhizoids ; stipe branched or unbranched, monosiphonous, bearing one or more flabelliform, net-like expansions, consisting of articulate ramuli, fusing with each other on either side of the stipe by haptera to form the network.

(43) Struvca delicatula Kuetz. Fig. 23.

BOERGESEN, *Journ. Ind. Dot. Hoc.* Vol. XII, 1933- *P- 3-*



In,, *13. Slruvea delicatula:* Frond showing the mode of attachment by means of tenacula and the undivided top cells, x 24.

Abundant in shallow tide pools in the *Colpomenia* smosa-belt, **intermingled** with *Acetabularia Mobii.*

Plant 1-2 cm. high, profusely branched at the apex, stipe cell 350-400^ broad, 3-10 times as long as broad, bearing at its base annular constrictions and much branched rhizoids with thick contents ; ramuli given off oppositely which fuse with each other on either side of the stipe by haptera ; ramuli 150-225 ^ broad, *~3 times as long as broad, cut off by transverse septa ; branches in one plane only ; chromatophores are plate-shaped, irregularly Polygonal forming a network, each with a large pyrenoid ; plants are light-green in colour which fades with exposure and long preservation.

Genus Cladophoropsis Boergesen.

Plants consisting of branched filaments, often showing unilateral ramification and exhibiting apical growth ; entangled together to form cushions, attached to the substratum by rhizoids

filaments united together by haptera formed at the ends of tin side branches ; no septa present at the base of the branches.

(44) **Cladophoropsis zoolingeri** (Kuotz.) Boergs. Fig. 24.

HOHRGESEN, ***Contributions*** *à la Cunnaisance de genre Siphonochdus Schniis.* **[Oversight** Kge. danske **videoskol.** Selskali. **FORHAHDUNGEH, 1905, No. 3,** ***p.*** *288).*

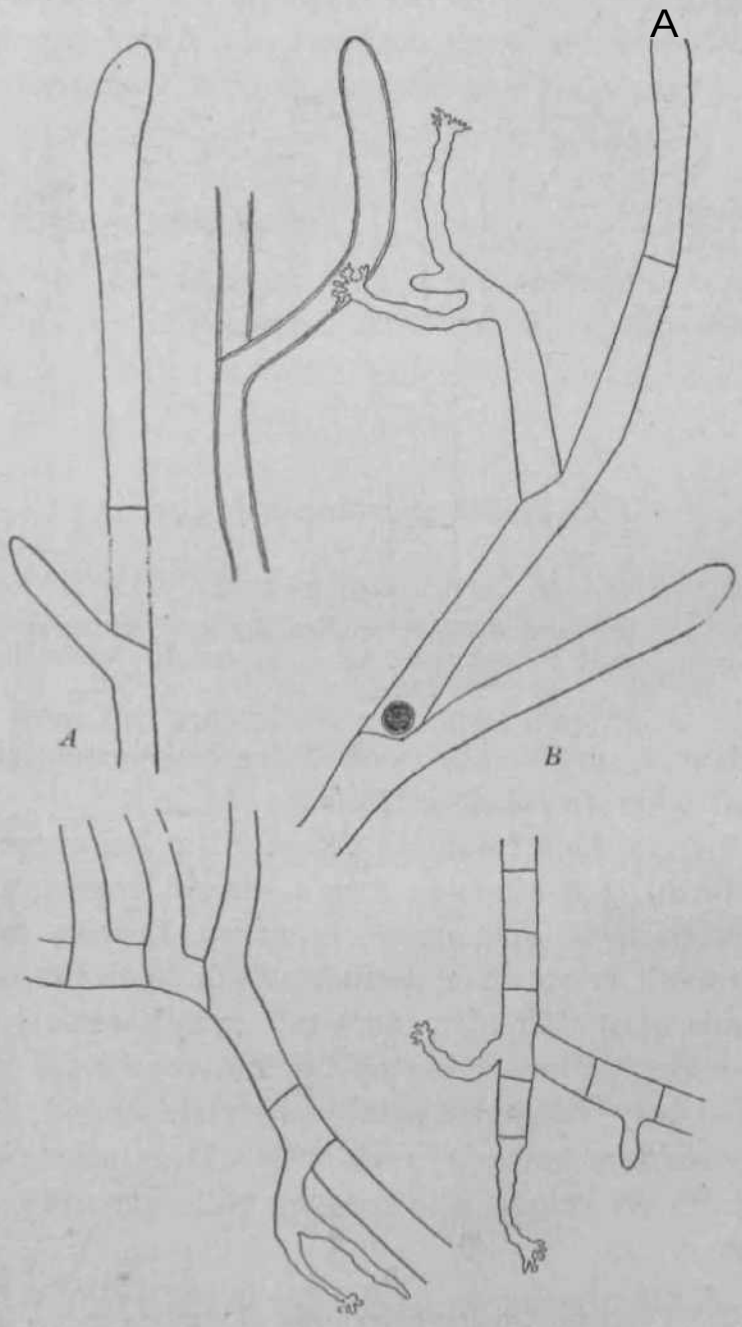


FIG 24. *ttadophoyopsis zoolingeri,* x 32 ; *A,* A **portion** "f tin- filament showing the terminal cell slightly swollen below the apex ; *B,* Portion of the ih.ilhis with haptera; *C—D,* Basal portions with numerous septa and bearing rhizoids.

Abundant on rocky ledge in the *Colpomenia sinosa-be\t,* forming dark-green matted tufts on mud-covered flat stretches of areas.

Filaments irregularly ramified, branches arising at irregular intervals, as a rule unilateral ; cross walls occur very irregularly ; terminal cell very long and slightly swollen below the obtuse or rounded apex ; cells about 150 *fx* broad ; walls slightly lamellate ; rhizoids basal or terminal, some of these ending in the characteristic **hapteia** establishing a firm connection with the surrounding plants in the mat ; occasionally rounded ball-like structures, rich m chloroplasts have been observed as described by Boerge^n in *Cladophoropsis membranacea.*

Usually the basal older portion becomes vi-ry **much** septate and bears one or more characteristic rhizoids ending in haptcm. From some of these cells erect branches arise,

(45) **Cladophoropsis membranacea** Boergs. Figs. 25-26.

Frequently associated with *Chaetomorpha proslmta* in the sandy **bottom** rock pools in the *Colpomenia* smosa-belt

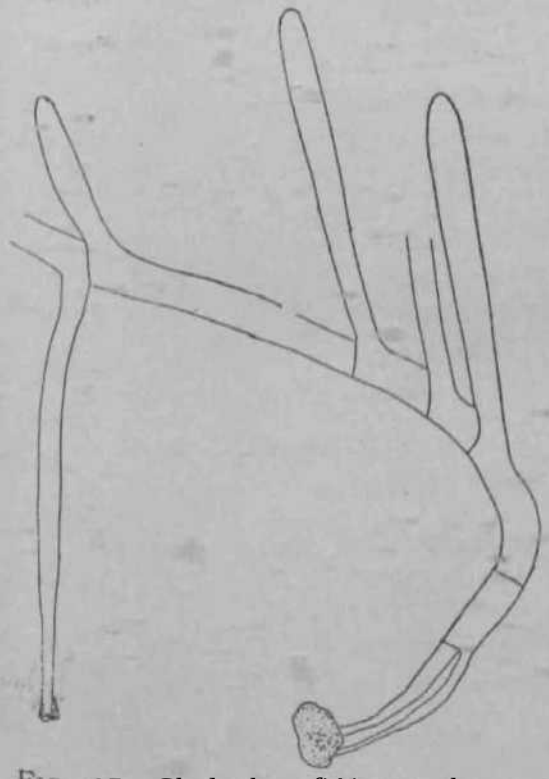


FIG. 25, *CladophorofiAis nn-mhmncea'.* Basal portion, x 24.

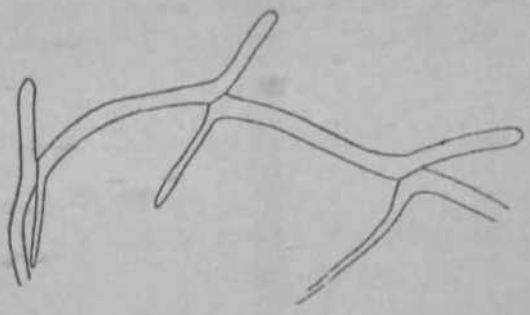


FIG. 26. *Cladophoropsis memhranacua:* Portion of a procumbent filament showing the characfceiistact er branches and rhizoids, x 16.

Plants about 1 cm. high ; most of the filaments are, as a rule, declined, twisted and contorted forming entangled masses,

firmly fixed in the substratum by means of rhizoids ; terminal cell very long and slightly swollen below the apex ; cells of the main axis 150-275 *p* broad (usually 200-250 ^) ; walls highly lamellate. A very interesting feature that has been observed in plants from this locality is lhat nearly every cell in the procumbent filaments gives out a branch at its upper end below the septum and a rhizoid at its lower and above the septum. These rhizoids are fairly long and help in the firm fixation of the plants in the loose sand.

Here again, as in *Chaetomorpha prostrata,* with which it is commonly associated, the presence of rhizoids is an adaptation to conditions of growth and helps to bind the lose sand into a compact substratum.

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23. TAYLOR, W. R. 1937—Marine Algae of North Eastern Coast of North America. Ann-Arbora.

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I'M., **r.** General view of the rocky ledge, Manora, Karachi.

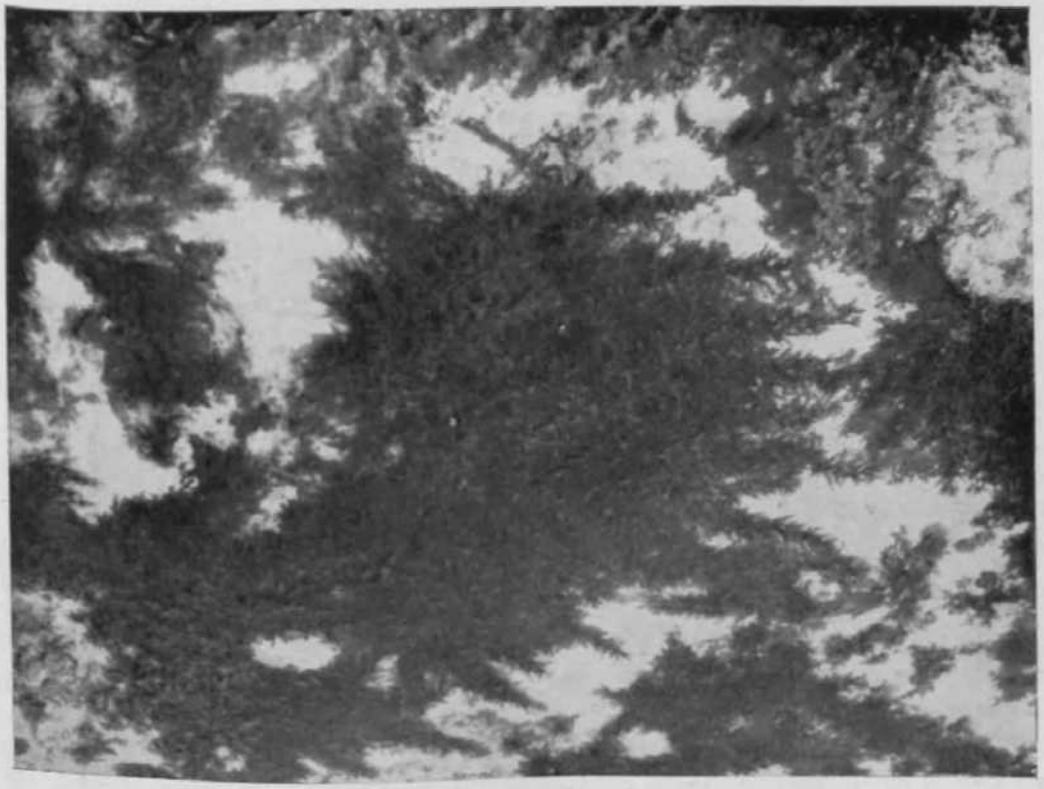


FIG. 2. *Sargassum-Cystoseira*-community in rock pools in ***Coipomenia*** *sinosa*-belt.

l[r]n;. j. *Ulva* **inaKca-commwnity.** ***Ulva indica*** *forming* ***a*** **dense compact mat on** tin- silt **covered stones** along the **margin of the** rock pools in *llvaliitti-mHiorplm-h&t:*

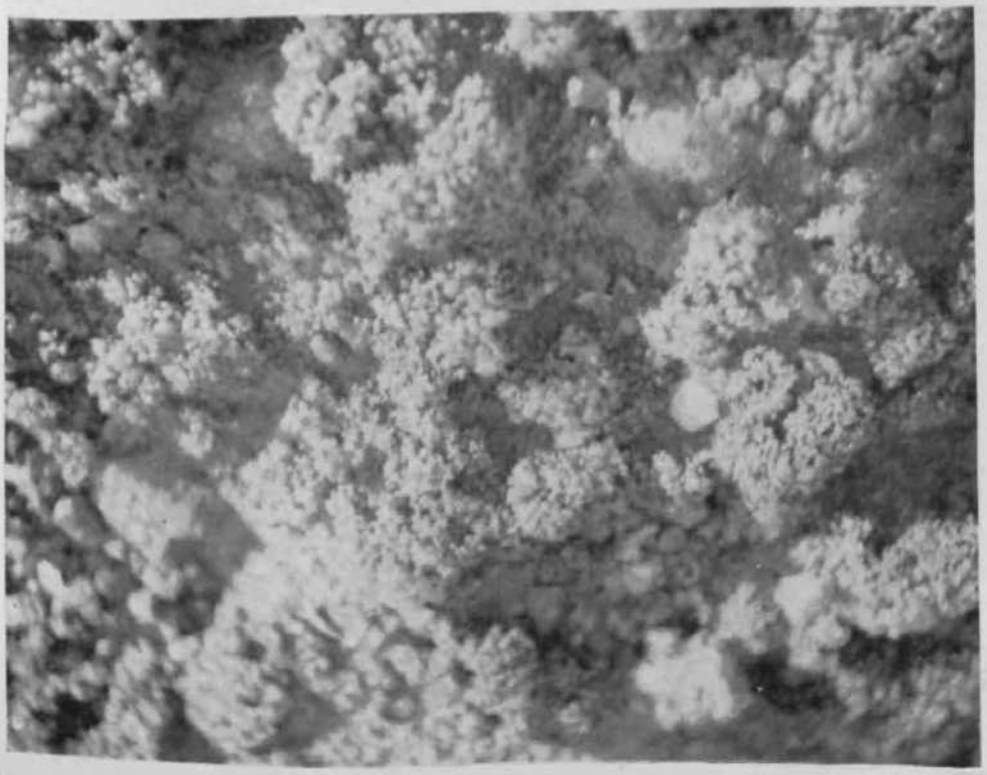
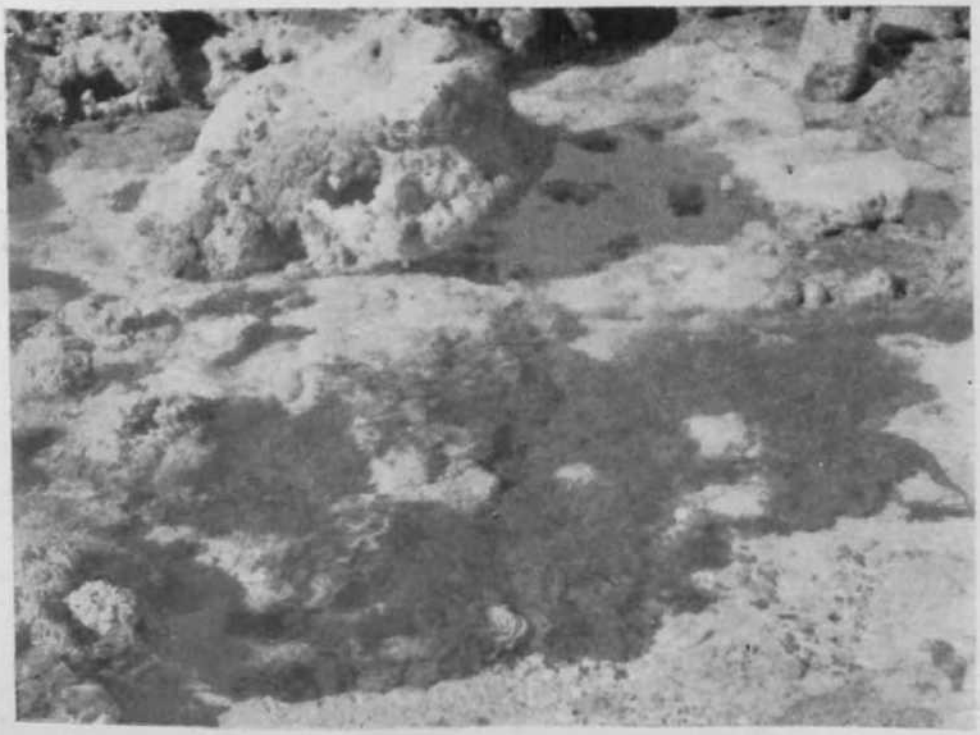


FIG. 5- *Cauk'rpu* ***racemOsa-COttiinunity*** on **covered** rocks, in rock pools in the *Colponwuia sinosa*-belt.

FIG. 6. ***Hypnea-chrystnenta-covamunity*** **from tht- firift** algae.



I'[11]-. 7. ***Padina tetrastromatica-comnmnity*** in shallow rock i"[in]l^ in ***Ulva-Enteromorpha-*** and *Colpomenia* ***sinosa-h***elts.

FIG. 8. ***Enterotnorpha*** *intestinalis* **Knetz.** forma ***flageliifonnis*** Chapman.*

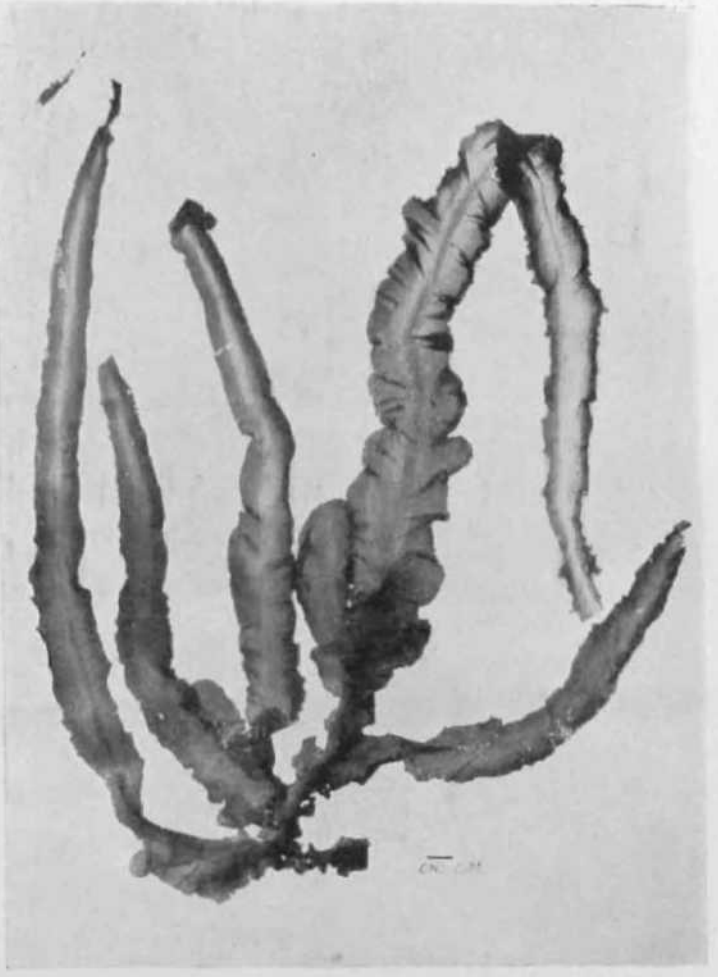
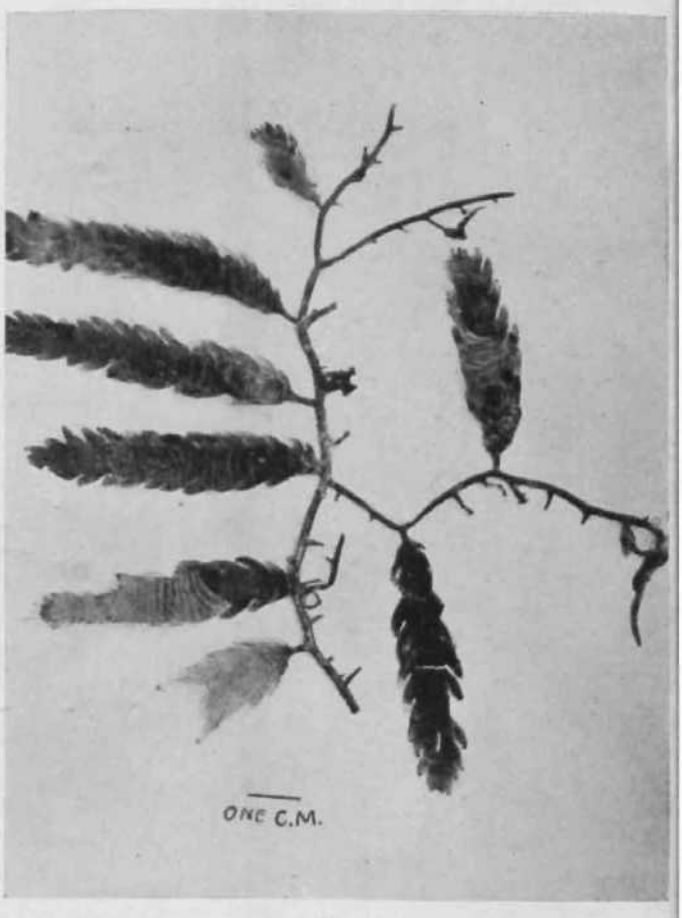


FIG. **9.** ***Viva fasciata*** Delile.

FIG. 10. *Ulva fasciata* Delile forma *taeniata* [illegible]

FIG. 11. *Caulerpa Fritschii* Anand.

FIG. 12. ***Cladophora FfitschU*** Ana **ml** (young plliiiil I.



Fi<;. IJ. *C a tiler pa taxifolia* (Vahl.) Ae.

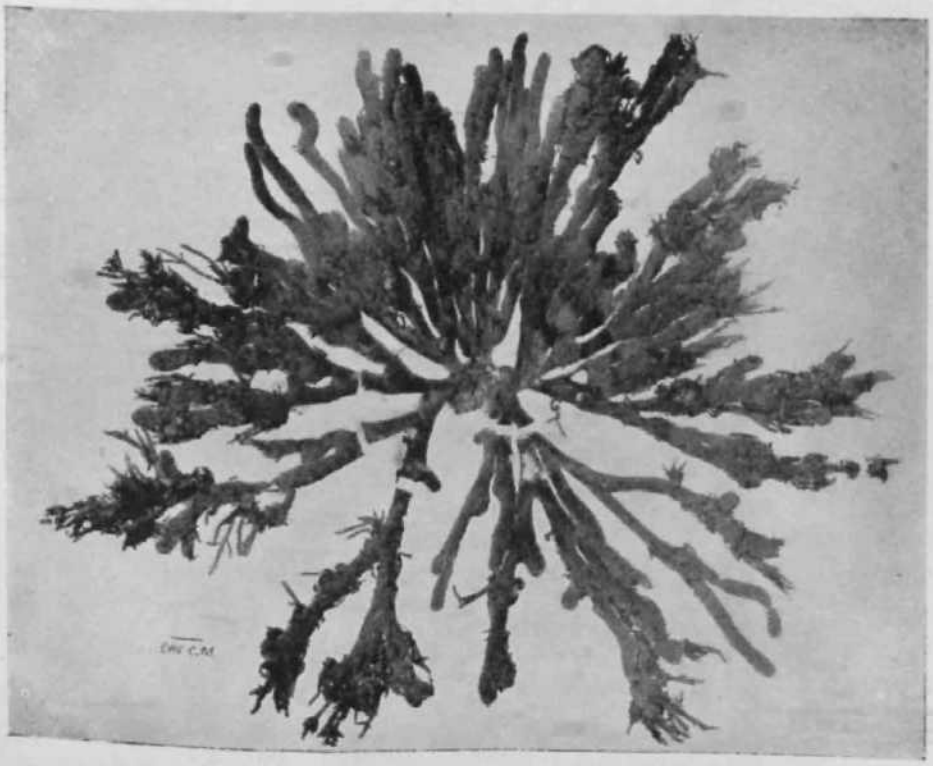


FIG. **14.** **(*odium elongutum* Agardh with *Champia* *compressa*** growing as an epiphyte.

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MARINE ALGAE FROM KARACHI

PART II RHODOPHYCEAE

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MARINE ALGAE FROM KARACHI

PART II RHODOPHYCEAE

BY

PYARE LAL ANAND, M.SC. (Panjab), Ph.D. (Lond.),
S. *D. College*
and
Department of Botany, Panjab University, Lahore

WITH A FOREWORD

BY

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FOREWORD

The publication of the Marine Algae from Karachi, Part II, *Rhodophyceae*, has been delayed on account of the difficulties in obtaining suitable Paper and the cost of printing going up. At one time, I had my hesitations about publishing it during this emergency period. But now I have come to feel very strongly about the importance and urgency of a publication of this kind, as there are no other, publications on *Rhodophyceae* from any part of India than the scattered ones by Boergesenand the few stray descriptions of plants by some others. So the publication of a handbook on Indian Marine Algae at this moment needs no apology.

Dr. Anand has not only carefully described and illustrated the species of the Red Algae from Karachi, but he has, at my suggestion included short descriptions of the genera and noted most of the species not collected by him but described by other workers from Karachi. He has given full references to these papers. This will, no doubt, be of great help to the workers interested in the Indian *Rhodophyceae*. The ecological point of view in the study of the-algae has again been emphasised. Dr. Anand deserves every praise for his painstaking and thorough study of the Marine Algae from Karachi, and I feel I am lucky in having him as a colleague in the Botany School. I am sure he will give us many more Publications on this line.

Before concluding, I have to mention that the paper used in this volume is not so good as in the first one ; this is however the best we could afford. Any way, we have not been sparing in the matter of illustrations, and our thanks are due to Messrs. Sree Saraswaty Press Ltd., Calcutta, for printing this volume so quickly and efficiently.

H. CHAUDHUPI

Botany Honours School,
Panjab University,
Lahore, 16.343.

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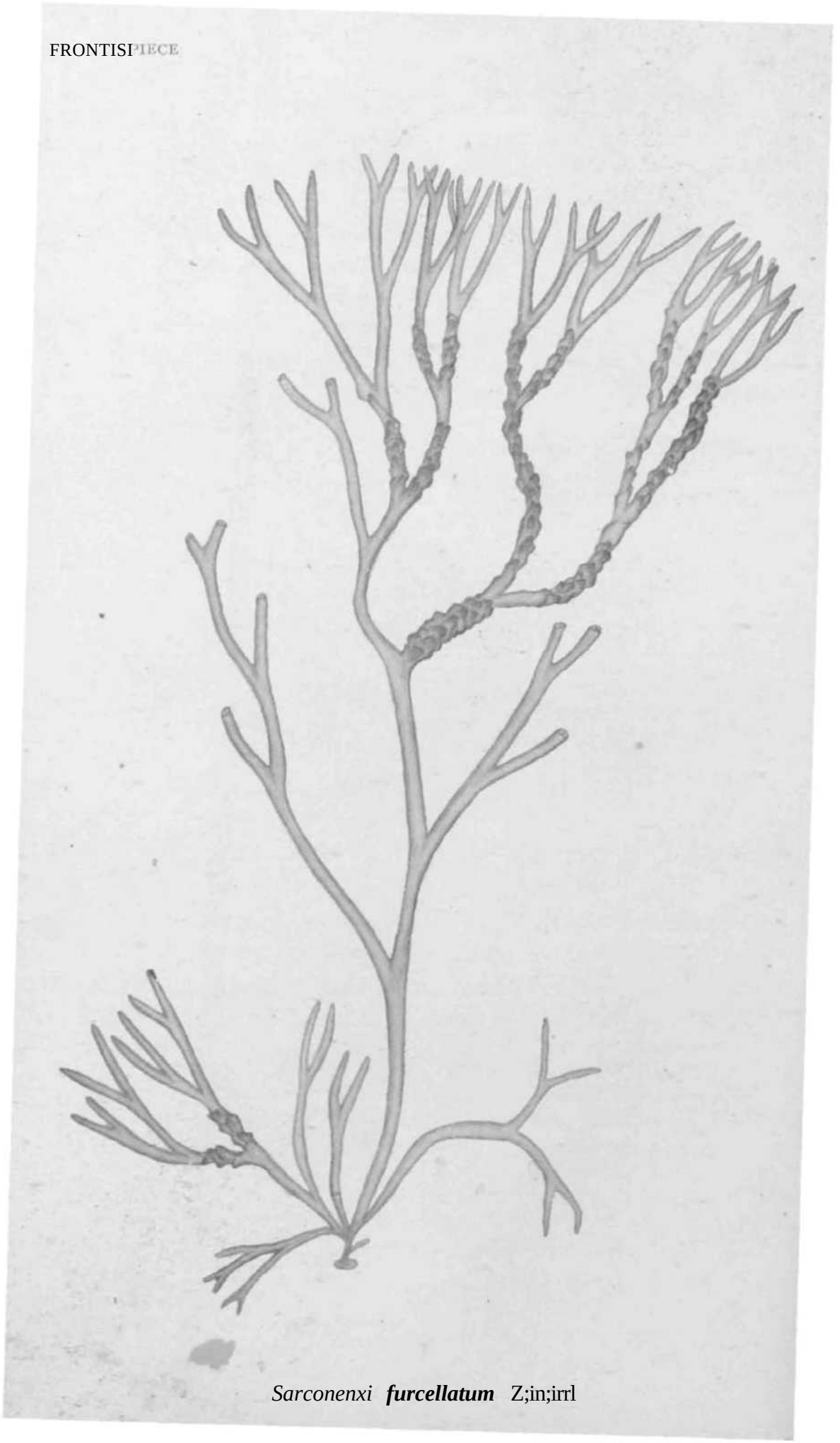
FRONTISPIECE



Sarconenxi ***furcellatum*** Z;in;irrl

Introduction

This paper is the second instalment of the Marine Algae from Karachi.[1] Like the first one, this part is also based upon collections made during the months of December and April from various localities, such as the Rocky Ledge at Manora, buoys, piers and floating wooden wharves in the Kemari harbour and the sandy beach at Sandspit. It was pointed out in the first part, that the vegetation at the Rocky Ledge, was very luxuriant and arranged in four distinct belts, each having a distinct colour, determined by that of the dominant species. The Rhodophyceae form the last visible belt on the rock ledge near the low water mark, fluminated by *Gelidium pusillum, Polysiphonia platycarpa* and *Ceramium miniaium.* Practically none of the higher forms occur on this belt. Most of these mentioned in this paper have been collected as drift algae. The plants occur in deep sea but may Set detached and cast ashore at high tide. The organs of attachment in these plants are, as a rule, very firm, so that most of them when collected are either incomplete, with the organ of attachment missing, or complete while still attached to a portion of the rock on which they grow. The community of these plants has been referred to as *Hypnca-Botryocladia*[2] cornmunfty, dominated by *Hypnea musciformis* and *Botryocladia leptopoda.* In the following list, the species of Rhodophyceae comprising this community are arranged in order of frequency.[3]

Hypnea musciformis	...	...	d.
Botryocladia leptopoda	...	...	d
Calliblepharis fimbriata	...	...	v.a.
Agardhiella robusta	...	...	a

1. The Marine **Algae from Karachi, Part** I, Chlorophyceae.

2. Boergesen has included his *Chrysymenia uvaria* forma *luxurians* **«nder** *Rolryocla&ia leptopoda* (J. Ag.) Kylin. The plant from Karachi **•gteea very well** v. ith Boer^rsen's plant. I have, therefore. decided **to** ill **the** *llypfwa-Ciirysyiiif-nHi*-community referred to in Part I. as **the** *yP*[ne]*u-Botryocladia-comm*unity and substitute *Botryocladia leplopoda* for *Chr ysyttienia uvaria* forma *luxuriuns.*

3- The following symbols are used to indicate **the degree of frequency** of each species:

d. dominant, v.a. very **abundant,** a. abundant, c. common. o **occasional, t. frequent, r. rare.**

Halymenia porphyroides	...	...	c
Gracilaria dentata	...	...	c
Scinaia indica ...	...	...	c
Scinaia Hatei ...	...	...	c
Cystoclonium purpuriens	...	...	f
Sarconema scinaioides	...	...	o
Gracilaria corticata	...	...	o
Coelarthrum Muelleri	...	...	o
Scinaia complanata	...	...	r
Halymenia polydactyla	...	...	r
Solieria chordalis	...	...	r
Coelarthrum opunti	...	...	r

Amongst the Rhodophyceae collected from the Karachi harbour the community that has been referred to in the first Part is the *Acanthophora Delilei-community* occurring on buoys in the harbour. *Acanthophora Delilei* is the dominant sp., occasionally associated with *A. specif era* and A. *dendroides.* The plants are intolerant of exposure and thus invariably occur below the low water mark.

Calaglossa Leprieurii is another small attached form occasionally collected from the iron-work of a pier in the Kemari harbour growing amongst the barnacles. As a rule the plants are submerged below low tide mark but in shaded localities are able to grow even somewhat above the surface of the sea. It was only collected in December, 1936, while during both the visits in April (1937 and 1938) it was not found. It is perhaps an example of an alga that occurs in one or more places in any given season and may be wanting in any one of these places in other seasons.

The most conspicuous community on the rocky ledge is the *Gelidium-Polysiphonia-community. Gelidium pusillum* is the dominant species and forms large but low cushions, seldom more than 1 cm. high on rough surfaced rocks richly covered with barnacles. The plants spread by long runners, bearing at frequent intervals branched rhizoids fixing them firmly to the substratum, and upright, dark-purple fronds, usually expanding into firm lanceolate expansions, giving the belt its characteristic colour. Although it is fairly tolerant of drought conditions, being able to endure long exposure to dry air, it shows more luxuriant growth in moist and sheltered localities, where the plants are higher and

the cushions **cover** more extensive areas. Here the plants are abundantly associated with *Polysiphonia platycarpa* and *Centroceras clavatum.* The fronds *of Centroceras clavatum* are matted together forming low cushions, upto 2 mm. high, giving off numerous rhizoids. The plants are rigid and harsh and able to withstand little exposure, being occasionally associated with *G. pusillum* even in the exposed localities. The plants here, however, grow partly under the shade of G. *pusillum.*

In the rock pools on the rocky ledge, the Rhodophyceae art not only confined to those present in the *Gelidium-Polysiphonia-Ger*iimiHm-belt but may extend into those in the next *Colpomenia sin* **Mtf-belt.** These rock pools are of different depths and it is seen that not only do the plants in the deeper rock pools show a more luxuriant growth but there are larger number of species present. The Rhodophyceae in these rock pools may be divided into the following vegetational group: —

1. Plants growing on loose soil
2. Plant attached to stones, shells, etc.
3. Epiphytes living on members of any one of the abovie group or other larger forms.

(;\ *Plants growing on loose soil:* (The Enhalid formation of **Warming).** The plants lx!onging to this group show adaptations to bind the loose sand and bring about a firm fixation. Frequently, however, they may be carried to and fro, along with the sand particles, during high tides. The plants, as a rule, are small in size and are fixed to the so bstra **tum** by *m*eans of simple branched rhizoids or rhizoid-like branches. Additional stability is acquired 1)V 'lie presence of procumbent branches,* bearing organs of attachment at frequent intervals. The following sp<cies h **tave** been recorded: —

Gelidiiwi pusillum. Centroceras clavatum. Laurencia obtusa, tx irceUaria fastigiata, Ahnjcltia plicata, Gracilaria Pygmca, Corallina. offkinalis, Polysiphonia platycarpa, Ceramium Manorense, ^ ham pi a plumosa, C. *compressa and C. globulifera.*

(2) *Plants attached to stones, shells, etc.* The plant> although **remaining comparatively** much smaller in size as compared to the deep water forms, possess like them, fairly firm organs of attachment, in the form of haptera or discs. The **following** species are recognised :—*Gelidium pusillum, Gracilaria dentata. Sarconcma*

furcellatum, Jania adherens, J. capillacea, Corallina cubensis, Laurencia obtusa forma *littoralis, Amphiroa fragilisstnia, Chondria cornuata,* C. *tennuissima, Spyridia alter nans.*

(3) *Epiphytes :*—About 14 forms have so far been recorded as epiphytes on other algae, either frflm the rock pools or that are cast ashore. Majority of these, however, have been collected from those in the rock pools. The commonest are the members of the family Corallinaceae.

Melobesia pustulata is dominant on stems and leaves of *Sargassum, Cystosiera* and *Gelidium,* etc., forming thick dull purple, oblong or lobed encrusting patches. The growth is so abundant that some of the host plants, get more or less, completely covered particularly in the region of the stem by the epiphyte.. *Jania adherens* occasionally associated with /. *capillacea* and *Corallina cubensis* are common epiphytes, forming dense roundish cushions, 1-2 cm. high on larger algae.

Members of the sub-families *Crounanieae* and *Ceramieae* are abundant on smaller algae in the rock pools particularly on those growing in the sandy bottom ones.

The following epiphytic Rhodophyceae have been recorded: —

Erythrocladia subintegra, Achrocheetium Champii, A. Manorense, Melobesia pustulata, Jania adherens, /. capillacea, Corallina cubensis, Antithamnion elegans, Ceramium miniatum, C. Manorensis, Ceramium Manorensis forma, Champia compressa var. *scindica, Polysiphonia ferulacea* and *Heterosiphonia Wurdemanni.*

Most of the Rhodophyceae soon loose their colour in preserving fluids. The addition of enough borax to 8-10% solution of Formaline in sea water to render the solution distinctly alkaline and then adding about 5% glycerine, helps in retaining their, natural colour for slightly longer periods.

The colour could be retained for still longer periods if the material is kept away from light. It is advisable that the Rhodophyceae be preserved as herbarium specimens by the method advocated by Taylor, in the Marine Algae of the North Eastern Coast of North America.

I wish to express my deep sense of gratitude to Dr. H. Chaudhuri for his instructive suggestions in the publication of this paper. My thanks are also due to Mr. Shamas-ul-Islam Khan for his assistance in making some of the drawings.

RHODOPHYCEAE*

PROTOFLORIDEAE

BANGIALES

Fam Ban&iacem*

SUBFAM. ERYTHROTKICHACE/li

Genus **Erythrocladia** Rosenv.

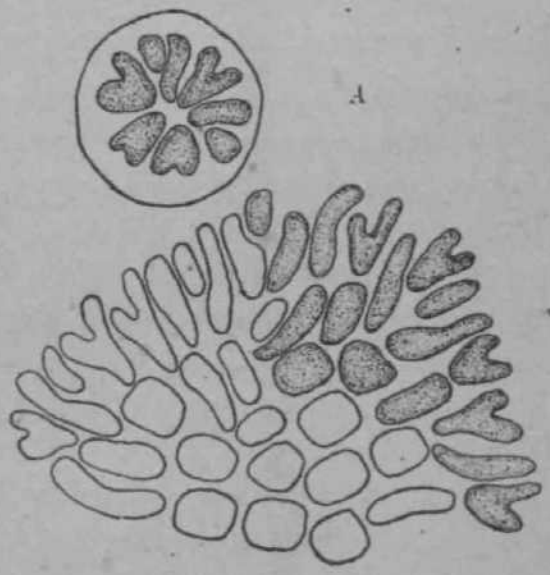
Plants as attached expansions of radial fiilaments, without erect growth, young specimens nearly circular, older ones with irregular and undulating margin ; growth marginal, chromatophore parietal ; sporangia cut off at the ends of the vegetative cells.

(1) Erythrocladia subintegra Rosenv. Fig. **1 A., B,**

ROSEN viNt^E, *Mar. **Alg.** Denmark,* Part I, Kobenhavrn, njog ; UOERGESEN, *Mar. Alg. Danish West **Indies,*** Vol. **II,** *p.* ;, Figs. 3 & 4.

[1] Abundant as an epiphyte on *Chcetotnorpha media* and *Chatnpia parvula*, the former growing on floating wooden wharves in the Kemari harbour while the latter In **the** shallow sandy-bottom [r]ock pools, in the *Colpotpenia $inosa-belt* at the rocky ledge, Manora.

Plants forming rose-coloured, membranous, completely attached, small rounded or irregular discs, 100-50^ in **diameter ; when young,** the [q]**scs have nearly a circular** outline but later larger



!? (; . 1. *Erythrocladia **subintegra*** Rosenv. .'], young plants seen from above; *B.* **older plants with more irregular margin** (x .625).

*The system of classification followed, as far as possible, is **thai** of Boergeser1 adopted by him in Marine Algae of the Danish **West** Indies, V[d]. H. 1915-20.

irregular patches are formed ; cells irregularly placed, polygonal, oblong or irregular, 4-6/x (rarely io/x or more) in diameter, marginal cells usually elongated, forked or dichotomously divided, the bifurcation is mostly unequal, one arm being, as a rule, larger than the other ; sterile.

This plant is a new record for Karachi. It has been previously recorded by Boergesen from Mahablipuram, south of Madras.

FLORIDEAE

NEMALIONALES

Fam. HelminthocladiacesB

SUBFAM. CHANTRANSIEiE

Genus **Achrochaetium** Naegeli

Plants parasitic, epiphytic or endophytic ; attached to the substratum by a basal hold fast cell, disc or by decumbent filaments ; erect filaments simple or irregularly branched, uniseriate, may end in hairs ; tetrasporahgia and monosporangia terminal or lateral, clustered or in unilateral rows.

(2) **Achrochaetium Manorense** sp. nov. Fig. 2 **A.**

Common as minute erect tufts on leaves and branches of *Sargassum vulgare* growing in deep water rocky-bottom rock pools in the *Colpomenia sinosa-be\t.*

Plants erect forming dense tufts upto about i mm. high, rising from a small endophytic disc, more or less of rounded cells ; main filaments alternately branched near the base, unilateral higher up, cells near the base 3-4/x broad, 7-9/A long, gradually becoming narrower, ultimately tapering into a long thin hair (abrupt ending in a hair is also rarely seen) ; each cell has a parietal chromatophore without a distinct pyrenoid ; monosporangia sessile, seriately arranged on the upper side of short 2-3 celled ramuli, rarely singly, ovate, or slightly elongated, 2.5-3.5/x broad, 5-6/x long.

This species is nearly related to *A. flexuosum* Vickers because of its endophytic basal disc, mode of branching and seriate arrangement of monosporangia, but differs from it in the smaller size of the cells, presence of long terminal hairs and smaller size of the monosporangia.

This species is characterised by the presence of a small endophytic disc from each cell of which an erect filament **arises,** alternate branching, terminating in long hairs, seriate arrangement of monosporangia on short 2-3 celled branches, monosporangia ^{2}-5-3-5/^{i} broad, 5-6/1 long.

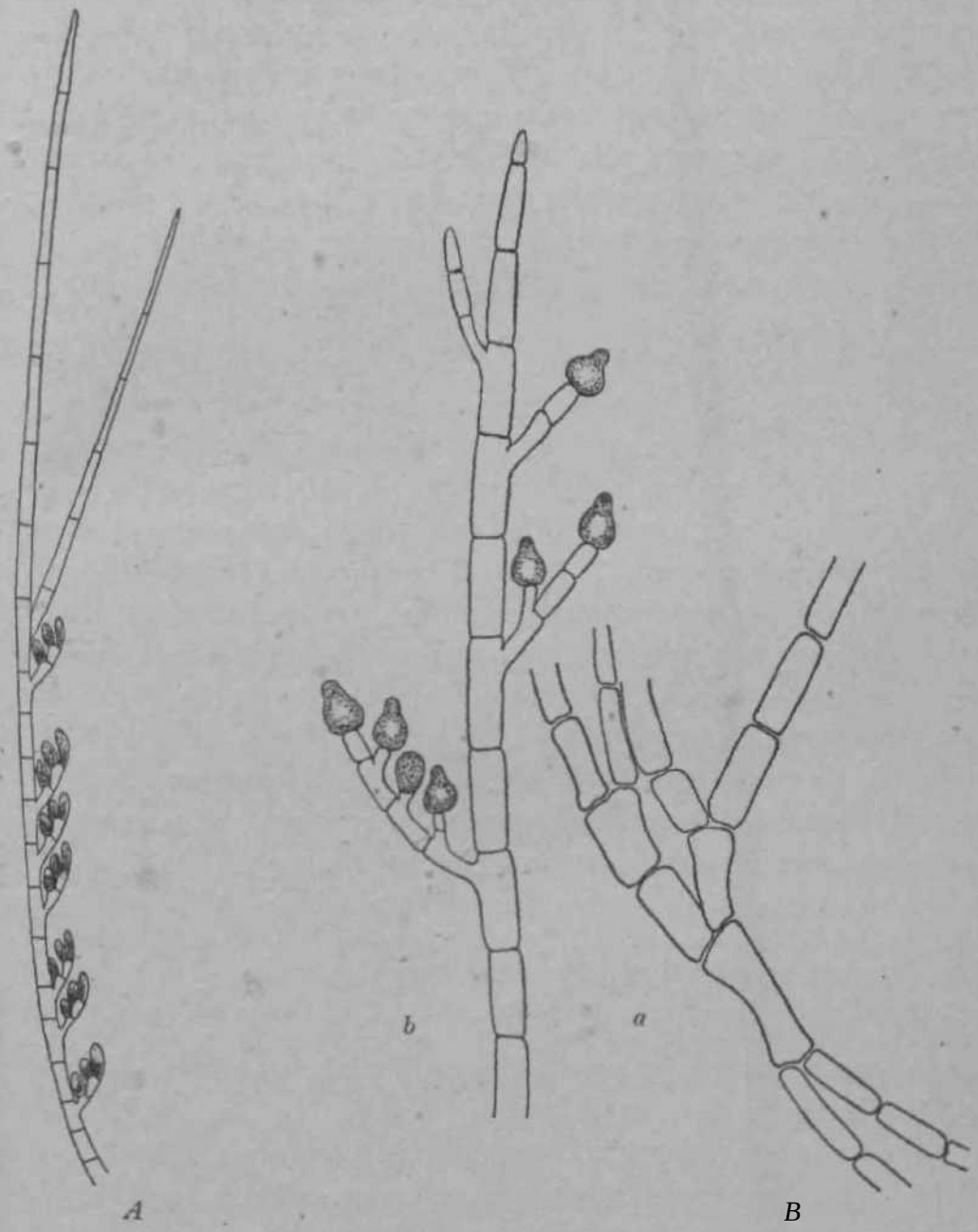


FIG. 2. *A, Achrocheetum M"norense* sp. nov. ; (x 175), *B. A. **Cham**pii* ^{S}P- nov. *a,* basal portion, *b,* **erect filaments** with **sporangia { *x.* 175).**

(3) **Achrochaetium Champii** sp. Nov. Fig. 2 B, a—b.

Occasional in small tufts on *Champia plumosa* in the sandy-bottom rock pools near the low-water mark at Manora.

Basal part consists of creeping filaments, partially immersed in the cuticle of the host, with cells io-12/x broad, 2-4 times as long as broad, bearing erect assimilating and spore bearing filaments, sparingly branched in a more or less alternate manner, branches given off at an acute angle ; main filaments slightly constricted at the cross walls, gradually tapering towards the apex, upper end acute without hairs, cells near the base 8-12/A broad, 30-40/x long, terminal cells 4-5/x broad, chromatophore parietal with a single pyrenoid, cells in the branches 4-5/x broad, \\-% times as long ; sporangia ovate, sessile or with a one celled stalk, one on each articulation, terminal or unilateral, on short lateral branches, 9-15/x broad, 21-25/* long.

This species resembles *A. Iyengeri* Boergs. in having basal creeping filaments, slightly moniliform erect filaments, sparse branching, ovate monosporangia but differs from it in the complete absence of hairs, greater dimension of cells, markedly ovate monosporangia which are much bigger in this species. It shows certain resemblance to *A. Krusadii* Boergs. in having creeping filaments, absence of hairs, terminal or unilaterally placed monosporangia but differs in the absence of a basal disc formed by the creeping filaments, larger size of the cells and the monosporangia.

This species is characterised by the basal creeping filaments, sparsely branched erect filaments without hairs, monosporangia ovate on short lateral branches, terminal or unilateral, usually with a one celled stalk, 9-15/1 broad, 21-25/x long.

(4) Achrochaetium Spathoglossi Boergs. Fig. **3 A.**

BOERGESEN, *Jour. Ind. Bot. Soc,* Vol. XVI, 1937. *P- 30.*

Frequent as an epiphyte on *Laurencia* growing in shaded localities near the low water mark.

Plants upto 300/x high, endophytic basal cell sunk in the tissue of the host from which several filaments arise ; cells of the main filaments 5/x broad, 16-20/x long ; branching sparse, irregular below, unilateral above, ramuli short ; cells of the ramuli .3-3.5/* broad, 8-10/z long, chromatophore parietal with

a large pyrenoid ; monosporangia pedicellate, oblong, borne on the main filaments as well as the branches, 7-9/i broad, ri-13/i long.

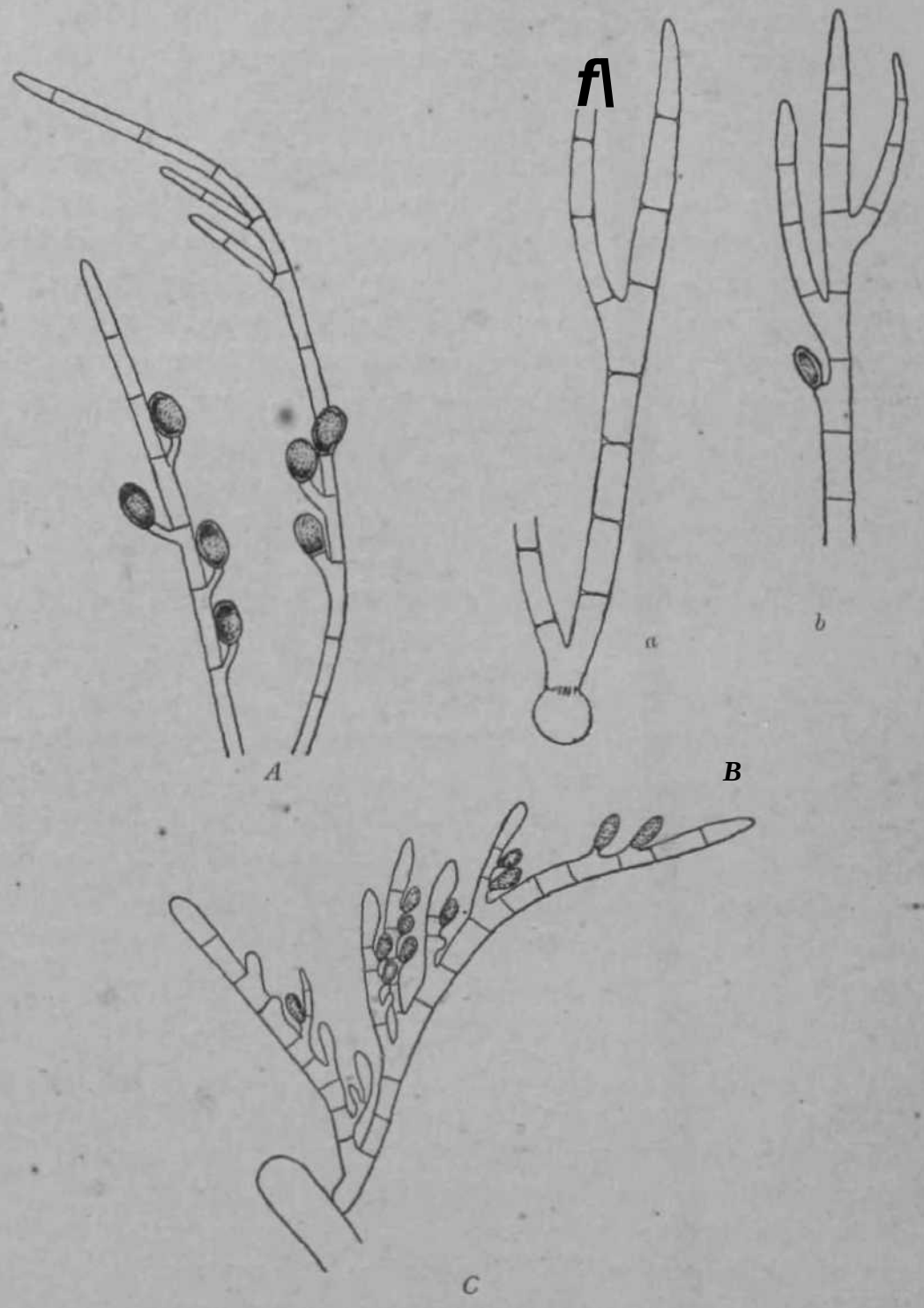


FIG. 3- *A, Achroch&tium Sf>athogloss*\ Boergs., erect filaments with sporagia (x 350) ; *B. A. wipes* Boergs. *a,* young **plant** with basal cell ; erect filament with a-sporangium (x 175) ; C, *A.* (subsenatum?) Boergs., epiphytic on *Cerunnum mxnudum* (x 175).

It differs from the type in the size of the monosporangia which are much bigger in this form.

(5) **Achxochsetium unipes Boergs,** Fig. 3 **B.**

BOERGESEN, ***Mar. Alg. Danish West Indies,*** **Vol. II, *p.* 55.**

Epiphytic on *Sargassum vulgare* from among the drift algae.

Plants small, erect, base consists of the original spore lying freely above the wall of the host plant, rounded, 16-18/x in diameter ; branching sparse, alternate, axils acute, branches pointing upwards, without hairs, gradually tapering to the apex ; cells in the main filament 9-10/x broad, 18-20/A long, apical cell 5-6/A broad, chromatophore parietal with a distinct pyrenoid ; monosporangia sessile on the main filament, oblong, 6-7/x broad, 9-10/x long.

This plant differs from that of Danish West Indies in the size of the monosporangia, which are smaller in the Indian plant.

(6) **Achrochaetium (subseriatium ?) Boergs.** Fig. **3 C.**

BOERGESEN, ***Kew Bull. No. 3,*** **1932.**

Epiphytic on *Ceramium miniatum* in the sandy-bottom rock pools in the *Gelidium-Polysiphonia-Ceramium-belt.*

Plants epiphytic, about 300/x high, attached by procumbent filaments, branching unilateral, axils acute, cells of the main filaments 8-10/x broad, 20-22/* long, each with a large parietal chromatophore having a distinct pyrenoid, apices obtuse, without hair ; monosporangia sessile, generally on the upper side of the lateral branches, singly or in series, occasionally singly on the main filament, obovate or slightly elongated, 6-8/x broad, 8-12/x (rarely 14/x) long.

There is some hesitation in putting this plant under *A. subseriatum.* I have come across only one specimen of this plant in my collections. In its creeping basal portion, size and structure of the cells, obtuse apices, partly seriate arrangement, form and size of the monosporangia, it resembles *A. seriatum,* but differs from it in the smaller size of the plant, unilateral branching, which is more profuse and on all sides in the Danish West Indies plant and the occasional occurrence of monosporangia on the main filament.

Fam. Getidiaceae

Genus Gclidium Lamx.

Plants cartilaginous, cylindrical or flattened, branched, attached to the substratum by rhizoids given off at short intervals from the under surface of the procumbent branches ; composed of long cylindrical cells around a central siphon, surrounded by roundisji cells becoming smaller towards the periphery ; cystocarps immersed in swollen branches ; tetrasporangia on jpdependent plants ; scattered in the cortex, cruciate.

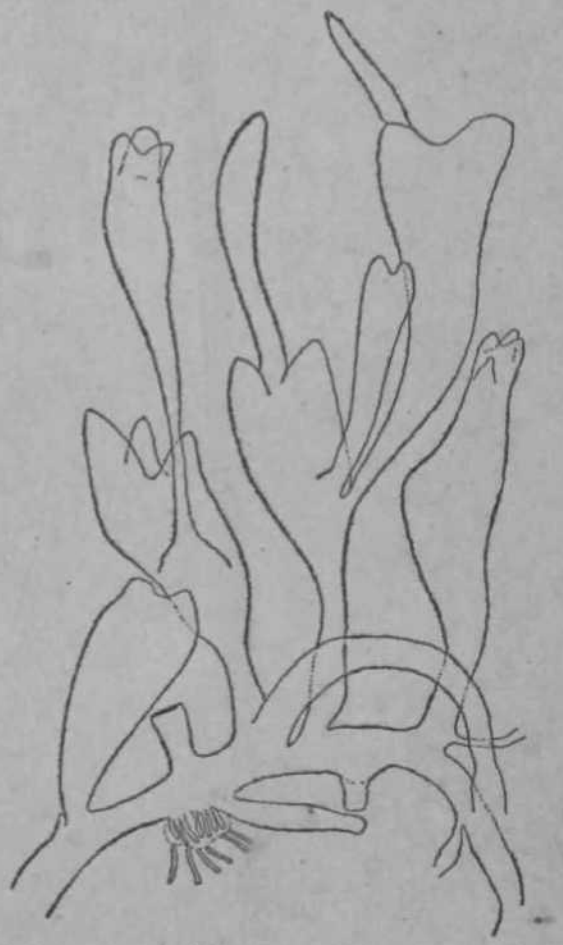


FIG. 4. *Gt'luhum* ***pusillum*** Le Jol **(x 20).**

(7) Gelidium pusillum Le Jol. Fig. 4.

LE JOL—*List Alg. Ciierli. '39 :* KUETZ,—*Tab. Ptiyc, xviii, 37*; BOERGESEN, *Kew Bull.* [No]- .i- 1933-

Dominant in the *Gelidi-*[U]*wi>-Polysiphonia-Cerafnxum-* belt near the low water mark.

Plant forming small or krge low cushions of dark-red colour, firmly attached to the substratum by rhizoids given off from the decumbent branches ; fronds seldom more than [1] cm high, some of the ramuli flattened, markedly attenuate at the base, irregularly arranged, apex broad, usually notched ; [r]^itilaginous in texture.

New record from Karachi.

Fam. ChaetanAiacese

SUBFAM. SCINAIEÆ

Genus Scinaia Birona

Pl^nts bushy, cylindrical or compressed, repeatedly dichotomously branched, sub-gelatinous or firm-gelatinous texture ;

composed of a medulla of slender filaments, obliquely giving off dichotomous filaments forming the middle layer,- containing numerous chromatophores ending in an outer epidermis of large colourless cells ; cystocarps below the cortical layer opening by a small ostiole ; antheridia spherical in small sori in the superficial cells.

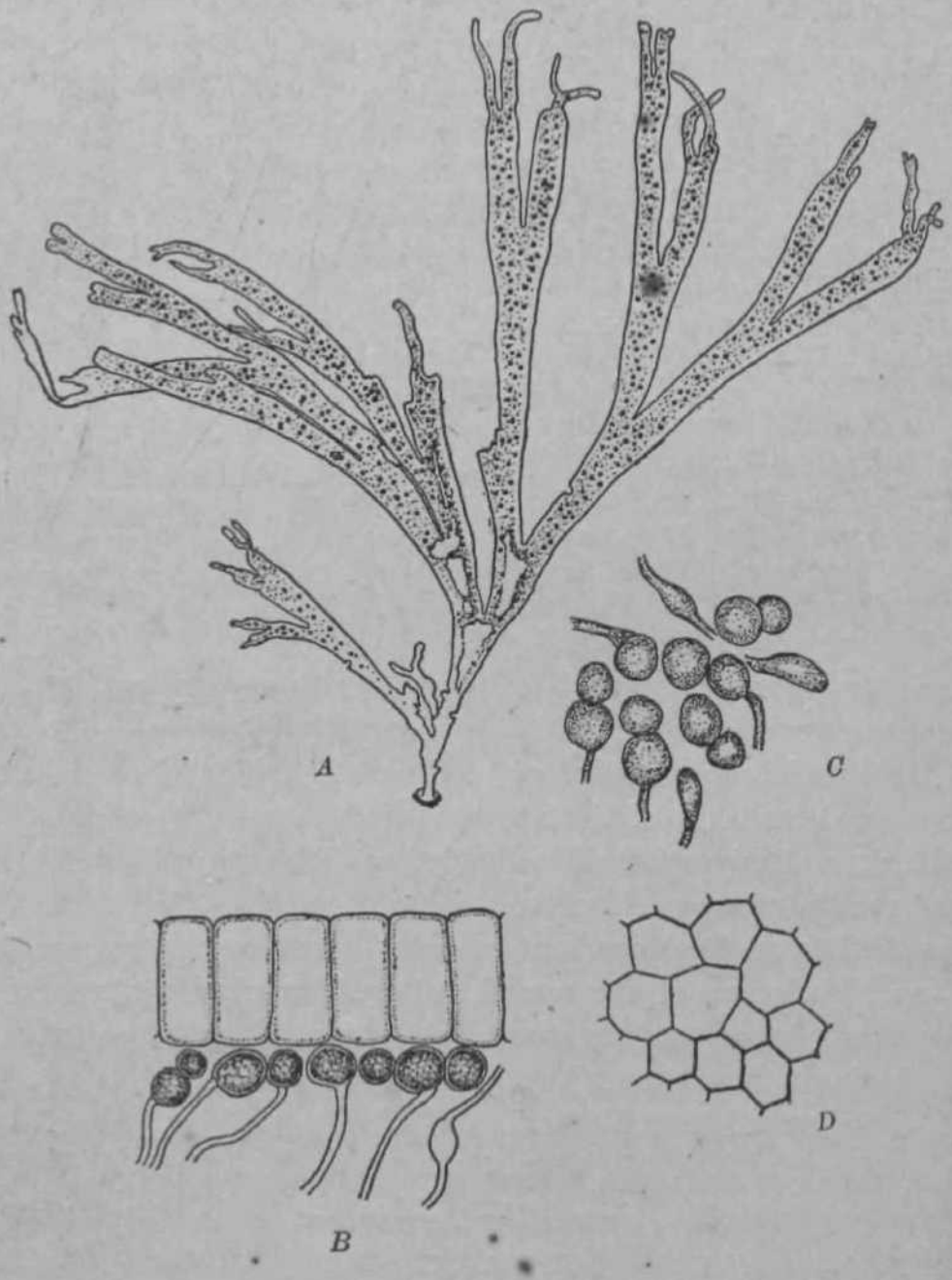


FIG. 5. *Scinaiu cvmpianata* (Coll.) Cotton. *A,* Entire plant (Natural), *B,* T. S. Thallus (x 350) ; C, peripheral cells seen from above (x 350) ; *D,* sub-epidermal cells seen from above (x 350).

(8) Scinaia complanata (Coll.) Cotton Fig. 5 A—D.

Scinaia complanata **(Coll.) Cotton,** ***Kew Bull.,*** **1907,** ***p. 260*** **;** ***Scinaia jurcellata*** **HARVEY,** ***Ner. Bor. Am.,*** **Part** ***2, />. 136.***

Cast ashore, Manora, Karachi.

Plants attached by a small disc ; upto 8 cm high, 2-3 mm broad ; fronds flattened repeatedly dichotomously branched, axils acute without any constriction at the base of the bifurcations, apices acute, ultimate ramuli more or less attenuated, without any distinct axial strands ; epidermal cells usually rectangular, 12-18/x broad, 30-32/x long, squarish to hexagonal in surface view, usually flattened at the upper ends and closely packed, below the* hypodermal layer of rounded cells, rich with chromatophores, 10-12/X in diameter? the central hypha-like filaments 2-3/x in diameter ; cystocarps scattered over the whole surface of the thallus, globular to pyriform, 180-200^ in diameter ; spores slightly elongated.

Previous authors have shown some doubt as to whether these small forms are flattened or not. Boergesen thinks they are terete. I have studied this plant both in the dried as well as preserved condition and have found it to be definitely a flattened form. This plant has been recorded for the first time from the Indian coast.

(9) **Scinaia Hatei Boergs. Fig. 6 A— E.**

BOERGESEN, ***Kew Bull. No. 1,*** **1931.**

Cast ashore, Manora, Karachi.

Plants upto 10 cm high, 3-4 mm broad, deep rose coloured, repeatedly forke<J, always constricted at the base of the joints, cylindrical, axial strands clearly visible in the preserved specimens ; epidermal cells colourless, 20/x broad, 28/1 long, polygonal from above, assimilating cells pyriform, 15/x broad, 25/x long ; axial strands composed of filaments 2.5/* broad, running in all directions ir* the central cavity filled with mucilage ; antheridia present in between the epidermal cells, filaments repeatedly forked ; cystocarps scattered over the surface.

The plants from Karachi differ from those found at Okha Port In being 3-5 mm broad.

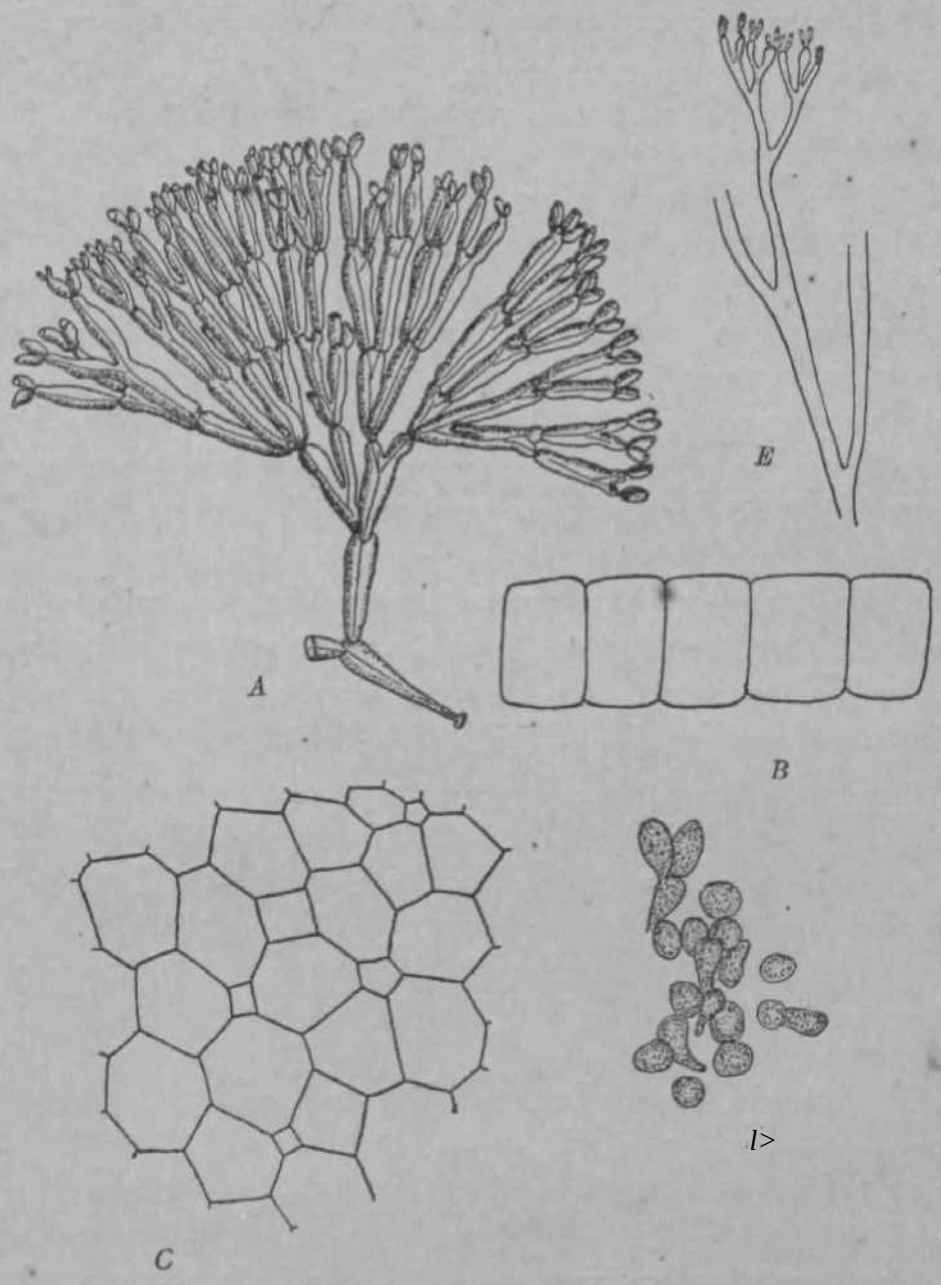


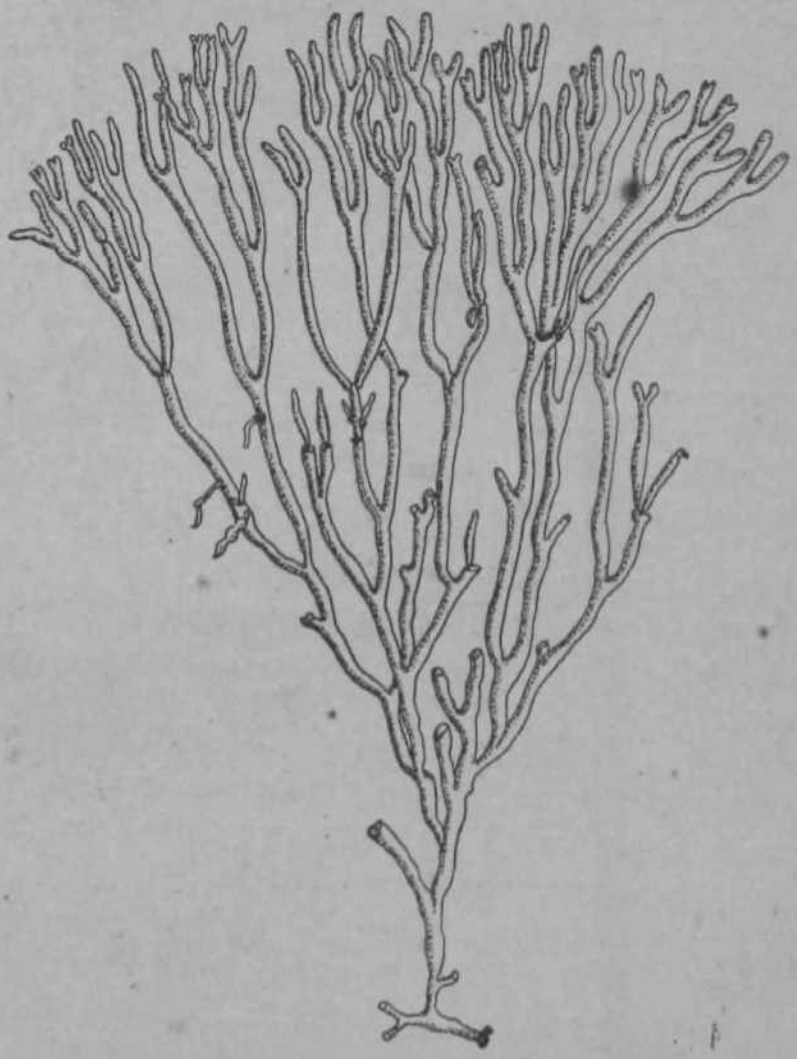
FIG. 6. *Scinaia Haiei* **BoergS.** *A,* part ol **the th&llns** {x \) ', *B,* T. S. thallus showing **epidenna]** cells ; *C,* epidcnnal **ccfla** seen from above ; *D,* **Ab-epiderma! cells sera *bom*** above ; *E,* filaments bearing antheridia (B—D, x 350).

(10) Scinaia indica Boergs. Fig- 7 A., B.

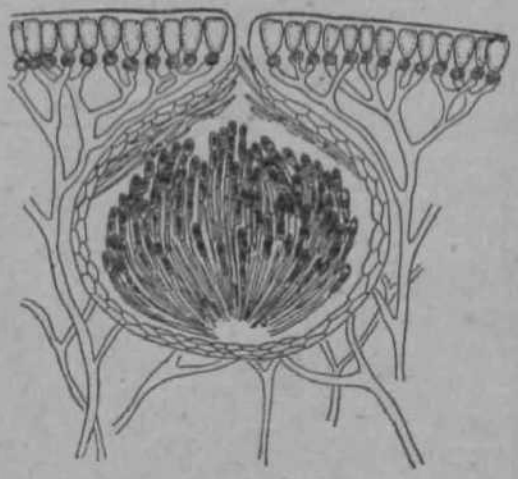
BOERGESEN, *Ksw Bull. No. I,* 1931.

Cast ashore, Manora, Karachi.

Plants upto 15 cm high, 2-3 mm broad, brownish red in colour, repeatedly forked, only rarely constricted.at the nodes, no



A



B

FIG. 7- *Scinuia itldj-a* itoergs *Al* Part of *a»* thallos (× *i)* . W. r. S- thallus in the region of the cystocarp [*x* 250).

visible axial strands ; epidermal cells 16-20/x broad, 40-50/x long, polygonal from above, assimilating cells about I6/A broad, pyriform or globular, filaments 3-10/x thick ; cystocarps scattered over the surface, 220-260/* in diameter.

This species flas been recorded by Boergesen from Dwarka and Okha Port but has been recorded from Karachi for the first time.

Genus **Galaxaura** Lamx.

Fronds dichotomous, thin incrustated with lime, composed of a medulla of longitudinal colourless, interwoven and anastomosing filaments and a cortex of closely packed coloured cells.

(11) Galaxaura oblongata Lamx.

BOERGESEN, ***Marine Algae Canary Island*, Hi, Rhodophyceae, Part I ; Kevv Bull. No. 1, 1931.**

Occasional in deep water rock pools at the rocky ledge, Manora.

Segments 1-1.25 mm, upto 2 mm broad, length 0.5-0.75 cm ; surface cells 12-14/x while the inner are 30/x in diameter.

Recorded by Boergesen from Karachi.

CRYPTONEMIALES

Fam. Grateloupiaceaa

Genus **Halymenia** C.Ag.

Thallus terete, compressed or flat, variously branched, soft and gelatinous, composed of a central portion of branched and anastomosing filaments, surrounded by a zone of roundish or oval cells, smallest neat the periphery ; cystocarps and tetrasporangia in outer layers, tetra-sporangia cruciate.

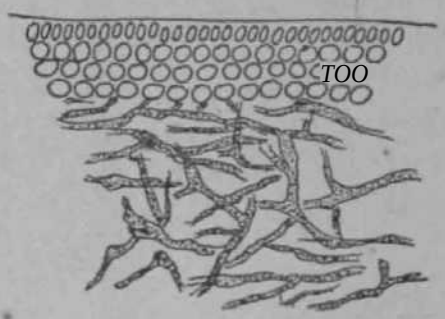
(12) Halymenia porphyroids Boergs. PL I, Fig. 1; Text Fig. 8.

BOERGESEN, ***Kew Bull. No. 2*, 1932, *p. 120.***

Cast ashore, rocky ledge, Manora.

Thallus tough, elastic, broadly cordate, leaf-like, rosy-red» with sinuate margin, 20-30 cm in diameter ; cells in the surface view rounded or oblong, 5-20/x in diameter, usually 8-15/*' transverse section of the thallus shows a peripheral limiting **laye**

of short rounded cells in 3-4 radial rows, the innermost being the largest ; in the mucilaginous interior of the thallus numerous transversely placed anastomosing filaments are found connecting the cortical layers on both sides ; **arising** from the stellately divided cells lying below the cortical layer are thinner filaments which run in all direction between the thicker ones ; tetrasporangia in **outer** layers, cruciate, I6JU broad, 24/x long ; the plant adheres firmly to paper.



I'I-;. S, *Halymenia porphyroides* Boergs. Portion of the I. S. of tile thallus (x 150).

(13) Halymenia polydactyla Boergs.

BOERGESEN, *Ksw Bull. No. 2,* 1932.

Cast ashore, rocky ledge, Manora.

Thallus repeatedly forked, fastigiate, but with a tendency to become fiabellate ; segments terete or little compressed below ; in the basal portion distance between the forks less than 2 cm, higher up 5 cm ; apices blunt, colour dark purpk- below, lighter above, tough consistency ; wall composed of thick-walled cells, polygonal from above, 5-9^ in diameter, with larger cells underneath passing into stellate ones, gland cells here and there ; tetrasporangia roudish to oblong.

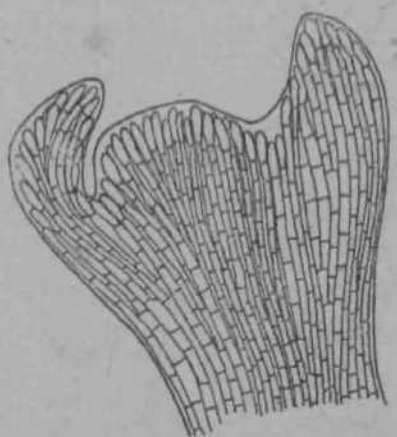


FIG. 9. ***M,elobesia pvstulata*** Lamour section through **the** thaHus (>: 350)

Fam$_t$ Corallinaceae

SUBFAM. MELOBESIE^E

Genus Melobesia Lamour

Plants calcareous horizontally expanded, completely attached to the substratum, composed of a single layer of cells in the vegetative part, while in the neighbourhood of the conceptacles 4-5 layered ; tetrasporangia in **conceptacles,** serial'e.

(14) **Melobesia pustulata** Lamour. Fig. 9

HARVEY, *Phycologia Bvittamca.* **Vol. II, Plate CCCXLVII.**

Dominant forming thick, dull purple, oblong or lobed incrusting patches on sten^ and leaves of *Sargassum, Cystosiera, Gelidium,* etc.", growing in the rock pools at Manora.

Patches small, thin and membranous in the beginning but later on becoming calcareous, irregular and frequently lobed ; 3-5 cm long 1-2 cm broad, closely adhering to flat surfaces or clasping cylindrical stems, the surface more or less uneven, monostromatic except about the conceptacles ; cells when seen from above 6-8/x broad, 8-15/A long ; conceptacles several on each patch, scattered superficially, hemispherical ; colour of the preserved plants finally changing to white.

This plant has been recorded for the first time from the Indian coast.

Genus **Amphiroa Lamx.**

Plant calcareous, terete, compressed or flattened, articulated, dichotomously branched, nodes cartilaginous ; fructifications wart-like, with an apical pore, sessile on any part of the articulations, tetrasporangia pyriform, four parted.

(15) Amphiroa anceps Lamx.

DEENE, SUR LES CORALLINES *{Am. Sc. Nat. 2, Sc.* **2,** *t. 18, p. 125) ;* HARVEY, *Net. Austr. g8, p.* **57 ;** BOERGESEN, *Kew Bull. No. 1,* **1934.**

Occasional with *Corallina* in sandy-bottom rock pools in the *Gelidium-Polysiphonia-Ceramium-belt,* near the low water mark in exposed localities at Manora.

Plants tufted, upto 8 cm high, reddish purple, changing to white in preservative, fragile, repeatedly dichotomous, at the lower nodes tri- to tetrachotomous, branches arise, as a rule, from the nodes but some, however, may arise immediately below the node, sub-compressed below flattened above, some of the upper nodes completely calcified so that no articulations are visible ; articulations below the ramifications slightly swollen, r-1.5 mm broad, 4-6 times as long as broad ; axils acute near the base but

wider above, ultimate ramuli trifid ; central strand has 3-4 rows of long cells, 50-70/* long, interrupted by a row of short cells, 19-34/1 long.

(16) Amphiroa fragilissima Lamx. Fig 10

HARVEY. *Ner, Boy. Amer., p. 8$;* BOERGESEN, *Kew Bull. No. 1,* J934-

Abundant in rock pools associated with *Caulerpa* in the *Colpomenia sinosa-bdl.*

Plants upto 1 cm high% light, purple, forming small dense cushions, fronds terete, repeatedly dichotomous, extremely fragile so that it is difficult to preserve it except in small bits, only slightly attenuated upwards ; axils obtuse, branches divaricate, articulations cylindrical, not swollen at the **extremities** ; 0.5-0.8 mm wide, 5-8 times as long ; central strand has 5 rows of long cells about 65/1 **long,** interrupted by a row of short cells, 20-22/A long ; some of the upper nodes ^ay be completely calcined ; colour changes to white in preserved specimens.

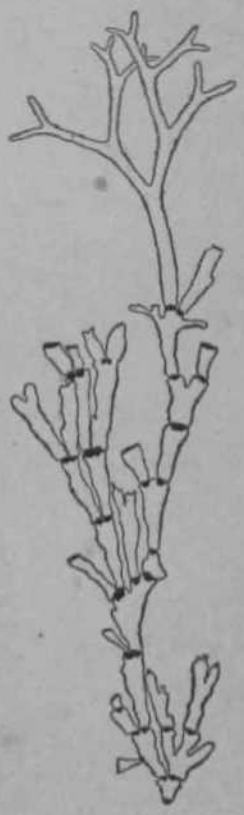


FIG. 10. *Amphiroa* ***fragUlissima*** Lamx (x 4).

Genus Jania Lamx.

Plants calcined, attached by basal **t*Jscs,** terete or compressed, dichtomously branched, chief characteristic by which it is differentiated from *Corallina* in which the branching is, as a rule, Pinnate, constricted at the joints ; conceptacles terminal, urceolate, lrequently tipped with two horn-like ramuli.

(17) Jania adherens Lamx. Fig. 11, A—C.

I-AMOUROUX I. U. F., *Hill, despolypiers corraligenes Mexile!. **Uulg.*** nor""<*** ***xooplytes.*** *awn 1816 ;*

BOERGESEN, *Marine Algae Danish West Indies,* Vol. II, *p.* /<,).'5.

Abundant as an epiphyte on larger algae such as *Cystosiera* and *Sargassutn* in the rocky-bottom rock pools in the *Colpomenia sinosa*-belt.

Plants forming dense, roundish cushions, 1-2 cm high, fronds slender, 110-150/* broad below, gradually tapering upwards, the

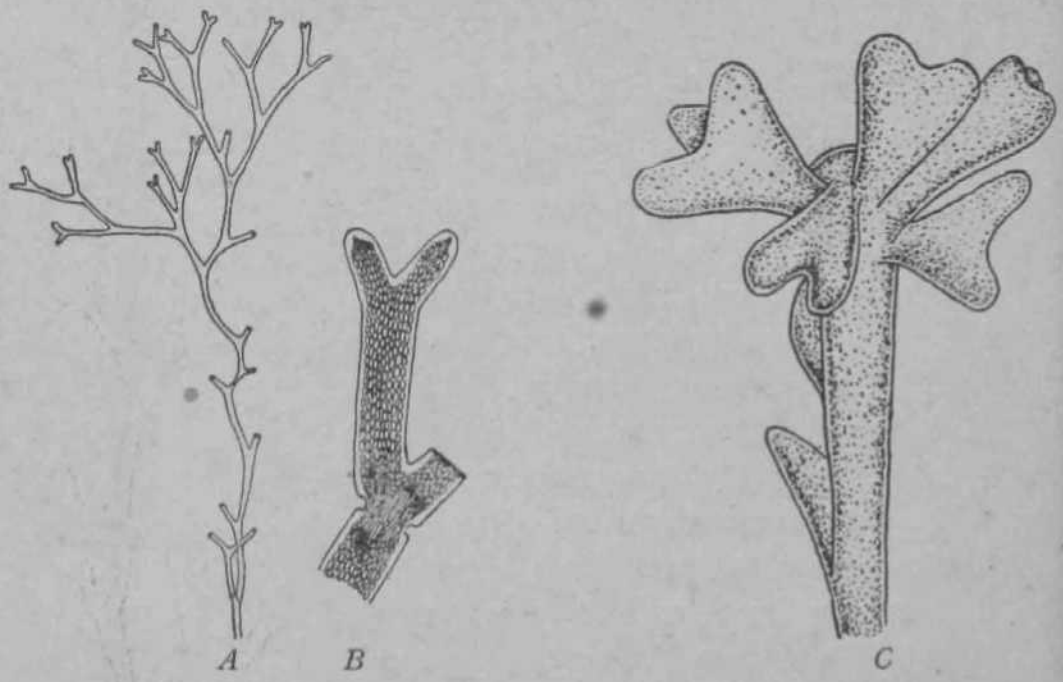


FIG. 11. *fania* ***adherens*** **Lamx.** *A,* Part of the thallus (x 0) ; *B,* L. S. of **the** HKLIIUS (x 35) ; C, a cluster of short and stumpy **branches (x 40).**

ultimate ramuli being 60-80/-1 broad ; repeatedly dichotomousb branched, branches more or less erect, distant between the ramifications being very long in the lower part, while it is very short nc ar the apices, thus **forming fastigiate** tufts ; articulations 5-7 tim< s as long as broad ; rarely the branches in these clusters do not grow to their normal size but remain short and stumpy, cells in thf nodes 6-8*p* broad, 150-160/* long ; conceptacles terminal, urn-shaped, 310-340,11 in diameter, tipped with two horn-like ramuli or with another similar conceptacle.

(18) Jania capillacea Harv. Fig. 12

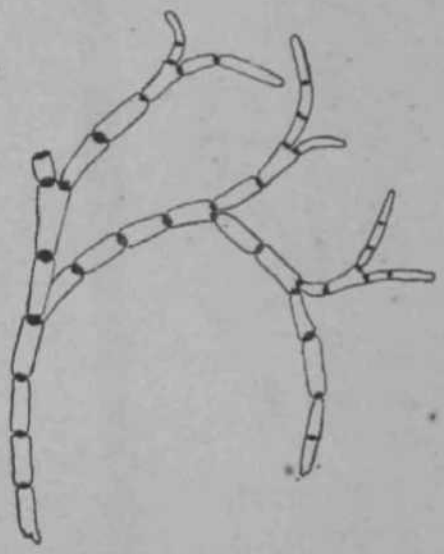
HARVEY, ***Ner Dor, Am., p. 84;*** **BOERGESEN,** ***Marine Algae*** *Danish West Indies.* Vol. II.

Abundant on stones or as an epiphyte on larger algae associate d with *Jania adherens.*

Plants forming small dense cushions, fronds o.8-r.2 cm higfcj firmly attached to the substratum by a minute disc, 200-250/ji in diameter, calcified except at the nodes and the tips of. the ramuli irregularly dichotomous below, regularly dichotomous abov*

branches curved and divaricate, articulations below the bifurcations slightly swollen, usually a single articulation in between successive branches, 150-200/u broad, 3-4 times as long, constricted at the nodes, nodal cells 4-5/i broad, 40-45/1 long ; .conceptacles terminal , urn-shaped, frequently tipped with two horn-like ramuli.

This species very *iuch resembles /. *adherens* but can be distinguished from it by its more stout consistency and curved and divaricate branches. Both the species of *Jania* are new records for the Indian coast.



FIG, 12. *Jamia* ***capillacea*** il.irv. Part **of a sterile** plant {x 15).

Genus Corallina Linn.

Plants calcified, attached by a basal disc, erect filaments terete to compressed, branching opposite in one plane ; articulated joints cylindrical to flattened, nodes ecorticate ; conceptecles by the conversion of lateral or terminal pinnules, naked or bearing horn-like projections, conceptacles bearing antheridia, carpospores or tetrasporangia terminal.

(19) Corallina Cubensis (Mont.) Kuetz. Fig. 13.

KUETZING, *Tah. Phyc,* Vol. 8, *p. jy ;* **BOEKGESEN,** *Mar. Alg.* ***Do-ish West*** *-Indies,* Vol. II, *p. I8J.*

Commonly growing on stones or other algae or amongst sponges forming dense, hemispherical cushions in the rock pools in the *Gelidiutn-Polysipkonia-Ceramium~* and the *Colpomenia sinosa-*k belts.

Plants attached by small discs formed on procumbent filaments ; fronds 1-2 cm high, filiform, terete" or subterete, branching **irregulary** pinnate ; pinnae may arise singly, in opposite Pairs or in a whorl of three, as a rule, from the node or the upper [e]nd of an articulation but occasionally from the middle or even the lower end of an articulation ; branches may arise from every **joint** [Or] one to several joints may intervene in between the branches ; ultimate branches usually dichotomously branched forming fastigiate tufts ; articulations in the lower part 250-300/* broad,

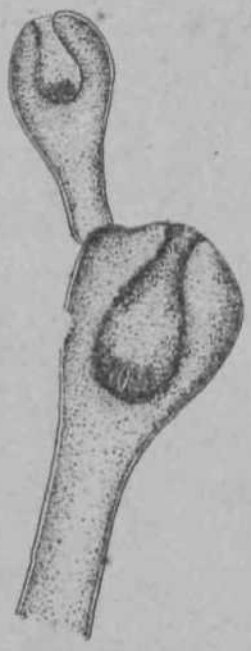


FIG. 13. ***Corallina ubensis*** (Mont). *Kuelz.* A terminal conceptacle **tipped** with anothrr similar conceptacle {× 50).

2-3 times as long, in the ramuli upto 150/i broad, 4-6 times as long, apices slightly swollen ; fronds intricately entangled or even attached to each **other** by terminal haptera borne by some ramuli, as a result of which it is difficult to separate the plants ; conceptacles terminal on the main branches or the ramuli, 320-350/1 in diameter, tipped with one or fcvo ramuli or with an other similar conceptable.

I have put this plant under *Corallina Cubensis* described by Boergesen from the Danish West Indies. It agrees with it in nearly all the characters except that the adventitious branches are not so thin as described by him and a conceptacle may be tipped with a similar conceptacle.

This plant is described for the first time from the Indian coast.

(20) **Corallina** officinalis Linn

BOERGESEN, *Kew Dull$_t$. No.* 5, 1933.

Forming dense intricate tufts in the stony bottom rock pools at Manora.

Plants small, upto 2 cm high, 1507* in diameter, pinnately branched, branches opposite, articulations in the upper part 2-4 times as long as broad.

Described by Boergesen from Dwarka and J, A. Murray's Collection from Karachi.

SUBFAM. CROUNANIEJE

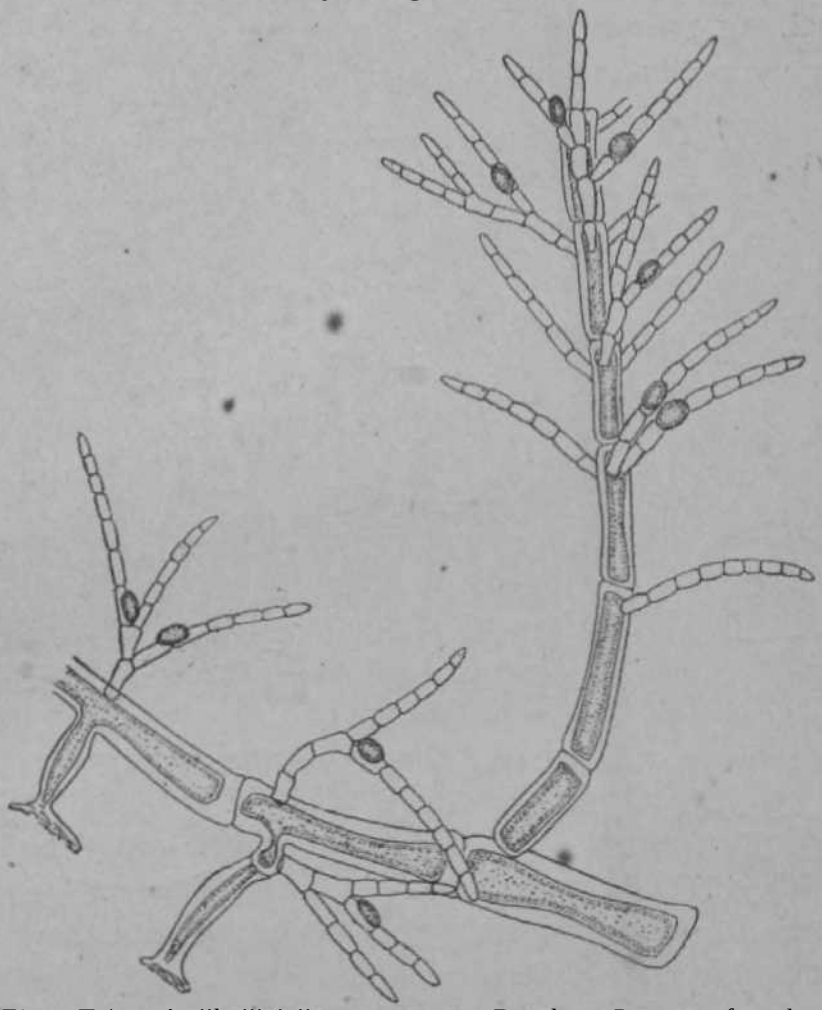
Genus **Antithamnion** Nsegl

Plants tufted, monosiphonous, uncorticated, ramuli opposite or whorled, arising considerably below the end of the supporting cell, gland cells often present ; cystocarps terminal on the **brancMets,** tetrasporangia oval, cruciate, sessile or stalked, often present in place of ultimate ramuli.

(21) Antithamnion elegans Berth. Figs. 14,15 A., B.

BERTHOLD, C, *Uber die vertheilung der Algen* ***vm Golf*** *von Neapel, p.* 316 ; BOERGESEN, *Mar. Alg. Canary* ***island,*** III, Rhodophyceae, Pt. III. Oramiales, 1930, *p. 56.*

Abundant on *Champia piumosa* and *Gelidium pusillum* between the tide levels on the rocky ledge, Manora.



Fin. T.(. *Antiiltaiiiniaii etegans* Berth. Part of the **fchalltt**S, showing procumbent and erect filaments (x 211).

Plants upto 1.5 cm high attached firmly to the substratum [lj]v means of small discs formed at the ends of short, one or two celled branches given out by the procumbent filaments ; cells of toe procumbent filaments 25-35/1 broad, 3-4 times as long ; wall [u]Pto 4^ thick ; from each articulations, as a rule, 3 pinnae are given off in a whorl, fhe lowermost forming the rhizoid and of the °ther two one remaining small and the other forming the erect filament ; cells of the erect filament 30-40/1 broad, 90-130/i l;[On]8 ; each articulation bearing a whorl of invariably 3 pinnae at [Its] upper end, pinnae much branched, cells of the pinnae 10-15/1 [br]oad, 2-3 times as long, any one of these pinnae may form a shoot [o][**Unlimited** growth ; gland **cells** large and oblong, 10-13/x **broad,** [16-20]μ long, resting as a **rule** in a single cell, more or less ha\ni_:

the same length as this, position of the gland cells variable, on **the** first, second or even the terminal cell of the ramuli ; cystocarps terminal, 65-75^ in diameter, carpospores rounded, quadrate slightly pyriporum, 15-20μ in diameter.

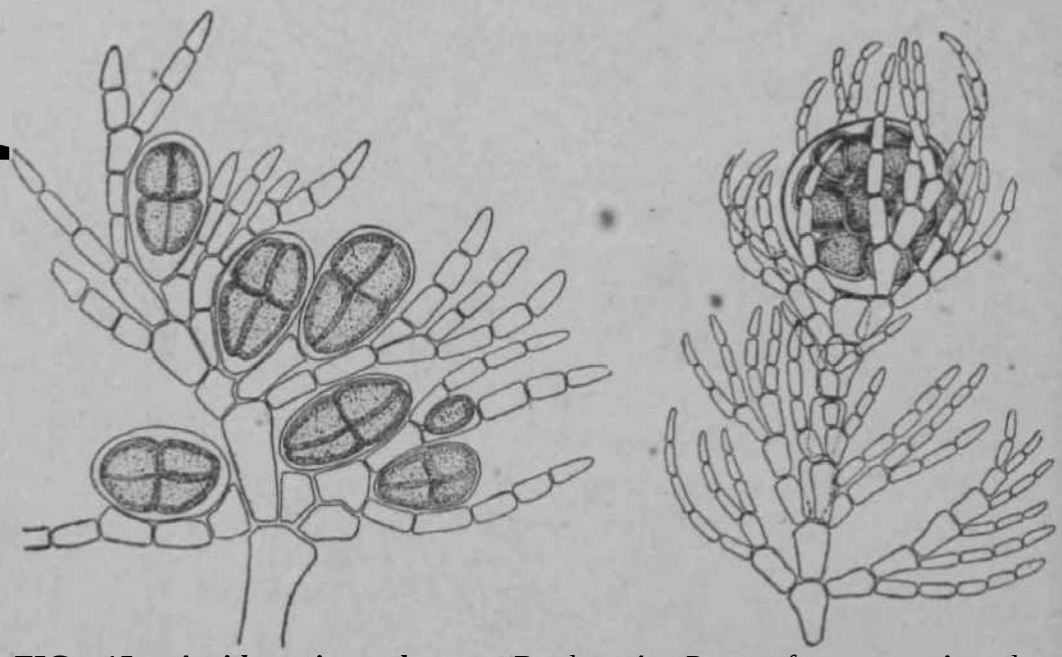


FIG. *15. Antithamniott slegans* Berth. *A,* Part of **tetrasporic** plant (x 120) ; *B,* Part of the tliallus with **a** ripe cysiocarp (x 90).

In the tetrasporic **plants,** the tetrasporangia are placed on the upper side of the branches, cruciate, 40-60/x long, 25-35^ broad.

Boergesen while describing *A. elegans* from Canary Island states that his plant differs from that described by Berthold in having four pinnae in each whorl. My plant agrees with that of Boergesen in more or less all the characters except that the number of pinnae in each whorl is invariably three, one of the characters by which Berthold differentiated this species from *A. cruciatiim.* The Indian plant is also more profusely branched and the position of the gland cell is fairly variable.

This is a new record for the coast of India.

SUBFAM. SPYRIDIE^E

Genus **Spyridia** Harv.

Plants tufted, monosiphonous, cylindrical, profusely branched, **older** plants of the main filaments corticated ; ramuli short, simple, irregularly borne all round the axis ; cystocarps stalked in groups on the branchlets, **surrounded** by involucre formed by the ramuli, tetrasporangia on separate individual, spherical, sessile on ramuli.

(22) Spyridia alternans Boergs.

BOERGESEN, *Kew Bull. No.* 3, 1933.

Cast ashore, Manora, Karachi.

Plants upto 25 cm high, dark red, most irregularly branched, markedly distichous, compressed, 1.5 mm near the base tapering upwards ; branching alternate, one on each segment, short ramu\ composed of 8 big cells.

SUBFAM. CERAMIEjE

Genus Centroceras Kuetz.

Fronds filiform, dichotbmous, articulated, corticated with quadrate to rectangular cells, arranged round the **intemodes** in longitudinal lines ; tetraspores formed by the transformation of some of the cortical cells, projecting from the surface, triangularly divided.

(23) **Centroceras clavatum** (Ag.) Mont. Fig. *16* A., B.

J. Ac, *Spec. Alg., p. 14.8;* EPICRISIS, *p, 108;* HARVEY, *Ncr.* I*Bor.* 4m., Pt. II. *p. 211,* tab. 33c; BOKRGKSEN, *Kew gull.* \><>. *i,* [934.

Co-dominant with *Gelidium pusillum* in the sandy-bottom rock pools in the *Gelidium-Polysiphonia-Ceramium~be\t.*

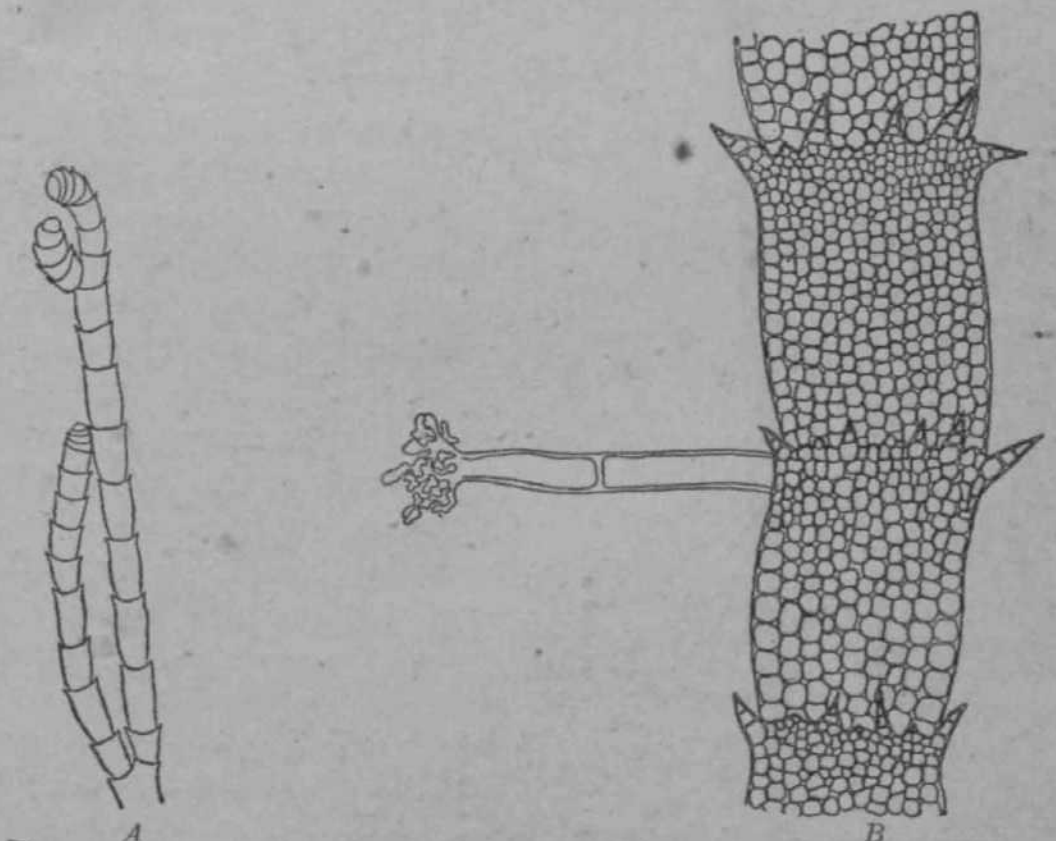
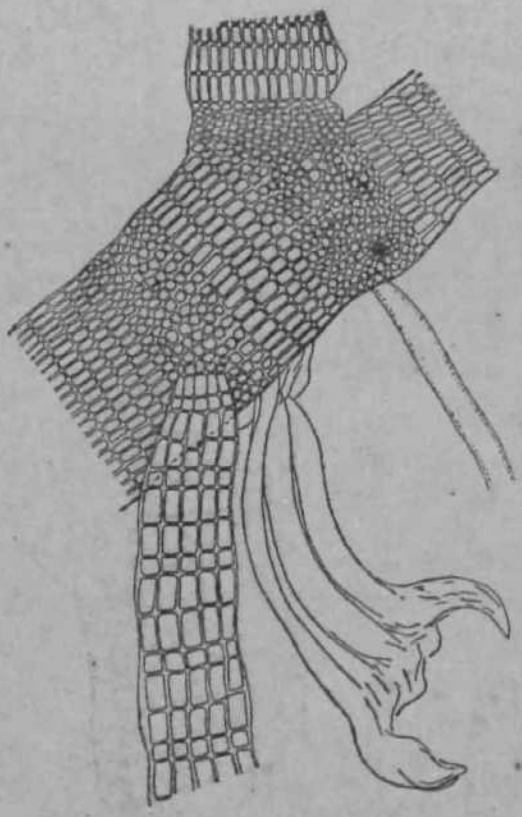


FIG. **r6. *Ceniroceras clavatum* (Ag.) Ment. *A,*** Pan cii tjn- **thallus** (× 25), ***B,*** **Part of the specimen** showing **longitudinally arranged** cortical cells **and nodes crowned with a whorl of small spine-like process (x** 150).

Fronds matted together forming very low cushions, upto 2 mm high, attached firmly to the substratum by means of rhizoids given off from the nodes, each ending in a broad disc ; plants rigid, harsh, breaking into small pieces on'drying, irregularly dichotomously branched, ultimate ramuli usually of unequal lengths, slightly curved inwards, apices broadly obtuse, completely corticated with coloured cells in longitudinal rows, cells near the nodes quadrate, *i2jx* in diameter, lower down rectangular, 12-14// broad, 18-21/z long ; each node crowned with a whorl of small spine like processes, usually 2-celled, which are gradually obliterated by age, very prominent in the youngest branches ; 9-10 articulations in each ramification, 120-150/i broad, 2^-3 times as long. Some of the plants were completely spineless.

(24) Centroceras sp. Fig. 17. *



Fie. 17. *Centroceras* sp. Part of the ilKillus i *K* 150).

Very rare, intermixed with *Centroceras clavatum.*

Plants **small, attached to the** substratum by rhiozoids, given off at the nodes, ending in irregularly lobed discs ; branching dichotomous, branches completely corticated with cells arranged in longitudinal striaeform lines ; the cejls in the nodal region small and quadrate, 6-8/1 in diameter, becoming gradually longer towards the base of the internode, attaining a **length oi** about 3 times the diameter ; small adventitious branchlets spring from any node, corticated with a single layer of quadrate cells, n-i3ju in diameter, alternating with a layers of elongated rectangular cells, Ii-I3$_t$a broad, 20-25 l°^{n}g' ^{a}^l cells arranged in rectangular cells, ir-13 broad, 20-25/i long, all cells arranged in longitudinal rows.

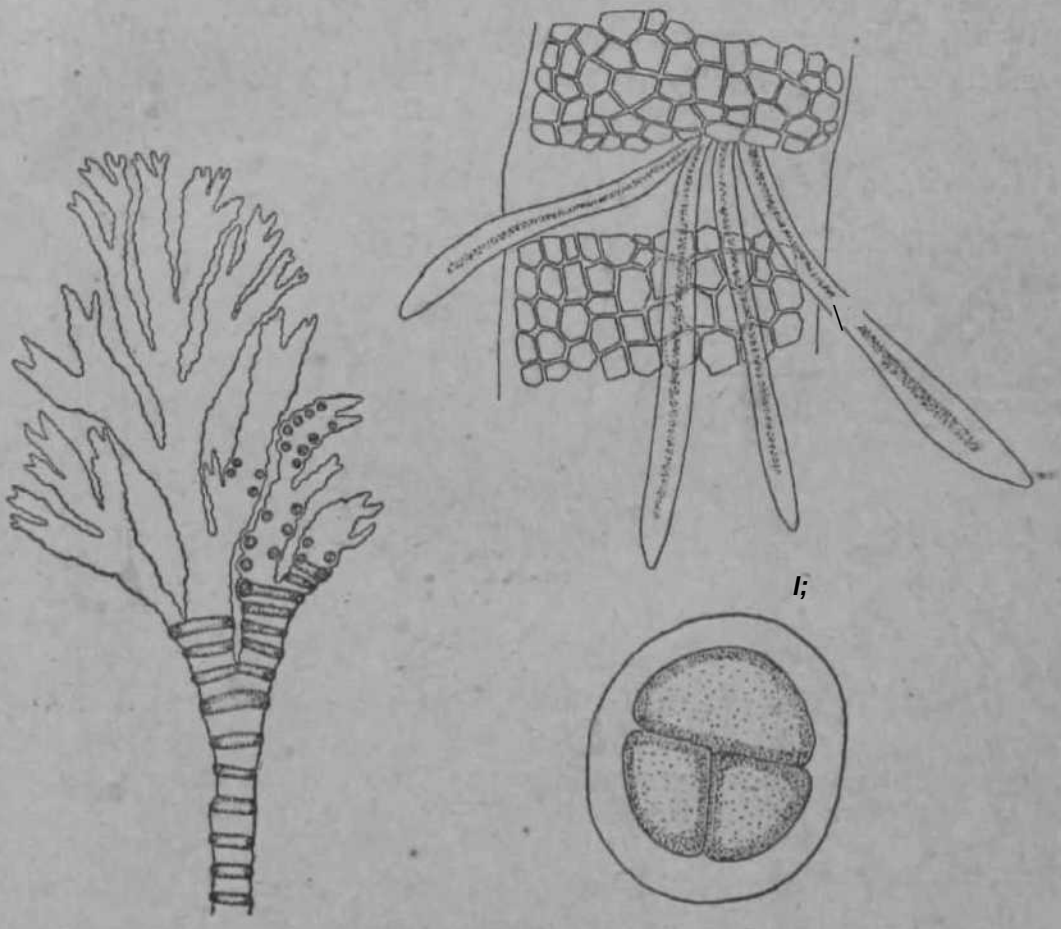
Genus Ceramium Lyngb.

Plants erect, may be partly matted, filiform, branched, dichotomous or subpinnate, branches segmented, uniseriate of large ovate of rectangular cells, corticated at the nodes by a ring of smaller cells, sometimes extending over the internodes between them in completely corticated species ; cystocarps sessile at the nodes, usually within an involucre of branchlets ; antheridia forming minute patches in the ramuli.

(25) **Ceramium miniatum** Suhr. Fig. 18 **A—**C

J. Ac, *Specks* ***Alg., i*** ; HARVEY, *Phyco. Austr..* PI. 206A ; BOERGESEN, *Kew Bull. No, i*$_t$ 1934.

Common as an epiphyte on *Sargassum, Cystosiera* and other larger algae in the rock pools in the *Colpomenia* smosa-bdt.



A *C*

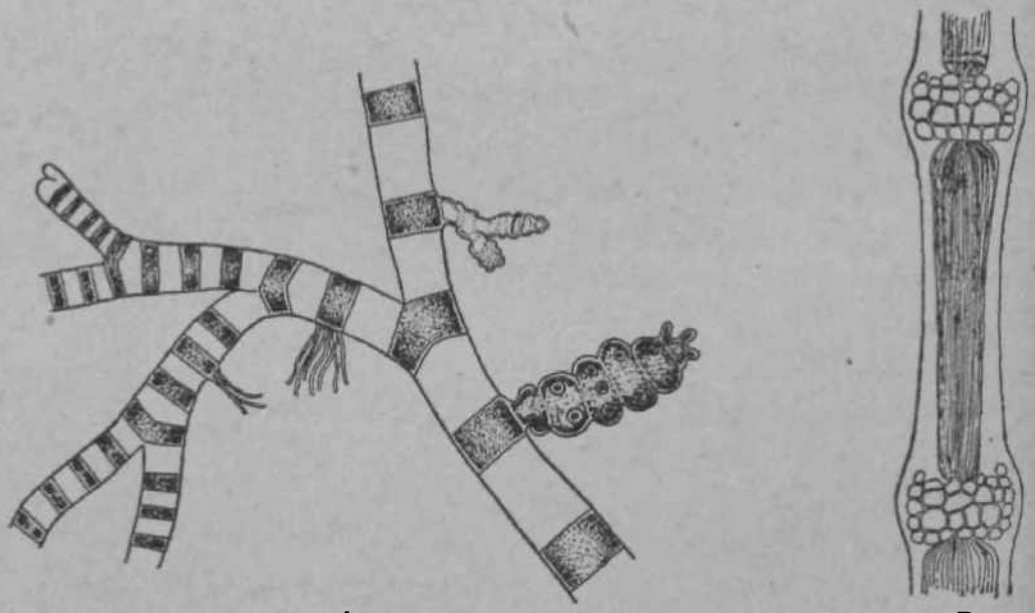
''•. is. *Ceramium miniatum* Sahr. .'. Part of the thaliui (x •o) ; "- Node <i a filamait sbowiog rhizoids (x 350) ; c, Tetrasporangium (x 300).

Plants up to r cm long, very slender and densely tufted, attached by **rhizoids** given off from the nodes of the procumbent filaments, erect filaments gradually attenuated upwards, distichously subpinnatc below, regularly dichotomous above, apices not hooked inwards, axils acute, about 5 articulations between successive ramifications, articulations 150^ broad, more or less as long, gradually becoming shorter upwards, only corticated at the nodes, tetrasporangia emergent, 2-4 at each node, rounded, cruciate, 80-85/i in diameter ; bright purple, **substance soft,** adhering to paper on drying.

(26) Ceramium Manorensis sp. nov. Fig, 19 A—D.

Abundant as an epiphyte on *Champia plumosa* growing in the sandy-bottom rock pools in the *Coipomenia sinosa-bv\t.*

Plants forming dense fastigiate tufts, 1-2 mm high, attached by rhizoids given off from the nodes of the procumbent filaments, erect fronds profusely branched, branching alternate below,

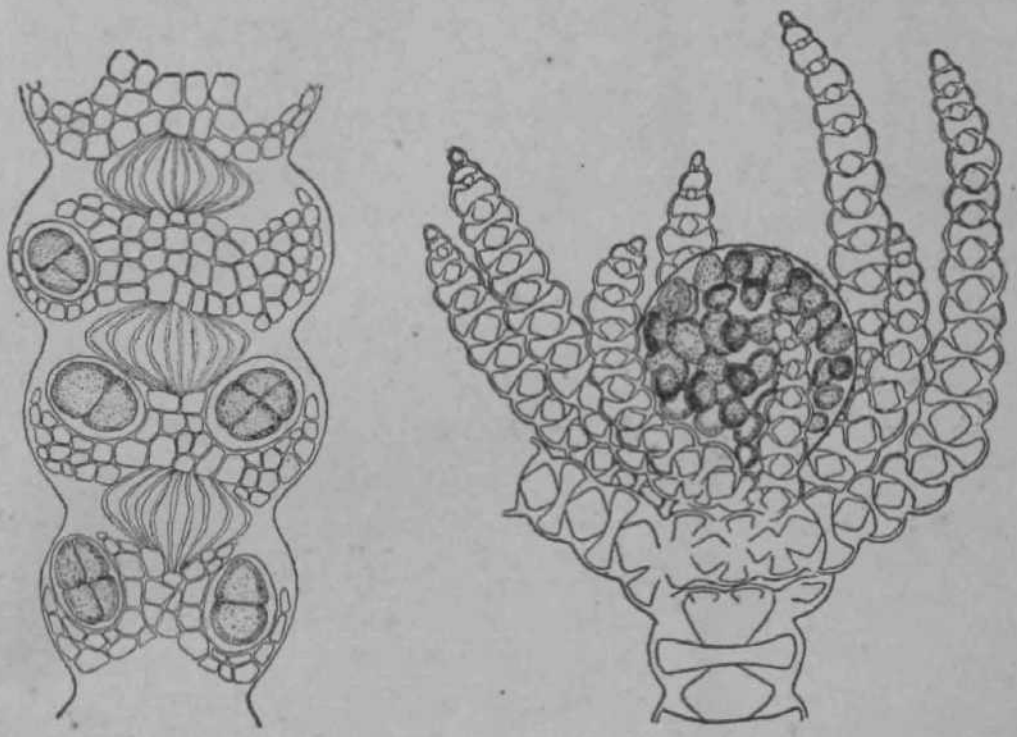


A ***B***

FIG. **19,** ***Ceramium Manorsisis*** **jp.** nov. *A,* Part oi **the** tliallus (x *60)', B,* Part **oi the filament** near the base (x 130).

irregularly dichotomous above, ultimate ramuli forcipate, not curved inwards, occasionally spreading, apices acute, only corticated **at** the nodes with 3-5 rows of cells, the cells of the central rotf being the largest, articulations 2-3 times as long as broad beloW gradually shorter above, in the ramuli £-£ times as long ; *$-4*

(rarely 6) articulations in each ramification ; in addition to normal erect fronds, there are short sparsely branched highly monUiform branches usually bearing tetrasporangia ; tetrasporangia emergent



C i *D*

FIG. 19. *C,* Part of the filament bearing tetrasporangia (x 300) ; *D,* Part of the thallus bearing the cystocarps (x 130).

or covered by the upgrowth of a few cortical cells, cruciate, 18-35/i in diameter, 2 at each node ; cystocarps terminal, i6o-2oo/t in diameter with 4-6 involucral branches which are usually larger than the cystocarp ; cystospores rounded, or oval, 20-25/* m diameter.

(27) Ceramium Manorensis forma Fig. 20 A—C.

Epiphytic on *Champia compressa* var. *Scindica* growing* in sandy-bottom rock pools in the *Gelidium-Polysiphonia-Ceramium-* belt.

Plants erect, upto 2 mm size, 110-150^ broad, gradually tapering upwards, branching alternate, occasionally dichotomous, axils acute, branches more or less erect, ultimate ramuli forcipatf , °nly slightly curved inwards, about 5 articulations in each ramification, only corticated at the nodes, with usually 2-3 layers °f cells, articulations in the lower region as long as broad,

gradually **shorter** upwards ; ramuli bearing tetrasporangia monili-form, tetrasporangia immersed, 2 or more at each node, cruciate, 15-18// broad, 20-25/* l°ng-

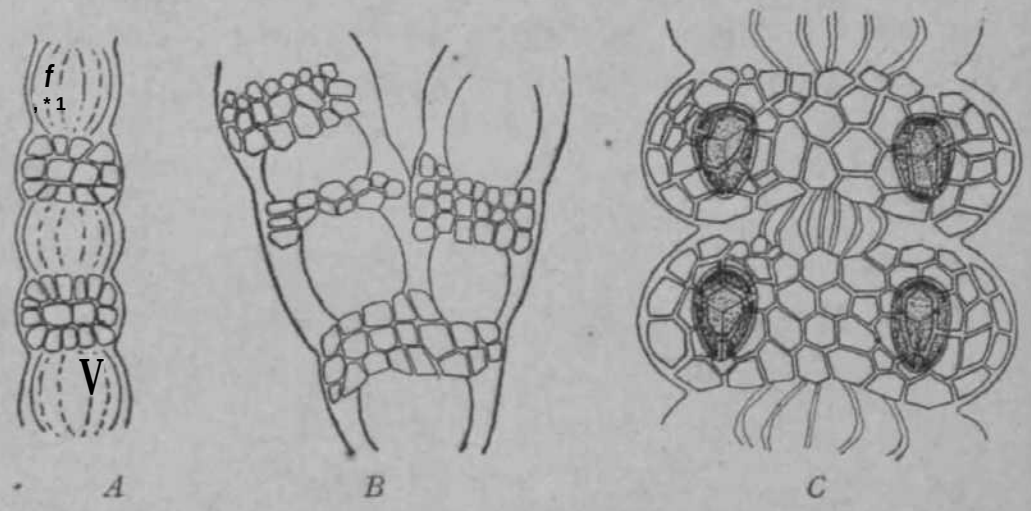


FIG. iu, <i<\uhinin ***Manorensis forma*** *A,* Part of the specimen (x 130) ; />, FiJament showing division (x IJO) ; C. Part of filament with tetxa&poxangia (x 300).

It differs from the type in having not more than 2 to 3 layers of cells at each node, shorter articulations, the longest being as long as broad, and the immersed tetrasporangia.

Fam. Rhodometacete

SUBFAM. LAURENCIE.E

Genus Laurencia Lamx.

Thallus cylindrical or compressed, branched, apices obtuse, central siphon may not be visible in the old axes, surrounded by elongated cells, bounded by a single layer of roundish **compact** cells, apical cell in a depression ; cystocarps urceolate, ovoid or **spherical,** sessile ; tetrasporangia near the tips of the ramuli.

(28) Laurencia filifoerais (Ag.) Mont.

J. An., *Spec Alg. 2,* 1745 ; YAMDA, *Notes* ***en Laurencia*** J-'J, *p. 18 ;* BOERGESEN, *Kew Bull. No. 1,* 1934.

Frequent in **the** rock pools at Manora.

Plants 12-14 cm hign of uniform thickness, branching irregular, lower irregularly alternate, upper secund, colour rose red ; soft consistency.

(29) Laurencia hypnoides Boergs. Fig. 21.

BOERGESEN, *Kew Bull. No. i,* 1934.

In rock pools intermingled with *Gelidium pusilum* near the **low** water mark.

Plants upto i cm high, yellowish green to brown-red, small almost cylindrical or sub-clavate, branchlets given off from the branches from all sides, Tarely the apices are forked ; tetrasporangia near the apices, 12-15^ in diameter. I have come across only me **specimen of** this plant.

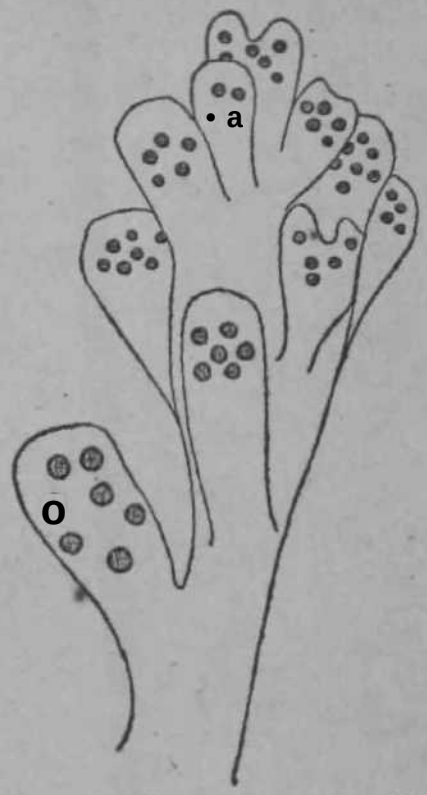


FIG. -2i. ***Lavrencia kypnt**ides* Boergs. Part of thi* **thallus with** clavate branches on all side bearing apical tetra-sporangia (x *130).*

(30) Laurencia obtusa (Huds). Lamx Fig. 22 A—D

LAMOUROUX, ***Essai in Annales du Museum d'Hist. Nat.j*** **Vol.** 20, 1813, *P-* ***130;*** J. An., *Spec. Alg.>* **Vbl*** *VL, p. 3;* EPICRISIS. *p. 653:* HARVEY, *Phyc. Brill.,* PI. 148.

forma *tyPica.*

Occasional in shaded localities in shallow rock pools in the *Gelidium-Polysiphonia'Ceramm»t~he\t.*

Fronds purple or yellowish red, 6-12 cm high, cylindrical of ^ore or less uniform diameter throughout, tapering towards the base ^to a small disc for attachment ; branching, as a rule, alternate, r^rely opposite or spiral, diminishing in length from the base to *he apex, ramuli short with obtuse or slightly truncate apices, "earing two or more process ; thallus composed of an epidermic °f small rounded cells, 25-32/x in diameter with a central tissue of *^rge isodi a metric cells, 75-80/i in diameter, the innermost largest ce^H attaining a diameter of iipto roo/i, the central cell is only

clearly seen ..in the sections of the young branches ; cystocarps conspicuous, distributed on the ramuli and the branches,

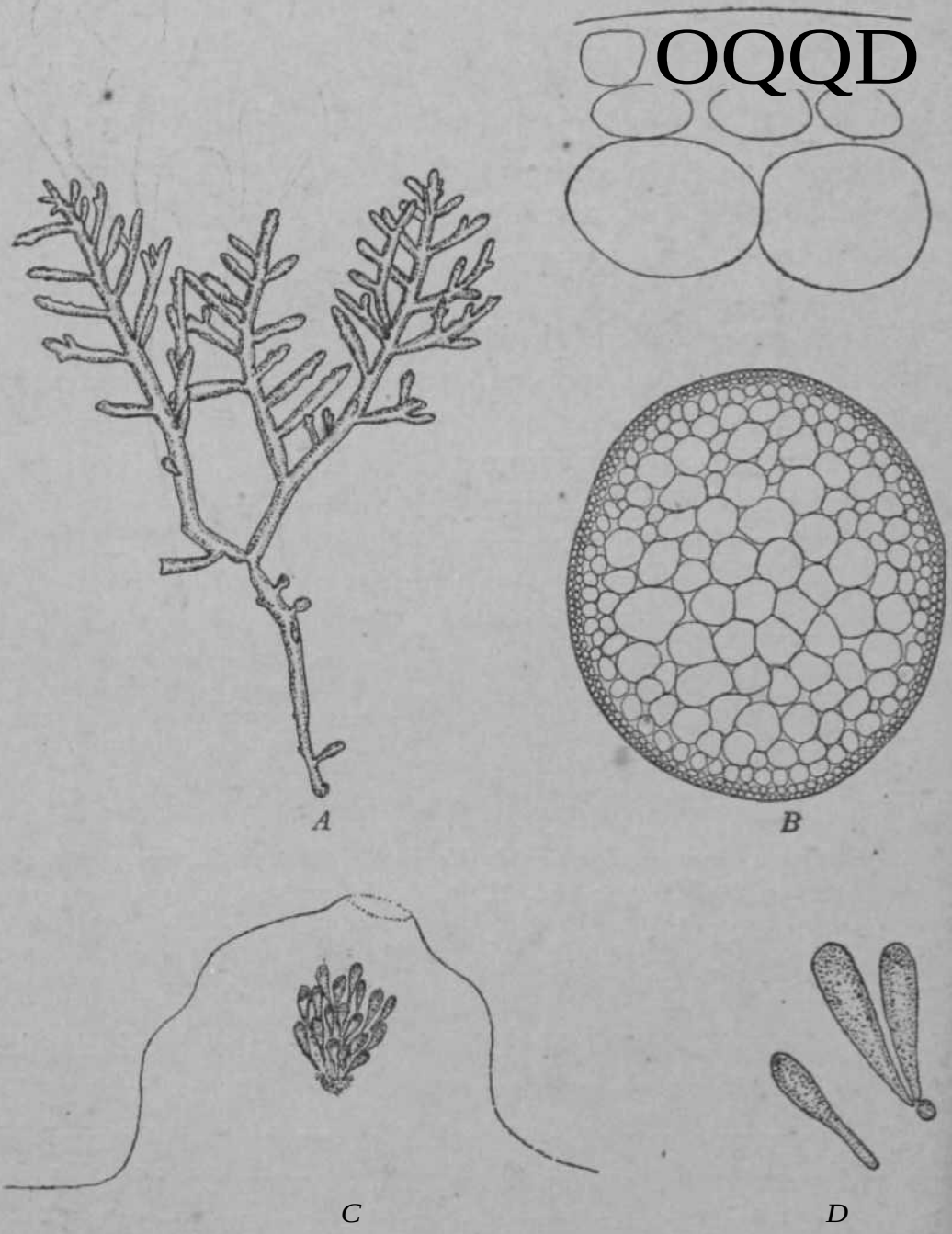


FIG. 22. *Laufencta obtusa* (Huds.) Lamx. *A,* Entire plant (x ½) ; *B,* T. S. of the thallns (x 100) ; *C,* T. S. cyslocarp (x 130) ;*D, Carpi* spores (x 150).

mammilate, upto 270/i broad at the widest portion opening by an orifice 50-60,11 in diameter, spores clavate 12-15/i broad at the greatest width, 120-130/n long ; plants cartilaginous and **brittle.**

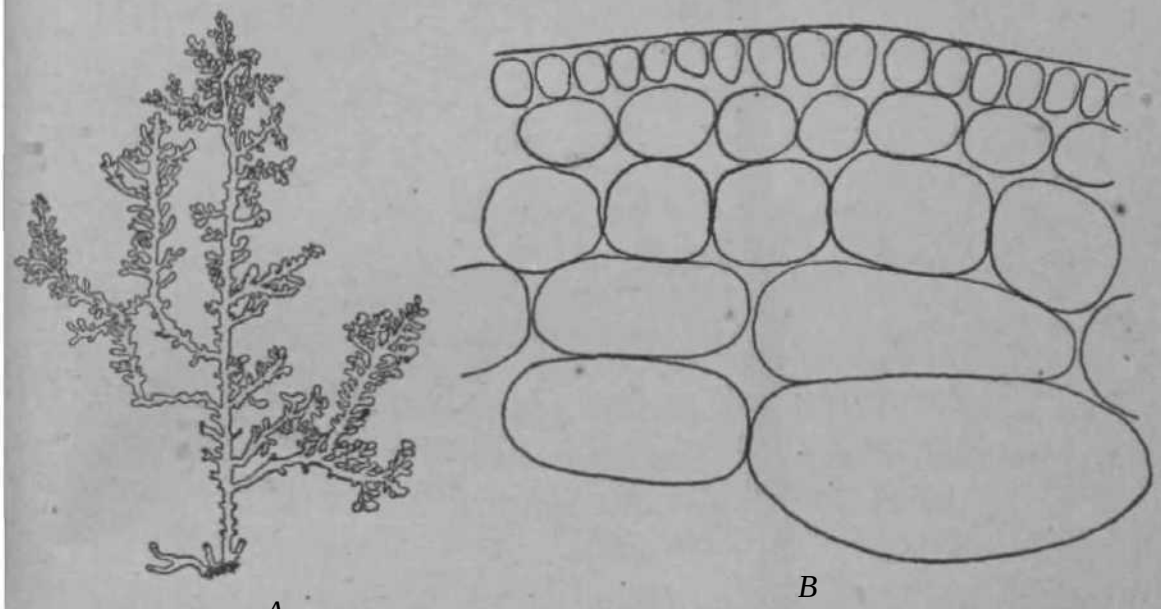
forma *litoralis* forma nov.

Growing on shells* of barnacles in the *Gelidiwn-Polysiphonia-Ceramium-belt*

Plants very small, rarely more than 1.5 cm high, branches erect, clavate, apices **trifid** ; tetrasporarigia at the apices.

(31) Laurencia pinnatifidia Lamx. Fig. 23 A, B.

IIARVEY, *Phyc. Brit.* PI. LV ; HARVEY, *Ner. Bor. Am., p.* 70.



A *B*

FIG. 2j. *Laurencia pinnatipida* Lamx. *A,* Entire plant (x Natural); *B.* T. S. thallus (x 200).

Cast ashore, Manora, Karachi.

Plants small, upto 4 cm high, 1 mm broad, tapering towards the base, slightly compressed, bi-to tri-pinnate, all the divisions **alternate** ; the branches bear short branchlets most of these being very short and tubercle-like, apices obtuse, simple or fobed ; tetrasporangia scattered towards the apices of the ramuli ; livid Purple in colour, imperfectly adhering to paper on drying.

This plant resembles very much var. *te?missima* in its **height,** naked basal portion, bipmnate branching above, but **the** characteristic urn-or cup-shaped bodies present in the tips of its ramuli are not seen.

(32) Laurencia platyclada Boergs.

BOERGESEN, *Kew Bull. No. 1,* 1934.

Thallus flat, about 2 times as broad as thick, peripheral cells as long as broad, in transverse section the free walls being a little convex ; stichidial branchlets short and irregularly cymose.

Thus plant has been described by Boergesen from Karachi but I have not come across it so far in *my* collections.

(33) Laurencia virgate J. Ag.

J. Ac, *spec. Ag. 2,* 752 ; BOERGESEN, *Kew Bull. No. 1,* 1934 : HARVEY, *Ner. Bor. Am,, p. jr.*

Occasional in rock pools near low water mark.

Fronds terete, pinnately branched, branches spreading to all sides, opposite or verticillate, elongate, ramuli opposite or whorled, erect, simple or corymbose-panniculate ; ramuli bearing tetrasporangia, clavato-cylindrical, markedly truncate, slightly constricted at the base.

SUBFAM. CHONDRIE/E

Genus Chondria Ag.

Thalliis cylindrical, profusely branched, composed of a **single** central siphon, surrounded by 4-6 pericentral siphons, bounded by rounded cells, becoming smaller near the periphery ; cystocarps sessile, ovate with a terminal pore ; tetrasporangia near the **apices** of the ramuli ; tetrahedral.

(34) Chondria cornuata Boergs.

BERGESEN, *Kew Bull. No.* 3, ig32.

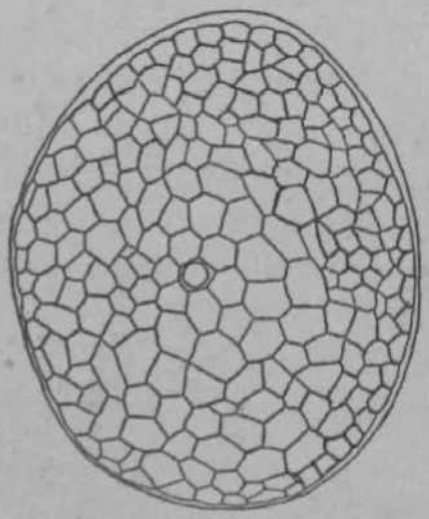


FIG. 24. *Chondria cornuata* Boergs. I. S. Challus.

On rocks or in rock pools in exposed places near or **a little** below the low water mark.

Plants forming dense tufts, dark red or brown, upto 15 *cm* high, branched only slightly below, more above, ultimate ramuli short and directed inwards ; filaments £-| mm thick ; composed of 5 pericentral cells surrounded by a cortex of rounded cells becoming shorter towards the periphery ; tetrasporangia in the upper ends of the branches and the ramuli ; **cystocarps** in short ramuli, 450/x in diameter ; no spines present at the base of the cystocarps.

(35) **Chondria dasyphylla (Woodw.) Ag.**

AGARDH, *Spec. Alg., p. 380 ;* BOERGESEN, *Kew Bull. No. 3,* 1932.

On stones and shells in pools near low water mark.

Fronds 10-15 cms high* sparsely divided main axis, ultimate ramuli short, obtuse and clavate, much attenuated at the base ; Cystocarps sessile on smaller branches.

(36) **Chondria tennuissima** (Good et Woodw.) Ag.

BOERGESEN, *Kew Bull. No. 3,* 1933.

On stones in shallow rock pools near low water mark.

Fronds 12-15 cm high, branching pinnate, branches attenuate upwards ; ultimate ramuli attenuated at each extremity ; cystocarps ovate, subsessile on ramuli ; colour pinkish purple, cartilaginous consistency.

Described by Boergesen from J. A. Murray's collection from Karachi.

Genus **Acanthophora** Lamx.

. Fronds filiform, cartilaginous, irregularly branched, coated* with small polygonal cells, axis articulated, polysiphonous, branches clothed with spine-like ramuli on all sides ; cystocarps urn-shaped borne on ramuli ; containing pear-shaped spores ; tetrasporangia in usually globose stichidia, formed in the ramuli.

(37) **Acanthophora Delilei Lamx.** Fig. 25 **A—**C.

LAMOUROUX, *Essai Thalassioph.,* 44 ; J. AG., *Spec. Alg., 2, p. Si7 ;* BOERGESEN, *Kew Bull. No. 1,* 1933, /»• 134.

Abundant below the water surface on a buoy in the air port harbour, Karachi.

Fronds large and bushy, 6-12 cm high, 1-2 mm broad, fixed to the substratum by a basal disc, profusely irregularly branched, ^ain filaments and branches beset with naked ramuli which in turn have solitary spines scattered upon them usually pointing upwards ; in transverse section the small central cell is surrounded by 6-8 large pericentral cells, 130-150/i in diameter, these* are bounded on the outside by a parenchymatous tissue of large ^in-walled cells inside and a single layer of small cortical cells °utside along the periphery ; cystocarps urn-shaped, borne on the ramuli, tetrasporangia in stichidial ramuli frequently tipped with * solitary spine, ovate or linear-oblong., tetrasporangia tripartite,

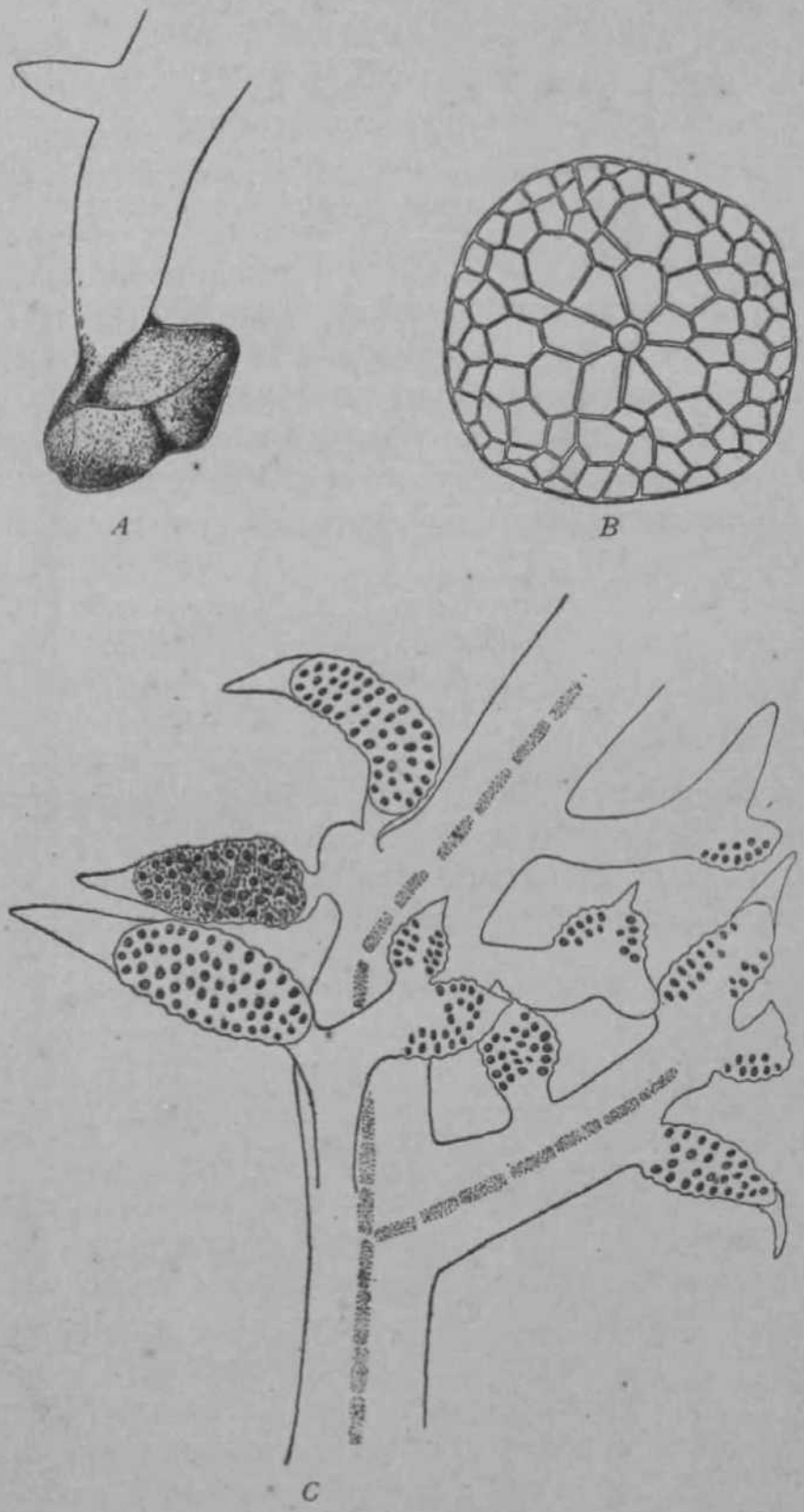


FIG. ^5. *Acanthophora Deitlri* **Lamx, ./, Basal disc (x 20) : *B*, T, S. thalliis (x 150); *C*, Portion of the** tli.Wins **with stichklia containing tetraspores (x 20).**

colour purple red becoming black on drying, substance cartilaginous adhering firmly to paper on drying. The Indian plant differs from the type in having solitary spines which are, as a rule, pointing upwards and the linear, oblong stichidia, frequently tipped with a solitary spine.

(38) **Acanthophora spicifera** (Vahl.) Boergs. PL IV Fig. 8 ; **Text Fig.** 26 A - C .

BOBKGESEN, *Mar. Atg. Dan. West Ind.,* Vol. 2, *p. 259 ;* ***AcatHhophora thierii*** **Lamx.** HARVEY, *Ner. Bor. Am.,* Vol. II, *p.* 7.

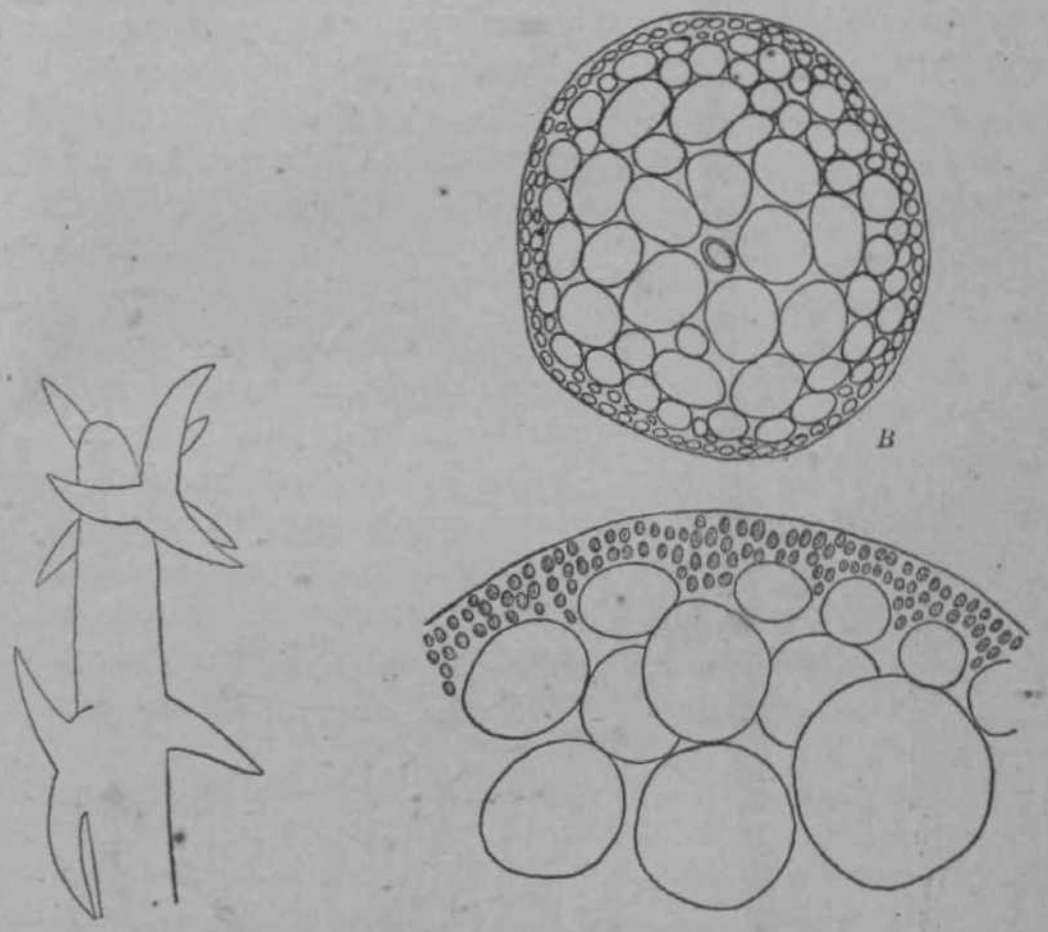


FIG. 26. ***Acanthophora spicifera*** (Vahl.) **Boergs.** ***A,*** Part of the **tballns** (t ***2D***j; ***B,*** **T. 5. tballua** (x **100);** *C,* Part uf **Qw** T. s. **thallos** (x 250).

Rarely intermixed with *A. Delilie.*

Plants 5-8 cm high alternately or irregularly branched, branches usually erect, ramuli densely bristled with short, simple or trifid, broadly subulate, patent or reflexed spines ; transverse section of the frond shows 5 perkentral cells surrounding **the**

central one, and a cortex of smaller, more or less rounded cells gradually diminishing 'in size towards the periphery, which is formed of very minute cells ; colour dark purple, becoming black on drying ; sterile.

(39) **Acanthophora dendroides** Harv.

HAKVEV, *Transact. Irish Academy,* 22, 538 ; J. Au., *Spec. Alg.. 2,* S18.

Ooccasionally mixed with *Acanlhophora Delilie.*

Fronds upto 16 cm high, 2-2.5 mm wide, pyramidally ramified on all sides, upper branches shorter ; apices rounded, here and there, especially near **the** upper ends of the branchlets, a short spine is present.

This species has been described by Boergesen from 1883 collection from Karachi.

SUBFAM. POLYSIPHONIEJE

(40) Genus Polysiphonia Greville

Plants erect, repeatedly dichotomously branched, **decumbent** branches may be present, filamentous, polysiphonous, axial cell surrounded by 4-20 pericentral cells ; some species may be corticated by rhizoidal outgrowths ; cystocarps urceolate on ramuli ; tetrasporangia[1] in the upper branches, one in each segment, often seriate ; antheridia on filamentous hairs produced at the tips of the branches and ramuli.

(41) **Polysiphonia platycarpa** Boergs. Fig. 27

BOERGKSKN, *Kew Bull, No. 1,* xjj-j :. A lisi of Marine Algae from Bombay, 1935.

Common on buoys and wooden wharves in the Kemari Harbour, Karachi.

!i.,. 27. *Polysiphon'a pUdycarp'a* Boergs (× 55).

Thallus tufted, brownish red, 2-4 cm high, erect, fixed to the substratum by means of rhizoids given off from the base of the erect fronds ; fronds corticated, tetrasiphonous, irregularly branched, rhizoids monosiphonous ; segments in the basal portion 220/1 broad, 220/J long, while in the middle 90-100/x broad, 160/A long, the trichoblasts at the tips

of the branches are as a rule well developed ; tetrasporangia oval or rounded, present in chains in ultimate branches, 90/x in diameter.

This plant has been previously recorded from Bombay but is a new record for Karachi.

(42) Polysiphonia ferulacea Suhr.

SUHR. Ms. IN J. Ac, *Spec. Alg.*, ii, 980 ; BOERGESEN, *Marine Algae Danish West Indies,* Vol. II, *p. 277,* figs. 277-280; *P. breviarticulata* Harv. *Net. Bor. Am.,* ii, *p. 36* tab. 16B.

Occasional as an epiphyte on *Gelidium pusillum* and shells of barnacle in the rock pools near the low water mark.

Filaments 450-500/x broad,' procumbent filaments bearing rhizoids ending in haptera ; 4 pericentral cells, uncorticated, cells usually quadrate, about 100/x broad ; tetrasporangia near the summits of the filaments. One in each segment, 55-70// in diameter.

(43) **Polysiphonia variegata (C. Ag.) Zan.**

BOERGESEN, *Kew Bull. No. 1,* 1934.

Plants forming dense bushes, dark purple red, attached to the substratum by rhizoids given off from the procumbent branches ; filaments taper upwards ; basal filaments 200/1 thick, apices 20-25/1, branches erect and nearly parallel, arising in the axils of trichoblasts, there are commonly 6-7 pericentral cells without any cortical layer.

Recorded by Boergesen from Karachi and Okha port.

Genus **Heterosiphonia** Mont.

Thallus usually erect, ramuli in two rows, one on each side of the branches, consisting of one central row, 4-6 pericentral siphons, bounded at the base by a band of longitudinal elongated cortical cells, articulations only visible in the smaller branches and ramuli, about as long as broad ; cystocarps urceolate, tetrasporangia borne in elongated, cylindrical, pedicellate stichidia.

(44) **Heterosiphonia Wurdemanni** (Bail.) Falkenberg Fig- 28 A, B.

FALKENBERG, *Rhodomalaceen,* 638 ; BOERGESEN, *Marine Algae Danish West Indies,* Vol. II, *p. 324.*

Occasional intermixed with *Ceramium* and *Champia* on stones or shells in the rock pools near low water mark.

Plants small, 1-1.5 cm high, **rigid,** attached to the substratum by rhizoid-Iike ends or discs often found at the summits of the

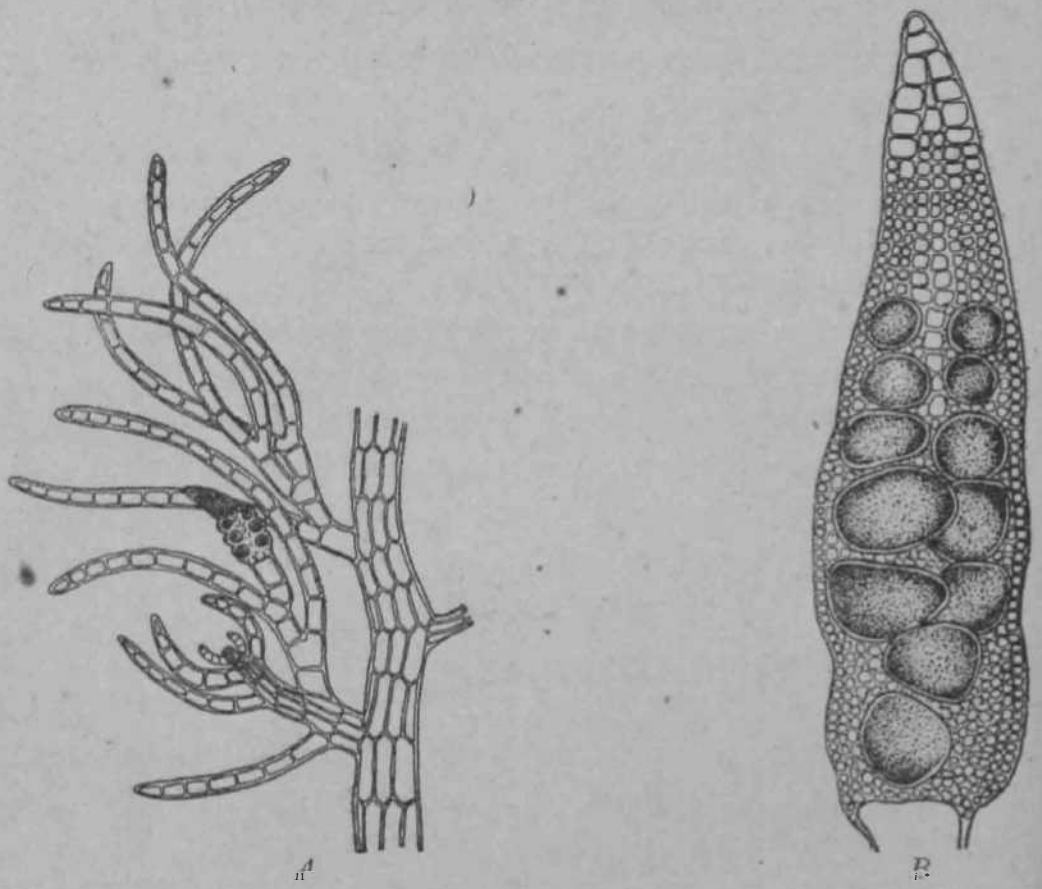


FIG. 28. *Helerosiphonia IVurdenianni* (Bail) Falkenberg. *A,* Part of the thallus (x 40) ; *B,* A stichidium containing sporangia (x 350).

branches ; uncorticated, erect branches irregularly dichotomouslj ramified, ultimate ramuli divaricate, squarrose, branches mainl} monosiphonous except in the basal segment where it is polysiphonous, eells in the basal part of the branches more or le ss quadrate, 60-70/1 broad, apical cell attenuated and curved I pericentral siphon 4-5 ; tetrasporangia in stichidia at the end of the ramifications, stichidia acute, sub-cylindrical with broadly rounded base, 65-85/z broad, upto 200/i long ; tetrasporangi fl cruciate, 25-30/1 in diameter.

Fam. Delesseriacese

StTBFAM. SARCOMENIK/E

Genus **Calaglossa** J. Ag.

Fronds livid-purple, leaf-like, delicately membranous, traversed by a precurrent midrib, fronds dichotomously branched

articulate-constricted, attached to the substratum by rhizoids given off at the forks ; conceptacles sessile on the midrib ; tetrasporangia in son, tripartite,

(45J Calaglossa Leprieurii (Mont.) J. Ag., Fie 29 A, B.

J. Ac, *Epicrisis, p. 499; Delesseria Leprieurii* Mont. HARVEY, *Ner. Bor, Am.,* II, *p. 98 ; Bypoglossum Leprieurii Kuetz. Spec. Alg., p. 8j$;* BOERGESEN, *Mar. Alg. Dan. West Indies,* II, *p. 341.*

Growing among barnacles on the iron-work in the Kemari harbour near the low water mark.

Thallus small, flat, leaf-like, livid-purple, 1 cm long, 0.5-r mm broad, thin of a single layer of cells, except in the region of the midrib, repeatedly forked and slightly constricted at each forking, giving the internodes a linear-lanceolate form ; fronds dorsiventral, fixed to the substratum by means of rhizoids given off from the undersurface at the forkings of the thallus ; apices bifid, midrib consists of 3-5 longitudinal rows of cylindrical cells **i4-2§//** broad, 7-10 times as long, while those of the membrane are hexagonal becoming shorter and broader towards the margin .substance membranous, not very closely adhering to paper on drying.

This is a new record for the Indian coast. It differs from the plant from Danish West Indies in being smaller, never exceeding wore than 1 cm.

Cottoniella Boergs.

Thallus with basal portion of decumbent filaments fixed t& substratum by rhizoids, erect filaments near the upper end bear [a] series of branchlets with limited growth in two rows along the **dorsal convex** sides ; growth by an apical cell ; composed of a central cell surrounded by four pericentral cells, older parts corticated, ramuli monosiphonous.

(46) **Cottoniella** fusiformis Boergs.

BOERGESEN, *Marine Algae, Canary Island, Rhodophyceas, HI, i.\\.* [fi]gs, 58-59; *Kew Bull.* No. 1, 1931.

Plants upto 12 cm high, irregularly ramified, in the upper [e]nd branches usually more or less curved, young **branches** "[1;]irkedly fusiform ; composed of a central siphon with 4 peri-[4n]"trai siphons, rose red in colour.

Described by Boergesen from Karachi.

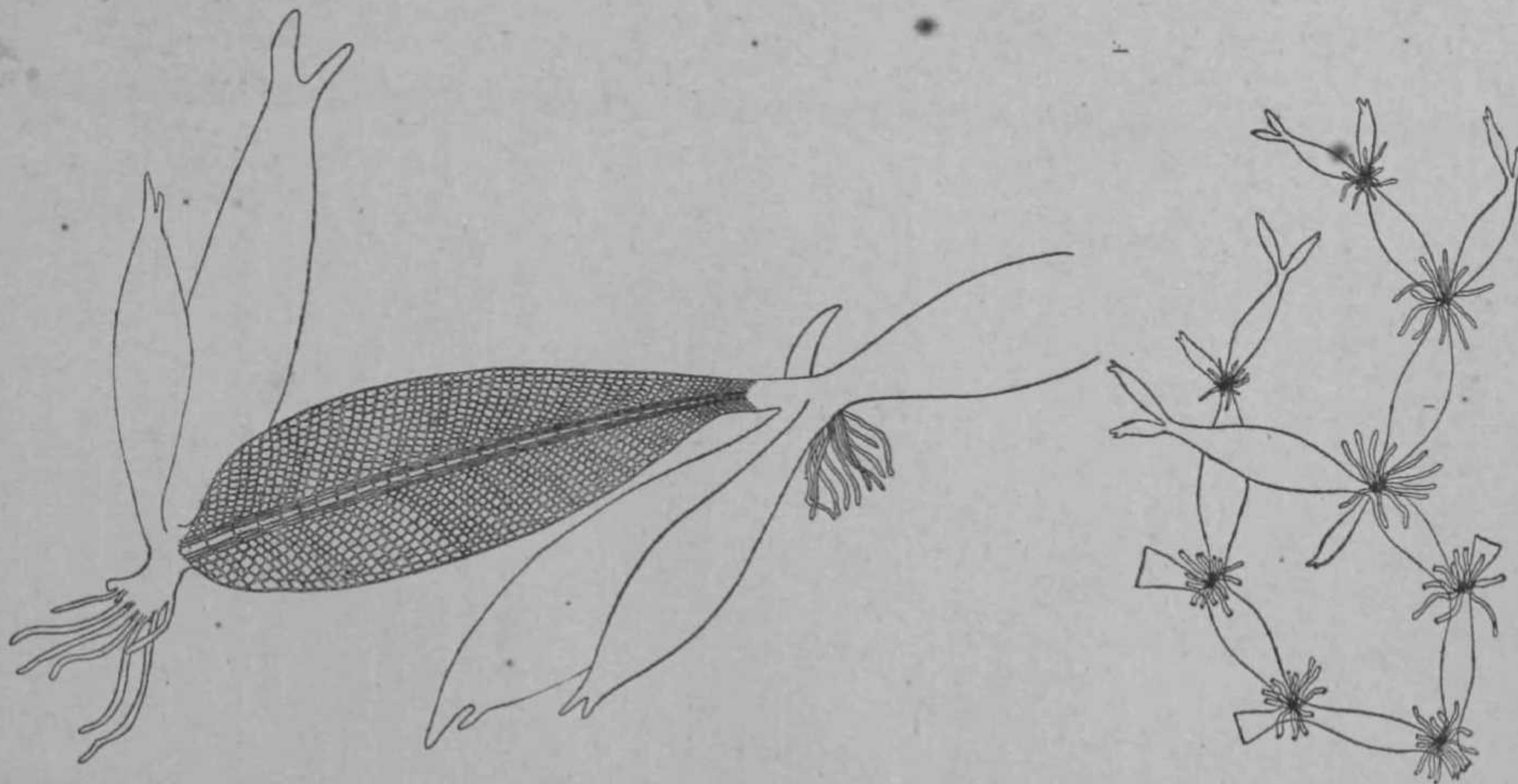


FIG. [illegible] Leprieurii (Mont.) [illegible] A. Entire plant (x 10); B. Part of a plant (x 40).

Membranoptera Stackh.

Thallus flat, with a conspicuous midrib, leafy portion monostromatic, irregularly dichotomous or pinnate ; cystocarps on midrib ; tetrasporangia in sori.

(47) Membranoptera Murrayi Boergs.

BOERGESEN, ***Kew Bull. No. 3,*** **1933.**

Thallus slender, thin, i£ to 2 mm broad, veins microscopic, midrib poorly developed ; tetrasporangia in long narrow belts on both sides of the midrib in the upper end of the lobes of the thallus ; rose red in colour, strongly adheres to paper.

Described by Boergesen from 1883 collection from Karachi.

Myriogramme Kylin

Thallus flat, leafy, irregularly lobed, upper parts monostromatic, lower polystromatic, veins present or absent ; Cystocarps distributed on the thallus, tetrasporangia in small sori on the upper surface of the thallus.

(48) **Myriogramme Okhaensis** Boergs.

BOERGESEN, ***Kew Bull. No. i,*** **1931.**

Thallus 7 cm high, 2-5 mm broad, divided irregularly into numerous lobes, which fix them to the substratum and often to other parts of the thallus, margin toothed, nerves and veins absent, composed of two layers, surface cells polygonal ; tetrasporangia scattered in the thallus.

Recorded by Boergesen from Karachi.

FAM. BONNEMAISONIACEiE

Genus Asparagopsis Mont.

Plants bushy, with creeping rhizome-like terete stems, bearing erect tufts, branching alternate, branches beset with short branchlets, axis corticated,' subtubular, composed of branched [a]*ial filaments surrounded by a cortex of large inner cells and Waller peripheral cells: cystocarps sub-sessile, urceolate, usually °Pposite a branchlet ; sporangia absent.

(49) **Asparagopsis sandfordiana Harv.**

HARVEY, ***Phyc. Astra.*** **Vol. IV.**

Described by Boergesen from A. B. Kotwal's collection from Karachi, dredged at a depth of 5-10 fathoms.

SUBFAM. NITOPHYLLIEiE

Genus **Nitophyllum** Grev.

Fronds membranous, may be irregularly cleft, rose-red, or purple, reticulated ; fructifications of two kinds ; tubercles containing a mass of spores borne on moniliform filaments fixed to the central placenta, tetrasporangia grouped in minute roundish son, profusely scattered over the greater part of the frond.

(50) **Nitophyllum punctatum** (Stackh) Grev.

HARVEY, *Phyc. Bnt.,* **pi. 202 ;** BOERGESEN, *Kew Bull. No. 1,* **1934.**

Thallus thin, membranous, rosy-red, fixed by a disc at the end of a short stipe, base 3-4 layers, monostromatic above ; irregularly divided into sub-cuneate lobes ; upper margin sinuate or emarginate, with or without proliferations.

Described by Boergesen from 1882 collection from Karachi.

FAM. NEMASTOMACEiE

Genus **Furcellaria** Lamx.

Fronds attached by branching rhizoids, cylindrical repeatedly dichotomously branched, solid, cartilaginous, apices attenuate, cQmposed of an axial strand of compact longitudinal filaments, surrounded by a wide band of cortical tissue, formed by rows of dichotomously branched filaments arranged at right angles to the surface, cells rounded or oval ; cystocarps and tetrasporangia in siliculose terminal ramuli.

(51) **Furcellaria fastigiata** (Huds.) Lamx. PI. II, **Fig. 30 A, B.**

LAMOUROUX, *Essai, p.* **-25 ;** HARVEY, *Phyc, Brit.,* **1. XCIV ; NhwioN,** *Brit. Seaweeds,* **1931,** *p.m 287.*

Rare in sandy-bottom rock pools in the *Gelidium-Polysiphonia-Ceramiutn-belt.*

Fronds tufted, 15-30 cm high, dark brownish red, filiform, 1-1.5 mm wide, attached to the substratum by tangled branching rhizoids, cylindrical, a number of erect filaments arising from the base, repeatedly dichotomously branched, angles acute, apices attenuate, sterile.

This plant very much resembles *Polyoides* from which it is difficult to distinguish except by the form of attachment. *1$*

Furcellaria the plants are attached by rhizoids while in *Polyoides* a compact disc is present.

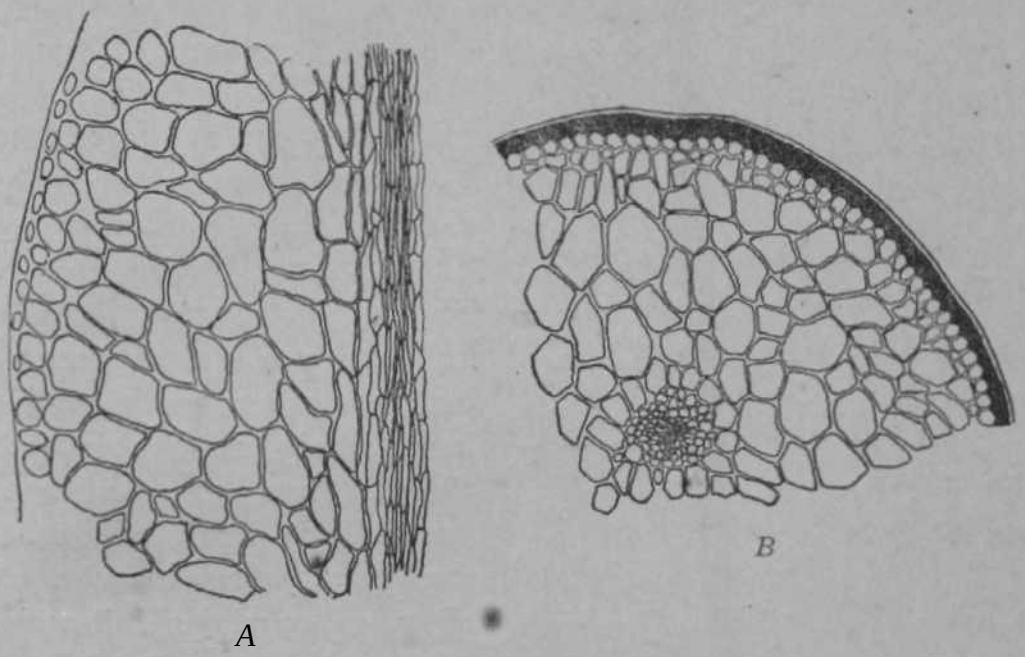


FIG. JO. ***Furcellaria*** *fasligiata* (Huds.) Lamx. *A*, L. S. thallus; *B*, T. S. thallus. (x ioo).

The plants so far collected are all sterile, therefore the siliculose terminal ramuli containing cystocarps and tetrasporangia could not *bv* **seen.** This is a new record for the Indian coast.

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r.IGARTINALES

Fam. Rhodophyllidacese

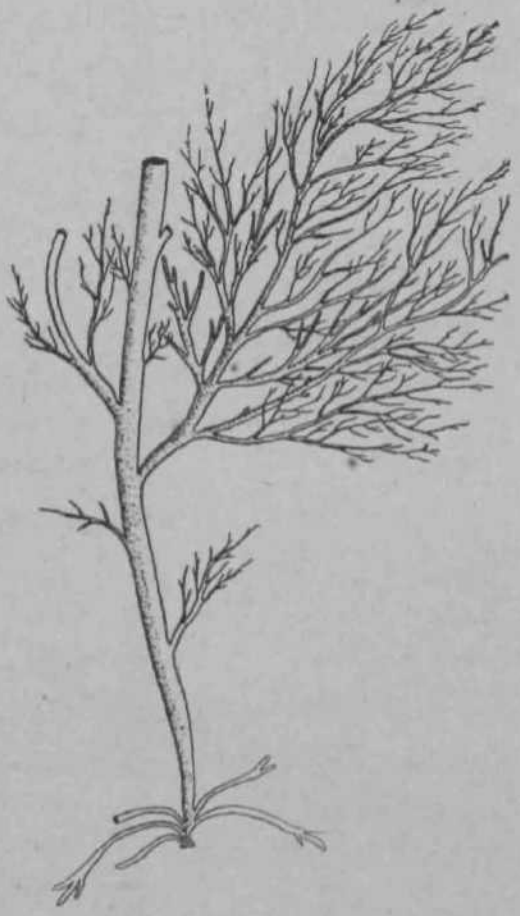
SUBFAM. CYSTOCLONIE 1

Genus Cystoclonium Kuetz.

Plants bushy with prominent main axis, widely branched, succulent, terete, cartilaginous, branches growing from an apical cell ; composed of three layers, a medulla of loosely interwoven filaments, inner cortex of large rounded alls and a **peripheral** layer of small assimilating cells ; antheridia in groups on upper branchlets ; cystocarps immersed in the frond ; tetrasporangia zonate, scattered in the peripheral layer.

(52) **Cystoclomium purpureum** (Huds.) Batters.

BATTERS, *Catal. Brit. Mar. Alg.,* 68, 1902 ; ROSENVINGE, *Mar. Alg. Devon.,* 589, 1931 ; *Fucus purpnrens,* HUDS, *Ft. AngL,* 471, 1762 ; BOERGESEN*i, Kew Bull. No. 1,* 1934.



I'M., jr. ***Cystoclonium*** *purpurtwm* (Huds.) Batters, Part of the plant showing the prominent main axis **quite** distinct from **the** branches (x Natural).

Cast ashore, Manora, Karachi.

Plants 10-15 cm high, *1-2,* mm (rarely more) wide, attached to the substratum by a small disc, in older plants replaced by coarsely fibrous holdfast, a few short decumbent filaments present near the base ; main axis thick and distinct from the branches, branches, as a rule, absent in the lower *portion, branches of all orders cylindrical, alternate or subdichotomous ; medullary filaments hypha-like, 10-12/t in diameter, cortical cells more or less isodiameteric, 30-35/i in diameter, surrounded by densely placed oblong assimilating cells forming the phenpheral layer, 10-12/1 in diameter ; sterile ; adheres to paper on drying.

Genus **Catenella** Grev.

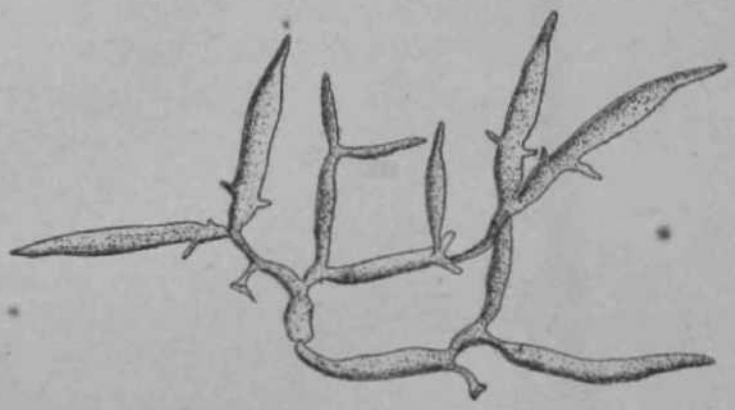
Fronds filiform, constricted at intervals, dull purple, composed of a lax network ol anastomosing longitudinal fiiaments, the periphery formed of densely compacted dichotomous moniliform filaments at right angles to the surface ; cystocarps elongated, sessile, tetrasporangia zonate.

(53) **Catenella opuntia** (G *et* W.J Grev. Fig 32.

GREEVUXE, ***Alg.*** *Brit.,* 1830, *p. 166 :* HAKVEY, *Phyc. Brit.,* pi. 88 I BOEKGESEN, *Mar. Alg. Dan. West Indies,* Vol. II, *p.* 559.

Rare, associated with *Gelidium pusillum* near the low water mark in the sandy-bottom rock pools.

Plants small, attached to the substratum by haptera developed from the lower side of procumbent branches, each frond upto i cm high, thallus regularly constricted at intervals ; composed of a lax network of branching and anastomosing filaments in the centre, surrounded by a firm cortex of small cells ; colour bluish purple, sterile.



PIG. j2. *Catenella opuntia* (G. et W.) Grev.

This is a new record for the Indian coast.

Genus **Agardhiella** Schmitz.

Plants tufted, bright red, profustely branched, cylindrical, tapering upwards, composed of a lax network of branching and anastomosing filament embedded in jelly forming the medulla, surrounded by an inner cortex of large cells and an outer of small compactly arranged cells ; tetrasporangia zonate, immersed in the cortex ; cystocarps prominent, half immersed.

l54) **Agardhiella robusta** (Grev.) Bocrgs. PI. **Ill,** Fig 6 ; Text, Fig. 33

BOERGESEN, *Kew Bull. No.* 2, 1932.

Common in the drift algae on the sandy beach, Manora.

Thallus tufted, dendroid, several fronds arising' from the Slnall basal disc, 10-25 *cm* high, main axis 2-3 mm wide ; {"vlindrical, very bushy, irregularly branched on all sides, usually alternate, occasionally polychotomous, branches, as a rule, rather suddenly constricted near the base to form a short thin stipe and rerriain almost cylindrical until they taper slowly into the upper ^cute apex, apices usually covered over by a tuft of 'short rudimentary branches, growth of the. fountain type, rarely the ^ain filament may also be constricted at the intervals. In 1\S.

and L.$. of the thallus a lax **network** of **longitudinal branching and** anastomosing **filaments,** 6-8/1 in <1 amete **r, is present** in the middle, surrounded by a cortex of large rounded or polygonal cells, 110-130/A in diameter, covered by a **layer oi** -.mall slightly elongated epidermal cells, 15-20/* broad, 30/x long, rounded **and loosely** placed in surface view ; plant- **adhere** firmly to paper on drying and tht-ir colour **Eades with** age **and long preservation.**

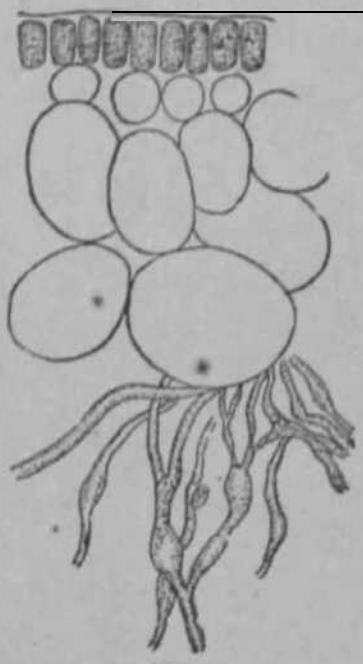


FIG. 33. *Aga* **u *ihu Ua to*** *\usta*. \'"\\'ion of a T. S. o**l the ih.illus (x 120).**

According to Boergescn, *Agardhieilu robusta* described by him in Kew Bull No- 3. 1932, sli mi hi be considered as *Solieria robusta* **be** cause **of the presena** of a large fusion cell in **the** middle **oi the gonimoblatts.** The plant from **Karachi** is sterile and so it is **rather** difficult to decide its systematic position. I mi **for** the **present** keeping it as *AganihirUa robusta.* Moreover, Boergesen **thinks** that plants from Karachi probably belong to *Solieria robusta* **var. *WigkUi* J. Ag. distinguished** by its **compressed** thallus from both sides of which branches issue and the **palisade-like epidermal** cells, which are **co/i** broad and 30/t lorig. My specimens are **invariably** cylindrical with branches issuing on ill sides and **the peripheral** cells are 15-20/i broad and 30/1 **lo**ng.

SUBFAM. SOLIERIEÆ

Genus **Solieria** Harv.

Fronds cylindrical, subcartilaginous, succulent ; composed **oi** a **central *h(* medulla** of longitudinal **anastomosing filamentt**, a middle cortex of several roundish cells, **the inner** ones being of a larger diafneter than **the outer ones,** and an **epidermis of two** or **three** rows of small **assimilating cells** ; conceptacle immersed to the axial region <j **me** branch, but prominent to one side, wall of filaments derived from the axis ; **central** placenta **bearing** numerous pedicellate spores ; tetrasporangia among the periph-eral cells* zonate.

(55) Solieria chordalis J. Ag. Fig. 34 A - D.

HARVEY, *Ner. Bor. Am,,* **1831,** *p, UJ.* **pi.** XXIII.

Cast ashore, Manora, Karachi.

Plants upto 15 cm high, rarely more, 2-4 mm (rarely 5) wide, attached to the substratum by a small thin disc ; near **the** base numerous branches given off on all sides, more or less in apparent whorls, above the branching is **alternate,** subdichotomous, or similarly whorled as at the base with fusiform, acute or **acuminate** ramuli ; transverse section of the thallus shows a central **medulla** of hypha-like, branching and anastomosing filaments, 10-15/1 thick, surrounded by a cortex ol large cells, 105-115/1 in **diametf**er, becoming smaller, upto 30/z in diameter, towards .the **periphery,** with an outer usually one or **rarely** two-layered epidermis of small assimilating cells, **10/u** in diameter ; cystocarps appca externally Hke obtusely conical **tubercles, with** a dark-coloured core, **scattered 1**rofuse**'y** over **the branches** of the **fertile specimens,** deeply sunk in the axial region of the branch, central placenta densely clot lied with sedicellate. oblong or **pear-shaped span**es ; **tetrasporarigia** in the peripheral portion, zonate.

There is some hesitation in **putting** it under *S. chordalis* because of the smaller size and slightly **differeni** mud.e n(branching as **compared to the** type described by Harvey. H<e has referred to **the** many varieties of this plant from the Anne:rican shores, which he hesitates to **separate specifically.**

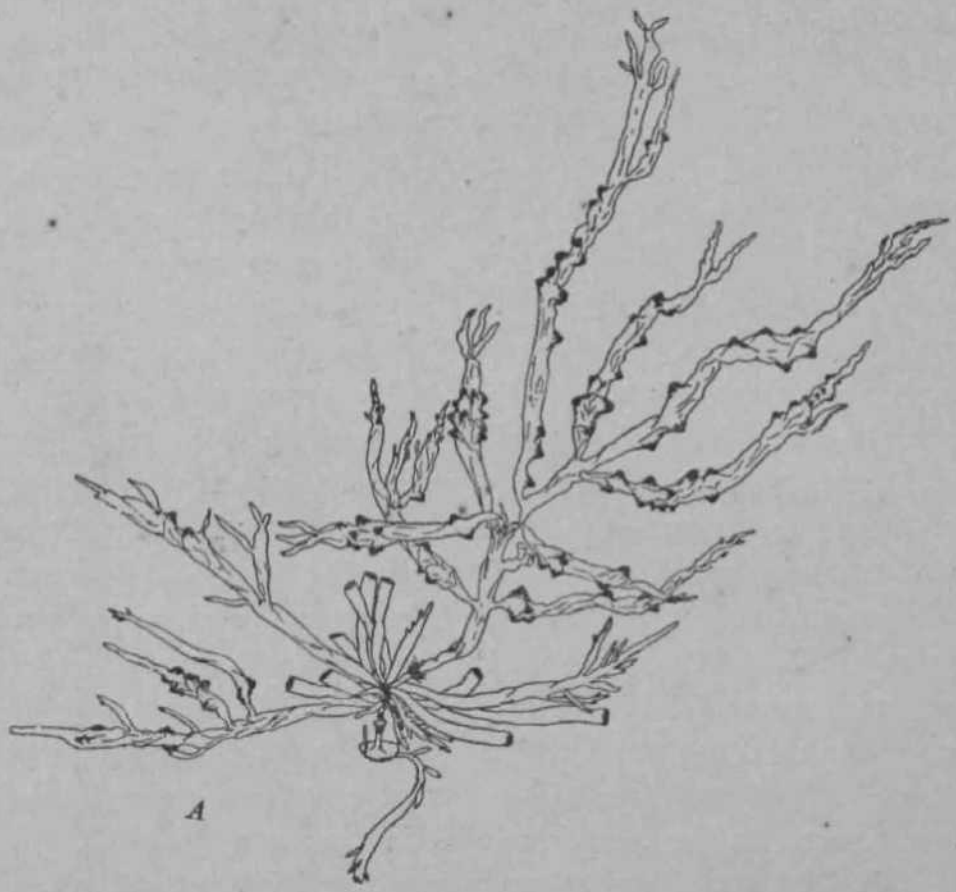
Genus Sarconema Zanard

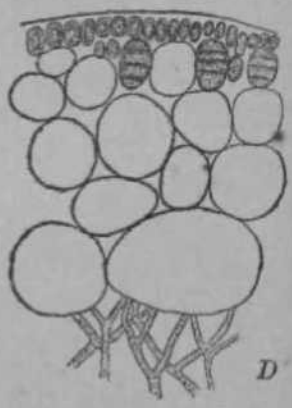
Fronds terete, solid, **cartilaginous** or gelatinous, repeatedly 'liHiotomously branched ; composed nl **three** strata, the **medulla** °f densely packed thick-wall* •* I **filaments,** cortex of large polygonal cells becoming smaller **outwards towards the periphery** and **an epidermis** of one or two layers of small **cells** ; **cystocarps** in **the** main stem as well as the branches, superficial or half immersed, **prominent** towards one side ; tetrasporangia zonate, immersed in the cortical region.

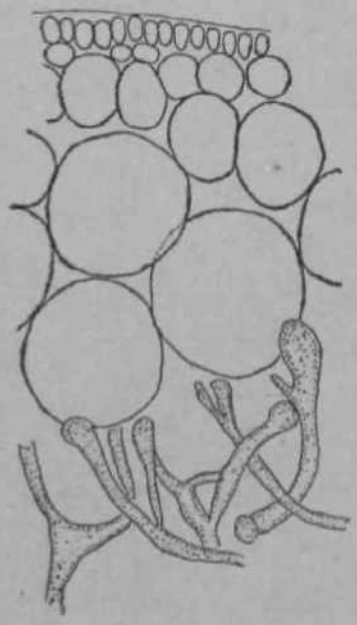
(56) Sarconema furcellatum Zanard. PI. Frontispiece ; Fig. 35 A, B.

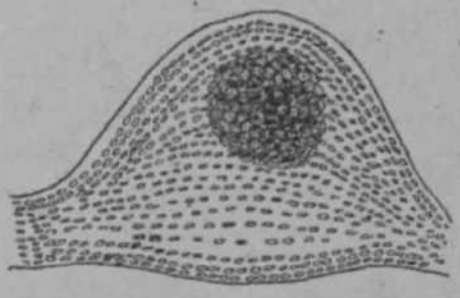
ZANARD, *PI. Mar.* ***Rubr,*** *K»um., /*>. **$<J, 1. 8, 1858; Bon**RGESEN, *Kew Bull* • **jVf- _J, i(jj**2. *p. I2t).*

Occasional on stones and **shells** near the **low water mark** in th! *'>tlidium-Polysiphotiia-Ceramium-bc\i.*









B *C*

FIG. 34. *Solieria chordalis* J. Ag. *A,* Part of **the** plant (x J) ; *B.* T. S thallus (x r2o ; C, Cystocarp {x 120) ; *D.* T. S. tluillu? with **tetrasporaogi**

[X I2O].

Thailus tufted, upto 15 cm high, 1-2 mm broad, repeatedly dichotomously branched, forming dense, broad, intricate, tufts ;

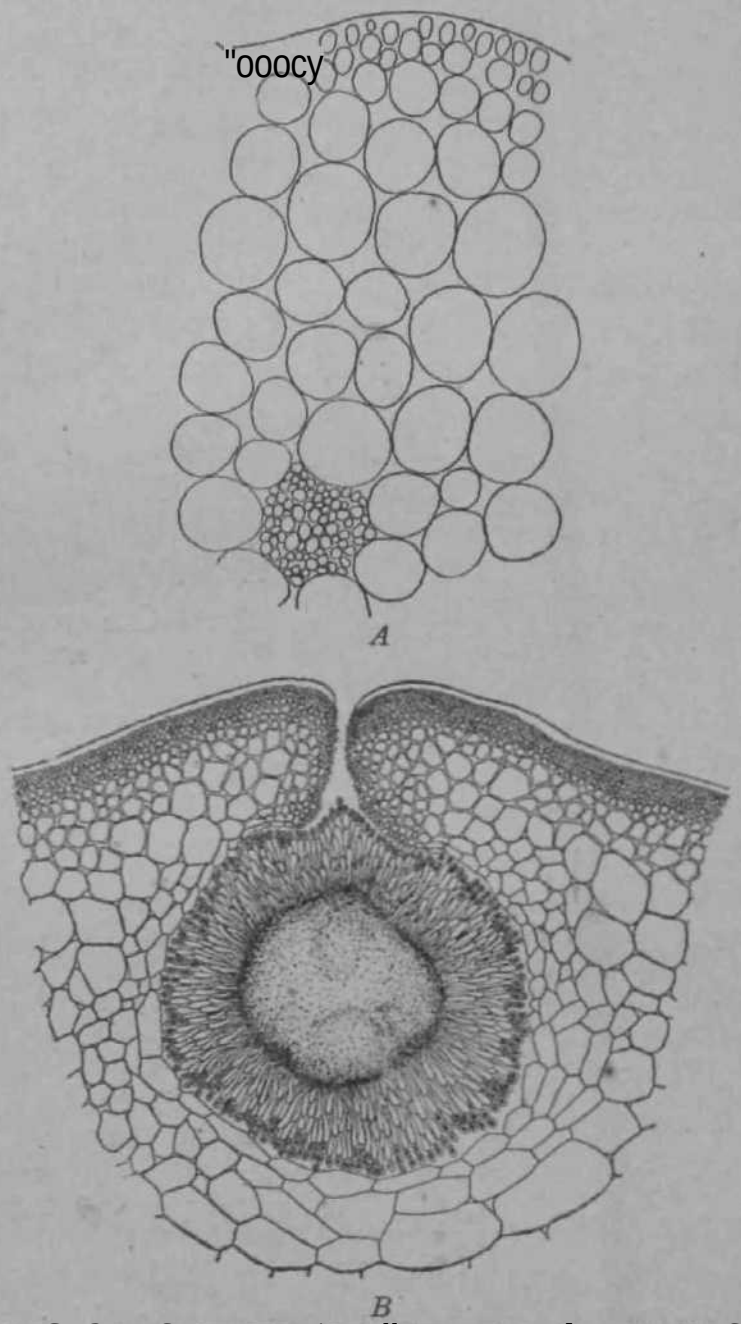


FIG. 35. *Sarconema jurcellatum* **Zaaard.** I. I . S. thailus (x 200) ; *B*, Section Cystocarp showing **central** placenta bearing spores at **the** periphery **(x 60).**

Medulla of compactly arranged thick-walled filaments, 4-8/i in diameter ; inner cortical cells 40-45/1. in diameter, outer 15-20/1 ; epi**dermis** of one or two layers of small cells, 6-8ju in diameter ;

cystocarps large, plentiiully lodged in the cortical tissue of the branches, prominent to one side, as if hemisphercial, mammilate or subconical, 700-750/* broad, central placenta, 350-400/1 broad, bearing numerous filaments at the ends of which rounded or oval spores, 15-20/x broad, 20-22/4 long are borne, a single ostiole present ; colour pinkish-red, fleshy consistency, plants breaking quickly when handled ; adhering firmly to paper on drying.

Although this species has already been recorded by Boergesen from Karachi, but no mention has so far been made about the cystocarps in this species. Moreover, the plants I have collected are of a highly fleshy consistency and may reach a width of 2 mm in the main filaments.

(57) **Sarconema filiformis** (Sond.) Kylin

Dicranema filiforme Sanders in Bot. Zeitung, **1845 ;** ***Cystoclonium filtforme*** **Kuetz. ;** **BOERGESEN,** ***Kew Bull. No.*** **3, 1932.**

Thallus 0.75 mm to 0.25 mm or less thick, parenchymatou* cells 130/1, central filaments 15/*.

This species has been recorded by Boergesen from J. A. Murray's collection (1883) at Kew Herbarium. It has been differentiated by him from *S. furcellatum* by its slender form.

(58) **Sarconema furcatum** Boergs.

BOERGESEN, ***Kew Bull. No.*** **3, 1932 ;** ***S. Martaquei*** **(Grun.).**

Described by Boergesen from J. A. Murray's collection, Herbarium, Kew.

(59) **Sarconema Scinaioides** Boergs.

BOERGESEN, ***Kew Bull. No. 3,*** **1932.**

Cast ashore, Manora, Karachi.

Plants upto 10-12 cm high, repeatedly dichotomously branched, gradually tapering to the apices, cuticle IO/A thick, peripheral cells 8-10/z broad, 12-15/x long, inner cells, 70-95/* in diameter, rarely upto no/x, central tissue 250-290/A wide, filaments thick-walled, 12-15/*, lumen 5-8/* ; firm consistency, pinkish red colour, adheres strongly to paper.

This plant differs from that described by Boergesen in having a very firm consistency.

FAM. PHYLLOPHARACE^S

Genus **Ahnfeltia** Fries

Plants wiry or horny, bushy, dichotomously, alternate or irreguarly proliferous, altogether cylindrical ; consisting of a medulla of slender longitudinal filaments, a peripheral layer of closely packed small assimilating cells ; reproductive structures apparently reduced to monosporangia grouped in small cushion-like nemathecia on the branches.

(60) **Ahnfeltia plicata** (Huds.) Fries. Fig. 36 A, B

BOERGESEN, *Kew Bull. No.* j , J933 ; NEWTON, *British Sea Weed*,* flUi. *p. 414..*

Plants forming bushy tufts, 5-10 cm. high soft or wiry in texture, branching irregularly dichotomous, polychotomuous, spreading or erect, axils rounded ; central filaments 9-12/x in diameter, cortical cells 36-48/* in diameter, and peripheral cells 4-6/z.

RHODYMENIALES

Fam. SphmroccocacesB

SUBFAM. MELANTHALIE^E

Genus **Sarcodia J. Ag.**

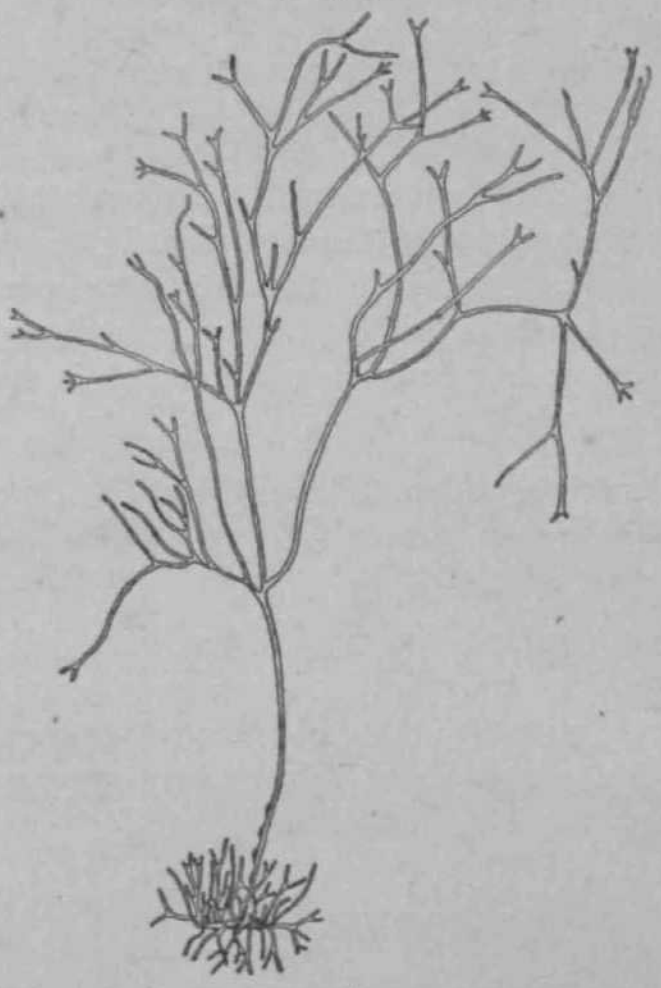
Plants richly proliferous along the margins or destitute of Proliferation ; tetrasporangia zonate in cortical layer ; thallus increases by the fountain type method.

(61) Sarcodia dichotoma Boergs.

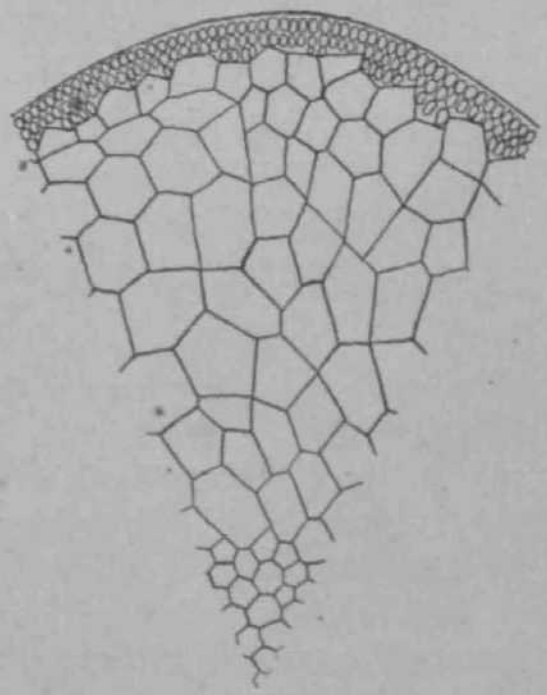
BOERGESEN, *Kew Bull. No.* 3, 1933.

Intermixed with *Gracilaria dentata* from rock pools near the low water mark.

Thallus, as a rule, flattened, repeatedly dichotomously "branched, upto 20 cm high, 5-9 mm broad, the margin bearing a few Proliferations only ; composed of a cortex of small coloured cells Grounding a medulla of large rounded colourless cells ; tetrasporangia zonate immersed in the cortical tissue ; brown purple in colour, gelatinuous to cartilaginous consistency, adhering to Paper.



A



B

FIG. *,(•). *Ahnfeltia plicata b'r.* **A.** Part of the plant (x 1} ; J3. T. S. thallus (x iso).

SUBFAM. GRACILARIEJE

Genus **Gracilaria J. Ag.**

Fronds filiform, compressed or flattened, cartilaginous or fleshy, dichotomous, irregular or proliferously branched ; composed of an inner core of large angular cells, surrounded by a cortex of small assimilating cells ; cystocarps sessile, external, spherical, hemispherical or conical, ostiole present ; tetrasporangia formed from surface cells, cruciate.

(62) **Gracilaria pygmea** Boergs. Fig. 37 A, B.
BOERGESEN, *Jour. Ittd. Bot. Soc,* 1937, *p. 328.*

Forming dense bush like tufts, associated with *Jania adherens* in Sandy-bottom rock pools, in the *Gelidium-Polysiphonia-Ceramium-belt.*

Plants attached to the substratum by a thin spreading disc, fronds 5-10 cm high, 2-4 mm wide, compressed, except near the base where it is subserete, dull purplish red, deeply cleft vertically in an irregularly dichotomous or palmate manner ; branches given off from the edges of the flat thallus either alternately or 2-3 seriately from the same side, the upper parts thus getting an antler-like appearance, upto 4 mm broad below the ramification, apices acute or bifid ; medullary tissue of large cells upto 250JU in diameter ; cystocarps hemispherical, prominent and profusely scattered on the flat side qf the thallus, spores rounded ; cartilaginous consistency.

Boergesen has described this species from Krusadi Island, where the fronds are 4 cm high, f-ij mm wide ahd 400/1 thick ;ind the medullary cells are ioo/x in diameter.

In my collection there appear to be two forms present ; a ^mailer one which is never more than 5-6 cm high, is profusely branched as the type and bears the cystocarps, while the bigger fme is usually upto 10 cm high not so profusely branched and sterile. In the mode of branching, width and thickness of the fronds and the size of the medullary cells both these 'forms are quite alike. The smaller form differs from the type species described by Boergesen in being taller, wider and thicker and in the diameter of the medullary cells which in the type species is only ioo/i. The lan^r f^riyj, however, shows a certain resemblance

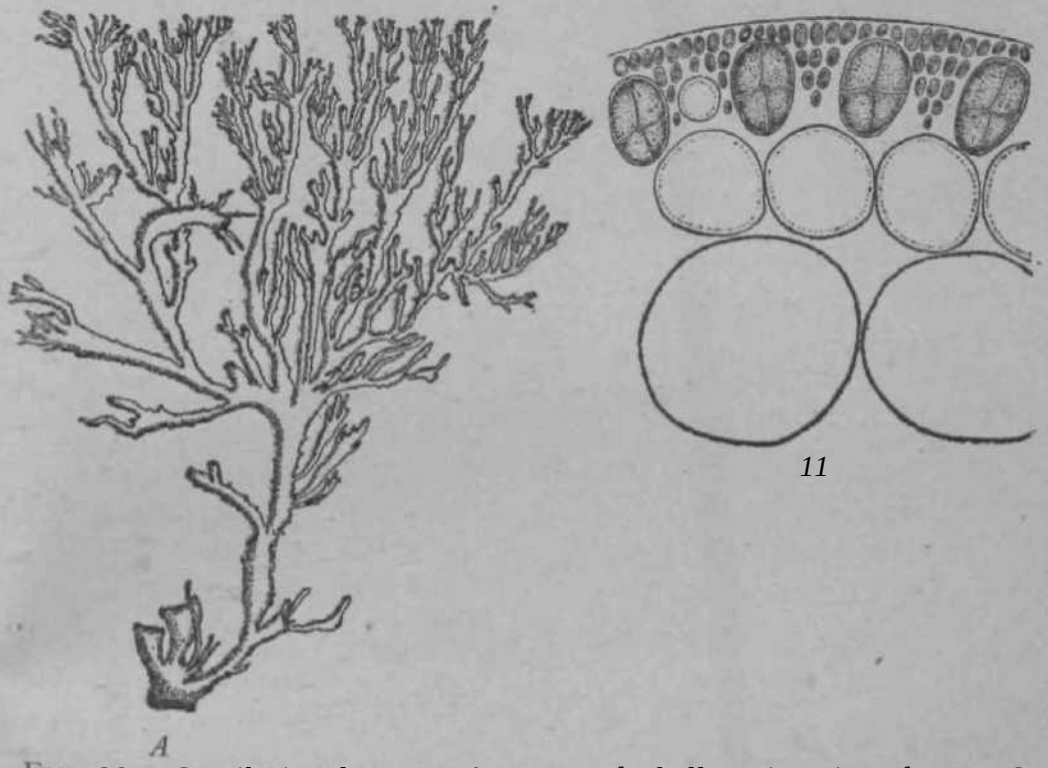
to G. *muliipartita* and it is probable that it may be an intermediate form and the two species may have to be merged into one later on.

FIG. J7. *(iracilaria pygmea* Boergs. *A,* Part of the thallus (x Natural) ; *B,* T. S. thallus in the region of the Cystocarp (x 20).

This is a new record for Karachi.

(63) Gracilaria dentata J. Ag. Fig. 38 A, B.

AGARDH, J., *Spec. Alg.* Vol. *i, p. 603* ; *Epicr., p. 424* ; *Sphaerococcus* ***oligacanthus*** Kuetz.—*Tab. Phyc,* Vol. XVIII, pi. 87 ; ***Sphaetococcus*** *rangiferinus* Kuetz. *Ibid,* pi. 86.



FIC:. 38. *Gracilaria dentata. A.* Part of thallus (x 4) ; fi, 1. S. thallus with tetrasporangia (x 30).

Plants upto 12 cm high, compressed or subtercte below, di-trichotomously branched, in the upper end 4-5 mm wide, below the bifurcation 5-8 mm, axils acute, margin of the thallus dentate, except the ultimate ramuli ; medullary cells upto 200^ in diameter, assimilating cells 5-6/1 broad, 7-8/1 long ; cystocarps hemispherical and prominent ; tetrasporangia scattered in the outer assimilating cells, 20-25/* broad, 30-35/i long, cruciate ; subcartilaginous consistency, most of the fronds covered by a polyzoan.

P Some of **the** plants have no dents and are not so cartilaginous md look very much like G. *lacilunata* (Vahl.) Boergs.

This is a new record for the Indian coast.

(64) Gracilaria corticata J. Ag.

BOERCESEN, *Kew Bull.,* 1933-

Common in the drift algae at the sandy beach, Manora.

Thallus 10-15 [cm] Wgh, 2-3 mm wide, more or less dichotomously **branched,** rigid with cartilaginous consistency,

upper portion and marginal ramuli less cartilaginous so that at these points the thallus firmly adheres to papers ; thickness of the frond more or less uniform throughout ; in transverse section the cortex of densely packed small cells, 6-io/i in diameter, surrounds the central portion of large rounded obi ong cefts, 170-200/A in **diameter,** cells not vertically elongated ; cystocarps large, sessile, roundish or subovate, with a subacute nipple, ostiole presi nt, plentifully Bcattered over the branches, spores rounded or oblong, 20-26/i in diameter ; plants partially adhere to paper on drying, colour fades with age.

(65) Gracilaria confervoides (L.) Grev.

GRI vnxE, *Ait>.* ***Brit.,*** *(>.* ***taj*** ; JIAKVI Y, *Ph, vc. lint..* PI. *IX V* ; BOERGESEN, *Del.* ***Kgl.*** *Danske V\dt'U Skabernes Se* ***Iskob..*** *livitut;:ske Medd.* i<liistr, 11. 6.

Plants filiform or rarely flat, attached by a small disc, more or less dichotomously ramified, branches erect, occasionally arched ; cystocarps rounded or subovate, profusely scattered over tin branches ; substance cartilaginous.

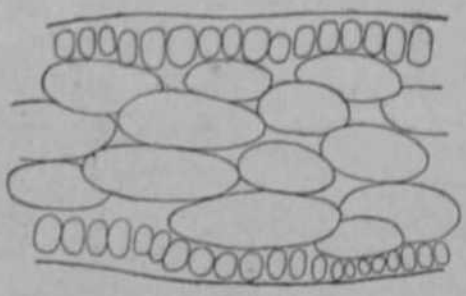
Recorded by Boergesen.

Genus Calliblepharis Kuetz.

Fronds flat, cartilagino-mem;1U<IM<H]S, dicbotomopinnate, margins bearing numerous simple <>r brani bed proliferations giving .1 Eringed appearance ; thallus composed of a medulla <f large and elongated cells in several rows, bounded by 0;ie or two layers <>t small assimilating cells ; cystocarps sessile on proliferation ; tetrasporangia in the peripheral cells of the fronds or the prolif.era- **tions,** zon;r e.

(66) Calliblepharis fimbriata Kuetz. PL III Fig. 5 ; Text Fig. 39

KUETZING, *Phyc., ,".* ***404;*** BOERGESEN, ***fiftfai*** *Hull. X<>. i,* 1932.



Fie. 39. ***Calliblepharis fimbriata*** Kueti T. S. >i the thaUa (× 80).

Abundant in the drift algae, cast ashore, Manora.

Plants attaining a height 0] about 30 cm, fixed to submerged stones by basal discs, growth by an apical cell thallus divided into several lohcs about **I** cni **broad,** flat,

membranous, branches and main axis nearly equal in width, bearing along the margin dense, short, pointed, invariably branched Horizontal proliferations, 1-2 cm long 0.3-0.6 cm broad, ... usually having a short stipe and irregularly divided upper part; in transverse section the thallus is 800-850μ thick, cortical cells small, rounded or slightly vertically elongated, 40-50μ in diameter, arranged in two rows bounding a central core of large rounded, oblong or angular cells, 180-200μ in diameter; purple red in colour and perfectly adhering to paper on drying, colour like other red algae fades with age and long preservation.

SUBFAM. HYPNEEAE

Genus Hypnea Lamx.

Plants bushy, virgate or spreading, slender, cylindrical, branches developing from an apical cell; composed of a medulla of longitudinal filaments surrounded by a cortex of large cells having at the periphery a layer of small assimilating cells; cystocarps and tetrasporangia grouped in separate short branchlets, tetrasporangia zonate.

(67) Hypnea musciforms (Welf) Lamx.—Pl. IV, Fig. 7; Text Fig. 40

BØRGESEN, *Kew Bull. No. 1*, 1934; TAYLOR, *Mar. Alg. of North-eastern Coast of North America.*

Very common in the drift algae at the sandy beach, Manoru; also collected from Sandspit, Karachi, from the nets of the fishermen.

Plants 10-30 cm high, pinkish red in colour, fronds filiform, cartilaginous, fronds bunched, branches irregular, giving a bushy look to the plant; tips of the main and principal lateral branches often elongate, typically swollen and crozier hooked. [illegible] hooked tendrils that [illegible] entangle together large seaweeds. At the point of contact haptera may be formed and thus a firm intimate connection is established. These hooked and swollen tendrils are characteristic feature of this species. The haptera have been noticed by [illegible] for the first time. In transverse section a central cell 16-18μ in diameter is surrounded by a ring of 6-7 large

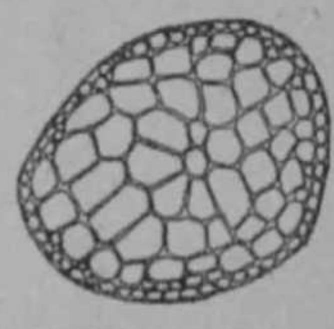


FIG. 40. *Hypnea musciformis* (Welf.) Lamx. T. S. of the thallus (× 150).

angular cells [illegible] in diameter, becoming smaller 10-11μ in diameter, towards the periphery. Plants adhere to paper under pressure and like other red algae their colour fades with age.

(68) Hypnea Valentiae (Turn.) Mont.

J. Ag., Sp. Alg., 2, 340; Børgesen, Kew Bull. No. 1, 1933.

Intermixed with *Hypnea musciformis* at the sandy beach Manora.

Characterised by bearing densely placed short branchlets along the main axis.

SUBFAM. RHODYMENIEAE.

Genus Botryocladia Kylin.

Fronds sub-terete, compressed or flat, tubular or solid, branched; the tube sometimes nearly empty or with a few percurrent longitudinal filaments surrounded by a cortex of large angular cells, with 2 or more layers of small assimilating peripheral cells; conceptacles scattered, immersed in the frond, hemispherical or urceolate; tetrasporangia scattered in the peripheral cells, cruciate.

(69) Botryocladia leptopoda (J. Ag.) Kylin—Pl. II. Fig. 4; Text Fig. 41.

KYLIN, Die Florideenordnung Rhodymeniales (Lunds Universitets Arsskrift N. F. Avd. 2 Bd. 27, 1931, *p.* 17, tab. 6 fig. 14); *Chrysymenia uvaria* var. *leptopoda* J. Ag. Epicris *p.* 329; *Chrysymenia leptopoda* (J. Ag.) Weber, Algues Siboga, *p.* 467, fig. 200; *Chrysymenia uvaria* Okamura, Kon. Jap. Alg. pl. 184. *Chrysymenia Uvaria* (L.) J. Ag. forma *lux*[illegible]

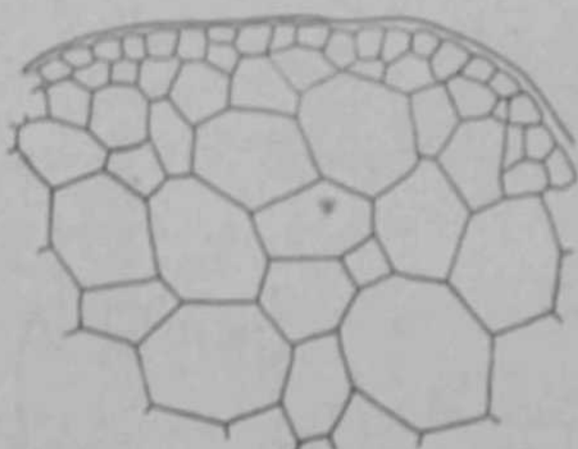


FIG. 41. *Botryocladia leptopoda* (J. Ag.) Kylin. Portion of the T. S. of the thallus (× 200).

BØRGESEN, *Kew Bull.*, 1931, *p.* 11, Fig. 1-5.

Abundant in drift algae on the sandy beach Manora; also collected from Sandspit from greater depths from the nets of the fishermen.

Thallus upto 50 cm long cylindrical, 2-2.5 mm broad, highly branched, branches irregular, irregularly covered with

hollow vesicles, 2-4 mm in diameter, oblong or rounded, swollen, broader at the upper end, constricted near the base ; main thallus composed of a central axis of large rounded cells, 50-130μ in diameter, surrounded by a cortex of small cells, 4-6μ in diameter. In longitudinal section the central cells are vertically elongated with small rounded gland cells upon and in between them, wall of the vesicle 50-60μ in thick, composed of a layer of large polygonal cells 40-50μ in diameter, abutting on the cavity of the vesicle, surrounded by one or two layers of small rounded cortical cells, 4-6μ in diameter. A single gland cell is, as a rule, present in the middle of each large cell. Plants gelatinous and adhere firmly to paper on drying.

My plant agrees fully with the description of *chrysymenia uvaria* forma *luxurians* Boergs described by him in Kew Bull. No. 1, 1931.

Genus Cœlarthrum Boergs.

Plants erect, attached by solid creeping stolons, fronds jointed, di-trichotomously branched, segments hollow, solid at articulations ; composed of inner layers of large rounded or elongated cells, bounded by one or more layers of small assimilating cells ; cystocarp hemispherical, with an apical pore, scattered upon the thallus ; tetrasporangia in cortical cells, cruciate.

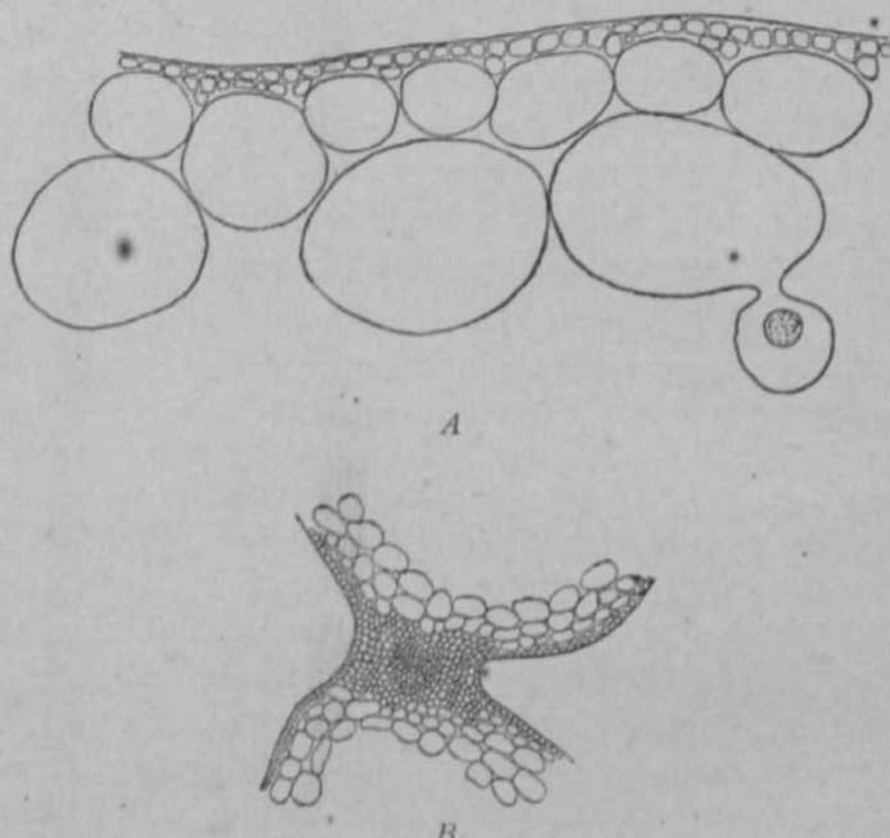
(70) **Cœlarthrum Muelleri** (Sond.) Boergs. Pl. I, Fig. 2 ; Text Fig. 42 A, B.

BOERGESEN, *Kew Bull. No. 1, 1931.*

Frequently cast ashore, Manora.

Plants upto 15 cm high, attached by solid, creeping cylindrical stolons, 2-3 mm in diameter, thallus jointed and fairly regularly di-trichotomously branched, lower portion of the basal segment solid and hard, segments hollow, solid at articulations, lower ones cuneate, 4-5 mm wide 1.5-2.5 cm long, upper ones relatively broader and more or less oval ultimate segments rounded 2-3 mm in diameter ; walls composed of 2-3 layers of large cortical cells, abutting on the hollow cavity, oblong or polygonal in surface view, upto 300μ long, 200-250μ broad, some of these bear small irregularly stellate cells carrying glands, surrounded on the outside by one or two layers of small cells, 8μ in diameter ; many-layered

diaphragm present at the articulations. In transverse section the stolon shows large polygonal cells in the centre, 100-150 μ in diameter and smaller, slightly elongated pyriform cells towards the periphery. The lower solid portion of the basal segment has the



S.
... the thallus (× 80); B, L. S. through the articulation (× 10).

same structure; cystocarpa hemispherical, scattered upon the thallus, each having a basal placenta bearing radiating sporogenous filaments, spores 30-40 μ in diameter; colour bright red, plant adheres firmly to paper.

(71) Cœlarthrum opuntia Boergs.

BOERGESEN, Journ. Ind. Bot. Soc., 1937, p. 333.

Rare in the drift algae on the sandy beach, Manora, intermixed with *Cœlarthrum Muelleri.*

Plants 8-10 cm high, attached by stolons, segments broader, 6-8 mm wide, 1-1.7 cm long, oblong or only slightly cuneate; larger cells 1-2 layered, 150-175 μ in diameter, smaller cells 8-1.J."

in diameter forming **a** single layer ; colour bright **red, plants** adhere firmly to paper. Stoloniiirons **branches** may be given off from some of the solid articulations.

Genus **Champia** Desv.

Fronds **filamentous, terete** or comj pressed, **branches** in a pinnate ma-nner, hollow, nodose, **formed** of **one** or more layers of roundish **or angular** cells **with diaphragms at the nodes, bra** versed inte **mally** by a few **longitudinal filaments;** <ystocarps external sessile, **with** a bas il placenta ; tetrasporangia tetrahedral, scatt< red in the cortex.

{72) Champia plumosa sp. nov. Fig. 43 A—D.

Common in Bandy-bottom rock pools near the low water mark.

Plants **upto** *b* cm **high attached to the substratum** by **a** small disc, numerous erect filaments arise **from the base, occasionally** procumbent libitum s pres **eni with adh** esive **discs;** the **ba** sal **r-i| mi >>\ each erect filament** without **any branches,** upper **portion** pro Misely branched ; tower ! branch **es longei** than the upper **giving the frond a pyramidal** form, each branch **beara aumerous dub-sha ped** or **cylindrical** ramuli **given** oft **in** all **directions so thai** several branches are crowded together, often **anastomosing to** <:ach other, **branches** and **branchlets inflated at intervals to give them** an intestine-like **appearai** nce, se **pta noi** very <iistinct, only slightly **constricted** at the **joints : I** urger cills **30-5011 broad, 45-55/1 I** ong, cort **:i** al **ceDs** 20-25/1 broad, 30-35/A long ; cystocarps urn **shaped** with a very short neck, 1100-1200/1 broad, 1200-1450/* long, in the region of the neck 450/1 in **diametei** ; trti a sporangia in the outer cortid tissne, 60-65/* lmiatl, 71-75^ **long** ; tetraspores 30^ broad, *50ft* long, pyriform ; colour purple **red,** firm consistency.

This speci<s resc uibles *Champia globulifera* in the presence of **procumbent** filaments with **adhesive** <ii>< ^ ami size <ii the **cells,** This species is characterised by presence of procumbent **nlamentB,** basal naked portion of erect **filaments, profuse irregulai branch** ing in all **directions,** pyramidal **E^>pear*ncjE** Oi the branched frond, mast<>!nosm^ among 4 the branches and **urn-shaped** evstocarps with short necks, **rioo-1200/j broad,** 1200-1450^ Iong.

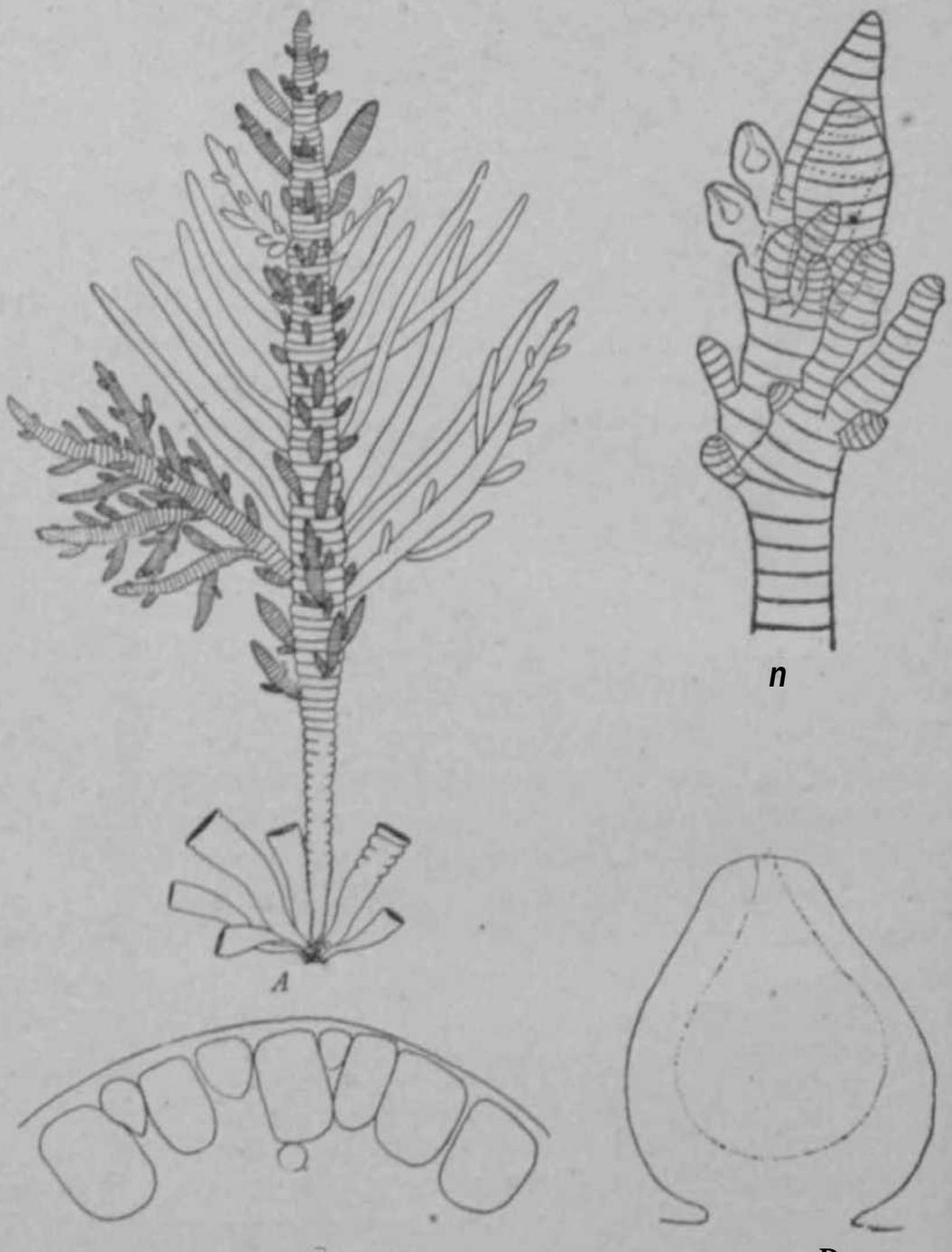


FIG. 43. < *hampm ph*>*mosa* sp. DOV. *A*, Part of the plant (× 4) ; *H*, Portion of the erect filaments naar \he apical region (× 3) ; *C*, T. S. ol tin tfaaUni (x 150) ; /'. Cystocarp (× 13),

(73) Champia compressa Harv. Fig. 44 **A**—C.

HiRVEY, *Ner. Austp* ?*i* [1]" **r««. sy»-** ^^.. **vol.** iv. />. 56/.

Occasional in **sandy-bottom** n>i*k **pooli in the** ***(Ol****pomenia sinosa*-be it.

Plants from 8-10 cm high, profusely branched, in some plants the basal 1 cm without any branches, branching alternate below verticillate or irregular above, terete below and compressed above,

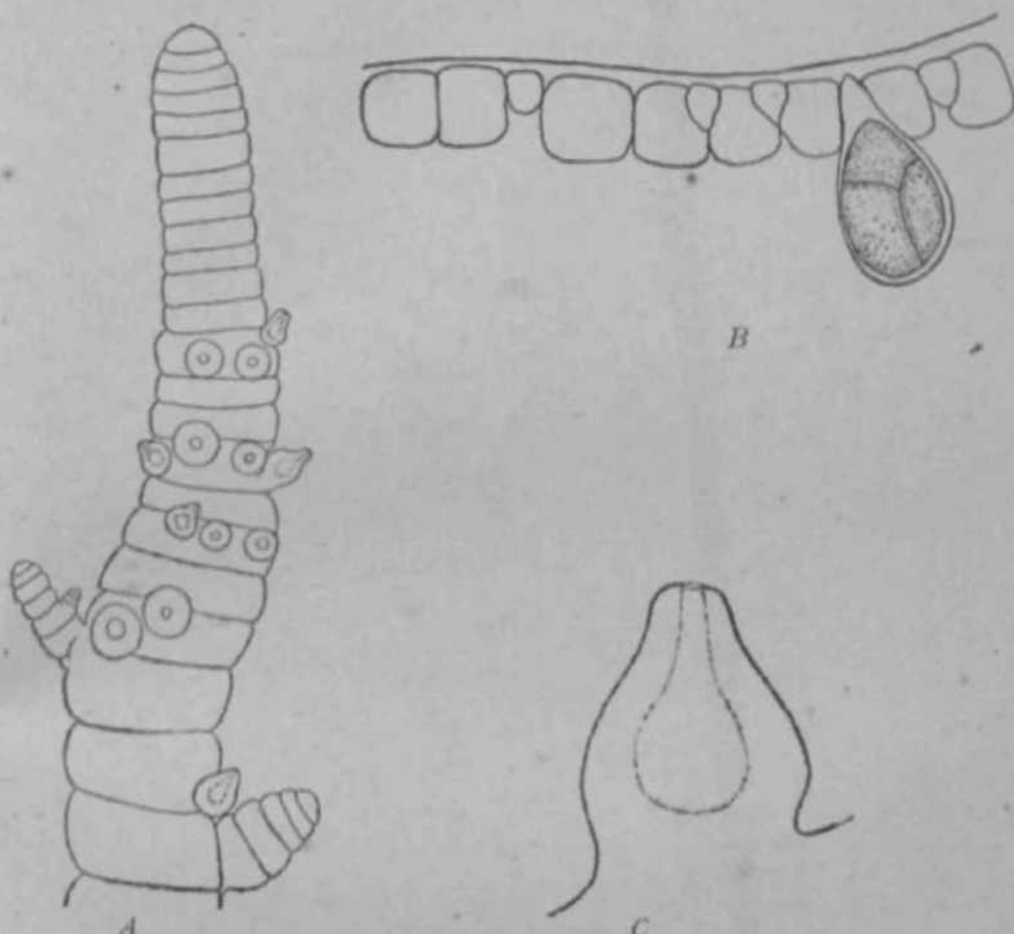


FIG. 44. *Champia compressa* Harv. *A*, Part of the thallus (× 8); *B*, T. S. of the thallus (× [illegible]30); *C*, Cystocarp (× 25).

joints markedly barrel-shaped [illegible] throughout the plant except near the apices; upto 2.5 mm broad, ramuli upto 2 mm wide, segments near the apices short [illegible], segments near the base not very clear; wall of a single layer of large, more or less squarish cells, 45-60μ broad, 50-60μ long, with a few scattered cortical cells, 28-35μ broad, 35-40μ long; vertical filaments in the cavity run parallel [illegible] towards the wall, 18-30μ in diameter; cystocarps more than [illegible] on each segment, distinctly urceolate, upto [illegible] neck region [illegible] spores [illegible] -30μ broad, 7[illegible] long; tetrasporangia [illegible] long, 70-75μ broad, colour purple and [illegible], gelatinous consistency.

This sped-es is recorded for tlie first time fora Karachi.

(74) Champia compressa var Scindica Bocrgs Fiji. 45 A—D.

Associated with *C. compressa.* in **the sandy-bottom rock** pools in the *Colpotnenia-sinosa-*

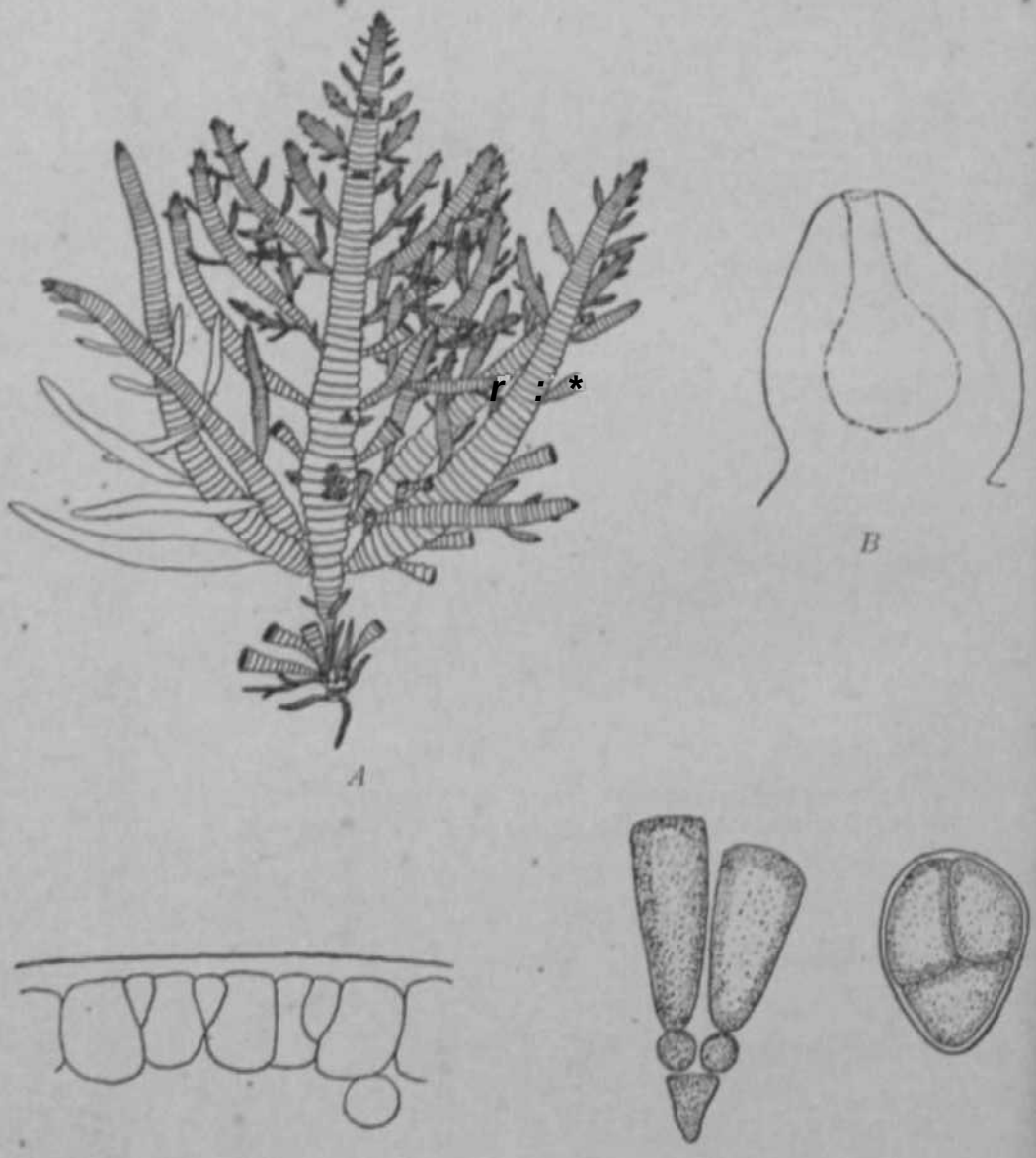


FIG. 45. *Champia compressa* var. *scindica* Boergs. *A*, Part of the plant i « }. ; *B*, P. S. UuUIui (• 150) ; *C*, Cystocarp (× 25) ; *D*, Carpospores (× 200) ; E, Tetrasporangia (× 200).

Planti apto i" **cm** hij;li. **very mud) ramified,** branching opposite b«?low, irregui arly verticillate above, compressed belo"*

but sub-terete above, upto 3.5 mm broad, branches 1.5-2.5 mm; septa not clear in the basal part so that in this region the filaments are smooth, very clear above where the joints are barrel-shaped, 0.8-1 mm long; larger cells 36-40μ broad, 45-5[illegible]μ long, cortical cells 20-16μ broad, 20-26μ long, vertical filaments 35μ in diameter; cystocarps urceolate or globular, five or more on each segment, 800-820μ in diameter, carpospores 40-45μ rarely upto 54μ broad, 80-[illegible]μ long, pyriform. Colour purple, consistency firm.

(7) **Champia parvula (Ag.) Harv.—Fig. 46 A, B.**

HARVEY, *Ner. Bor. Am.*, ii, 76; NEWTON, *Brit. Seaweeds*, 1931, *p.* ; BOERGESEN, *Kew Bull. No. 3*, 1933.

Abundant as epiphyte on *Codium* [illegible] Uttum [illegible] the low water mark.

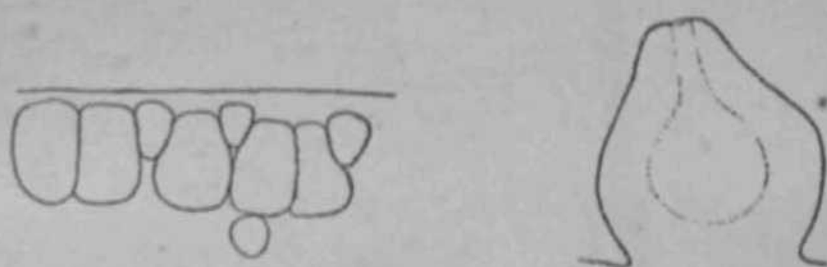


FIG. 46. *Champia parvula* (Ag.) Harv. *A*, T. S. thallus (× 150); *B*, *Cystocarps* (× 25).

Plants tufted upto 4 cm high, profusely branched, numerous branches arising from the base, [illegible] thickened thoughout at slightly broader in the middle, upto a mm wide, septa distinct, slightly constricted at the joints, terete with ultimate branches slightly compressed; larger cells 30-35μ broad, 40-45μ long, cortical cells 18-20μ broad, 20-23μ long, filaments 15μ in diameter; cystocarps not more than three on each segment, urceolate, 850μ broad, [illegible] long, region of the neck not elongated, carpospores 30μ in diameter; tetrasporangia borne on all sides, mostly in the basal region of the branches, 6[illegible]-48μ long, 52-55μ broad, spores pyriform; colour crimson red, gelatinous consistency.

This is a new record for Karachi and differs from the Mediterranean species in a smaller size and less elongated joints.

(76) Champia salicornoides Harv.— Fig 47 A—D.

HARVEY, *Ner. Bor. Am.*, II, p, 78; J. Ag., *Epicrisis*. p. 305.

Abundant as an epiphyte on *Codium elongatum* near the low water mark.

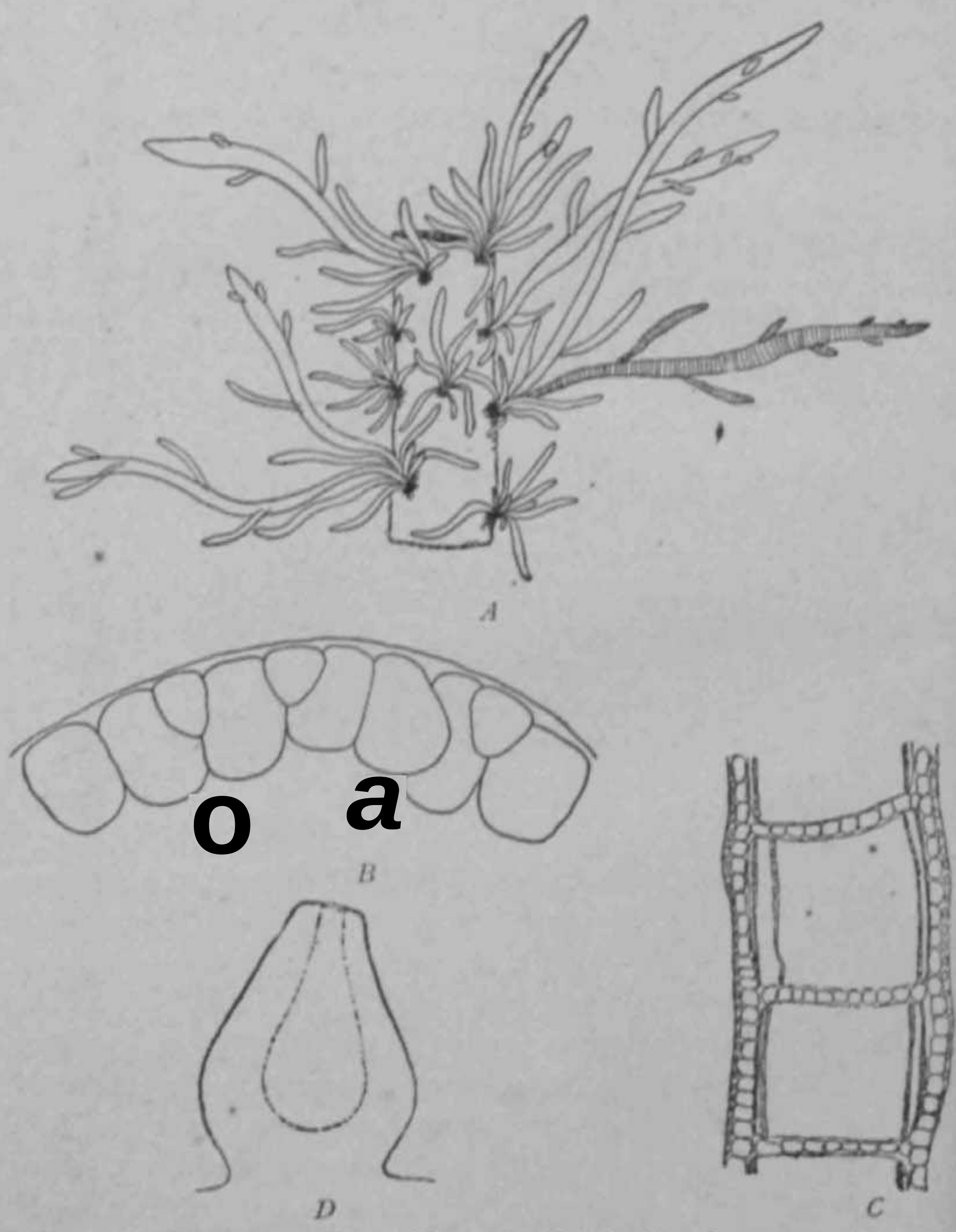


FIG. 47. *Champia salicornoides*. A, Epiphytic plants on *Codium elongatum* (× Nat. size); B, T. S. thallus (× 150); C, L. S. thallus (× 50); D, Cystocarp (× 75).

Plants tufted, upto 5 cm high, profusely branched, branching opposite below, verticillate above, some of the branches become

procumbent ; compressed below, terete above, fairly constricted at the septa ; larger cells 45-55μ broad, 50-55μ long, cortical cells 25-30μ broad and 30-35μ long, filaments 25-30μ in diameter; cystocarps 1 or 2 on each segment, more or less subconical in shape, 850μ broad, 1150μ long, 200μ at the tip, colour violet red or pinkish red. Distinguished from the previous species by the peculiar shape of its cystocarps.

(77) **Champia globulifera** Boergs.—Fig. 48 A, B.

Boergesen, *Jour. Ind. Bot. Soc.*

Epiphytic on *Ulva* near the high water mark.

Plants upto 3 cm high, a number of branches arising from the basal discs, procumbent branches bearing adhesive discs,

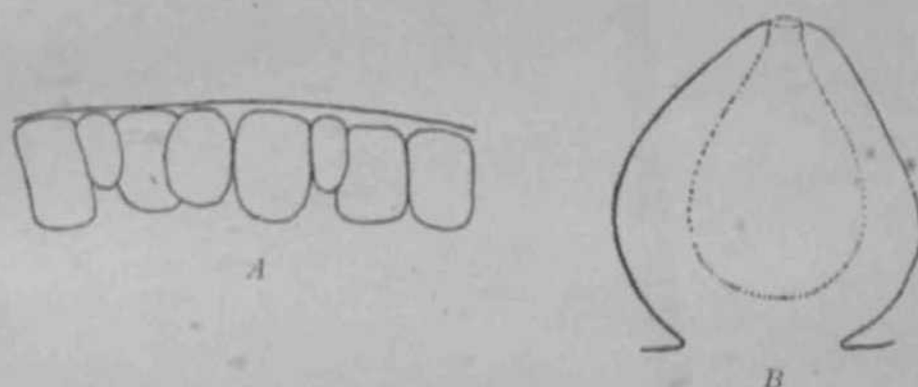


Fig. 48. *Champia globulifera* Boergs. *A*, T. S. thallus (× 150) ; *B*, Cystocarp (× 25).

branching opposite or alternate, compressed, 2-2.5 mm broad, attenuated at the base, broad at the middle, septa distinct, joints barrel shaped, hollow, smooth above, larger cells 30-35μ broad, 40-45μ long, cortical cells 15-18μ broad, 25-35μ long ; cystocarps globose, one or more near the joints, 835μ broad, 1084μ long, carpospore pyriform ; colour violet red, gelatinous consistency.

(78) **Champia somalensis** Hauck in *Hedwigia*, 1858.—Fig. 49 A, B.

Cast ashore, Blanoia.

Plants upto 30 cm. high, sparingly branched, basal stalk upto 1.5 cm without any branches, branching alternate, ultimate branches short and club-shaped, terete throughout, only slightly constricted

at the joints, main si.Uk upto 0 mm broad, b;anches 3 mm ; wall composed of two li'.ers of large cells, 9woou broad, 6o-8ou long.

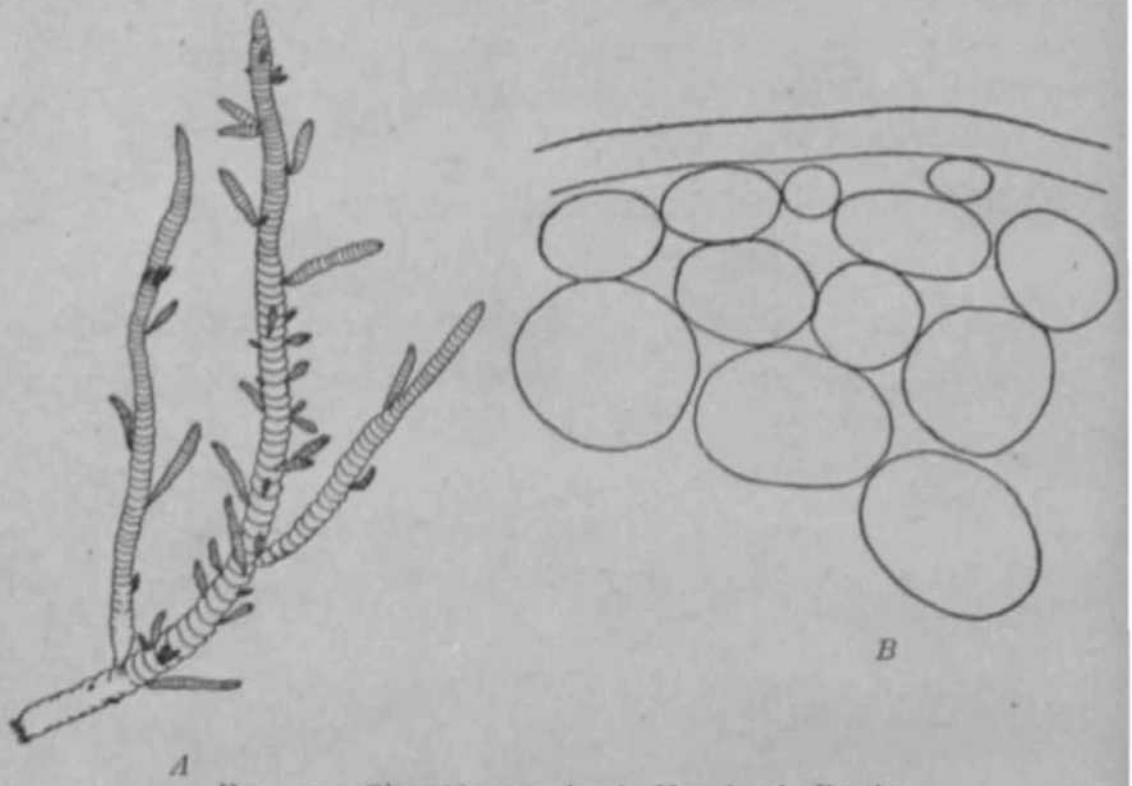


FIG. 49. *Champia somalensis Hauck*. *A*, Portion of the thallus (Natural, *B*, T. S. thallus (× 150).

covered more or less completely by a layer of ratlin **large** torical cells, 70-75μ broad, 40-45μ **long** witli a few scattered small *<ells, 25/f in (li.uu.ter, cuticle **thick, [8-a**μ ; sterile.

MH1AM. PLOCAMIEÆ

Genus Plocamium Lyngb.

Fronds compressled, membranous, pinnafely branched, composed of a ceutr.tt siphuii, an Inner layer of longitudinal oblong cells, bounde• I by a cortical layi 1 ol mall assimilative cHi : cystocarps stJked or wssile, prominent with bai&l placenta ; tt *tzagp*orangia zonate HI special itkhidia,

(79) Plocamium coccineum (Huds.) Lyngb

BOERGESEN, *Kew Bull. No.* 1933.

Generally below the **low watei** mark.

FIG. 1. *Halymenia porphyroids* Boergs.

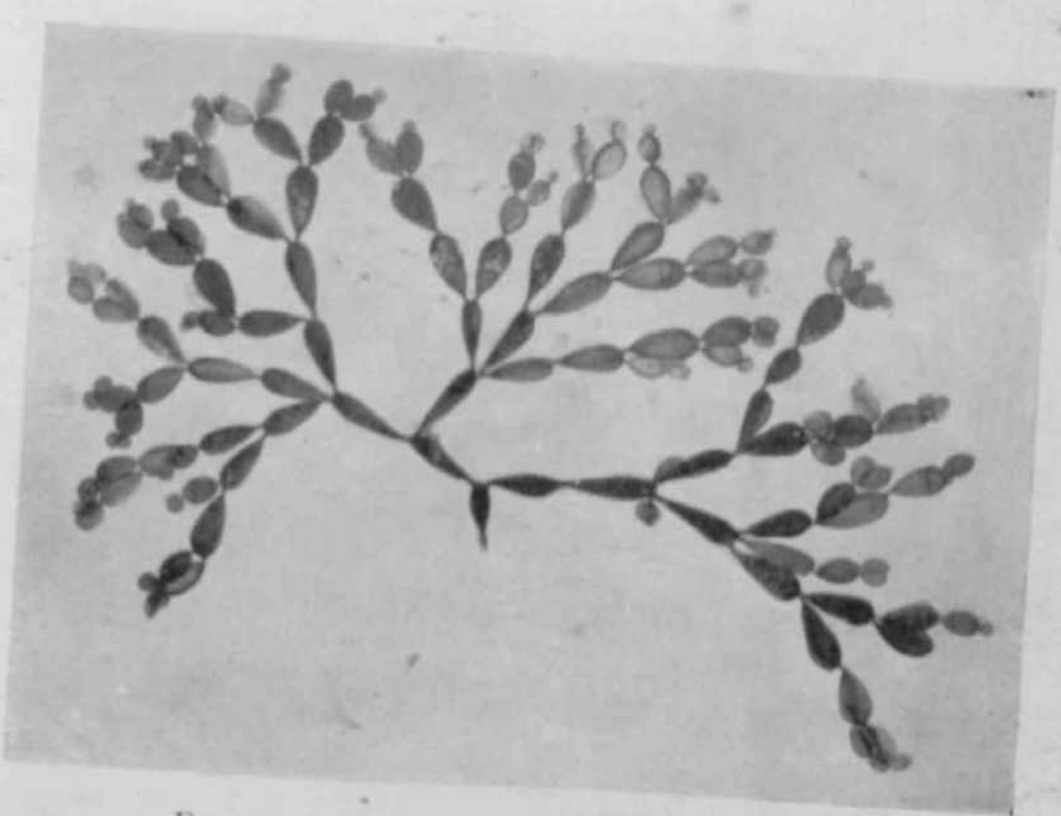


FIG. 2. *Cœlarthrum Muelleri* (Sond.) Borg.

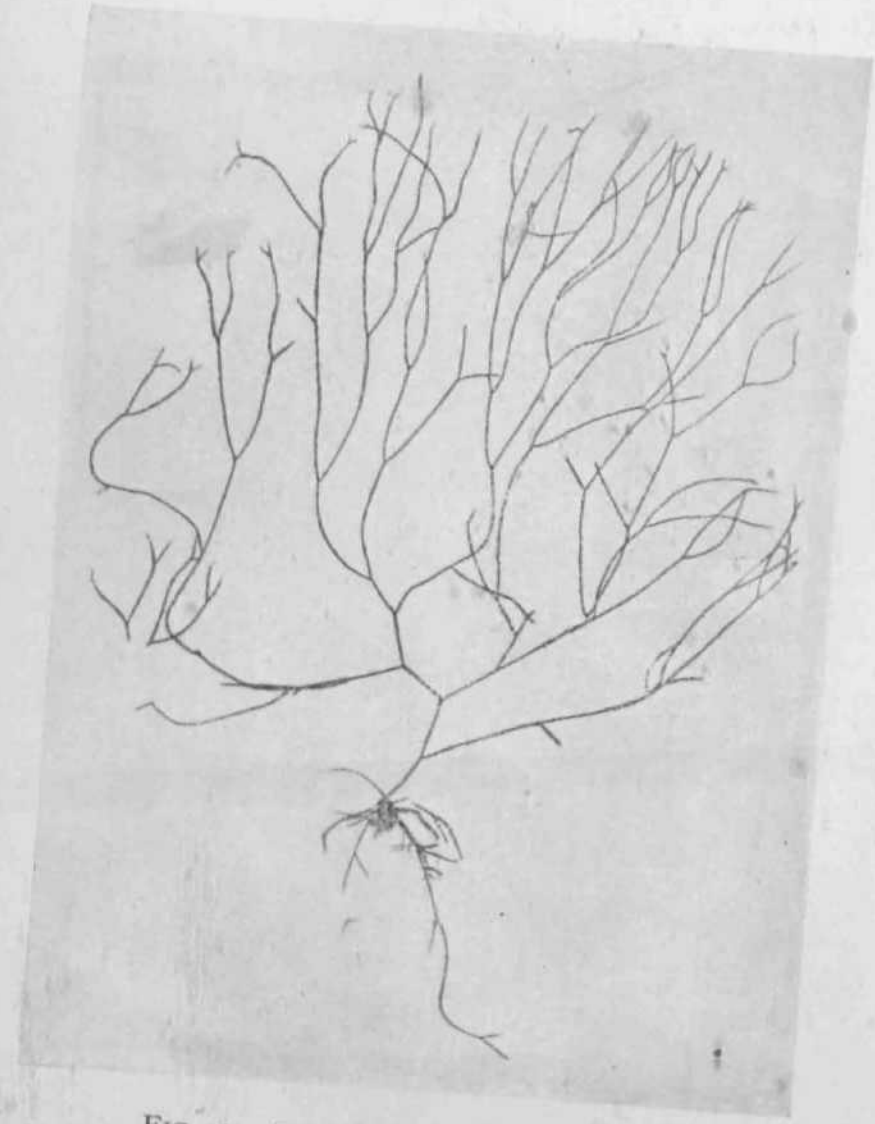


FIG. 3. *Furcellaira fastigiata* Umx.

FIG. 4. *Botryocladia leptopoda* (J. Ag.) Kylin.

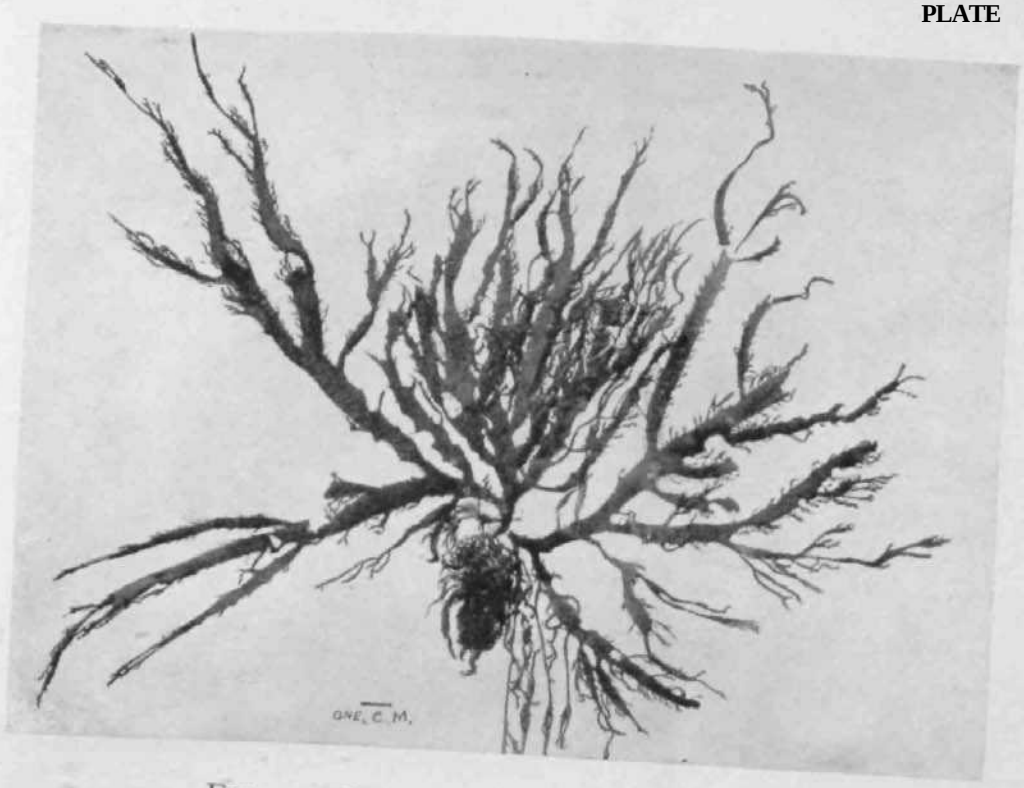


FIG. 5. *Calliblepharis fimbriata* Kuetz.

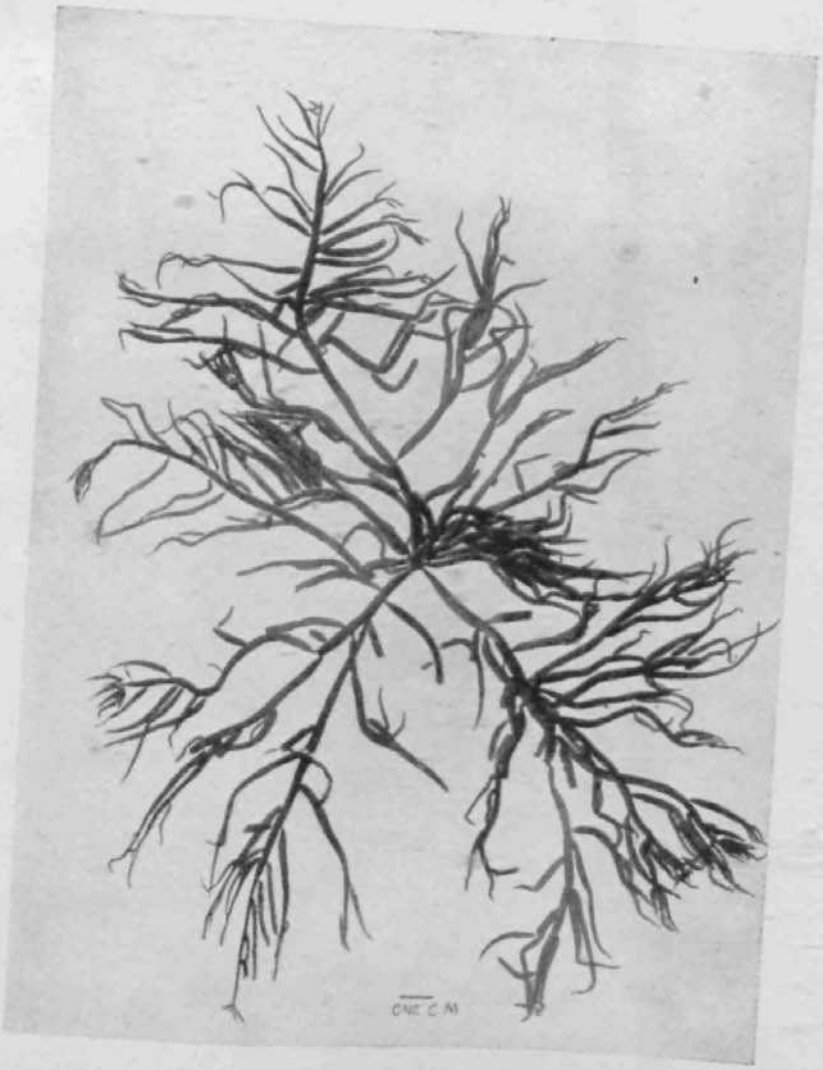
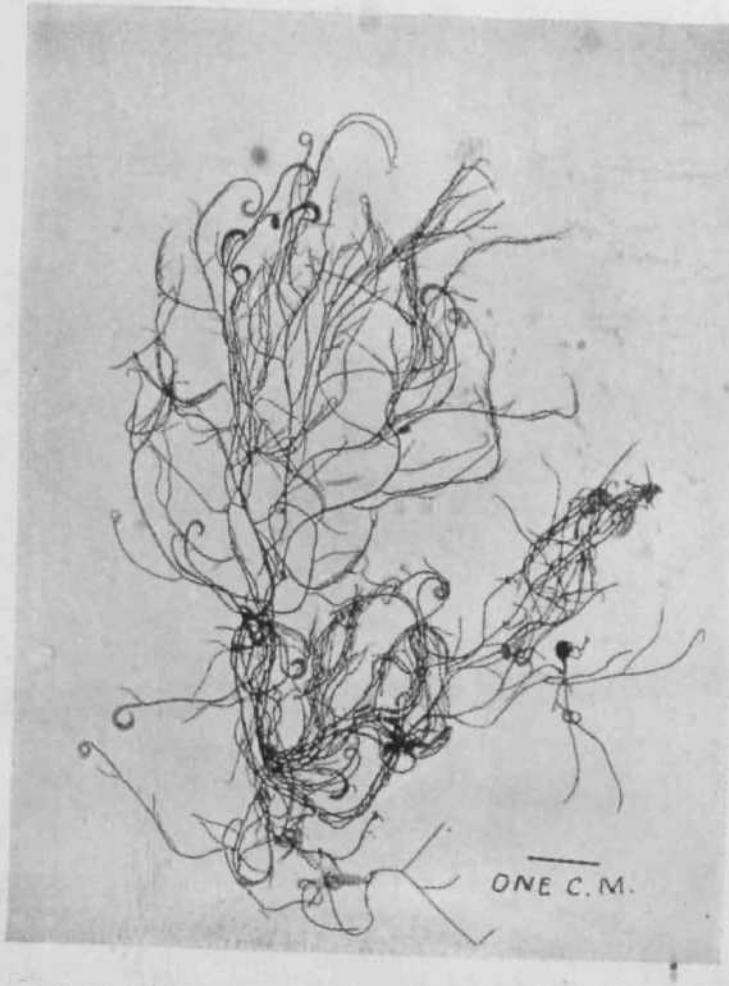


FIG. 6. ***Agardhielia*** *robusta* (Grev.) Boergs



Frt;. **7.** ***Hypnta museifortnts*** **(Watfen.)** Lamx.

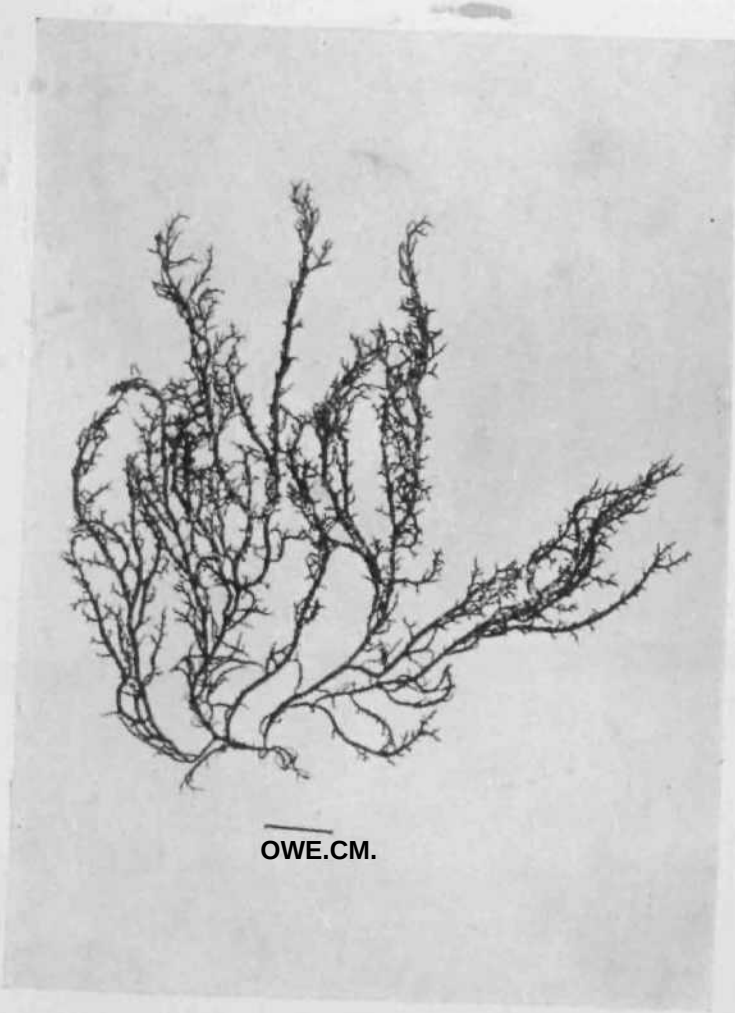


FIG. 8. *Aeanihophota spicifera* (Vahl.) Boergs.

Fronds cartilaginous, tufted, 5-30 cm high, profusely branched, compressed, main axis alternate or sub-dichotomously branched, branches distichous, often-secund ; cystocarp solitary, sessile on the edges of the axes and branches ; tetrasporangia in dichotomous or lanceolate stichidia.

(80) Plocamium Telfairiac Harv.

BOERGESEG, *Kew Bull. No.* 3, 1933.

Each sympodium carries only two branchlets of which the upper most continues in the same direction, thus forming alternately on each side of the stem the spine-like branchlet and one ramified branch, from the tips of the branchlets small proliferations grow out.

Both these species of *Plocamium* have been described by Boergesen from Manora, Karachi, the latter from A. B. Kotwal's Collection.

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