THE MARINE ALGÆ OF DENMARK

CONTRIBUTIONS TO THEIR NATURAL HISTORY

PART I

INTRODUCTION. RHODOPHYCEÆ I.

(BANGIALES AND NEMALIONALES)

BY

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WITH TWO CHARTS AND TWO PLATES

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PREFACE.

The study of the marine Algæ engaged my interest at an early period. Originally certain morphological, cytological and physiological questions were the objects of my studies, but later the plan to procure a general view of the Algæ found in the Danish waters gradually developed. In 1890 I began to make systematic collections in the Danish waters and continued during the following years, especially in 1891—95, when I became able to make extensive dredgings in all the Danish waters inside Skagen (Kattegat to Baltic) by means of official support during 4 years (from "Kommunitetet") and permission from the ministry to sail with the fishery control-steamers S. S. "Havørnen" and S. S. "Falken" and the fishery inspection-ship, the gunboat "Hauch". During the following years I have as occasion offered continued these collections partly onboard the Biological Station's S. S. "Sallingsund", especially on a cruise round Bornholm in 1901, the life-saving steamer S. S. "Vesterhavet" and the lightship transport S. S. "Nordsøen" in 1905 in the North Sea, the deep-sea research-ship S. S. "Thor" in the Skagerak, Kattegat and the Sound in 1907, a former revenue-cutter "Ragna" in private possession in 1904—1906 and partly in fishing boats, especially at different places on the north-western coast of Jutland.

The reason why my work has extended over such a long period is chiefly, that different works regarding Greenland's flora, vegetation and marine Algæ, have during a series of years taken up so much of my time that until 1898 I was mostly obliged to content myself with collecting material, while the working up of this could not begin until after that time. Another cause of the slow progress of the work is the abundance of the material collected, and lastly the scope of my work was gradually somewhat enlarged. From the beginning the aim of my investigations was, not only to state what species are found in the Danish waters, but to elucidate their extension here and also their variation and if possible their dependence on the external conditions. While working with the single species my investigations came more and more to have to do with morphology and the developmental history, and I saw how desirable it would be for the task I had undertaken if I could contribute as much as possible to the elucidation of the natural history of the separate species on the whole in Danish waters; I have also expressed this in the title of my work. I feel quite well, that I have not given

nearly so much as I could have wished in this direction, and I am by no means blind to the defects in my work just in this respect. But it is also quite clear to me, that if I do not wish to postpone the publication of my work until an uncertain future period, thus running the risk of never getting it finished, I must have it published, even if my investigations are not complete on many points.

On account of the extent of the work I have decided to have it published in small portions, to begin with the Rhodophyceæ. Of this family the well-known specialist, the conservator Mr. M. FOSLIE, several years ago undertook to determine the *Melobesieæ* and Mag. sc. Mr. HENNING E. PETERSEN undertook to work up the genus *Ceramium*. Mr. FOSLIE has already given the preliminary results of his work in several publications, but they will be dealt with in more detail in the present memoir. Mr. PETERSEN's work on the genus *Ceramium* was really destined to be embodied as a part of the same, but as it was finished before mine and was of considerable extent it was preferred to have it published separately[1].

Besides the two mentioned groups of red Algæ a large portion of the blue-green Algæ I have collected was worked up by Dr. JOHS. SCHMIDT in 1899[2]. It may also be mentioned here, that mainly on the basis of my own collections and investigations I have been able to enumerate not a small number of species, which have not been known before in the Danish waters, in my work on the Algæ in ROSTRUP's Guide to the Danish flora[3].

My thanks are due to many persons, who during the many years that have passed since I began my investigations have rendered me valuable assistance in different ways. I would here mention especially the different captains, the late fisheries supervisor Mr. A. BLOCH, Commander P. GROVE, the former fisheries supervisor Mr. HOLSTEIN, the present fisheries supervisor Mr. W. LARSEN, Captain ROSENKILDE, the retired Captain C. TROLLE; further the director of the Danish Biological Station Dr. C. G. JOH. PETERSEN and Dr. JOHS. SCHMIDT; also Dr. F. BØRGESEN, Dr. TH. MORTENSEN, Dr. C. H. OSTENFELD, Mag. A. OTTERSTRØM, Mag. OVE PAULSEN and Mag. HENN. PETERSEN, who have placed their collections of Danish marine Algæ at my disposal.

I desire here also to express my best thanks to the Directors of the Carlsberg Fund for the assistance they have given to defray various expenses in connection with the publication of this work, especially the charts and photographs of plants.

[1] HENNING E. PETERSEN, Danske Arter af Slægten Ceramium (Roth) LYNGBYE. K. D. Vidensk. Selsk. Skr. 7. R. 5. B. No. 2 1908.

[2] JOHS. SCHMIDT, Danmarks blaagrønne Alger (*Cyanophyceae Daniae*) I. Hormogoneae. Botanisk Tidsskrift Bd. 22.

[3] E. ROSTRUP, Vejledning i den danske Flora. Anden Del. Blomsterløse Planter. København 1904.

INTRODUCTION.

Earlier sources of our knowledge of Denmark's marine Algæ.

When on searching for the oldest statements in the literature on the Danish marine Algæ, we come upon OEDER's Enumeratio plantarum Floræ Danicæ[1], we might expect to find important information there, as the work deals specially with the "*Cryptantheræ*" i. e. the cryptogams. A considerable number of species of the genera *Conferva*, *Ulva* and *Fucus* are certainly mentioned there, but these are not known to occur inside the boundaries of the Danish kingdom. As the author, according to his own statement, had not studied the lower plants very closely, he contents himself with giving a good many North-European species, which he supposes might be found here. This paper therefore does not contain any more information about the Danish marine Algæ than that found in "Flora Danica", to which work reference is made for all the species figured there. OEDER has certainly mentioned not a small number of species in this monumental pictorial work, which began to appear in 1761, but they are almost all from Norway and Iceland or without indication of the locality. Only two species are noted from Denmark, namely Tab. 166, *Fucus siliquosus* (1763) [*Halidrys siliquosus* (L.) Lgb.] and Tab. 393, *Fucus fastigiatus* (1768) [*Furcellaria fastigiata* (Huds.) Lamx.].

In the parts of the same work edited by O. FR. MÜLLER (1775—1782) only a few marine Algæ from Denmark were mentioned (Tab. 763, *Ulva prolifera* [*Enteromorpha prolifera* (Müll.) J. Ag.]; Tab. 771, 2, *Conferva Linum* [*Chætomorpha Linum* (Müll.) Kütz.]; Tab. 821, *Fucus Filum* [*Chorda Filum* (L.) Stackh.]; Tab. 882 *Conferva flexuosa* [*Cladophora* sp.]; Tab. 889, *Ulva Linza* [*Enteromorpha Linza* (L.) J. Ag.]), and none at all in the parts edited by MARTIN VAHL. At the end of the 18th century information was thus present about only a very small number of species of marine Algæ found on the coasts of Denmark.

In 1803 SCHUMACHER[3] gives 26 species of Algæ from the coast of Sealand. A considerable proportion of these are however so insufficiently described that

[1] G. C. OEDER, Enumeratio plantarum Floræ Danicæ. Cryptantheræ. Hafniæ 1770.

[2] Icones Floræ Danicæ. Hafniæ 1761—1883 (Edit.: OEDER, O. F. MÜLLER, M. VAHL, HORNEMANN, LIEBMAN, JOH. LANGE).

[3]) C. F. SCHUMACHER, Enumeratio plantarum in partibus Sællandiæ septentrionalis et orientalis. Pars posterior, Hafniæ 1803.

they cannot be identified. Besides three species formerly known as Danish, the following may be mentioned: *Enteromorpha intestinalis* (L.) Link (*Conferva int.* Schum.), *Cladophora rupestris* (L.) Kütz. (*Conferva rup.* Schum.), *Chordaria flagelliformis* (Müll.) Ag. (*Ceramium longissimum* Schum.), *Ahnfeltia plicata* (Huds.) Fr. (*Ceram. plicatum* Schum.), *Fucus serratus* (L.), *Fucus vesiculosus* L. and *Rivularia atra* Roth (*Linckia hemisphærica* Schum.). Further LYNGBYE believed that he was able to identify *Elachista fucicola* (Vell.) Fr. (*Conferva ferruginea* Schum.) and *Chondrus crispus* (L.) Lgb. (*Fucus ceranoides* Schum.)[1].

No further information on Denmark's marine Algæ appears in the 2nd edition of HORNEMANN's "Plantelære"[2] published 3 years later. Only 11 species, all referred to the genus *Fucus*, are noted, but not a single one is expressly mentioned as found in Denmark.

It was only in the 2nd decade of the 19th century that a more exact study of the Algæ was begun in this country, first by N. HOFMAN BANG, the owner of Hofmansgave on the north coast of Fyen, and at his instigation also by H. C. LYNGBYE, private tutor at Hofmansgave from 1812—1817. The publisher at that time of Flora Danica, HORNEMANN, who was in close connection with these two investigators of Algæ, included in this work during the years 1813—1818 25 species of marine Algæ from Denmark, mostly until then unknown in its flora; the number of the species was by this addition more than doubled, but a decisive change was not accomplished until the publication of LYNGBYE's hydrophytology[3]. This work was originally written in 1817 as an essay to which the University had awarded a prize in the previous year, but it was enlarged so much later that the Algæ from Holstein, the Færoes, Iceland, Greenland and also partly from Norway all came to be included in it. On the whole 323 species are mentioned here, for Denmark about 100 species with 12 varieties of marine Algæ; Denmark thus rose at once to the level of the countries, in which the algal flora was relatively well investigated. This work holds a good place as one of the main works among the earlier descriptive phycologies by reason of its careful descriptions of species and its numerous good figures. With regard to Denmark it is essentially based upon numerous collections by HOFMAN BANG and by LYNGBYE at Hofmansgave and upon studies of the latter at the same place, in less measure upon collections in the Sound, while other localities are very incompletely represented. Consequently it deals relatively exhaustively with the algal flora of the north coast of Fyen, while it gives very little

[1] Among these species *Ceramium cartilagineum* (l. c. p. 112) must also be mentioned. LYNGBYE who had the opportunity to examine SCHUMACHER's specimen, found between Amager and Sjælland, discovered that it really belonged to *Fucus cartilagineus* Turner (= *Gelidium cartilagineum* (Turn.) Gaill.) a species, the native place of which is at the Cape of Good Hope, and he found that, in regard to the epiphytic animals it also agreed with samples of this species from that place, consequently he was right in concluding that it in some way, e. g. by a ship, had been transported from its original, far-off home (LYNGBYE Hydr. p. 56).

[2] J. W. HORNEMANN, Forsøg til en dansk oekonomisk Plantelære. Kjøbenhavn 1806.

[3] H. C. LYNGBYE, Tentamen Hydrophytologiæ Danicæ. Hafniæ 1819.

information about the distribution of the species within the Danish area. As LYNGBYE's work will be cited in the following pages when dealing with the single species, its importance to the knowledge of the Danish marine algal flora need not be more closely explained here.

During the following years several Danish marine Algæ were included in the parts of Flora Danica published by HORNEMANN, without anything essentially new being given in addition to what is found in LYNGBYE's work.

A greater increase in the number of Danish species appears in the 3rd edition of HORNEMANN's "Plantelære"[1], the number here reaching 127. The real increase was however far from being so great. Thus, two of the species mentioned belong to the animal kingdom (*Alcyonidium diaphanum* and *flavescens*); some seem to have been included by mistake as found in Denmark, as they have not been discovered here by others and no Danish specimens are known (*Sphœrococcus ciliatus, S. laciniatus, Zonaria dichotoma*). Several of the new species are scarcely sufficiently distinct from others found earlier, e. g. several *Hutchinsia*-species, *Vaucheria litorea* Ag. (*V. clavata* Lgb.) etc. But even after these reductions, a number of real additions remain of which the most important are:

Calothrix fasciculata Ag.
Rivularia pellucida Ag.
Bryopsis plumosa Ag.
Ectocarpus tomentosus Ag.
Zonaria deusta Ag. (*Ralfsia verrucosa*)
Chordaria divaricata Ag.
Bangia atropurpurea Ag. (*B. fuscopurpurea*)
Halymenia palmata Ag. (*Rhodymenia palmata*)
Rhodomela dentata Ag. (*Odonthalia dentata* Lgb.)
Callithamnion roseum Ag.
Ptilota plumosa Ag. (*Plumaria elegans*)
Halymenia edulis Ag. (*Dilsea edulis*)

Two years later LIEBMAN[2] made some new additions to the Danish marine algal flora. A great part of these species were however not really new in the flora; thus his *Laminaria latifolia* is only a form of *L. saccharina, Asperococcus echinatus* = *Scytosiphon Lomentaria, Punctaria cœspitosa* = *Phyllitis Fascia, Sphacelaria cœspitula* not identical with LYNGBYE's species of that name but perhaps only small specimens of *Sphacelaria cirrosa, Polysiphonia lepadicola* = *P. urceolata*. — New to the flora are however at all events *Callithamnion pyramidatum* Liebm. = *C. fruticulosum* J. Ag. and *Lyngbya lutescens* Liebm. = *L. lutea* (Ag.) Gom., and probably *Ptilota plumosa*. His *Dictyota dichotoma* is also new, but however, as the specimens prove, is *Taonia atomaria*; but this Atlantic species cannot have grown on the coasts of Denmark, but must probably have been transported by a ship.

A smaller contribution to the flora was given by ØRSTED in 1841 in an account of an excursion to an alluvial deposit at Hofmansgave[3], where some blue-

[1] J. W. HORNEMANN, Dansk oeconomisk Plantelære 3. Udg. 2. Del. 1837.

[2] F. LIEBMAN, Bemærkninger og Tillæg til den danske Algeflora. KRØYER's Naturhist. Tidsskrift 2. Bd. 5. Hefte, 1839.

[3] A. S. ØRSTED, Beretning om en Excursion til „Trindelen", en Alluvialdannelse i Odensefjord. KRØYER's Naturhistorisk Tidsskrift 3. Bd. 1841, p. 552.

green Algæ were especially mentioned, amongst others a new species *Spirulina subsalsa*.

ØRSTED's dissertation[1], published three years later, in which the distribution of the marine Algæ in the Sound is discussed, is of greater importance. In this paper, which deals with the geographical, geological, botanical and zoological conditions of the Sound, all the species of Algæ are mentioned, which were found there by the author, but the single species are not described in detail, which is the reason why it is not always possible to know the meaning of a name given by the author. A number of species, considered by him as new, are however described in the comments under the text, but mostly so briefly and incompletely, that the plant cannot be recognised; and the result has been, that none of the genera and species, given by ØRSTED, have been maintained. Some of them have later been published in Flora Danica. The systematic value of the paper in thus very small, but its importance for our subject lies in this that it is based upon systematic investigations by means of dredgings, with the result, that for the first time the Algæ are not only discussed in regard to their horizontal distribution but also in regard to their vertical. It cannot be determined what new species have been added to the flora by ØRSTED's work without examining his specimens.

Already several years before the appearance of ØRSTED's work, LYNGBYE in 1836 had written a treatise of a somewhat kindred character, but, on account of special conditions, it was not published before 1880[2]. In floristic regard it is not of so much importance in enriching the flora, as in its being based upon investigations in the southernmost part of the Kattegat off Gilleleje, a region not investigated before, and especially by its containing more exact data on the distribution of the Algæ in relation to the depth. Neither his nor ØRSTED's divisions into regions of depth need be mentioned here.

Since ØRSTED's work there has not until the end of the 19th century appeared any noteworthy, floristic or systematic contribution to the Danish literature on the Danish marine Algæ. In Flora Danica marine Algæ from Denmark were included up to 1861, but very few new species were added beyond those mentioned by LIEBMAN and ØRSTED. *Helminthocladia purpurea*[3], found by Miss CAROLINE ROSENBERG, is perhaps the most interesting addition. During the same period publications which partly deal with the algal flora in Danish territory have appeared

[1] A. S. ØRSTED, De regionibus marinis, elementa topographiæ, historiconaturalis freti Øresund. Hauniæ 1844.

[2] H. C. LYNGBYE, *Rariora Codana* (Opusculi posthumi pars). Vidensk. Meddelelser fra den naturh. Foren. i Kjøbenhavn, 1879—80, p. 215.

[3] In "Nomenclator Floræ Danicæ" published by JOH. LANGE in 1881 a systematic summary, prepared by myself, was given of all the Algæ mentioned in this work with data on their occurrence. This general summary, which in regard to the determination of the species, is essentially based upon the references available in the literature and consequently in part out of date, comprises the following Danish marine Algæ: 47 *Rhodopyceæ*, of which two are however incorrectly named as Danish, 38 *Phæophyceæ* (1 incorrectly named Danish), 18 *Chlorophyceæ* and 7 *Cyanophyceæ*. By accident the *Characeæ* were omitted in this work.

in the neighbouring countries. Bornholm's algal flora has thus been investigated, in connection with that of the inner Baltic, by KROK[1] who gave valuable information regarding this region, not investigated until then. During the years 1870—1875 two expeditions were made from Kiel respectively to the Baltic and to the North Sea, on which occasions some dredgings were also made in the Danish waters, mostly in the Great Belt, and reports on these have been given by P. MAGNUS[2]. By these dredgings the existence of Algæ at great depths was determined in the Great Belt, among which were some species not found before in the Danish waters (*Antithammion Plumula, Chylocladia clavellosa* (*Lomentaria clavellosa*), some *Lithothamion*-species and the new species *Callithamnion* (*Rhodochorton*) *membranaceum* Magn.).

The marine Algæ have not in general been included in the Danish local floræ, or only the most obvious mentioned *en passant*; in J. P. JACOBSEN's list of the plants[3] found in Læsø and Anholt only some few species of marine Algæ from each of these islands have also been mentioned. COLLIN's work on the marine fauna[4] of the Limfjord contains some remarks about the flora of this fjord, in which some of the most important species in the composition of the flora are mentioned, partly from the information given by J. P. JACOBSEN. The number of the species stated is however also here too small to be of any importance in floristic regard. One of the species mentioned, *Rhodomenia mamillosa* (*Gigartina mamillosa* (Good. et Woodw.) J. Ag.) is however of interest, as it had not previously been found on the coasts of Denmark.

For two smaller groups however we find special contributions in the literature. The *Characeæ*, which in this country have not usually been studied in connection with the other Algæ, were included in two editions af LANGE's manual[5] and were later exhaustively studied by P. NIELSEN, especially in South West Sealand[6]. In 1880 I published a preliminary report on the submarine *Vaucheria*-species, the number of the known Danish species being thereby augmented[7].

Collections employed for the present work.

My work is naturally mostly based upon my own collections, but it need hardly be said that I have also employed all the marine Algæ accessible to me

[1] Th. O. B. N. KROK, Algfloran i inre Östersjön och Bottniska viken. Öfversigt af K. Vet. Akad. Förhandl. 1869.

[2] P. MAGNUS, Botanische Untersuchungen der Pommerania-Expedition vom 3. bis 24. August. Aus dem Bericht über die Expedition .... Pommerania. Kiel 1873.

P. MAGNUS, Die botanischen Ergebnisse der Nordseefahrt vom 21. Juli bis 9. Septbr. 1872. II. Jahresber. der Kommission z. Unters. d. deutsch. Meere in Kiel. Berlin 1874.

[3] J. P. JACOBSEN, Fortegnelse over de paa Læsø og Anholt i 1870 fundne Planter. Botan. Tidsskrift. 11. Bind 1879.

[4] JONAS COLLIN, Om Limfjordens marine Fauna. Kjøbenhavn 1884.

[5] JOH. LANGE, Haandbog i den danske Flora. 2. edition 1859, 3. edition 1864.

[6] P. NIELSEN, Exsiccatsamling af Characeer, navnlig fra Danmark. 1869. Idem, Sydvestsjællands Vegetation. Botanisk Tidsskrift 2. R. 2. Bd. 1873.

[7] Botanisk Tidsskrift Bd. 12, p. 11.

which have been collected in Danish waters by others in earlier and more recent times.

Other collections. LYNGBYE's herbarium of Algæ, kept in the Botanical Museum of Copenhagen, is of the greatest importance for the study of the Danish marine Algæ, as it contains the original specimens of LYNGBYE's Hydrophytology. The specimens in this herbarium have not been particularly well prepared, but they are furnished with exact indications of the place and time of collecting; most of them originate from the neighbourhood of Hofmansgave on Fyen.

The Botanical Museum's Danish herbarium contains a considerable number of specimens of marine Algæ. The majority of these come however, like LYNGBYE's herbarium, from the neighbourhood of Hofmansgave and have been collected mainly by HOFMAN BANG and Miss CAROLINE ROSENBERG. The latter, who passed the greater part of her life († 1902) at Hofmansgave, has from there during a long series of years sent a large number of carefully prepared specimens of marine Algæ, many of which have come to be housed in the Botanical Museum's herbarium. As they have been collected at different seasons, they provide a good material for following the development of the single species during the course of the year. Further, specimens are also present from HORNEMANN, LIEBMAN and ØRSTED, by which the determinations of the latter can be controlled, and also from J. VAHL, C. M. POULSEN, JOH. LANGE, CHR. THOMSEN (mostly from Samsø), J. P. JACOBSEN (mostly from the Limfjord), E. ROSTRUP, C. RASCH and others.

Since I began my systematic collections, some material collected by others has further been left to me. Dr. TH. MORTENSEN has thus placed at my disposal a valuable collection principally from the Limfjord procured at different seasons in 1894—95; and Dr. F. BØRGESEN has permitted me to examine the Algæ dredged on two expeditions with the fishery-inspection ship S. S. "Guldborgsund" in 1897 and in 1898 in the Skagerak, Kattegat and the Baltic. Smaller collections have been given me by Dr. C. H. OSTENFELD, Mr. A. OTTERSTRØM, Mag. OVE PAULSEN and Mag. HENNING E. PETERSEN.

My own collections. I began my first collections of Danish marine Algæ already towards the end of the seventies, but it was not until 1890 that I made extensive and systematic collections and they were carried on most energetically during the years 1891—1895, whilst later they have been continued almost every year though less extensively. My aim has been to make as uniform an investigation of the Danish waters as possible and also, as far as possible, to investigate them at different seasons; for that purpose I have made dredgings at more than 700 different places and besides made collections at numerous harbours and at other places close to the land; I have made these collections during all the months of the year, chiefly however during May—September. The dredgings have almost all been made by means of a triangular dredge with sharp steel teeth (Reinke's model), more rarely with a quadrangular dredge without teeth or with seine. The greater part of the material has been preserved as herbarium specimens, of which I possess

ca. 8000 samples, averaging at the least twice as many specimens. I have also preserved several hundreds of specimens in alcohol or formalin and likewise a considerable number of samples of stones and the like with incrusted Algæ. Neither the conditions nor time have as a rule permitted a more exact examination of the collected material at the place investigated; the aim was to keep or at least to note all the species present at the single dredging localities. I have however, during longer stays at some places on the Danish coasts, been able to make closer microscopical examination of fresh material. The main portion of my investigations is however based upon preserved material.

Remarks on the Danish waters.

As the present work does not intend to give a complete account of the floristic conditions nor of all the algal communities, the natural conditions of the Danish waters need not be described in detail here, but only the most important points, which may serve as a guide for understanding the distribution of the separate species and their biological conditions.

The boundaries of the region. These are partly determined by the political limits. Thus, my investigations extend southward in the North Sea to the boundary towards Slesvig, and east of Jutland as far as a line drawn between the German and Danish territories thus to the boundary of the region investigated by REINKE[1]. I have made dredgings in the North Sea as far out as the lightship on Horns Reef and the eastern side of the Jutland Reef ca. 24 miles from land, in the Skagerak ordinarily only to 4 miles from the land except north of Vendsyssel where the distance is greater. In the Kattegat my investigations have extended to the eastern channel and the grounds in and near it, and in the Sound to the deep channel east of Hveen in order to obtain the flora belonging to the salt under-current there. The waters surrounding Bornholm constitute a special region, which is however connected with the waters east of Møen by some few scattered dredgings.

The conditions of depth. A general view of these is obtained from the charts, which show that a deep channel (the eastern channel) passes from the Skagerak southward through the eastern Kattegat, while the water in the western part of this sea is relatively shallow. Narrower channels lead further from the eastern channel through the Sound and the Belts, of which that through the Great Belt is the most important. At Gjedser—Darsserort this channel meets with a barrier, the maximum depth over which is 18 meters, whilst a similar barrier, which has a maximum depth of only 8 M., occurs at Saltholm and forms the southern boundary of the deep channel through the Sound. South of Schonen the depth increases in the Baltic, but becomes specially considerable north and east of Bornholm. For the rest, reference may be made to the charts.

[1] J. REINKE, Algenflora der westlichen Ostsee deutschen Antheils. 1889.

The nature of the bottom. The most important kinds occurring in the Danish waters, are (1) stony bottom, (2) sand-bottom and gravel-bottom, (3) mixed bottom consisting of a mixture of sand and clay or mud and (4) soft bottom consisting of clay or mud. To these may be added (5) rocky bottom and (6) compact clay (tertiary or glacial). I shall not endeavour here to describe more closely the distribution of these kinds of bottom, as the nature of the bottom is very variable from place to place. With regard to the Kattegat reference may be made to C. G. Joh. Petersen's chart[1]. For the rest some information is given below in the list of my dredgings; it may however be remarked, that I have chiefly dredged at places with stony bottom. The rule is, that sand-bottom is connected with shallower water, soft bottom with the deeper and mixed bottom with the intermediate depths. The stones are mostly found in shallow water and on reefs, which are for a great part noted on the charts. There are grounds, however, the surface of which is exclusively or predominantly sand, e. g. Horns Reef, Anholt's N. W. Reef and Gjedser Reef, which is the reason, why they are not overgrown with Algæ. The extent of the true stone-reefs, the surface of which consists only of stones, is relatively small; on the larger banks and flats stony bottom is ordinarily intermixed with gravel, sand or even clay. In deep channels with strong current stony bottom is often found, which is kept clean by the current. Rocky bottom is found at several places near Bornholm, but elsewhere is scarcely known with certainty; it occurs perhaps at some places in the Skagerak near Hanstholm and Bulbjerg. On the other hand, firm glacial clay occurs at many places in the Skagerak and firm tertiary clay at all events in the Little Belt.

The salinity and temperature of the sea-water. As these conditions are of the greatest importance in understanding the distribution of the species, the conditions which are of special importance for our subject may briefly be discussed here; for the rest, reference may be made to the hydrographical works mentioned below[2]. In consequence of the fact that the salinity in the North Sea is more than 32‰, while in the true Baltic (east of Gjedser—Darsserort) it is ordinarily less than 10‰, the greater part of the Danish waters is a mixed region with complicated and variable hydrographical conditions, the most important moment in which is that the heavy North Sea water from the Skagerak penetrates along the bottom through the deep channel in the eastern Kattegat and further as

[1] C. G. Joh. Petersen, Kanonbaaden Hauchs Togter, 1893, Kort III.

[2] Martin Knudsen, Havets Naturlære. Hydrografi med særligt Hensyn til de danske Farvande. Skrifter udg. af Kommissionen for Havundersøgelser. Nr. 2. København 1905.

De internationale Havundersøgelser 1902—1907. Skrifter udg. af Kom. f. Havundersøg. Nr. 4. 1908.

J. P. Jacobsen, Mittelwerte von Temperatur und Salzgehalt, bearbeitet nach hydrographischen Beobachtungen in Dän. Gewässern 1880—1907. Meddel. fra Komm. for Havundersøgelser Ser. Hydrografi. Bind I, Nr. 10. 1908.

Nautical-meteorological Annual 1902—1906, published by the Danish Meteorological Institute.

I am much obliged to Mr. J. P. Jacobsen for placing at my disposal some unpublished lists with hydrographical averages. I am much indebted to Mr. Martin Knudsen and Mr. J. P. Jacobsen for various pieces of information regarding the hydrography of the Danish waters.

a bottom-current through the channels in the Sound and the Belts, especially the Great Belt, while a surface-current streams out from the Baltic in an opposite direction. On account of the rotation of the earth this northward so-called Baltic Current is forced eastward and consequently remains on the eastern side of the Kattegat along the Swedish coast, and for the same reason the north-going surface-water moves more rapidly in the Sound than through the Belts. Vice versâ the salt bottom-current is forced westward. The boundary between the two water-layers is very distinct in summer, while the transition is uniform in winter.

The salinity does not vary much in the North Sea. At the lightship on Horns Reef the conditions in the years 1880—94[1] were:

	Temperature		Salinity	
	Mean minimum	Mean max.	Mean minimum	Mean max.
0 M. . . .	2,2° (Febr.)	15,8° (Aug.)	32,7 ‰	33,2 ‰
23 - . . .	2,6° (March)	15,5° (Sept.)	33,1 ‰	33,7 ‰

The numbers are the averages of the monthly means; the variations are thus a little greater than indicated by the numbers. Along the coast a narrow and not very deep margin occurs with a somewhat lower salinity.

The conditions in the part of the Skagerak which lies nearest Jutland are essentially like the corresponding part of the North Sea, the water mainly streaming from the North Sea towards the Swedish coast.

In the waters inside the Skaw (Skagen), at every place where the depth is considerable, an upper, relatively not very salt layer, the temperature of which almost constantly follows that of the air, can be distinguished from a deeper layer with salter water and with special conditions as to temperature. With regard to the surface water, the highest temperature of the year is commonly observed in the beginning of August and is in the greater part of the waters on an average 16°, while the lowest temperature of the year, which on an average is 2°, is ordinarily observed in the middle of February. In fjords and bays, where the renewal of the water is not considerable, the maximal temperature is however higher and falls in July, and the minimal temperature is lower in winter. In the deeper and salter water-layers both the maximal temperature and the minimal temperature occur later than at the surface, and the maximum temperature is lower than at the surface, the minimum temperature higher. The differences from the surface are various but are essentially regulated by the depth.

With regard to the hydrography of the Limfjord only some few observations are available. In this shallow water there is only a small difference between the surface and the deeper water-layers. The water in the western part is most like that of the North Sea, the eastern part like the surface-water of the Kattegat. It is only for Oddesund and Aalborg that continuous observations on the surface-water are available. In 1902—1906 the salinity at Oddesund was on an average

[1] Meteorologisk Aarbog for 1896.

29,3‰ (the monthly mean was 26,3—32,4‰); at Aalborg it was during the same period on an average 23,5‰ (18,4—27,7‰). At the same time the monthly mean temperature at Oddesund alternated between +0,2° (Febr.) and 18,5° (July). At Aalborg it alternated between +1,4° and 18,3°. The conditions characteristic of the Limfjord are: a relatively high salinity, especially in the western part, a higher summer temperature than in the open waters and the absence of a salter underlayer with smaller alternations in the temperature.

In the northern Kattegat, north of Læsø, an active exchange takes place between the surface-current and the under-current, which is the reason why the salinity decreases considerably in both from north to south. As a rule the salinity of the water streaming in at Skagen is between 30 and 35‰, and the salinity of the surface-water is ordinarily more than 25‰. According to J. P. Jacobsen the result of daily observations for 1880—1905 shows, that the temperature and salinity at Skagens Reef vary on an average in the following manner;

	Temperature	Salinity
0 M.	2,5°—16,2° (mean 8,8°)	27,3—31,4
20 -	3° —15°	32,3—33,8
38 -	4° —13,9° (mean 8,2°)	33,3—34,5

At Læsø Trindel the salinity, according to the charts in J. P. Jacobsen's paper, is: at 0 M. 23—27‰, at 10 M. 28—29‰, at 20 M. 31—32‰.

In the eastern Kattegat the salinity of the surface water gradually decreases southward; not nearly so great an exchange however occurs here as in the northern Kattegat.

At Anholt's Knob the salinity is at 0 M. 19—23‰, at 10 M. 23—25‰, at 20 M. 29—31‰ and at the same place the temperature alternates at the surface between 1,6° (mid. Febr.) and 17° (ca. 1. Aug.) at a depth of 28 M. between 4,2° and 13,5°, at a depth of 40 M. between 4° and 11,5°.

In the western Kattegat (Km.), which is only of small depth, the salt bottom water is absent, except in Læsø Channel. At the lightship in Læsø Channel in 1880—94 the averages were:

	Temperature		Salinity	
	mean minim.	mean max.	mean minim.	mean max.
0 M.	2,2° (Febr.)	16,1° (July)	22,3‰	27,8‰
24 -	3,4° (March)	13,9° (Aug., Sept.)	32,2‰	33,9‰

The salt water coming through the Læsø Channel causes on mixing the water in this region to become relatively saline, especially to the north and along the coast of Jutland. In the greater part of the region the salinity at the bottom is however not more than 25‰.

In the Southern Kattegat and the waters east of Samsø the salinity at the surface is fairly uniform. In this area there is, especially in summer at a depth of 10—20 M., a very distinct limit between an upper layer, which has ca. 20‰

salinity, and an under layer, which has 28—32 ‰. Where the depth is greater the salinity is even higher. At Schultz's Grund it increases during the summer months, when it is greatest, up to 32—33 ‰ at a depth of 26 M. During the winter months the salinity at the bottom is less (at Schultz's Grund ca. 29—30 ‰), while at the same time the surface salinity increases on account of the intermixing. The maximal temperature at the bottom is relatively low, lower than it is both north and south of the region. The mean temperature of the bottom-waters for the year is 7°. According to J. P. Jacobsen (l. c.) the conditions at Schultz's Grund are the following:

0 M.	10 M.	20 M.	26 M.
Salinity	Salinity	Salinity	Salinity
16—21,6 ‰	19,9—23,3 ‰	27,8—31,5 ‰	29,1—32,9 ‰
Temperature	Temperature	Temperature	Temperature
1,5° (Febr.)—17° (Aug.)	2° (Febr.)—16,5° (Aug.)	3,3° (Mch.)—13° (Aug.)	3,8° (Mch.)—12° (Aug.)

In the area between Samsø, Jutland and Fyen the depths are mostly not more than 20 M. The salinity at the surface increases considerably towards the Jutland coast, where it is greater than in the adjacent regions, which is caused by the salt bottom-water here being nearer the surface and mixed with the surface-water. On account of this also the surface water's maximum temperature is here 1° lower than in the Kattegat. At a depth of 20 M. the salinity is 25—30 ‰, the temperature 2,5—13,5.

To illustrate the conditions in the Isefjord the following averages for the surface-water at Rørvig, near the mouth, and at Frederikssund, half way up Roskildefjord, during the years 1902—1906 may be given:

	Salinity	mean temperature in	
		February (the coldest month)	July (the warmest month)
Rørvig	19,4 ‰	0,6° (÷ 0,9— + 1,8)	17,3° (16,1—18,7)
Frederikssund	15 ‰	0,4° (÷ 0,6— + 1,9)	18,0° (16,6—19,7)

In the Great Belt the salinity of the surface-water is very variable. Thus, at Sprogø it varies between 10 ‰ and 20 ‰. The highest salinity is found at the coast of Fyen. A salt bottom-water is found here, but the boundary between this and the surface-water is here not so distinct as in the Kattegat. At a depth of 20—25 M. the temperature alternates between 3° and 13°, at the same depth the maximum salinity is reached in July and is 27 ‰.

The following averages for 1895—1902 illustrate the conditions (manuscript lists). The western part of the Great Belt; 55°18′ N. L. 10°54′ E. L.

	Temperature		Salinity	
	Min.	Max.	Min.	Max.
0 M.	2,2 (March)	16,6 (Aug.)	13,4 ‰	18,3
15 -	2,2 (March)	13,9 (Sept.)	17,1 -	24,3
23 -	2,4 (March)	13,2 (Sept.)	18,7 -	27,6

In the Little Belt there is only a small difference between the salinity at the surface and in deep water; it is about 20 ‰ or a little less. The temperature at the surface is comparatively low in summer (during 1902—1906 on an average 13,7° in June, in July 15,2°, in Aug. 15,1°), comparatively high in winter (during the same period 2,5° in January, 1,7° in Febr.). There is generally a strong current, especially in the narrowest part of the Belt.

In the Sound a salt bottom layer is found as far as Saltholm Tærskel, sometimes however passing it. The salinity greatly decreases southward in the upper layers. The salinity of the bottom-layer also decreases southward; north of Hveen it is 25—28 ‰ at a depth of 20 M. In deep hollows the salinity may be 30—32 ‰ and here the temperature in winter is constant for a long time. The following numbers found at the lightship on Lappegrunden are very instructive.

Average of 1883—94 (Meteorol. Aarbog):

	Temperature		Salinity	
	Min.	Max.	Min.	Max.
0 M.	1,0° (Febr.)	17,0° (July)	12,0 ‰	16,7 ‰
11 -	3,1° (March)	15,7° (Aug.)	21,0 -	26,2 -
17 -	4,1° (March)	11,5° (Sept.)	28,3 -	32,8 -
23 -	3,5° (April)	11,3° (Oct.)	28,3 -	34,0 -

North of Saltholm (1880—1907):

Salinity 0 M. 10—13 ‰, 10 M. 13—16 ‰.

In the western Baltic there is also, at any rate in the summer, a contrast between the surface-water and the salt bottom-water, but as a considerable mixing occurs the surface-water west of Fehmarn is comparatively salt, 11—18 ‰, and has a somewhat lower temperature in summer than in the true Baltic. The salt bottom-water has its maximal salinity in July and August, when it is ca. 20 ‰ at a depth of 20 M. In the area between Fehmarn and Gjedser—Dars—Tærskelen the salinity decreases considerably in the upper water-layers eastwards. The salinity also decreases somewhat in the bottom-water (ca. 15—20 ‰ at a depth of 20 M.).

At the lightship on Gjedser Reef the average salinity was in 1880—94:

0 M.	8,7—12,8 ‰
8 -	9,8—13,6 -
11 -	11,1—14,1 -

In the Baltic round Møen, from Gjedser to Sweden, the salinity and temperature are fairly uniform from surface to bottom. At Møen the salinity at the surface is on an average ca. 8 ‰, at a depth of 20 M. 8—10 ‰. From this place the salinity increases both at the surface and at the bottom towards the two entrances, the Gjedser—Dars—Tærskel and the Drogden Tærskel.

To illustrate the hydrography of the Baltic round Bornholm it may be mentioned that the salinity of the surface-water at Christiansø in 1902—1906 was on

an average 6,7 ‰ (the monthly means varying between 5,5 and 8,8 ‰). A salter bottom-water is found here, but only at a rather considerable depth. At a station north of Bornholm, 55°26′ N. L. 14°46′ E. L., the salinity of the surface-water is ca. 7—8 ‰, of the bottom-water ca. 13—15 ‰. The boundary lies at a depth of about 60 M. The salinity however increases somewhat above this boundary, as will be seen from the following numbers found by the international investigations during the years 1903—1907 (Bulletin trimestriel).

North of Bornholm 55°26′ N. L., 14°46′ E. L. The salinity were at depths of:

0—30 M. ...	8 ‰
40 - ...	7,32—11,56 ‰
50 - ...	7,38—11,94 -
60 - ...	10,61—14,89 -

The currents in the Danish waters are complicated and variable; they depend not only on the above-mentioned exchange between the waters of the North Sea and the Baltic, but also on the wind, in a less degree on the tide and of course on the configuration of the coast and the bottom. When the wind is strong it determines the strength and direction of the surface currents. Thus, with westerly winds salt surface-water streams from the Skagerak into the Kattegat, and from the Kattegat a northerly current brings relatively salt water in through the Sound and the Great Belt. Easterly winds produce the contrary effect. A sudden change in the direction of the wind often causes a strong current, especially in the narrow belts and sounds. There is on the whole almost always a more or less strong current in the latter, e. g. in the Little Belt, in the Sound at Helsingør, sometimes as strong as in a river. That currents can be produced by the tide is not only seen at the most southerly part of the Jutland west coast, south of Skallingen, but also at some single places inside Skagen, for instance in the bay inside Korsør and in some of the Sounds in the Smaaland Sea, where the current, at any rate during calm conditions of the weather, regularly changes with the tide (every 6 hours).

The height of the water-level at the Danish coast is only in a small degree dependent on the tide. This is only at the southern part of the Danish North Sea coast of a fairly considerable magnitude. North of Thyborøn channel and in the waters inside Skagen its greatest height is only at some few places 1 foot or a little more, at other places it is only some few inches, and at Bornholm there is no tide at all. According to "the Danish Pilot"[1] the following heights occur:

The North Sea and Skagerak		Waters inside Skagen	
mean high-water above mean low-water		the mean height of the spring-tide	
Esbjerg	5 feet	Frederikshavn	1 foot
Nordby (Fanø)	4 — 9 inches	Aarhus	1 — 2 inches
Blaavands Huk	5 —	Fredericia	„ — 11 —
Nyminde Gab	3 —	Korsør	„ — 11 —

[1] Den danske Lods; 4. edit. 1893, p. 29.

The North Sea and Skagerak		Waters inside Skagen	
mean high-water above mean low-water		the mean height of the spring-tide	
Thyborøn channel ..	1 foot 6 inches	Slipshavn.....	1 foot
Agger	1 — 1 —	Helsingør.....	„ — 5 inches
Hirshals	1 — „ —	Copenhagen	„ — 7 —
Skagen	1 — „ —		

The figures for the places inside Skagen are so small that they are often neutralized by the change of level caused by the winds. The wind's influence on the height of the water-level is at many places very distinct and well known. Thus, westerly winds cause a high level of the water in the Kattegat on account of the influx of water from the Skagerak, while easterly winds cause a low level of the water. With the variable winds, so pronounced in our country, the changes in the level of the sea are also very variable; but as certain directions of the wind are predominant at certain seasons, others at other seasons, the average height of the water-level is also different at different periods of the year. From Adam Paulsen a general summary is given here of the average deviations of the water-level at three different places on the Danish coasts from the height of the mean water-level during the twelve months of the year, calculated as the averages of observations made during the years 1889—1902 [1].

The annual variation of the height of the water-level.

Station	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm	cm
Hirshals	—0,3	—4,6	—8,8	**—10,8**	—10,7	—2,2	5,2	7,2	8,8	6,6	3,7	6,6(4)
Frederikshavn	1,2	—4,7	—7,4	**—11,6**	— 9,6	—3,2	3,9	5,5	6,6	6,7	5,3	7,3(5)
Fredericia	0,6	—2,7	—4,5	**— 6,6**	— 5,4	—2,6	1,3	2,8	5,1	6,0	3,4	2,6(2)

The numbers in parenthesis for December indicate the annual mean-height of the water during this month, when the extraordinary mean-height for December 1898 is left out of consideration.

It appears from this, that the lowest water-level at all three places is in April, and it is in agreement with this, that easterly winds according to simultaneous observations are most predominant in April. This condition is of the greatest importance to the upper littoral vegetation, and it is the reason why an upper belt of vegetation, which has grown perfectly well during the course of the winter, is killed every spring.

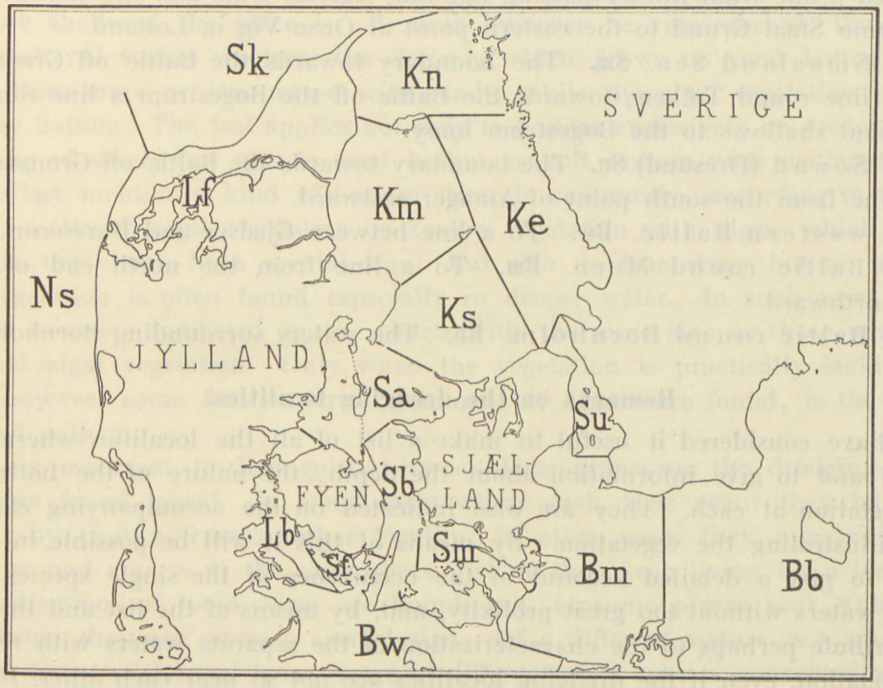
Division of the Danish waters. To facilitate the summary over the distribution of the Algæ, I have not only maintained the ordinary divisions, but have also made further subdivisions in the Kattegat and Baltic. These will be found

[1] Adam Paulsen, Meddelelser om det danske meteorologiske Instituts Vandstandsmaalinger. (Account of the measurements of the height of the sea-level, carried out by the Danish Meteorolog. Institute). Nautisk-Meteorologisk Aarbog 1906, København 1907.

on the present chart, and the boundaries are more exactly indicated below. The limits between the waters are for the most part those commonly accepted (see e. g. "The Danish Pilot"); I have however moved the boundary between the Kattegat and the Sound a little to the south-east for the purpose of including the Ostindiefarer Grund and Søborghoved Grund, and I have moved the southern boundary of the Sound up to the southern point of Amager, as a distinct biological boundary is found nearly at this place.

North Sea. **Ns.** Boundary towards the Skagerak: Hanstholm point.

Skagerak. **Sk.** The boundary towards the Kattegat is a line from Skagen to the Paternoster rocks at Marstrand.



The northern part of the Kattegat. **Kn.** The boundary to the south is a line from Sæby to Læsø north-west Reef, the north coast of Læsø, and a line from the east point of Læsø due east.

The eastern part of the Kattegat. **Ke.** The boundary to the west is marked by the Kobber Grund and a line from its south point to the east point of Anholt and thence to Gilbjerg Hoved on Sealand; the boundary towards the Sound is a line from Nakkehoved to the point of Kullen.

The central part of the Kattegat. **Km.** The boundary to the south is a line from the south point of Anholt to Fornæs Point.

The southern part of the Kattegat. **Ks.** The boundary to the south-west is a line from the end of the Sjællands Odde to Hjelm.

The Samsø area. **Sa.** The boundary towards the Little Belt is a line from Æbelø to Bjørnsknude and towards the Great Belt a line from Fyens Hoved to Refsnæs Point.

The Little Belt (Lillebælt). **Lb.** The boundary to the south is a line from Pøls Huk on Als to Vejsnæs on Ærø, and towards the South Fyen waters a line from Hornenæs to Skjoldnæs.

The South Fyen waters (Sydfynske Øgaard). **Sf.** The boundary towards the Great Belt is a line between Turø Reef and Næs Hoved on Langeland.

The Great Belt (Storebælt). **Sb.** The boundary to the south is a line between Gulstav at Langeland and Kappel church on Lolland, towards the Smaaland Sea a line from Korsør passing Egholm, Agersø, Omø and the south-westerly Omø Staal Grund to the eastern point at Onse Vig in Lolland.

The Smaaland Sea. **Sm.** The boundary towards the Baltic off Grønsund is a line round Tolken, towards the Baltic off the Bøgestrøm a line round the sand shallows to the Bøgestrøm buoy.

The Sound (Øresund) **Su.** The boundary towards the Baltic off Grønsund is a line from the south point of Amager eastward.

The western Baltic. **Bw.** To a line between Gjedser and Darsserort.

The Baltic round Møen. **Bm.** To a line from the north end of Rügen northward.

The Baltic round Bornholm. **Bb.** The waters surrounding Bornholm.

Remarks on the dredging localities.

I have considered it useful to make a list of all the localities where I have dredged and to give information about the depth, the nature of the bottom and the vegetation at each. They are also indicated on the accompanying charts by signs, illustrating the vegetation. By means of this it will be possible in the following to give a detailed account of the occurrence of the single species in the Danish waters without too great prolixity, and, by means of the list and the charts, to contribute perhaps to the characterization of the separate waters with regard to the vegetation, even if the dredging localities are not so near each other, that they can serve as base for a chart showing the distribution of the vegetation. To obtain this, much more numerous observations than I have been able to make are necessary. The Danish waters are so complicated, and the nature of the bottom often so variable from place to place, that it is not possible, from the dredging at one place to draw conclusions as to the conditions at another close by. It may also be remembered, that the aim of my investigations was not so much to determine, to what extent the bottom was overgrown, as to study the distribution and the mode of occurrence of the single species. That is why I have usually preferred to dredge at places where I could expect the bottom to be overgrown. If the result has nevertheless been, that so great a number of the dredging localities have proved to be without vegetation, the reason is, that a relatively large

part of the bottom in the Danish waters is not overgrown, especially in the more open waters. This is especially the case with regard to the North Sea, which is quite without vegetation except at some few places in the most northern part of the region referred to here. In the Skagerak the greater part of the bottom is also quite without vegetation, even on stony bottom Algæ are often lacking. Here and there some small overgrown plots are however found, but it is only at some few places that a more abundant vegetation is found, especially near the land, e. g. at Hirshals and Bragerne. Also in the other waters large tracts are without vegetation, especially the soft bottom, which in the Kattegat and the Baltic extends over wide areas in the greater depths.

A main rule is, that the total quantity of the vegetation is generally the greater the more sheltered the place is. It must however be remembered, that in the more sheltered waters we have the *Zostera*, which grows on sand bottom or on mud bottom more or less mixed with sand[1], while the algal vegetation is found on stony bottom. The last applies not only to bottom exclusively or predominantly consisting of stones but also to sand bottom or soft bottom with scattered stones. On the last mentioned kind of bottom there is commonly, according to the conditions, scattered algal vegetation or *Zostera* vegetation with Algæ, which is indicated on the charts by a special sign. But also on true stony bottom scattered algal vegetation is often found especially in deeper water. In such cases the locality is however indicated on the charts with the same sign as those with uninterrupted algal vegetation. Only when the vegetation is practically lacking, but where however some few scattered specimens of Algæ were found, is the locality indicated with ⊙.

It is important to distinguish between Algæ grown on the dredging locality and those found loose[2]. In some cases where such Algæ occur they have been brought by chance from another locality, in other cases they appear in large quantities and always at the same place, where they keep living for a long time. Such collections of loose Algæ are found e. g. at some places near Anholt and near Møen; they are given a special sign. Of a different nature is a number of more or less transformed loose forms of different algal species connected with the *Zostera* vegetation; probably they have been carried into this vegetation after having been torn loose, but when there have been kept among the *Zostera* plants and have gone on living perhaps for a long time, propagating by division, while reproduction by spores has ceased and the appearance has become more or less transformed[3].

[1] C. H. Ostenfeld, Aalegræssets (*Zostera marina's*) Vækstforhold og Udbredelse i vore Farvande. Beretn. fra den danske biologiske Station. XVI. 1908. (Report from the Danish Biological Station. XVI.)

[2] Such a distinction has not been made in C. G. Johs. Petersen, "Kanonbaaden Hauchs Togter" where the signs indicating the *Zostera*, *Laminaria* and some other higher Algæ in the Kattegat are given on the Atlas, Plate III (1893). In some single cases at any rate, plants are here noted as growing at localities, where according to my experience the bottom is quite without vegetation.

[3] The largest and perhaps the best known is *Ascophyllum nodosum* f. *scorpioides*; of others may also be mentioned: *Phyllophora Brodiæi*, *membranifolia* and *rubens*, *Ahnfeltia plicata*, *Polysiphonia nigrescens* and *violacea*, *Cladostephus verticillatus*, *Halopteris filicina* and *scoparia*, *Sphacelaria cirrosa* etc.

In the following list of the dredging localities are indicated for each locality the most common and predominant species, which above all others contributed to the characterization of the vegetation, the most important first, the less predominant in parenthesis. With regard to the indication of the locality it must be remarked that the bearings are always by compass. Besides the localities mentioned in the list, I have also made collections at many harbour-piers, stone-reefs and at other places near the land, which are for the most part indicated by a mark on the charts together with the name of the place concerned. In the list the localities are arranged for the North Sea from south to north, for the Skagerak and the Limfjord from west to east, for the rest of the waters generally from north to south, or from without inwards, in the Baltic however essentially from west to east. In the Samsø region the area east of Samsø is distinguished from that west of this island. The same method as in the lists will be kept in the following pages. To facilitate the orientation the detailed list is supplemented by a chronologically arranged summary of the dredging localities with indications of the waters where they are situated.

List of stations arranged according to the different waters.

North Sea. (Ns)

aH. 5/8 1905. Vyl light-ship N.W. by W. 1/2 W., 6 miles. — 20 meters. — Fine grey sand with shells. — No vegetation (at the same station Dr. A. C. Johansen took, in 1903, several fresh *Laminaria* together with *Halidrys* and *Furcellaria* in trawl, but it was uncertain whether they were growing on that spot).

aL. 5/8 05. Vyl light-ship S.E. 1/2 S., 6 1/3 miles. — 25 meters. — Coarse sand with small pebbles. — No vegetation.

aI. 5/8 05. Vyl light-ship S.W. 1/4 W., 6 1/3 miles. — 9,5 meters. — Firm coarse sand (with small pebbles). — No vegetation.

aK. 5/8 05. A little more south than aI. — 8 meters. — Coarse sand with pebbles. — No vegetation.

aQ. 8/8 05. A tract immediately N. of the light-buoy at the south end of Slugen (Horns Reef). — 7,5 to 19 meters. — We searched here with grapnel for a wreck and dredged several times, but only bare sand without vegetation was found; the shells were without Algæ.

aN. 5/8 05. Horns Reef light-ship N.W. 2/3 W., a good 6 miles. — About 23 meters. — Sand with small pebbles. — No vegetation.

aM. 5/8 05. Horns Reef light-ship N.W. by W. 1/4 W., 7 miles. — 16,5 to 18 meters. — Coarse sand with a few small pebbles. — No vegetation.

aM 1. 5/8 05. A little more to the south. — 22,5 meters. — Coarse sand. — No vegetation. — 24,5 meters. — Sand, pebbles. — No vegetation.

aR. 8/8 05. Double broom at Søren Bovbjergs Knob S.E. by E. 2/3 E. 1 1/4 miles. — 13 meters. — Sand. — No vegetation.

aS. 8/8 05. The light buoy at the north end of Slugen W.N.W 1/4 W. 3 miles. — 9,5 meters. — Sand. — No veg. (loose *Fucus vesiculosus*).

aP. 5/8 05. Horns Reef light-ship W. 3/4 N. a good 6 1/2 miles. — 11,5 meters. — Sand. — No vegetation.

aO. 5/8 05. 1 mile E. of Horns Reef light-ship. — 30 meters. — Partly sand, partly stony bottom. — No vegetation.

aB. 27/7 05. Off Harboøre; Bovbjerg light-house S. 1/4 W., 6 1/2 miles. — 24,5 meters. — Sand, thereafter stones. — No vegetation.

aA. 27/7 05. Thyborøn beacon E. 1/2 N., ca. 10 miles. — 22 to 25,5 meters. — Coarse sand. — No vegetation.

ZZ. 27/7 05. Thyborøn beacon S.E. by E., 5 miles, 4 miles off land. — 24,5 meters. — Sand. — No vegetation.

aC. 27/7 05. Thyborøn beacon S.E. by S. 1/2 S., 3 miles. — 21 meters. — Sand, firm clay. — No vegetation.

ZR. 24/7 05. Lodbjerg light-house E. 7/8 N., 10 2/3 miles, near the 15 meter shallow. — 28 meters. — Sand. — No vegetation.

aF. 1/8 05. Thyborøn beacon S.E. 1/2 E., 14 1/2 miles. — 31 meters. — Sand with small pebbles to coarse gravel with pebbles. — Vegetation very poor to rather rich: *Ectocarpus siliculosus*, *Brongniartella*, *Chorda Filum* and *Ch. tomentosa*....

ZQ. 24/7 05. Jutland Reef; Lodbjerg light-house E. by S., 26 1/2 miles. — 24,5 meters. — Gravel with small and partly a little larger pebbles. — In two dredgings *Chorda Filum*, (*Laminaria saccharina* and *hyperborea* (?), fragment ...); in one dredging *Phyllophora membranifolia* a. o.

aG. 1/8 05. Thyborøn beacon S.E. 1/2 E., 19 1/2 miles. — 38 meters. — *Ectocarpus siliculosus.*

aD. 27/7 05. Lodbjerg light-house S.E. 3/4 S., ca. 4 1/2 miles. — 23,5 meters. — Stones. — a) *Ectocarpus siliculosus*, *Desmarestia viridis*, *Flustra foliacea* with *Derbesia* a. o. — b) *Ectocarpus*, *Desmarestia aculeata.*

aE. 27/7 05. Lodbjerg light-house S. by W. 1/2 W., 7 1/3 miles. — 16 meters. — Sand. — Some few *Ectocarpus* and *Brongniartella.* (The dredge foul).

XR. 9/8 00. Off Ørhage (by Klitmøller), at most 1 mile off land. — 11 to 13 meters. — Stones. — *Cystoclonium*, *Delesseria sangvinea*, *Spermothamnion.* Vegetation scare, partly wanting.

Skagerak. (Sk)

YT. 7/8 02. N. and W. of Helshage (Hanstholm).

1) N. of the point. — 5,5 to 7,5 meters. — Stones. — Very few Algæ (*Delesseria sangvinea*, *Phyllophora membranifolia*).

2) A little farther from land. — 9 to 11 meters. — Stones. — Very few Algæ (*Phyllophora membranifolia*).

3) A shallow about off the light-house. — About 5,5 meters. — Stones. — Richer vegetation (*Dilsea edulis*, *Laminaria hyperborea*).

4) Farther from land. — About 15 meters. — Stones. — Very scarce Algæ (*Deless. sangvinea*).

5) Another shallow farther S. — About 13 meters. — Stones. — Richer vegetation: *Laminaria saccharina*, *Polyides.*

6) From 5) landward. — 7 to 11,5 meters. — Stones. — Much the same species as in 5) but scarcer, further *Laminaria hyperborea.*

YU. $^{8}/_{8}$ 02. At Roshage (Hanstholm), near land.

1) Immediately E. of Roshage, on a dry rock near land, the bottom in a depth of 2 meters. — *Polysiphonia Brodiæi* (at the upper level), *Polys. nigrescens*, species of *Ceramium* ....

2) Eastside of Roshage, near land. — About 2 meters. — Stones. — Abundant vegetation: *Spermothamnion Turneri*, (*Chondrus*, *Corallina off.*).

3) Inside the rock [1)]. — 1,5 meters. — Stones. — Rich vegetation: *Chorda Filum*, *Ceramium rubrum*. ...

4) Off Roshage and from thence along the shore towards the landing-place. — 2 to 2,5 meters. — *Ceramium rubrum*, *Cystoclonium*, *Polysiphonia*; in some places *Laminaria digitata*; on the W. shore *Gracilaria confervoides*.

YM. $^{10}/_{7}$ 02. The W. and S. part of Bragerne (a bank). — 2,5 meters. — Stones. — 1) *Florideæ*, rather scarce (*Rhodomela*, *Polysiphonia violacea* var. *fibrillosa*, *Corallina off.*). — 2) The same Algæ and *Laminaria hyperborea*).

YM^{1}. $^{10}/_{6}$ 02. Bragerne. — 1 to 2 meters. — Stones. — *Mesogloia*, *Ceramium fruticulosum*, *Laminaria digitata* and *saccharina*, *Fucus serratus*, *Cystoclonium*, *Corallina off.* — 1 meter: *Laminaria*, *Punctaria*, *Spongomorpha*.

YN. $^{10}/_{6}$ 02. Immediately inside Bragerne. — 4,5 meters. — Stones. — *Fucus serratus*, *Laminaria digitata*.

YN^{1}. $^{10}/_{6}$ 02. A little nearer to land. — 6,5 meters. — Stones. — *Chorda Filum*, *Brongniartella*.

YN^{2}. $^{10}/_{6}$ 02. S.E. of Bragerne. — 10,5 meters. — Stones. — *Laminaria hyperborea*, *Chorda Filum*, *Phylloph. Brodiæi*, *rubens*, *Spermothamnion*, *Corallina offic.*

YN^{3}. $^{10}/_{6}$ 02. S.E. of Bragerne, near land, towards Sandnæshage. — About 2 meters. — Sand and boulders. — Almost no Algæ (*Polysiphonia elongata*).

SZ. $^{21}/_{8}$ 94. About 2 miles N.W. of Løkken. — Stones. — No vegetation.

SY. $^{19}/_{8}$ 94. About 1 mile N. of Løkken. — ca. 13 meters. — Stones. — Scarce vegetation, mostly *Cystoclonium*, *Rhodomela* and *Spermothamnion*.

ZK$^{0-13}$. $^{2-4}/_{8}$ 04. Off Lønstrup.

0) W. side of Mellemgrund, 1,5 miles from land. — 7,5 to 9,5 meters. — Stones. — *Halidrys*, *Cystoclonium*.

1) N. end of Stenrimmen, 2 miles from land. — ca. 7,5 to 9,5 meters. — *Laminaria digitata*, *saccharina*, *Halidrys*; *Florideæ*, mostly *Corallina offic.*, *Furcellaria*.

2) E. end of Mellemgrund. — 7,5 to 9,5 meters. — Stones. — *Laminaria hyperborea*, *Halidrys*, *Florideæ*.

3) Mellemgrund. — 13 to 15 meters. — Stones. — Some few *Halidrys* and single *Florideæ*.

4) Grønne Grund 1 mile from land. — 9,5 to 11,5 meters. — Stones. — *Halidrys*, *Florideæ*, particularly *Cystoclonium*, *Phyllophora membranifol.*, further *Laminaria hyperborea* and *saccharina*.

5) Palen, abreast of Rubjergknude light-house, 1 mile from land. — ca. 11 meters. — Stones. — Veg. as in 4).

6) Shallow off the landing-place. — 11 to 13 meters. — Firm clay with stones. — *Phyllophora membranif.*, *Furcellaria*, *Laminaria*.

7) E. end of Rimmen, abreast of Rubjergknude light-house, about 4 miles from land. — 17 to 19 meters. — Stones. — *Halidrys*, *Laminaria sacchar.* and *hyperborea*. — Later, clay with pebbles and scarce Algæ, mostly *Heterosiphonia coccinea*.

8) A little more S. — Sand without vegetation.

9) Stenrimmen, about 4 miles from land. — 13 meters. — Stones. — Few Algæ; *Halidrys*, single *Florideæ*.

10) Mellemgrund, something more than 2 miles from land. — 11,5 meters. — Stones. — *Halidrys*, *Laminaria hyperb.*, *Cystoclonium*.

11) Graagrund, off Maarup church, about 1,5 miles from land. — 9,5 meters. — Stones. — Rather scarce vegetation: *Halidrys*, (*Lomentaria clavellosa*, *Cystoclonium*).

12) Kongshøj Grund, off Maarup church, 1 mile from land. — 8,5 meters. — Stones. — *Cystoclonium*, (*Polyides*, *Deless. sangvin.*, *Halidrys*).

13) Near land, immediately N. of the landing-place. — 1 meter. — Stones, clay; *Mytilus*, acorn-shells. — Various *Florideæ*, as species of *Polysiphonia*, *Gracilaria confervoides*.

YL. 1/8 01. Hirshals light-house S.E. 2,5 miles (Pullen). — 13 meters and something more. — Stones. — *Halidrys* with *Florideæ*.

YL[1]. 1/8 01. Hirshals light-house S.E. 1,5 miles. — Stones. — A few specimens of *Brongniartella byss.*

21/5 02. Hirshals light-house S.E., ca. 1 mile (the church between the hills). — Stones. — *Flustra foliacea* with various small Algæ, *Delesseria sangvinea* (scarce *Halidrys*, *Cystoclonium*).

21/5 02. N. and W. end of Bredegrund, N.W. of Hirshals. — ca. 11 meters. — Stones. — Few Algæ (*Halidrys*, *Cystoclonium*, *Laminaria hyperborea*).

21/5 02. Within Bredegrund. — 19 meters. — Stones. — One specimen of *Halidrys*.

21/5 02. The channel within the stony shallows N.W. of Hirshals. — 19 meters. — Clay. — No vegetation.

YK. 1/8 01. Hirshals light-house in S.S.E. 2 miles (the church on the brook). — 14 meters. — Stones. — *Cystoclonium*, *Brongniartella*, *Laminaria digitata*. — 15 meters. — *Flustra foliacea* with few Algæ.

XO. 8/8 99. Møllegrund by Hirshals, ca. 1/2 mile from land. — 11 to 15 meters. — Stones. — *Laminaria hyperborea* and *Halidrys*, (*Laminaria saccharina*).

21/5 02. Off the brick-works at Hirshals, near land. — 6,5 meters. — Sand with stones. — *Rhodomela*, *Polysiphonia nigrescens*.

21/5 02. Off the marine hotel at Hirshals. — 4,5 meters. — Stones. — *Polyides*.

VJ. 12/6 95. Off Hirshals, W. of the mole. — 4,5 meters. — Stones alternating with sand. — On the stones *Polyides* and *Furcellaria*.

bD. 6/7 07. 13 miles N.N.W. 1/2 N. of Hirshals; 57°46′ N., 9°44′ E. — 32 meters. — Soft bottom. — No vegetation.

bC. 6/7 07. Hirshals light-house S. 1/2 W. 12 miles. — 45 meters. — Soft bottom, ooze. — No vegetation.

bE. 6/7 07. 6 miles N.E. by N. of Hirshals. — 23 meters. — Coarse sand. — No vegetation.

bF. 6/7 07. Skagbanken; 9 miles N.E. by E. of Hirshals. — 16,5 meters. — Sand. — No vegetation.

bB. 5/7 07. Skagens light-house E. 10 miles; Lat. N. 57°41′,5, Long. E. 10°20′. — 24 meters. — Stones and sand. — No vegetation.

bG. 9/7 07. Northside of Skagens Gren, N.N.W. of Skagens light-house. — 5,5 to 17 meters. — Sand. — Few loose Algæ.

15/8 03. Between Gammel Skagen and the Siren, within the first shoal. — Small pebbles. — *Chorda Filum*, *Polysiphonia nigrescens*.

bG. $^{15}/_{8}$ 03. Between first and second shoal. — 3,5 to 4,5 meters. — Small pebbles. — *Polysiphonia nigrescens*, *Ceramium rubrum*.

$^{16}/_{8}$ 03. Between Gammel Skagen and Højens light-house; between first and second shoal. — 3,5 to 5,5 meters. — Small stones. — Few Algæ, mostly species of *Polysiphonia*, (acorn-shells and young *Mytilus*).

Limfjord. (Lf)

ZS. $^{25}/_{7}$ 05. Under the land at Kobberød. — 2 to 4 meters. — Stones. — *Fucus serratus*.

ZV^{1}. $^{26}/_{7}$ 05. In the middle of Nissum Bredning; the broom for Mullerne E. 2,5 miles. — 5 meters. — Soft bottom. — *Cladophora gracilis*. (*Ciona canina* in abundance).

ZV^{2}. — A little farther N.; the broom E. by S. $^{1}/_{2}$ S. 2,5 miles. — (Small shells, *Ophioglypha albida*, often infested by a *Dactylococcus*).

LY. $^{24}/_{8}$ 93. Between Gellerodde and Inderrøn near Lemvig. — 3 to 3,5 meters. — Sand with spots of loose *Furcellaria*, (*Cladophora*, *Phyllophora Brodiæi*).

M. $^{9}/_{9}$ 90. Søndre Røn near Lemvig. — 1 meter. — Stones. — *Fucus vesicul.*, here and there *Zostera*.

ZU. $^{26}/_{7}$ 05. W. of the N. end of Rønnen near Lem Vig. — 3 meters. — Stones. — *Fucus vesicul.* — Thereafter (northward) 4 meters — sand with *Ciona canina* and *Fucus serratus*.

LX. $^{24}/_{8}$ 93. Rønnen, a reef near Lem Vig. — Uppermost *Fucus vesicul.*; — 2 to 4 meters *Fucus serratus*; — 4 to 5,5 meters broad-leaved *Zostera*.

ZT. $^{25}/_{7}$ 05. Off Østerbol. — about 4 meters. — *Zostera*, and a little farther out loose *Furcellaria* and *Cladophora gracilis* in great quantities.

XV. $^{19}/_{6}$ 01. N. of Rønnen by Lem Vig. — Oysters, *Furcellaria*.

XX. $^{19}/_{6}$ 01. Midway between XV and Mullerne. — 5,5 meters. — *Furcellaria*, (*Cladophora gracilis*).

LZ. $^{26}/_{8}$ 93. Off Røjens Odde. — 4 meters. — Clay-mud with a few stones. — No vegetation.

ZX. $^{26}/_{7}$ 05. Immediately E. of the broom at Mullerne. — 6,5 meters. — Soft bottom. — *Cladophora gracilis*.

ZY. $^{26}/_{7}$ 05. Nearer to land. — 4,5 meters. — Stones and soft bottom. — *Zostera*, *Fucus serratus*.

XY. $^{19}/_{6}$ 01. Near Mullerne. — 6,5 meters. — Soft bottom with stones. — *Fucus serratus*, (sparingly *Zostera*).

MA. $^{26}/_{8}$ 93. Off Jestrup. — 5 meters. — Stones. — Scarcely any vegetation, only single specimens of *Fucus serratus*, *Chorda Filum* and *Desmarestia aculeata*.

LV. $^{24}/_{8}$ 93. Off Nissum Huk. — 5,5 meters. — Clay-mud mixed with sand, with stones and oysters. — No plants.

LU. $^{24}/_{8}$ 93. Off Kamstrup Røn. — Scarcely 7,5 meters. — Clay-mud without plants (a few *Cladophora gracilis*).

XU. $^{19}/_{6}$ 01. Immediately W. of Oddesund-Nord. — 4 meters. — Sand with single stones. — *Fucus serratus*, (*Halidrys*).

MB. $^{26}/_{8}$ 93. S.W. of Oddesund-Nord. — 6,5 meters. — At first bare sand, then clay-mud with single Florideæ and, rather abundantly, loose *Cladophora gracilis*.

MD. $^{26}/_{8}$ 93. Studemilen, right opposite Doverodde. — Thick *Zostera* vegetation everywhere; up on the bank also stones with *Fucus vesiculosus*.

ME. $^{27}/_{8}$ 93. Off Skjoldborg (Thy), near the shoal. — 7,5 meters. — Soft bottom without vegetation.

MF. $^{27}/_{8}$ 93. Sundby Stengrund, at the N. side of Mors. — Stones. — *Chorda Filum.*

MG. $^{27}/_{8}$ 93. Stony reef by Hanklit. — *Fucus vesiculosus*, covered with *Melobesia*, *Lithophyllum pustulatum* and *Laurencia pinnatifida*. — Outside the reef *Zostera*.

MH. $^{28}/_{8}$ 93. Bank off Skrandrup, Thisted Bredning. — Stones. — *Fucus vesiculosus*, (*Chorda Filum*, *Corallina offic.*).

I. $^{8}/_{9}$ 90. Venø Bugt, off Nørskov, Venø. — 3,5 meters. — Stony bottom with *Zostera*, (few Algæ, *Phyllophora membranifol.*).

K. $^{8}/_{9}$ 90. Venø Bugt, off Nørskov, Venø, N. of Venø Tap. — 4,5 to 5,5 meters. — *Furcellaria* and *Phylloph. membranif.*

L. $^{8}/_{9}$ 90. Venø Bugt, Nygaards Hage. — 3,5 meters. — Stones. — *Zostera*, (*Furcellaria*, *Phyllophora membranif.*).

XT. $^{19}/_{6}$ 01. South side of Jegindø Tap. — 4,5 meters. — Clay. — *Zostera*, (loose *Furcellaria*).

MC. $^{26}/_{8}$ 93. Jegindø Tap, immediately W. of the broom. — 6,5 meters. — Clay-mud without veg.

MC^{1}. $^{26}/_{8}$ 93. East side of Jegindø. — From shallow water to 4 meters depth *Zostera*, farther out clay-mud without vegetation.

H. $^{6}/_{9}$ 90. Kaas Bredning, off Sillerslev, Mors. — 7,5 meters (?). — Clay-mud without vegetation.

XN. $^{14}/_{7}$ 99. Sallingsund, immediately S. of Glyngøre. — 4 to 9 (?) meters. — Stones, oysters. — *Chorda Filum*, *Fucus vesiculosus*.

XM. $^{13}/_{7}$ 99 and $^{21}/_{6}$ 06. Off Snabe. — 4 to 5,5 meters. — *Zostera* and stones with *Fucus vesiculosus*, *Chorda Filum* etc.

XY^{1}. $^{25}/_{6}$ 01. Vodstrup Hage (Skælholm) near Nykøbing. — Stones. — *Fucus vesic.*, *Rhodomela*, *Furcellaria* (loose).

LT. $^{22}/_{8}$ 93. Immediately outside the broom at Vodstrup Hage. — Ca. 5,5 meters. — Firm bottom with *Zostera*, (*Polysiphonia nigrescens*).

LS. $^{22}/_{8}$ 93. Off Alsted (Arnakke), Mors. — 5 meters. — Clay-mud with dead shells. — *Florideæ*, particularly *Polysiphonia nigrescens*.

LS^{1}. — Nearer to land. — 1 to 3 meters. — Stones with *Fucus vesiculosus*; in some places also *Zostera*; farther out clay-mud with scarce *Florideæ*.

aT. $^{22}/_{6}$ 06. Outer part of Draaby Vig, off Alsted church. — 4 to 5,5 meters. — Soft bottom with *Zostera* and *Furcellaria*; in other places stones and oysters but few Algæ, farther out, 7,5 meters — soft bottom with shells, without vegetation.

MF. $^{28}/_{8}$ 93. Løgstør Bredning, off Ejerslev. — From land to 4 meters depth clayey sand with *Zostera*; in shallow water stones with *Fucus vesiculosus*.

MK. $^{28}/_{8}$ 93. Holmtunge Hage. — Stony reef with *Fucus vesiculosus*, here and there *Zostera*.

LQ. $^{22}/_{8}$ 93. Lendrup Røn. — Stones. — *Fucus vesiculosus*, (*Fucus serratus*, *Laurencia pinnatifida*).

LR. $^{22}/_{8}$ 93. E. of Livø. — 6,5 meters. — Soft bottom. — *Zostera*.

F. $^{5}/_{9}$ 90. Skive Fjord, North side of Lundø Hage. — Ca. 5,5 meters. — Soft bottom. — No vegetation.

F^{1}. — On the bank. — 3 meters. — *Zostera*, (a few loose *Furcellaria* and *Phyllophora Brodiæi*).

G. $^{5}/_{9}$ 90. Off Skive. — 3,5 meters. — *Zostera* (a few loose *Furcellaria*). — On bare bottom loose clumps of *Furcellaria*, (*Phyllophora Brodiæi*, *Cladophora gracilis*).

E. $^{4}/_{9}$ 90. Louns Bredning, W. of Trangmanden. — 5,5 meters. — Soft bottom. — Loose Algæ: *Cladophora gracilis*, (*Rhodomela*, *Phyllophora Brodiæi* etc.).

E^{1}. — A little farther northwards. — Same depth and bottom, similar vegetation.

ML. $^{29}/_{8}$ 93. Outside the broom near Klitgaard in Gjøl Bredning. — Thick broad-leaved *Zostera* vegetation with *Melobesia Lejolisii* and some *Ceramium rubrum*.

Kattegat, Northern part. (Kn)

bH. $^{9}/_{7}$ 07. 8 miles S.E. by E. $^{1}/_{2}$ E. of Skagen. — 30 meters. — Soft bottom. — No vegetation.

FG. $^{13}/_{7}$ 92. Herthas Flak. — 19 to 22,5 meters. — Stones, gravel. — *Laminaria saccharina*, *Desmarestia aculeata*, (*Deless. sangvin.*, *Cystoclonium*).

XI. $^{29}/_{7}$ 96. Herthas Flak. — 20 to 22,5 meters. — Gravel and stones. — *Lamin. sacch.*, *Desmar. acul.*, *Deless. sangv.*, *Ceram. rubrum*, *Callithamnion corymbosum*, *Sporochnus*. (Vegetation spread).

— $^{14}/_{7}$ 05. — 20,5 to 24,5 meters. — The bottom alternately clay-mud and gravel with single stones; on these some few incrusting Algæ, for the rest nearly no vegetation (repeated dredgings).

bI. $^{9}/_{7}$ 07. S.E. of Herthas Flak; 11 miles S.E. $^{1}/_{4}$ S. of Skagen. — 26,5 meters. — Clay-mud. — No plants.

IZ. $^{15}/_{5}$ 93. Skagens light-house N.N.W. $^{4}/_{5}$ W. a good 7 miles. — About 24,5 meters. — No vegetation (seine).

IY. $^{15}/_{5}$ 93. Hirsholm light-house S.W. by S. a good 5 miles. — 22,5 meters. — Clay-mud. — No vegetation.

KA. $^{15}/_{5}$ 93. Hirsholm light-house S. by E. $^{1}/_{2}$ E. a good 5 miles. — 13 meters. — Fine sand. — scarce *Zostera* (seine).

TV. $^{1}/_{10}$ 04. Krageskovs Rev, northern shoal. — Stones and sand. — 5 meters. — Abundant vegetation: *Halidrys*, *Fucus serratus*, *Laminaria sacch.*, *Furcellaria*, (*Corallina off.*).

KC. $^{15}/_{5}$ 93. Krageskovs Rev, southern shoal. — 4 to 5,5 meters. — Stones. — Abundant vegetation: *Halidrys*, *Fucus serratus*, *Laminaria digitata*.

KB. $^{15}/_{5}$ 93. Off Snedkergaarde. — 4,5 meters. — Fine bare sand with only a few spots most probably of *Zostera*.

TX. $^{2}/_{10}$ 94. Inside the broom N. of Græsholm (Hirsholmene). — 7,5 to 9,5 meters. — Stones. — Dense vegetation: *Halidrys*, *Fucus serratus*, *Laminaria hyperborea*.

— $^{5}/_{1}$ 95 and $^{24}/_{7}$ 95. Same vegetation; of predominant species further *Laminaria digitata* and *saccharina*, *Furcellaria*.

YR. $^{31}/_{7}$ 02. Naamands Rev N. of Græsholm. — Stones. — *Halidrys*, *Laminaria digitata*.

XK. $^{4}/_{7}$ 99. N.E. of Græsholm. — 7,5 to 11,5 meters. — Stones. — *Laminaria hyperborea*....

YS[1]. $^{31}/_{7}$ 02. E. of the broom N. of Græsholm. — Ca. 9 meters (?). — Soft bottom. — No vegetation.

YS[2]. $^{31}/_{7}$ 02. The broom N. of Græsholm W.S.W. ca. 1 mile. — 15 meters. — Clay-mud with snails etc. — On the snail-shells some Algæ (*Antithamnion*, *Polysiphonia atrorubescens*, *P. elongata* a. o.).

YX. $^{11}/_{7}$ 04. E. of the broom at N.E. reef by Hirsholm. — 22,5 to 28 meters. — Soft bottom. — On mollusc shells: *Polysiphonia atrorubescens*, *P. elongata* a. o. Algæ.

TU. $^{1}/_{10}$ 94 and $^{5}/_{1}$ 95. At the broom at N.E. reef by Hirsholm. — ca. 9,5 meters. — Sand and stones. — *Laminaria saccharina*, (*Desmarestia aculeata*, *Laminaria hyperborea*).

— $^{11}/_{7}$ 04. Same place, but within the broom. — 7,5 to 9,5 meters. — Stones. — *Laminaria hyperborea*, *L. sacchar.*, *Furcellaria* a. o. *Florideæ*.

TU. $^{11}/_{7}$ 04. Outer side of the same reef. — 9,5 to 11,5 meters. — Soft bottom and gravel (?). — *Stictyosiphon, Striaria* a. o.

NF. $^{21}/_{9}$ 93. Immediately outside the harbour of Hirsholm. — 4 meters. — Sand. — *Zostera.*

TY. $^{2}/_{10}$ 94.. The bank S. of Hirsholm. — 7,5 meters. — Sand and single stones. — Scattered *Zostera.*

NE. $^{21}/_{9}$ 93. Off Lerbæk. — 5,5 meters. — Gravel. — *Zostera.*

YQ. $^{25}/_{7}$ 02. E. side of Kølpen. — 2 to 5,5 meters. — Stones. — Abundant algal vegetation: *Fucus vesicul., F. serratus, Chorda Filum, Halidrys, Laminaria sacchar., L. digit....*

XG. $^{2}/_{8}$ 95. E. of Deget. — 4 to 5,5 meters. — Stones. — *Halidrys, Fucus serr., Florideæ, (Laminaria hyperb.).*

GO. $^{23}/_{9}$ 92. Outside Busserev near Frederikshavn. — 3 meters and more. — Stones. — *Fucus serratus, Halidrys, (Laminaria digitata).*

UD. $^{5}/_{1}$ 95. Marens Rev. — 4,5 to 5,5 meters. — Stones. — *Halidrys, (Laminaria digit., sacchar., Fuc. serr.).*

XH. $^{9}/_{7}$ 96. The beacon buoy at Marens Rev W. by S. ca. 1 mile. — 15 meters. — Clay-mud with snails (*Turritella, Aporrhais.*). — On the shells *Polysiphonia atrorubescens.*

XL. $^{8}/_{7}$ 99.. The buoy at Marens Rev W. by N. a good 1,5 miles. — 19 to 20,5 meters. — Clay-mud. On *Aporrhais* and *Turritella*: *Polysiphonia atrorubescens, Stictyosiphon tortilis, Antithamnion, Sphacelaria.*

FH. $^{15}/_{7}$ 92. Borrebjergs Rev, near the triple broom. — 4 to 7,5 meters. — Sand. — *Zostera.*

YP^{1}. $^{25}/_{7}$ 02. Outside Laurs Rev. — Stones. — *Halidrys* (with *Ectocarpus*).

YP^{2}. $^{25}/_{7}$ 02. Borrebjergs Rev. — Stones. — *Halidrys, (Laminaria digitata* and *sacchar.).*

YP^{3}. $^{25}/_{7}$ 02. Laurs Rev. — Stones. — *Halidrys, Lamin. digit., hyperb.* and *sacchar.*

TZ. $^{3}/_{1}$ 95. Between Borrebjergs Rev and Laurs Rev. — No vegetation.

YO. $^{20}/_{7}$ 02. 1 mile S.E. of Laurs Rev. — Soft bottom. — Dead *Zostera*-leaves.

$^{13}/_{7}$ 05. In the deep channel N.W. of Læsø. — Soft bottom. — No Algæ.

BP. $^{24}/_{8}$ 91. Off Sæby. — 7 meters. — Firm clayey sand. — In spots *Zostera.*

TM. $^{27}/_{9}$ 94. Nordre Rønners light-house S.E. by S. 2,6 miles. — 13 meters. — Sand without vegetation.

VT. $^{3}/_{7}$ 95. Nordre Rønners light-house S. scarcely 2,5 miles. — 9,5 meters. — Sand. — *Zostera, Fucus serratus, Florideæ, (Laminaria sacchar.).*

UA. $^{3}/_{1}$ 95. Nordre Rønners light-house S. scarcely 2 miles. — 11,5 meters. — No plants.

TI. $^{26}/_{9}$ 94. Nordre Rønners light-house E.S.E. scarcely 1,5 miles. — 12,5 meters. — Firm clay with stones. — *Laminaria sacchar., Desmarestia acul.* a. o. (vegetation not abundant).

TL. $^{27}/_{9}$ 94. Nordre Rønners light-house E. by N. $^{1}/_{4}$ N. $1^{1}/_{3}$ miles. — 7,5 meters. — Stones. — Rich vegetation: *Fucus serratus* and *Florideæ.*

— — Nearer to the reef. — 4 to 5,5 meters. — Sand with stones. — Alternately sand without vegetation or with scarce *Zostera*, or stony bottom with various Algæ.

TK. $^{26}/_{9}$ 94. Nordre Rønners light-house E. by N. $2^{2}/_{3}$ miles. — 9,5 meters. — Sand. — *Zostera.*

KD. $^{15}/_{5}$ 93. At the beacon-buoy at Nordvestrevet, Læsø. — 11,5 to 22,5 meters. — Sand to sandy clay-mud. — No vegetation.

ZP. $^{15}/_{7}$ 05. The broom N.E. of Nordre Rønner S. $^{1}/_{2}$ E. 1 mile. — 11,5 meters. — Sand with stones. — *Zostera, Halidrys,* (scarce *Fucus serratus*).

NG. $^{21}/_{9}$ 93. N. of Nordre Rønner. — 4 meters. — Stones. — Abundant vegetation: *Halidrys, Fucus serratus, (Laminaria digitata, Fucus vesiculosus).*

UC. $^{3}/_{1}$ 95. At the broom N.E. of Nordre Rønner. — ca. 9,5 meters. — Stones. — *Halidrys*, *Fucus serratus*, (*Florideæ*, *Laminaria digitata*).

VU. $^{3}/_{7}$ 95. Nordre Rønners light-house S.W. by W. $^{3}/_{4}$ W. 2,5 miles. — 15 meters. — Stones. — *Halidrys*, *Cruoria*.

GL. $^{21}/_{9}$ 92. $^{1}/_{2}$ mile E. of the broom at Nordre Rønner. — 9,5 meters. — Sand without vegetation.

GN. $^{21}/_{9}$ 92. Anchoring ground at the E. side of Nordre Rønner. — Ca. 4 to 5 meters. — Stones. — *Fucus serratus*, (*Halidrys*, *Laminaria digitata* and *sacchar.*).

UB. $^{3}/_{1}$ 95. Nordre Rønners light-house W.N.W. $2^{2}/_{3}$ to $3^{1}/_{2}$ miles. — Here and there stones. — *Halidrys*, *Fucus serratus*, *Florideæ* mostly *Furcellaria* and *Corallina*, (*Zostera*).

TH. $^{26}/_{9}$ 94. Nordre Rønners light-house W.N.W. $^{1}/_{4}$ N. a good 3 miles. — 10,5 meters. — Sand. — *Fucus serratus*, (*Florideæ*, *Zostera*).

ZL. $^{5}/_{7}$ 05. 3 miles S.E. by E. of Nordre Rønner. — 6,5 meters. — Sand with stones. — *Fucus serratus*, (*Fuc. vesiculosus*, *Halidrys*).

ZL^{1}. — Near the preceding. — 9,5 meters. — Similar vegetation but moreover *Zostera* and *Desmarestia acul.*

ZL^{2}. — Near the preceding. — 11,5 meters. — Stones. — Similar vegetation, in abundance *Furcellaria* and *Corallina off.*

TN. $^{27}/_{9}$ 94. Trindelen light-ship E.S.E. $5^{1}/_{3}$ miles. — 12 meters. — Sand. — No vegetation.

NH. $^{21}/_{9}$ 93. Trindelen light-ship E. $5^{1}/_{2}$ miles. — 15 meters. — Gravel. — Almost no vegetation.

ZM. $^{5}/_{7}$ 05. Ca. $4^{1}/_{2}$ miles E. $^{3}/_{4}$ N. of Nordre Rønner. — 15 meters. — Gravel and small pebbles. — Almost no Algæ.

IX. $^{12}/_{5}$ 93. Trindelen light-ship N.E. $^{2}/_{3}$ E. 4 miles. — ca. 19 meters (in the channel). — *Desmarestia acul.*, *Laminaria sacch.*, (*Halidrys*).

GM. $^{21}/_{9}$ 92. At Engelskmands Banke. — Ca. 5,5 meters. — Stones. — *Fucus serratus*, *Chorda Filum*, *Florideæ* (*Phyllophora*).

— $^{3}/_{7}$ 95. Stony reef by Jegens Odde. — 2 to 4 meters. — *Fucus serratus* with *Polysiphonia violacea*, *Halidrys*. — On a dry rock particularly *Chordaria flagelliformis*, *Ahnfeltia*, *Spermothamnion*, *Chondrus*.

TG. $^{26}/_{9}$ 94. Syrodde Pynt (Læsø) S.S.E. $1^{1}/_{2}$ miles. — 9,5 meters. — Sand. — *Halidrys*, *Fucus serratus*, *Florideæ*, mostly *Furcellaria*, (*Zostera*).

TO. $^{27}/_{9}$ 94. Tønneberg Banke; Trindelen light-ship S. $2^{1}/_{2}$ miles. — 18 meters. — Stones. — *Laminaria saccharina* (large specimens) and *Florideæ*.

TP. $^{27}/_{9}$ 94. Tønneberg Banke; Trindelen light-ship S.S.W. $^{1}/_{2}$ W. $2^{1}/_{2}$ miles. — 16 meters. — Sand (?) with stones. — *Florideæ*, *Halidrys*, *Laminaria saccharina*.

ZA. $^{26}/_{7}$ 04. Tønneberg Banke; Trindelen light-ship S.W. by S. 2 miles. — 12 to 18 meters. — Stones. — *Desmarestia aculeata*, *Halidrys*, *Brongniartella*, *Fucus serratus*, later *Laminaria sacchar.*

YZ. $^{26}/_{7}$ 04. Kummel Banke; Trindelen light-ship S.W. by W. $^{3}/_{4}$ W. $3^{3}/_{4}$ miles. — 38 meters. — Clay. — No Algæ.

NK. $^{21}/_{9}$ 93. Kummel Banke. — 28 to 30 meters. — Gravel. — No vegetation.

ZB. $^{26}/_{7}$ 04. Trindelens light-ship W. by S. $^{3}/_{4}$ S. $2^{1}/_{2}$ miles. — 28 to 30 meters. — Gravel, shells. — *Lithothamnion calcareum*, *Corallina offic.*, *Furcellaria*, *Rhodomela*.

FF. $^{13}/_{7}$ 92. Double broom at Trindelen S. by W. $^{1}/_{2}$ W. $^{1}/_{2}$ mile. — 15 meters. — Stones. — *Halidrys*, *Laminaria sacchar.*, (*Florideæ*).

FE. $^{13}/_{7}$ 92. Trindelen, immediately E. of the double broom. — 9,5 to 11,5 meters. — Stones. — *Fucus serratus*, (*Laminaria*, *Furcellaria*).

NI. $^{21}/_{9}$ 93. Trindelen. — 9,5 to 10,5 meters. — Stones. — *Halidrys*, *Fucus serratus*, *Florideæ*; abundant vegetation.

TQ. $^{27}/_{9}$ 94. At Trindelen light-ship. — Stones, mostly rather small. — Incrusting Algæ, e. gr. *Lithoderma*, *Cruoriella Dubyi*, (other Algæ scarce).

TR. $^{27}/_{9}$ 94. Trindelen light-ship N.W. $1^{1}/_{4}$ miles. — 23,5 meters. — Stones. — Incrusting Algæ e. gr. *Lithoderma*, *Cruoria pellita*, *Aglaozonia* ..., (*Desmarestia acul.*, *Laminaria sacch.*).

IV. $^{12}/_{5}$ 93. Triple broom S. of Trindelen E. by S. $^{1}/_{2}$ mile. — Ca. 11 meters. — Sand. — No vegetation.

VV. $^{3}/_{7}$ 95. E. of the triple broom S. of Trindelen. — 32 to 36 meters. — Clay-mud (?). — No vegetation.

VX. $^{3}/_{7}$ 95. Bøchers Banke. — 29 meters. — Gravel. — Almost no Algæ (scarce *Laminaria sacch.*, *Desmarestia acul.*, *Odonthalia*).

Kattegat, eastern part. (Ke)

FD. $^{13}/_{7}$ 92. E. of Flyndergrund, E. of Læsø, Lat. N. 57°16′25″, Long. E. 11°15″. — 9,5 to 11,5 meters. — Dark sand. — In spots *Zostera*.

FC. $^{13}/_{7}$ 92. E. of Flyndergrund, Lat. N. 57°16′10″, Long. E. 11°16′6″. — 17 to 18 meters. — Soft bottom. — Molluscs with single Algæ.

FB. $^{13}/_{7}$ 92. E. of Flyndergrund, Lat. N. 57°15′45″, Long. E. 11°18′. — 30 to 36 meters. — No vegetation.

EY. $^{12}/_{7}$ 92. Kobbergrundens light-ship E. by S. $^{4}/_{5}$ mile. — 13 meters. — Fine sand. — No plants.

ZH. $^{29}/_{7}$ 04. North end of Groves Flak; Kobbergrundens light-ship W. $^{1}/_{2}$ S. $6^{3}/_{4}$ miles (?). — 32 meters. — Soft bottom, partly firm clay, also pebbles. — Scarce vegetation: *Laminaria sacch.*, single *Delesseria sinuosa*.

ZI. $^{29}/_{7}$ 04. North end of Groves Flak; Kobbergrundens light-ship W. $4^{2}/_{3}$ miles. — 26,5 meters. — Stones and gravel, shells. — Almost no Algæ.

EX. $^{12}/_{7}$ 92. Groves Flak, Lat. N. 57°7′30″, Long. E. 11°31′40″. — 26,5 meters. — Sand. — Scarce algal vegetation.

VZ. $^{5}/_{7}$ 95. Groves Flak, Lat. N. 57°6′18″, Long. E. 11°32′40″. — 24,5 meters. — Gravel and stones. — Incrusting Algæ: *Cruoria pellita*, *Cruoriella Dubyi* (*Lamin. sacch.* overgrown with *Membranipora*, *Desmarestia aculeata*).

IR. $^{12}/_{5}$ 93. Groves Flak; Kobbergrundens light-ship N.W. by W. a good 8 miles. — 24,5 meters. — Stones. — *Cruoria pellita*, (*Desmarestia acul.*).

IS. $^{12}/_{5}$ 93. Groves Flak; Kobbergrundens lightship N.W. a good 7 miles. — 22,5 meters. — Sand. — *Desmarestia aculeata*, (*Laminaria sacch.*).

IT. $^{12}/_{5}$ 93. Groves Flak, S.W. border; Kobbergrundens light-ship N.W. $^{1}/_{2}$ N. 7 miles. — 24,5 meters. — *Desmarestia acul.*, *Deless. sangvin.* (trawl).

IU. $^{12}/_{5}$ 93. Same place. — 30 to 38 meters (seine). — *Desmarestia acul.*, (*Delesseria sangvin.*).

EV. $^{12}/_{7}$ 92. South end of Groves Flak, Lat. N. 57°4′50′ , Long. E. 11°35′. — 22,5 meters. — Stones. — *Laminaria sacch.*, (*Lamin. digit.*, *Desmarestia acul.* and *viridis*, *Florideæ*.).

IL. $^{12}/_{5}$ 93. Fladen, Nidingen N. E. $^{1}/_{2}$ N. a good 4 miles. — 24,5 meters. — Stones and gravel. — *Lithothamnia*, (*Laminaria sacchar.*, *digit.*, *Desmarestia aculeata*).

IL[1]. $^{12}/_{5}$ 93. Fladen, Nidingen N.E. $4^{2}/_{3}$ miles. — 28 meters. — Gravel and stones. — *Lithothamnia*, (*Laminariæ*, *Odonthalia*).

IM. $^{12}/_{5}$ 93. Fladen, Lat. N. 57°12′50″, Long. E. 11°47′. — 16 meters. — Gravel. — *Halidrys*, *Desmarestia acul.*, *Laminaria sacch.*

ZG. $^{28}/_{7}$ 04. Fladens light-ship S.E. by S. a good 2 miles. — 18 meters. — Stones. — *Halidrys*, *Florideæ*, *Laminaria hyperb.*, *Desmar. acul.*, *Corallina off.*

VY. $^{5}/_{7}$ 95. Fladen, Lat. N. 57°11′22″, Long. E. 11°44′. — 18 meters. — Sand with stones. — Vegetation not abundant: *Halidrys*, *Desmarestia acul.*, *Polysiphonia elongata.*

IN. $^{12}/_{5}$ 93. Fladen, Lat. N. 57°11′10″, Long. E. 11°45′. — 15 meters. — Gravel, stones, — *Fucus serratus*, *Halidrys*, *Desmar. acul.*

IO. $^{12}/_{5}$ 93. Fladen, Lat. N. 57°10′40″, Long. E. 11°44′40″. — 10,5 to 11,5 meters. — Stones. — *Fucus serratus*, *Halidrys.*

ZF. $^{28}/_{7}$ 04. Fladens light-ship S. by E. a good mile. — 22,5 meters. — Stones. — The three species of *Laminaria*, particularly *L. digitata*, various *Florideæ.*

ZE. $^{28}/_{7}$ 04. Immediately W. of Fladens light-ship. — 26,5 meters. — Stones. — *Laminaria digit.*, *sacch.*, *Fucus serratus*, a few *Florideæ.*

ZE[1]. $^{28}/_{7}$ 04. Fladens light-ship S.E. by E. $^{1}/_{6}$ mile. — 19 meters. — Stones. — *Laminariæ* 3 species, various *Florideæ* e. gr. *Odonthalia.*

— — Fladens light-ship S.E. by E. $^{1}/_{3}$ mile. — 15 meters. — Stones. — *Florideæ*, mostly *Furcellaria*, *Halidrys*, *Fucus serratus.*

IP. $^{12}/_{5}$ 93. W. side of Fladen, Lat. N. 57°10′, Long. E. 11°41′20″. — Ca. 21 meters. — Stones. — *Desmarestia acul.*, (*Lamin. sacchar.*, *Lithothamnia*, *Halidrys*).

IQ. $^{12}/_{5}$ 93. W. side of Fladen, Lat. N. 57°9′30″, Long. E. 11°41′40″. — 21,5 to 30 meters. — Stones. — *Laminaria sacch.*

— — — 30 to 38 meters. (seine). — Incrusting Algæ, *Desmarestia aculeata.*

XA. $^{5}/_{7}$ 95. Kobbergrundens light-ship N. by W. $^{1}/_{2}$ W. a good $6^{1}/_{2}$ miles. — 13 meters. — Gravel with stones, shells. — Scarce vegetation: *Halidrys*, *Chorda Filum*, various *Florideæ.*

IK. $^{10}/_{5}$ 93. Lille Middelgrund, the beacon S.W. by W. $1^{2}/_{3}$ miles. — 17 to 19 meters. — Gravel. — *Lithothamnia.*

IL. $^{10}/_{5}$ 93. Lille Middelgrund, the beacon S.E. by S. $^{1}/_{2}$ S. $^{5}/_{6}$ mile. — 14 meters. — Stones. — *Fucus serratus*, (*Furcellaria*).

EU. $^{12}/_{7}$ 92. Lille Middelgrund, Lat. N. 56°56′28″, Long. E. 11°51′52″. — 14 meters. — Gravel with stones. — *Corallina offic.*, (*Halidrys*, *Chorda Filum*, *Lithothamnion Lenormandi*).

ET. $^{12}/_{7}$ 92. Lille Middelgrund, Lat. N. 56°56′25″, Long. E. 11°52′40″. — 12 meters. — Stones, gravel. — *Fucus serratus.*

ES. $^{12}/_{7}$ 92. S.W. of Lille Middelgrund. — 24,5 meters. — Coarse brown sand. — No vegetation (1 specimen of *Laminaria sacchar.*).

IH. $^{10}/_{5}$ 93. The beacon at Lille Middelgrund N.W. by N. $^{1}/_{2}$ N. a good 4 miles. — 20 to 28 meters. — Stones and gravel. — *Lithothamnia*, (*Laminaria sacchar.*, *Desmarestia acul.*).

IG. $^{10}/_{5}$ 93. The beacon at Lille Middelgrund N.W. $^{4}/_{5}$ N. 6 miles. — 36 meters. — Sand and clay-mud. — No vegetation.

ER. $^{12}/_{7}$ 92. Fyrbanken, the beacon at Anholt Knob S. by W $1^{5}/_{6}$ miles. — 28 meters. — Sand with stones. — Scarce algal vegetation, (mostly *Desmarestia viridis*).

EQ. $^{12}/_{7}$ 92. At the beacon at Anholt Knob. — 9,5 to 16 meters. — Scarce algal vegetation.

IF. $^{10}/_{5}$ 93. Røde Banke, the beacon at Anholt Knob N.W. by W. $^{1}/_{2}$ W. 8 miles. — 31 meters. — Red clayey sand. — No vegetation.

IE. $^{10}/_{5}$ 93. Near Røde Banke, Anholt Knobs light-ship N.W. 7 miles. — 34 to 36 meters. — No vegetation.

RU. $^{1}/_{8}$ 94. Tylø light-house E. S. E. $^{1}/_{2}$ E. scarcely 9 miles. — 26,5 meters. — Clay-mud. — Scarce *Florideæ*.

RV. $^{1}/_{8}$ 94. Tylø light-house S.E. $^{1}/_{2}$ S. $5^{1}/_{2}$ miles. — 20,5 meters. — Stones. — Nearly no Algæ.

RT. $^{1}/_{8}$ 94. Store Middelgrund, Lat. N. 56°37,5′, Long. E. 12°4,5′. — 24,5 meters. — Sand. — No vegetation.

ID. $^{10}/_{5}$ 93. Store Middelgrund, Lat. N. 56°34,5′, Long. E. 12°5,5′. — 19 meters. — Stones. — *Corallina offic.*

IC. $^{10}/_{5}$ 93. Store Middelgrund, Lat. N. 56°33′20″, Long. E. 12°5′10″. — 10,5 meters. — Stones. — *Fucus serratus*, (*Furcellaria*).

IB. $^{10}/_{5}$ 93. Store Middelgrund, Lat. N. 56°33′, Long. E. 12°5′. — 11,5 to 13 meters. — *Fucus serratus, Halidrys, Furcellaria, Laminaria digitata.*

IA. $^{10}/_{5}$ 93. Store Middelgrund, Lat. N. 56°32′50″, Long. E. 12°5′20″. — 11,5 to 13,5 meters (trawl). — *Fucus serratus.*

— $^{12}/_{7}$ 07. Nearly in the same place. — Stones with incrusting Algæ, *Cruoria pellita, Lithothamnia*, and *Delesseria sangvinea, Desmarestia acul., D. viridis, Corallina offic.*

HX. $^{10}/_{5}$ 93. Store Middelgrund, south side, Lat. N. 56°32′30″, Long. E 12°3′40″. — 17 meters. — Stones. — *Fucus serratus, Halidrys, Corallina offic.*

HY. $^{10}/_{5}$ 93. Store Middelgrund, south side, Lat. N. 56°32′20″, Long. E. 12°5′20″. — 15 meters. — Reddish gravel. — *Fucus serratus.*

HZ. $^{10}/_{5}$ 93. Store Middelgrund, south side, Lat. N. 56°32′, Long. E. 12°5′40″. — 25,5 meters. — Few Algæ.

GI. $^{21}/_{7}$ 92. Ostindiefarer Grund. — 4 to 8,5 meters. — Stones. — 4,5 meters: *Halidrys, Laminaria digitata, Fucus serratus, Florideæ.* — 4 to 7,5 meters: *Florideæ*, mostly *Phyllophora membranifolia, Furcellaria*, (*Fucus serratus*).

OO. $^{18}/_{4}$ 94. Søborghoved Grund. — 8,5 meters. — Stones. — *Fucus serratus, Halidrys, Phylloph. membranif.*, (*Phylloph. Brodiæi, Lithothamnia, Corallina off., Laminaria digit., sacchar.*).

Kattegat, central Part. (Km)

TT. $^{1}/_{10}$ 94. W. of Dvalegrunde, Læsø Rendes light-ship S.E. $^{1}/_{2}$ E. $2^{2}/_{3}$ miles. — 7,5 meters. — Coarse sand. — *Zostera.*

FI. $^{15}/_{7}$ 92. Dvalegrund, by the double broom. — 4,5 meters. — Sand with shells. — No Algæ.

BO. $^{24}/_{8}$ 91. By the broom at Stensnæs. — 5,5 meters. — Sand. — Narrow-leaved *Zostera.*

BN. $^{24}/_{8}$ 91. Asaa W. by N., the broom at Stensnæs N.N.E. — Ca. 9,5 meters. — Sandy clay-mud. — Scarce vegetation: *Halidrys*, (*Polysiphonia nigresc.*).

TS. $^{1}/_{10}$ 94. Off Hov, Lat. N. 57°$2^{1}/_{2}$′, Long. E. 10°27′. — 7,5 meters. — Clayey sand with few stones. — *Zostera, Halidrys, Corallina offic.*

VQ. $^{2}/_{7}$ 95. Svitringen, Lat. N. 57°, Long. E. 10°35′. — 11,5 meters. — Sand. — Scarce *Zostera.*

VS. $^{2}/_{7}$ 95. Læsø Rende, Ryggen, the light-ship S.W. $^{1}/_{2}$ S. $2^{3}/_{4}$ miles. — 18 meters. — Sand. — No vegetation.

KE. $^{15}/_{5}$ 93. By the broom at Søndre Rønners Flak. — 7,5 meters. — Sand without vegetation.

VR. $^{2}/_{7}$ 95. Læsø Rendes light-ship N.W. by N. $^{1}/_{2}$ N. $3^{3}/_{4}$ miles. — 20,5 meters. — Soft bottom without vegetation.

XF. $^{5}/_{7}$ 95. Søndre Rønners beacon E.N.E. 4 miles. — 8,5 meters. — Sand with few stones. — *Zostera* with *Fucus serratus*, (*Ahnfeltia*, *Corallina offic.*, *Cystoclonium*).

KF. $^{15}/_{5}$ 93. Læsø Rendes light-ship N.W. by N. $^{1}/_{5}$ N. a good 14 miles. — 6,5 meters. — Sand with pebbles. — *Fucus serratus*, very broad, (*Fuc. vesiculosus*, *Zostera*).

XE. $^{5}/_{7}$ 95. Near the broom at Silderøn. — Mostly 2 to 4 meters. — Sand. — *Zostera*, (*Fucus serratus*).

FA. $^{12}/_{7}$ 92. E.S.E. of Hornfiskerøn, S. side of Læsø. — Within $^{1}/_{2}$ meter line bare sand, outside this line *Zostera*-vegetation.

EZ. $^{12}/_{7}$ 92. W. of Mellemflak, S. of Læsø. — 4 meters. — Sand. — *Zostera*.

YY. $^{23}/_{7}$ 04. From the broom at the N. end of Kobbergrund northwards. — 4,5 meters. — First bare sand, later single stones with *Fucus serratus*.

ZC. $^{27}/_{7}$ 04. The broom at the N. end of Kobbergrund N.E. 1,5 miles. — 4 to 4,5 meters. — Sand. — *Zostera* in spots, with various Algæ, *Fucus serratus*.

ZC^{1}. $^{27}/_{7}$ 04. Inside Kobbergrund. — 5 meters. — Sand. — *Chorda Filum*, *Spermatochnus*.

ZD. $^{27}/_{7}$ 04. Kobbergrundens light-ship E.S.E. 4 miles. — 7,5 meters. — Sand. — *Zostera* with *Fucus serratus*, large, broad plants.

XD. $^{5}/_{7}$ 95. The broom at Silderøn, N. $^{3}/_{4}$ W. nearly 8 miles. — 9,5 meters. — Sand. — *Zostera* (with *Fucus serratus*).

XB. $^{5}/_{7}$ 95. Kobbergrundens light-ship N. $^{3}/_{4}$ E. $8^{3}/_{4}$ miles. — 12 meters. — Stones. — *Fucus serratus*, *Furcellaria* a. o. *Florideæ*.

BM. $^{23}/_{8}$ 91. The broom at Muldbjerg Grund W. $^{2}/_{3}$ N. a good 2 miles. — 8,5 meters. — Sand (?) with stones. — *Zostera* and *Halidrys*.

VP. $^{2}/_{7}$ 95. The broom at Muldbjerg Grund N.N.W. $^{1}/_{3}$ N. $5^{1}/_{2}$ miles. — 7,5 meters. — Fine sand. — Scarce *Zostera*.

BL. $^{23}/_{8}$ 91. Mariager Fjord S.W. by W. $^{3}/_{4}$ W., Muldbjergene N.W. $^{3}/_{4}$ N. — 9,5 meters. — Sand. — *Zostera*.

VO. $^{2}/_{7}$ 95. Off Stevn in Mariager Fjord. — Mud with *Mytilus*, scarce *Ceramium rubrum*.

VN. $^{1}/_{7}$ 95. The buoy at the mouth of Randers Fjord N.W. $3^{1}/_{3}$ miles. — 8,5 meters. — Sand. — Loose *Furcellaria* in abundance, very scarce *Zostera*.

VM. $^{1}/_{7}$ 95. The buoy at Tangen N.E. $^{2}/_{3}$ E. $4^{1}/_{4}$ miles. — 8 meters. — Sand. — Loose *Furcellaria* in abundance.

BK. $^{23}/_{8}$ 91. By the buoy at Tangen. — 7 meters. — Coarse sand with stones. — *Zostera*, rather narrow-leaved with broad *Fucus serratus*, (*Furcellaria*).

VL. $^{1}/_{7}$ 95. The buoy at Tangen N.N.W. $5^{1}/_{2}$ miles. — 10,5 meters. — Sand. — Dead *Zostera*-leaves, loose *Furcellaria*.

NC. $^{19}/_{9}$ 93. E. of Tangen, Fornæs light-house S. $^{1}/_{4}$ W. 7 miles. — 8,5 meters. — Sand with stones. — *Fucus serratus*, *Laminaria digitata*, *Furcellaria*, *Corallina offic.*

BI. $^{23}/_{8}$ 91. Gjerrild Flak; Fornæs light-house S. by E. $^{1}/_{3}$ E. a good 6 miles. — 7,5 meters. — Sand with sparse spots of *Zostera*, (*Furcellaria*).

BH. $^{23}/_{8}$ 91. Off Gjerrild Klint, $^{1}/_{2}$ mile from land. — 7,5 meters. — Bare sand with spots of vegetation: *Zostera* and *Furcellaria*, (*Fucus serratus.*)

VK. $^{1}/_{7}$ 95. Fornæs light-house S. $^{1}/_{2}$ W. $2^{2}/_{3}$ miles. — 12 meters. — Pebbles. — A clump of *Halidrys*.

VK[1]. 1/7 95. 2/3 mile W. by N. of VK. — 10,5 meters. — Sand and pebbles. — No vegetation.

FK. 15/7 92. Aalborg Bugt, Lat. N. 56°56,5′, Long. E. 10°45,5′. — 12 to 13 meters. — Sand. — No vegetation.

FL. 15/7 92. Lat. N. 56°56,5′, Long. E. 10°46,8′. — 9,5 meters. — Sand, alternately bare and covered with *Zostera*.

FM. 15/7 92. The buoy at Tangen W. by S. 1/2 S. a good 8 miles. — 13 meters. — Sand, shells. — No vegetation, only single specimens of *Corallina offic.*

FN. 15/7 92. Fornæs light-house S. 1/2 W. nearly 14 miles. — 12 meters. — Sand with stones. — *Halidrys.*

ND. 19/9 93. Fornæs light-house S. by W. 1/2 W. 11 3/4 miles. — 11,5 to 13 meters. — Sand with single stones. — Very scarce vegetation: *Lithothamnion, Halidrys.*

HT. 9/5 93. Fornæs light-house S.W. 5/8 W. 7 miles. — 16 meters. — Sand and pebbles. — No vegetation.

HU. 9/5 93. Fornæs light-house S.W. by W. 1/4 W. nearly 13 miles. — 17 meters. — Sand with stones. — No vegetation.

XC. 5/7 95. The double broom at the end of Anholt Nordvest Rev S.S.E. 1/2 E. 11 miles. — 11,5 meters. — Gravel with stones. — *Halidrys.*

bK. 12/7 07. 15 miles N.W. by W. 1/2 W. of Anholt light-house. — 15 meters. — Stones. — Very few Algæ (*Polysiphonia elong., Desmarestia viridis.*).

bL. 12/7 07. 13 miles W. by N. 1/4 N. of Anholt light-house. — 19 meters. — Sand. — No vegetation.

KF[1]. 16/5 93. Anholt Nordvest Rev, 2 miles of the broom. On the reef and on both sides of it bare sand.

KF[2]. 16/5 93. N. of Anholt, E. of Nordvest Rev. — Ca. 8 to 13 meters. — Bare sand, here and there spots of loose *Furcellaria* partly mixed with *Polyides.*

KG. 16/5 93. W. of the double broom by Rønneløbet by Anholt. — 4,5 meters. — Sand with stones. — *Fucus serratus.*

HV. 9/5 93. Anholt light-house N.E. by E. 1/6 E. 7 1/2 miles. — 5,5 to 7,5 meters. — Sand. — No vegetation.

Kattegat, southern part. (Ks)

RQ. 31/7 94. Fornæs light-house W. 1/4 S. 1 mile. — 17 meters. — Coarse sand. — Almost no vegetation.

FO. 15/7 92. Off Havknude. — 5,5 to 6,5 meters. — Sand. — Very scarce vegetation (*Fucus serratus, Florideæ*).

NB. 18/9 93. Havknudeflak. — 7,5 to 8,5 meters. — Sand with stones. — Vegetation in spots: *Furcellaria*, (*Fucus serratus, Brongniartella, Zostera*).

FP. 15/7 92. Jessens Grund, by the buoy. — 4 meters. — Stones. — *Fucus serratus*, (*Laminaria digitata, Florideæ, Halidrys*).

NA. 18/9 93. Hjelm light-house S.W. by S. 1/4 S. 5 1/4 miles. — 17 to 18 meters. — Fine gravel. — No plants.

KH. 17/5 93. The broom at Jessens Grund N.N.W. 1/4 W. 3 1/2 miles. — 18 meters. — Stones. — No vegetation.

MZ. 18/9 93. Hjelm light-house S. by E. 2 miles. — 10,5 to 13 meters. — Gravel (?) with stones. — *Chorda Filum*, (*Corallina offic.*).

BG. $^{21}/_{8}$ 91. $1^{1}/_{3}$ miles N. by E. $^{1}/_{2}$ E. (?) of Hjelm light-house. — 38 meters. — No vegetation.

EP. $^{12}/_{7}$ 92. Pakhusbugt by Anholt. — 19 meters. — Sand. — Loose *Furcellaria*.

ZN. $^{10}/_{7}$ 05. Anholt light-house N.E. $^{1}/_{2}$ N. 12 miles. — Gravel and sand. — No vegetation.

RS. $^{1}/_{8}$ 94. Fornæs light-house W. $^{1}/_{2}$ S. 15 miles. — 20,5 meters (?). — No vegetation.

RR. $^{1}/_{8}$ 94. Fornæs light-house W. $^{1}/_{2}$ S. 7 miles. — 17 meters (?). — No vegetation.

ZO. $^{10}/_{7}$ 05. Lat. N. 56°28′15″, Long. E. 11°23$^{1}/_{2}$′. — 15 meters. — No vegetation.

EO. $^{11}/_{7}$ 92. The light-house S. by E. 9,1 miles. — 26,5 meters. — Clay-mud with shells. — No vegetation, on *Modiola* some few *Lithothamnia* and *Antithamnion plumula*.

HS. $^{9}/_{5}$ 93. Briseis Grund. — 7,5 to 13 meters. — Stones. — *Fucus serratus*, *Furcellaria*, (*Halidrys, Laminaria digitata*).

RP. $^{31}/_{7}$ 94. Near Briseis Grund, Lat. N. 56°18,5′, Long. E. 11°17,7′. — 20,5 meters. — Stones (gravel?). — No vegetation.

OS. $^{18}/_{4}$ 94. Hastens Grund, the buoy S.W. by W. $1^{5}/_{6}$ miles. — 13 to 14 meters. — Gravel and stones. — *Fucus serratus*.

OS[1]. $^{18}/_{4}$ 94. Hastens Grund, the buoy S.W. $^{1}/_{2}$ S. 1 mile. — 16 meters. — Gravel. — *Fucus serratus*, (*Halidrys*).

OT. $^{18}/_{4}$ 94. Hastens Grund, the buoy N.W. by W. $^{1}/_{2}$ mile. — 9,5 meters. — Stones. — *Laminaria digitata*, *Halidrys*.

OU. $^{18}/_{4}$ 94. Schultz's Grund, the buoy S.W. $^{1}/_{2}$ mile. — Sand with stones. — 9,5 meters. — Abundant vegetation: *Halidrys*, *Laminaria digitata*, (*Fucus serratus*, *Furcellaria*, scarce *Zostera*).

OV. $^{18}/_{4}$ 94. The beacon on Sjællands Rev S.E. $^{1}/_{2}$ E. $1^{2}/_{3}$ miles. — 17 to 19 meters. — Sand. — No vegetation.

OX. $^{19}/_{4}$ 94. W. of the beacon on Sjællands Rev. — 9,5 meters. — Stones. — No vegetation.

OY. $^{19}/_{4}$ 94. Nearer land. — ca. 4 meters. — Stones. — *Fucus serratus*.

GG. $^{21}/_{7}$ 92. Sjællands Rev, E. side of Mellemrevet. — A good 4 meters. — Stones. — *Fucus serratus*, (*Furcellaria* a. o. *Florideæ*).

GF. $^{21}/_{7}$ 92. Sjællands Rev, in the Snekkeløb. — 8 meters. — Stones. — *Fucus serratus*, (*Florideæ*.)

OQ. $^{17}/_{4}$ 94. E. of Lille Lysegrund, Hesselø light-house S.E. by S. $^{1}/_{3}$ S. $8^{1}/_{3}$ miles. — 20,5 meters. — Sand. — No vegetation.

OR. $^{18}/_{4}$ 94. S.W. side of Lille Lysegrund. — 17 to 18 meters. — Brown Sand. — No vegetation.

EL. $^{11}/_{7}$ 92. N. of Lysegrund, $2^{2}/_{3}$ miles N.W. $^{1}/_{2}$ W. of the buoy. — 20,5 meters. — Clayey sand. — No vegetation.

EN. $^{11}/_{7}$ 92. Lysegrund, $^{1}/_{2}$ mile N. of the 2 meters shallow. — 14 meters. — Stones. — Scarce *Lithoderma*, otherwise no Algæ. — 17 meters: *Polysiphonia violacea*, *Ectocarpus*.

EM. $^{11}/_{7}$ 92. Lysegrund, $^{1}/_{3}$ mile N. of the 2 feet shallow. — Ca. 9,5 meters. — Stones. — *Fucus serratus*, (*F. vesiculosus*, *Furcellaria*).

OP. $^{18}/_{4}$ 94. Lysegrund, near the 2 meters shallow. — 6 meters. — Stones and gravel. — *Fucus serratus*, *Halidrys*, *Laminaria digitata*.

EK. $^{11}/_{7}$ 92. W. side of Lysegrund. — 14 meters. — Sand. — No vegetation.

EJ. $^{11}/_{7}$ 92. Lysegrund, near the triple broom. — 4 to 5,5 meters. — Stones. — *Fucus serratus*, (*Fucus vesiculosus*, *Florideæ*).

HQ. $^{8}/_{5}$ 93. E. side of Lysegrund. — Ca. 9,5 meters. — Sand. — Single clumps of *Fucus serratus* (and *F. vesiculosus*).

HP. $^{8}/_{5}$ 93. S. E. of Lysegrund, $4^{1}/_{2}$ miles N.W. by W. $^{1}/_{6}$ W. of Hesselø light-house. — 25,5 meters. — *Furcellaria*, (*Fucus serratus*).

RO. $^{31}/_{7}$ 94. W. of Hesselø. — 20,5 meters. — Sandy clay-mud. — *Desmarestia viridis*, otherwise no plants.

HR. $^{8}/_{5}$ 93. S. of Hesselø. — 19 meters. — Soft bottom. — No vegetation.

RN. $^{31}/_{7}$ 94. By the Sydostrev by Hesselø. — 21,5 meters. — Gravel. — *Desmarestia viridis*, otherwise no plants.

B. $^{17}/_{7}$ 90. Hesselø light-house N.W. $^{1}/_{3}$ N. a good 3 miles. — 24,5 to 32 meters. — Soft bottom. — No vegetation.

A. $^{17}/_{7}$ 90. Hesselø light-house N.W. $^{3}/_{4}$ N. nearly 4 miles. — 28 meters. — Soft bottom. — Loose *Dilsea edulis*, shells of *Cyprina*, *Aporrhais* a. o. with *Lithothamnia* and boring Algæ.

C. $^{17}/_{7}$ 90. 5 miles N. of the buoy at Grønne Revle. — Ca. 19 to 22,5 meters (?). — No vegetation (only some few *Desmarestia viridis* on *Buccinum* and loose *Dilsea edulis*).

GH. $^{21}/_{7}$ 92. Lat. N. 56°1′40″, Long. E. 11°30$^{1}/_{2}$′. — 19 meters. — Clay-mud. — No vegetation.

aU. $^{6}/_{8}$ 06. Lumbsaas mill S. 32° W. 2 miles. — 13 meters. — Sand with few stones. — *Furcellaria*, (*Zostera*, *Fuc. serratus*, *Polyides*, *Ectocarpus*). — Another dredging: Larger stones with *Furcellaria*, *Fuc. serratus*, *Laminaria digitata*.

D. $^{17}/_{7}$ 90. 1 mile N. of the buoy at Grønne Revle. — 11,5 meters. — Stones. — Abundant vegetation: *Fucus serratus*, *Furcellaria*, (*Zostera*, *Phylloph. Brodiæi*, *Laminaria digit.*, *Polyides*, *Ahnfeltia* . . .).

HO. $^{8}/_{5}$ 93. Hesselø light-house W. by N. $^{1}/_{4}$ N. 12 miles. — 22,5 meters. — Clay-mud with stones. — *Lithothamnia*.

RM. $^{31}/_{7}$ 94. Off Raageleje, Lat. N. 56°10′10″, Long. E. 12°5$^{1}/_{2}$′. — 19 meters. — Sand. — No vegetation.

RL. $^{30}/_{7}$ 94. The buoy at Ostindiefarer Grund S.E. by E. $2^{1}/_{2}$ miles. — 15 meters. — *Florideæ*, particularly *Cystoclonium*, *Furcellaria*, *Phyllophora*, *Chondrus*, (*Laminaria digitata*, *L. saccharina*, *Fucus serratus*).

EJ. $^{11}/_{7}$ 92. Isefjord, midway between Korshage and Spodsbjerg. — Ca. 4,5 meters. — Sand almost without vegetation.

EH. $^{11}/_{7}$ 92. Off Lynæs, $^{1}/_{3}$ mile W. of the broom. — 4,5 meters. — Sand with pebbles. — *Chorda Filum*, (*Zostera*, *Rhodomela*, *Polysiphonia elongata* and *nigresc.*).

NL. $^{23}/_{9}$ 93. $1^{5}/_{6}$ miles W. $^{1}/_{2}$ S. of Lynæs. — 4 meters. — Sand with *Zostera*.

NM. $^{25}/_{9}$ 93. Roskilde Fjord off Nordskov, Kulhus mill W. $^{1}/_{3}$ N. $1^{3}/_{4}$ miles. — 7,5 meters. — Mud with broad-leaved *Zostera*.

PQ. $^{3}/_{5}$ 94. E. of Bogenæs in Roskilde Fjord. — 3 meters. — Stones. — *Zostera*, *Mytilus*, *Polysiph. nigresc.*, *Phylloph. Brodiæi*.

PQ^{1}. $^{3}/_{5}$ 94. Between Bogenæs and Boserup. — Stones. — *Zostera*, *Potamogeton pectinatus*, *Polysiphonia*, *Ceramium*, *Spirulina versicolor*.

Samsø area. (Sa)

KK. $^{17}/_{5}$ 93. Klørgrund, S. of Hjelm. — 6,5 to 8,5 meters. — Stones. — *Fucus serratus*, *Halidrys*, (*Fucus vesic.*).

KI. $^{17}/_{5}$ 93. Hjelm light-house N. $^{1}/_{2}$ W. $2^{1}/_{2}$ miles. — 13 meters. — Stones. — *Lithothamnion norvegicum*, *Corallina offic.*

KL. $^{17}/_{5}$ 93. Bjarkes Grund, S.W. of Hjelm. — 5,5 to 7,5 meters. — Stones. — *Halidrys*, *Laminaria digitata*, *Fucus serratus*.

KM. $^{17}/_{5}$ 93. Hjelm light-house E. by N. $^{3}/_{8}$ N. a good $3^{1}/_{2}$ miles. — 9,5 to 17 meters. — Stones. — *Halidrys*, *Fucus serratus*, (*Laminariæ* . . .).

PJ. $^{21}/_{4}$ 94. Ebeltoft Vig, Ellemands Bjerg S.W. $3^{5}/_{8}$ miles. — 13 meters. — Clay-mud with stones. — Scarce *Florideæ*.

FR. $^{16}/_{7}$ 92. Near Pikkelgrund in Ebeltoft Vig. — 5,5 meters. — Soft bottom. — Dead *Zostera*-leaves, loose Algæ.

FQ. $^{16}/_{7}$ 92. E. side of Ebeltoft Vig. — 8 meters. — Soft bottom. — Broad-leaved *Zostera* and *Chorda Filum*, (loose Algæ).

MY. $^{18}/_{9}$ 93. Sletterhage light-house N.W. by N. $3^{3}/_{4}$ miles. — 9,5 to 14 meters. — Sand with stones. — *Halidrys*, (*Laminaria sacch.*, *L. digit.*, *Fuc. serratus*, *Corallina off.*).

FT. $^{16}/_{7}$ 92. Klepperne, at the N. end of Samsø, inside the double broom. — 5,5 meters. — *Halidrys*, (*Laminaria digitata*, *Florideæ*, in particular *Cystoclonium*).

PH. $^{21}/_{4}$ 94. Lindholms Dyb W. of Vejrø, $^{1}/_{4}$ mile S. of the double broom. — 20,5 meters. — Mud with stones. — *Lithothamnion norvegicum* and *Cruoria pellita*.

FS. $^{16}/_{7}$ 92. Vejrø Sund, N. of Bosserne. — 4 to 19 meters, (dredging up the slope). — Stones. — Abundant vegetation: *Fuc. serratus*, (*Fuc. vesic.*, *Lamin. digit.*, *L. sacch.*, *Chorda Filum*, *Halidrys*, *Florideæ*).

PG. $^{21}/_{4}$ 94. The beacon on Hatter Rev E. by S. $^{3}/_{4}$ S. $1^{2}/_{3}$ miles. — 7,5 to 8,5 meters. — Stones. — *Laminaria digitata*, (*Lam. sacch.*, *Florideæ*, *Zostera*).

OZ. $^{19}/_{4}$ 94. W. of Gniben, Sjællands Odde point in E. $^{2}/_{3}$ S. $1^{2}/_{3}$ miles. — 14 meters. — Sand without vegetation.

PA. $^{19}/_{4}$ 94. Near Albatros, on the W. side of Sjællands Odde. — Ca. 7,5 meters. — Stones. — *Furcellaria*, (*Laminaria*, *Fucus serratus*).

GD. $^{21}/_{7}$ 92. $1^{1}/_{2}$ miles N.E. by N. of Sejerø light-house. — 11,5 to 14 meters. — Stones. — *Fucus serratus*, (*Laminaria digit.*, *Florideæ* in particular *Furcellaria*, *Delesseria sangvin.*, *sinuosa*, scarce *Zostera*.

GE. $^{21}/_{7}$ 92. Sejerø light-house S.W. by S. 1 mile. — 7,5 to 9,5 meters. — Stones. — *Halidrys*, (*Zostera*, *Fuc. serratus*, *Lamin. digit.*, *Florideæ*, in particular *Furcellaria*).

PB. $^{19}/_{4}$ 94. Sejerø Bugt, Sejerø light-house N.W. by W. $^{2}/_{3}$ W. nearly 7 miles. — 14 meters. — Clay-mud without plants.

PC. $^{19}/_{4}$ 94. Between Sejerø and Ordrups Næs, the point of Ordrups Næs E.S.E. nearly 2 miles. — 4 meters. — Stones. — *Fucus serratus*, *Laminaria digitata*, *Florideæ*.

YV. $^{3}/_{6}$ 04. The light-buoy at Hatterbarn N. $2^{1}/_{2}$ miles. — 15 meters. — Stones. — *Florideæ*, in particular *Furcellaria*, *Delesseria sinuosa*, *sangvin.*, *Polysiph. elongata*, and *Laminaria digit.* and *sacchar.*

PD. $^{19}/_{4}$ 94. S. of Sejerø, Lat. N. 55°48′, Long. E. 11°5′. — Ca. 13 meters (?). — Sand without vegetation.

PE. $^{19}/_{4}$ 94. Refsnæs light-house S. by E. $^{1}/_{2}$ E. $1^{1}/_{4}$ miles. — 23,5 meters. — Clay-mud, gravel and pebbles. — *Laminaria digitata*, *Desmarestia acul.*

PF. $^{21}/_{4}$ 94. The light-buoy at Refsnæs S.E. by E. a good half mile. — 18 to 20,5 meters. — ? with stones. — Scarce vegetation: *Florideæ*, in particular *Delesseria sinuosa*, and *Desmarestia acul.*

MP. 16/9 93. Falske Bolsax. — 11,5 to 13 (to 19) meters. — Stones. — *Laminaria sacchar.*, *Florideæ*, (*Laminaria digit.*, *Fucus serratus*).

DK. 12/5 92. Bolsaxen, N.E. of the broom. — 13 to 15 meters. — Stones. — *Halidrys*, *Laminaria digit.*, (*Desmar. acul.*, *Florideæ*).

AH1. 12/8 91. Lillegrund by Fyens Hoved, by the northernmost broom. — 9,5 meters. — Stones. — Abundant algal vegetation: *Furcellaria*, *Fuc. serratus*, *Lamin. sacchar.*

AH. 12/8 91. Same reef, by the middelmost buoy. — 7,5 meters. — Stones. — *Fucus*, (*Laminaria digitata*, *Furcellaria*).

BF. 21/8 91. Off Sletterhage, ca. 1/2 mile. — 14 meters. — Stones. — *Lithothamnion norvegicum*, (*Corallina offic.*, *Cruoria*, *Brongniartella*).

BE. 21/8 91. Off Sletterhage, ca. 2/3 mile. — 10 meters. — Stones. — *Halidrys*, (*Corallina off.*, *Lithothamnion spp.*, *Chorda Filum*).

FU. 18/7 92. S. side of Begtrup Vig. — 5,5 meters. — Dead *Zostera*-leaves, living *Zostera*, *Chorda Filum*.

KN. 17/5 93. Sletterhage light-house S.E. 3/4 S. 5 miles. — 15 meters. — Sandy clay-mud with small pebbles. — No vegetation.

AR. 18/8 91. S.W. of Skødshoved, nearly 1 mile. — 4 meters. — Sand. — *Fucus serratus* and *vesiculosus*, (*Halidrys*, *Zostera*).

PP. 23/4 94. Aarhus Bugt, Ryes Flak. — 4,5 meters. — Small pebbles and gravel. — Spots of *Zostera*, *Fucus vesiculosus*, *Fuc. serratus*, *Halidrys*.

AP. 18/8 91. W.N.W. of Skødshoved, 2/3 mile of land. — 17 meters. — Clay-mud without veg.

PM. 23/4 94. Kalø Vig, Skødshoved S. by E. 1 mile. — 5,5 to 11,5 meters. — No vegetation.

AQ. 18/8 91. Off the entrance to Knebelvig. — 9,5 meters. — Mud. — *Zostera* in spots.

PN. 23/4 94. Kalø Vig, Skødshoved point S.W. 2 2/3 miles. — 5,5 to 11,5 miles (?) — *Zostera*.

PO. 23/4 94. Kalø Vig, by Kalø. — 9,5 meters. — Mud without vegetation.

PL, 23/4 94. E. side of Wulffs Flak. — 9,5 to 13 meters. — Clayey sand. — *Fucus serr.*, *Desmarestia acul.*, *Lithothamnion glaciale*, *Corallina off.* a. o. *Florideæ*.

FV. 18/7 92. E. side of Hesbjerg Grund. — 6,5 meters. — Sand with small pebbles. — *Zostera*, (*Fucus vesic.*, *Halidrys*, *Furcellaria*).

PK. 21/4 94. E. side of Norsminde Flak, the broom in S. 1/2 mile. — 5,5 meters and some more. — Sand with stones. — *Zostera* with *Chætopteris* a. o., *Rhodomela*, *Fucus vesic.* and *serr.*, (*Halidrys*, *Corallina off.*).

AS. 18/8 91. W. side of Meilgrund. — 4 to 5,5 meters. — *Zostera* with *Fuc. serratus*, (*Halidrys*, *Ahnfeltia*).

BD. 21/8 91. Tunø light-house S. 3/8 E. 3 miles. — 15 meters. — Sandy clay-mud. — Scarce vegetation, mostly *Polysiphonia elongata forma*.

MX. 18/9 93. N. side of Tunø Rev. — 7,5 to 11,5 meters. — Sand. — *Zostera*.

FX. 18/7 92. Off Dyngby Hage, Tunø light-house E.S.E. 5 1/2 miles. — 6 meters. — Sand. — *Florideæ*, in particular *Furcellaria*, (*Zostera*, loose *Halidrys*).

MV. 18/9 93. Kirkegrund S.W. of Tunø. — 7,5 to 9,5 meters. — *Zostera* with scarce *Florideæ*, mostly *Furcellaria*.

BC. 21/8 91. Abreast of Hov Røn, the broom N.E. 1/2 E. 4/5 mile. — 5,5 meters. — Sand and mud with stones. — Dense *Zostera*-vegetation (with *Fuc. vesic.* and *Furcellaria*).

MU. 18/9 93. Abreast of Søby Rev, Kolse Nak point S.W. by W. 1/6 W. 3 1/2 miles. — 6,5 to 7,5 meters. — Dense broad-leaved *Zostera*.

BB. $^{21}/_{8}$ 91. By the buoy at Søgrund. — 3 to 4 meters. — Sandy mud with single stones. — Dense broad-leaved *Zostera*, (*Fucus vesiculosus*).

AT. $^{19}/_{8}$ 91. Svanegrund, $^{1}/_{2}$ mile E.S.E. of the broom at its S.E. side. — 4,5 meters. — Gravel (and sand). — *Fucus serratus*, (*Furcellaria*, *Halidrys*).

BA. $^{21}/_{8}$ 91. Skomagergrund, near the double broom. — 8,5 meters. — Soft bottom. — Dense broad-leaved *Zostera*-vegetation.

MT. $^{16}/_{9}$ 93. Horsens Fjord, by the broom W. of Alderø. — 4 to 11,5 meters. — Broad-leaved *Zostera* with *Laminaria saccharina* and *Chorda Filum*.

AZ. $^{20}/_{8}$ 91. S. side of Søndergrund S. of Hjarnø. — 9,5 to 11,5 meters. — Mud. — Pure *Zostera*-vegetation.

aV. $^{7}/_{8}$ 06. Vestborg light-house E. by S. $5^{1}/_{2}$ miles. — 8,5 to 9,5 meters. — Sand. — 1) Broad-leaved *Zostera*, *Halidrys*, *Lamin. sacchar.*, *Fucus vesic.* — 2) *Zostera* and dead *Zostera*-leaves, with many loose Algæ, in particular *Ahnfeltia*.

AO. $^{15}/_{8}$ 91. $1^{1}/_{2}$ miles S.E. by E. of the S. point of Endelave. — 7,5 meters. — *Zostera* (*Fucus serratus*).

MR. $^{16}/_{9}$ 93. Æbelø light-house W. by S. $^{1}/_{2}$ S. nearly 8 miles. — Ca. 26 meters. — Soft bottom. — No vegetation.

MQ. $^{16}/_{9}$ 93. S. of Paludans Flak, Vestborg light-house N. $^{1}/_{2}$ E. 4 miles. — 11,5 meters. — Sand with stones. — *Fucus serratus*, *Furcellaria*, (*Laminaria digit.*, *Corallina off.*, *Halidrys*, scarce *Zostera*).

aX. $^{8}/_{8}$ 06. At the south side of Endelave. — 4,5 meters. — Sand. — *Zostera*, in spots, with single *Fucus vesic.* and *F. serratus*; numerous loose Algæ between the *Zostera*, on the sand bottom.

MS. $^{16}/_{9}$ 93. S. of Klophagen, Æbelø light-house S.S.W. $^{1}/_{6}$ W. $5^{2}/_{3}$ miles. — 15 meters. — Sandy mud with stones. — *Florideæ*, mostly *Polys. nigresc.*, and *Desmarestia acul.*, *Chorda Filum*.

AY. $^{20}/_{8}$ 91. By the broom at Ashoved. — 9,5 to 11,5 meters. — Sand with stones. — *Zostera*, *Fucus vesic.*, *F. serrat.*, *Furcellaria*.

FY. $^{19}/_{7}$ 92. 1 mile N.E. by E. of the point of Bjørnsknude. — 5,5 meters. — Sand with stones. — *Fucus vesiculosus*, (*F. serratus*, *Lamin. digit.*, *Zostera*, *Halidrys*).

OA. $^{20}/_{8}$ 94. E. of the buoy N. of Æbelø. — 7,5 meters. — *Zostera*, (*Fucus vesicul.*).

AJ[1]. $^{12}/_{8}$ 91. By the N. side of Æbelø. — 4 meters. — Stones. — *Fucus serrat.*, *Furcellaria*, *Ahnfeltia*, *Lamin. digit.*

GB. $^{20}/_{7}$ 92. Æbelø light-house W. $3^{4}/_{5}$ miles. — 17 to 18 meters. — Soft bottom. — No vegetation.

DJ. $^{11}/_{5}$ 95. E. of Æbelø. — 7,5 meters. — Sand with stones. — *Fuc. serratus*, *Furcellaria*, (*Fuc. vesicul.*).

GC. $^{20}/_{7}$ 92. Æbelø light-house W. by N. $^{1}/_{3}$ N. $6^{1}/_{4}$ miles. — 13 meters. — Sand with stones. — *Desmar. aculeata*, (*Florideæ*, dead leaves of *Zostera*).

NZ. $^{20}/_{3}$ 94. Off Tørresø, Fyns Hoved E. $^{1}/_{6}$ S. $5^{3}/_{4}$ miles. — 4,5 meters. — *Fucus serratus*, *F. vesic.*, *Furcellaria*.

aY. $^{8}/_{8}$ 06. Fyns Hoved E. $^{3}/_{4}$ N. $4^{3}/_{4}$ miles. — 8,5 to 9,5 meters. — Sand with stones. — *Zostera*, *Fucus vesicul.*, *F. serratus*.

aZ. $^{8}/_{8}$ 06. Fyns Hoved E. $^{3}/_{4}$ N. $5^{1}/_{2}$ miles. — 4 to 5,5 meters. — Sand with stones. — *Fucus vesic.* and *serratus*, (*Zostera* with loose Algæ).

NY. $^{20}/_{3}$ 94. Off the entrance to Odense Fjord. — 6,5 meters. — *Fucus serratus* and *vesicul.* (*Florideæ*, in particular *Furcellaria*, and *Zostera*).

Little Belt. (Lb)

AX. $^{20}/_{8}$ 91. Near the double broom at Bjørnsknude. — 9,5 meters. — Clayey sand. — *Zostera*, (*Fuc. serratus*, *Furcellaria*).

GA. $^{20}/_{7}$ 92. W.N.W. of Æbelø, $2^{1}/_{3}$ miles. — 18 meters. — Clay-mud. — No vegetation.

AU. $^{19}/_{8}$ 91. Vejle Fjord, off Barritskov, 1 mile off land. — 17 meters. — No vegetation.

AV. $^{19}/_{8}$ 91. Vejle Fjord, off Rosenvold. — 19 meters. — Mud. — No vegetation.

FZ. $^{20}/_{7}$ 92. Near the triple broom at Kasser Odde. — 6,5 meters. — Sand with stones. — *Fucus vesicul.* and *serratus*, *Halidrys*, *Furcellaria*, *Laminaria digit.*

AJ. $^{14}/_{8}$ 91. Trelde Næs N.W. by W. 4 miles. — 13 meters. — Sandy mud. — No vegetation.

AK. $^{14}/_{8}$ 91. Stavrshoved W. by S. 1 mile. — 17 meters. — Soft bottom. — No vegetation.

AL. $^{14}/_{8}$ 91. W. side of Baaring Vig. — 7,5 meters. — Sand (?). — *Furcellaria*, *Zostera.*

DJ. $^{11}/_{5}$ 92. Trelde Næs N.N.W. 3 miles. — 13 meters. — Mud with dead *Zostera*-leaves. — Few *Florideæ.*

OB. $^{20}/_{3}$ 94. Off Stavrshoved, $^{1}/_{3}$ mile off land. — 9,5 to 11,5 meters. — Stones. — *Laminaria saccharina* a. o.

AM. $^{14}/_{8}$ 91. Sand bank N.E. of Fredericia. — 5,5 to 6,5 meters. — Bare sand.

AN. $^{14}/_{8}$ 91. Off the N. end of the wall at Fredericia. — 4 to 5,5 meters. — Stones. — *Fucus vesiculosus*, (*Fuc. serrat.*, *Chorda Fil.*, *Zostera*).

XQ. $^{12}/_{7}$ 00. Lyngsodde S. by W. $^{3}/_{4}$ W. 1 mile. — Ca. 19 meters. — Stones. — *Delesseria sanguinea*, *Phylloph. membranifolia.*

NX. $^{20}/_{3}$ 94. E.N.E. of Middelfart. — 15 meters. — Clay with stones. — *Laminaria digit.*, *sacchar.*, (*Florideæ*, in particular *Phylloph. membranif.* and *Deless. sinuosa*).

XP. $^{10}/_{7}$ 00. Nearly the same place. — Ca. 19 meters. — Stones. — *Laminaria sacch.*, *Deless. sangv.*, *Desmar. viridis*, *Phylloph. membranif.*

NV. $^{19}/_{3}$ 94. Between Middelfart and Kongebroen. — 15 to 19 meters. — Stones, and clay with pebbles. — *Laminaria digit.* and *sacchar.*, *Desmarestia acul.*

EG. $^{26}/_{6}$ 92. By the N.E. side of Fænø Kalv. — Stones. — *Laminariæ* and *Florideæ.*

OC. $^{23}/_{3}$ 94. S. of Fænø Kalv. — 14 meters. — Soft bottom. — No vegetation.

EF. $^{18}/_{6}$ 92. Fænø Sund, S.E. of Hindsgavl. — Below the *Zostera*-zone stones with *Florideæ* and *Laminariæ.*

EF[1]. $^{21}/_{6}$ 92. S. of Hindsgavl. — 9,5 to 11,5 meters. — Stones. — *Laminariæ* and *Florideæ.*

ED. $^{10}/_{6}$ 92. S. end of Fænø Sund. — 13 meters. — *Desmarestia acul.*, *Ectocarp. silicul.*, *Laminariæ*, *Florideæ.*

EE. $^{11}/_{6}$ 92. Between Midskov and Fænø.

1) and 2). In the middle of the Belt. — 54,5 to 56 meters. — Stones. — No attached Algæ, but loose fresh *Florideæ.*

3) More westerly. — 34 meters. — Stones. — Fresh Algæ, uncertain whether attached.

4) More westerly. — 13 meters. — Stones. — *Laminariæ*, *Florideæ*, *Desmarestia acul.*

5) E. of 1). — 28 to 36 meters. — Clayey sand with dead shells.

6 and 7). More easterly. — 24,5 and 13 meters. — Sand with stones. — *Desmarestia aculeata.*

8) More easterly. — 11,5 meters. — *Zostera*, (*Florideæ*).

EC. $^{10}/_{6}$ 92. S. of Fænø. — Ca. 5,5 meters. — *Zostera* with single *Fucus vesiculosus* and *Laminaria digitata.*

OD. $^{23}/_{3}$ 94. S. of the broom at Stenderup Hage. — 17 meters. — Gravel. — Scarce vegetation (*Phylloph. Brodiæi, Furcellaria*).

DH. $^{11}/_{5}$ 92. Near Flækøjet, the broom at Stenderup Hage N.N.E. 1 mile. — 11,5 to 15 meters. — Stones (?). — Scarce Algæ (*Desmarestia aculeata, Florideæ*).

OE. $^{23}/_{3}$ 94. At the N. side of Brandsø. — 8,5 meters. — *Zostera*, (*Furcellaria*).

DG. $^{11}/_{5}$ 92. Off Ivernæs. — 5,5 meters. — Sand with stones. — *Zostera*, (*Fucus vesic., Florideæ*).

OF. $^{23}/_{3}$ 94. Fyrrenden, Baagø church E. by N. $^{5}/_{8}$ N. $1^{1}/_{4}$ miles. — 13 meters. — Mud with dead *Zostera*-leaves, scarce *Florideæ*.

DF. $^{11}/_{5}$ 92. Remmen, E. of Baagø. — 5,5 meters. — Sand (?) with a few stones. — *Zostera*, (*Fucus vesic.*).

DE. $^{10}/_{5}$ 92. By the broom at Thorø. — 5,5 meters. — Sand. — *Zostera*, (*Ceramium Rosenvingii, Rhodomela*).

DD. $^{10}/_{5}$ 92. N. side of Thorø Banke. — 7,5 meters. — Sand. — *Fucus vesic., Zostera*.

DC. $^{10}/_{5}$ 92. Aakrog Bugt, off Brunshus. — 5,5 meters. — Sand (?) with stones. — *Fucus vesicul.*, (*F. serratus, Furcellaria*).

DB. $^{10}/_{5}$ 92. Lillegrund, W. of Helnæs, near the buoy. — 7,5 meters. — Stones. — *Furcellaria*, (*Fuc. serratus . . .*).

CD. $^{21}/_{9}$ 91. Helnæs Hoved Flak. — 4 meters. — Sand with stones. — *Zostera*, (*Fuc. vesiculosus*).

CE. $^{21}/_{9}$ 91. S. of Helnæs Hoved Flak. — 26,5 meters. — Mud. — No vegetation.

DA. $^{10}/_{5}$ 92. Off Bøjgden. — 5,5 meters. — Stones. — *Fucus vesiculosus* and *serratus*.

CF. $^{22}/_{9}$ 91. Near the broom W. of Lyø. — 15 meters and some less. — *Florideæ*, (scarce *Zostera*).

DY. $^{14}/_{5}$ 92. W. side of Skjoldnæs, Ærø. — 7,5 to 9,5 meters. — Bare sand with spots of *Zostera* (rather small and narrow-leaved).

LG. $^{4}/_{7}$ 93. Off Vidsø, Ærø, $^{1}/_{4}$ mile of land. — 8 to 10,5 meters. — Sand with a few stones. — *Zostera*, (*Fucus vesiculosus*).

DX. $^{14}/_{5}$ 92. Vodrups Flak. — 13 meters. — Sand with stones. — *Florideæ*, in particular *Furcellaria, Deless. sinuosa*, (*Fucus serratus, Laminaria digit.*).

LF. $^{4}/_{7}$ 93. Vodrups Flak. — 9,5 meters. — Sand. — *Zostera, Fucus serratus*, (*Furcellaria*).

The South Fyen Waters (Sydfyenske Øgaard). (Sf)

CC. $^{21}/_{9}$ 91. S. side of Hornenæs. — 7,5 meters. — Sand with stones. — *Zostera, Furcellaria, Fucus vesiculosus* and *serratus*.

CZ. $^{10}/_{5}$ 92. E. of CC. — 9,5 to 15 meters. — Soft bottom. — Few Algæ (*Phyllophora Brodiæi*).

CB. $^{21}/_{9}$ 91. Near the N. side of Lyø Rev. — Ca. 21 meters (?). — Mud. — No vegetation.

CX. $^{10}/_{5}$ 92. Between the N. end of Lyø and Knollen. — 19 meters. — Mud. — No vegetation.

CY. $^{10}/_{5}$ 92. Near CX. but nearer to Lyø. — 20 meters. — Mud with dead leaves of *Zostera*. — No vegetation.

CA. $^{21}/_{9}$ 91. Faaborg Fjord, W. of the broom at Højen. — Dense vegetation of broad-leaved *Zostera*.

CG. $^{22}/_{9}$ 91. S. end of Skrams Flak. — 6,5 meters. — Sand with stones. — *Zostera* with *Fucus serratus* and *vesiculosus*, (*Polys. nigrescens, Furcellaria*).

BZ. $^{19}/_{9}$ 91. W. of Svelmø. — 15 meters. — Mud, dead *Zostera*-leaves. — No vegetation.

CU. $^{9}/_{5}$ 92. Near the buoy at Flæskholms Flak, N. of Drejø. — 5,5 meters. — *Zostera*.

CV. $^{9}/_{5}$ 92. Billes Grunde, N. of Ærø, the most eastern bank. — 5,5 meters. — Sand with stones. — *Fucus vesic.* and *serratus, Florideæ*: *Phyllophora Brodiæi, Ceramium Rosenvingii*.

UX. 25/5 95. Skjoldnæs light-house S. 3/4 W. 3/4 mile. — 9,5 meters. — First sand with *Zostera*, farther out stones with *Laminaria digit.*, *Furcellaria* a. o. *Florideæ*.

UV. 25/5 95. Skjoldnæs light-house N.W. 2/3 W. nearly 5 miles. — 13 meters. — Stones. — *Florideæ*: *Furcellaria*, *Deless. sangvinea* ..., (*Fucus serratus*).

DZ. 14/5 92. Egholms Flak, near the buoy at the N. end of Mørke Dyb. — 5,5 meters. — *Zostera*.

V. 18/9 90. At the W. side of Birkholm. — 4 to 7,5 meters. — *Zostera* with *Fucus vesic.*, *F. serratus*, *Chorda Filum*.

U. 18/9 90. Same place, nearer to land. — 1 to 2 meters. — *Fucus vesic.*, *Chorda Filum*.

CT. 9/5 92. The bank W. of Knudedyb W. of Taasinge. — 2 meters. — Stones. — *Fucus vesicul.* and *serratus*. Outside the stones: *Zostera*.

BY. 18/9 91. Svendborgsund, W. of the pier at Taasinge. — 7,5 meters. — Stones. — *Florideæ*, (*Laminaria sacchar.*).

BX. 17/9 91. E. of Svendborg, near Taasinge. — 5,5 meters. — Sandy mud, dead *Zostera*-leaves, with scarce *Florideæ*.

EB. 15/5 92. Near the broom at Stenodde, E. side of Taasinge. — 7,5 meters. — Mud. — *Zostera*.

EA. 15/5 92. Near the buoy on Middelgrund at the N. end of the Rudkøbing channel. — 5,5 meters. — *Zostera*.

Great Belt. (Sb)

MO. 16/9 93. Refsnæs light-house N.W. 1/3 W. 3 miles. — 19 meters. — Clay-mud with stones. — No vegetation.

DL. 12/5 92. S. side of Refsnæs, 1 1/2 miles from the light-house. — 6,5 to 7,5 meters. — Bare sand with patches of *Fucus serratus*.

MN. 16/9 93. The broom at Asnæs S.W. 3/5 W. a good 3 miles. — 10,5 to 11,5 meters. — Fine sand with stones. — *Zostera*, *Fuc. serratus*, *Laminaria digit.*

GT. 9/11 92. 1/3 mile N. of the broom at Asnæs. — 7,5 meters and probably more. — Stones. — *Florideæ*, in particular *Furcellaria*, (*Deless. sangv.*, *Del. sinuosa*).

DM. 12/5 92. Asnæs Rev, inside the broom. — 6,5 meters. — Shells. — Scarce Algæ (*Desmar. aculeata*, *Chorda tomentosa*).

GU. 9/11 92. The broom at Asnæs N.W. 3/4 N. 2 miles. — 19 meters. — Stones. — *Laminaria sacch.*, *Desmar. acul.*, *Deless. sangv.*

GS. 9/11 92. N. side of Lysegrunde S. of Asnæs. — 9 meters (?). — Sand with stones. — *Zostera*, *Fucus serratus*.

LK. 6/7 93. Elefantgrund. — 6,5 to 11,5 meters. — Stones. — *Fucus serratus*, *Laminaria digitata*, *Florideæ*, in particular *Furcellaria*.

AG. 12/8 91. By the broom at Klæpen W. of Romsø. — 4 meters. — Sand with vegetation in spots of *Furcellaria*, (*Fuc. vesicul.*, *F. serratus*).

LM. 6/8 93. By the S. side of Romsø. — 4 to 5,5 meters. — Sand with stones. — *Fucus vesic.*, *F. serratus*, *Halidrys*, (*Lamin. digit.*, *Furcellaria*).

GV. 9/11 92. By the buoy S.E. of Romsø. — Stones. — *Furcellaria*, (*Halidrys*, *Laminaria sacch.*, *Fuc. vesic.*).

LN. 6/8 93. Off the E. side of Stavreshoved. — 5,5 meters. — Stones. — *Fucus vesicul.*, *F. serrat.*, *Halidrys*, *Lamin. digit.* — Also sand with *Zostera*.

LP. 17/8 93. Off the S.E. side of Stavreshoved. — 2 to 4 meters. — Stones. — *Fucus vesicul.*, (*F. serratus*).

AF. $^{12}/_{8}$ 91. Møllegrund S. of Stavreshoved. — 8 meters. — Sandy mud with dead *Zostera*-leaves. — *Furcellaria*, *Phylloph. Brodiæi*, *Polys. nigresc.*

LL. $^{2}/_{8}$ 93. Rønnen off Broløkke by Kerteminde. — 4 to 5,5 meters. — Stones. — *Fucus vesicul.*, (*Halidrys*, *Furcellaria*).

AE. $^{10}/_{8}$ 91. Off the slope at Lundsgaard. — 7,5 to 9,5 meters. — Clayey sand. — *Zostera*, (*Furcellaria*).

LO. $^{14}/_{8}$ 91. Off the valley S. of Lundsgaard. — Ca. 5,5 meters. — Sand with stones. — *Fucus vesicul.*, (*Halidrys*, *Furcellaria*, *Spermatochnus*).

AD. $^{10}/_{8}$ 91. Off Risingehoved, ca. $^{3}/_{4}$ mile off land. — 13 meters. — Clay-mud with dead shells. — Very sparse vegetation on tubes of Annelids a. o.

MM. $^{15}/_{9}$ 93. The buoy at Elefantgrund N. by W. $^{3}/_{8}$ W. 3 miles. — 19 to 20,5 meters. — Soft bottom. — No vegetation.

GR. $^{9}/_{11}$ 92. Musholm Havn. — 4 meters. — *Zostera.*

GQ. $^{9}/_{11}$ 92. W. side of Slettings Grund. — 7 meters. — *Zostera*, (*Fucus vesic.*, *F. serratus*).

NU. $^{25}/_{1}$ 94. Off the Strandskov by Bogense, $^{1}/_{2}$ mile of land. — 11,5 meters. — Sand (?) with a few stones. — *Furcellaria.*

AA. $^{9}/_{8}$ 91. Sprogø light-house S.E. $5^{1}/_{6}$ miles. — Ca. 26,5 meters. — Clay-mud. — Nearly no vegetation (*Brongniartella*, *Polys. nigrescens*, *Ectocarpus*).

Z. $^{5}/_{8}$ 91. Off Skagbo Huse, Sprogø light-house S.E. by E. $^{1}/_{8}$ E. 5 miles. — 19 meters. — Sandy mud. — Scarce veg.: *Desmar. acul.*, *Polys. nigr.*

GX. $^{10}/_{11}$ 92. Sprogø light-house S.E. 3 miles. — More than 21 meters. — Clay-mud. — No veg.

AB. $^{9}/_{8}$ 91. Off the S. end of Teglgaardsskov by Nyborg, $^{1}/_{2}$ mile of land. — 7,5 meters. — Sand with stones. — *Fucus vesicul.*, *F. serr.*, *Zostera*, scarce *Florideæ.*

AC. $^{10}/_{8}$ 91. Knudshoved light-house S.W. $^{1}/_{2}$ S. $^{3}/_{4}$ mile. — 17 meters. — ? with small pebbles. — Scarce veg. of *Florideæ* (*Polys. nigresc.* and *Brongniartella*) and *Desmarestia acul.*

GY. $^{10}/_{11}$ 92. W. side of Gjellegrund S. of Sprogø. — 5,5 meters. — Sand with stones. — *Zostera*, (*Fuc. serratus*).

NO. $^{22}/_{1}$ 94. E. of Gjellegrund, Sprogø light-house N.W. by N. $^{1}/_{4}$ N. $1^{2}/_{5}$ miles. — 13 meters. — Sand (?) with stones. — *Florideæ* and *Chætomorpha Melagonium*, (*Zostera*).

GP. $^{9}/_{11}$ 92. Near the light-buoy at Halskov Rev. — 9,5 to 11,5 meters. — Stones. — *Laminaria digitata*, *Delesseria* three species.

NR. $^{23}/_{1}$ 94. Immediately N.W. of the entrance to Korsør harbour, between the double broom and the buoy. — Stones. — *Fucus vesiculosus.*

NP. $^{22}/_{1}$ 94. $^{2}/_{3}$ mile W. $^{1}/_{2}$ S. of the broom at Badstue Rev. — 9,5 meters. — Sand with stones and *Mytilus.* — *Polysiph. elong.* a. o.

NQ. $^{23}/_{1}$ 94. Badstue Rev. — 4 to 5,5 meters. — Sand with stones. — *Zostera*, *Mytilus* with a few *Florideæ*, in particular *Rhodomela.*

NN. $^{22}/_{1}$ 94. Sprogø light-house N.E. $^{3}/_{4}$ E. $3^{1}/_{3}$ miles. — 19 meters. — *Florideæ* (*Delesseria sangv.*, *D. sinuosa*, *Rhodomela*).

NT. $^{25}/_{1}$ 94. Knudshoved light-house W. by N. $^{6}/_{7}$ mile. — 19 meters. — Clay-mud or sand. — No vegetation.

NS. $^{24}/_{1}$ 94. Between Slipshavn and Knudshoved, $^{2}/_{5}$ mile of land. — 5,5 meters. — Sand with stones. — *Fucus vesicul.*, *F. serrat.*, *Florideæ*, *Zostera.*

BS. $^{15}/_{9}$ 91. W. side of Palegrund. — 7,5 meters. — Mud. — *Zostera*, (*Furcellaria*).

LJ. $^{5}/_{7}$ 93. E. of Palegrund. — 16 meters. — Soft bottom with dead *Zostera*-leaves and some loose *Florideæ*.

XS. $^{27}/_{10}$ 00. By Kløverhage, Knudshoved light-house N.E. $^{2}/_{3}$ N. $2^{3}/_{4}$ miles, and a little more north. — 5,5 to 7,5 meters. — Mostly *Zostera*, here and there stones with *Furcellaria*, *Phylloph. Brod.*, *Polys. nigresc.*

BT. $^{15}/_{9}$ 91. S. of Kløverhage. — 7,5 meters. — Sandy mud. — Dense *Zostera*-vegetation.

Y. $^{19}/_{9}$ 90. By the broom at Stokkebæk Flak. — 4,5 meters. — Sand with stones. — *Fucus vesicul.*, *F. serratus.* — $^{1}/_{4}$ mile S. of the broom. — 7,5 meters. — *Zostera.*

BU. $^{15}/_{9}$ 91. Off Lundeborg. — 5,5 meters. — Mud. — Dense broad-leaved *Zostera*-vegetation.

CJ. $^{23}/_{9}$ 91. $^{1}/_{3}$ mile S.S.W. of the entrance to the Stoense channel. — 5,5 meters. — *Zostera.*

BV. $^{15}/_{9}$ 91. Off the S. side of Elsehoved. — 6 meters. — Dense, pure *Zostera*-vegetation.

UU. $^{24}/_{5}$ 95. Snøde Rev. — 4 to 4,5 meters. — Dense *Zostera*-vegetation.

X. $^{19}/_{9}$ 90. 2 miles N.E. of the broom at Turø Rev. — 11 meters. — Clay-mud. — Broad-leaved *Zostera*, no Algæ.

LH. $^{5}/_{7}$ 93. S. of Egeløkke Rev, off Bøstrup. — 8,5 to 10,5 meters. — Soft bottom with stones. — *Zostera*, (*Furcellaria*).

CH. $^{23}/_{9}$ 91. $1^{1}/_{3}$ miles E.N.E. $^{1}/_{3}$ E. of the broom at Turø Rev. — 11,5 meters. — Mud with dead *Zostera*-leaves. — No vegetation.

bA. $^{10}/_{8}$ 06. Sprogø light-house N.N.W. 4 miles. — 22,5 to 23,5 meters. — Sand. — No vegetation.

UE. $^{20}/_{5}$ 95. By the buoy at Vresens Puller. — 6,5 to 7,5 meters. — *Zostera* (with stones on which *Fuc. vesic.*, *F. serratus*, *Lamin. digit.*, *Furcellaria* a. o. *Florideæ*).

UF. $^{20}/_{5}$ 95. N. point of Langeland S.W. by W. $^{2}/_{3}$ W. $2^{1}/_{2}$ miles. — 8,5 meters. — Sand and stones. — *Zostera*, *Fucus serratus*, *Florideæ*, (*Laminaria digitata*).

DN. $^{13}/_{5}$ 92. Vengeance Grund. — 11,5 to 12 meters. — Stones. — *Florideæ* with *Laminaria digitata*, *Fucus serratus* and *Halidrys.*

DO. $^{13}/_{5}$ 92. Langelandsøre, W. side of Omø. — 4 to 5,5 meters. — *Zostera*-vegetation and stones with *Fucus vesiculosus.*

UG. $^{20}/_{5}$ 95. Langelandsbelt, abreast of Østerhuse, the point by Hov N. by W. $^{1}/_{4}$ W. $2^{1}/_{2}$ miles. — 33 meters. — ? with stones. — Some few loose Algæ.

UH. $^{20}/_{5}$ 95. Tranekær light-house S.W. by W. $4^{1}/_{2}$ miles. — 19 to 21,5 meters. — Stones. — *Lamin. digit.*, *Delesseria sangvin.*

T. $^{17}/_{9}$ 90. $^{1}/_{2}$ mile N.W. of the buoy at Staalgrunden. — 4 to 5,5 meters. — Sand with stones. — *Zostera* with a few *Fucus vesicul.*, *Chorda Filum* a. o.

UT. $^{22}/_{5}$ 95. Tranekær light-house E. by N. $^{1}/_{3}$ N. $2^{2}/_{3}$ miles. — 19 meters. — Coarse sand with stones. — *Delesseria sangvin.* a. o. *Florideæ*, *Laminaria sacch.* and *digit.*

UK. $^{21}/_{5}$ 95. Abreast of Tranekær light-house, $1^{1}/_{2}$ miles. — 12 meters. — Gravel (?) with some stones. — *Desmarestia acul.*, (*Phylloph. Brodiæi*).

DP. $^{13}/_{5}$ 92. The broom at Onsevig S.W. $^{1}/_{2}$ W. a good 1 mile. — 6,5 meters. — Sand with some stones. — *Zostera* with some *Fucus vesic.*

UI. $^{20}/_{5}$ 95. The broom at Onsevig S. a good $^{1}/_{2}$ mile. — 7,5 meters. — *Zostera*, (*Florideæ* in particular *Furcellaria*, *Rhodomela*).

DQ. $^{13}/_{5}$ 92. N.W. of Nakskov Fjord, Taars ferry outer light-house S.E. $^{1}/_{2}$ E. $2^{1}/_{4}$ miles. — 5,5 meters. — Sandy clay-mud. — *Zostera*, (with *Florideæ*; numerous shells).

US. $^{22}/_{5}$ 95. Gillebjerg N.W. $^{1}/_{4}$ W., Taars light-house E. — Ca. 45 meters. — Stones. — Scarce *Delesseria sinuosa* and *sangvinea.*

US[1]. $^{22}/_{5}$ 95. Gillebjerg N.W. $^{1}/_{2}$ W., Taars light-house E. — 20 meters. — Stones. — *Laminaria digitata* and *sacch.*, *Deless. sangvinea.*

DR. $^{14}/_{5}$ 92. Near the buoy at Albu Triller. — 8,5 meters. — *Zostera*, (with *Florideæ*).

DS. $^{14}/_{5}$ 92. The buoy at Albu Triller N.E. by E. $^{1}/_{4}$ E. 2 miles. — 11,5 meters. — Sand (?). — No vegetation.

DT. $^{14}/_{5}$ 92. Off Magleby on Langeland, $^{2}/_{5}$ mile of land. — 7,5 to 9,5 meters. — Sand. — *Zostera.*

LB. $^{4}/_{7}$ 93. Kjelsnor light-house W. nearly 4 miles. — 17 meters. — Mud with stones. — *Florideæ*, mostly *Delesseria sangvin.*, (*Laminaria digitata*).

UR. $^{22}/_{5}$ 95. S. of Albuen, Kappel church E. $^{1}/_{4}$ N., Fakkebjerg light-house W. $^{1}/_{2}$ N. — 7,5 meters. — ? with stones. — Rather dense *Zostera*-vegetation, (*Mytilus*, various *Florideæ*, some *Fucus serratus*).

Smaaland Sea. (Sm)

GZ. $^{10}/_{11}$ 92. 1 $^{1}/_{2}$ miles N. of the N. end of Egholm. — 6,5 meters. — Sand with stones. — *Zostera*, (*Fucus serratus*, *F. vesicul.*).

HA. $^{10}/_{11}$ 92. Agersø Sund, the broom off the channel to Skelskør Nor S.E. $^{1}/_{4}$ E. a good 1 mile. — 11,5 meters. — Stones. — *Florideæ*, (*Polysiphonia*, *Delesseria*).

VB. $^{27}/_{5}$ 95. E. side of Omø Tofte. — 5,5 meters. — Sand with *Mytilus*, among which various Algæ, mostly *Furcellaria* and *Ceram. rubrum.*

HB. $^{11}/_{11}$ 92. S. end of Agersø Sund, Helleholm light-house N.W. by W. $^{3}/_{8}$ W. 3 miles. — 8,5 meters. — Stones and *Mytilus.* — *Rhodomela* and *Polysiph. nigresc.*, (*Zostera*).

VC. $^{27}/_{5}$ 95. Venegrund, inside the buoy. — 4 to 5,5 meters. — Sand with stones. — *Zostera*, not dense, various Algæ, *Mytilus.*

HC. $^{11}/_{11}$ 92. By the broom at Knudshoved Odde. — 11,5 meters. — *Zostera.* — *Florideæ* (*Polys. nigrescens*).

CK. $^{23}/_{9}$ 91. 2 miles S. by E. $^{3}/_{4}$ E. of the buoy at Staalgrund. — 9,5 meters. — Sand (?) with stones. — *Furcellaria*, (*Phyllophora membranif.*, *Ph. Brodiæi*, *Polys. nigresc.*).

CL. $^{23}/_{9}$ 91. In the middle of Raagø Sund. — 5,5 meters. — Dense veg. of broad-leaved *Zostera.*

CM. $^{23}/_{9}$ 91. By the broom at Kragenæs. — 4,5 meters. — Dense broad-leaved *Zostera.*

S. $^{16}/_{9}$ 90. By the W. side of Fejø. — 5,5 meters. — *Zostera.*

CN. $^{23}/_{9}$ 91. N.E. of Middelgrund at the E. end of Fejø. — 4,5 meters. — *Zostera*, (*Fuc. serratus*, *Furcellaria*).

HD. $^{11}/_{11}$ 92. Knudskov Rev. — 4,5 meters. — *Fucus vesicul.*, (*Zostera*).

CQ. $^{25}/_{9}$ 91. 1 $^{3}/_{4}$ miles N.E. by E. $^{1}/_{5}$ E. of the broom at Kogrund. — 4,5 meters. — Sand with a few stones. — *Zostera*, (*Fucus vesicul.*).

Q. $^{15}/_{9}$ 90. N. of Vesterskovsflak. — 7,5 meters. — Sand. — *Zostera.*

P. $^{15}/_{9}$ 90. Between Kogrund and Suderø, $^{1}/_{4}$ mile S.E. by E. of the broom inside of Kogrund. — 3 meters. — Dense *Zostera*-vegetation with scarce *Fucus.*

CO. $^{23}/_{9}$ 91. By the broom at Vigsø Skal. — Ca. 6 meters. — *Zostera.*

CP. $^{25}/_{9}$ 91. By the broom at Guldborg. — 4 meters. — *Zostera.*

O. $^{15}/_{9}$ 90. Off Guldborg. — 5,5 meters. — Mud without vegetation.

N. $^{14}/_{9}$ 90. Guldborgsund, off Vennerslund. — 1 to 2 feet: *Polysiphonia violacea* f. *aculeata* a. o. scattered. — 2 feet: *Potamogeton pectinatus* and *Zannichellia pedicellata.* — 3 feet: *Spermatochnus paradoxus*, *Fucus serratus* a. o. — 3 to 4 feet and outwards: *Zostera.*

CR. $^{25}/_{9}$ 91. By the beacon at the W. end of Stor Strøm. — 4,5 meters. — Broad-leaved *Zostera*.

HE. $^{11}/_{11}$ 92. W. end of Masnedsund, near the beacon. — 4 to 5,5 meters (?). — Sand. — Pure *Zostera*-vegetation.

KP. $^{2}/_{7}$ 93. S.E. of Masnedø, between Kalvestrøm and Færgestrøm. — Ca. 3 meters. — *Zostera*, with scattered *Fucus vesic.*

HF. $^{12}/_{11}$ 92. W. of Farø, about $^{2}/_{3}$ mile of land. — 12 meters. — Mud with stones and dead *Zostera*-leaves. — Very scarce *Florideæ*.

R. $^{16}/_{9}$ 90. Off Petersværft, near land. — Ca. 2 meters. — *Zostera*.

R^{1}. $^{16}/_{9}$ 90. Off Sprove, Møen, right opposite Langø. — From 1,3 meters outwards *Zostera*. — In the channel mud without vegetation.

HJ. $^{12}/_{11}$ 92. Bredemands Hage by the S. side of Bogø. — 6,5 meters. — *Zostera*, dead and probably also growing, (scarce *Florideæ*).

KQ. $^{2}/_{7}$ 93. Grønsund, off the N. end of Østerskov. — 4 meters. — Bare sand. — 3,5 meters: *Zostera*.

The Sound. (Su)

RX. $^{1}/_{8}$ 94. Outside of Møllegrund off Höganäs. — 15 meters. — Clay-mud with stones. — No vegetation.

BQ. $^{12}/_{9}$ 91. Off Ellekilde. — 5,5 meters. — Stones. — *Fucus vesic.*, *Fuc. serratus*, (*Furcellaria* a. o. *Florideæ*).

BR. $^{12}/_{9}$ 91. Off Odinshøj. — 9,5 to 11,5 meters. — *Zostera*-vegetation.

CS. $^{1}/_{5}$ 92. Off Aalsgaarde. — 4 to 5,5 meters. — Stones. — (*Fucus vesiculosus*, *F. serratus*, and *Florideæ*.

GK. $^{4}/_{8}$ 92. Off Hellebæk. — Between first and second shoal. — Stones. — *Fucus serratus*, (*F. vesicul.*, *Furcellaria*).

ON. $^{17}/_{4}$ 94. E. side of Lappegrund. — 6,5 to 9,5 meters. — Coarse sand with pebbles. — No vegetation.

HN. $^{8}/_{5}$ 93. Øretvisten, E. side, Kronborg light-house S.W. $^{3}/_{5}$ S. 2 miles. — 17 to 19 meters. — No vegetation.

HM. $^{8}/_{5}$ 93. Øretvisten, Kronborg S.W. $^{3}/_{5}$ S. $1^{3}/_{5}$ miles. — 24,5 to 28 meters. — Clay-mud. — (A stone with a young *Lithothamnion*, one spec. of *Delesseria sangvinea*).

HL. $^{8}/_{5}$ 93. Øretvisten, Kronborg S.W. $^{1}/_{4}$ S. $1^{1}/_{4}$ mile. — 41,5 meters. — Soft bottom (?). — No vegetation.

OK. $^{17}/_{4}$ 94. Disken, Lat. N. 56°0,3′, Long. E. 12°38,5′. — 7,5 meters. — Bare sand.

OM. $^{17}/_{4}$ 94. W. side of Disken, Lat. N. 56°0,2′, Long. E. 12°38′. — Sand. — No vegetation (*Mytilus*).

OL. $^{17}/_{4}$ 94. E. side of Disken, Lat. N. 56°0′, Long. E. 12°37,7′. — 14 to 16 meters. — Sand. — No vegetation.

PX. $^{23}/_{7}$ 94. Off Tibberup. — 8,5 meters. — Sandy mud with a few small pebbles. — Dense vegetation of *Zostera*, (with *Fucus vesiculosus*, *Rhodomela*, *Polysiph. nigrescens*).

TD. $^{10}/_{9}$ 94. Hveens revolving light S. $^{1}/_{2}$ W. $2^{1}/_{2}$ miles. — 20,5 meters. — No vegetation (seine).

OI. $^{17}/_{4}$ 94. Nivaa Flak, off Nivaa. — 6,5 meters. — *Rhodomela* (seine).

HK. $^{8}/_{5}$ 93. Off the N.W. end of Hveen. — 17 meters. — Clay-mud. — No vegetation. — 9,5 to 21,5 meters: In part clay-mud. — A few Algæ (*Polysiph. nigresc.*, *Ceramium rubrum*, *Delesseria sinuosa*).

TC. $^{10}/_{9}$ 94. Hveens revolving light N. $^{1}/_{2}$ W. $^{1}/_{2}$ mile. — 17 meters. — Clay-mud (?). — No vegetation (seine).

PV. $^{23}/_{9}$ 94. N. end of Lous's Flak, Hveens revolving light E. by N. $^{1}/_{2}$ N. 3 miles. — 10 meters. — Fine sand. — *Zostera.*

OH. $^{17}/_{9}$ 94. Vedbæk W.S.W. $^{1}/_{4}$ S. 1 mile. — 9,5 to 10,5 meters. — Sandy clay-mud with a few stones. — *Florideæ*, in particular *Furcellaria* and *Rhodomela*, (*Laminaria sacchar.*).

PY. $^{23}/_{7}$ 94. E. of Hveen, Haken light-house S. $^{1}/_{2}$ W. 1 mile. — 40,5 meters. — Clay-mud. — No vegetation.

PZ. $^{23}/_{7}$ 94. Near the E. side of Hveen, Haken light-house S. by E. $^{1}/_{4}$ E. 1 mile. — 10,5 to 19 meters. — Stones, from 12 meters upwards. — *Florideæ*, *Laminaria sacchar.*

TE. $^{25}/_{9}$ 94. W. of Staffans Flak, Haken light-house N.N.W. $^{1}/_{4}$ N. a good 1,5 mile. — 22,5 to 30 meters. — Clay-mud with stones. — No plants.

— The channel between Hveen and Landskrona. — 45 meters. — Clay-mud. — No plants.

TF^{1}. $^{25}/_{9}$ 94. Staffans Flak. — 12 to 13 meters. — Stones. — *Laminaria sacch.*, *Florideæ*, in particular *Furcellaria*, (*Chorda Filum*).

TF^{2}. $^{25}/_{9}$ 94. Immediately S. of Staffans Flak. — 28 to 32 meters. — Clay-mud and stones. — No plants.

TF^{3}. $^{25}/_{9}$ 94. S.W. border of Staffans Flak. — 14 to 18 meters. — *Laminaria digitata*, *Florideæ*, *Phymatolithon polymorphum.*

QA. $^{23}/_{7}$ 94. By the buoy at Pilhaken, off Landskrona. — 24,5 to 39,5 meters. — No vegetation.

QB. $^{23}/_{7}$ 94. S. of the same buoy. — 16 meters. — Coarse sand, almost without vegetation, (a few *Desmarestia viridis* and *Ectocarpus*).

bM. $^{14}/_{7}$ 07. S. of Hveen, 1 mile W.S.W. $^{1}/_{4}$ S. of the whistle buoy at Pilhaken. — 22,5 meters. — Stones. — Abundant vegetation: *Laminaria digitata*, *L. sacchar.*, *Florideæ*, in particular *Delesseria sinuosa* and *sangvinea.*

RZ. E. of Lous Flak, Lat. N. 55°51,6′, Long. E. 12°41,5′. — 13 meters. — Clay-mud. — A few Algæ.

RY. Lous Flak, Lat. N. 55°51,5′, Long. E. 12°38′. — 12 meters. — Sandy clay-mud. — *Cladophora gracilis.*

bN. $^{14}/_{7}$ 07. — Off Vedbæk, Lat. N. 55°51′, Long. E. 12°36,5′. — 13 meters. — Abundant vegetation of Algæ and *Zostera*; of Algæ mostly *Ectocarpus*, *Furcellaria*, *Polysiphonia elong.* and *nigrescens*, *Rhodomela.*

RK. $^{30}/_{7}$ 94. Off Eremitagen, $^{3}/_{4}$ mile of land. — 7,5 meters. — Sand and mud. — *Zostera* and *Furcellaria* (probably loose).

PT. $^{21}/_{7}$ 94. By the broom at Taarbæk Rev. — Stones. — Abundant vegetation: *Fucus serratus*, *Furcellaria*, *Polysiph. nigrescens*, *Chorda Filum*, *Zostera.*

OG. $^{17}/_{4}$ 94. Taarbæk Rev, nearly 1 mile W. of the broom. — 6 meters. — Sand with stones. — *Florideæ*, in particular *Furcellaria* and *Rhodomela*, *Fuc. serratus.*

PU. $^{21}/_{7}$ 94. The broom at Taarbæk Rev N.W. by W. $^{1}/_{3}$ W. $2^{1}/_{8}$ miles. — 12 meters. — No vegetation.

TB. $^{10}/_{9}$ 94. The harbour of Skovshoved W.S.W. $^{1}/_{2}$ mile. — 5,5 meters. — Sand (?) with stones. — *Furcellaria*, *Zostera*, (*Chorda Filum*).

TA. $^{10}/_{9}$ 94. Near the harbour of Skovshoved. — 4,5 meters. — Sand. — *Zostera.*

PS. $^{21}/_{7}$ 94. Off Charlottenlund, the broom at Taarbæk Rev N.E. $^{1}/_{2}$ N. $2^{1}/_{3}$ miles. — 5,5 meters. — Sand with stones. — Abundant vegetation: *Zostera*, *Ectocarpus*, *Chorda Filum*, *Furcellaria.*

KO¹. 18/6 93. Off the fort of Charlottenlund. — 3 meters. — Stones. — *Chorda Filum*, *Cladophora.*

KO². 18/6 93. A little farther out. — 7 meters. — Stones. — *Fucus serratus*, *Laminaria sacch.*, *Furcellaria*, *Zostera.*

OG¹. 16/4 94. Between Trekroner and Middelgrund. — Ca. 9,5 meters (?). — *Desmarestia acul.*, *Delesseria sinuosa* and *alata*, *Chætopteris*....

RI. 30/7 94. S. end of Middelgrund, between the beacon and the triple broom. — 5 meters. — Gravel with stones. — *Chorda Filum*, (scarce *Zostera*).

QE. 23/7 94. Nordre Røse. — 10,5 meters. — Gravel and stones. — No plants. — 5 to ca. 10 meters: Stones. — *Zostera*, *Chorda Filum*, (*Mytilus*).

RH. 30/7 94. S. end of Knollen. — 9,5 meters. — Stones. — *Laminaria sacchar.*, *Florideæ*, mostly *Polysiphonia violacea*, broad-leaved *Zostera.*

QC. 23/7 94. E. side of Saltholms Flak, 2/3 mile E. 5/6 S. of the broom. — 6 meters. — Sand (?) with stones. — Dense vegetation of *Fucus vesiculosus*, *F. serratus*, *Furcellaria* a. o. *Florideæ*, *Chorda Filum.*

QD. 23/7 94. E. of the N. end of Saltholm, 1 mile S.S.W. 1/2 S. of the beacon. — 5,5 meters. — Sand (?) with stones. — Dense vegetation of *Fucus serratus*, *Furcellaria*, *Polysiph. nigrescens*, *Zostera.*

SA. 2/8 94. Flinterenden; 1/4 mile S. of the buoy at N. Flint. — 10,5 meters. — Stones and black mud. — Broad-leaved *Zostera*, *Laminaria sacchar.*, (*Dictyosiphon*, *Laminaria digit.*).

SB. 2/8 94. Flinterenden; 3/8 mile S.W. of Oscargrund light-ship. — 8,5 meters. — Stones. — *Fucus serratus*, (*Florideæ*, *Dictyosiphon foeniculaceus*).

PR. 24/5 94. Off Dragør. — 7,5 to 9,5 meters. — Hard bottom with stones. — *Florideæ*: *Rhodomela*, *Polysiph. nigrescens*, *Furcellaria* and *Zostera.*

PR¹. 24/5 94. About the same place but farther out. — Ca. 7,5 meters. — *Zostera* and the same Algæ as in PR.

Baltic, Western Part. (Bw)

VA. 25/5 95. Vejsnæs Nakke E. 1/3 N. — 26,5 meters. — Sand and pebbles. — No vegetation.

DV. 14/5 92. S. of Marstal, Fakkebjerg light-house S. E. 3/4 E. nearly 7 miles. — 9,5 to 11,5 meters. — Sand with pebbles. — *Zostera*, *Fucus serratus*, *Furcellaria.*

LE. 4/7 93. N. side of Vejsnæs Flak. — 9,5 meters. — Sand. — *Zostera*, (*Fucus serratus*, *Florideæ*).

UY. 25/5 95. Vejsnæs Flak. — 9,5 meters. — Bare sand with a few stones, on which *Fucus vesiculosus* and *F. serratus*, (and some *Florideæ*).

UY¹. 25/5 95. S. side of Vejsnæs Flak. — 18 meters. — Sandy clay-mud. — Loose *Furcellaria*, *Laminaria digitata.*

UZ. 25/5 95. In the channel E. of Vejsnæs Flak. — 34 meters. — Clayey sand with small stones. — No vegetation.

LD. 4/7 93. Fakkebjerg light-house E.S.E. 1/4 E. 6 3/4 miles. — 20,5 to 22,5 meters. — Clay-mud without vegetation (*Ophiuræ*).

DU. 14/5 92. Off Dimesodde S. of Bagnkop, 1/3 mile of land. — 11 meters. — Stones. — *Furcellaria*, (*Fucus serratus*, *Laminaria digitata*...).

LC. 4/7 93. S. of the buoy at Gulstav. — 11,5 meters. — Stones. — *Florideæ*, mostly *Furcellaria*, (*Fucus serratus*, *Halidrys*, *Laminaria digit.*).

UL. $^{21}/_{5}$ 95. Femerbelt; Øjet, Markelsdorf Huk S. $^{5}/_{8}$ E. 7 miles. — 20 meters. — Gravel with stones. — Abundant vegetation: *Laminaria digitata*, *L. saccharina*, *Florideæ*.

LA. $^{3}/_{7}$ 93. Kappel church N. by W. $^{3}/_{4}$ W., W. end of Vesterskov N. $^{1}/_{4}$ W. — 7,5 meters. — Sand with some stones. — *Zostera*, *Florideæ*, (*Fucus vesiculosus*).

UQ. $^{22}/_{5}$ 95. Tillitse church N.E., Kappel church N. by W. $^{1}/_{2}$ W. — 12 meters. — Gravel and stones. — *Mytilus* with *Polysiphonia nigrescens* and a few other *Florideæ*.

UP. $^{22}/_{5}$ 95. Off Kramnisse Gab, $1^{1}/_{4}$ miles of land. — 8,5 meters. — Sand with stones. — Some *Zostera*, scarce *Furcellaria* and *Fucus serratus*, (*Mytilus*).

KZ. $^{3}/_{7}$ 93. Immediately outside Kramnisse Gab. — 7,5 meters. — *Zostera*, *Fucus serratus*, *Furcellaria*.

KY. $^{3}/_{7}$ 93. Ølstrup church E.N.E. 6 miles. — 12,5 meters. — Gravel and stones, *Mytilus*. — *Florideæ*, in particular *Ceramium* and *Polysiph. nigrescens*, (dead *Zostera*-leaves).

KX. $^{3}/_{7}$ 93. Olenburg Huk S.W. by W. $^{3}/_{4}$ W. a good 6 miles. — 26,5 meters (?). — Mud. — A few *Florideæ* on stones.

KV. $^{3}/_{7}$ 93. S. of Nysted, the buoy N.E. by N. $^{1}/_{2}$ mile. — 5,5 meters. — Sand. — *Zostera* in large patches, *Florideæ*.

KU. $^{3}/_{7}$ 93. Schønheyders Pulle. — 6,5 meters. — Stones. — *Fucus serratus*, *Florideæ*, (*Laminaria digitata*).

— $^{21}/_{5}$ 95. — 7 meters. — Small pebbles or coarse gravel, in great measure without vegetation, with however patches of *Fucus serratus* and a few *Florideæ* and some *Zostera*, (*Mytilus*).

KT. $^{2}/_{7}$ 93. Gjedser Rev, near the inmost broom. — 8,5 meters. — Stones. — *Fucus serratus*, *Florideæ*, in particular *Ceramium Rosenvingii*.

UO. $^{21}/_{5}$ 95. Gjedser Rev, Trindelen. — 5,5 to 7 meters. — Sand, gravel. — No vegetation.

UN[1]. $^{21}/_{5}$ 95. Gjedser Rev, Yderknoben. — 5,5 to 9,5 meters. — Sand and coarse gravel without vegetation.

UN. $^{21}/_{5}$ 95. Gjedser Rev, by "Varsko". — 9,5 meters. — Sand without vegetation.

UM[1]. $^{21}/_{5}$ 95. Near Gjedser Revs light-ship. — 19 meters. — Sand without vegetation.

UM. $^{21}/_{5}$ 95. Kadetrenden; Gjedser Revs light-ship N.W. $1^{1}/_{6}$ miles. — 24,5 to 25,5 meters. — Small pebbles. — No vegetation, (a few *Hildenbrandtia* a. o.).

Baltic, Part around Møen. (Bm)

QF. $^{23}/_{7}$ 94. W. of Lille Grund by Flinterenden, Drogdens light-ship N. by W. $^{1}/_{4}$ W. nearly 3 miles. — 9,5 meters (?). — Stones. — *Zostera*, *Fucus serratus*, broad, *Ectocarpus*, (*Mytilus*).

RG. $^{30}/_{7}$ 94. Falsterbo light-house S.S.E. 6 miles. — Sand, stones. — *Fucus serratus*, *Florideæ*, (the Algæ probably in part loose).

QG. $^{24}/_{7}$ 94. Abreast of Bredgrund, $^{1}/_{2}$ mile N.E. $^{1}/_{2}$ E. of the broom at Virago Grund. — 7,5 meters. — Stones. — *Fucus serratus*, *F. vesiculosus*.

QM. $^{24}/_{7}$ 94. N. of Juels Grund, harbour of Køge W. $5^{1}/_{2}$ miles. — 6,5 to 7,5 meters. — Sand with stones. — Abundant vegetation of *Fucus vesiculosus*, *Polysiph. nigrescens* a o. *Florideæ*, *Zostera*.

QL. $^{24}/_{7}$ 94. S. of Juels Grund. — 11,5 meters. — No vegetation.

QK. $^{24}/_{7}$ 94. Off Køge Søhuse. — 9,5 meters. — Fine sand. — *Zostera*.

QN. $^{24}/_{7}$ 94. Off Køge Søhuse, $^{3}/_{4}$ mile of land. — 6,5 meters. — Stones. — *Fucus serratus*, (with *Florideæ*).

QI[1]. $^{24}/_{7}$ 94. Køge Bugt, 7 miles due N. of Stevns light-house. — 16 meters (seine). — *Florideæ*, *Laminariæ*.

QO. $^{24}/_{7}$ 94. Køge Sønakke N.W. $^{1}/_{4}$ W. 1,3 miles. — 4,5 to 5,5 meters. — Stones. — *Fucus vesiculosus*, *Florideæ*.

QP. $^{24}/_{7}$ 94. Kalkgrund, at the N. end of Stevns Klint. — 3 to 4 meters. — Limestones. — *Fucus vesiculosus* and *F. serratus*, (*Ceram. rubrum*, *Chorda Filum*).

VF. $^{28}/_{5}$ 95. Off Mandehoved, Stevns. — 4 to 9,5 meters. — Limestones. — Rather abundant vegetation: *Fucus vesiculosus* and *F. serratus*, (*Polys. nigrescens*).

QJ. $^{24}/_{7}$ 94. 6 miles due W. of Falsterbo light-house. — 16 meters. — Fine sand. — No vegetation.

QH. $^{24}/_{7}$ 94. Falsterbo light-house N.E. $^{1}/_{2}$ E. $2^{1}/_{2}$ miles. — Ca. 7,5 meters. — Sand. — *Zostera*, *Fucus vesiculosus* a. o.

SC. $^{2}/_{8}$ 94. Falsterbo light-ship S.E. $^{1}/_{2}$ S. $2^{1}/_{2}$ miles. — 9,5 meters. — Fine Sand. — No vegetation.

VE. $^{28}/_{5}$ 95. Stevns light-house N.E. $^{1}/_{2}$ E. $1^{1}/_{3}$ miles. — 15 meters. — Gravel, small pebbles. — No vegetation.

QQ. $^{24}/_{7}$ 94. Off Rødvig. — 6,5 to 7,5 meters. — Stones. — *Fucus vesiculosus*, (*F. serratus*).

VD. $^{27}/_{5}$ 95. Near the whistle buoy at the entrance to Bøgestrømmen. — 7,5 meters. — Sand with stones. — *Fucus vesiculosus*, *F. serratus*....

RA. $^{25}/_{7}$ 94. Hollænder Grund. — 5,5 meters. — Stones. — *Fucus vesiculosus*, *Spermatochnus*.

RB. $^{25}/_{7}$ 94. Inside Hollænder Grund. — 4,5 meters. — Sand and gravel with stones. — *Fucus vesiculosus*, *Zostera*; the vegetation here and there wanting.

QR. $^{25}/_{7}$ 94. Gyldenløves Flak. — 7,5 meters. — Gravel with stones. — *Fucus vesiculosus*.

SD. $^{2}/_{8}$ 94. Stevns light-house N. by W. $^{1}/_{4}$ W. nearly 13 miles. — 23,5 meters. — Sand. — Loose *Florideæ* in abundance, in particular *Furcellaria*, *Delesseria sangvinea*, *D. alata*, *Rhodomela*, *Polysiphonia nigrescens*.

QS. $^{25}/_{7}$ 94. The Møen cliff S.S.W. 7 miles. — 20,5 meters. — Gravel and small stones. — *Florideæ*, in particular *Rhodomela*, *Delesseria sangvinea*, *D. alata*, for the most part loose, (many *Mytilus*).

VG. $^{28}/_{5}$ 95. N. of the Møen cliff, abreast of Hellehavns Nakke, $^{3}/_{4}$ mile of land. — 17 meters. — Gravel and stones. — *Mytilus* with various *Florideæ*.

RC. $^{26}/_{7}$ 94. Inside "Danneskiold" near the Møen cliff. — 7,5 meters. — Stones. — *Fucus vesiculosus*.

QZ. $^{25}/_{7}$ 94. Abreast of Møen light-house. — Ca. 7,5 meters. — Stones. — *Fucus vesiculosus*, *F. serratus*, a great many loose *Rhodymenia palmata*.

QY. $^{25}/_{7}$ 94. S. side of Bjelkes Flak. — 10,5 meters. — Stones. — *Fucus serratus*.

VH. $^{28}/_{5}$ 95. S. side of Böchers Grund. — 8,5 to 10,5 meters. — Sand and stones. — *Fucus serratus* and *F. vesiculosus*.

VI. $^{28}/_{5}$ 95. Off Hjelm, Møen, near land. — 5,5 to 6,5 meters. — Gravel with stones. — *Fucus serratus* and *vesiculosus*, (*Rhodomela*, *Polysiph. nigrescens*).

HG. $^{12}/_{11}$ 92. Præstebjergs Rev, N. of the broom. — 7 meters. — Stones. — *Fucus vesiculosus* and *serratus*.

HH. $^{12}/_{11}$ 92. The broom at Præstebjergs Rev N.W. by W. a good 2 miles. — 17 meters. — Clay-mud. — No vegetation.

KR. $^{2}/_{7}$ 93. By Korselitze Grund. — 7,5 meters. — Sand with stones. — *Fucus vesiculosus*, *F. serratus*, *Florideæ*.

KS. $^{2}/_{7}$ 93. E. of Falster, off Ulfslev; Gjedser light-ship S.S.W. $^{3}/_{4}$ W. $11^{1}/_{2}$ miles. — 9,5 to 11,5 meters. — Gravel and stones, *Fucus vesicul.* and *serratus*, *Florideæ*, in particular *Rhodomela* and *Polys. nigrescens.*

bO. $^{17}/_{7}$ 07. Lat. N. 54°37′, Long. E. 12°25′ (Mag. O. Paulsen). — 15 meters (trawl). — *Laminaria sacchar.*, *Desmarestia acul.*, various *Florideæ.*

QV. $^{25}/_{7}$ 94. Lat. N. 54°43,6′, Long. E. 12°28,5′. — 17 meters. — Sand. — No vegetation.

QX. $^{25}/_{7}$ 94. Lat. N. 54°49,7′, Long. E. 12°28,4′. — 20,5 meters. — Fine sand. — No vegetation.

QU. $^{25}/_{7}$ 94. Lat. N. 54°46,6′, Long. E. 12°34$^{2}/_{3}$′. — 16 meters. — Fine sand. — No vegetation.

SE. $^{2}/_{8}$ 94. Lat. N. 55°4, Long. E. 12°47′. — 28 meters. — Clay-mud without vegetation.

QT. $^{25}/_{7}$ 94. Møen light-house W. by N. $10^{2}/_{3}$ miles. — 34 meters. — Clay-mud with fine sand. — No vegetation.

bP. $^{18}/_{7}$ 07. E. side of Kriegers Flak, Lat. N. 55°3′, Long. E. 13°5′ (?) (Mag. O. Paulsen). — Ca. 15 (18?) meters. — *Rhodomela*, *Ceramium strictum*, *Desmarestia viridis* a. o.

RF. $^{30}/_{7}$ 94. Lat. N. 55°10′, Long. E. 13°15′. — 37,5 meters. — Sand and clay-mud, a few small stones. — No vegetation.

Baltic, Part around Bornholm. (Bb)

RE. $^{30}/_{7}$ 94. Lat. N. 55°10′, Long. E. 14°. — Ca. 40 meters. — No vegetation.

SF. $^{3}/_{8}$ 94. Adler Grund, $^{1}/_{2}$ mile S. of the light-ship. — Ca. 10,5 meters. — Sand with stones. — *Furcellaria*, *Ceramium vertebrale.*

SG. $^{3}/_{8}$ 94. Adler Grund, $1^{3}/_{4}$ miles S. by E. $^{1}/_{4}$ E. of the light-ship. — Stones. — 10,5 meters. — *Furcellaria*, *Ceramium vertebrale.*

SU. $^{7}/_{8}$ 94. Rønne Banke, Lat. N. 54°54′, Long. E. 14°33′. — 24,5 meters. — Hard sand with stones. — Scarce vegetation, in particular *Rhodomela* and *Ectocarpus littoralis.*

ST. $^{7}/_{8}$ 94. W. side of Rønne Banke, Lat. N. 54°55$^{3}/_{4}$′, Long. E. 14°33′. — 18 meters. — Stones. — *Mytilus*; a few *Florideæ* and *Ectocarpus littoralis.*

SS. $^{7}/_{8}$ 94. W. side of Rønne Banke, Lat. N. 54°58$^{1}/_{4}$′, Long. E. 14°32$^{1}/_{2}$′. — 19 meters. — Stones, gravel. — *Sphacelaria racemosa.*

SH. $^{3}/_{8}$ 94. Rønne Banke, Lat. N. 54°59$^{1}/_{3}$′, Long. E. 14°45$^{1}/_{3}$′. — Stones. — *Stictyosiphon*, *Ceramium.*

SR. $^{7}/_{8}$ 94. Rønne Banke, Lat. N. 55°1$^{3}/_{4}$′, Long. E. 14°41$^{1}/_{3}$′. — 15 to 16 meters. — Gravel and stones. — *Florideæ*, in particular *Rhodomela* and *Ectocarpus.*

YI. $^{11}/_{7}$ 01. Port of Rønne E. by N. $2^{3}/_{4}$ miles. — 33 meters. — No vegetation.

YH. $^{11}/_{7}$ 01. Port of Rønne E.N.E. $1^{1}/_{2}$ miles. — 24,5 meters. — Stones. — Incrusting Algæ (*Hildenbrandtia*, *Lithoderma*), a few arbuscular *Florideæ.*

RD. $^{27}/_{7}$ 94. Hvidmæhrn, S. of Rønne. — 9,5 meters. — Stones. — *Fucus vesiculosus*, (*F. serratus*).

SK. $^{3}/_{8}$ 94. Rønne Banke: Højbratterne, $^{1}/_{6}$ mile S. of the broom. — 11,5 meters. — Gravel and stones. — *Fucus serratus*, *F. vesicul.*, (*Furcellaria* with *Ceramium*).

SI. $^{3}/_{8}$ 94. Rønne Banke, Lat. N. 55°$^{1}/_{2}$′, Long. E. 14°47$^{3}/_{4}$′. — 13 meters. — Gravel. — No vegetation.

YF. $^{11}/_{7}$ 01. Inside Arnager Rev. — 5,5 meters. — *Fucus serratus* and *vesiculosus*, (scarce *Zostera*).

YG. $^{11}/_{7}$ 01. Arnager Rev, a good mile of the port. — 7 meters. — Limestone. — *Fucus vesiculosus* a. o.

YE. $^{10}/_{7}$ 01. Off Ølenaa, $^{1}/_{3}$ mile of land. — 10,5 meters. — Stones or rock. — *Polysiph. nigrescens*, *Furcellaria*, (*Fucus serratus*).

SN. 6/8 94. Davids Banke. — 15 to 17 meters. — *Fucus serratus*, (*Ectocarpus*).
— — — — 24,5 to 28 meters. — Stones. — *Laminaria saccharina.*
XZ[1]. 5/7 01. — — N.W. side of the bank. — 29 meters. — Stones. — Red and brown Algæ, no *Laminariæ.*
XZ[2]. — Davids Banke — 12 to 22,5 meters. — Stones. — *Fucus serratus* (and some *Florideæ*).
XZ[3]. — — — 15 meters. — Stones. — *Fucus serratus* with red and brown Algæ.
XZ[4]. — — — 19 to 20,5 meters. — *Laminaria saccharina* in abundance, *Fucus serratus.*
XZ[5]. 5/7 01. Hammer Odde S.E. by E. 7 miles. — 41 to 43 meters. — Firm clay with a few small stones. — No plants.
SM. 6/8 94. N. of Hammeren, Lat. N. 55°18,8′, Long. E. 14°46′. — 24,5 meters. — Sand. — No vegetation.
SL. 5/8 94. Off Allinge. — Ca. 5,5 to 11,5 meters. — Rock and stones. — *Fucus vesiculosus*, *Ceramium rubrum*, *C. vertebrale*, *Sphacelaria racemosa.*
SO. 6/8 94. Off Gudhjem. — 5,5 to 11,5 meters. — Rocky ground. — *Florideæ*, in particular *Ceramium rubrum* f. *baltica*, *C. vertebrale*, *Phyllophora membranifol.*, *Ph. Brodiæi*, *Furcellaria*, *Dictyosiphon*, *Fucus serratus.*
SP. 6/8 94. 1/4 mile N. by W. 1/2 W. of Møllenakke by Svaneke. — 28 meters. — Gravel. — No vegetation.
SQ. 6/8 94. Close S. of Broens Rev. — 9 meters. — Rocky ground. — *Fucus serratus*, (very few *Florideæ*).
YD. 6/7 01. The double broom at Salthammer Rev W. 1/4 S. 1 mile. — 19 meters. — Stones. — Abundant vegetation of red and brown Algæ: *Ectocarpus littoralis*, *Delesseria sangvinea*, *Rhodomela*, *Polysiphonia elongata var.* a. o.
YC. 6/7 01. The double broom at Salthammer Rev N.W. 3/4 N. 1 1/2 miles. — 24,5 meters. — Rather rich vegetation of *Ectocarpus littor.*, *Rhodomela*, *Polysiph. elongata var.* a. o.
YA. 6/7 01. Dueodde light-house W. 5 3/4 miles. — 37,5 meters. — *Rhodomela*, *Sphacelaria racemosa*, *Furcellaria*, *Deless. sinuosa.*
YB. 6/7 01. Dueodde light-house W. 6 miles. — 43,5 to 45 meters. — Stones. — No plants.
SV. 8/8 94. Nordvestgrund by Christiansø. — 30 to 32 meters. — Rocky ground. — No vegetation.
SX. 8/8 94. That by Christiansø. — 0 to ca. 15 meters. — Abundant vegetation.

List of stations arranged chronologically, with indication of the waters where they are situated.

July 1890.	A—D	Ks.	Aug. 1891.	AI—AN	Lb.	Sept. 1891.	BS—BV	Sb.
Sept. —	E—M	Lf.	— —	AO—AT	Sa.	— —	BX—CC	Sf.
— —	N—S	Sm.	— —	AU—AX	Lb.	— —	CD—CF	Sb.
— —	T	Sb.	— —	AY—BF	Sa.	— —	CG	Sf.
— —	U—V	Sf.	— —	BG	Ks.	— —	CH—CI	Sb.
— —	X—Y	Sb.	— —	BH—BO	Km.	— —	CK—CR	Sm.
Aug. 1891.	Z—AG	Sb.	— —	BP	Kn.	May 1892.	CS	Su.
— —	AH—AI[1]	Sa.	Sept. —	BQ—BR	Su.	— —	CT—CZ	Sf.

May	1892.	DA—DI	Lb.
—	—	DJ—DK	Sa.
—	—	DL—DT	Sb.
—	—	DU—DV	Bw.
—	—	DX—DY	Lb.
—	—	DZ—EB	Sf.
June	—	EC—EG	Lb.
July	—	EH—EP	Ks.
—	—	EQ—EY	Ke.
—	—	EZ—FA	Km.
—	—	FB—FD	Ke.
—	—	FE—FH	Kn.
—	—	FJ—FN	Km.
—	—	FO—FP	Ks.
—	—	FQ—FY	Sa.
—	—	FZ—GA	Lb.
—	—	GB—GE	Sa.
—	—	GF—GH	Ks.
—	—	GI	Ke.
Aug.	—	GK	Su.
Sept.	—	GL—GO	Kn.
Nov.	—	GP—GY	Sb.
—	—	GZ—HF	Sm.
—	—	HG—HH	Bm.
—	—	HI	Sm.
May	1893.	HK—HN	Su.
—	—	HO—HS	Ks.
—	—	HT—HV	Km.
—	—	HX—IU	Ke.
—	—	IV—KD	Kn.
—	—	KE—KG	Km.
—	—	KH	Ks.
—	—	KI—KN	Sa.
June	—	KO	Su.
July	—	KP—KQ	Sm.
—	—	KR—KS	Bm.
—	—	KT—LA	Bw.
—	—	LB	Sb.
—	—	LC—LE	Bw.
—	—	LF—LG	Lb.
—	—	LH—LK	Sb.
Aug.	—	LL—LP	Sb.
—	—	LQ—ML	Lf.
Sept.	1893.	MM—MN	Sb.
—	—	MO—MY	Sa.
—	—	MZ—NB	Ks.
—	—	NC—ND	Km.
—	—	NE—NK	Kn.
—	—	NL—NM	Ks.
Jan.	1894.	NN—NU	Sb.
March	—	NV—NX	Lb.
—	—	NY—OA	Sa.
—	—	OB—OF	Lb.
Apr.	—	OG—ON	Su.
—	—	OO—OY	Ks.
—	—	OZ—PP	Sa.
May	—	PQ—PQ[1]	Ks.
—	—	PR—PR[1]	Su.
July	—	PS—QE	Su.
—	—	QF—RC	Bm.
—	—	RD—RF	Bb.
—	—	RG	Bm.
—	—	RH—RK	Su.
—	—	RL—RQ	Ks.
Aug.	—	RR—RS	Ks.
—	—	RT—RV	Ke.
—	—	RX—SB	Su.
—	—	SC—SE	Bm.
—	—	SF—SX	Bb.
—	—	SY—SZ	Sk.
Sept.	—	TA—TF	Su.
—	—	TG—TR	Kn.
Oct.	—	TS—TT	Km.
—	—	TU—TY	Kn.
Jan.	1895.	TZ—UD	Kn.
May	—	UE—UK	Sb.
—	—	UL—UQ	Bw.
—	—	UR—UU	Sb.
—	—	UV—UX	Sf.
—	—	UY—VA	Bw.
—	—	VB—VC	Sm.
—	—	VD—VF	Bm.
—	—	VG—VI	Bm.
June	—	VJ	Sk.
July	—	VK—VK[1]	Km.
July	1895.	VL—VS	Km.
—	—	VT—VX	Kn.
—	—	VY—XA	Ke.
—	—	XB—XF	Km.
Aug.	—	XG	Kn.
July	1896	XH—XI	Kn.
July	1899	XK—XL	Kn.
—	—	XM—XN	Lf.
Aug.	—	XO	Sk.
July	1900.	XP—XQ	Lb.
Aug.	—	XR	Ns.
Oct.	—	XS	Sb.
June	1901.	XT—XY	Lf.
July	—	XZ—YI	Bb.
Aug.	—	YK—YL	Sk.
July	1902.	YM—YN	Sk.
—	—	YO—YS	Kn.
Aug.	—	YT	Ns.
—	—	YU	Sk.
June	1904.	YV	Sa.
July	—	YX	Kn.
—	—	YY	Km.
—	—	YZ—ZB	Kn.
—	—	ZC—ZD	Km.
—	—	ZE—ZI	Ke.
Aug.	—	ZK	Sk.
July	1905.	ZL—ZM	Kn.
—	—	ZN—ZO	Ks.
—	—	ZP	Kn.
—	—	ZQ—ZR	Ns.
—	—	ZS—ZY	Lf.
—	—	ZZ—aE	Ns.
Aug.	—	aF—aS	Ns.
June	1906.	aT	Lf.
Aug.	—	aU	Ks.
—	—	aV—aZ	Sa.
—	—	bA	Sb.
July	1907.	bB—bG	Sk.
—	—	bH—bI	Kn.
—	—	bK—bL	Km.
—	—	bM—bN	Su.
—	—	bO—bP	Bm.

Rhodophyceæ.

A. *Protoflorideæ.*

I. Bangiales.

Fam. 1. Bangiaceæ.

J. Agardh (1883), Till Algernes Systematik. Tredje afd. VI. Ulvaceæ. Lunds Univ. Årsskrift Tom. XIX.
G. Berthold (1881), Zur Kenntniss der Siphoneen und Bangiaceen. Mittheil d. zoolog. Station zu Neapel, II.
— (1882), Die Bangiaceen des Golfes von Neapel. Leipzig.
H. Hus (1902), An Account of the species of Porphyra found on the Pacific coast of North America. Proc. Calif. Acad. sc. 3. ser. vol. II No. 6, San Francisco.
H. Kylin (1907), Studien über die Algenflora der schwedischen Westküste. Upsala.
Fr. Oltmanns (1904), Morphologie und Biologie der Algen, I, p. 529—534.
Fr. Schmitz (1894), Kleinere Beiträge zur Kentniss der Florideen. V. La Nuova Notarisia, Ser. V, p. 717.
— (1896), Bangiaceen. Engler-Prantl, Natürl. Pflanzenfam. I, 2, p. 307—316.

With regard to the natural history of the *Bangiaceæ* reference may be made to the above-quoted works of Berthold, Schmitz and Oltmanns; I wish only to make some remarks on the spores produced asexually. Berthold named them "neutral spores", a name in my opinion but little applicable, as these spores cannot be said to be more neutral than the carpospores. Schmitz named them monospores as they are produced by the whole contents of a cell, but the carpospores were given by him the same name, and consequently this was not a name peculiar to the spores produced asexually. Besides, it seems to me more reasonable to compare the cell, which after division produces a number of spores, with the tetrasporangium in the *Florideæ*, than to compare the daughter-cell the contents of which become a spore with the monosporangium of *Chantransia*, for the fact is that the spores in the tetrasporangium are also separated by cell-walls. If the term monospore might be used within this family, it must be for the cases where one spore only is produced by each originally vegetative mother-cell (e. g. *Goniotrichum*, *Erythrotrichia*). When more than one spore are produced by a mother-cell, it might be desirable to give them the same designation as the tetraspores of the *Florideæ*, but against that we have the fact that the number of spores is not fixed and may be reduced to one. In order to avoid a long designation the spores produced without sexual process may be named gonidia. According to their mode of development the family may be divided into the following sections.

1. *Bangieæ*. Gonidia arising by division (or also without division) from an originally vegetative mother-cell.
   Frond filiform ..... *Bangia*.
   Frond flat ..... *Porphyra*.
2. *Erythrotrichieæ*. Gonidia arising in special monosporangia, cut off by a curved wall in a vegetative cell.
   Frond erect, filiform ..... *Erythrotrichia*.
   Frond first cushon-like, thereafter vesicular, ruptured and expanded in a monostromatic plane ..... *Porphyropsis*.
   Frond consisting of creeping branched filaments, more or less confluent to a monostromatic disc..... *Erythrocladia*.
   (Frond a monostromatic parenchymatous disc..... *Erythropeltis*).
3. *Goniotrichieæ*. Gonidia arising without cell-division.
   Gonidia naked..... *Goniotrichum*.
   Gonidia provided with cell-wall..... *Asterocytis*.

Bangia Lyngb. emend.

1. **Bangia fusco-purpurea** (Dillw.) Lyngb.

Lyngbye Hydr. p. 83, tab. 24 C; Harvey Phyc. Brit. pl. 96; Reinke in Pringsh. Jahrb. 9. Bd. p. 274 tab. 12; Berthold (1882) fig. 12—14; Kylin (1907) p. 107.

Conferva fusco-purpurea Dillw. Brit. Conf. pl. 92.

Bangia atro-purpurea (Roth) *β*, *fusco-purpurea* (Dillw.) Ag. Syst. p. 76; Fl. Dan. tab. 1841; J. Agardh (1883) p. 36.

In 1806 Roth described (Catal. bot. III p. 208), under the name of *Conferva atro-purpurea*, a filamentous Alga found in a water-mill at Bremen; it was referred to the genus *Bangia* by Lyngbye and was found in similar localities at many other places in Europe. Three years later, Dillwyn described a somewhat similar species, *B. fusco-purpurea*, first found on the British shores, and largely distributed on the Atlantic and Mediterranean shores. The resemblance between the two species, however, was so great, that Lyngbye referred Roth's species as a variety to *B. fusco-purpurea*, while C. Agardh conversely regarded *B. atro-purpurea* as the main species and *B. fusco-purpurea* as variety. The latter view was also maintained by J. Agardh, who, however, expressly distinguished the freshwater form from the marine form while the older Agardh only took the colour into consideration. I shall not enter on the question of the relation of these species, but like most of the marine phycologists record the marine species under Dillwyn's name. The distribution of the species on the Danish shores does not favour the supposition of a gradual transition to the freshwater form, as it does not occur in water of low salinity.

The plant is at first a filament consisting of a single row of cells, and fixed at the base by rhizines, which grow downwards from the lower cells in the common outer-wall (Reinke l. c. fig. 1). In this form the plant can attain a considerable size, but sooner or later longitudinal walls occur, which have a more or less radial position and which divide the articles into wedge-shaped cells.

According to BERTHOLD (l. c. p. 9), the first stage in the formation of the "neutral spores" or gonidia begins with the protoplasmic body increasing in mass, while at the same time shining globules occur, which are soluble in water and are stained brown by iodine, more rarely minute starch-grains, and the pyrenoid occupies the centre of the cell. During the first stages of these changes one or two divisions take place and then the cell-bodies are set free as spores. BERTHOLD does not indicate, if these divisions are only anticline or if they can also be pericline. According to SCHMITZ (1896 p. 311), these spores can also arise without division from the whole of the contents of a vegetative cell. The first dividing wall of the fertilized carpogonium is, according to BERTHOLD (l. c. p. 16), parallel with the surface of the thread, while the following are radial, and we thus have as result eight carpospores in vigorous threads. These though of very variable size are smaller than the gonidia, and differ from the latter, according to BERTHOLD, by containing minute granules of starch and a smaller and less lobed chromatophore; they show amoeboid movements though slower than those of the other spores.

It will be understood from the above, that it is not always easy to decide if we have to do with gonidia or with carpospores, especially in examining dried specimens, and when the direct traces (e. g. canal) of the fecundation process have disappeared. — Male filaments I have met with rather seldom, though at different seasons, but most frequently and best developed in spring. While the formation of spermatia ordinarily takes place very uniformly, all cells in the same part of the thread being in the same stage of development, some threads collected in July at Frederikshavn showed a more irregular disposition, the antheridia being intermingled with cells which were little or not at all divided, and which undoubtedly would not reach to the production of spermatia. They could not be supposed to be carpogonia as there were no spermatia attached outside them and they showed no periclinal walls. BERTHOLD states also, that the species is dioecious "mit wenigen Ausnahmen".

Female filaments with attached spermatia I have met with in February, April and May, and I have also several times been able to see the fine fertilization tube, though it seems to disappear rapidly along with the spermatia. In fig. 1 some fertilization tubes are still visible after the disappearance of the spermatia. The carpogonia may appear in thin threads, which are only divided by a few longitudinal walls, as well as in thicker filaments the articles of which consist of several cells (fig. 1). Fig. 2 *A* and *B* show transverse sections of female filaments which, seen from the side, showed spermatia attached to the surface. The cells, which have been divided by periclinal walls, must be supposed to be fertilized carpogonia. How many cells belong to the individual cystocarps in fig. 3 *B* is difficult to decide; it seems that vegetative periclinal divisions have also taken place, either before or after fertilization. I have only seldom seen carpospores containing starch-grains, e. g. in specimens collected at Hirshals in April, showing distinctly the process of

fertilization (fig. 1). In dried specimens I could not see distinct starch-grains, but only indistinctly limited spots giving blue-violet colour with iodine.

Gonidia seem to occur much more frequently than the carpospores on our coasts, as I have met with the species at all seasons and most frequently with spores, which must be regarded as gonidia. These spores may arise in very thin threads whose articles show only one longitudinal wall, but their origin can also take place in thick threads with numerous longitudinal walls. As a rule two or four spores are produced by each mother-cell; most frequently I found no starch in these spores, but in a few cases I observed numerous very small starch-grains in spores which were undoubtedly gonidia (Thyborøn and Skagen, July). In May I saw the spores escape from threads recently collected at Hirshals, a process that took place very rapidly; amoeboid movements I did not observe, but the chromatophore showed alterations of form. In one spore it had taken a globular form and was sharply defined; shortly afterwards it became angular and seemed about to take the ordinary stellate shape, but it soon took again the rounded form. In other cases these spores showed the amoeboid movements.

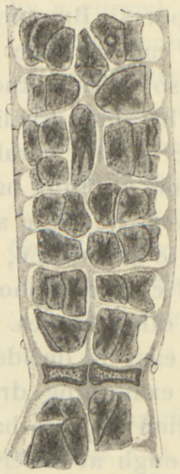


Fig. 1.
Bangia fusco-purpurea. Fragment of female filament with fertilization tubes and a few spermatia still adhering. 390 : 1.

This species occurs at ordinary high-water mark and higher, so that it is frequently out of the water and even dried up and in great measure only wetted by the spray of the waves. It is therefore easy to understand why it is not commoner than it is at the Danish shores, where the tide is mostly insignificant; in unfavourable periods with continual low water and calm, dry weather it would be in danger and would be killed at all the places, where it is not protected by special conditions against desiccation of long duration. At Frederikshavn it grows chiefly on the outer sides of the moles, where with a westerly wind the level of the sea is proportionally high, while with an easterly wind the level is low but the mole ordinarily washed by the waves. The most dangerous condition for the *Bangia* vegetation is a fairly long period of easterly winds with the wind so light, that this vegetation is not reached by the waves, especially when the weather at the same time is bright and dry. Its occurrence is therefore very different, not only at various seasons, but also in different years. In winter it is very abundant, but the critical period of the spring will every year kill a greater or smaller part of it and on the duration and intensity of this period depends to what degree that will take place. In summer for example it occurs at

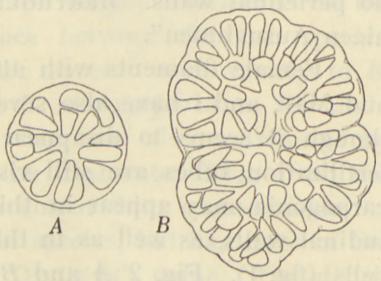


Fig. 2.
Bangia fusco-purpurea. Transverse sections of female threads with cystocarpia. 200 : 1.

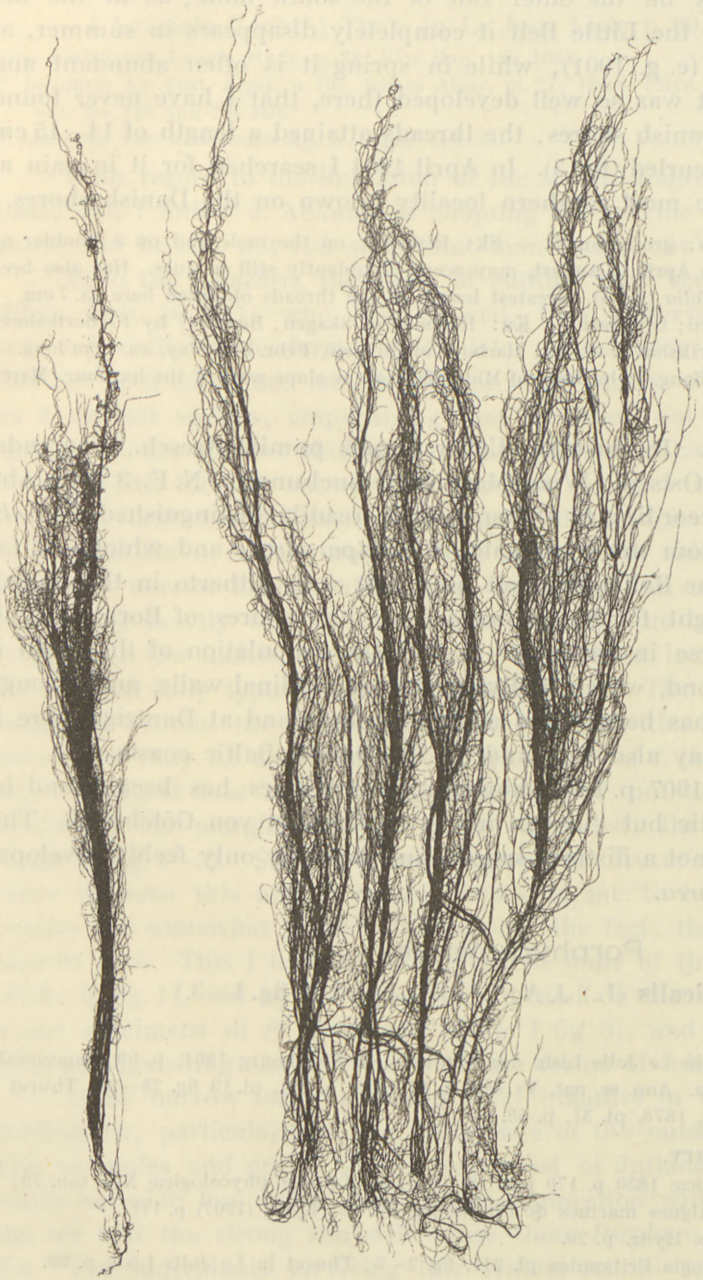


Fig. 3.
Bangia fusco-purpurea. Specimens collected at Middelfart (Kongebro) March 1894. After photograph, natural size.

Fig. 4.
Bangia fusco-purpurea, growing on Phyllitis zosterifolia, mole at Hirshals, Aug. Phot., nat. size.

Frederikshavn in some years only in small quantities, while in others it forms extensive growths especially on the outer side of the south mole, as in the beginning of August 1902. In the Little Belt it completely disappears in summer, at all events in certain years (e. g. 1901), while in spring it is often abundant and luxuriant. In March 1894 it was so well developed there, that I have never found it better developed on the Danish shores; the threads attained a length of 14—15 cm and were above thick and curled (fig. 3). In April 1904 I searched for it in vain at the same place. This is the most southern locality known on the Danish shores.

Localities. Ns: Thyborøn, groin No. 58. — Sk: Hirshals, on the mole and on a boulder on the shore, observed in the months April to August, may occur abundantly still in July. Has also been found growing on *Phyllitis zosterifolia* (fig. 4). Greatest length of the threads observed here ca. 7 cm. — Lf: Harbour of Lemvig (?); Thisted; Glyngøre. — Kn: Harbour of Skagen; Busserev by Frederikshavn (April and July); harbour of Frederikshavn. — Ke: Harbour of Gilleleje, Febr. and May, ca. 1 cm long. — Lb: Harbour of Fredericia (Hofm. Bang, !); harbour of Middelfart, stone-slope west of the harbour, March and April, Kongebro.

Bangia pumila Aresch. (Darbishire, Ueber Bangia pumila Aresch., eine endemische Alge der östlichen Ostsee. Wiss. Meeresuntersuchungen, N. F. 3. Bd., Abt. Kiel 1898, S. 25) which according to Darbishire is readily distinguished from *B. fusco-purpurea* as well as from the fresh-water *B. atro-purpurea*, and which, as far as known, is endemic in the Baltic, has not been met with hitherto in the Danish shores, though I have sought for it, particularly on the shores of Bornholm. It differs from *B. fusco-purpurea* in particular in that the articulation of the frond is still distinct in the older frond, which is divided by longitudinal walls, and through smaller cystocarps. As it has been found at Swinemünde and at Dantzig, there is reason to believe that it may also be found on the Danish Baltic coasts.

According to Kylin (1907 p. 109), however, this species has been found by Areschoug not in the Baltic but "in den innersten Buchten von Göteborg". This author regards it as being not a distinct species but probably only feebly developed specimens of *B. fusco-purpurea.*

Porphyra Agardh.

1. **Porphyra umbilicalis** (L.) J. Ag. (Plate I and II fig. 1—3.)

J. Agardh (1883) p. 66.

P. laciniata (Lightf.) Ag.; Thuret in Le Jolis Liste des Alg. mar. de Cherbourg 1864, p. 99, Janczewski, Études anat. sur les Porphyra. Ann. sc. nat. Ve sér., t. 17 1873, p. 241, pl. 19 fig. 25—26; Thuret et Bornet, Études phycologiques, 1878, pl. 31, p. 58.

f. *linearis* (Grev.) Harv.

P. linearis Greville, Algæ britannicæ 1830 p. 170 tab. 18; Kützing Tabulæ phycologicæ XIX tab. 79; J. Agardh, l. c. p. 71; Le Jolis Algues marines de Cherbourg No. 96; Kylin (1907) p. 111.

Ulva purpurea β, elongata Lyngb. Hydr. p. 29.

P. vulgaris forma, Harvey Phycologia Britannica pl. 211, fig. 2—3; Thuret in Le Jolis Liste p. 99.

P. hiemalis Kylin, (1907) p. 112 Taf. 3 fig. 2.

f. *vulgaris* (Ag.) Thur. in Le Jol. Liste p. 99.

Ulva purpurea Roth Catalecta I p. 209, Lyngb. Hydr. p. 29.

Porphyra vulgaris Agardh, Flora 1827 II p. 642, Icones Algar. tab. 28; Harv. Phyc. brit. pl. 211; Aresch. Alg. Scand. exs. No. 261.

f. *laciniata* (Lightf.) Thur. in Le Jolis Liste p. 99.

Ulva umbilicalis Lyngb. Hydr. p. 28; Flor. Dan. tab. 1663.

P. laciniata Ag. Syst. Algar. p. 191, Icones Algar. pl. 27; Harv. Phyc. Brit. pl. 92; Areschoug Alg. scand. exs. No. 116 and No. 260.

P. laciniata var. *umbilicalis* Ag. Ic. Algar. tab. 26.

With regard to the limitation of the species I agree with THURET (in LE JOLIS Liste), but I follow J. AGARDH in adopting the specific name of LINNÉ, as it is the oldest and besides not less significant than LIGHTFOOT's name *laciniata*.

As to the f. *linearis*, the views of authors have been divergent. It was HARVEY (Phyc. Brit. pl. 211) who first showed, from observations in nature, that it is only a juvenile winter-form, which later passes over into the broader form, and this has been confirmed later by THURET and others. J. AGARDH regards it however as a distinct species, emphasizing that it occurs not only in winter but also in spring. KYLIN follows this author but without discussion of his view. Having observed this form in nature in winter and spring, I cannot but come to the same result as HARVEY and THURET. In winter this species is abundant on the moles at Frederikshavn, on the inner as well as the outer side, and it occurs then mainly in rather narrow forms, which pass gradually and evenly into specimens which correspond exactly with *P. linearis* Grev. While the latter is said to attain only a length of a few inches, specimens more than 20 cm. long but less than 1 cm. broad, for the rest fully typical, were commonly found. The largest specimen I have collected is without the basal portion but is notwithstanding 43 cm. long with a breadth of only 0,8 cm. The typical specimens of f. *linearis* have a well developed stipe, rounded base and the margin a little or not undulated. In some broader specimens the margin becomes more undulated, the base broader and cordate (Plate II fig. 1—3). Such specimens agree with KYLIN's *P. hiemalis*; the only difference between this and *P. linearis* seems to me to be, after KYLIN's description, besides the somewhat greater dimensions, the fact, that the sporocarps form long narrow sori. This I have also observed in some of the specimens mentioned here (Plate II fig. 1), but by no means in all, and on the other hand it occurs also in broad specimens of *P. umbilicalis* (Plate I fig. 3), and therefore it cannot be used as a distinguishing character between the forms of this species.

These narrow forms occur in great quantity in winter on the moles of Frederikshavn, particularly on the outer side of the outer moles, at high level, and also on moles and groins on the west coast of Jutland. In spring, when easterly winds occasion low water, this fact in connection with the increasing dryness of the air and the strong sun will cause these *Porphyra* plants to a great extent to die. The individuals surviving this critical season are those growing at a rather low level or in places which are protected by particular conditions against drying up during low water. In growing older the frond of these individuals increases more in breadth than in length, and the same frond may then pass in development

from f. *linearis* through f. *vulgaris* to f. *laciniata* (comp. THURET in LE JOLIS Liste p. 100). In f. *vulgaris* the longitudinal axis of the frond is much longer than the radii going outwards or downwards, but under the continued growth of the frond in transverse direction this difference diminishes and at last entirely disappears, the frond obtaining an approximately orbicular outline, at the same time becoming more or less laciniated and, on account of the continuous transverse growth, much radially folded (Plate I fig. 2). The point of attachment in this stage is only apparently, not really central and umbilicate, as supposed in the older descriptions and drawings (LINNÉ, Spec. plant. II 1763, and DILLENIUS, Hist. muscor. 1741, tab. 8).

Though the f. *linearis* normally disappears in spring on the Danish shores, it can however be found much later in the year if rarely. Thus I have met with it on the outer side of the northern mole of Frederikshavn, near the entrance of the harbour, at a place where the sea is as a rule agitated, in July 1895 and September 1892. The specimens found in September were very well developed, up to 30 cm. long, 0,5 to 1,3 cm. broad, fully typical, only of a lighter colour than the specimens occurring in winter. These discoveries, however, may be very rare exceptions, for I have otherwise never found this form in summer at Frederikshavn, one of the best investigated localities in Denmark, as little as in any other locality. ARESCHOUG has also found it in August on the shore of Bohuslän (Phyc. scand. mar. p. 180).

This species has been met with in all the months of the year, and it occurs at all seasons in fully developed specimens. It can probably attain an age of more than one year, but most of the specimens die, as said above, at a rather young age. It has been found fertile at all seasons, and then nearly always with sexual organs (or carpospores). While several authors state that the species is as a rule dioecious (THURET, BERTHOLD, KYLIN), I have found it most frequently monoecious on the Danish shores, at all events in summer. In winter only have I found the specimens generally dioecious, particularly f. *linearis* (Plate II fig. 2—3). In the specimens met with in summer the frond is generally divided by a longitudinal limiting line into a male and a female portion, distinguishable thereby that the margin of the first is yellowish white, that of the second purple. The limiting line is most often remarkably straight; it is very distinct towards the margin, while downwards it becomes indistinct and finally vanishes on reaching the sterile portion of the frond (Plate I fig. 1). The male and female parts of the frond are in some cases of equal size, in others the male or the female is broadest. Even the narrow winter forms can be monoecious and show a well marked limiting line (Plate II fig. 1). According to HUS (1902, p. 197), the sporocarpia and antheridia in *Porphyra laciniata* (*umbilicalis*), when they are developed in the same frond, "occur in patches very much as in *P. perforata*". If that is really normal to the species of the Pacific coast, it must be supposed that it is a different species from the European *P. umbilicalis*.

The decoloration of the developing antheridia generally takes place gradually from the margin inwards. Some few specimens from Helsingør showed however, at some distance from the margin, some lighter spots, reminding one of the an-

theridial spots in *P. leucosticta*. They were found to consist of antheridia earlier in their development than the surrounding antheridia, which were still in division.

As first shown by BERTHOLD (1880 and 1882), the spermatia attach themselves to the female portions of the frond, and a fine fertilization canal is formed through the wall of the carpogonium-cell. These fertilization canals contain a thin strand of protoplasm, which is still to be seen a long time after the fertilization, while the exhausted spermatium quickly disappears. Their number is often remarkably great, much greater than that of the carpogonia (fig. 5 *A*—*C*). It is evidently a very common case that several fertilization tubes are introduced to one carpogonium.

The fertilised carpogonium divides, as is well known, by a transverse wall; thereafter follow often one or two further transverse walls, whereupon arises a 3- or 4-celled prismatic body wich thereafter may be further divided by differently orientated walls (fig. 5 *D*, *F*). Such divisions result no doubt in cystocarps with numerous carpospores, while the typical case is regarded to be eight carpospores in two layers. Extraordinarily large cystocarps, containing a great number of spores, were found in specimens collected in the harbour of Skagen in April, the frond of which was unusually thick, 90 to 115 μ (fig. 5 *D*—*E*). Comp. BERTHOLD (1882) fig. 10.

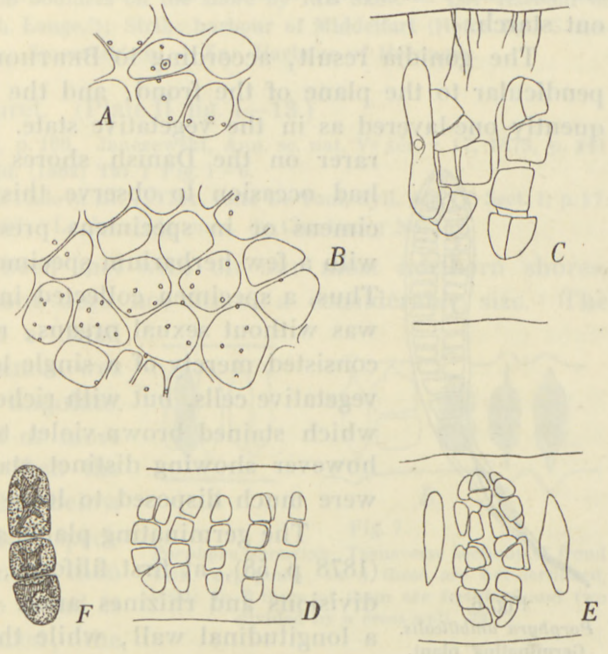


Fig. 5.
Porphyra umbilicalis. *A*—*E*, specimens from the harbour of Skagen, July. *A* and *B*, parts of frond seen from the surface; the cell-walls and, at a higher level, the fertilization tubes and in *A* a spermatium are shown. *C*, part of frond with fertilization-tubes and cystocarps in transverse section. *A*—*C* 390 : 1. *D* and *E*, transverse sections of frond with cystocarps from the same locality, April. 230 : 1. *F*, incompletely divided cystocarp, Frederikshavn December. 500 : 1.

In a number of specimens (52) collected in March on groins near Thyborøn, nearly all belonging to f. *linearis*, a few to f. *laciniata*, I found only cystocarps containing about 8 carpospores arranged in two layers, but in no case could spermatia or fertilization tubes be observed, and none of the plants contained antheridia. As the spores in all cases examined resulted from a division parallel to the frond, it may be supposed that we have here a case of apogamy, if it should not be found that the monospores can result also from such divisions.

The development of the cystocarps is as a rule uniformly progressive from the margin of the frond inward. Sometimes, however, the maturation takes place

more rapidly in some irregularly ramified spots than in the surrounding parts, and these spots appear therefore with a deeper red colour, as observed earlier by BERTHOLD (1882 p. 16). As mentioned above, this is to be found in broad as well as in narrow forms, and it cannot be used as distinctive character between them.

The carpospores contain as a rule numerous minute starch-grains which are stained brown-violet with iodine. I have also found fertilised carpogonia containing starch before dividing, but on the other hand I have also seen carpospores without starch.

The gonidia result, according to BERTHOLD, from one or two divisions perpendicular to the plane of the frond, and the frond after these divisions is consequently one-layered as in the vegetative state. These spores seem to occur much rarer on the Danish shores than the carpospores. I have not had occasion to observe this kind of fructification in fresh specimens or in specimens preserved in alcohol; I have only met with a few herbarium specimens which seemed to contain gonidia. Thus, a specimen collected in the harbour of Sæby in September was without sexual organs, rather uniformily rose-coloured, and consisted merely of a single layer of cells of the same size as the vegetative cells, but with richer, more granular plasmatic contents, which stained brown-violet to nearly dark with iodine, without however showing distinct starch-grains. Further, the cell-bodies were much disposed to leave the cell under the softening.

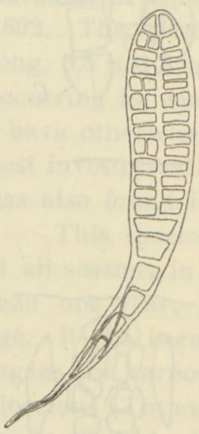


Fig. 6. *Porphyra umbilicalis.* Germinating plant, growing on Nemalion multifidum. 240:1.

The germinating plants are, as shown by THURET and BORNET (1878 p. 58), at first filiform, but at an early period longitudinal divisions and rhizines arise. The apical cell is early divided by a longitudinal wall, while the inferior part of the thallus is still filiform (fig. 6).

The species grows, on the Danish shores, about at ordinary water level, or at some distance above it, especially in winter, or a little under it, but hardly under the lower water-level. When occurring in the *Fucus*-zone, it grows only in the upper part of it. At Esbjerg it occurs only in the upper part of the littoral region. It thrives best where the salinity of the water is comparatively high and the locality tolerably protected. It attains therefore its greatest size at Esbjerg and in the Limfjord, where it becomes more than 40 cm. long, while it is smaller on the more exposed groins and moles at Thyborøn and Hirshals. In the most southern localities in the seas within Skagen I found the following maximal sizes of the frond: in Little Belt (Middelfart) 24 cm., in Great Belt (Smørstakken) 29 cm., in the Sound (Helsingør) 12 cm. Most of the Danish places for this species are moles; the natural habitats are emerging reefs and boulders near land. It grows also on wood, more seldom on *Fucus*; young specimens have been found growing on *Nemalion multifidum*.

Localities. **Ns:** Nordby, Fanø (C. Rasch, abundantly in the *Fucus*-zone!); Esbjerg (Børgesen, on moles and embankments in the upper half of the littoral region!); groins by Thyborøn (in spring chiefly f. *linearis*, in summer only broader forms. — **Sk:** Hirshals (on the mole and on boulders on the shore, in spring f. *linearis* abundantly above high-water mark, in summer the species disappears entirely or almost entirely). — **Lf:** Harbours of Lemvig, Struer and Thisted; Aalborg, harbour and piers of bridge (!, Th. Mortensen and unknown collector in herb. C. Rosenberg); Nørre Sundby; Hals. — **Kn:** Harbour of Skagen; Busserev (with *Bangia* near high-water level, small specimens in April; harbour of Frederikshavn (in winter f. *linearis* abundantly, mainly at high-water level, in summer only broader forms, as a rule in small quantity); harbour of Sæby. — **Ks:** Harbour of Grenaa. — **Sa:** Kyholm (upper *Fucus*-zone, with *Ralfsia*); Aarhus, harbour, and on boulders on the shore by Riis Skov. — **Lb:** Harbour of Bogense (!, Børgs.); Fredericia (Hofm. Bg., Joh. Lange,!); Strib; harbour of Middelfart (Hofm. Bg., C. Rosenb.,!), Kongebro. — **Sb:** Harbour of Lohals; Smørstakken. — **Su:** Harbour of Helsingør.

2. **Porphyra leucosticta** Thuret. (Plate II fig. 4—13.)

Thuret in Le Jolis, Alg. mar. de Cherb. 1864, p. 100. Janczewski, Ann. sc. nat. Ve sér. t. 17, 1873, p. 241 pl. 19 fig. 1—14. Berthold (1881) p. 79. Id. (1882) Taf. 1 Fig. 1—6.
Porphyra atropurpurea Olivi in Saggi Accad. di Padova III. 1. 1791, teste De-Toni, Syll. Alg. IV. Sect. 1, p. 17.
Exsicc.: Crouan Alg. mar. du Finistère No. 397. Le Jolis Alg. mar. de Cherbourg No. 156.

This species which has only been met with on our most northern shores, occurs there in its typical shape but does not attain a considerable size. The largest observed specimens are (in a dried state) 10—11 cm. long, only one specimen was 16 cm. long. The longest fronds are lingulate, about 2—4 cm. broad, with rounded or more frequently cordate base, but very often the margins of the frond overlap each other below the base, particularly in the broadest specimens, in which the attachment may then become apparently umbilicate. The frond is generally entire, rarely a little lobed, the margin more or less undulated. The colour is as a rule a little more reddish than in *P. umbilicalis*, but the difference is not absolute; the two species can occur with exactly the same colour. The thickness of the frond I found to vary between 28 and 44 μ.

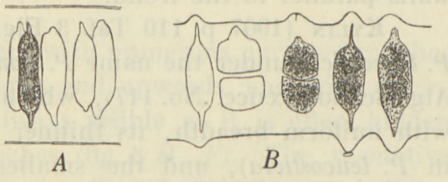


Fig. 7.
Porphyra leucosticta. Transverse sections of frond with carpogonia; in *A* these are not fertilized, while in *B* three of them are fertilized and two divided by a cross-wall. 390 : 1.

The specimens met with in April were all provided with sexual organs, in so far as they had attained a tolerable size. The antheridia formed the well known patches, running longitudinally in the upper part of the frond, 5—10 mm. long, 1—1,5 mm. broad. There are, however, also very small antheridial patches, originating in a group of very few mother-cells. The number of spermatia arising from each mother-cell is fairly often smaller than 64. As shown by JANCZEWSKI (l. c. p. 247), isolated cystocarps are often scattered among the antheridia. The carpogonia had very often produced a hyaline protuberance at each extremity, a state which, according to BERTHOLD, is due to the fact that the carpogonia have been obliged to wait a long time for fecundation. When all the carpogonia assume this form, the frond becomes papillose on both sides. Fig. 7 *B* shows a spermatium

attached to the top of a papilla, while the adjacent carpogonium has divided by a transverse wall after fecundation; the fertilization-canal of this carpogonium is yet to be seen below. The carpogonia produce 4 or 8 spores in two layers.

This species seems to disappear during the summer. On July 2nd 1905 on the moles of the harbour of Skagen I only found some very small specimens 1—1,5 cm. high, being evidently the under part of specimens which had exhausted their spermatia and carpospores; there were namely still to be seen remnants of emptied antheridial sori and some few cystocarps containing 8 spores, while the upper border of the frond consisted of emptied cell-walls (Plate II fig. 9—13). In 1907 the species remained longer, perhaps in connection with the fact, that the summer was unusually cold with predominant westerly winds. On July 11th 1907 I found in the same locality rather large specimens, some of which showed antheridia, in part not emptied, and cystocarps. Other specimens did not show these organs and did not seem to have produced them earlier. In such a specimen the cells in the upper part of the frond had more granular contents than the vegetative cells, for which reason I am inclined to believe, that they were producing gonidia (Plate II fig. 8). These cells had a sharply limited lateral vacuole; they were not divided by walls parallel to the frond.

Kylin (1907 p. 110 Taf. 3 Fig. 1) has established a species nearly related to *P. leucosticta* under the name *P. elongata* (Aresch.) Kylin (*P. laciniata* var. Areschoug Alg. Scand. exsicc. No. 117), which is distinguished by its elongated form of frond with uniform breadth, its thinner frond (25—33 μ while it is said to be 33—40 μ in *P. leucosticta*), and the smaller antheridial sori; it may be added that the author found it epiphytic and fructiferous in August. It appears to me, however, to be rather doubtful if it can really be regarded as a species distinct from *P. leucosticta*; at all events, the alleged characters are hardly conclusive. As said above *P. leucosticta* has often a lingulate form (comp. Pl. II fig. 4—8), and that is so also in specimens from the coasts of France. The thickness of the frond was found, in the Danish specimens of this species, to vary on both sides of the limit given by Kylin (se above). That the sori of antheridia in the specimens of Kylin reached only a size of 2 mm., while they attained a length of 10 mm. in the Danish specimens, is scarcely sufficient for specific distinction. I have found no specimen on the Danish coasts fully agreeing with *P. elongata* Kylin, the specimen most similar to it was 16 cm. long, 2 cm. broad, on the one side with a small lobe; it had a thickness of 28 μ, but the antheridial sori were long.

The plant grows on stones at the mean level of the sea.

Localities. Sk: Hirshals, on the mole and on a large boulder on the shore, April 1906. — Kn: Harbour of Skagen; it appeared contemporaneously with the construction of the harbour; it was detected by Mag. M. L. Mortensen, 9/4 1905, on the moles commenced the preceding year and constructed, as far as known, exclusively of stones taken on land. Later, I have found it, on several visits in April and July, on the outer and inner sides of the moles, but only or principally near land.

Erythrotrichia Areschoug.

Phyceae Scandinavicae marinae 1850 p. 209.

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

J. Agardh (1883) p. 15.

Conferva carnea Dillwyn, Brit. Conf. 1809 pl. 84.

Conferva ceramicola Lyngb. Hydr. 1819 p. 144 tab. 48 D (teste specim.)

Bangia ceramicola Chauvin, Rech. sur l'org. de plus. genr. d'Algues, Caen 1842, p. 33; Harvey, Phyc. Brit. pl. 317: Hauck, Meeresalg. p. 22.

Erythrotrichia ceramicola Aresch. l. c. p. 210; Le Jolis (Thuret), Alg. mar. Cherb. p. 103 pl. III fig. 1—2!; Berthold (1882).

This species is attached to the substratum not by means of a basal layer of cells, but only by the basal cell which gives off short ramified rhizines radiating in all directions on the surface of the substratum, while the other cells of the filament produce no rhizines. In fig. 8 C the rhizines are rather irregular as the plant was attached to the border of a *Porphyra* thallus. At the base the filaments are a little thinner than higher up, but the outer cell-wall becomes by and by incrassated. The filaments often attain only a length of 0,5 cm., but where the plant thrives well it becomes at least 3 cm. long. The thickness of the filaments is 16—24 μ, a little less at the base.

The cells contain a star-shaped chromatophore with numerous narrow branches radiating in all directions, in particular downwards and upwards, and with a central pyrenoid. The nucleus is small and not always visible as it is often hidden behind the chromatophore or between its branches (fig. 8 *D*—*F*). The vegetative cells contain in general no starch; some specimens collected in Sallingsund, Limfjord, in July were however the exception in this respect, all cells containing numerous small starch grains staining blue-violet with iodine; yet the sterile cells showed not so many starch grains as the sporangia. The length of the cells in proportion to the breadth is rather variable. In specimens collected in January the cells were very short and their contents very dense; their length was always shorter than the breadth, often only a third, while in summer filaments are often met with, the cells of which are 3—4 times as long as broad and then with rather poor contents. Plants collected on Herthas Flak (Kn) in 19 meters depth in September consisted of cells of about equal height and breadth. I have only seldom met with a few cells divided by longitudinal walls and they gave one rather the impression of being somewhat abnormal. Berthold (l. c. p. 25) also found longitudinal divisions very seldom, while J. Agardh (l. c. p. 14—15) thought that they were common in this species[1].

This species has only non-sexual reproduction. The spore-mother cell is, as well known, cut off by an oblique wall at the upper end of a cell which is not different in form from the vegetative cells. Its formation begins with the nucleus

[1] It may be doubtful, whether all that is referred to this species by this author, belongs really to it, as for inst. his Tab. I fig. 8, which represents a polysiphonous proliferous filament.

dividing into two, the one lying over the other at the one side of the cell. Then the chromatophore divides after a longitudinal plan into two of unequal size lying side by side (Fig. 8 *D*); the larger later moves upwards and is taken up in the spore together with the upper nucleus (Fig. 8 *E*, *F*). In the lower chromatophore the pyrenoid is very small and indistinct shortly after the division, while the upper contains a large and distinct pyrenoid; it is therefore probable that the original pyrenoid passes undivided over into the larger chromatophore, while a new pyrenoid is formed in the smaller. The fructiferous cells contain many small starch-grains which stain dark-violet with iodine; they are to be found in the sporangia as well as in their sister-cells. The sporangium is in general smaller than its sister-cell; when the mother-cell is very short, however, they can be of equal size or even larger. As shown by THURET and BERTHOLD, the under-lying cell, after the evacuation of the spore, expands and occupies the place of the original mother-cell, and the process of spore-formation may be repeated.

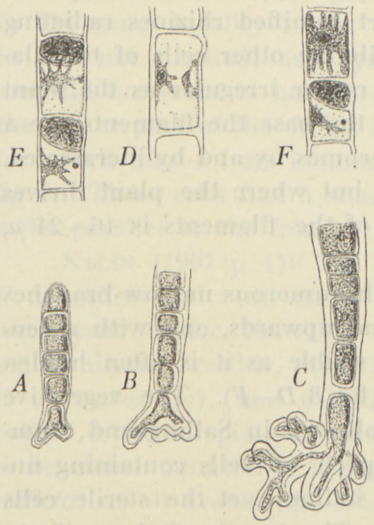


Fig. 8.
Erythrotrichia carnea. *A*—*C*, young plant and bases of plants attached to Porphyra. 380 : 1. *D*—*F*, fructiferous cells; in *D* the chromatophore and the nucleus have recently divided, in *E* and *F* the sporangial cell has been cut off. 412 : 1.

The plant has been found in almost all Danish waters excepted the Baltic, as a rule, however, only in small quantities and therefore not conspicuous. In greater quantity only found at Struer, in the Limfjord, (Sept. 1890) and in the harbour of Frederikshavn (particularly in August 1891 and July 1896). It is a summer Alga, nearly exclusively met with in the months July to September; it has however also been collected in winter (Nov. and Jan.). It has been found fructiferous in all the months named. It does not like much agitated water; it has been found most frequently and in greatest quantity in harbours, on piers and the like, in small depths, but it has been found down to 19 meters. It is always epiphytic and has been found growing on a number of different Algæ, e. gr. *Polysiphonia nigrescens* and *violacea*, *Ceramium rubrum*, *Brongniartella*, *Bryopsis*, *Porphyra umbilicalis* and many others.

Localities. **Sk**: SY, off Løkken, 13 meters. — **Lf**: Harbour of Struer; Sallingsund, at Glyngøre and off Snabe, 4—6 meters; LS, off Arnakke, 7 meters; MI, off Ejerslev, 4 meters. — **Kn**: Herthas Flak, 19 meters, (Børgs.); harbour of Frederikshavn; Borrebjergs Rev; Nordre Rønner; GM, 6 meters. — **Km**: BL, 9,5 meters; BH, off Gjerrild Klint, 4 meters. — **Ks**: Holbæk Fjord. — **Sa**: Kalø Rev; Hofmansgave (Lyngbye, Hofm. Bg.). — **Lb**: Harbour of Middelfart. — **Su**: BQ, off Ellekilde, 5,5 meters; PZ, E. of Hveen.

Porphyropsis gen. nov.

Frons initio pulvinata parenchymatica, dein vesiculosa et ruptura in membranam monostromaticam expansa. Sporæ (gonidia), ut in *Erythrotrichia*, divisione obliqua in cellulis frondis gignuntur. Reproductio sexualis ignota.

1. **Porphyropsis coccinea** (J. Ag.).

Porphyra coccinea J. Agardh, Novitiæ fl. Svec. 1836 p. 6 (without description); J. Areschoug, Phyc. Scand. mar. 1850 p. 181 tab. I D; J. Agardh (1883) p. 56; P. Kuckuck, Bemerk. z. mar. Algenveg. Helgoland II, 1897, p. 390 fig. 13, 14.

This pretty little Alga, which has been referred till now to the genus *Porphyra*, I have met with only at three places in the eastern Kattegat, at the two only in extremely small quantity. As its mode of fructification has been hitherto unknown, its systematic position has remained uncertain, as pointed out by Kuckuck, who showed that the chromatophore has no central pyrenoid as in the other species of *Porphyra* but that it forms a much divided parietal plate. It will be seen from the following that this plant also in other respects differs so much from the typical species of *Porphyra*, that it must be removed from this genus. Thus the development of the frond is quite different; whereas in *P. umbilicalis* this begins as a filament which early becomes leaf-like, being divided by longitudinal walls, in *Porphyropsis coccinea* the frond is at first cushion-like, parenchymatous and composed of more than one layer of cells. The frond increases in height and becomes globular and vesicular. Such a condition is to be seen in Fig. 9 *A*. As this and other similar plants were growing together with more advanced stages of this species and as they much resembled the lower, basal portions of the latter, I conclude that they belong really to the same species. The plant figured is nearly hemispherical with a lobed plane of attachment, in the margin of which the cells are somewhat elongated. The upper part of the frond consists of a layer of cells which are actively dividing by anticlinal walls; the growth caused by these divisions has caused a separation of this cell-layer from the cells lying within, and the continued growth must necessarily cause the plant to become more and more vesicular. A rupture of the vesicle must, however, take place at an early period, for small individuals occur with an irregularly lobed monostromatic frond tapering downwards and ending in a cushion-like, basal disc resembling the under part of fig. 9 *A*. In consequence of this development the young frond is usually more or less cup-shaped; in particular, the margins immediately above the basal cushion are most frequently bent inwards to the same side. The expanded frond projects from the one side of the basal cushion, the greater part of which is situated at the hollow side of the young frond. On the side of the cushion opposite to the frond are often to be seen irregular projections representing the lower border of the split by which the monostromatic frond has arisen. The lap visible below on the left in fig. 9 *C* belongs undoubtedly to this category. The formation of the split itself I have unfortunately not observed; probably a transverse split is formed on the one side of the vesicular frond. The development here described is not entirely unknown; J. Agardh (1883 p. 56) describes the young plants thus: "Hoc modo plantam nondum lineam altam fere hemisphæricam vidi, nempe lamina marginibus ita involuta ut media pars sursum spectaret, apice marginibusque ad ambitum hemisphærii decumbentibus (Tab. II fig. 41); dum dein circumcirca increscit, sensim magis

erigitur et fit fere cucullatim involuta, marginibus sursum hiantibus (l. c. fig. 42)". The celebrated author has not perceived that the leaf-like frond arises by splitting of a globular vesicle, but his fig. 41 seems to represent just the state where the split is formed. When the frond grows older, numerous rhizines are formed from the cells in the lowest part of the frond, which may result in the original basal cushion becoming less distinct; it is however always evident that the cells in the basal portion of the frond are situated in more than one plane.

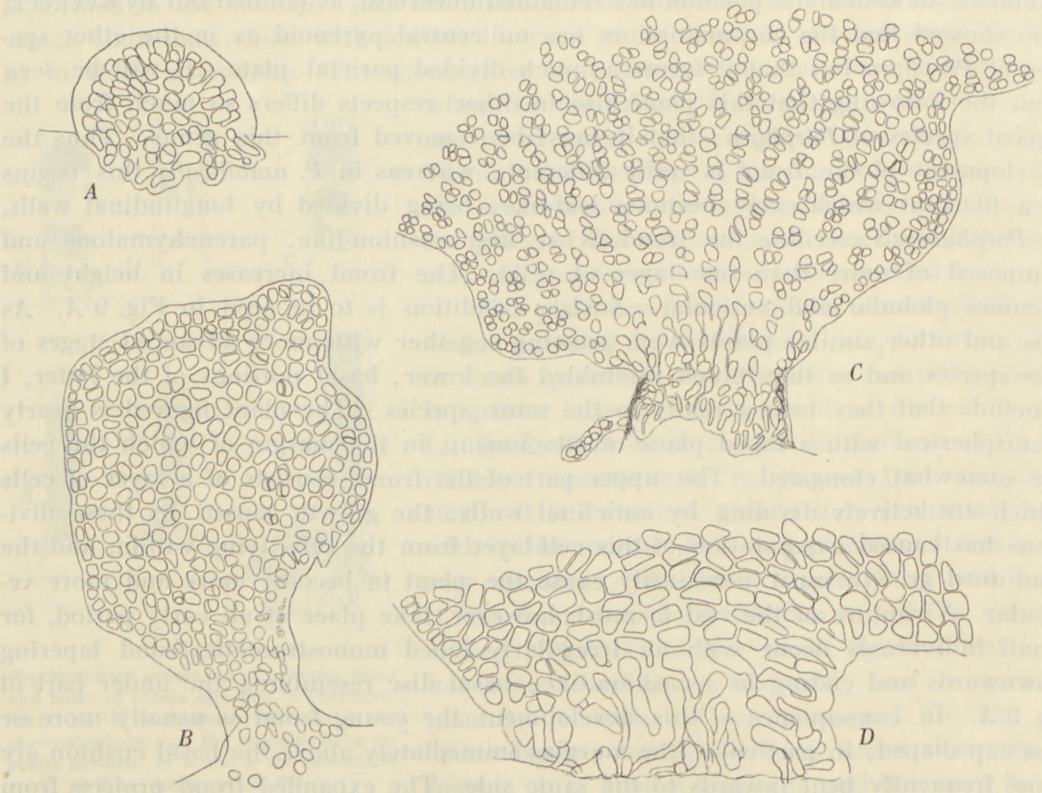


Fig. 9.

Porphyropsis coccinea. *A*, young plant, still hemispherical. 550 : 1. *B*, more developed plant with expanded lamina and spore-mother cells scattered over the frond. 340 : 1. *C*, lower part of older plant; it was not plane, but the borders were curved somewhat backwards. 340 : 1. *D*, basal portion of frond showing the rhizines. 550 : 1.

This plant offers an interesting analogy to the genus *Monostroma* among the *Chlorophyceæ* and the genus *Omphalophyllum* among the *Phæophyceæ*. In *Porphyra naiadum* Anderson the frond also begins according to Hus (1902, p. 212) as a parenchymatous cushion, but the later development is quite different from the above described, the cushion producing from its surface hair-like projections which, dividing in two directions, give rise to a monostromatic frond.

The cell-divisions take place in some measure uniformly over the whole

monostromatic frond, more frequently however at the border, where the cells are therefore a little smaller and closer together. The intensive marginal growth results in the margin becoming much undulated. In fig. 9 *C*, which was drawn after a dried specimen, the cells are seen to be arranged in groups of two or four or a little more, rather distant from each other.

As said above, the reproduction has hitherto been unknown in this species, and I have also searched in vain for any indication of a fructification in several fully developed specimens. In other cases, however, I succeeded in finding a formation of spores corresponding to that in *Erythrotrichia*; even in very small specimens it could be observed. Thus in fig. 9 *B* several cells are divided by an inclined curved wall into a roundish cell filled with protoplasmic contents, the spore-mother cell, and a crescent-shaped sterile cell. The spore-mother cells are scattered without order over the whole frond; even marginal cells may produce them (fig. 9 *B*, at the summit). In fig. 10 is shown a small fragment of another, larger plant where most of the cells have produced spores. As I have only examined the plant in preserved condition I cannot give any information of the behaviour of the sterile cell on the escape of the spore.

The described fructification along with the peculiar development of the frond justify the establishment of this plant as the representative of a new genus. On account of the resemblance in appearance to the genus *Porphyra* I have named it *Porphyropsis*; a diagnosis is given above.

Fig. 10. *Porphyropsis coccinea*. Part of frond with sporangia. 630 : 1.

Only found in the eastern Kattegat in 20 to 25,5 meters depth, epiphytic on various Algæ. The largest specimens, 5 mm. high, with much undulated margin, were met with at the end of July; young plants were collected in May and July.

Localities. Ke: Fladen, ZF, on stalks of *Laminaria digitata*, on *Dilsea edulis* and *Rhodymenia palmata* a. o.; Groves Flak, VZ, on *Desmarestia aculeata*; Lille Middelgrund, IK, on *Odonthalia dentata*.

Erythrocladia gen. nov.

Thallus horizontaliter expansus, e filis ramosis, aliis algis adfixis, radiatim egredientibus, initio inter se discretis, dein in discum tenuem unistratosum confluentibus, constans. Crescentia filorum apicalis. Sporangia eodem modo ac in genere *Erythrotrichia* in cellulis intercalaribus vel rarius terminalibus gignuntur. Generatio sexualis adhuc ignota[1].

[1] Batters has in 1896 (Journ. of Botany Vol. 34) established a genus *Colaconema*, characterized by branched filaments living in the cell-walls of various Algæ and by monosporangia "formed from portions either of the terminal cells of the principal axes, or of short swollen 1- or few-celled lateral branches, or even from a portion of a cell in the continuity of the filament. The undifferentiated portions of the cells forming cup-like bases for the sporangia". This genus was later placed by Batters (Journ. of Bot. Vol. 40, 1902, Supplement p. 57) near to the genus *Acrochætium* (*Chantransia*) and one species was removed to this genus. The indicated mode of formation of the monosporangia suggests however that the genus may include forms belonging to the *Erythrotrichieæ*, and the sporangia arising

1. **Erythrocladia irregularis** sp. nov.

Thallus minutus, ambitu irregulari. Fila lateraliter ramosa, irregulariter radiantia, sæpe maxima pro parte inter se discreta. Rami plerumque in cellula subterminali nascuntur. Cellulæ plerumque oblongæ, long. 7—11 μ, lat. 3,5—5 μ, chromatophorum unicum parietale, ut videtur pyrenoide instructum, continentes. Sporangia diametro c. 4 μ.

Schmitz has established a genus *Erythropeltis* (1896 p. 313), which in its reproduction agrees with the genus *Erythrotrichia* but differs from it by the frond consisting only of a monostromatic disc with continuous border and with marginal growth. To this genus is only referred one species, *E. discigera* (Berth.) Schmitz[1], and to the same species Batters has later referred a new variety, var. *Flustræ*, (Journ. of Botany, Vol. 38, 1900 p. 376). The thallus is described in this as "orbicular, becoming confluent and irregular in outline", and it must therefore be supposed that the irregularity only appears by the fusion of originally separate discs. In our plant, on the contrary, the frond consists of mutually separate filaments which only at a later stage are partly confluent, and it must therefore be referred to a new genus.

The plant of which a diagnosis is given above was found in rather great numbers on some specimens of *Polysiphonia urceolata* dredged off Hirshals in the Skagerak. It forms irregular spots of up to 100 μ in diameter on the surface of the host-plant. It consists at first of branched filaments whose branches are mutually entirely separate. As shown in fig. 11 *A* the primary filament grows out in two opposite directions and gives off branches at both sides. These branches grow out and branch further, and in the more developed plant the filaments are therefore radiating in all directions in the horizontal plane, and the filaments are then more or less fused together in the central part of the frond. The filaments show apical growth, and transverse walls appear only in the terminal cells, a natural consequence of the filaments being fixed to the substratum. The branches usually arise in the subterminal cell, sometimes also in cells nearer the centre of the frond, but the terminal cell is only very seldom ramified. The ramification is thus strongly monopodial. Not seldom a number of consecutive cells each give off a branch, now alternating, now secund. The outline of the plant is always more or less irregular, some filaments growing longer than others.

The cells contain a single chromatophore, the form and structure of which I have not been able to determine with certainty, as I have only had dried specimens at my disposal. In several cases however it appeared to be undoubtedly parietal, and I often saw a body which I took to be a pyrenoid, though it was not very distinct (fig. 12).

from a cell in the continuity of the branched filaments recall the genus *Erythrocladia*, but the plants need further examination. None of the described species can apparently be referred to the genus *Erythrocladia*.

[1] The genus is founded on *Erythrotrichia discigera* Berth.; but, according to Berthold (1882 p. 25), the disc in this species sometimes produces erect filaments, and it must therefore be supposed that Schmitz has taken the species in a more restricted sense than Berthold.

The sporangia are cut off in the ordinary vegetative cells, in a similar manner as in the genus *Erythrotrichia*, by a more or less oblique curved wall. The formation of sporangia takes place usually in the inner, intercalary cells, more rarely in the terminal cells. The orientation of the wall is not always the same; usually the sporangium is cut out at the proximal end of the cell, apparently very seldom at the distal end; but the wall is not seldom longitudinal, particularly in short cells from which a branch is given off (fig. 12). The spores are in the fully developed state nearly globular, about 4 μ in diameter; they have more granular contents than the vegetative cells and often show a distinct parietal chromatophore (fig. 11 *C*, *D*, fig. 12).

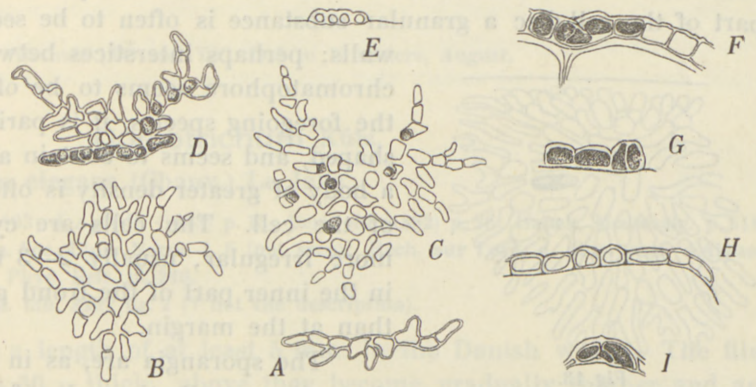


Fig. 11.
Erythrocladia irregularis. *A*, young plant seen from above. *B*—*D*, more developed plants with sporangia seen from above. *E*—*I*, plants in vertical section, *F*—*I*, with sporangia. *A*—*E* 390 : 1. *F*—*I* 620 : 1.

It is evident that the above described plant cannot be referred to the genus *Erythropeltis* on account of the structure of the frond. It differs further from *E. discigera* var. *Flustræ* Batters by its much smaller spores, while the spores in Batters' plant are about 9 μ in diameter.

Fig. 12.
Erythrocladia irregularis. Plant with sporangia seen from above. 730 : 1.

Localities. Sk: Møllegrund off Hirshals, 11,5 to 15 meters, on *Polysiphonia urceolata*, August.

2. **Erythrocladia subintegra** sp. nov.

Thallus minutus suborbicularis. Fila sat regulariter radiantia, plerumque fere ad apices lateraliter connata, cellulis terminalibus tamen inter se plus minus discretis. Ramificatio fit in cellulis terminalibus, sæpe dichotoma. Cellulæ plerumque cylindricæ, lat. 3—4 (—5) μ, long. 8—10,5 μ. Sporangia in parte proximali aut distali cellularum orta diametro c. 4 (—5) μ.

In company with the foregoing species I found some individuals of a species evidently nearly related to it, but showing however such differences that I think it best to consider it as a distinct species. It is more regular, more or less approaching to the orbicular form, and consists of more regularly radiating, closer together and a little thinner threads (3—4 μ), which are most often united almost to

the extremity, the terminal cells, however, being usually more or less free, and the same being also sometimes the case with the cell next to the end-cell. The ramification takes place exclusively or principally in the end-cells, and it has usually the character of a dichotomy, the cell bifurcating with two equally developed branches; the one branch, however, may sometimes be stronger than the other. The cell-walls of the filaments are thin and often not easily distinguishable. In the inner part of the cell-disc a granular substance is often to be seen in the middle of the walls; perhaps interstices between the filaments. The chromatophore seems to be of the same shape as in the foregoing species, it is parietal, apparently mantle-shaped, and seems to contain a pyrenoid; at all events a body of greater density is often visible in the middle of the cell. The cells are cylindrical or oblong or more irregular, usually 2—3 times as long as broad, in the inner part of the frond generally a little broader than at the margin.

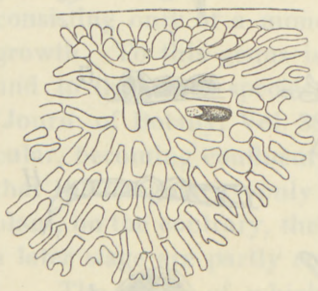


Fig. 13.
Erythrocladia subintegra. Frond growing on the rounded surface of Polysiphonia urceolata. In one cell a sporangium is cut off. 660 : 1.

The sporangia are, as in *E. irregularis*, cut off in the ordinary cells through a faintly curved wall, sometimes at the proximal, sometimes at the distal end of the cell; they have a parietal, cupshaped chromatophore and measure 4 μ in diameter.

This species shows more resemblance than the preceding to the genus *Erythropeltis*, from which it differs, however, by the margin of the frond consisting of separate filaments. If we supposed, that the distinction established between these two genera might prove not to be constant, there would be reason to compare *Erythrocladia subintegra* with *Erythropeltis discigera* Schmitz. Such a comparison, however, is difficult to undertake, as the last-named species is imperfectly known, in particular on account of what is alluded to above (p. 72) with regard to the limitation of the species. Using the magnification indicated by Berthold I have calculated that the cells of his species are 5,5 to 7 μ broad, thus considerably broader than in *E. subintegra*, and in *Erythropeltis discigera* var. *Flustræ* Batt., where the spores are much larger than in our species, namely 9 μ in diameter; the cells are also larger than in *E. subintegra*. It must therefore be supposed, that the species described here has not hitherto been observed, but I admit that it needs further investigation as well as the species of *Erythropeltis* and the relation between this genus and the genus *Erythrocladia*, and the relation between the genera *Erythropeltis* and *Erythrotrichia*.

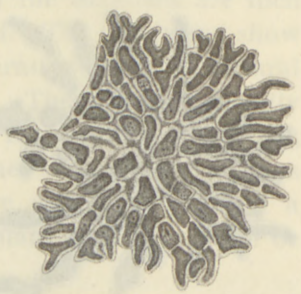


Fig. 14.
Erythrocladia subintegra. Frond seen from above. A few sporangia are visible. 630 : 1.

The description given above refers only to the specimens mentioned as found

on *Polysiphonia urceolata*. Later I have found, on *Flustra foliacea*, some discs which I think must be referred to the same species; they differed in their slightly larger dimensions and in the margin being partly continuous, the filaments being united to the extremities. These discs were thus still more similar to *Erythropeltis*, but the filaments had always partly free endings. The filaments were 3,5—5 μ thick, narrowest at the border, broadest in the middle of the frond. The spores were 4—5 μ in diameter.

Localities. Sk: Off Hirshals (XO and YK), 11,5 to 15 meters, August.

Goniotrichum Kütz.

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

Le Jolis, Alg. mar. Cherb. p. 103; J. Agardh (1883) p. 13; Berthold (1882) p. 26; Hauck, Meeresalg. p. 518.
Bangia elegans Chauvin, Mém. Soc. Linn. Norm. t. 6 (not seen); Rech. sur l'org. d. plus. genr. d'Algues, Caen 1842 p. 33; Harvey Phyc. Brit. pl. 246.
Ceramium ceramicola Fl. Dan. tab. 2207 fig. 2 (? not the description).

This plant attains a length of at least 5 mm. in the Danish waters. The filaments are below up to 50 μ thick, above they become gradually thinner and are at the summit only 15 μ thick. The increase in thickness below is usually due only to the thickening of the gelatinous outer wall, the diameter of the cells not increasing, and the cells forming usually a single row. There may be, however, more than one cell at the same level. This was caused, in the cases examined by me, not by longitudinal division of the cells but by displacement of the cells, so that the growing axes became inclined, the cells dividing then as usually by walls perpendicular to the growing axis and becoming arranged in two irregular longitudinal rows, or even more than two cells may occur at the same level (fig. 15 *E*). The outer wall is usually uniform, limited outwards by a fine line. Sometimes, however, the cells are provided with a denser, special membrane. In the plant represented in fig. 15 *E* a rather thick, dense cuticular-like outer-wall was visible in the lower part of the plant; the cells were here also provided with dense special membranes, and between these and the outer membrane a stratification was often visible.

The ramification takes place in a manner reminding one of the so-called false branching of the *Scytonemataceæ*. The branches rise at a great distance from the end of the filament, a cell growing outward through the gelatinous wall, dividing by a wall perpendicular to the new direction of growth (fig. 15 *B*, *C*). The further growth results in the branch coming to form a direct continuation of the principal filament and often takes nearly the same direction as this, the upper part of the principal filament being more or less pushed aside and taking the appearance of a branch (fig. 16). The cell lying at the origin of the branches is divided by a transverse wall as well as all the other cells. New branches very often arise below the older; even in old filaments new branches may arise (fig. 15 *A*).

The cells are of rather variable length, usually about as long as broad or somewhat longer, up to 3 times as long, in the last case usually barrel-shaped. On the other hand they may be sometimes much shorter than broad, up to 3 to 4 times as broad as long (fig. 15 *B*); they are then proportionally broad, 9—12,5 μ, being otherwise 6,5—10 μ broad. The cells contain, as is well known, a star-shaped chromatophore with a central pyrenoid. The colour is lilac; in very light localities, however, it is faded, feebly yellowish or grayish. Such a pale yellowish specimen was placed in a glass-vessel filled with sea-water in a room with subdued light for some days. After 24 hours the colour was already somewhat reddish, and after

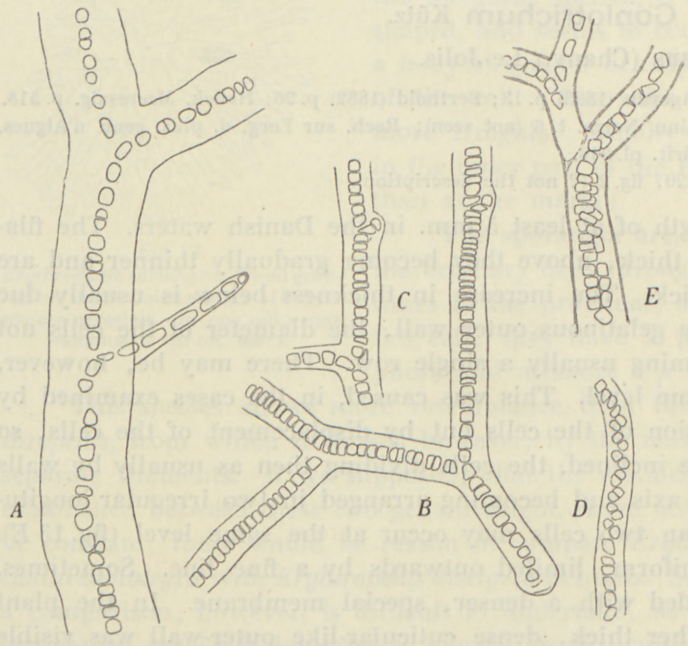


Fig. 15.

Goniotrichum elegans. *A*, portion of the older part of a frond with young branch below the older. — *B* and *C* show the normal ramification; the cells partly very short. — *D* and *E*, the cells displaced, giving up the uniserial arrangement; the cuticle in *E* very thick. — *B* and *C* from the Skagerak, the others from Sallingsund. — All figures 190 : 1.

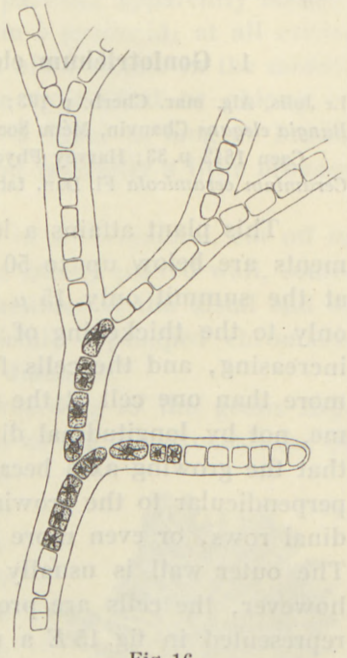


Fig. 16.

Goniotrichum elegans. After a living plant from Sallingsund. 290 : 1.

3 days the plant had a decided lilac colour. When dying the cells assume a light blue-green colour.

Concerning the reproduction I have made no observations. According to Schmitz (1894 p. 718 (14) and 1896 p. 314), monospores are produced by the ordinary cells, the cell-content being condensed and liberated as a naked spore. I have not seen this spore-formation, but I have sometimes remarked, that single cells were wanting in the filaments, probably because they had been set free in the form of spores.

The species has hitherto been found in the Skagerak, Limfjord and Kattegat,

but it is not improbable that it may have a somewhat larger distribution. The plant represented in Flora Danica tab. 2207 fig. 2, which is said to have been found by LYNGBYE in Odense Fjord, seems to judge from the figure to belong to this species; the description, however, belongs not to it but to *Erythrotrichia carnea*. In LYNGBYE's herbarium I have, from the locality in question, seen only the last-named species, not *Goniotrichum*, and it must therefore remain doubtful, if *Goniotrichum elegans* really occurs in Odense Fjord. — It has been found growing on various species of *Polysiphonia*, on *Rhodomela*, *Gloiosiphonia*, *Zostera* and *Flustra foliacea* in depths of 2 to 15 meters; it has only been observed in summer (June to August).

Localities. **Sk**: YK, N.W. of Hirshals, 15 m. — **Lf**: MH in Thisted Bredning; at several places in Sallingsund; LS, N. of Nykøbing. — **Kn**: Busserev at Frederikshavn; VT, N. of Læsø. — **Km**: BL, 9,5 m. — **Sa**: (Odense Fjord, Lyngbye?).

Asterocytis Gobi.

1. **Asterocytis ramosa** (Thwaites) Gobi.

C. Gobi in Arbeiten St. Petersb. Naturf. Gesellsch. Bd. X 1877 p. 85; Fr. Schmitz 1894 p. 717; id. 1896 p. 314; N. Wille, Algolog. Notizen, I—IV. Nyt Mag. f. Naturvid. Bd. 38, 1900 p. 7 Taf. I fig. 8—14.

Hormospora ramosa Thwaites in Harv. Phyc. Brit. pl. 213.

Goniotrichum ramosum Hauck, Meeresalg. p. 517, Batters, Mar. Alg. Berw. p. 13; Lakowitz, Algenfl. Danziger Bucht 1907 p. 79.

Goniotrichum simplex Lakowitz l. c. p. 80.

The genus *Asterocytis* has been established by GOBI in his "Bericht über die im Sommer 1877 ausgeführte algologische Excursion" published in 1879 in "Arb. St. Petersb. Nat. Ges." Bd. X. As this report has only been published in the Russian language, I give in the note below a translation in German of that part of the report which treats of this genus, and which Professor GOBI has kindly communicated to me[1]. Later the genus and the species on which it was founded, *A. ramosa* (Thwaites) Gobi, has been mentioned by SCHMITZ (1894) who examined specimens of it from water of very low salinity at Greifswald and found that it had nearly the same mode of reproduction as the genus *Goniotrichum*, only with this difference that the monospores in the last-named are set free by the sporangial wall becoming mucilaginous, while in *Asterocytis* they escape through an opening in the

[1] "Die sogenannte *Hormospora ramosa* Thwaites (Vid. Harvey, Phyc. Brit. Tab. 213; auch Rabenhorst Fl. Eur. Alg. etc. Bd. III, p. 49) welche bis jetzt (als Pseudoparasit) nur an den Küsten Englands im Meerwasser angetroffen wurde, habe ich schon mehrere Male auf meinen früheren Excursionen im Finnischen Meerbusen (1872 u. 1873) gefunden und zwar auch immer nur auf anderen Meeresalgen aufsitzend in Form einzelner einfacher oder schwach verzweigter Fäden. — THWAITES, welcher zuerst diese Form beschrieb, (die im lebenden Zustande bis jetzt nur von SMITH beobachtet wurde), sah sie als zur Gattung *Hormospora* Brébisson gehörend an, mit welcher Gattung jedoch sie nichts Gemeinschaftliches hat sowohl in structureller Hinsicht, als auch in der Färbung ihres Zellinhaltes. Meiner Ansicht nach muss diese Alge als eine neue Gattung angesehen werden, für die ich provisorish den Namen *Asterocytis* (strahlende Zelle) vorschlage, mit dem einzigen bis jetzt bekannten Repräsentanten *Asterocytis ramosa* (Thwaites) mihi." (l. c. p. 85—86).

unaltered sporangial membrane. In the treatise on the *Bangiaceæ* by the same author (1896), however, these characters are not mentioned; the author states only some less essential differences and declares that at least *A. ramosa* might possibly be referred to the genus *Goniotrichum*. In 1900 WILLE has given a more detailed description of an Alga which he had found at Mandal on the South coast of Norway, and which he refers to the same species. He gives a description of the setting free of the spores which is in accordance with that of SCHMITZ in 1894, but apparently without knowing the treatise of SCHMITZ, and he recommends that the genus *Asterocytis* should be kept distinct from *Goniotrichum*, primarily on account of the blue-green colour, but also because the author supposes that it produces resting cells, akinetes. It seems further that we may add as a distinctive character, that *Asterocytis ramosa* grows in brackish water, as stated by several authors (HARVEY, HAUCK, SCHMITZ, BATTERS), while *Goniotrichum elegans* needs water of higher salinity.

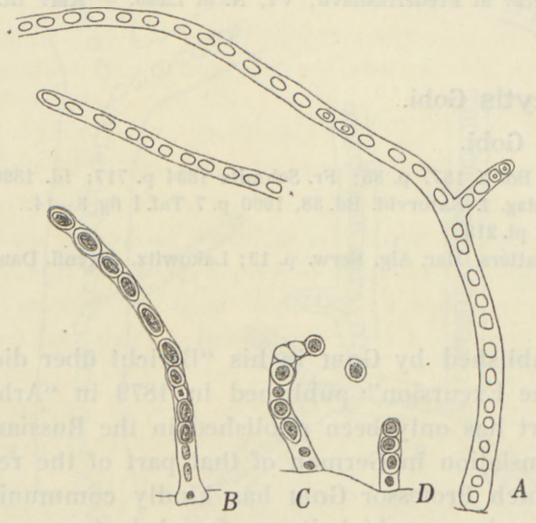


Fig. 17.
Asterocytis ramosa (from Guldborgsund). *A*, filament with branch; in some cells the pyrenoid is shown. *B—D*, small unbranched filaments with akinetes. 220:1.

I have found in several localities in the inner Danish waters a small Alga with blue-green cells, undoubtedly belonging to this species. It occurred, however, as a rule in small individuals, most frequently even unbranched, and in such cases agreeing with *Goniotrichum simplex* Lakowitz. Some of these specimens were short and only 9—11 μ thick, with vegetative cells 3—6 μ broad. Others were longer and somewhat thicker below, and the most vigorous provided with one or a few branches. Such specimens had often a thickness of 16 μ near the base, in a single case of 25 μ; the vegetative cells were about of the same size as in the smaller specimens, or they might be up to 7,5 μ broad. In the plants examined by WILLE the cells were, to judge from his figures and the magnification indicated, not a little greater (8—11,5 μ broad), and the plants were as a whole more vigorously developed. In the Danish specimens the cells are usually oblong or ellipsoidal, often ca. 2 times as long as broad, sometimes shorter, nearly globular. The chromatophore, as is well known, is star-shaped with a distinct pyrenoid; this, however, is not always central in the cell, the chromatophore being often nearer to the one side of the cell (fig. 17 *B*).

The occurrence of akinetes supposed by WILLE I have been fortunate enough to confirm with certainty. In nearly all my gatherings of this species there was found a number of filaments, the cells of which were for the most part transformed

into spores, being provided with a thick firm wall, of a much denser consistency than the gelatinous wall of the vegetative filaments. The akinetes are only surrounded by a thin common membrane, much thinner than the wall of the vegetative cells, and it is thus beyond doubt that the walls of the akinetes have risen by transformation of the innermost layers of the original gelatinous wall, and these cells thus agree completely with the conception of akinetes by WILLE. In some cases the akinetes are close together, in others they are separated. They are partly ellipsoidal or oblong, partly globular, measuring 8,5 to 10,5 μ in transverse diameter, up to 15 μ in length. In fig. 17 *C* a free akinete is to be seen and two emptied cells which have contained an akinete. As shown in fig. 17 *C* and *D*, the formation of akinetes may take place in very small plants.

As mentioned above, I have no doubt but that the specimens from the Danish waters really belong to *Asterocytis ramosa*, though it seems that the species does not attain in these waters the same dimensions as e. g. on the Norwegian coasts. The frequently occurring unbranched individuals do not represent a distinct species but only a reduced form, f. *simplex* (Lak.).

The species has been found with certainty in some places in the Smaaland Waters and in the Baltic, but is probably widely distributed in brackish water. I have formerly noted it from Holbæk Fjord and from Kertinge Vig, but omitted to keep the specimens. It has been found in shallow water near land, fixed on *Polysiphonia violacea* and *nigrescens* and *Ceramium*, only in summer (July to September).

Localities. Ks: (Holbæk Fjord). — Sb: Kertinge Vig by Kerteminde. — Sm: Kragevig; off Petersværft; Guldborgsund, near Vennerslund. — Bb: Rønne, the reef S. of the town.

B. *Florideæ*.

II. Nemalionales.

J. AGARDH, Species genera et ordines Algarum, Vol. II, pars II, Lundæ 1851—52; Vol. III, 1876.

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G. Thuret in Le Jolis, Liste des Algues marines de Cherbourg. Cherbourg 1864, p. 104.

Fam. Helminthocladiaceæ.

Tribe Chantransieæ.

Chantransia (D. C.).

As shown by Thuret (1864 p. 104), Elias Fries was the first to define the genus *Chantransia* in such a manner that it had a natural limitation, and one could clearly see what plants it comprised. It was better characterized in 1864 by Thuret who emphasized the fact that it has no tetrasporangia but only monosporangia. He mentioned at the same time the antheridia of *Ch. corymbifera*, and in 1876 (Notes alg. I p. 16) he described in conjunction with Bornet the sexual reproduction in this species, and the genus came thus to comprise species with and without sexual reproduction (comp. Murray and Barton (1891)). In 1904, however, Bornet has proposed to separate the species with sexual reproduction from those bearing only sporangia, the first being kept in the genus *Chantransia*, while the others are referred to the genus *Acrochætium* Nægeli (1861), which might otherwise be regarded as synonymous with *Chantransia*. I do not make this distinction in what follows, as I have arrived at the view that it would not lead to a natural classification of the species. In several cases there is great resemblance and probably also relationship between species with and without sexual reproduction, as e. g. between *Chantransia hallandica* and *baltica*, *Ch. efflorescens* and *Ch. pectinata*, *Ch. Thuretii* and *Ch. Daviesii*, and on the other hand the sexual species are mutually very different. That is also evident from Bornet's paper (1904) in which the species are divided after the differences in the basal portion of the frond, while in every group distinction is made between the asexual species, referred to *Acrochætium*, and the sexual ones, referred to *Chantransia*. There is in reality no other difference whatever between the two genera than that of the presence or absence of sexual reproduction. It would, in my opinion, be equally justifiable to remove from other genera of Florideæ all the species in which only tetrasporangia are known. Undoubtedly, sexual organs will later be found in some of the species hitherto known as only asexual, as I have succeeded in detecting them in *Ch. hallandica*, where Kylin had only described monosporangia, but on the other hand there is no doubt that many species are really devoid of sexual organs.

The great number of species described below will certainly appear surprising to many phycologists; it is the result of a careful search through a large material of Algæ. Many of them are very small and inconspicuous and need careful examination for determination. It is therefore not to be wondered at that they have been overlooked or perhaps so incompletely described that it is impossible to recognize them.

As two-thirds of the species described below are new, and as I have several new observations on most of the formerly described species, it might be useful to make here some general remarks on the genus *Chantransia*, based on the observations communicated below.

As shown by BORNET (1904), the structure and development of the basal portion of the frond within the genus *Chantransia* offers considerable differences which can be used in subdividing the genus. I fully agree with this excellent phycologist who by his small but important paper has largely contributed to the classification of this genus. If my classification does not always coincide with that of Dr. BORNET, it depends on the fact that I have not found representatives for all the subdivisions of Bornet in the Danish waters, and that I have found new species which do not fall under these groups. I may now give an account of the types found by me.

In some species the germinating spore is a globular or hemispherical basal cell which keeps its form and divides only on branching. This cell is fastened to the substratum by a cementing substance staining intensely blue by MAYER's Hæmalum[1]. In some cases it gives off only free filaments (first group), in others it also produces endophytic filaments from its under side (BORNET's second group, of which no representative is mentioned below). In *Ch. efflorescens* (fig. 61) and *Ch. Thuretii* (figs. 30, 31) the hemispherical basal cell gives off an erect filament and several radiating, creeping, epiphytic filaments which later unite to a pseudoparenchymatous disc giving off a number of erect filaments. During this development the original basal cell becomes indistinguishable amongst the other cells of the basal disc. I believe that the basal part of the frond probably develops in a similar manner in some other species, the germination of which has not been observed (*Ch. attenuata, stricta, Daviesii*). In a small group of species (*Ch. polyblasta* (fig. 43) and *Ch. humilis* (fig. 44)), to which may be added the partly endophytic species *Ch. Dumontiæ* (fig. 52) and *Ch. cytophaga* (fig. 50), the germinating spore is divided before ramification by a vertical wall into two cells of equal size each growing out in a creeping filament, which branches and forms a filamentous basal structure; in the central part of this the filaments may later fuse together, while a large number of relatively short erect filaments are given off from their upper side. In *Ch. virgatula* (incl. *secundata*) the germinating spore is usually divided by 3 excentric walls into 4 cells forming a parenchymatous disc, which for some time keeps this character during continued divisions of the cells, while later on some of the marginal cells may grow out into creeping filaments (figs. 37—41). In *Ch. leptonema* the development begins in the same manner, but the parenchymatous stage is very short, the disc at an early stage growing out into long creeping filaments (fig. 48). In *Ch. Macula* the basal disc behaves in a somewhat similar manner as in *Ch. virgatula*, but the erect filaments are much reduced or wanting, the sporangia being

[1] This substance attains an extraordinarily great development in *Ch. microscopica* var. *collopoda* Rosenv. (Deux. Mém. Alg. mar. Groenl., Medd. om Grønl. XX, 1898, p. 11), which, however, does not belong to *Ch. miscroscopica* Næg. but ought to be regarded as a distinct species, *Ch. collopoda* Rosenv.

situated directly on the basal disc or at the end of short unbranched erect filaments (fig. 42). An equally extreme reduction occurs in *Ch. reducta*, the frond of which consists of creeping filaments bearing sessile or short-stalked sporangia (fig. 49).

In certain species the thallus is partly endophytic. In *Ch. cytophaga* the development begins as in *Ch. polyblasta*, and it is only when the plant has become multicellular that some of the cells in the creeping filaments produce short filaments from their underside, which penetrate into the cells of the host plant (*Porphyra umbilicalis*), pushing aside the protoplasm and taking without doubt nutriment from it. This plant is thus a true parasite. The intracellular filaments or haustoria do not seem to penetrate from one cell into another but they may make their way again to the surface of the host plant (figs. 50, 51). In *Ch. Dumontiæ* the development begins in the same way but the endophytic filaments are intercellular and become much longer (fig. 52). These intercellular filaments are still more developed in *Ch. Nemalionis*, where they form a widely extended system of branched threads, giving off free filaments at many points through the surface of the host (*Nemalion*), while creeping epiphytic filaments are wanting (figs. 53, 54). The germination has not been observed in this species. Finally, there is a group of species the filaments of which are entirely endophytic. *Ch. endozoica* Darb. forms a transition to this group, the (endozoic) filaments sending out through the surface of the *Alcyonidium* it inhabits numerous short slightly branched sporangia-bearing filaments. In *Ch. emergens* only the solitary short-stalked sporangia are free (fig. 55), and in *Ch. immersa* and *Ch. Polyidis* the solitary sporangia are even more or less sunk in the host plant (figs. 56, 58, 60)[1].

Most of the *Chantransia* are usually epiphytic and then not bound to particular host plants; several species also occur on Hydroids and Bryozoa, further on Mollusc-shells, *Ch. efflorescens* even on stones. Probably other species may also sometimes grow on stones but have not been detected there on account of their small size. On the other hand, the endophytic species appear to occur only in one particular species of Algæ, or several nearly related. Thus, *Ch. Dumontiæ* has been found growing only in *Dumontia filiformis*, *Ch. cytophaga* only in *Porphyra umbilicalis*, *Ch. corymbifera* only in *Helminthocladia*, *Ch. Nemalionis* in *Nemalion lubricum* and *multifidum*, *Ch. immersa* in *Polysiphonia nigrescens* and *violacea* and in *Rhodomela subfusca*. The endozoic *Ch. endozoica* occurs only in *Alcyonidium gelatinosum*.

The form of the chromatophore is of great systematic value as pointed out by Kylin (1906, p. 122). In the vast majority of Danish species the cells contain only one chromatophore, but these may again be divided into two groups. In a fairly large number of species the chromatophore has a central body lying in the

[1] *Rhodochorton Brebneri* Batters (Journ. of Botany 1897 p. 437 and 1900 Tab. 414 fig. 17), which is endophytic in *Gloiosiphonia capillaris*, is evidently a *Chantransia* belonging to this group, to judge from the mode of growth, the hairs and the chromatophore; its name must therefore be *Chantransia Brebneri* (Batt.) Rosenv. The genus *Colaconema* Batters (see page 71 note) seems also to comprise species referable to the group of the endophytic *Chantransiæ*.

axis of the cell, usually in its upper part, and giving off a number of lobes in several directions towards the periphery of the cell. These lobes proceed further along the periphery of the cell and may together form a more or less interrupted cylindrical parietal layer. In the middle of the central body lies a pyrenoid, which is thus situated in the axis of the cell. This form of chromatophore shows a particularly fine development in *Ch. immersa*, where the lobes are very long and distinct (fig. 57); but it must be confessed that in this species the pyrenoid is not always central (fig. 57 *B, C*). In two species, *Ch. Dumontiæ* (fig. 52) and *Ch. cytophaga* (fig. 50), which also have stellate chromatophores, I have not been able to see any pyrenoid and must therefore suppose that it is wanting. In other species the chromatophore is an entire or somewhat lobed parietal plate containing a pyrenoid which is thus excentric in the cell. The pyrenoid is always prominent in the interior of the cell, and it is sometimes so large that it reaches almost to the opposite part of the chromatophore; when seen in profile, however, it is always easy to determine that it is parietal (figs. 30, 34, 54). Only in some species with very thin filaments it may be difficult to decide if the pyrenoid is axile or parietal, and transitions may perhaps occur. In *Ch. Polyidis* the chromatophore has a very peculiar structure, which I have unfortunately not been able to fully elucidate; it seems to be single but becoming very much branched (fig. 60). A third (or fourth) type of chromatophore occurs in *Ch. efflorescens* and *pectinata*, where each cell contains usually more than one spiral-shaped or more irregular band-like chromatophores (figs. 64, 66). — In pyrenoids of *Ch. immersa* treated with picric acid an angular body, probably a crystalloid, was observed (fig. 57).

The cells always contain a single nucleus lying almost in the central part of the cell, thus at a lower level than the pyrenoid. In some cases it is easily visible, even in the living state (fig. 30 *C*), in other it is concealed by the chromatophore; in *Ch. immersa* it is even sometimes found in a hollow in the mass of the chromatophore (fig. 57).

In nearly all the species hyaline, unicellular hairs occur at the ends of the filaments, which, when the filaments develop farther, are pushed aside, while the filament continues its way in the same direction as before, but really sympodially. This development has been pointed out by Kylin (1906 and 1907) in some species, and I have found the same in all the species with hyaline hairs examined by me. The hair arises as the terminal cell of the filament, being however much narrower than the usual cells and containing no chromatophore but protoplasm and a nucleus. In the out-growing hair the protoplasm is collected towards the upper end of the cell and decreases in bulk on the lengthening of the hair. In some cases, however, e. gr. *Ch. rhipidandra*, the hair is not pushed aside but retains its terminal position, and the filament then makes a bend for each hair it produces, with the result that the sympodial nature of the filament becomes very evident (figs. 20, 21). But even in the cases where the hair is early shed, this process often causes a more or less pronounced obliquity of the upper end of the cell (fig. 18). The

duration of the hairs is very different in the different species; thus they are vigorous and very persistent in *Ch. virgatula*, while in other species they only appear in the young plants or parts of the plant but soon fall off. They occur in the endophytic *Ch. immersa* (fig. 57) and *Ch. Polyidis* (fig. 60 *B*), while they are wanting in the equally endophytic *Ch. emergens* (fig. 55). The hairs appear very early in the young plants; it may even happen that the germinating spore produces a hair before giving off any other organ (*Ch. gynandra*). In *Ch. Thuretii* the above-mentioned hairs seem to be wanting, but on the other hand the branches often taper into hair-like threads, the cells of which become long and discoloured and finally die, as in the hair-like organs of the Phæophyceæ (fig. 32 *B*). Similar hair-like organs occur in *Ch. Daviesii* (fig. 34 *C*).

Sexual organs have been observed in 5 of the species mentioned below. Four of these are monoecious, *Ch. rhipidandra* only is dioecious.

The carpogonium has nearly the same form in all species, being bottle-shaped with a trichogyne of about the same length as the ventral part. It is never borne at the end of a special carpogonic branch as in most other Florideæ even the Nemalieæ. In *Ch. gynandra* (fig. 18) and *rhipidandra* (fig. 20) the carpogonia are sessile and lateral on the main filaments. In the other species they are situated, usually laterally, on branched or unbranched branchlets, bearing often also antheridia or even sporangia (*Ch. hallandica*, figs. 21 *A*, *E*, 22 *B*; *Ch. Thuretii*, figs. 30, 31). In *Ch. efflorescens* their position is very remarkable, intercalary carpogonia very often occurring besides others which are lateral (fig. 62). In such cases the lowest cell in the short fertile branchlet develops into a carpogonium, sending out at its upper end a trichogyne upwards along the cell situated above the carpogonium. When the branchlet is two-celled, the upper cell is usually sterile and bears antheridia, but it may happen, though rarely, that two carpogonia are situated the one above the other (fig. 62 *B*). Intercalary carpogonia were hitherto unknown among the Florideæ; they were, however, also found in the here described *Ch. gynandra* where an antheridium is very often seated on the top of the carpogonium (fig. 18 *H*—*K*).

The antheridia[1] are small roundish cells usually placed two or more together on the fertile branchlets. Only in extremely dwarfish plants of *Ch. gynandra* and *Ch. hallandica* they were found sitting directly on the main filaments, which consist indeed of only very few cells (figs. 18 *D*, 24 *C*). In the monoecious species antheridia usually occur in the neigbourhood of the carpogonia, often very near, and in *Ch. gynandra* an antheridium is often, as already mentioned, placed directly on the carpogonium.

After fertilization the ventral part of the carpogonium grows out and divides by a transverse wall, the trichogyne being pushed aside and later thrown off, and

[1] The mother-cells of the spermatia, the spermatangia of SCHMITZ, may here in agreement with OLTMANNS (1904 p. 669) be named antheridia. Quite recently N. SVEDELIUS has entered a plea for the term spermatangium (Bau und Entwicklung der Florideengattung Martensia. K. Svenska Vetenskapsakad. Handlingar. Band 43 No. 7. Uppsala 1908).

after further transverse divisions it becomes a 3- to 5-celled filament giving rise to a number of branches. The trichogyne or a small remnant of it may often be seen some time afterwards on the convex side of the second cell in the main filament of the gonimoblast (figs. 18 *C*; 20 *E*, *H*; 62 *E*, *F*, *H*). Unfortunately, I have not been able to follow the development of the cystocarp in *Ch. hallandica*, where it seems to be somewhat different (figs. 21, 22). In four of the five sexual species mentioned the carpospores arise only in the terminal cells of the branched gonimoblast. In *Ch. gynandra, rhipidandra* and *Thuretii* the branches are numerous, the cystocarp capituliform; in *Ch. hallandica* the number of the branches and the carpospores is very low. *Ch. efflorescens* is also in this respect different from the other species, the carpospores arising not only in the terminal cell but also in one or two of the cells lying behind in the filaments of the cystocarp, thus seriately (fig. 63).

Sporangia occur in all known species of *Chantransia*. For some time it was generally accepted that monosporangia only occur in this genus, the older statements of tetrasporangia by HARVEY being supposed to be due to some error. In later years, however, tetrasporangia have been pointed out with certainty in some species by SCHMITZ and HAUPTFLEISCH (1896), BØRGESEN (1903) and KYLIN (1906 and 1907), and I have been able not only to confirm these statements but also to find tetrasporangia in five other species, so that the occurrence of tetrasporangia is now established in eight of the species mentioned below (*Ch. Thuretii, Daviesii, virgatula, polyblasta, cytophaga, Dumontiæ, efflorescens, pectinata*). In *Ch. Dumontiæ* and *polyblasta* tetrasporangia only have been met with, in the others also monosporangia. The division of the tetrasporangia is always cruciate, the first division being horizontal. Amoeboid movements of the monospores immediately after the liberation, similar to those described formerly for *Helminthora divaricata*, were observed in *Ch. Thuretii* (fig. 30).

In most of the species provided with sex-organs sporangia occur in the sexual plants, in the monoecious species as well as in the dioecious *Ch. rhipidandra*. On the other hand, as the sex-organs are not present in all the plants, individuals bearing only sporangia will always be met with. In *Ch. efflorescens* only there is a sharp distinction between sexual plants and sporangia-bearing plants. This is perhaps connected with the fact that tetrasporangia occur in this species. As shown by YAMANOUCHI[1] the tetrasporic plants of *Polysiphonia violacea* show double the number of chromosomes to that of the sexual plants, and a reduction in the number of chromosomes takes place by the formation of the tetraspores. If that is general for the Florideæ, a similar alternation of tetrasporic plants with sexual plants must be supposed to exist in *Ch. efflorescens*, and that is supported by the fact that the sporangia-bearing plants occur in the Danish waters chiefly in spring, the cystocarp-bearing plants in summer. In the sexual species with monosporangia such alternation of generations does not occur, and the reduction of chromosomes must be supposed to take place not in the sporangia but probably in the cystocarps, as in

[1] S. YAMANOUCHI, The life-history of Polysiphonia violacea. Botanical Gazette Vol. XLII. 1906.

Nemalion[1]. Several questions connected with that just mentioned deserve a closer examination, thus, the cytological behaviour of the monosporangia of *Ch. efflorescens* in comparison with that of the tetrasporangia of the same species, further the nuclear division of the tetrasporangia in the non-sexual species.

The following classification of the species is based in particular on the characters of the basal part and of the chromatophore. *Ch. efflorescens*, however, which differs from the others in several characters, as mentioned above, is first separated as representing a particular sub-genus, *Grania*, named after the Norwegian investigator who first described its sex-organs, and to the same sub-genus is referred *Ch. pectinata*, with similar chromatophores and probably related to it.

Key to the Danish species of Chantransia.

I. Subg. *Euchantransia*. One chromatophore, carpospores only in the last cell of the sporogenous filaments.

1. Frond epiphytic.
   2. A single basal cell. Group I.
      3. With sex-organs.
         4. Antheridia situated on the carpogonia or on unicellular branchlets ..... 1. *Ch. gynandra.*
         4. Antheridia never situated on the carpogonia.
            5. Antheridia singly or two together, cystocarps with few carpospores; monoecious ..... 3. *Ch. hallandica.*
            5. Antheridia usually in flat triangular clusters, cystocarps nearly globular with numerous carpospores; dioecious ..... 2. *Ch. rhipidandra.*
      3. Without sex-organs.
         4. Pyrenoid parietal ..... 1. *Ch. gynandra.*
         4. Pyrenoid axile.
            5. Cells nearly cylindrical.
               6. Filaments 9—11 μ thick, spor. 14—15 $\times$ 9—10 μ 2. *Ch. rhipidandra.*
               6. Filaments at most 7 μ thick.
                  7. Filaments 5—6 μ thick, sporangia 10 $\times$ 6—7 μ 3. *Ch. hallandica.*
                  7. Filaments 6—7 μ thick, sporangia 12—16 $\times$ 8—10 μ ..... 4. *Ch. baltica.*
            5. Cells roundish, frequently barrel-shaped ..... 5. *Ch. moniliformis.*
   2. Basal layer multicellular. Group II.
      3. Basal layer composed of filaments more or less fusing together into a pseudoparenchymatous disc.
         4. Erect filaments well developed; pyrenoid parietal.
            5. Erect filaments branched.
               6. Branches scattered; monospores, rarely tetraspores.

[1] Comp. J. J. Wolfe, Cytolog. Stud. on Nemalion, Ann. of Botany Vol. 18 Oct. 1904.

7. Sex-organs may occur; thickness of filaments usually less than 10 μ, cells usually 5—8 diam. long, sporangia sessile or on unicellular branchlets on the inner side of the branches ..... 6. *Ch. Thuretii.*
7. Without sex-organs; filaments 9—12 μ thick, cells 2—4 diam. long; sporangia-bearing branchlets repeatedly branched, often in the axils ..... 7. *Ch. Daviesii.*

6. Branches partly opposite ..... 8. *Ch. attenuata.*

5. Erect filaments unbranched, bearing only numerous sporangia-bearing branchlets, nearly from the base to the top ..... 9. *Ch. stricta.*

4. Erect filaments numerous, rather short (up to 300 μ) to very short or wanting; pyrenoid axile.
5. Erect filaments up to ca. 300 μ long, branched.
6. Filaments 7—10 μ thick, sporangia tetrasporous 12. *Ch. polyblasta.*
6. Filaments 3—4 μ thick, sporangia monosporous 14. *Ch. leptonema.*
5. Erect filaments up to ca. 60 μ long, usually unbranched, sporangia monosporous.
6. The cells of the creeping filaments give off 2—3 erect filaments bearing terminal and lateral sporangia ..... 13. *Ch. humilis.*
6. The cells of the creeping filaments bear one sessile or stalked sporangium ..... 15. *Ch. reducta.*

3. Basal layer first a parenchymatous disc, later growing out into radiating filaments; pyrenoid axile (*Ch. leptonema*).
4. Erect filaments 1—2 mm. long ..... 10. *Ch. virgatula.*
4. Erect filaments very short or wanting; sporangia sessile on the basal disc or terminal on the erect filaments .. 11. *Ch. Macula.*

1. Frond partly or entirely endophytic or endozoic. Group III.
2. Vegetative part partly endophytic.
3. Epiphytic creeping filaments present.
4. Endophytic filaments intracellular ..... 16. *Ch. cytophaga.*
4. Endophytic filaments intercellular ..... 17. *Ch. Dumontiæ.*
3. Epiphytic creeping filaments wanting ..... 18. *Ch. Nemalionis.*
2. Vegetative part entirely endophytic or endozoic.
3. Vegetative filaments endozoic, giving off short free, sporangia-bearing filaments ..... 19. *Ch. endozoica.*
3. Filaments entirely endophytic.
4. Filaments creeping in the outer cell-wall of *Polysiphonia*; sporangia entirely free, short-stalked, single ..... 20. *Ch. emergens.*
4. Filaments intercellular; sporangia partly or entirely immersed in the host.

5. Chromatophore stellate ..... 21. *Ch. immersa.*
5. Chromatophore much divided ..... 22. *Ch. Polyidis.*

II. Subg. *Grania.* Chromatophores ribbon-like, spiral-shaped, usually more than one; carpogonia often intercalary; carpospores seriate. Group IV.

1. Filaments usually 5—6 μ thick; free descending filaments usually present; sporangia tetrasporous or monosporous, on alternate or opposite branchlets; sex-organs present ..... 23. *Ch. efflorescens.*
1. Filaments near the base 6—9 μ (or thicker); free descending filaments usually wanting; sporangia or sporangia-bearing branchlets seriate on the inner side of the branches; sex-organs wanting 24. *Ch. pectinata.*

Subgenus Euchantransia.

Group I. Frond epiphytic with a single basal cell.

1. **Chantransia gynandra** sp. nov.

Thallus minutus. E cellula basali subglobosa, diametro 7,5—9 μ, egrediunt fila 2—4 simplicia, ad circ. 200 μ alta, e cellulis diametro plerumque 2—3-plo longioribus, crassitudine 5—6 μ, superne nonnunquam leniter (ad 7 μ) incrassatis, constantes. Ramuli nulli vel pauci, minuti, unicellulares. Chromatophorum parietale zonale, pyrenoide instructum, mediam partem cellulæ occupans. Pili hyalini terminales et laterales adsunt. Sporangia, antheridia et carpogonia in uno eodemque individuo occurrunt. Sporangia in filis lateralia sessilia solitaria vel in uno articulo duo approximata vel opposita, vel in ramulis terminalia monospora, ovata, long. 9,5—10 μ, lat. 5—6 μ. Carpogonia in filis lateralia. Antheridia ad apicem ramulorum solitaria vel sæpius gregaria vel carpogonio juxta trichogynum solitaria imposita, hemisphærica, oblique breviter ovata vel subconica, long. c. 2,5 μ. Cystocarpia capitula irregularia e filis radiantibus longitudine vario constantia, carposporis in cellulis ultimis, sporangiis similibus, formatis.

This interesting species was found in abundance growing on some specimens of *Ectocarpus confervoides* dredged in the Northern Kattegat. The nearly globular basal-cell, which is fixed to the host by a very thin layer of a cementing substance, gives off a filament upward and usually two similar, though often shorter, filaments out to the sides. The filaments are either absolutely unbranched or bear, besides reproductive organs, only a few one-celled or rarely two-celled branchlets. The cells which are usually a little constricted at the transverse walls, contain a belt-shaped, rather narrow chromatophore containing a pyrenoid projecting inward. Hyaline hairs always occur; they are either terminal on the filaments and the branchlets or lateral. The hair situated at the top of the terminal cell is later pushed to the side, the terminal cell growing out beyond the insertion of the hair (fig. 18 *K*) which, after the next cell-division, comes to be situated at the upper end of the subterminal cell. Nearly all the lateral hairs have developed in this manner;

it seems however that really lateral hairs may also sometimes occur. At all events two hairs may be found on one cell (fig. 18 *G*). Most of the hairs are early thrown off, leaving however a vestige in the outline of the cell, this being a little enlarged at the upper end. I have once seen a hair given off from a basal cell which had not yet produced any filament.

Most of the plants bear at the same time sporangia and both kinds of sexual organs, some plants, however, bear only sexual organs. The sporangia are sessile on the sides of the filaments or sometimes borne by the unicellular branchlets (fig. 18 *A*); they open by a split at the top (fig. 18 *A*, *G*).

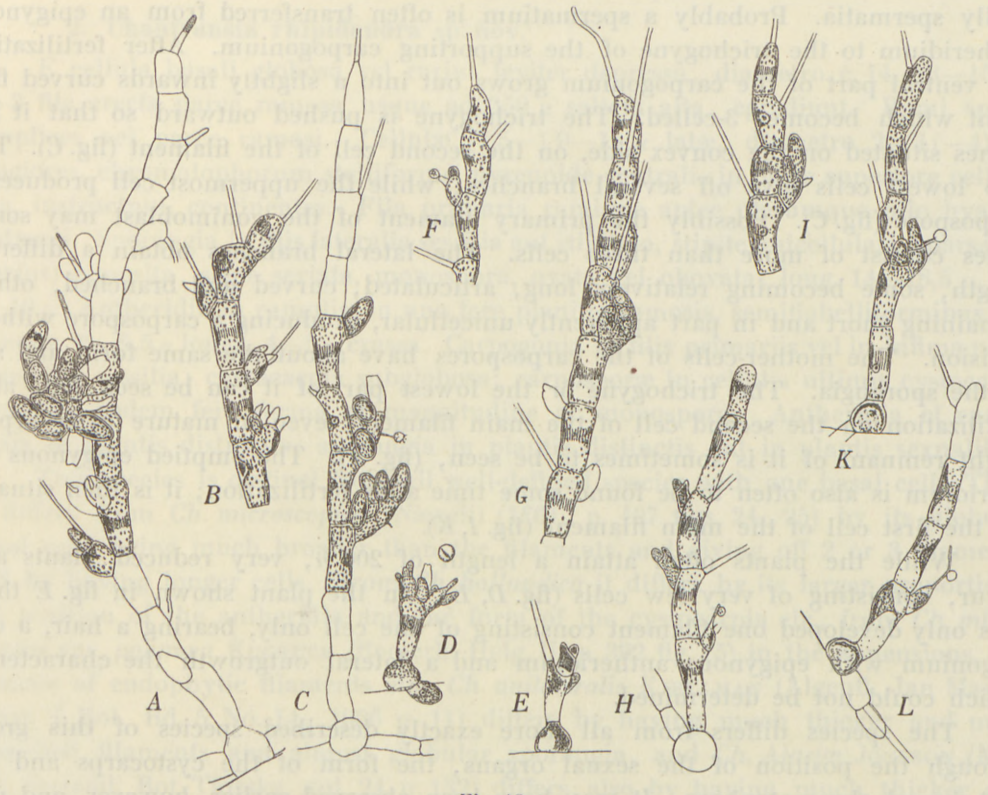

Fig. 18.

Chantransia gynandra. *A*, plant with 3 branchlets, a cystocarp and sporangia. *B*, upper end of filament with branchlets bearing antheridia. *C*, plant with two cystocarps and one sporangium. *D*, dwarfed plant with antheridia and one carpogonium; a spermatium is lying above. *E*, dwarfed plant (comp. text). *F*, two antheridia on a branchlet; a spermatium is situated immediately outside one of the antheridia. *G*, part of filament with a young cystocarp and two empty sporangia. *H*, plant with three carpogonia with epigynous antheridia, two young, the third in the fertilization stage. *I* and *K*, plants with young cystocarps and epigynous antheridia. *L*, plant with carpogonium in fertilization stage. 630 : 1.

The carpogonia are situated on the sides of the filaments at various distances from the base; they are bottle-shaped, the trichogyne being of almost the same length as the ventral part. The antheridia are situated either on the carpogonia or on the ramuli; in the first case they are always solitary, in the latter there are

usually two or more crowded together. Only in the dwarfed plant represented in fig. 18 *D* have I seen the antheridia situated directly on the filament, but in this case the filament was only two-celled. The juvenile stages of the epigynous antheridia show that these antheridia are really terminal, while the trichogyne rises as a lateral outgrowth from the subterminal carpogonium (fig. 18 *E*, *H*), a case hitherto unknown among the Florideæ. I have repeatedly, in material preserved in alcohol, observed a little globular body lying immediately outside an empty antheridium or at a slight distance from it (fig. 18 *F*, *D*); as it agreed in size with the spermatia adhering to the trichogynes (fig. *C*, *K*, *L*), I have no doubt that they were really spermatia. Probably a spermatium is often transferred from an epigynous antheridium to the trichogyne of the supporting carpogonium. After fertilization the ventral part of the carpogonium grows out into a slightly inwards curved filament which becomes 3-celled. The trichogyne is pushed outward so that it becomes situated on the convex side, on the second cell of the filament (fig. *C*). The two lowest cells give off several branches, while the uppermost cell produces a carpospore (fig. *C*). Possibly the primary filament of the gonimoblast may sometimes consist of more than three cells. The lateral branches obtain a different length, some becoming relatively long, articulated, curved and branched, others remaining short and in part apparently unicellular, producing a carpospore without division. The mother-cells of the carpospores have about the same form and size as the sporangia. The trichogyne or the lowest part of it can be seen long after fertilization on the second cell of the main filament; even in mature cystocarps a slight remnant of it is sometimes to be seen, (fig. *A*). The emptied epigynous antheridium is also often to be found some time after fertilization; it is then situated on the first cell of the main filament (fig. *I*, *K*).

While the plants often attain a length of 200 μ, very reduced plants also occur, consisting of very few cells (fig. *D*, *E*). In the plant shown in fig. *E* there was only developed one filament consisting of one cell only, bearing a hair, a carpogonium with epigynous antheridium and a lateral outgrowth the character of which could not be determined.

The species differs from all more exactly described species of this group through the position of the sexual organs, the form of the cystocarps and the belt-shaped chromatophore. It may have been observed earlier, however, and possibly some of the plants mentioned under the name of *Callithamnion minutissimum* have belonged to this species. Zanardini's species of this name (Synops. Alg. mar. Adr. 1841 p. 176; Hauck, Oesterr. bot. Zeitschr. 1878 Taf. II fig. 7—8), however, belongs not to this group; and as to Suhr's species (Kützing Spec. alg. 1849 p. 640, Tab. phyc. XI tab. 57), it is impossible to identify it from the description and figures. On the other hand, the specimens referred to that species by Crouan (Alg mar. du Finistère No. 114, Florule du Finistère p. 134) show so much resemblance with the species here described, that they might probably be identical. This, however, cannot yet be decided with certainty as the specimens of Crouan bear no sexual

organs (Comp. BORNET 1904 p. XIX). On the contrary, they bear abundant sporangia, in much greater number than in the Danish plants, very often two on each cell, 10—11 μ long, 6—7 μ broad, consequently nearly as in our plants, and of the same shape. The thickness of the filaments is the same (5,5—6 μ), the basal cell is ca. 10 μ in diameter and the chromatophore is parietal, and finally CROUAN's plant grows on an *Ectocarpus* like the Danish plant. All these agreements suggest that CROUAN's plants are asexual individuals of *Ch. gynandra*.

Locality. Kn: Tønneberg Banke, ZA, 12 to 18 meters, July.

2. **Chantransia rhipidandra** sp. nov.

E cellula basali globosa vel rarius leviter depressa, diametro c. 14 (13—15) μ, 2—3 fila erecta parce ramosa usque ad 350 μ saltem alta, egrediunt. Rami sparsi simplices vel parce ramosi. Cellulæ (7,5—) 9—11 μ latæ, diametro 2—3 (—4)-plo longiores, chromatophorum stelliforme, pyrenoide centrali, in parte superiore cellulæ sito, instructum, continentes. Fila primaria ramique apice plerumque pilo hyalino instructi. Sporangia in filis lateralia sessilia aut stipitata, stipite unicellulari, sparsa vel (rarius) opposita, sæpe seriata, monospora, ovata vel obovata, long. 14—18,5 μ, lat. 9—10 μ. Antheridia in ramulis, in una fere planitie ramosis, semiflabelliformibus terminalia, 6—6,5 μ longa, 4—5 μ crassa. Carpogonia in filis primariis vel in infima parte ramorum sessilia; cystocarpia subglobosa; carposporæ in cellulis ultimis cystocarpii formatæ, eadem fere forma et magnitudine ac monosporæ. Antheridia et carpogonia in plantis distinctis, sporangia in plantis distinctis aut in plantis sexualibus.

This species is distinct from all well-defined species with one basal cell. Thus, it differs from *Ch. microscopica* (Nægeli) (1861, p. 407 figs. 24, 25) by its globular basal cell[1] being much broader than the filaments and giving off 2 or 3 filaments, and by having longer cells. From *Ch. hallandica* it differs by its larger proportions, the position of the antheridia and the form of the cystocarpia etc., from *Ch. microscopica* var. *pygmæa* KUCKUCK (Bemerk. Helg. II, p. 392 fig. 15) in the dimensions, the absence of endophytic filaments etc. *Ch. unilateralis* KJELLMAN (Algenfl. Jan Mayen, Arkiv f. Bot. Bd. 5 No. 14, 1906 p. 11) differs by having much thicker and more branched filaments and almost globular sporangia, and *Ch. Alariæ* JÓNSSON (Mar. Alg. Iceland. Bot. Tidsskr. vol. 24 p. 132) differs also by having much thicker and more branched filaments, and further by the branches being often opposite; both these species are devoid of sexual organs. From the short description given of *Ch. microscopica* BATTERS (Journ. of Bot. 1896 p. 9) it appears that this species can scarcely be identified with our species, for according to BATTERS the antheridia form "very compact clusters at short intervals along the axes and branches", and

[1] NÆGELI mentions and figures in *Acrochætium microscopicum* a basal disc, "von welcher es (nach Untersuchung an getrockneten Exemplaren) zweifelhaft bleibt, ob es eine niedergedrückte scheibenförmige Zelle oder nur Verdickung der Membran ist (Fig. 24, 25)". On examining the specimens of this species in RABENHORST's Die Algen Europas No. 1650, I have found that this basal disc is a cementing substance, occurring in all the species of this section.

the cystocarpia are "clustered near the basal disc", and according to KUCKUCK (l. c.) the filaments are narrower (4,5—7 μ) in BATTERS' species than in *Ch. rhipidandra*.

To the description given above the following remarks may be added. The basal cell is fastened to the surface of the host plant by a very distinct disc consisting of a cementing substance staining intensely blue in MAYER's hæmalum. The sporangia are usually alternate or more or less regularly secund (fig. 19 on the left), seriate, as the plant generally has a tendency to unilateral ramification. When each cell bears two sporangia, they are usually, but not always, opposite, and several pairs of sporangia are then often superposed (fig. 19 to the right). When the sporangium is placed on a unicellular branchlet, this often bears also a hair; the hair being terminal, the sporangium is then lateral on the branchlet (fig. 19).

Fig. 19.
Chantransia rhipidandra. Two spore-bearing plants. 300 : 1.

The antheridia are placed in characteristic, flat, usually triangular clusters consisting of 2- to 5-celled branchlets branched only on the upper side; they are produced in a number of one to three on all the terminal cells of the cluster, and also singly by some of the other cells (fig. 20 *A*, *B*).

The carpogonia are sessile on the upper part of the main filaments or on the lower part of the branches; they are bottle-shaped, with a trichogyne of about the same length as the ventral part (fig. 20 *D*, *c*). After fertilization the carpogonium grows out in a three-celled filament which still bears the trichogyne or a remnant of it on the second cell (fig. 20 *E*, *H*, *t*). A branch is now given off from the lowest cell, the primary filament is further divided so that it becomes 4- or 5-celled, and it gives off more branches from the lower cells. In fig. 20 *F*, the primary filament is seen to be 5-celled; the uppermost cell produces a carpospore, the others, with exception of the subterminal cell, each bear two branches which are either unicellular and produce directly a carpospore or become 2- or 3-celled and produce a carpospore in the end-cell. The ripe cystocarpium is of somewhat irregular, nearly globular shape; its peripheral cells are swollen and each produce a carpospore (fig. 20 *D*).

This species has only been found at Frederikshavn, where it was collected in August 1891 growing on *Porphyra umbilicalis* on the outer and the inner side of the moles. It grew on the flat side of the fronds, in some cases so abundantly that the frond of *Porphyra* had become dull and purplish.

Locality. Kn: Frederikshavn.

3. **Chantransia hallandica** Kylin.

H. Kylin (1906) p. 123.
Ch. parvula Kylin (1906) p. 124.

Kylin in 1906 described two allied species, *Ch. hallandica* and *Ch. parvula*, differing from each other by the filaments being a little thinner, giving branches off at all sides and consisting of longer cells, further by the sporangia being often stalked and then usually placed two or three together in *Ch. hallandica*, while *Ch. parvula* is smaller, has shorter, a little thicker filaments with branches placed in one or two rows and usually sessile sporangia. In several places in the Danish waters I have met with *Chantransiæ* agreeing exactly with these two species, but I have also found specimens which were intermediate in regard to one or more of the characters mentioned. As I have also found sexual organs, besides the sporangia described by Kylin, it will be necessary to mention these plants more closely.

Fig. 20.
Chantransia rhipidandra. *A* and *B* male plants, *B* also with sporangia, *s*. — *C*—*I* portions of female plants. The carpogonia and the young cystocarpia made more easily recognizable by shading; in *C* an unfertilized carpogonium and a young cystocarp; in *D* carpogonia, *c*, and a ripe cystocarp; in *E* a fertilized carpogonium, 3-celled, still with trichogyne, *t*; in *F* a nearly ripe cystocarp after having been subjected to pressure; in *G* an unripe cystocarp and two sporangia; in *H* a young cystocarp and an empty sporangium; in *I* a young cystocarp. 300 : 1.

In the plants corresponding to Kylin's *Ch. hallandica*, the basal cell is (7,5—) 9—11 (—14) μ in diameter, thick-walled; it gives off usually 3, at the most 4 erect filaments, (4—) 5—6 μ thick and consisting of cells usually 3—4 (—5) times as long as broad. Hyaline hairs are usually present. The originally terminal hair is often pushed aside by the cell bearing it growing out sympodially in the same direction as before, and the hair leaves then only a faint mark at the upper end of the cell which has produced it; but in other cases the hair retains it terminal position, and the filament, i. e. the branch, grows out in another direction (fig. 21 *E*). Transitional cases are also found. The cells contain

a stellate chromatophore with central pyrenoid lying in the upper part of the cell, the strands radiating from the central body forming a more or less continuous peripheral layer. As KYLIN (1906 fig. 8 *G*) represents the pyrenoid as being sometimes lateral, it may be remarked that I have always found it central.

Fig. 21.

Chantransia hallandia α, typica. *A*, with sexual organs and sporangia, 385 : 1. *B*, with sporangia, 385 : 1. *C*, with cystocarps, 300 : 1. *D*, fragment of plant bearing branchlets with antheridia and sporangia, 620 : 1. *E*, fragment of plant bearing a branchlet with carpogonium and antheridia, and an emptied sporangium. 620 : 1. *A* and *C* from AH[1], *B*, *D*, *E* from LC.

The sporangia are lateral on the filaments, sessile or stalked, i. e. situated on one-celled branchlets and then usually two on each stalk-cell. The branchlet may also be two-celled, the primary stalk-cell bearing, besides a terminal sporangium, a lateral stalk-cell with a sporangium. Usually only one sporangium or sporangium-bearing branchlet is situated on each cell in the filaments. The sporangia are ovate to oblong, (8,5—) 9,5—10,5 (—13) μ long, (4—) 6—7 (—9) μ broad.

Many plants bear exclusively sporangia, but by searching, specimens bearing also or exclusively sex-organs are easily found, at all events in the Danish waters. In describing the sexual organs I refer also to the plants belonging to the var. *brevior*. The antheridia

are placed singly or in small groups of two or three at the end of shorter branches; they are round, 3 μ long, 2,5 μ broad. The carpogonia are situated on similar, rather short, usually 1- to 5-celled, branches as those bearing the antheridia, and they are often placed in the immediate vicinity of the antheridia (figs. 21 *E*, 22 *B*). I have not succeeded in following the development of the cystocarpia, especially the first stages. It seems that the trichogyne disappears very soon after fertilization. In fig. 21 *E* is shown a carpogonium immediately before fertilization, in fig. 23 another with adhering spermatia, and in fig. 22 *A* and *C* abortive carpogonia are shown, but I have never seen a trichogyne on a carpogonium after the commencement of the divisions; it might perhaps have been on the place marked with * in fig. 22 *D*; the two spores situated on each side of this must then be carpospores and the whole cell-complex a cystocarpium. A very similar case is shown in fig. 23 *B*, and the plant shown in fig. 21 *C* bears undoubtedly also two or three cystocarps. The cystocarps are thus corymbiform and produce only a very small number of carpospores. Usually only two carpospores are present at the same time, but it is probable that others may develop after the first have been exhausted. The carpospores are somewhat larger than the sporangia, viz. 14—18 μ long, 7—9 μ broad.

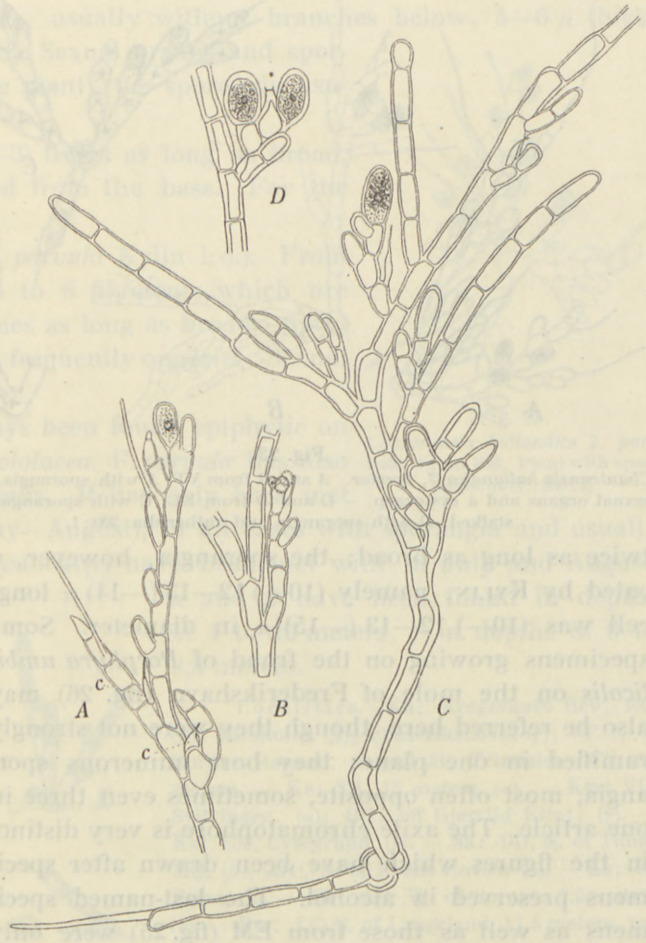

Fig. 22.

Chantransia hallandica α, *typica*. *A*, fragment of plant with abortive carpogonia and sporangia. *B*, branchlet with antheridia and carpogonium. *C*, plant with abortive carpogonia and probably unripe cystocarps. *D*, cystocarp, at * perhaps the place of the trichogyne. 550 : 1. All plants from AH[1].

At some places, mostly in the northern Kattegat, specimens were met with which agreed in all essentials with those described above but differed in having shorter cells, about twice (1½—3 times) as long as broad. The cells being, as in the main form, often a little enlarged at the upper end, they may differ somewhat

from the cylindric form (fig. 23 *C*). These plants are lower than the main form and usually branched from the base, while the main form is most often without branches below. In the specimens from VT the sporangia were almost always sessile, alternate, secund or opposite (fig. 23 *A*), while in the specimens from KC they were often stalked (fig. 23 *C*). This form may be named f. *brevior*.

Fig. 23.
Chantransia hallandica β, *brevior*. *A* and *B* from VT, *A* with sporangia, *B* with sexual organs and a cystocarp. — *C* and *D* from KC, *C* with sporangia, partly stalked, *D* with sporangia and antheridia. 390 : 1.

The specimens just described are only slightly different from others agreeing with KYLIN's *Ch. parvula*. Fig. 25 shows such a specimen, the filaments of which are 5—7 μ thick and the cells about twice as long as broad; the sporangia, however, were somewhat larger than indicated by KYLIN, namely (10—) 12—13 (—14) μ long, 6—8 (—9) μ broad. The basal cell was (10—) 12—13 (—15) μ in diameter. Some specimens growing on the frond of *Porphyra umbilicalis* on the mole of Frederikshavn (fig. 26) may also be referred here, though they were not strongly ramified in one plane; they bore numerous sporangia, most often opposite, sometimes even three in one article. The axile chromatophore is very distinct in the figures which have been drawn after specimens preserved in alcohol. The last-named specimens as well as those from EM (fig. 25) were only provided with sporangia; on the other hand, specimens from BH (fig. 24) had also sexual organs. Fig. 24 *B* fully agrees otherwise with KYLIN's figures, while fig. 24 *A* might perhaps be better referred to f. *brevior*, but these plants grew side by side and were connected by transitional forms. A very reduced plant provided with all kinds of organs of reproduction is shown in fig. 24 *C*. It seems not improbable that the small cells shown in KYLIN's fig. 9 *h*, *i* (1906) may have been antheridia.

Fig. 24.
Chantransia hallandica γ, *parvula*. From BH. *A* with longer cells and alternate sporangia, *B* with sporangia and antheridia, *C*, dwarfed plant with sporangium and sexual organs. 390 : 1.

From what has been explained above it may be concluded that all the specimens mentioned must be referred to one species, *Ch. hallandica*, which may be divided into three forms not separable by distinct limits.

α, *typica*. From the basal cell are given off usually three upright filaments which are branched on all sides, usually without branches below, 5—6 *μ* thick. Cells ca. 4 times as long as broad. Sexual organs and sporangia present, often in the same plant, the sporangia usually alternate, often stalked.

β, *brevior*. Cells ca. 2 (1½—3) times as long as broad, primary filaments often branched from the base. For the rest as *α*.

γ, *parvula* (Kylin). (Syn. *Ch. parvula* Kylin l. c.). From the basal cell are given off up to 6 filaments which are (5—) 6—7 *μ* thick. Cells ca. 2 times as long as broad. Sporangia almost always sessile, most frequently opposite. Sexual organs often wanting.

Fig. 25.
Chantransia hallandica γ, parvula. From EM. Plant with sporangia only. 390 : 1.

The species has almost always been found epiphytic on *Polysiphonia nigrescens* and *Pol. violacea*. F. *parvula* has also been found on *Porphyra umbilicalis*. It has only been met with in the summer months (May—August), in all cases with sporangia and usually also with sexual organs; ripe cystocarps have been met with in July and August. *α* and *β* have been found in depths of 4 to 15 meters, *γ* in depths of 0 to 9,5 meters.

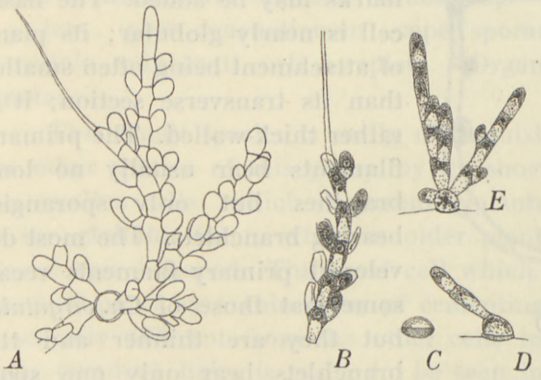

Fig. 26.
Chantransia hallandica γ, parvula. From Frederikshavn, growing on *Porphyra umbilicalis*. *A*, plant with sporangia. — *B*, filament with partly emptied sporangia. — *C*, germinating spore. — *D* and *E*, young plants, still sterile. 300 : 1.

Localities. **Kn**: Krageskovs Rev, KC, (*β*); Hirsholm, (*β*); Frederikshavn, (*γ*); VT, N. of Nordre Rønner, (*α* and *β*); Trindelen, FF, 15 meters. — **Ke**: XA, 13 meters, (*α*). — **Km**: VQ, Svitringen, (*α*); BH, off Gjerrild Klint, (*γ*). — **Ks**: EM, Lysegrund, (*γ*). — **Sa**: BD, N. of Tunø; MQ, (*β*); AH¹, N. of Fyens Hoved, (*α*). — **Lb**: At Fænø, (*α*). — **Sb**: AB, W. of Sprogø, 7,5 meters (*α*). — **Bw**: LC, S. of Langeland, 11,5 meters, (*α*).

4. **Chantransia baltica** sp. nov.

E cellula basali globosa, diametro 10,5—14 *μ*, fila usque 6 subsimplicia, longitudine 400 *μ* vel ultra, egrediunt. Cellulæ (5—) 6—7 (—9) *μ* crassæ, in filis bene evolutis diametro 4—6 (—7)-plo longiores, chromatophorum axile, pyrenoide centrali instructum, in parte superiore cellulæ situm, continentes. Sporangia monospora ovata, 12—16 *μ* longa, 8—10 *μ* lata, vulgo c. 14 *μ* longa, 10 *μ* lata, in filis primariis lateralia vel terminalia, sessilia vel stipitata, in stipite unicellulari singula, in articulis filorum sæpe bina, opposita,

superne nonnunquam subsecunda. Organa sexualia desunt. Pili hyalini crebri, in ramulis sporangiferis terminales.

This species which has been found only in two localities in the Baltic is certainly nearly related to *Ch. hallandica*, but however so different from it, that I do not hesitate to set it up as a distinct species. It differs by the primary filaments being more numerous, less branched, somewhat thicker and consisting of somewhat longer cells, by the sporangia being larger, by the sporangial stalks bearing only one sporangium, and by the want of sexual organs. In some of the characters mentioned, the more numerous and thicker filaments, and the sporangia often opposite, it resembles *Ch. hallandica* f. *parvula*, but it is very different from this by the long cells and the sporangia being often stalked.

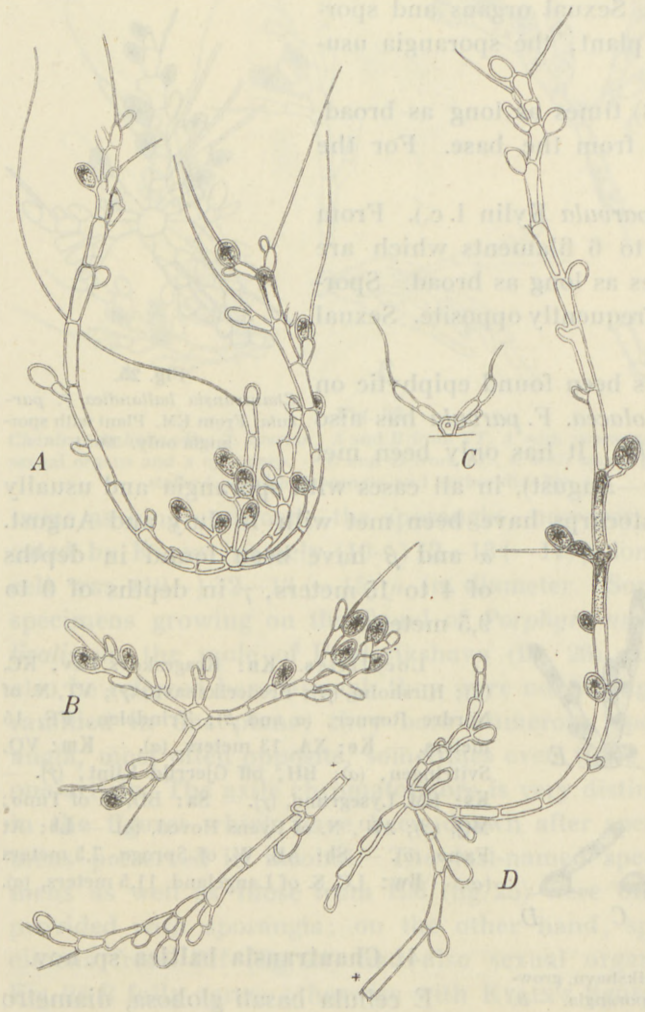

Fig. 27.
Chantransia baltica. (From QR). *A*, *B* and *D*, fully developed plants with sporangia, *C* young plant, seen from the side. 300 : 1.

To complete the description given above, the following remarks may be added. The basal cell is nearly globular, its plane of attachment being often smaller than its transverse section; it is rather thick-walled. The primary filaments bear usually no long branches but only sporangia-bearing branchlets. The most developed primary filaments recall somewhat those of *Ch. virgatula*, but they are thinner and the branchlets bear only one sporangium. The shorter filaments consist of shorter cells, 2—3 times as long as broad and often somewhat enlarged above. In some specimens from SQ the longer filaments were up to 9 μ thick below, upward thinner, ca. 5 μ in diameter, the cells being up to 7 times as long as broad. The chromatophore reaches in the longer cells often only to the middle of the cell, the pyrenoid lies near the upper end of the cell. The spores contain a very distinct stellate chromatophore. I have never

seen a sporangial stalk bearing more than one sporangium, and a renewal of an emptied sporangium within the sporangial-wall from the stalk-cell has not been observed, but a new sporangium may sometimes be developed beside an emptied. Colourless hairs are always present; they are terminal or lateral, in the latter case, however, certainly always originally terminal.

Localities. Bm: Gyldenløves Flak, QR, 7,5 meters, on *Polysiphonia violacea*, July. — Bb: SQ, S. of Broens Rev, 8,5 meters, on *Polysiphonia elongata*, August.

5. **Chantransia moniliformis** sp. nov.

Thallus minutus cæspitulosus, 50—150 μ altus vel parum ultra (sine pilis). Cellula basalis singula subglobosa, fila 2—3 (vel plura?) erecta vel decumbentia et adscendentia, a basi ramosa, e cellulis plus minus inflatis constituta, emittens. Cellulæ diametro æquilongæ ad duplo longiores, plerumque fere sesquilongæ, subglobosæ aut doliiformes vel in parte superiori incrassatæ, 7—10 μ latæ, 7—14 μ longæ. Chromatophorum stelliforme, pyrenoide centrali instructum, in parte superiori cellulæ situm. Fila ramique, præcipue in statu juvenili, sæpe piligeri, pilis initio terminalibus, dein evolutione sympodiali (pseudo-)lateralibus. Sporangia monospora sessilia, rarius pedicellata, lateralia, secundata vel opposita, ovata, 13,5—15 μ longa, 7 μ lata, post evacuationem sæpe sporangio novo, e cellula subjacenti orta, repleta. Organa sexualia ignota.

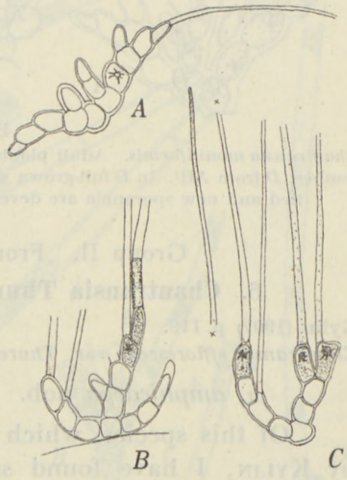

Fig. 28.
Chantransia moniliformis. Young plants with hairs. *A* from Helsingør, *B* and *C* from D. 390:1.

This small species is easily distinguishable from the other species of this group by its short, more or less swollen cells, which in juvenile plants approach to the globular form, while in older plants they are almost barrel-shaped. The basal cell which is fixed to the host plant by a thin layer of cementing substance is scarcely different from the other cells in form. The displacement of the originally terminal hairs is easily to be seen in the young plants (fig. 28 *C*); in older plants no hairs are to be found. In the plant represented in fig. 28 *B* the cell situated beneath the upper terminal hair-cell had lengthened and become almost colourless, approaching thus to the character of a hair-cell; but this case appears to be very rare. The branches are mainly given off at the upper side of the decumbent or ascending principal filaments, and this holds good also of the sporangia which are often seriate on the upper side of the filaments. After the evacuation the sporangial wall is seen to be lamellate, but the acroscopic part of it is often dissolved (fig. 29 *B*). — On dried material I once saw a specimen with a blue-green colour; unfortunately I have not examined the species in the living state.

This inconspicuous species has been found epiphytic on *Polysiphonia violacea* and *nigrescens*, in company with other species of *Chantransia* (*virgatula*, *hallandica* etc.), at several places but in small quantities. It has been met with in May to September, in depths from 1 to 11,5 meters, and was collected with sporangia in the same months.

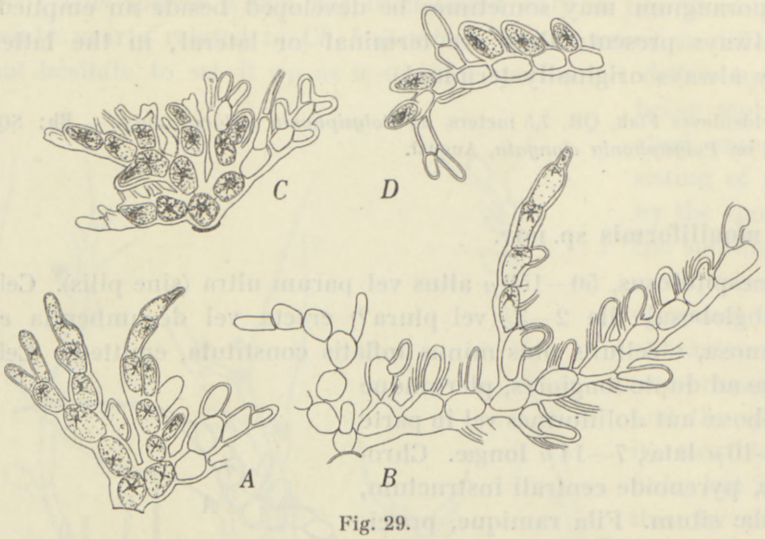

Fig. 29.

Chantransia moniliformis. Adult plants with sporangia. *A*—*C* from Helsingør, September, *D* from AH[1]. In *D* full-grown sporangia, in *B* the sporangia have been emptied and new sporangia are developing within their membranes. 390 : 1.

Localities. **Kn**: Krageskovs Rev, KC. — **Ks**: D, N. of Isefjord, 11,5 meters. — **Sa**: AH[1], N. of Fyens Hoved; MQ, S. of Samsø, 11,5 meters. — **Su**: Stone-slope at Helsingør (Kronborg). — **Bw**: LC, S. of Langeland, 11,5 meters. — **Bm**: QR, Gyldenløves Flak.

Group II. Frond epiphytic with a pluricellular basal layer.

6. **Chantransia Thuretii** (Born.) Kylin.

Kylin (1907) p. 119.
Chantransia efflorescens var. *Thuretii* Bornet (1904) p. XVI pl. I.

α, *amphicarpa* nob.

Of this species, which is quite distinct from *Ch. efflorescens* (J. Ag.), as shown by Kylin, I have found specimens fully agreeing with Kylin's description and drawings. Such specimens, provided with monosporangia and sexual organs, were met with repeatedly in July near Frederikshavn. In some cases the sporangia and the sexual organs occur on different branches of the same plant, but as shown by Kylin, the sporangia are often situated near the sexual organs, and all the three kinds of organs of reproduction may then occur very close together, as is seen in fig. 30 *B*, where the same cell bears a carpogonium and a sporangium, while a cluster of antheridia is situated on the next branchlet. Also in fig. 31 *B*, the sporangium is situated close to the carpogonium and in fig. 31 *A* a two-celled branchlet is seen to bear a carpogonium, an antheridium and a sporangium.

When not occurring together with the sexual organs the sporangia are situated on the inner side of the branches near the base, usually 2 or 3 together on one-celled branchlets, or they are sessile at the same place; more rarely the branchlets are 2- or 3-celled. It may sometimes happen, that two sporangiferous branchlets are seated on the same cell, the one over the other (fig. 30 *A*). On maturation the spore leaves

the sporangium through a narrow opening at its upper end. After liberation, which was observed in July, the spores took an ovoid form, thereafter they became globular and then showed amoeboid movements.

The germinating spore forms an orbicular basal cell which gives off one upright filament but for the rest remains unaltered for some time (fig. 30 *D*); later on it forms cells in the periphery which grow out in creeping filaments fusing together to a rather large-celled basal disc, which produces more upright filaments (fig. 31 *C*). The original basal cell is for some time distinguishable in the centre of the disc. As shown by KYLIN, no downwards growing filaments occur at the base of the upright filaments. However, I have once observed two short vigorous descending filaments given off very near the base of an upright filament, and each producing an upright filament on its convex side (fig. 31 *D*).

The chromatophore, the form of which KYLIN was not able to determine, is shown in fig. 30 which was drawn after living plants; it is a parietal plate, often with a lobed margin and with a large pyrenoid which is also parietal but much projecting inward in the cell. The nucleus often lies at the opposite side of the cell from the pyrenoid (fig. 30 *B*, *C*).

Plants similar to those mentioned above were found at a locality in the Samsø Waters in September. They were, however, only provided with ripe cystocarpia and bore no sporangia, perhaps to be explained by the sporangia accomplishing their development faster than the cystocarps.

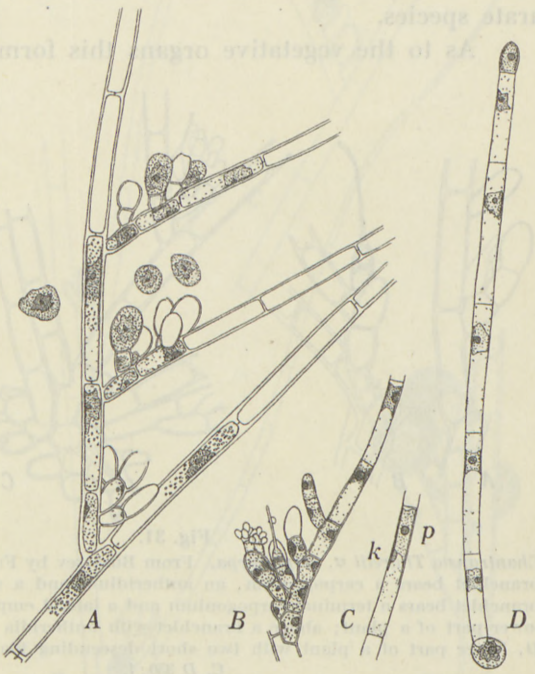

Fig. 30.
Chantransia Thuretii α, amphicarpa. Drawn after living plants from Busserev by Frederikshavn. *A*, plant with sporangia and liberated spores. *B*, branch with branchlets bearing antheridia, a carpogonium and sporangia; behind the carpogonium an emptied sporangium is visible. *C*, cell with chromatophore, pyrenoid *p* and nucleus, *k*. *D*, young plant. 320 : 1.

Referring for the rest to KYLIN's description, I may remark finally, that the filaments in my plants were 7,5—9,5 μ thick, that I have once observed a pair of opposite branches, that the sporangia were 14—16 (—17) μ long, 9—11 μ broad, and that the carpospores were 19—21 μ long, 11—12,5 (—14) μ broad.

The main form has been found growing on *Polysiphonia violacea*, *Ceramium rubrum*, *Cystoclonium* and *Dictyosiphon*, with sexual organs and ripe carpospores and monospores in July, with ripe carpospores in September.

Localities. **Kn**: Busserev by Frederikshavn, July. — **Sa**: MP, Falske Bolsax, 11—13 meters.

β, agama var. nov.

In the Danish waters plants only provided with sporangia are much more frequent than the above described sexual plants. As they greatly resemble these, I conclude that they belong to the same species; as they are different, however, not only by the want of sexual organs but also by somewhat larger sporangia they may be mentioned separately; and this will appear all the more legitimate when we remember the great likeness between the sporangia-bearing filaments of *Ch. Thuretii* and those of *Ch. corymbifera* Thur. (BORNET et THURET 1876 pl. V), so that it is not excluded that the specimens mentioned here might represent a separate species.

As to the vegetative organs this form agrees with the sexual plants; the principal filaments, however, are as a rule a little thicker, namely 8—11 μ in diameter. In some cases the thickness reached 12 μ, and in some specimens from the North Sea (aF, fig. 32 *F*) it attained even 13 μ. On the other hand principal filaments only 7 μ thick may also occur. The cells are, as in the sexual plants, rather thick-walled; in the lower part of the filaments they are proportionally short (seldom however so short as in fig. 32 *A*), upward longer.

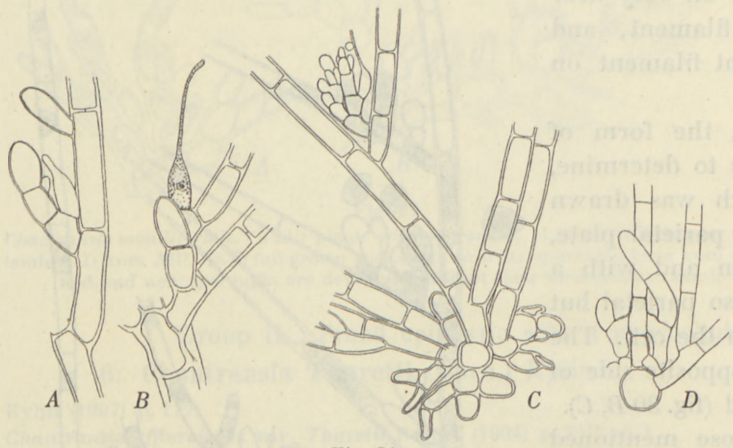

Fig. 31.

Chantransia Thuretii α, amphicarpa. From Busserev by Frederikshavn. *A*, the branchlet bears a carpogonium, an antheridium and a sporangium. *B*, the branchlet bears a terminal carpogonium and a lateral emptied sporangium. *C*, lower part of a plant; above a branchlet with antheridia and a carpogonium. *D*, lower part of a plant with two short descending filaments. *A*, *B* 560 : 1, *C*, *D* 350 : 1.

The branches are somewhat thinner than the principal filaments and become thinner towards the apex. Sometimes they taper into very thin hair-like threads consisting of long, thin cells, the contents of which become colourless (fig. 32 *B*); this may also occur in *α*. Descending filaments at the base of the plants were not observed in typical specimens of this form. The chromatophores have the same shape as in the sexual plants.

The sporangia have the same position and shape as in the sexual form but are somewhat larger. The length is usually 19—22 μ, but it may attain 24 μ and may sometimes be only 17,5 μ; the breadth varies between 8 and 12 μ (7—13 μ). Only once have I seen a sporangium or a sporangium-bearing branchlet situated beneath another sporangium on the same cell (fig. 32 *C*, comp. fig. 30 *A*). In specimens collected towards the end of September in the Northern Kattegat (TP),

some peculiar crooked branchlets were observed, mostly rising from the sporangia-bearing branchlets, more rarely independently of these, and then usually given off from the lower end of the cells (fig. 33); in some cases they bear sporangia (fig. 33 *A*). Sometimes they occur in great number on a branchlet, forming a short-stalked capitulum (fig. 33 *B*). These crooked filaments showed rich, coloured contents; they must without doubt be regarded as abnormal formations.

Besides the monosporangia tetrasporangia have also been met with, but only in one locality in the North Sea (aF, 31 meters) in August. The specimens bore numerous, typical monosporangia and in smaller number tetrasporangia, having a similar position to the former. The number of tetrasporangia on one branchlet was frequently greater than usual, but that was also the fact for the monosporangia in these specimens. The tetrasporangia were almost globular, a little longer however than broad, 25—26 μ long, 21—22 μ broad (fig. 32 *D*). In one branchlet only one sort of sporangia occurred, but branchlets with monosporangia were found at a little distance from those with tetrasporangia on the same plant. Some plants bore only monosporous sporangia.

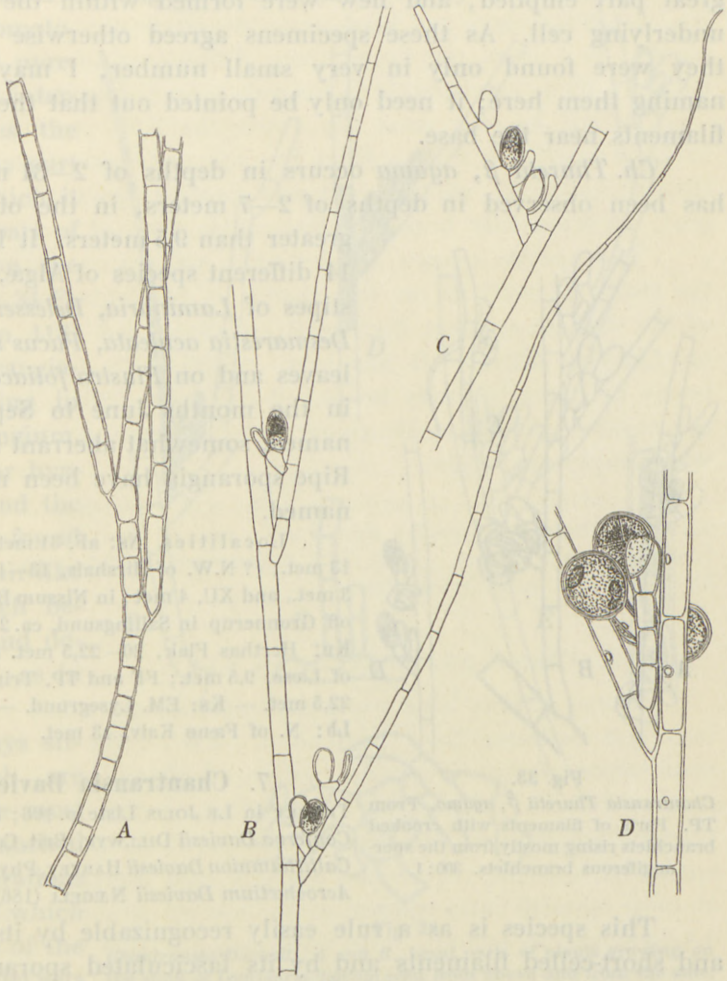

Fig. 32.
Chantransia Thuretii β, *agama*. *A*—*C* from ZL[1]. 265 : 1, *A* from the lower, *B* from the upper part of the plant. *C*, branch with sporangia, partly 2 on each cell. *D*, from aF. 345 : 1, branchlet with tetrasporangia. The pyrenoids have been drawn in some of the cells.

Some specimens growing on *Flustra foliacea* dredged in the Skagerak N.W. of Hirshals in May (no. 7109) may be mentioned here, as they are somewhat different in the smaller size of the sporangia and the more irregular position of the spor-

angia-bearing branchlets. These were namely not restricted to the inner side of the branches but occurred on all sides of the filaments and at various distances from the base, and the sporangia were usually only 11—14 μ long, 7,5—8 μ broad; one, however, was found to be 16 μ long, 9,5 μ broad. The sporangia were for a great part emptied, and new were formed within the sporangial wall from the underlying cell. As these specimens agreed otherwise with the f. *agama*, and as they were found only in very small number, I may content myself with just naming them here; it need only be pointed out that they showed short descending filaments near the base.

Ch. Thuretii β, *agama* occurs in depths of 2—31 meters. In the Limfjord it has been observed in depths of 2—7 meters, in the other waters only in depths greater than 9,5 meters. It has been found growing on 14 different species of Algæ, as species of *Polysiphonia*, stipes of *Laminaria*, *Delesseria sangvinea*, *Gloiosiphonia*, *Desmarestia aculeata*, *Fucus serratus*, further on *Zostera*-leaves and on *Flustra foliacea*. It has only been found in the months June to September, except the above named, somewhat aberrant specimens collected in May. Ripe sporangia have been met with in all the months named.

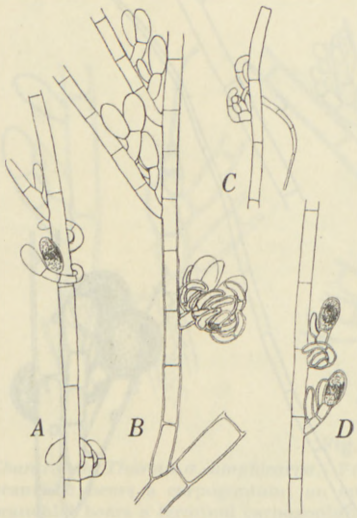

Fig. 33.
Chantransia Thuretii β, *agama*. From TP. Parts of filaments with crooked branchlets rising mostly from the sporangiferous branchlets. 300 : 1.

Localities. Ns: aF, 31 meters. — Sk: ZK[6] off Lønstrup, 11—13 met.; (? N.W. of Hirshals, 13—15 met., May, no. 7109). — Lf: ZU, 3 met., and XU, 4 met, in Nissum Bredning; MH in Thisted Bredning; off Grønnerup in Sallingsund, ca. 2 met.; LS and MI East of Mors. — Kn: Herthas Flak, 20—22,5 met. (!, Børgs.); Frederikshavn; ZL[1] N. of Læsø, 9,5 met.; FF and TP, Trindelen, ca. 15 met. — Ke: Fladen, 22,5 met. — Ks: EM, Lysegrund. — Sa: MQ, S. of Samsø, 11,5 met. — Lb: N. of Fænø Kalv, 13 met.

7. **Chantransia Daviesii** (Dillw.) Thur.

Thuret in Le Jolis Liste p. 106; Kylin (1907) p. 117 fig. 27.
Conferva Daviesii Dillwyn, Brit. Conf. 1809 p. 73, pl. F (teste specim.).
Callithamnion Daviesii Harvey, Phyc. Brit. pl. 314; J. Agardh Sp. III p. 8.
Acrochætium Daviesii Nægeli (1861) p. 405; Bornet (1904) p. XXII.

This species is as a rule easily recognizable by its fairly thick, thick-walled and short-celled filaments and by its fasciculated sporangia-bearing branchlets. It is undoubtedly nearest related to *Ch. Thuretii* which it may sometimes very closely resemble, while it is very different from *Ch. virgatula* with which it was formerly often confused. Although it was the first described of all the marine species of the genus, it is imperfectly known in some respects, for which reason a short description of the Danish specimens may be given here.

The basal part consists of branched creeping filaments which may become so densely interwoven that they form a continuous basal disc. When the plant is growing on an irregular surface, as e. g. the stalk of *Laminaria hyperborea*, the filaments are very irregularly curved and may grow over one another, and the basal

part may thus become two or even three cells thick, as stated by HARVEY GIBSON (Journ. of Bot. 1892 p. 104), but a real parenchymatous disc I have never seen. From the basal layer numerous erect filaments appear, forming 6 mm. high clusters. The filaments are usually 9—12 μ thick, but the thickness may vary from 8 to 13 μ. The cells are usually 2—4 times as long as broad (more rarely 1—5 times). The cells contain a parietal chromatophore with a well developed pyrenoid, very prominent in the interior of the cell; sometimes the pyrenoid is so large that the part of the chromatophore in which it lies reaches nearly to the part of the same chromatophore on the opposite side of the cell (fig. 34 *F*). According to KYLIN (1907 p. 118) hairs rarely occur, a sporangia-bearing branchlet terminating in a hair instead of a sporangium. I have never seen unicellular hyaline hairs; on the other hand the fertile branchlets were often found tapering into very thin hair-like filaments, the cells of which become longer and thinner and decoloured upwards (fig. 34 *C*), as in *Ch. Thuretii*.

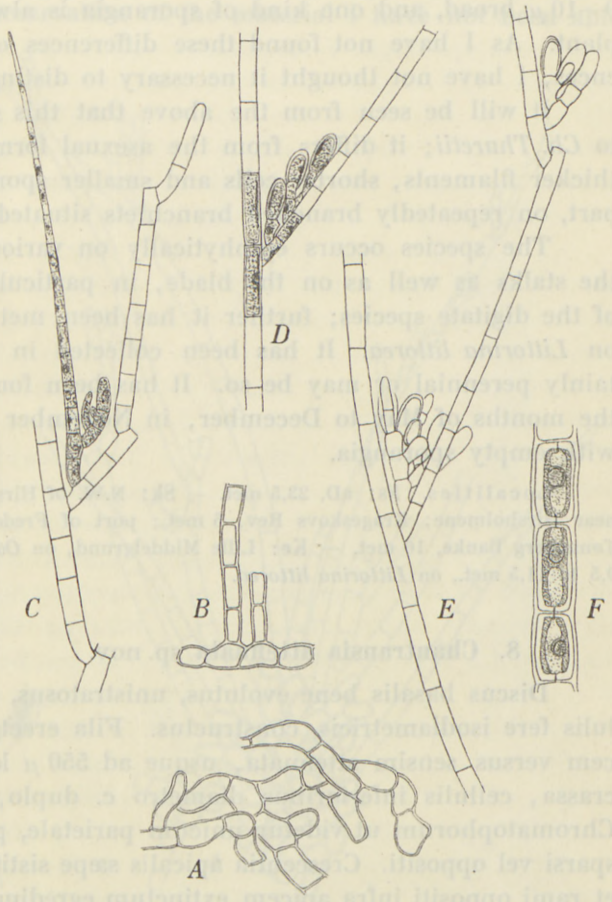

Fig. 34.
Chantransia Daviesii. *A* and *B*, basal parts of plants growing on the stalk of *Laminaria digitata* seen from above and from the side. *C—E*, erect filaments with sporangia-bearing branchlets. *F*, three cells showing the chromatophore (December). *A—E* 300 : 1, *F* 390 : 1.

The sporangia are always situated on branchlets which are more or less branched; the most vigorous are repeatedly branched and consist of at least 3 generations of branches, the youngest of which is situated on the inner side of the foregoing, so that the branchlet gets the form of a fan-shaped fascicle. These branchlets are mainly placed in the axils of the branches, on the inner side of their undermost cell, but they may also occur scattered on the sides of the principal filaments. In the first case one fascicle only is placed in each axil, especially when the branchlet is well developed, but not rarely two less branched branchlets are placed the one over the other (fig. 34 *D*), and there is then a resemblance with *Ch. Thuretii*; typical sporangia-bearing fascicles are, however, always to be found on the same plants. I found

always only monosporangia, but KYLIN states (1907 p. 118) that tetrasporangia may occur together with the monosporangia. The size of the sporangia was found to be somewhat different, the length varying from 11 to 19 μ, the breadth from 8 to 10 μ. It seems however that two groups of sporangia are distinguishable with regard to the size, the one being 11—14 μ long, 8—9 μ broad, the other 15—19 μ long, 9—10 μ broad, and one kind of sporangia is always only to be found on the same plant. As I have not found these differences of size connected with other differences, I have not thought it necessary to distinguish the two kinds of individuals.

It will be seen from the above that this species must be considered related to *Ch. Thuretii*; it differs from the asexual form of this particularly by somewhat thicker filaments, shorter cells and smaller sporangia being placed, at any rate in part, on repeatedly branched branchlets situated in the axils of the branches.

The species occurs epiphytically on various Algæ, especially *Laminariæ*, on the stalks as well as on the blade, in particular on the borders of the segments of the digitate species; further it has been met with on *Flustra foliacea* and once on *Littorina littorea*. It has been collected in 1 to 23,5 meters depth. It is certainly perennial or may be so. It has been found, in all cases with sporangia, in the months of May to December, in November and December in a great measure with empty sporangia.

Localities. **Ns**: aD, 23,5 met. — **Sk**: N.W. of Hirshals, 11 to 15 met. — **Kn**: XK, TX and TU near Hirsholmene; Krageskovs Rev, 5 met.; port of Frederikshavn; Busserev; Borrebjergs Rev; TP, Tønneberg Banke, 16 met. — **Ke**: Lille Middelgrund, on *Odonthalia*, 17 to 19 met. — **Sb**: Kerteminde, 9,5 to 11,5 met., on *Littorina littorea*.

8. **Chantransia attenuata** sp. nov.

Discus basalis bene evolutus, unistratosus, e filis repentibus confluentibus, cellulis fere isodiametricis, constructus. Fila erecta sat numerosa, parce ramosa, apicem versus sensim attenuata, usque ad 550 μ longa, basi 6,5—7 μ, superne c. 5 μ crassa, cellulis inferioribus diametro c. duplo, superioribus 3—4-plo longioribus. Chromatophorum ut videtur unicum parietale, pyrenoide laterali instructum. Rami sparsi vel oppositi. Crescentia apicalis sæpe sistitur, formatione pili vel sporangii (?), et rami oppositi infra apicem extinctum egrediuntur. Monosporangia 7,5—9 μ longa, 4,5—6 μ lata, in ramulis unicellularibus solitaria vel bina, vel in ramulis majoribus plura sessilia, pedicellata et terminalia conferta.

This species has only been met with once, growing on *Desmarestia aculeata* dredged in the Limfjord in August, and was then in a rather advanced stage of development. As moreover I have had only rather few dried specimens for examination, my description is in some respects incomplete; the species seems, however, to be distinct from all known species.

The well developed basal layer resembles that of *Ch. Thuretii*. As the most striking character may be mentioned the frequent occurrence of opposite branches, which, however, were only found when the growth of the filament was stopped

seemingly by the formation of a terminal hyaline hair. The hair had usually disappeared, leaving only a faint scar, in some few cases it was still visible (fig. 35 B). The principal filaments consist in their lower part of short cells, about twice as long as broad; upwards the filaments become gradually somewhat thinner, and the cells at the same time longer. On the whole, the filaments are not much branched. Owing to the defective state of preservation of the material I have not been able to determine with certainty the form of the chromatophore. In some cases, however, I have seen that it is parietal, and I suppose it to be single and to have one parietal pyrenoid.

The position of the sporangia is somewhat variable; they occur mostly in the upper part of the plant and are relatively often placed singly, more rarely two together on unicellular branchlets, or they are, though rarely, sessile on the filaments. Sometimes a greater number is placed on somewhat larger, often branched branchlets, but such branchlets grade evenly to the long filaments. The sporangia-bearing branchlets show usually no distinct arrangement on the filaments.

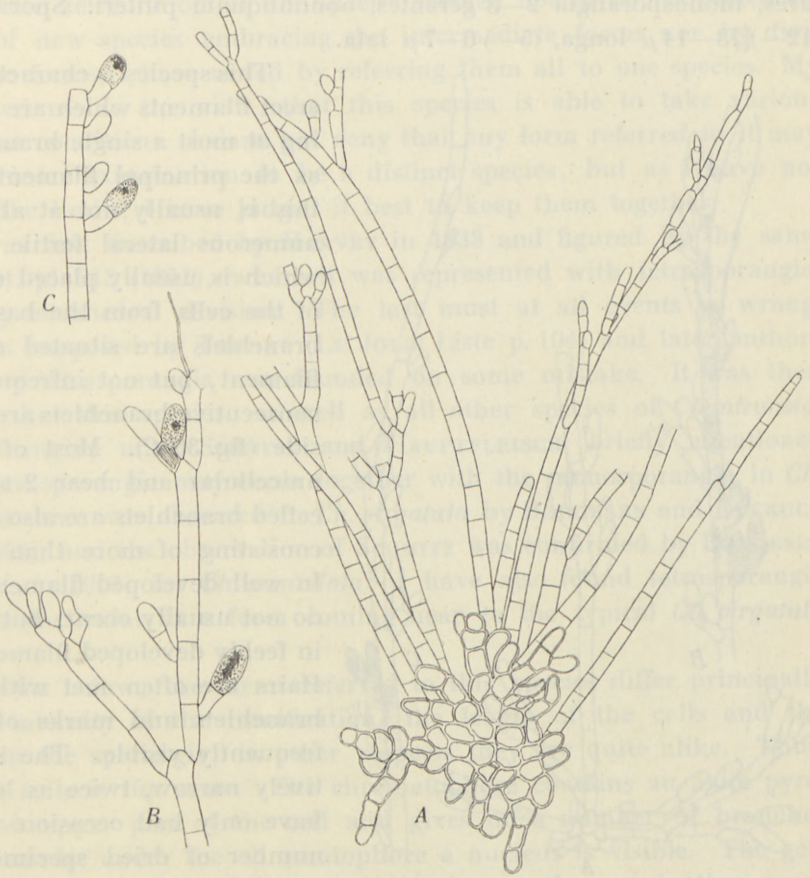

Fig. 35.
Chantransia attenuata. *A*, plant the basal layer of which is seen from the under face. 350 : 1. *B* and *C*, upper ends of filaments with sporangia. 560 : 1.

The species is perhaps related to *Ch. Thuretii*; it differs from it by the opposite branches and the small sporangia.

Locality. Lf: MA in Nissum Bredning, 5 meters, on *Desmarestia aculeata*.

9. **Chantransia stricta** sp. nov.

Discus basalis unistratosus e filis lateraliter confluentibus compositus. Fila erecta pauca e centro disci egredientia simplicia vel subsimplicia, stricta, usque ad 1 mm. et ultra longa, 6—7 μ crassa, ramulos sporangiferos per totam fere longitudinem gerentia; cellulæ 3—4,5 diametra longæ, chromatophorum parietale, pyrenoide instructum continentes. Ramuli sparsi, nonnunquam secundati, erecti, uni—bicellulares, monosporangia 2—3 gerentes, nonnunquam piliferi. Sporangia anguste ovata, (12—)13—14 μ longa, (5—)6—7 μ lata.

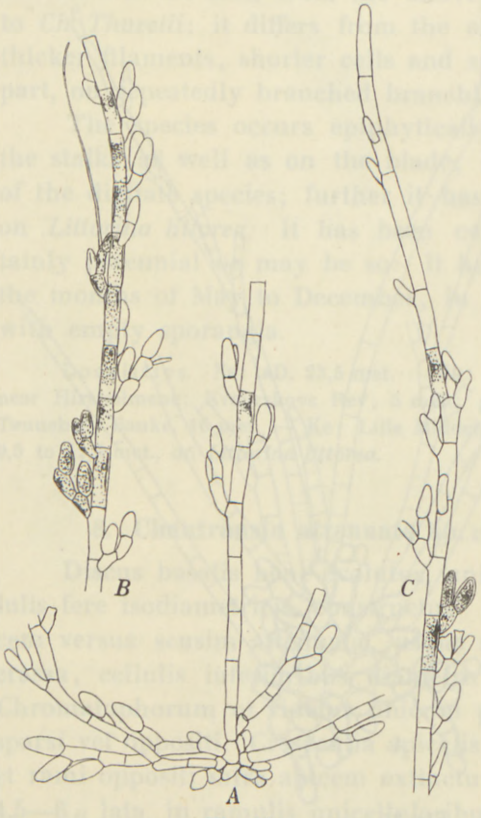

Fig. 36.
Chantransia stricta. *A*, lower part of a plant, *B*, fragment off the middlemost part, and *C*, the upper part of the same plant. 350 : 1.

This species is characterized by its straight erect filaments which are unbranched or bearing at most a single branch of the same kind as the principal filament. The direction of this is usually not at all influenced by the numerous lateral fertile branchlets, one of which is usually placed on nearly every one of the cells from the base to the top. The branchlets are situated on all sides of the filament, but not infrequently a number of consecutive branchlets are placed on the same side (fig. 36 *C*). Most of the branchlets are unicellular and bear 2 sporangia, but two-celled branchlets are also frequent, while such consisting of more than two cells are rare. In well developed filaments sessile sporangia do not usually occur, but they may be found in feebly developed filaments (fig. 36 *A* at left). Hairs are often met with at the end of the branchlets and marks of decayed hairs are frequently visible. The sporangia are relatively narrow, twice as long as broad. As I have only had occasion to examine a small number of dried specimens, I cannot give any information on the development of the basal layer.

As far as I can see, this species cannot be identified with any of the more exactly described species. The nameless species described by Reinsch (Contrib. ad Alg. et Fung. 1877 p. 38 pl. XII fig. 1—2) which also has unbranched filaments, (setting aside the branchlets) differs among other things by its much smaller dimensions, shorter cells, less erect branchlets and more roundish sporangia.

Only found in small quantity together with other species of *Chantransia* on *Polysiphonia nigrescens* in depths of 7,5 to 11,5 meters, in July and August.

Localities. **Km**: BH off Gjerrild Klint. — **Ks**: D, N. of Isefjord. — **Sa**: AH[1] off Fyens Hoved.

10. **Chantransia virgatula** (Harv.) Thur. emend.

I have for a long time been in doubt whether the forms mentioned under this species ought to be regarded as distinct species or as forms of one species. It is easy to point out within this group of forms some fairly different types, and I tried at first to carry out the first alternative, but I then repeatedly met individuals which might apparently with equal right be referred to one or other of the presumed species. As the delimitation of the species seemed not to be facilitated by the establishment of new species embracing the intermediate forms nor by division otherwise of the forms, I have ended by referring them all to one species. My observations have led me to the view, that this species is able to take various forms under different conditions. I dare not deny that any form referred to it may possibly prove on closer examination to be a distinct species, but as I have not been able to draw the limits, I have judged it best to keep them together.

The species was first described by HARVEY in 1833 and figured by the same author in Phyc. Brit. pl. 313 (1851), where it was represented with tetrasporangia, showing even partly tetrahedral division. The last must at all events be wrong, and it has also been supposed by THURET (LE JOLIS Liste p. 104) and later authors that the statement of tetrasporangia was founded on some mistake. It was then generally accepted, that this species, as well as all other species of *Chantransia*, had only monosporangia, until SCHMITZ and HAUPTFLEISCH briefly mentioned (1896 p. 331) that tetrasporangia may occur together with the monosporangia in *Ch. secundata*. Later the same was observed in *Ch. virgatula* by BØRGESEN and KUCKUCK (BØRGESEN 1902 p. 351), and the observation of SCHMITZ was confirmed by BØRGESEN (l. c. p. 350) and KYLIN (1907) for *Ch. secundata*. I have also found tetrasporangia in the latter but in particular in a form coming near to the typical *Ch. virgatula* (f. *tetrica*).

As will be shown below, the forms referred to this species differ principally in the nature and intensity of the ramification, the length of the cells and the number of spores in the sporangia; in other respects they are quite alike. Thus, the structure of the cells is the same. The chromatophore contains an axile pyrenoid situated in the upper part of the cell and gives off a number of branches downwards and upwards; under the chromatophore a nucleus is visible. The germination takes place in the same manner in all the forms, the germinating spore dividing by excentric walls into an inner triangular and three peripheral cells, without changing the orbicular outline (figs. 37 *C*, 38 *A—C*, 39 *C—D*, 40 *E*, 41 *A*), (comp. MURRAY and BARTON (1891) p. 212 pl. 37 fig. 5; KYLIN (1907) fig. 24). Some small differences may sometimes occur (fig. 40 *F*), but the greater part of the spores germinate as described. The orbicular outline of the basal disc may sometimes hold out for a long time, in other cases some of the peripheral cells grow out to creeping filaments at an early period (figs. 39, 40). The number of erect filaments given off from the basal disc is usually low; the first is produced by the central triangular cell, the following from the neighbouring cells.

α, luxurians (J. Ag.).

Callithamnion luxurians J. Agardh Sp. II p. 14.
Chantransia luxurians Kylin l. c. p. 117 fig. 26.
Callithamnion virgatulum Crouan Alg. mar. Finist. p. 116.
Chantransia virgatula Thuret in Le Jol. Liste p. 106; Kylin (1907) p. 116 fig. 25; Borgesen, M. A. Fær. p. 351 fig. 52.
Trentepohlia virgatula Farlow Mar. Alg. New Engl. p. 109 pl. X fig. 3.

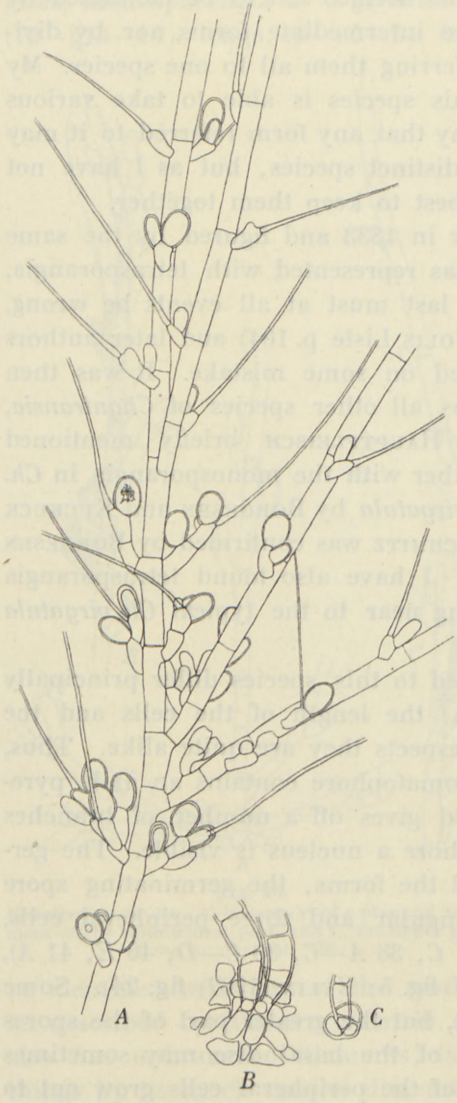

Fig. 37.
Chantransia virgatula α, luxurians. *A*, part of plant with sporangia. *B*, basal part. *C*, basal part of young plant. 260 : 1.

This form which corresponds to the *Ch. virgatula* in the common restriction of the authors is the commonest form in the Danish waters. It has two or three generations of long filaments, which are straight, up to 2 mm. long, 10 to 14 μ thick, more rarely up to 16 μ thick or even thicker, consisting of cells 3 to 5 times as long as broad. There is a distinct contrast between the long filaments and the branchlets which occur in great number, one or two on each cell of the filaments, in the first case often secund, in the latter usually opposite; they are usually 1 to 3 cells high, unbranched or branched and bear generally two or more sporangia and most frequently also one or more vigorous hairs. The sporangia are monosporous, ovate or broadly ellipsoidal 17—21 (—26) μ long, 13—16 (—19) μ broad.

Under this species I have included two forms regarded by Kylin as distinct species, namely *Ch. virgatula* and *Ch. luxurians*, because I have not been able to distinguish them after the alleged characters. In most of the Danish specimens the thickness of the filaments varies between 11 and 13 μ, thus within the limits indicated for *Ch. luxurians* by Kylin, and the dimensions of the sporangia also agree with the measurements indicated for this species. On the other hand, the specimens with thicker filaments, thus agreeing better with *Ch. virgatula* Kylin, had not shorter, approximately globular sporangia as indicated by Kylin, but were of the same dimensions. The thickest filaments were found in some specimens from Lysegrund in Ks (9,5 meters); they varied from 13 to 20 μ in thickness, the cells were thick-

walled, 3 to 4 times as long as broad, the sporangia 17,5—19 μ long, 14—15 (16) μ broad. As a contrast to these some specimens may be mentioned which were found growing on *Porphyra umbilicalis* in Thyborøn Channel (Lf); they agreed on the whole fairly well with this form, but the filaments were only 7—8 μ thick. Such a small thickness I have otherwise never observed in the specimens referred to this form, though certainly in f. *secundata* which occurs along the west coast of Jutland; I imagine that these specimens may have originated from f. *secundata* but have developed in a more sheltered locality. It deserves notice that groin no. 63 is more sheltered than no. 62 where f. *secundata* was found growing, and that the species has otherwise not been found in the Limfjord with the exception of at Hals at the eastern entrance of the fjord where f. *secundata* has been met with. — For the rest the specimens referred to this form are on the whole homogenous.

This form has been found in all the Danish waters within Skagen, from low-water mark to 11,5 meters depth. The specimens found at Bornholm are typical but not very vigorous and with little branched filaments. It was mostly met with in the summer months and is undoubtedly mainly a summer Alga; for the rest it has been met with in the months April to November, in all cases with sporangia. It was most frequently found growing on *Polysiphonia violacea* and *nigrescens*, further on *Ceramium rubrum* a. o. species, *Cystoclonium*, *Zostera*-leaves, *Porphyra umbilicalis* and *Sertularia pumila*.

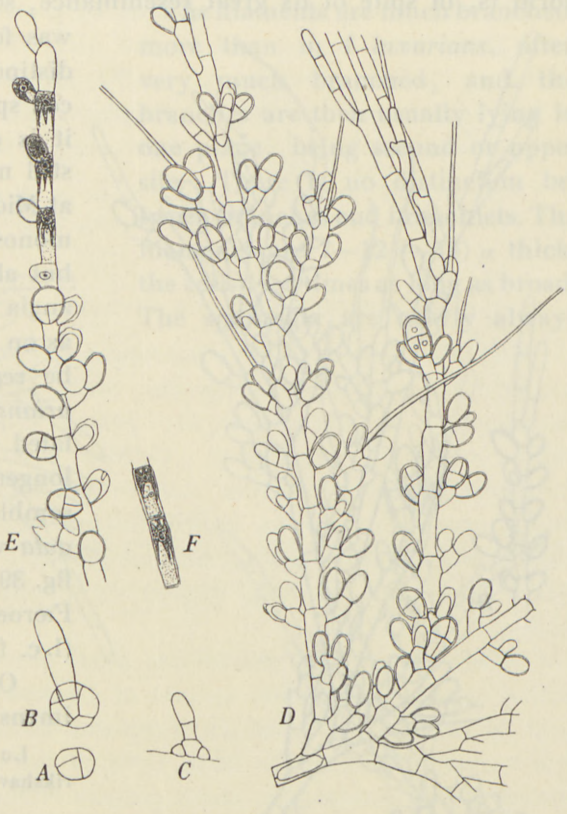

Fig. 38.
Chantransia virgatula β, tetrica. *A*, *B* and *C*, young plants seen from above and from the side. *D*, branched filament with tetrasporangia mostly on opposite branchlets. *E*, filament with sessile tetrasporangia. *F*, two cells showing the chromatophore. 265 : 1.

Localities. **Lf**: Thyborøn Channel, groin no. 63, otherwise not found in the Limfjord. — **Kn**: Harbour of Skagen; Hirsholm; Frederikshavn (Th. Mortensen, !); Nordre Rønner; stony reef by Jegens Odde (GM). — **Ks**: Lysegrund; D, 11,5 meters. — **Sa**: Rønnen in Begtrup Vig; Kalø Rev; AS, Mejlgrund. — **Lb**: Fænø. — **Sb**: Kertinge Vig. — **Sm**: Petersværft; Guldborgsund. — **Su**: BQ, off Ellekilde; Helsingør; Copenhagen. — **Bm**: QP, Kalkgrund; QR, Gyldenløves Flak. — **Bb**: Rønne; off Allinge.

β, tetrica nob.

Filaments (8—) 9—12 μ thick, cells 2—4 diameters long, sporangia on opposite branchlets or sessile on the long filaments, all or partly tetrasporous and then 19—22 μ long, 13—17 μ broad.

The above diagnosis is made after specimens growing on *Porphyra umbilicalis* in the harbours of Skagen and Frederikshavn. They are somewhat more branched than f. *luxurians* and have a little thinner filaments and shorter cells. The sporangia are very numerous and, at least in many specimens, all tetrasporous. They are in a great measure placed on branchlets which are usually opposite, partly also sessile on the sides of the filaments. From the characters mentioned this form is, in spite of its great resemblance, so different from the main form, that I was for some time inclined to regard it as a distinct species, but some other less pronounced specimens have led me to the result that it is closely related to the f. *luxurians* and still more to the f. *secundata*. Thus I found at Middelfart some specimens having chiefly monosporangia, 16—20 μ long, 11—13 μ broad, but also some tetrasporangia, and the sporangia were placed on the filaments as well as on the branchlets. These specimens might be regarded as intermediate between f. *luxurians* and f. *tetrica*, but they were also related to f. *secundata*, differing however by longer cells (3—5 diameters long). The resemblance between the f. *tetrica* and f. *secundata* will be seen on comparing fig. 38 with fig. 39. To this form at least some of the Færoese specimens mentioned by Børgesen (l. c. fig. 53) may be referred.

Fig. 39.
Chantransia virgatula γ, *secundata*. Plants growing on *Porphyra umbilicalis* at Esbjerg. *A* and *B*, branched filaments with monosporangia. *C* and *D*, young plants. 260 : 1.

Only found in summer, the typical specimens growing on *Porphyra umbilicalis*.

Localities. **Kn**: Harbours of Skagen and Frederikshavn. — **Sa**: Middelfart, on *Cladophora*.

γ, *secundata* (Lyngb.).

Callithamnion Dawiesii β, *secundatum* Lyngb. Hydr. p. 129 tab. 41.
Acrochætium secundatum Næg. Beitr. Ceram. p. 405.
Chantransia secundata Thur. in Le Jol. Liste p. 106; Børgesen, M. A. Fær. p. 350; Kuckuck in Oltmanns, Morph. Alg. I p. 650; Kylin (1907) p. 115.

That *Ch. virgatula* and *Ch. secundata* are nearly related and often difficult to distinguish from each other has often been admitted, also by Børgesen and Kuckuck, who think however that for the present they ought be kept distinct (Børgesen l. c. p. 354). I have also wished to regard *Ch. secundata* as a distinct species, but I have ended by referring it as a form to *Ch. virgatula*, as the limit between them, according to my experience, cannot be drawn without arbitrariness. As mentioned above,

tetrasporangia have been found together with monosporangia by earlier authors in this form; I have found the same in Danish specimens in some few cases, but I was then usually in doubt whether the specimens ought to be referred to this or to the foregoing form. They pass really, in my experience, gradually into each other.

The filaments are much branched, more than in f. *luxurians*, often very much branched, and the branches are then usually lying in one plane, being secund or opposite. There is no distinction between branches and branchlets. The filaments are 7—12 (—14) μ thick, the cells 1—3 times as long as broad. The sporangia are nearly always monosporous, (13—) 15—20 (—21) μ long, (9—) 10—14 (—15) μ broad. They are sessile on the sides of the filaments or terminal and lateral on the branchlets. The sporangia as well as the sporangia-bearing branches are often secund, and then situated on the upper, inner side of the branches (fig. 40 *A*), but they may also be opposite or at least situated two on the same cell (figs. 39, 41). The basal layer is

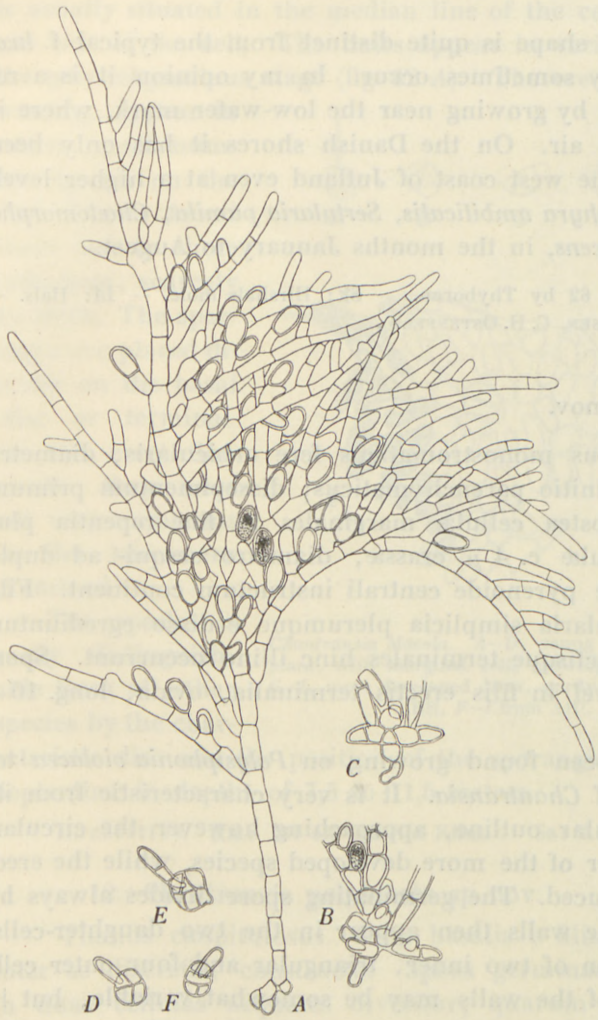

Fig. 40.
Chantransia virgatula γ, *secundata*. Plants growing on *Porphyra umbilicalis* at Thyborøn. *A*, much branched plant with monosporangia. *B* and *C*, basal portions of plants. *D*—*F*, young plants seen from above. 260 : 1.

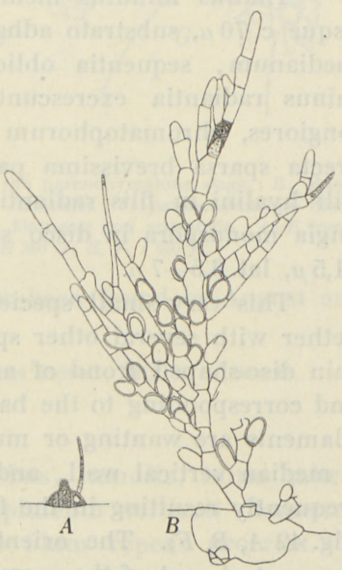

Fig. 41.
Chantransia virgatula γ, *secundata*. Plants growing on *Porphyra umbilicalis* at Thyborøn. *A*, young plant. *B*, plant with monosporangia. 260 : 1.

sometimes proportionally much developed (fig. 41), but like KYLIN I found it always consisting of one layer of cells, while PRINGSHEIM (Beitr. Morph. Meeresalg. p. 26 Taf. VII fig. 2), BØRGESEN and COLLINS (1906 p. 194) found it consisting of two or several layers.

While this form in its typical shape is quite distinct from the typical f. *luxurians*, intermediate specimens may sometimes occur. In my opinion it is a reduced form of the species produced by growing near the low-water mark, where it may sometimes be exposed to the air. On the Danish shores it has only been found at the low-water mark, on the west coast of Jutland even at a higher level. It has been found growing on *Porphyra umbilicalis*, *Sertularia pumila*, *Chætomorpha Melagonium* and *Polysiphonia nigrescens*, in the months January to August.

Localities. Ns: Esbjerg; groin no. 62 by Thyborøn. — Sk: Hirshals mole. — Lf: Hals. — Kn: Frederikshavn, harbour (!, TH. MORTENSEN, C. H. OSTENFELD).

11. **Chantransia Macula** sp. nov.

Thallus minutus membranaceus monostromaticus fere orbicularis, diametro usque c. 70 μ, substrato adhaerens, initio parenchymaticus; dissepimentum primum medianum, sequentia obliqua; postea cellulæ marginales in fila repentia plus minus radiantia excrescunt. Cellulæ c. 4 μ crassæ, diametro sesqui- ad duplo longiores, chromatophorum stellare pyrenoide centrali instructum continent. Fila erecta sparsa brevissima paucicellularia simplicia plerumque e disco egrediuntur. Pili hyalini in filis radiantibus erectisque terminales hinc illinc occurrunt. Sporangia monospora in disco sessilia vel in filis erectis terminalia, ovata, long. 10—11,5 μ, lat. 6,5—7 μ.

This very small species has been found growing on *Polysiphonia violacea* together with several other species of *Chantransia*. It is very characteristic from its thin disc-shaped frond of an irregular outline, approaching however the circular, and corresponding to the basal layer of the more developed species, while the erect filaments are wanting or much reduced. The germinating spore divides always by a median vertical wall, and oblique walls then appear in the two daughter-cells, frequently resulting in the formation of two inner, triangular and four outer cells (fig. 42 *A*, *B*, *F*). The orientation of the walls may be somewhat variable, but in the central part of the more developed discs one or two triangular cells are usually recognizable, thus indicating the place of the first division wall. In some cases one of the primary daughter-cells only is divided by oblique walls (fig. 42 *D*), and more rarely both cells are divided by a wall parallel to the first. The plant keeps for some time its parenchymatous character and a fairly regular outline, often up to the eight-celled stage, but then the marginal cells begin to grow out into creeping filaments which from the first may be rather irregular but later by the increasing number become more regularly radiating, forming a pseudoparenchymatous disc with irregular border formed by the separate ends of the filaments. The

filaments branch laterally from the subterminal cells or by subdichotomous division of the terminal cell (fig. 42 *H*). The cells are somewhat various in shape, usually longer than broad, and contain a stellate chromatophore with central pyrenoid which is usually situated in the median line of the cell, sometimes however nearer to the one side of the cell. The hairs appear in various quantity, sometimes already in the parenchymatous stage (fig. 42 *A*). The erect filaments, if they are not entirely wanting, appear in rather small number spread on the disc; I have found them one to three cells long, scarcely 4 μ thick. The sporangia are placed directly on the basal disc or terminal on the erect filaments; they were not very numerous in the specimens examined.

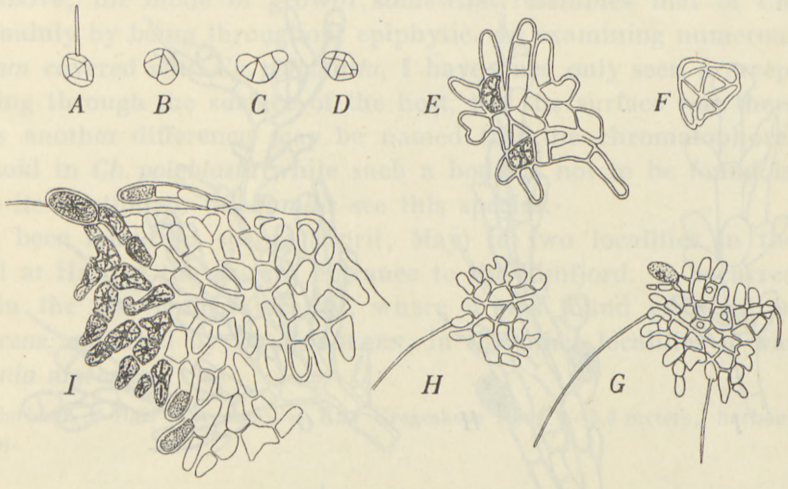

Fig. 42.
Chantransia Macula. *A—D*, young plants in the parenchymatous stage. *E*, older plant, with marginal cells growing out into filaments. *F*, parenchymatous disc. *G—I*, more developed discs, partly with erect filaments and sporangia. *A—E* from BH, *F—I* from AH[1]. *A—D*, *G—H* 390 : 1; *E*, *F*, *I* 630 : 1.

The species is easily distinguishable from all other species by the characteristic disc and the position of the sporangia. It has been found in August and September in depths of 7,5 to 11,5 meters.

Localities. **Km**: BH off Gjerrild Klint. — **Sa**: AH[1] by Fyens Hoved; MQ, S. of Samsø.

12. **Chantransia polyblasta** sp. nov.

Thallus cæspitulosus. Pars basalis e filis repentibus, ramosis, initio saltem inter se discretis, constructa. Spora germinans dissepimento verticali diametrali in duas cellulas aequales dividitur, quarum utraque filum repens procreat. E filo primario lateraliter fila repentia et sursum fila erecta numerosa per totam longitudinem egrediuntur. Fila erecta usque ad c. 270 μ longa, maxima ex parte brevia, longiora ramosa, ramis ramulisque numerosis in quoque articulo singula vel bina, ramis majoribus eodem modo ramosis. Pili hyalini apicibus filorum et ramulorum impositi occurrunt. Cellulæ 7—10 μ crassæ, diametro 2—3 (—4)-plo longiores, chromatophorum stelliforme, pyrenoide centrali instructum, continentes. Sporangia tetraspora, ovata, (16—) 18—21 μ longa, 10—12 μ lata, in filis erectis primariis vel in ramis lateralia vel terminalia, lateralia sessilia vel in ramulis unicellularibus vulgo singula.

In its mode of growth this species resembles the species *Ch. Dumontiæ* and *Ch. cytophaga* described below. The germinating spore divides, as in these, into two equal cells giving rise to two creeping filaments growing out in opposite directions and giving off new creeping filaments which appear to be later confluent into a pseudoparenchymatous disc in the central part of the basal layer. Usually one erect filament is given off from each of the cells of the basal layer, the outer as well as the inner, and not rarely the same cell gives off two filaments, the one behind the other (fig. 43 *E*, *F*). Most of the filaments attain only a small size and remain unbranched, but some of them grow out and become much branched. The most vigorous filaments are much and repeatedly branched; usually each cell bears one or two branches, long filaments or branchlets, but there is no distinction between these two kinds of branches, as transitions between them frequently occur. When two branches are borne by the same cell, they are very often not opposite but placed near each other on the same side of the cell. In fig. 43 *E*, *F* the last cell of the creeping filament is seen to be somewhat raised above the substratum and ends in a hair. Transitions between creeping and erect filaments thus appear to occur; however, I have never seen the transformation of a creeping filament into a true erect one. The cells are cylindrical, by ramification frequently a little broader at the upper end. The stellate chromatophore contains a distinct central pyrenoid.

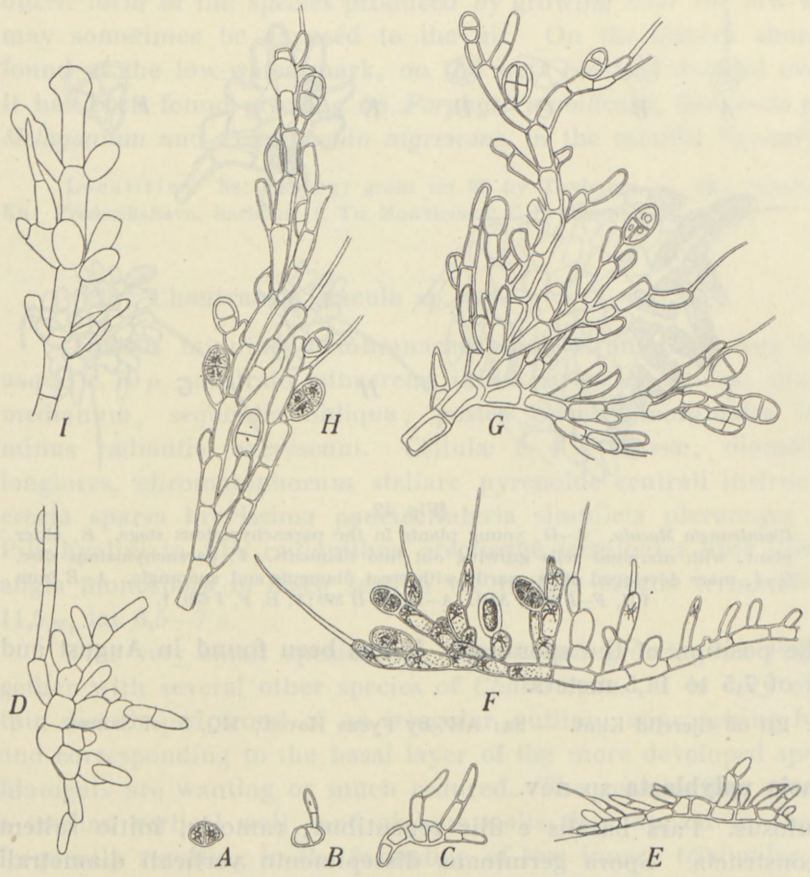

Fig. 43.

Chantransia polyblasta. (From Hals). *A*—*C*, young plants seen from above. *D*, more developed plant seen from above. *E*, *F*, plants seen from the side with short erect filaments. *G*, *H*, more developed, branched erect filaments, *I*, end of erect filament. *A*—*C*, *E*—*H* 300:1, *D*, *I* 390:1.

The sporangia are very often sessile on the sides of the filaments; the same cell then also bears frequently a branch or a branchlet, or it may bear up to four lateral organs (fig. 43 *I*). But the sporangia may also be terminal on the filaments or on one-celled branchlets. It also sometimes happens that the sporangia are produced directly by the creeping filaments. The sporangia are always tetrasporous; monosporangia were never observed.

As mentioned above, the mode of growth somewhat resembles that of *Ch. Dumontiæ*; it differs mainly by being throughout epiphytic. In examining numerous sections of *Cystoclonium* covered with *Ch. polyblasta*, I have once only seen a creeping filament penetrating through the surface of the host, but the surface was there evidently injured. As another difference may be named that the chromatophores have a distinct pyrenoid in *Ch. polyblasta* while such a body is not to be found in *Ch. Dumontiæ*. As to its relation to *Ch. humilis* see this species.

The species has been found in spring (April, May) in two localities in the northern Kattegat and at Hals at the eastern entrance to the Limfjord. It occurred in greatest quantity in the last named locality, where it was found growing on *Cystoclonium purpurascens*, collected by Dr. Børgesen; in the other localities it was growing on *Polysiphonia nigrescens*.

Localities. Lf: Harbour of Hals (Børgesen). — Kn: Krageskovs Rev, 4—5,5 meters; harbour of Frederikshavn (Børgesen).

13. **Chantransia humilis** sp. nov.

Thallus pulvinatus. Pars basalis e filis repentibus ramosis breviarticulatis in parte centrali demum confluentibus, constructa. Spora germinans in duas cellulas æquales divisa est, quarum utraque filum repens procreat. E filis primariis lateraliter fila repentia et superne fila erecta numerosa per totam longitudinem, e quaque cellula 2—3, egrediuntur. Fila erecta brevia, 2—4-cellularia, c. 60 μ alta, simplicia; cellulæ apicem versus sensim incrassatæ, superne 5,5—7 μ crassæ, diametro 2—3-plo longiores, chromatophorum axile, pyrenoide centrali instructum continentes. Pili hyalini apicales crebri. Sporangia monospora ovata vel oblonga, long. 11—14 μ, lat. 7 μ, in filis erectis terminalia vel lateralia.

In its mode of growth and the structure of the cells this species somewhat resembles *Ch. polyblasta*, from which it differs however by its short, unbranched, erect filaments and by the smaller, monosporous sporangia. The basal layer develops as in the species named; as shown in fig. 44 *D*, the germinating spore is nearly globular, much higher than the primary creeping filaments, and the two primary cells are for a long time recognizable from the other cells in the basal layer. In fully developed plants the creeping filaments are more or less confluent in the inner part of the plant; the cells are there usually short, roundish, 7—9 μ broad. The formation of the erect filaments begins as a rule when the basal layer is two-celled (fig. 45) but I have in some cases seen an erect filament given off from a basal cell still undivided. Hyaline hairs frequently occur at the end of the

erect filaments, more rarely at the sides of them. It appears that the usual displacement of the originally terminal hairs occurs also in this species, but that the hairs soon disappear; the fact that the upper end of the cells is usually prominent at one side is in accordance with this supposition. The hairs may appear already in the two-celled stage of the plants (fig. 44 *C*). The erect filaments seem to be always unbranched; their great number in conjunction with their small size give the plant a pulvinate appearance. The cells of the erect and creeping filaments, as well as the sporangia, contain a stellate chromatophore giving off a number of branches towards the periphery. The species has hitherto only been found in one locality, growing on *Polysiphonia nigrescens* in May.

Locality. Sb: pier at Spodsbjerg, Langeland.

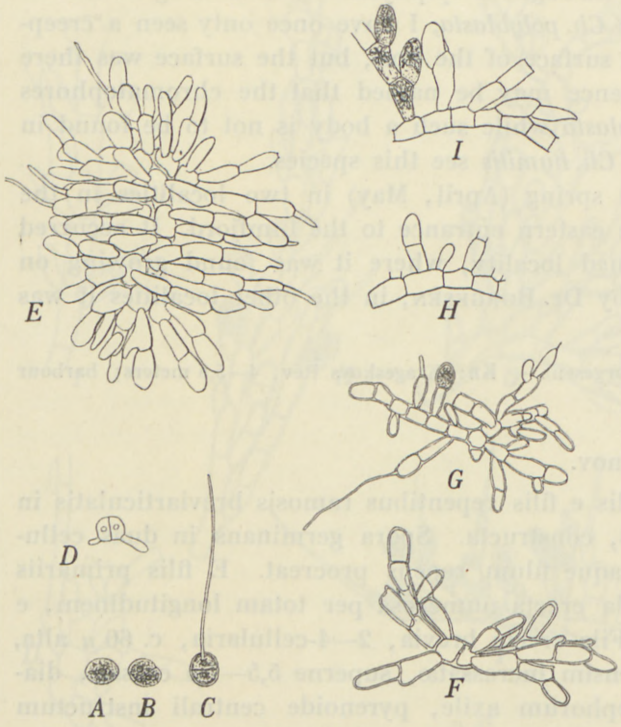

Fig. 44.
Chantransia humilis. *A*—*C*, germinating plants, *C* with a hair. *D*, the two first creeping filaments are given off; the pyrenoids are shown. *E*, adult plant seen from above. *F*, *G*, plants seen from above, *G* with sporangium. *H*, *I*, plants seen in vertical section, *I* with lateral sporangia. *A*—*F*, *H*, *I* 390 : 1. *G* 300 : 1.

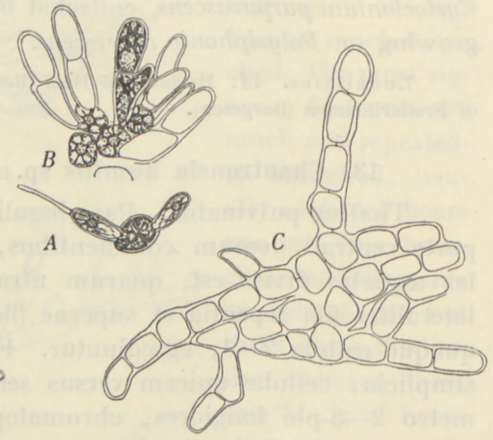

Fig. 45.
Chantransia humilis. *A*, young plant, seen from above. *B*, part of a plant showing the basal layer and erect filaments with terminal sporangia. *C*, basal layer seen from below. 560 : 1.

14. **Chantransia leptonema** sp. nov.

Thallus minutus e filis repentibus et filis erectis numerosis constructus. Fila repentia irregularia, lateraliter ramosa, plerumque ut videtur inter se libera, cellulis plus minus tumidis, lat. 3—4 μ, diametro sesqui- ad triplo longioribus. Spora germinans discum parenchymaticum serius in fila repentia excrescentem gignit. Fila erecta simplicia vel parce ramosa, usque ad 300 μ longa, 3—4 μ lata, cellulis diametro duplo ad 5-plo longioribus, cylindraceis vel, in cellulis brevibus, leviter tumidis, chromatophorum cylindraceum pyrenoide centrali munitum continentibus.

Pili hyalini terminales occurrunt. Sporangia monospora (et tetraspora?) in filis primi et secundi ordinis lateralia vel terminalia, plerumque sparsa, unilateraliter seriata, rarius opposita, nonnunquam in ramulis unicellularibus bina vel solitaria, etiam in filis repentibus sessilia, ovata, long. 10—12,5 μ, lat. 5,5—6,5 μ.

The above diagnosis is essentially made after specimens growing on *Chondrus crispus* found at Hanstholm, on which it formed a fine felted covering. One erect filament is usually given off from each cell in the creeping filaments, except the outermost ones. In the most developed erect filaments the cells are cylindrical, usually 3—4 diameters long (up to 17 μ long), while in shorter filaments and in the fructiferous parts of the longer the cells are shorter and often somewhat swollen. The shape of the chromatophore was not easily discernible, as I had only dried material at my disposal; in some cases, however, a chromatophore was visible, consisting of a cylindrical parietal plate and an axile part containing a central pyrenoid lying in the upper part of the cell (fig. 47 *A*). Most of the erect filaments attain only a small size and remain unbranched, but some grow longer and may then bear one or some few vegetative branches. Terminal hairs frequently occur and may give rise to sympodial branching. The sporangia are in great measure lateral on the erect filaments and then as a rule seriate, a position which often causes a recurvation of the filament (fig. 46 *A*, *G*). The sporangia are more rarely opposite, but they are frequently terminal, in the long filaments as well as in the very short (figs. 46, 47); in the specimens from Hanstholm sporangia sitting directly on the creeping filaments were not observed. Sporangia borne on unicellular branchlets also occur, one sporangium being terminal, the other lateral (fig. 46 *B*, *C*). The long filaments are only sporangia-bearing in their upper part. The sporangia are only a little varying in shape and size, nearly twice as long as broad. They appear to be

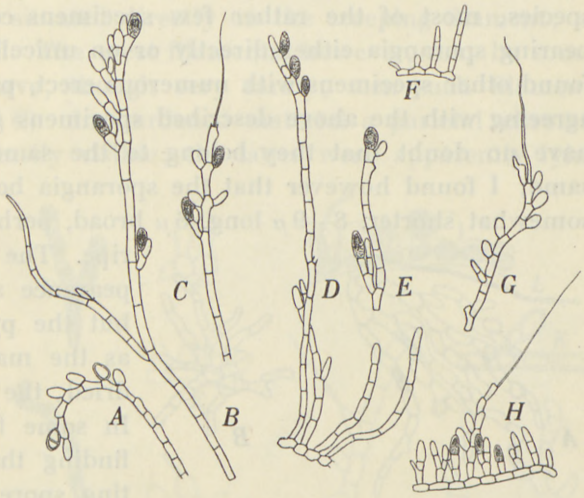

Fig. 46.
Chantransia leptonema (Hanstholm). *A*—*C*, *E*, *G*, erect filaments with sporangia. *D*, *F*, *H*, creeping filaments with erect filaments. 300 : 1.

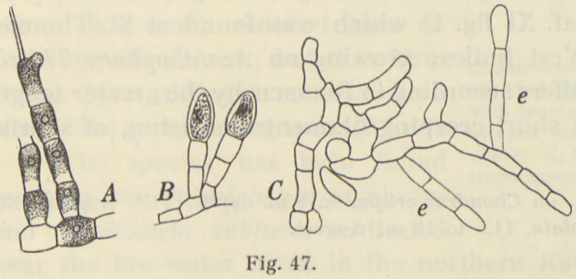

Fig. 47.
Chantransia leptonema (Hanstholm). *A* and *B*, fragments of creeping filaments with short erect filaments. *C*, creeping filaments seen from below and two erect filaments, *e*. 620 : 1.

usually monosporous; in some cases, however, the contents seemed to be divided into two or four parts (fig. 46 *A*), but conclusive observations were not arrived at.

On *Polysiphonia urceolata* dredged near Hirshals I have found, growing in company with other interesting Algæ (*Erythrocladia irregularis* and *subcontinua, Chantransia emergens*), a small *Chantransia* which I believed at first to be a different species, most of the rather few specimens consisting only of creeping filaments, bearing sporangia either directly or on unicellular stalks (fig. 48). Later however I found other specimens with numerous erect, partly sporangia-bearing filaments fully agreeing with the above described specimens growing on *Chondrus*, and I therefore have no doubt that they belong to the same species. The dimensions were the same; I found however that the sporangia borne directly on the basal layer were somewhat shorter, 8—9 μ long, 6 μ broad, perhaps only because they were not fully ripe. The chromatophore showed the same appearance as in the specimens from Hanstholm, but the pyrenoid appeared not to be central; as the material from both localities was only dried, the question must however be left open. In some fairly juvenile plants I succeeded in finding that the first divisions of the germinating spore take place in a similar manner as in *Ch. virgatula*, three peripheral cells being cut off round an inner triangular cell (fig. 48 *B*).

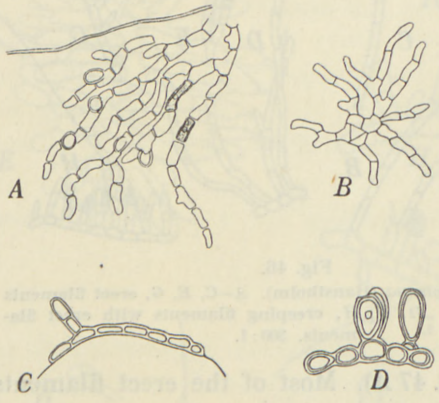

Fig. 48.
Chantransia leptonema. (From XO). *A*, creeping filaments on the surface of *Polysiphonia urceolata*, bearing sporangia. *B*, fairly young plant seen from above. *C* and *D*, plants seen in vertical section, *D* with sporangia. *A*—*C* 390 : 1. *D*, 730 : 1.

This species appears to be distinct from all hitherto described species especially by its mode of growth and its slight thickness. *Ch. chiloensis* Reinsch (Contrib. ad Alg. et Fung. Vol. I 1877 p. 37 Taf. XI fig. 1) which was found at St. Thomas, West Indies, growing on *Acanthophora Thierii*, differs according to Reinsch by the greater length and thickness of the filaments, by the short creeping filaments consisting of shorter cells and by broader sporangia.

Localities. **Sk**: Hanstholm, Roshage, on *Chondrus crispus* in 2 m. depth, YU[4], August; XO, Møllegrund off Hirshals, on *Polysiphonia urceolata*, 11,5 to 15 m., August.

15. **Chantransia reducta** sp. nov.

Thallus filiformis ramosus repens substrato affixus. Spora germinans in cellulas duas divisa est quarum utraque filum repens procreat. Cellulæ filorum repentium leviter tumidæ, c. 4 μ crassæ, longitudine diametro fere æquali vel sæpius duplo longiores, chromatophorum parietale, pyrenoide fere axili munitum, continentes; utraque cellula demum superne sporangium aut filum brevissimum gerens. Fila erecta 1—3-cellularia simplicia, rarissime ramosa, 4,5—6 μ lata, cellulis diametro fere æquilongis vel paullo longioribus, nonnunquam pilum hyalinum apicalem

brevem gerentia. Sporangia monospora in filis repentibus sessilia aut in filis erectis terminalia, ovata vel subsphærica, long. 7—9,5 μ, lat. 5,5—7,5 μ.

The erect filaments are extremely reduced in this species; only in *Ch. Macula* among the epiphytic species here mentioned are they as much reduced. In most cases the reduction process is carried so far that the erect filament has completely disappeared, and the sporangium is situated directly on the creeping filament, or it is represented by a single stalk-cell. The erect filaments, however, may be sometimes two- or three-celled, and I have, though very rarely, seen such filaments bearing a unicellular branch (fig. 49 *C*). In hardened material a parietal chromatophore with a large pyrenoid was easily visible; the latter were apparently lying in the median line of the cell, but were, in some cases at least, certainly excentric (fig. 49 *A*, *B*). The two cells resulting from the division of the germinating spore remain easily recognizable by their greater breadth and rounded outline (fig. 49 *A*, *G*, *H*, *I*). In this mode of germination the species recalls *Ch. humilis* (p. 117) which has also little developed erect filaments, but this species differs by its greater dimensions, by two or three erect filaments given off from each cell in the basal layer, and by stellate chromatophores. The *Ch. leptonema* just described may also occur in a much reduced form resembling *Ch. reducta*; but that form differs by a different mode of division of the germinating spore (fig. 48).

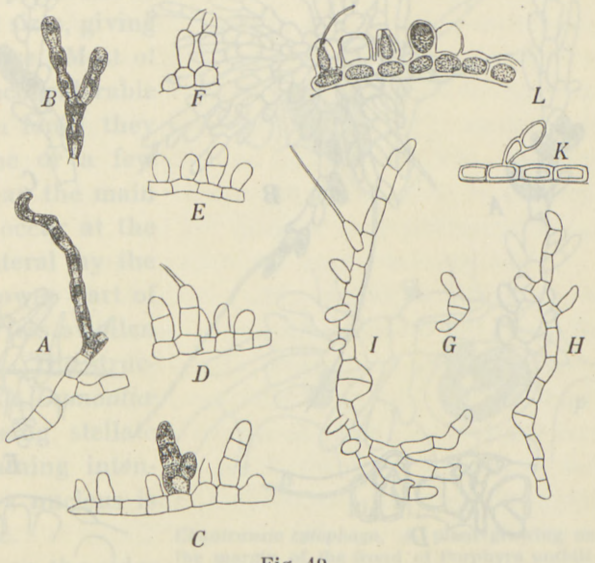

Fig. 49.
Chantransia reducta. *A* and *B* (Frederikshavn), creeping filaments showing the chromatophores. *C*—*F*, plants in vertical section with sporangia. *G*, young plant seen from above. *H*, more developed plant seen from the under side. *I*, plant seen from above. *K*, fragment of plant in vertical section, with a stalked sporangium. *L*, fragment of plant with sessile sporangia, in vertical section. *C*—*L* from GM. 560:1.

The species has been found growing on *Polysiphonia nigrescens* and *Rhodomela subfusca* collected near the low-water mark in the northern Kattegat, in July and September.

Localities. **Kn**: Hirsholm; harbour of Frederikshavn; dry rock near Jegens Odde (GM).

Group III. Frond partly or entirely endophytic.

16. **Chantransia cytophaga** sp. nov.

Thallus cæspitosus, ad 0,2 mm. altus, e filis 1^0 repentibus plantæ hospiti affixis, 2^0 erectis sporangiferis et 3^0 endophyticis constructus. Spora germinans dissepimento verticali in duas cellulas divisa est quarum utraque filum horizontale

procreat. E filis primariis lateraliter fila repentia, subtus fila endophytica et superne fila erecta numerosa egrediuntur. Fila endophytica brevia ramosa, in cellulas hospitis penetrantes. Fila erecta simplicia vel parce ramosa, 7—10 μ lata, apicem versus paullo attenuata. Cellulæ diametro fere duplo longiores, superne vel medio tumidæ, chromatophorum stelliforme, ut videtur sine pyrenoide, in parte superiori cellulæ situm continentes. Pili hyalini adsunt. Sporangia in filis lateralia, sessilia, in utroque articulo plerumque 2—3, monospora aut tetraspora, ovata vel ellipsoidea, latitudine fere duplo longiora, monospora (11—) 13—17 μ longa, 7,5—8 μ lata, tetraspora c. 19 μ longa, 10 μ lata.

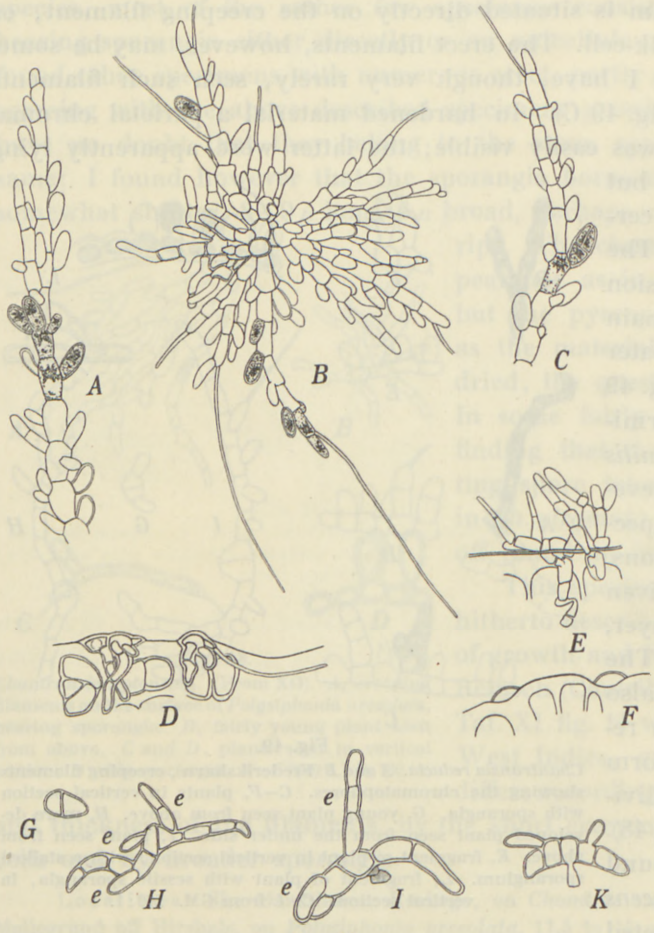

Fig. 50.

Chantransia cytophaga. *A*, Filament with monosporangia. *B*, plant seen from above. *C*, filament with tetrasporangium. *D*, young plants fastened to the margin of the frond of Porphyra. *E*, transverse section of Porphyra with the parasite. *F*, two spores on the point of germinating on the margin of the Porphyra. *G*, two-celled plant. *H*, more developed plant with three erect filaments, *e*. *I* and *K*, plants with two erect filaments and haustorium. *A*—*G* 300 : 1. *H*—*K* 400 : 1.

This species forms small cushions on the margin and at a small distance from the margin of the frond of *Porphyra umbilicalis*. It reminds one in its mode of growth as well as in other respects of *Ch. Dumontiæ* but is smaller. The basal layer develops as in *Ch. polyblasta* and *Ch. humilis* and finally consists of filaments radiating on all sides though often rather irregularly, and it sometimes happens that one filament is growing over another (fig. 50 *D*). When the *Chantransia* is situated on the margin of the *Porphyra*, the filaments make their way on both sides of the flat frond. From some of the cells in these filaments are given off haustorial filaments penetrating into the host. The place of the endophytic filaments is indistinct, but they appear to be mainly given off from the central part of the basal layer. They make their way through the outer wall of the host and penetrate into the nearest cell, the protoplasm of which is more or less displaced by the intruding haustorium (fig. 51). As shown in fig. 51 *A* two haustoria may some-

times penetrate into one cell. The filaments often branch within the host cell, and some of the branches may again become free, growing outwards through the wall of the host, and the same occurs with endophytic filaments without branching (in fig. 51 the free endings of the haustorial filaments are not shaded). As far as I have observed, these filaments do not penetrate from one cell into another, and therefore do not serve as propagating organs. The protoplasm of the host cell is more or less shrunk and evidently yields nourishment to the *Chantransia* which is thus a veritable parasite.

A great number of erect filaments are given off from the creeping filaments, from the peripheral part as well as the central. As new erect filaments are constantly produced, a fully developed plant shows numerous erect filaments of different sizes, giving the plant a cushion-shaped appearance. Most of these filaments attain only an inconsiderable length, the greatest are about 200 μ long; they are either unbranched or bear one or a few branches which are much shorter than the main filament. Hyaline hairs frequently occur at the ends of the filaments, becoming lateral by the continued growth of these. In the lower part of the filaments the cells are more or less swollen at their upper ends or in the middle. The structure of the cell is the same as in *Ch. Dumontiæ* (see p. 124), the chromatophore being stellate without pyrenoid, while a body staining intensely by hæmalum and undoubtedly a nucleus is to be seen under the chromatophore.

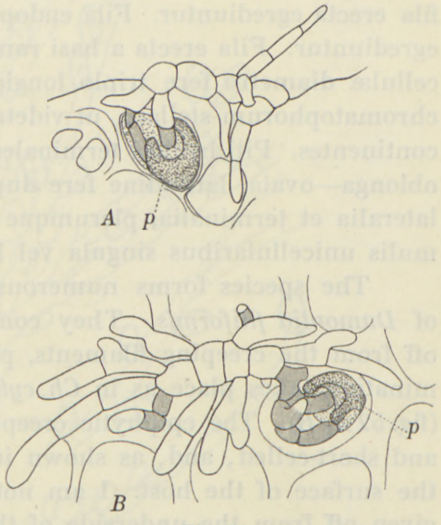

Fig. 51.
Chantransia cytophaga. *A*, plant growing on the margin of the frond of Porphyra umbilicalis, to the left two haustoria penetrating into the same cell. *B*, plant growing on the flat side of the frond seen from above, showing three haustorial filaments. The endophytic filaments are shaded, their free emerging ends are white; *p*, protoplasm of the host cell. 550 : 1.

The sporangia are always sessile on the sides of the erect filaments, in their whole length. From the first each cell bears one sporangium, but very soon one or two others appear, and each cell bears thus usually two or three sporangia, the two being as a rule opposite. The latest formed sporangium is sometimes seated at a lower level than the other, near the middle of the cell. Terminal sporangia were not observed. Nearly all the sporangia were monosporous, very few tetrasporous; the latter were somewhat larger than the other. Possibly some of the undivided sporangia were unripe tetrasporangia; I imagine, however, that most of them were really monosporangia.

The structure of the cell and the mode of growth bring this species near to *Ch. Dumontiæ*; it differs from it in particular by the intracellular haustoria, by shorter, less branched erect filaments, by shorter cells and by the want of terminal

sporangia. *Ch. polyblasta* and *Ch. humilis* differ by the want of endophytic filaments and by the presence of a distinct pyrenoid.

Locality. Su: Only found at Helsingør, growing on *Porphyra umbilicalis* on the outer side of the southern mole in September.

17. **Chantransia Dumontiæ** sp. nov.

Thallus cæspitulosus ad 0,5 mm. altus, e filis 1^0 horizontalibus epiphyticis 2^0 erectis ramosis sporangiferis et 3^0 endophyticis constructus. Spora germinans dissepimento verticali diametrali in duas cellulas æquales divisa est quarum utraque filum horizontale procreat. E filis primariis lateraliter fila repentia et superne fila erecta egrediuntur. Fila endophytica intercellularia ex parte saltem e filis erectis egrediuntur. Fila erecta a basi ramosa, ramis numerosis sparsis plus minus ramosis; cellulæ diametro fere triplo longiores, superne 6,5—9 μ crassæ, inferne tenuiores, chromatophorum stellare, ut videtur sine pyrenoide, in parte superiori cellulæ situm continentes. Pili hyalini terminales vel pseudolaterales adsunt. Sporangia tetraspora oblonga—ovata, latitudine fere duplo longiora, 15—19 μ longa, 8—11 μ lata, in filis lateralia et terminalia, plerumque sessilia, sparsa vel opposita, nonnunquam in ramulis unicellularibus singula vel bina.

The species forms numerous small, dark-purple tufts or cushions on fronds of *Dumontia filiformis*. They consist of numerous erect branched filaments given off from the creeping filaments, partly also from the endophytic threads. The germination takes place as in *Ch. cytophaga* and others of the above described species (fig. 52 *A*, *B*). The epiphytic creeping filaments are often somewhat irregular, thick and short-celled, and, as shown in fig. *E*, they are not always densely attached to the surface of the host. I am not able to say if the first endophytic filaments are given off from the underside of the creeping filaments or not. At all events endophytic filaments are also given off from the base of the erect filaments (fig. *D*). The endophytic filaments are much branched growing intercellulary in the host, and free erect filaments may again be given off from them through the surface of the frond. I believe that this may take place also at a greater distance from the point of departure of the endophytic filaments, these thus serving to propagate the *Chantransia* in the host. The free filament shown in fig. *D* has probably emerged from the endophytic one. It appears that relatively few endophytic filaments are given off in the same cushion.

The erect filaments arise in great number from the creeping filaments, from their peripheral as well as their central parts, and the plant forms therefore tufts or cushions of $^1/_2$—1 mm. in diameter. These filaments are fairly strongly branched, as a rule from the base, and often a branch is given off from each cell in a great part of the primary filaments, and the branches may also be branched. The cells are usually broader at the upper end than below, depending on the abundant ramification. In the central part of the stellate chromatophore I was not able to detect any pyrenoid staining stronger with hæmalum than the remaining substance

of the chromatophore, while the nucleus, lying under the chromatophore but near the periphery of the cell, more rarely at the same level as the chromatophore, was very intensely stained by this reagent.

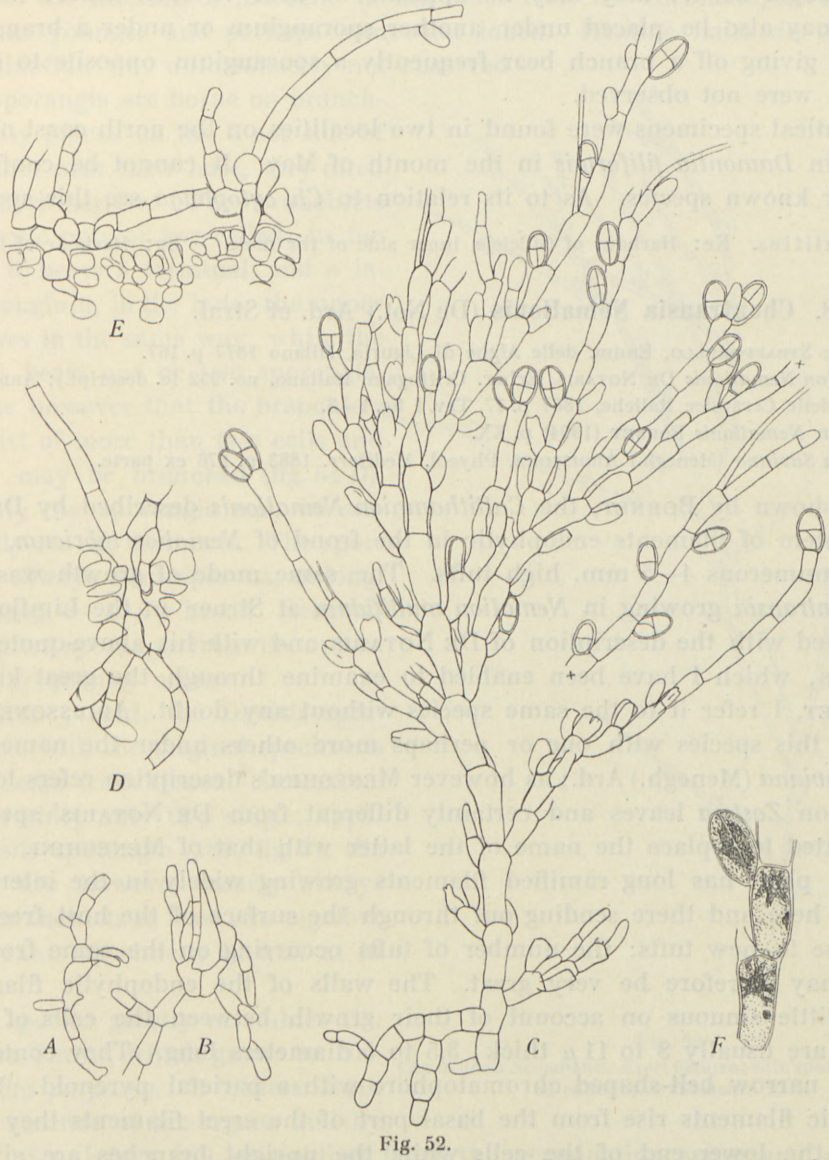

Fig. 52.

Chantransia Dumontiæ. *A* and *B*, young plants seen from above. *C*, plant with tetrasporangia, below horizontal and descending filaments. *D* and *E*, transverse sections of Dumontia with Chantransia, showing endophytic, horizontal and erect filaments of the latter. *F*, two cells and a sporangium, the cells showing chromatophore and nucleus. A—E 390 : 1, F 550 : 1.

The sporangia are most frequently sessile on the sides of the filaments, or they are placed on unicellular branchlets singly or two together, or lastly they

may be terminal on the long branches. From the first the cells bear usually only one sporangium or a sporangium-bearing branchlet, but later further sporangia may develop so that a great number of the cells bear two or three sporangia. When two sporangia occur, they may be opposite or near to each other, but a sporangium may also be placed under another sporangium or under a branch (fig. *C*). The cells giving off a branch bear frequently a sporangium opposite to it. Monosporangia were not observed.

Identical specimens were found in two localities on the north coast of Sealand, growing in *Dumontia filiformis* in the month of May. It cannot be confused with any other known species. As to its relation to *Ch. cytophaga* see this species.

Localities. Ke: Harbour of Gilleleje, inner side of the mole. — Su: Harbour of Helsingør.

18. **Chantransia Nemalionis** (De Not.) Ard. et Straf.

Ardissone e Strafforello, Enum. delle Alghe di Liguria, Milano 1877 p. 167.
Callithamnion Nemalionis De Notaris, Erbar. Crittogam. Italiano, no. 952 (c. descript.); Ardissone, Prospetto delle Ceramiee italiche, 1867 p. 17, Tav. I fig. 1—3.
Acrochætium Nemalionis Bornet (1904) p. XX.
Chantransia Saviana (Menegh.) Ardissone, Phycol. Mediterr. 1883 p. 276 ex parte.

As shown by Bornet, the *Callithamnion Nemalionis* described by De Notaris has a system of filaments endophytic in the frond of *Nemalion lubricum*, on which it forms numerous 4—5 mm. high tufts. The same mode of growth was observed in a *Chantransia* growing in *Nemalion multifidum* at Struer in the Limfjord. As it fully agreed with the description of De Notaris and with his above-quoted original specimens, which I have been enabled to examine through the great kindness of Dr. Bornet, I refer it to the same species without any doubt. Ardissone has later confused this species with one or perhaps more others under the name of *Chantransia Saviana* (Menegh.) Ard.; as however Meneghini's description refers to a species growing on *Zostera* leaves and certainly different from De Notaris' species, it is unwarranted to replace the name of the latter with that of Meneghini.

The plant has long ramified filaments growing widely in the interior of the host and here and there sending out through the surface of the host free filaments giving rise to new tufts; the number of tufts occurring on the same frond of *Nemalion* may therefore be very great. The walls of the endophytic filaments are often a little sinuous on account of their growth between the cells of the host; the cells are usually 8 to 11 μ thick, 3,5 to 5 diameters long. They contain in the middle a narrow belt-shaped chromatophore with a parietal pyrenoid. When the endophytic filaments rise from the basal part of the erect filaments they are given off from the lower end of the cells while the upright branches are given off at their upper end, and a similar polarity is as a rule, though not always, present in the endophytic filaments (fig. 54 *A*).

The erect filaments greatly resemble those of *Ch. corymbifera* and *Ch. Thuretii*; they form up to 5 mm. high tufts with spread branches which are multilateral but

with some tendency to unilaterality. The cells are cylindrical, not constricted at the transverse walls, (7,5—) 9—11 (—12) μ broad, 3—7, usually 4—5 diameters long. They contain a parietal chromatophore with a large parietal pyrenoid much projecting into the interior of the cell. In the older cells the chromatophore is larger than in the younger and perhaps somewhat lobed. Hyaline hairs do not occur. The germination was unfortunately not observed.

The sporangia are borne on branchlets, usually placed on the inner side of the branches near their base, very often two or three seriate. The branchlets are as a rule one- or two-celled; in the first case it bears a terminal and a lateral sporangium, in the latter the upper cell behaves in the same way, while the lower cell bears one or two sporangia. It happens however that the branchlets may consist of more than two cells and that they may be branched (fig. 54 *D*). Only rarely the sporangia may be sessile directly on the filaments. The sporangia are always monosporous, oblong, 18—19 μ long, 9—10,5 μ broad. Renewal of the emptied sporangia from the underlying cell frequently occurs.

As already said, the Danish specimens agree with the original specimens of De Notaris from Genoa. Ardissone figures certainly only two single, apparently sessile sporangia (1867 fig. 3); the sporangia are however nearly always borne on branchlets at least two together in De Notaris specimens as well as in mine.

Fig. 53.
Chantransia Nemalionis. Erect filament with sporangia, below an endophytic filament. 95 : 1.

This species greatly resembles *Ch. corymbifera* Thur.[1], which grows on *Helminthocladia purpurea*. It differs from it by the absence of sex-organs and by the want of a larger cell originating from the germinating spore and giving off erect filaments and descending endophytic filaments. In spite of repeated search I have never found such a cell and that is in accordance with Bornet's statement

[1] G. Thuret in Le Jolis Liste p. 107; Bornet et Thuret, Not. alg. I p. 17 pl. V; Bornet 1904, p. XX.

that the cell rising from the germinating spore is not different from the cells which it produces. To judge from the figures of BORNET and THURET the sporangia become a little larger in *Ch. corymbifera* than in *Ch. Nemalionis*, namely up to 22 μ long. It is interesting that this species hitherto only known from the Mediterranean and the Gulf of Gascony has been found in the Limfjord, a water with relatively high salinity and summer temperature.

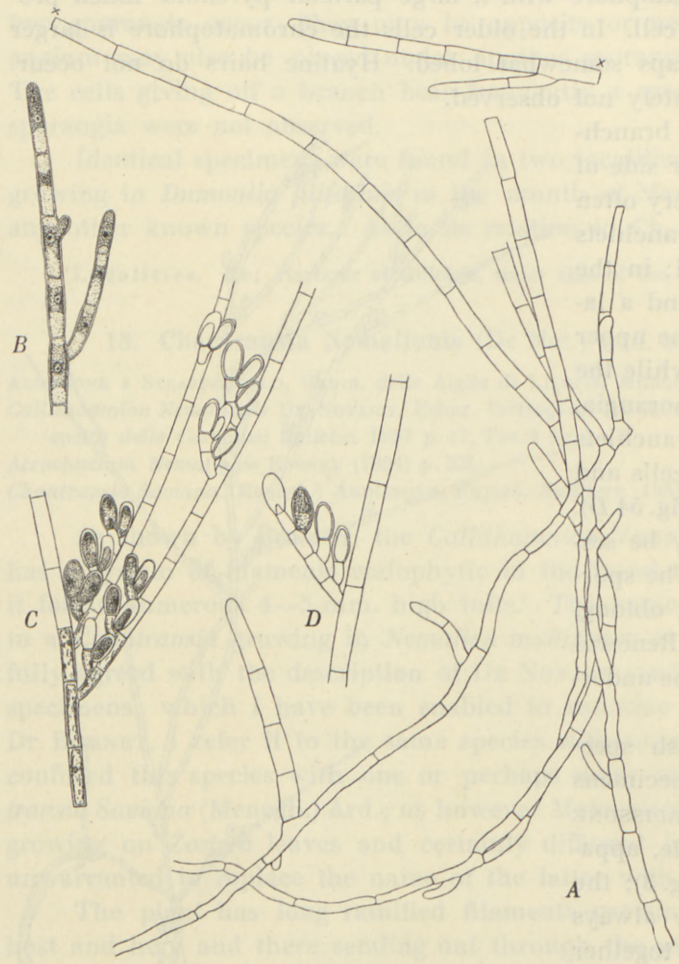

Fig. 54.
Chantransia Nemalionis. *A*, endophytic filaments giving off a number of erect filaments. *B*, upper end of erect filament showing chromatophores with pyrenoid. *C* and *D*, filaments with sporangia-bearing branchlets. 200 : 1.

Locality. Lf: Struer, outer side of the mole, September.

19. **Chantransia endozoica** Darbish.

O. V. DARBISHIRE, Chantransia endozoica Darbish., eine neue Florideen-Art. Ber. deutsch. bot. Ges. 1899, Bd. 17 p. 13 Tafel I.

The greater part of the frond of this species grows in the thick outer wall of the Bryozoan *Alcyonidium gelatinosum*. The endozoic filaments are dichotomously branched and give off numerous free, short, branched fertile filaments bearing monosporangia. I have only met with very few specimens and must therefore content myself by referring to the above-quoted paper of DARBISHIRE. I regret that I am not able, any more than this author, to give information on the form and structure of the chromatophore. The sporangia were 13,5—17 μ long, 9—10 μ broad.

Locality. Sk: In a specimen of *Alcyonidium gelatinosum* washed ashore on the beach of Hirshals, August, with ripe sporangia.

20. **Chantransia emergens** sp. nov.

Fila vegetativa endophytica infra cuticulam hospitis (*Polysiphoniæ urceolatæ*) horizontaliter expansa, ramosa, ramis sparsis vel oppositis, sub angulo recto plerumque

egredientibus, cellulis subcylindricis medio vel paullo supra medium plus minus inflatis, 6—10,5 μ longis, 2—3,5 μ latis. Chromatophorum ut videtur, unicum parietale pyrenoide instructum. Pili hyalini desunt. Monosporangia extra cuticulam emergentia solitaria breviter stipitata, stipite unicellulari, rarius in filis endophyticis sessilia, ovata, 5—6,5 μ longa, 3—4 μ lata.

In a specimen of *Polysiphonia urceolata* dredged in the Skagerak off Hirshals

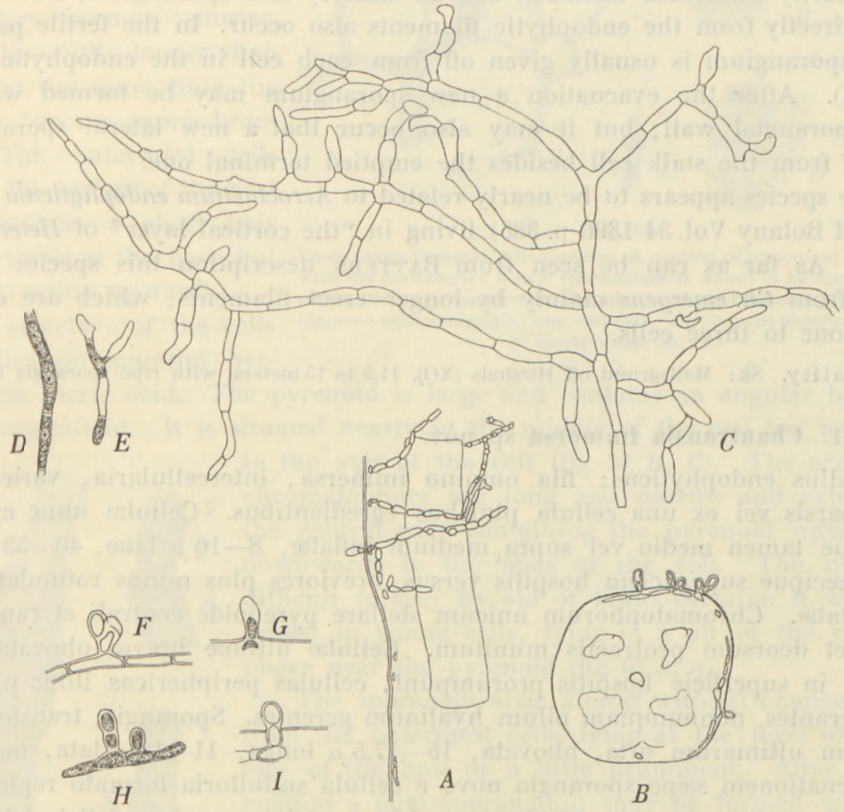

Fig. 55.

Chantransia emergens. *A*, filaments growing under the cuticle of the host, seen partly from the face partly in profile (at left); a pericentral cell of Polysiphonia is shown. *B*, transverse section of Polysiphonia with the endophyte. *C*, endophytic filaments. *D* and *E*, cells showing the chromatophore and the supposed pyrenoid. *F*—*I*, filaments with sporangial branchlets seen in profile, in *G* an emptied sporangium, in *F* a new sporangium is formed besides an emptied one. *A*—*B* 290 : 1, *C*—*I* 610 : 1.

this little species was found rather abundantly, growing in the outer wall close within the cuticle but never penetrating into the radial walls between the pericentral cells. The filaments are very thin, the cells very thin-walled, usually 3—5 diameters long; they were in the dried specimens, the only ones I examined, uniformily rose-coloured and seemed to contain a parietal chromatophore occupying the greater part of the periphery of the cell. In the middle or somewhat over

the middle of the cell a body staining in hæmalum is visible, probably a pyrenoid. The branches are given off at a certain distance from the acroscopic transverse wall, sometimes from the middle of the cell or even, though rarely, a little under the middle. All the vegetative branches are given off in a plane parallel to the surface of the host, while the extremely short fertile branchlets break through the cuticle in a direction perpendicular to that plane. These branchlets consist of a short partly immersed stalk-cell and an entirely free sporangium, but sporangia arising directly from the endophytic filaments also occur. In the fertile part of the plant a sporangium is usually given off from each cell in the endophytic filament (fig. 55 *A*). After the evacuation a new sporangium may be formed within the empty sporangial wall, but it may also occur that a new lateral sporangium is given off from the stalk cell besides the emptied terminal one.

The species appears to be nearly related to *Acrochætium endophyticum* Batters (Journ. of Botany Vol. 34 1896 p. 386) living in "the cortical layer" of *Heterosiphonia coccinea*. As far as can be seen from Batters' description this species is distinguished from *Ch. emergens* mainly by longer erect filaments, which are composed of from one to three cells.

Locality. Sk: Møllegrund off Hirshals (XO), 11,5 to 15 meters, with ripe sporangia in August.

21. **Chantransia immersa** sp. nov.

Thallus endophyticus; fila omnino immersa, intercellularia, varie ramosa, ramis sparsis vel ex una cellula pluribus egredientibus. Cellulæ nunc cylindricæ plerumque tamen medio vel supra medium inflatæ, 8—10 μ latæ, 40—53 μ longæ, nunc, præcipue superficiem hospitis versus, breviores plus minus rotundatæ, usque ad 15 μ latæ. Chromatophorum unicum stellare pyrenoide centrali et ramis longis sursum et deorsum protractis munitum. Cellulæ ultimæ breves obovatæ vel rotundatæ, in superficie hospitis prorumpunt, cellulas peripherica illius plerumque non superantes, nonnunquam pilum hyalinum gerentes. Sporangia, transformatione cellularum ultimarum orta, obovata, 15—17,5 μ longa, 11—12 μ lata, monospora, post evacuationem sæpe sporangio novo e cellula suffultoria formato repleta.

This species occurs in *Rhodomela subfusca* and in species of *Polysiphonia*. As the endophytes are essentially identical in structure, they are referred to the same species, but as their behaviour to the different hosts is somewhat different, two forms may be distinguished.

Forma *Rhodomelæ*. In *Rhodomela* I have only found the endophyte growing in tumours and occurring in fairly great quantity at Frederikshavn in July 1895 and 1896. These tumours are irregularly roundish and somewhat remind one in form and size of *Harveyella mirabilis*. I conclude that they are occasioned by this endophyte, but it deserves notice that these tumours also contained an endophytic *Ectocarpus* or *Streblonema* and the very common endophyte *Bolbocoleon piliferum*. The *Chantransia* grows intercellularly through the whole tumour, the filaments running mainly in a radial direction. The swellings have essentially the same

structure as the normal branches; there appears to take place only an acceleration of the growth, their structure assuming the appearance of that of much older branches. In the interior of the tumour the cells of the endophyte are usually several times as long as broad, nearly cylindrical; towards the periphery they become shorter, lastly only a little longer than broad. At the same time the filaments become more branched. The outermost cells reaching the surface of the host bear sometimes a short hair ca. 4,5 μ thick at the base but quickly tapering upwards.

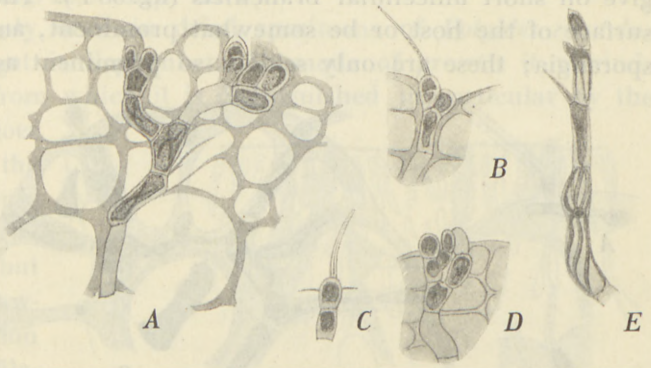

Fig. 56.
Chantransia immersa f. *Rhodomelæ*. *A*, section of tumour of Rhodomela with the endophyte; a new sporangium is about to be formed within an emptied sporangial-wall. *B* and *C*, ends of filaments with hair. *D*, filament with sporangia, one emptied. *E*, filament showing the chromatophores. 300 : 1.

The structure of the cells was studied on material hardened with picric acid. The pyrenoid is large and contains an angular body, probably a crystalloid. It is situated nearly in the middle of the cell but not always in the axis of the cell (fig. 57 *B*, *C*). The arms of the chromatophore are long and narrow and extend from the central part containing the pyrenoid upwards and downwards to the ends of the cell. The nucleus is difficult to see; by aid of borax-carmine it was determined in young cells, lying in a pit in the chromatophore near the pyrenoid (fig. 57 *A*, *n*).

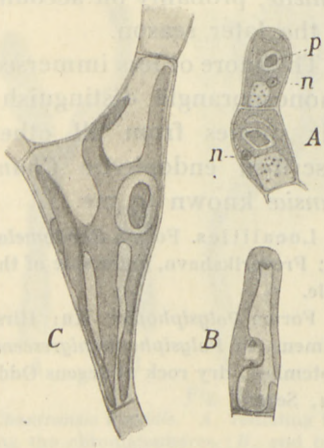

Fig. 57.
Chantransia immersa f. *Rhodomelæ*. Cells showing the chromatophore; hardened with picric acid. *A*, young cells, *p*, pyrenoid, *n*, nucleus. *B*, the pyrenoid contains a crystalloid. *C*, the chromatophore with long arms, the pyrenoid excentric. A 730 : 1. B 580 : 1. C 1100 : 1.

The sporangia arise almost without change of form from the outermost cells lying at the level of the surface of the host or a little prominent. After the evacuation a new sporangium may be formed within the emptied wall from the under-lying cell (fig. 56 *A*).

Forma *Polysiphoniæ*. Of this form which has been found growing in *Polysiphonia nigrescens* and *P. violacea* I have particularly examined specimens infesting *P. nigrescens* collected at Hirsholmene in September. It occasions here no tumours but grows intercellularly between the central cell and the pericentral cells as well as between the latter mutually. Long straight filaments consisting of cylindrical or feebly swollen cells often run longitudinally between the central cell and the pericentral cells, sending off between the pericentral cells radiating filaments ending with short cells breaking through

the cuticle of the host (fig. 58 *C, E*). But longitudinal filaments running a short distance from the surface between the pericentral cells also occur, and these filaments give off short unicellular branchlets (fig. 58 *F*). The peripheral cells may reach the surface of the host or be somewhat prominent, and the same is the case with the sporangia; these are only seldom so prominent as that shown in fig. 58 *C*. The peripheral cells bear sometimes a hair which may be more vigorous than in f. *Rhodomelæ* and two hairs in one cell may even be observed (fig. 58 *A*). The chromatophore has the same structure as in f. *Rhodomelæ*, and the sporangia are also alike. Formation of a new sporangium within an emptied sporangial wall frequently occurs, apparently repeatedly (fig. 58 *C, D, G*). The sporangia were as a rule better developed than in f. *Rhodomelæ*, probably on account of the later season.

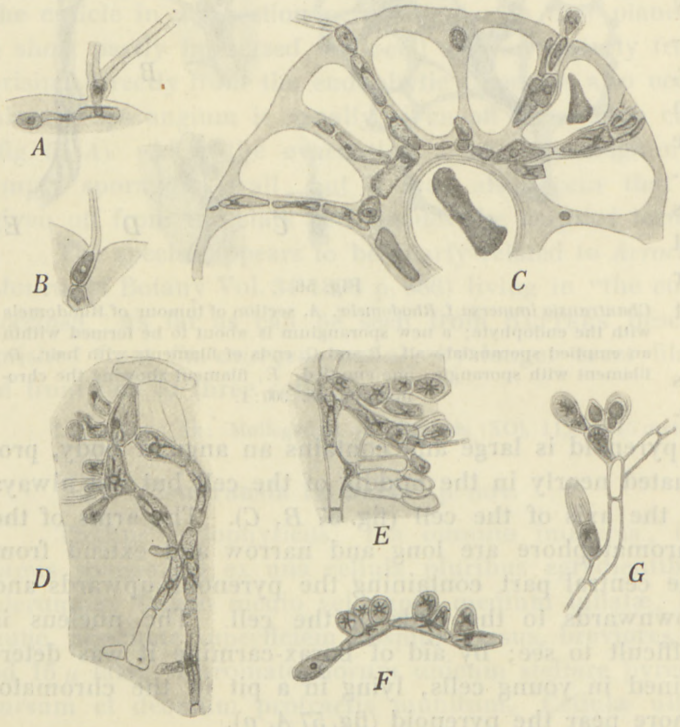

Fig. 58.
Chantransia immersa f. *Polysiphoniæ*. *A*, filament giving off an emerging cell bearing two hairs. *B*, end of filament with hair. *C*, transverse section of Polysiphonia nigrescens with the endophyte. *D* and *E*, longitudinal filaments giving off radiating filaments with sporangia. *F*, longitudinal filament with unicellular branchlets. *G*, filament with sporangia-bearing branches. 300 : 1.

The more or less immersed monosporangia distinguish this species from all other described endophytic *Chantransiæ* known to me.

Localities. Forma *Rhodomelæ*. Kn: Frederikshavn, outer side of the mole.

Forma *Polysiphoniæ*. Kn: Hirsholmene, in *Polysiphonia nigrescens*, September; dry rock at Jegens Odde in the same, Sept.; Trindelen (NI), 9,5 to 10,5 met., in *Polys. violacea*, Sept.

22. **Chantransia Polyidis** sp. nov.

Thallus endophyticus; fila in cortice exteriori et interiori hospitis (*Polyidis rotundi*) intercellularia, vario modo, in directione radiali et transversali vel etiam intermedia, præsertim tamen radiali, peripheriam versus crescentia, ramosa, ramis sparsis. Cellulæ forma varia, plerumque cylindricæ vel utriculosæ, sæpe aliquantum curvatæ, long. 30—56 μ, lat. 10,5—14 μ, peripheriam versus breviores, adultæ ut videtur chromatophorum unicum valde ramosum, fere reticulatum continentes. Cellulæ ultimæ rotundatæ, oblongæ vel clavatæ, superficiem hospitis attingentes sed

non superantes, raro pilum paullo evolutum portant. Sporangia in apice filorum radiantium singula vel rarius bina, immersa, superficiem hospitis non vel vix superantia, monospora, oblonga, long. 15,5—18 μ, lat. 9 μ.

This species was found only once in dried specimens of *Polyides rotundus* collected in the Northern Kattegat in September. In mode of growth it reminds one somewhat of *Ch. immersa* from which it is distinguished in particular by the form of the chromatophore. It does not occasion any deformation of the host plant in the intercellular substance of which it lives. It grows principally in a radial direction but has also stoloniform filaments growing out in a transverse direction and giving off new radiating filaments (fig. 59). The filaments are as a rule fairly strongly branched, however, one branch only is given off from each joint, and some cells bear no branch. Sometimes the branches are fasciculated in the radial filaments (fig. 59 *A*). The cells are usually somewhat swollen; at some distance from the surface very thick cells, over 20 μ broad, may frequently be met with. Hyaline hairs seem to occur only in very small quantity and feebly developed. The end-cell shown in fig. 60 *B* is probably a young hair which has not yet reached above the surface of the host.

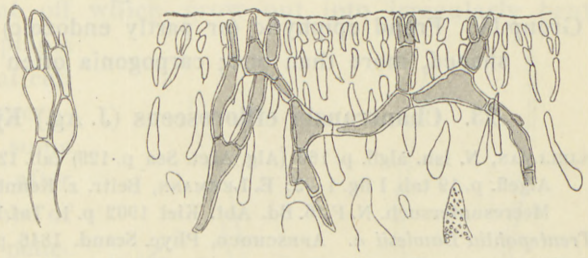

Fig. 59.
Chantransia Polyidis. *A*, radiating filament with fasciculated branches. *B*, transverse section of Polyides with Chantransia showing transverse and radiating filaments. 300 : 1.

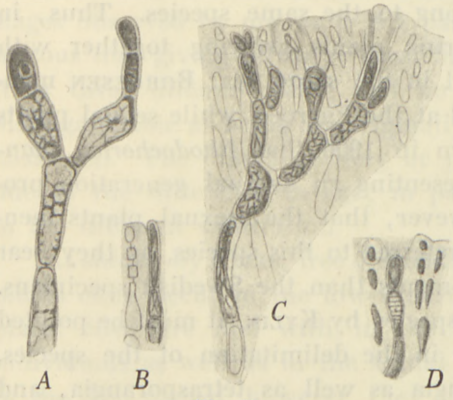

Fig. 60.
Chantransia Polyidis. *A*, radiating filament showing the chromatophores. *B*, end of filament the end-cell of which is apparently about to form a hair. *C*, branched filament with partly emptied sporangia. *D*, end of filament with terminal sporangium. *A* 390 : 1. *B—D* 300 : 1.

As I possess only dried material I cannot give a sufficient account of the structure of the chromatophore, which seems to be rather peculiar. In the end-cells the chromatophore appears often as a compact mass filling out the greater part of the cell, in the centre of which a body is visible which seems to be a pyrenoid (fig. 60 *A*). In the somewhat older cells the chromatophore shows often an upper dome-shaped part while the rest of it is divided into a number of strands or plates, concerning which I am not able to decide if they are all continuous or partly separate. The dome-shaped part soon disappears and the supposed pyrenoid was also as a rule not visible in the more developed cells. The whole process has apparently the character of a vacuolization of the chromatophore.

The sporangia are terminal on the outward growing filaments. Besides the

really terminal sporangium another lateral is often developed, inserted at the same level. The sporangia are entirely immersed or only a little prominent above the surface of the host; they are about twice as long as broad.

Locality. Kn: Tønneberg Banke, TP, 16 meters, September.

Subgenus Grania.

Group IV. Frond epiphytic (or partly endozoic); chromatophores long, usually spiral-shaped, more than one; carpogonia often intercalary, carpospores seriate.

23. **Chantransia efflorescens** (J. Ag.) Kjellm.

Kjellman, N. Ish. algfl. p. 166 (Alg. Arct. Sea p. 129) tab. 12 fig. 1—2 (f. *tenuis* Kjellm.); Gran, Kristianiafj. Algefl. p. 19 tab. I fig. 1—3; E. Lehmann, Beitr. z. Kenntn. von Chantransia efflorescens J. Ag. sp., Wiss. Meeresuntersuch. N. F. 6. Bd. Abt. Kiel 1902 p. 1, Taf. I; Børgesen (1902) p. 355; Kylin (1906) p. 113.
Trentepohlia Dawiesii a. Areschoug, Phyc. Scand. 1846 p. 117. tab. V D.
Callithamnion efflorescens J. Agardh, Sp. Vol. II p. 15.
Rhodochorton chantransioides Reinke, Algenfl. p. 23, Atlas Deutsch. Meeresalg. Taf. 21.

Much has been added to our knowledge of this interesting Alga during the last thirteen years. Gran described the sex-organs in 1896, showing that the formerly known clusters of spores were cystocarps. According to Gran and other observers the sexual plants do not bear sporangia; but later, sporangia have been observed on other individuals supposed to belong to the same species. Thus, in 1902 E. Lehmann recorded monosporangia-bearing plants growing together with sexual plants on stones in the bay of Kiel, and in the same year Børgesen mentioned similar plants with monosporangia found at the Faeroes, while sexual plants were not met with. Finally, Kylin has shown in 1906 that *Rhodochorton chantransioides* Reinke belongs to this species, representing an asexual generation provided with tetrasporangia. Kylin doubts, however, that the asexual plants mentioned by Lehmann and Børgesen ought to be referred to this species, as they bear monosporangia and have somewhat thicker filaments than the Swedish specimens.

Referring to the careful description of the species by Kylin, it must be pointed out that I do not fully agree with this author in the delimitation of the species, as I have found that it may have monosporangia as well as tetrasporangia, and that the filaments may often be somewhat thicker than stated by him. While the filaments according to Kylin are 5 μ thick, I have found, on the basis of a great number of measurements, that in plants from all Danish waters they are usually 5—6 μ thick, but that the thickness varies from 4 to 7,5 μ. My observations are not sufficiently numerous to allow any certain conclusion as to the influence of the outer conditions upon the thickness; I shall only state that the specimens from the Baltic were 4—5 μ thick, while plants collected in the North Sea in 38 meters depth were 6 μ thick.

The germination, which was hitherto unknown, has been studied in specimens growing on the theca of a hydroid polyp, collected in the Samsø Waters (YV) in

June. The germinating plants were found among fully developed plants bearing monosporangia and originated undoubtedly from monospores. As shown in fig. 61 the germinating spore becomes a hemispherical basal cell the diameter of which is much greater than that of the filaments, namely 8—10 μ. This cell keeps its form, at all events for some time, and divides only by peripheral walls, by ramification. An erect filament is early given off from the upper face of the cell, and from the margin small cells are cut off which grow out into irregularly bent creeping filaments. In somewhat older plants two erect filaments rising from the basal cell and an increasing number of radiating creeping filaments are visible (fig. 61 *E*). In some cases it was observed that a filament, after having run some distance on the surface of the wall of the hydroid, had suddenly penetrated the wall and continued its way within it (fig. 61 *E*). I do not know if this species can also penetrate the Algæ on which it grows. LEHMANN figures a basal part of the f. *petrophila* described by him (l. c. fig. 10), which is rather different from the young stages observed by me, as it is a parenchymatous disc giving off three erect filaments from three different cells, and no cell is distinguishable as being the originally single basal cell. The difference may be possibly due to the difference in age, in part also to the different substratum.

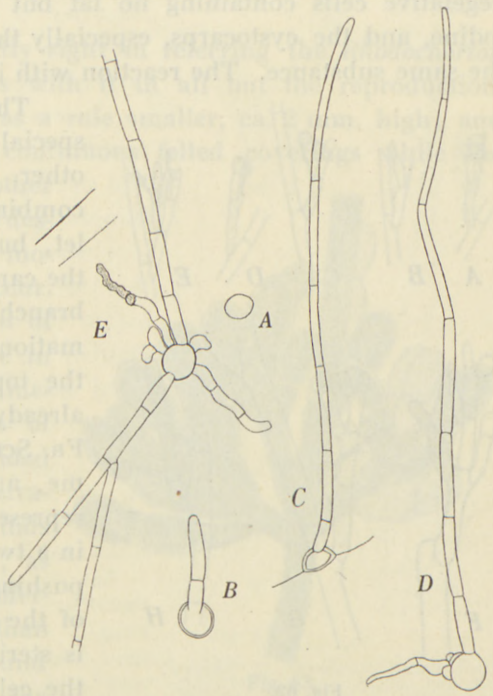

Fig. 61.
Chantransia efflorescens. Germinating plant on tube of Hydroid, from YV, June 1904. *A*, spore, provided with membrane but still undivided. *B*, the basal cell has given off an erect filament. *C*, older plant in the same stage. *D*, creeping filaments are given off from the periphery of the basal cell. *E*, the basal cell has given off two erect and four creeping filaments; one of the latter has penetrated into the membrane of the Hydroid. The endozoic part of the filament is shaded. 560 : 1.

As shown by KYLIN, free descending filaments often occur in the lower part of the plant; they are met with in the asexual individuals as well as in the sexual plants; in the first named, however, they are often wanting.

The chromatophores are, as shown by REINKE and KYLIN, parietal spiral-shaped bands. Usually there appears to be two, sometimes only one, and in other cases they are more irregular, either more numerous or more branched, a matter difficult to decide. LEHMANN states expressly that the cells contain one much-branched chromatophore only, the apparently distinct chromatophores being always connected by anastomoses. Though this statement is in contradiction to the figures of KUCKUCK (REINKE, Atlas Taf. 21 fig. 3) and KYLIN and though I also think I have observed more than one chromatophore

in the cells (fig. 64), I dare not deny it decidedly, as it is in reality very difficult to convince oneself of the absence of anastomoses between the chromatophores, which never run quite regularly. According to KYLIN (l. c. p. 115) the chromatophores contain small granules which are interpreted by him as pyrenoids. I have observed the same granules but cannot give any information as to their nature; their appearance seemed not to be constant. While the cells in LEHMANN's specimens contained fat and no starch, I found in cystocarp-bearing specimens the vegetative cells containing no fat but minute starch-grains staining red-brown in iodine, and the cystocarps, especially the carpospores, contained a great quantity of the same substance. The reaction with iodine was rather similar to that of glycogen.

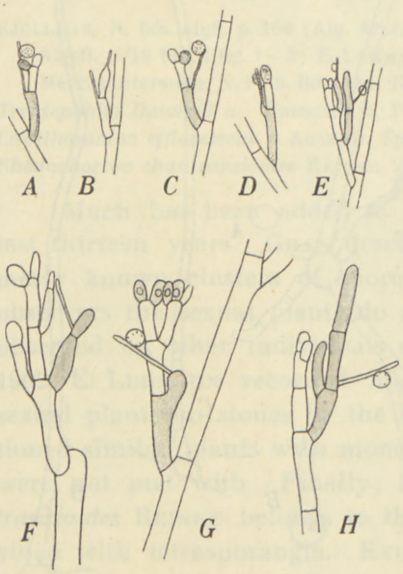

Fig. 62.
Chantransia efflorescens. Fertile branchlets. See the text. The carpogonia and the cells produced by them after fertilisation are shaded. *A*—*D* 390 : 1. *E* 300 : 1. *F*—*H* 620 : 1.

The sex-organs develop, as shown by GRAN, on special fertile branchlets, generally very near each other. Later, KYLIN has accounted for the various combinations of the sex-organs on the same branchlet, but he has not noticed the curious fact that the carpogonia are not always lateral on the fertile branchlet but often intercalary, rising by transformation of the second or even the third cell from the top. The intercalary carpogonia, which were already observed in 1893 by the late Professor FR. SCHMITZ who mentioned them in a letter to me, are very common. A very frequent case is represented in fig. 62 *A*, *C*, *D* where the lower cell in a two-celled branch has become a carpogonium, pushing forward a trichogyne from the upper end of the cell along the upper cell which in all cases is sterile bearing two antheridia. In fig. 62 *B* both the cells have developed into carpogonia, the one superposed on the other. In fig. 62 *G* the carpogonium has arisen from the lowest cell in a three-celled branched branchlet, and in fig. 62 *E* and *F* they are lateral. In the same branchlet a lateral and a terminal carpogonium frequently occur. The intercalary carpogonia show very often a swelling at the base of the trichogyne (fig. 62 *D*) which may formerly perhaps have been interpreted as the whole ventral part of the carpogonium. Fertilized carpogonia with adhering globular spermatia frequently occur. After fertilization the separation of the trichogyne takes place in the intercalary carpogonia at the upper end of the swelling (fig. 62 *G*). Thereafter the fertilized carpogonium increases in length, the trichogyne is pushed aside, and the lengthened body divides by a transverse wall a little under the insertion of the trichogyne (fig. 62 *E*, *F*, *H*). Even in this stage and later the trichogyne with adhering spermatium may yet be visible. In fig. 62 *H* the primary filament of the young cystocarp is three-celled and has produced a

branch. The further divisions and branchings I have not followed; they result in the formation of a glomerule of radiating filaments, the two or three last cells of which are swollen and produce each a carpospore. As each fertile branch bears as a rule more than one carpogonium, the glomerules may perhaps sometimes be composed of two or even three cystocarps, being thus syncarps. The position of the antheridia in the neighbourhood of the carpogonia results in emptied antheridia being frequently visible in ripe cystocarpia amongst the spore-producing filaments (fig. 63).

I have no doubt that KYLIN is perfectly right in referring the *Rhodochorton chantransioides* to this species, as it agrees with it in all but the reproduction. However, the tetraspore-bearing plants are as a rule smaller, ca. 2 mm. high, and it may be added that they usually form continuous felted coverings while the sexual plants form isolated tufts. On the other hand specimens fully agreeing with those described by REINKE and KYLIN, only bearing monosporangia instead of tetrasporangia, also occur. Young still undivided tetrasporangia are out of the question in this connection, for I have in many cases met with specimens bearing numerous well-developed monosporangia, some of which were emptied but not one with divided contents. Usually each plant bears either tetrasporangia or monosporangia, but the two kinds of plants often grow together side by side, as the plants represented in fig. 64. The only difference is that the monosporangia are smaller than the tetrasporangia. The monosporangia I found (10—) 11—18 μ long, 5—7 (—8,5) μ broad, the tetrasporangia 15—28 μ long, 8—12,5 μ broad. Referring to the above quoted descriptions it may be added that two sporangia-bearing branchlets are frequently sitting on one cell in the monosporangia-bearing as well as in the tetrasporangia-bearing plants; they are usually opposite but may also be placed near each other on one side of the filament (fig. 64).

Fig. 63.
Chantransia efflorescens. Branchlet with ripe cystocarp showing still two emptied antheridia at the top of the branchlet. 835 : 1.

The species has been met with in the Danish waters in the months April to August. Sporangia-bearing plants occur in April to June, more rarely in July. Sex-organs have been met with in all the months named, fully developed cystocarps only in June to August. This in connection with the fact that the two kinds of reproductive organs occur in different individuals suggest the existence of an alternation of an asexual generation appearing in spring with a sexual one occurring principally in summer. If this supposition is right, the germinating plants mentioned above (fig. 61) must be young sexual plants. Unfortunately LEHMANN does

not mention if the basal disc figured by him (l. c. fig. 10) belonged to an asexual or a sexual plant.

The species attains in the Danish waters a length of 5 mm., but it is relatively seldom more than 3 mm. high. As mentioned above, the asexual plants are as a rule smaller than the sexual ones; however I have found in the Little Belt a specimen with monosporangia measuring 5 mm. in length. It grows principally on other Algæ; I have recorded it on 15 different species, most frequently on *Delesseria sangvinea*, *Furcellaria*, *Desmarestia aculeata*, *Cystoclonium purpurascens*, *Polysiphonia elongata*, further on leaves and roots of *Zostera*, on tubes of Hydroids, Ascidians, shells of *Buccinum* and finally on stones. It has been met with in depths of 7,5 to 38 meters, most frequently 11 to 23 meters. In the following list of localities the depth is only indicated when it is outside the last named limits. It is interesting that this subarctic species has been met with in nearly all the Danish waters, also in the Baltic, but not in the Limfjord nor in other shallow waters where the summer temperature is comparatively high.

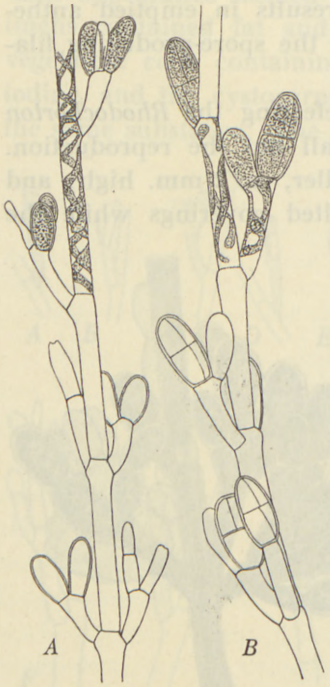

Fig. 64.
Chantransia efflorescens. *A*, filament with monosporangia, partly emptied. *B*, filament with tetrasporangia. 560 : 1.

Localities. **Ns**: AG near the Jutland Reef, 28 met. — **Kn**: FG, Herthas Flak; FH near Frederikshavn 4—7,5 met.; VU and VT, 9,5 met., N. of Læsø. — **Ke**: FC; ZE[1] and VY, Fladen; IK, Lille Middelgrund; IA, Store Middelgrund; RL. — **Km**: XF, Læsø channel, 8,5 met. — **Ks**: OS, Hastens Grund. — **Sa**: FS, Vejrø Sund; YV, south of Hatterbarn; DK, Bolsaxen. — **Lb**: XP, Middelfart; common around Fænø. — **Sb**: Z; near Sprogø (Ostenfeld); Langelandsbelt: UH, UT and LB. — **Su**: bM, south of Hveen; OG[1]. — **Bw**: LC, south of Langeland; Femerbelt: UL and KX. — **Bb**: XZ[4], Davids Banke, 19—20,5 met.

24. **Chantransia pectinata** Kylin.

Kylin (1906) p. 120.

I have repeatedly met with a *Chantransia* agreeing with Kylin's description and figures of this species, which appears to be related to *Ch. efflorescens*. The only discordance is that in some cases I have found free descending filaments near the base of the erect filaments, while *Ch. pectinata* according to Kylin is distinguished from *Ch. efflorescens* just by the want of such filaments. They occur however seldom and are not so long as in the latter and they appear to have partly the character of stolons, growing out in horizontal direction (fig. 65 *C*). In spite of the presence of these filaments I regard the two named species as quite distinct, *Ch. pectinata* being characterized by thicker filaments, shorter, more thick-walled cells and by the sporangia-bearing branchlets being seriate on the inner side of the lateral filaments.

The main filaments were in my specimens 6—9 μ thick near the base; they are repeatedly branched. Opposite branches sometimes occur (fig. 65 *D*). The branches are tapering upward, finally only 3,5—4 μ thick. The cells of the main filaments are usually 4—7 times as long as broad. As shown by KYLIN, the chromatophores have almost the same shape as in *Ch. efflorescens*; they may also contain small refractive bodies which are possibly pyrenoids.

The sporangia-bearing branchlets are sometimes composed of more than 3 cells and transitions to longer filaments may then occur. Sometimes the sporangia may also be terminal on long filaments (fig. 65 *A*). The sporangia are always monosporous; after the evacuation a new sporangium is often formed within the emptied membrane. In some cases the sporangial wall was distinctly lamellate, consisting of two layers at least (fig. 65 *A*, *B*) in other cases this could not be observed. The sporangia were in the Danish specimens 10—14 μ long, 5,5—7,5 μ, most frequently 7 μ thick.

The species has been found in depths of 13 to 24,5 meters, growing on *Phyllophora Brodiæi*, *Desmarestia aculeata*, *Buccinum undatum* and *Flustra foliacea*, in June and July.

Localities. Ke: VZ, Groves Flak. — Lb: Fænø Sund and N. and W. of Fænø.

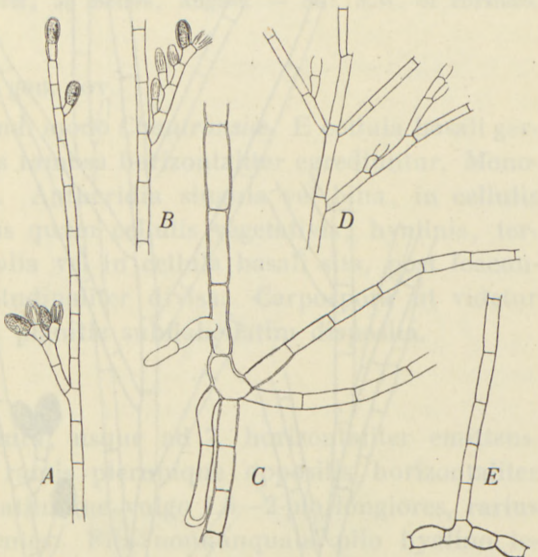

Fig. 65.
Chantransia pectinata. From Little Belt near Fænø. *A*, end of long filament with terminal sporangium and lateral sporangia-bearing branchlets. *B*, 4-celled sporangia-bearing branchlet. *C*, lower part of erect filament with descending and horizontally outgrowing filaments. *D*, erect filament with opposed branches. *E*, fragment of a filament of the basal layer with erect filament. A, B, D 270 : 1. C 560 : 1. E 350 : 1.

β, *cimbrica* var. nov.

Filis principalibus crassioribus, inferne 8—10,5 μ crassis, sporangiis partim tetrasporis 18—19 μ longis, 10,5—13 μ latis, partim monosporis, 11—13 μ longis, 6—8 μ latis.

In the Skagerak a *Chantransia* was found in May, growing on *Flustra foliacea*, which differed from the typical *Ch. pectinata* by thicker filaments and by the presence of tetrasporangia, but for the rest resembling the latter so much that it must be considered as a variety or form. Some specimens were almost the same as the typical species or only differing by a little thicker filaments, having the typical seriate sporangia-bearing branchlets with monosporangia. But others showed less numerous fertile branchlets bearing at most 2 sporangia, which were larger than the others and containing 4 spores. As I have had very scarce material I cannot say if the two kinds of sporangia may occur in the same individual. At all events

some specimens bore exclusively monosporangia; the tetrasporangia occurred only in small quantity.

As in the main species short descending filaments occurred at the base of the

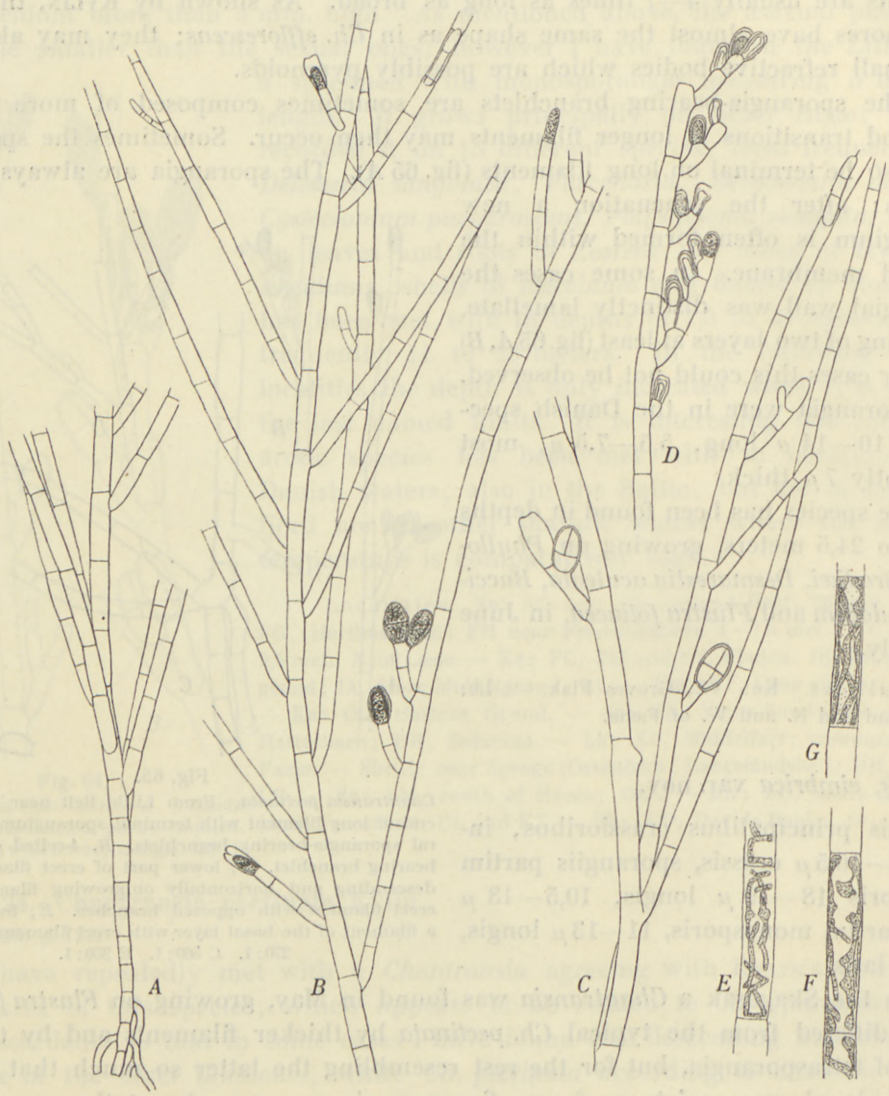

Fig. 66.

Chantransia pectinata β, *cimbrica*. *A*, lower part of erect filament. *B*, upper part of the same with sporangia; one of these showing a transverse wall. *C*, branched filament with tetrasporangia. *D*, filament with branchlets bearing monosporangia. *E*—*G*, cells showing the chromatophores. *A*, *B* 260 : 1. *C*, *D* 340 : 1. *E*—*G* 550 : 1.

erect filaments (fig. 66 *A*). The branches taper upwards, at last 5,5 μ thick. There is more than one chromatophore, parietal, long and narrow, sometimes spiral-shaped but more frequently rather irregular.

Similar specimens to those just described, but bearing only monosporangia, were found attached to *Flustra foliacea* near the Jutland Reef. To this variety may also be referred some small specimens found nearly in the same place as the first described, and on the same substratum (no. 7109). Their primary erect filaments were up to 11 μ thick but consisted of rather short cells, 1,5—5 diameters long, and the fertile branchlets were placed more irregularly, often on the primary filaments and occurred often in small quantity. As they otherwise agreed with the just described f. *cimbrica* they must be regarded as poorly developed specimens belonging to this variety.

Localities. Ns: aG, near the Jutland Reef, 38 meters, August. — Sk: N.W. of Hirshals, 13—15 meters, May.

Kylinia gen. nov.

Plantæ minutissimæ, habitu et crescendi modo *Chantransiæ*. E cellula basali germinatione sporæ orta fila libera plus minus ramosa horizontaliter egrediuntur. Monosporangia in filis terminalia vel lateralia. Antheridia singula vel bina, in cellulis androphoricis erectis, multo angustioribus quam cellulis vegetativis, hyalinis, terminalia. Carpogonia terminalia vel lateralia vel in cellula basali sita, post foecundationem primo latitudine aucta et longitudinaliter divisa. Carpospora ut videtur pauca oblonga vel leviter curvata, in una planitie subflabellatim disposita.

1. **Kylinia rosulata** sp. nov.

Cellula basalis hemisphærica fila plura, usque ad 7, horizontaliter emittens. Fila simplicia vel plus minus ramosa, ramis plerumque oppositis horizontaliter egredientibus. Cellulæ 4,5—5,5 μ crassæ, latitudine vulgo 1,5—2-plo longiores, rarius ultra, chromatophorum parietale continentes. Fila nonnunquam pilo hyalino tenuissimo terminata. Sporangia terminalia vel lateralia, ovata, 6,5—8,5 μ longa, 5—5,5 μ lata. Cellulæ androphoricæ 1—1,5 μ latæ, c. 4—7 μ longæ, ad apicem et dorsum cellularum vegetativarum vel, ut videtur, carpogoniorum, singulæ rarius binæ. Antheridia 2—4 μ longa, 1,5—2,5 μ lata. Cystocarpia, ut videtur, paucicellularia, carposporis c. 3.

This curious little plant has only been met with once in the Northern Kattegat where it was found growing fairly abundantly on a specimen of *Sporochnus pedunculatus*. It occurred only on the assimilating filaments which form a tuft on the fertile branches of this plant, and their number was often so great that these filaments were rose-coloured in spite of the extreme smallness of the epiphyte. Its appearance is that of a *Chantransia* of the group with one basal cell; it is indeed somewhat similar to *Chantransia hallandica* γ, *parvula*. The basal cell is hemispherical, attached to the substratum by a thin layer of cementing substance (fig. 67*E*). It gives off at all sides in a horizontal direction, but not from the upper side, a number of filaments, in well developed plants 6 or 7. These filaments grow out along the surface of the filament of *Sporochnus* but are not attached to it; they

are thus growing in a cylinder, and the branching takes place in the same plane. The filaments attained only an inconsiderable length; I found them at most 5-celled. As I possess only dried specimens of the plant, I have not been able to determine with certainty the form of the chromatophore; I can only state that it is parietal and probably single. In the spores it appeared to be distinctly belt-shaped (fig. *A—D, N*). In some cases I believed I saw a pyrenoid (fig. *H, P*). The end-cells

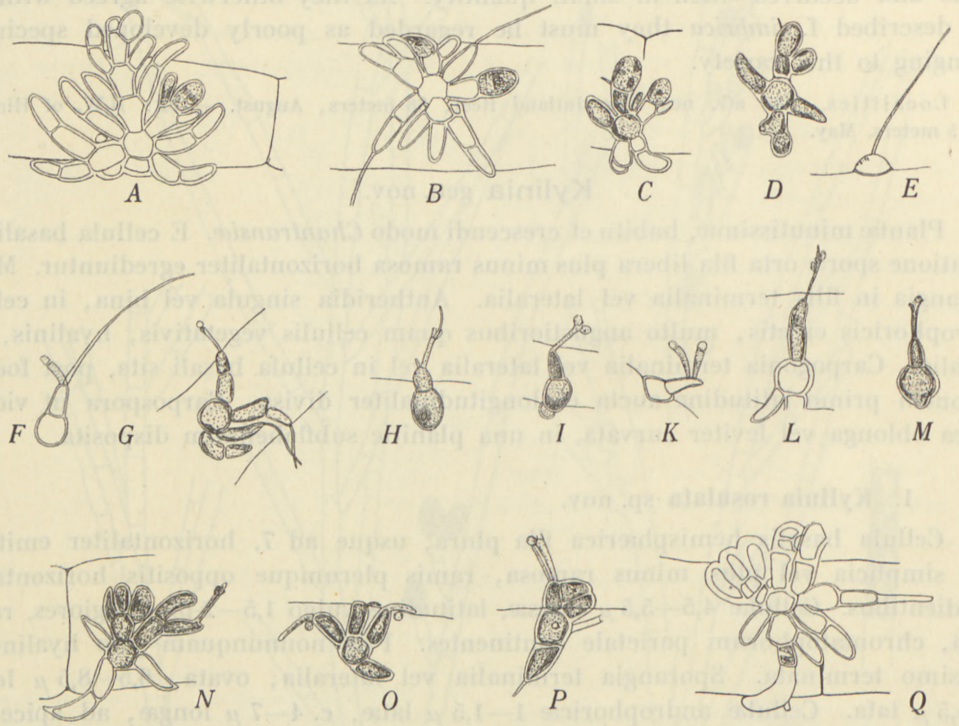

Fig. 67.

Kylinia rosulata. *A—D*, plants with sporangia. *E*, basal cell, still undivided, bearing a hair. *F*, plant consisting of a basal cell giving off a one-celled branch which bears a terminal hair and an androphore-cell with an antheridium. *G*, plant with androphore-cell. *H, I*, plants with androphore-cell bearing two antheridia. *K*, a cell giving off two androphore-cells. *L*, the outer cell in a two-celled filament transformed into a carpogonium; two spermatia adhering to the trichogyne (compare text). *M*, the cell given off from the basal cell seems to be a carpogonium; the threadlike organ to the right is probably the trichogyne, that to the left an androphore-cell. *N*, to the right probably a carpogone with adhering spermatium; at the upper side a short filament with sporangia. *O*, the thin cell to the left is probably a young androphore; above possibly a trichogyne. *P*, the basal cell bears to the right an androphore-cell, above a three-celled complex, probably a young cystocarp; this bears an androphore-cell with two antheridia and a trichogyne. *Q*, plant bearing above a three-celled, presumed young cystocarp and to the left a more developed cystocarp. 550:1.

bear frequently a very thin, hyaline hair tapering upwards; such a hair is also sometimes given off from the upper side of the basal cell even before branching. The plants are often much reduced, the basal cell giving off only one or a few short filaments consisting of one or very few cells (fig. *E—M, P*).

The sporangia-bearing plants bear usually no other reproductive organs. The sporangia are often terminal on primary filaments, being frequently separated from

the basal cell only by one sterile cell (fig. *A*—*D*). Sporangia sitting immediately on the basal cell I have not observed.

The antheridia arise at the end of peculiar narrow, cylindrical, colourless or feebly coloured cells given off from the apical end of the end-cells, not rarely from cells sitting directly on the basal cell; in fig. *P* such a cell is even situated directly on the basal cell. These androphore-cells, as they may be named, are not given off in the same plane as the other branches but rise more or less vertically from the horizontally directed cells. Usually one androphore only is given off from the same cell, but two androphores situated near each other also occur (fig. *K*). As mentioned below, the androphore-cells may also be situated on the carpogonia. The end of these androphore-cells gives rise to one or two antheridia. In the first case a small cell, a little longer than broad, is cut off by a transverse wall (fig. *F*, *G*, *K*), in the latter the antheridial cells are cut off by inclined walls from the end of the androphore-cell, leaving a little point between the two antheridia (fig. *H*, *I*); this point may sometimes be lengthened into a short hair-like organ.

As to the carpogonia and cystocarps, I am sorry to say that I have not arrived at clearness, on account of the state of preservation of the material and perhaps also because these organs occurred in very small number and in insufficient stages of development. In particular it appeared difficult to find unquestionable trichogynes. I think however that the cell shown to the right in fig. *N* is really a carpogonium with a spermatium attached to the trichogyne. In fig. *P* a cell-complex, probably a young cystocarp, is seen bearing an androphore and quite near to it a thin thread, which is perhaps a trichogyne, but no spermatium is attached to the latter. A similar case is shown in fig. *M*, where a cell bears two thin, threadlike organs, the one being certainly an androphore-cell, the other probably a trichogyne. The great resemblance between the androphore-cells and the trichogynes cause great difficulty, in particular when the antheridia are formed on the side of the androphore-cell. Thus the case represented in fig. *L* might perhaps raise some doubt. The resemblance between the filiform organ figured here and the androphores represented in figs. *H* and *I* might perhaps suggest that it is an androphore with two antheridia and prolonged point; the continuity of the protoplasmic contents in the filiform organ and that of the cell from which it is given off goes however to prove, that these two organs belong together, being a carpogonium, and that the two spermatia must have come from elsewhere and become attached to the trichogyne. Small round cells looking like spermatia have sometimes been found attached to various points on the surface of the plants (fig. *A*, *O*, *Q*). In the latter case (fig. *Q*) the small cell was adhering to a hyaline curved cell, the significance of which I do not know.

Of stages which could be supposed to be fertilized carpogonia or cystocarps I have only found very few. The three-celled complex situated at the side of the basal cell turned upwards in fig. *P* I regard as a young cystocarp. A similar three-celled stage is shown in fig. *Q* at the upper side, partly hidden by an over-

lying filament. If this interpretation is right, the fertilized carpogonium is first divided by a vertical wall and thereafter one of the daughter-cells is divided by a wall perpendicular to the first. The cell-complex shown to the left in fig. *Q* I take to be a more developed, perhaps a fully ripe cystocarp. The three larger, upwards directed cells are probably the carpospores; they are somewhat diverging, lying in one plane, the same as that of the branching of the plant. A stage so much developed was only once observed.

In spite of the likeness of our plant to the genus *Chantransia* in habit and in the monosporangia, it seems correct not to refer it to this genus but to regard it as the representative of a new genus, characterized in particular by the androphore cell being very different from the ordinary cells, and further by the development and structure of the cystocarps. Among the sexual species of *Chantransia*, *Ch. hallandica* seems to be the one where the cystocarp offers most similarity with that of *Kylinia*, but unfortunately its development is not known. The fact that the androphore-cell is often situated on the carpogonium is analogous to the above described case, that an antheridia-bearing cell is often superposed on the carpogonium in *Chantransia efflorescens*.

The genus is called after the Swedish phycologist, Dr. H. Kylin, who has contributed so much to our knowledge of the northern marine Algæ.

Locality. Kn: TP, Tønneberg Banke, 16 meters, on *Sporochnus pedunculatus*, September.

Tribe Nemalieæ.

Nemalion Targioni Tozzetti.

1. **Nemalion multifidum** (Web. et Mohr) J. Ag.

J. Agardh, Linnæa Bd. 15 p. 453, Spec. II, p. 419, III p. 508; Harvey, Phyc. Brit. pl. 36; Bornet et Thuret, Rech. féc. Florid., Ann. sc. nat. Ve sér. t. 7, 1867 p. 141, pl. 11 fig. 1—5; Janczewski (1877) p. 113, Plate 3 fig. 3; Wille, Ueber die Befrucht. bei Nemal. multif., Ber. deut. bot. Ges. 1894 p. 57; Grace D. Chester, Notes concerning the development of Nemalion multifidum, Botan. Gazette Vol. 21, 1896 p. 340 Pl. XXV and XXVI; J. J. Wolfe, Cytolog. Stud. on Nemalion, Annals of Botany, Vol. 18, Oct. 1904; Oltmanns (1904) p. 539, 540, 542.

Rivularia multifida Weber et Mohr, Naturhist. Reise 1804 p. 193 Taf. III fig. 1.

Chordaria multifida Lyngb. Hydr. p. 51; Flora Dan. Tab. 1669.

As to the structure of the frond reference may be made to the descriptive works and the paper of Grace D. Chester. The ramification is said to be dichotomous and it may possibly be so, but it may also be lateral, as shown in fig. 68 *A*, representing a young plant. The structure of the cells has been studied by Wolfe, from whose statements it appears that the presumed pyrenoid is not a true pyrenoid but a vacuolar cavity without organized contents. While the chromatophore is in general stellate, I found it in a basal disc globular without branches given off towards the periphery of the cell.

As stated by Miss Chester the germinating spores develop at first into short branched, creeping filaments consisting of short rounded cells. Later on filaments

composed of long, narrow cells with less protoplasmic contents are developed in the continuity of the primary ones. They form later at their upper end fasciculated branches reminding one of the peripheral assimilative filaments in the older frond. The author named supposes that such thin erect filaments may meet and twist together, thus giving rise to an erect frond. I have not observed the species in this stage of development. In February at Gilleleje I found crusts apparently formed by densely united creeping filaments like those described by Miss CHESTER, but almost no erect filaments were observed. Young plants with the normal structure are shown in fig. 68; the assimilative filaments were only less numerous in the lower part of the plants than later.

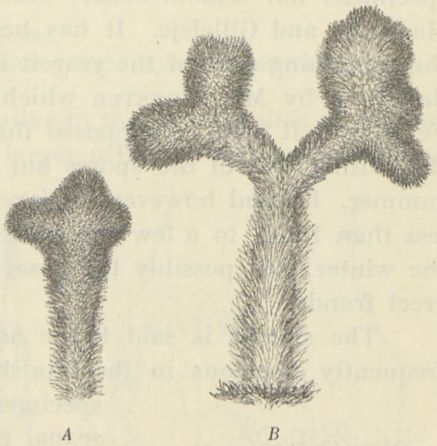

Fig. 68.
Nemalion multifidum. Young plants from the mole at Gilleleje, November 1902. C. 33 : 1.

The assimilative filaments terminate in hyaline hairs of various length, generally rather short. The shortest are almost entirely filled with protoplasm, while in the longer the protoplasm with the nucleus is concentrated in the upper end, the rest of the cell containing only a thin parietal layer. When a hair dies a new one is often formed at the same place from the subjacent cell; the lower part of the old membrane remains however surrounding the base of the new hair as a sheath. A new hair may also be formed beside and below the terminal one, and this may also be renewed (fig. 69).

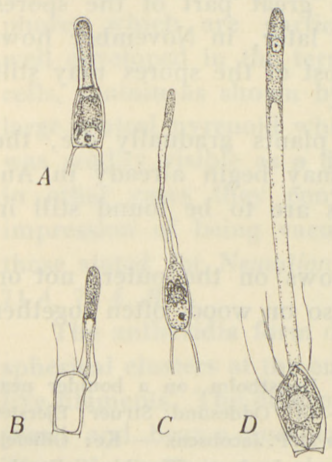

Fig. 69.
Nemalion multifidum. End-cells of assimilative filaments with hairs; in *D* the nucleus is visible. 630 : 1.

The antheridial branches form clusters at the ends of the assimilative filaments as described by BORNET and THURET (1867) and WOLFE. Each cell in the antheridial branch gives rise to four antheridia or fewer (fig. 70). The spermatogenesis has been worked out by WOLFE.

The carpogenic filaments are terminal on the assimilative filaments and usually 3-celled, (according to WOLFE 2- to 5-celled). Concerning the fertilization and the development of the cystocarp reference may be made to the quoted papers of BORNET and THURET, JANCZEWSKI, SCHMITZ, WILLE and WOLFE. The fertilised carpogonium divides by a transverse wall into a basal or placental cell, remaining undivided, and an upper cell dividing by vertical walls into a number of cells giving rise to branched sporogenous filaments, the end-cells of which produce carpospores.

The species occurs in all the Danish waters except the Baltic, growing in the littoral region, thus being out of the water at low-tide. It varies but little in shape in the different localities; it attains very often a length of ca. 20 cm., but larger specimens not seldom occur; thus specimens measuring 40 cm. were met with at Harboøre and Gilleleje. It has been found in the months July to November; in the remaining part of the year it is probably represented by the creeping filaments described by Miss CHESTER which were, as mentioned above, observed by me in February. It may be supposed that the germination takes place immediately after the setting free of the spores but that the erect plants only develop in the next summer. I found however in November on the mole at Gilleleje young plants from less than 1 mm. to a few cms. in length; they would probably have perished during the winter, but possibly the basal portions would have been able to produce new erect fronds.

The species is said to be as a rule monoecious; I found it however most frequently dioecious in the Danish waters. In the proportionally few monoecious specimens (about 10 per cent) I found the two kinds of sexual cells near to each other in all parts of the plant and there is thus no reason to believe that the dioecious specimens would have proved to be really monoecious on closer examination. Antheridia occur in all the months July to November, but in the last months they are in a great measure emptied. Ripe cystocarps may occur already in July; in August a great part of the spores are often set free as well as later, in November however cystocarps containing most of the spores may still be found.

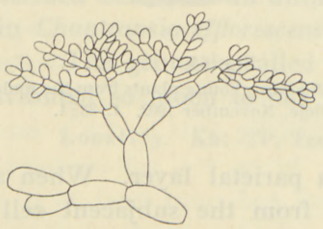

Fig. 70.
Nemalion multifidum. Antheridial branches at the ends of assimilative filaments. 340 : 1.

In autumn or the beginning of the winter the plants gradually die, the assimilative filaments being the first destroyed. This may begin already in August, but on the other hand fairly well-kept specimens are to be found still in November.

The species prefers agitated water; it therefore grows on the outer, not on the inner sides of the moles. It occurs on stones but also on wood, often together with *Fucus*.

Localities. **Ns**: Groins at Harboøre and Thyborøn. — **Sk**: Hanstholm, on a boulder near land; Lønstrup (Warming); Hirshals (!, Børgs.); Skiveren, on wreck. — **Lf**: Oddesund; Struer; Ejerslev Røn. — **Kn**: Frederikshavn; harbour of Vesterø, Læsø; Hornex, Læsø (J. P. Jacobsen). — **Ke**: Gilleleje (Lyngb., !). — **Km**: Anholt harbour; Herringholm (Lyngbye). — **Ks**: Grenaa harbour; Tisvilde (C. Rasch); near Klintebjerg, Odsherred (J. Vahl); Isefjord: Nykøbing; Lynæs; off Nordskov; Ourø; Holbæk Fjord; Bramsnæs Vig. — **Sa**: Kyholm, in the middlemost Fucus-zone; Sælvig (Hjalmar Jensen); Koldby Kaas; Hofmansgave (Hofm. Bg., Lyngb., C. Rosenb.); Juelsminde. — **Lb**: Bogense. — **Sf**: Rødlok Grund off Nakkebølle Fjord; Svendborg; Birkholm; Rudkøbing. — **Sb**: Kerteminde; Korsør; Lohals. — **Sm**: Guldborg. — **Su**: Hellebæk; Helsingør; Humlebæk (Henn. Petersen); near Hveen (Ørsted); Trekroner near Copenhagen (Ørsted).

Helminthocladia J. Agardh.

1. **Helminthocladia purpurea** (Harv.) J. Ag.

J. Agardh, Spec. II, p. 414, III, p. 506; Flora Danica tab. 2699; Schmitz, Chromatophoren der Algen, p. 63 fig. 11—12.

Mesogloia purpurea Harvey in Hooker Brit. Flora II, 1833, p. 386.

Nemalion purpureum Chauv.; Harvey, Phyc. Brit. Pl. 161; Kützing, Tab. phyc. 16. Band Pl. 62 c, d.

The structure of the frond is somewhat similar to that of *Nemalion multifidum*, but the assimilative filaments are composed of larger cells, of which the terminal ones are the largest (fig. 71). These terminal cells bear no hairs, and these organs are upon the whole rare in the older parts of the plants, while they occur fairly abundantly in the younger parts. They are given off from thinner branches not reaching the surface of the frond and are partly terminal, partly lateral; they have the same structure as other similar hairs, are fairly thick and attain a considerable length (fig. 71 *A*, *B*). Besides the hair a little cell with fairly dense contents is visible; such cells are also to be found in the older parts of the frond without hairs. The chromatophores which are particularly large and well developed in the terminal club-shaped cells, contain as shown by Schmitz (l. c.) a large central pyrenoid which in some cases was readily visible as a dense body, while in other cases they conveyed rather the impression of being vacuolar cavities like those stated for *Nemalion* by Wolfe (figs. 71 *A*, 72 *A*, *B*).

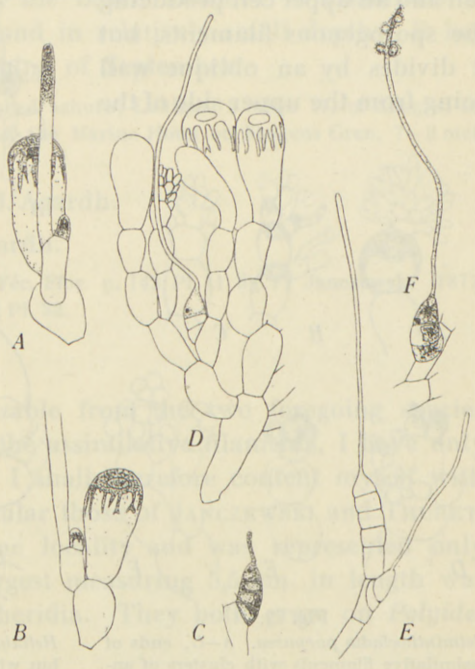

Fig. 71.

Helminthocladia purpurea. *A*, end of assimilative filament with young hair. *B*, similar with base of hair. *C*, young 4-celled carpogenic filament. *D*, assimilative filaments with antheridia and carpogenic filament. *E*, end of branch with a terminal 4-celled and a lateral 2-celled carpogenic filament. *F*, carpogenic branch in stage of fertilization. 350 : 1.

The antheridia form dense, often hemispherical clusters at the end of the assimilative filaments. The outermost cells are then small and bear a number of short much branched antheridia-bearing branchlets. These branchlets are shorter than in *Nemalion* and *Helminthora* and their joints are often nearly globular (fig. 72 *A*—*C*). In some cases a number of globular cells were found crowded together at the upper end of the last cells in the assimilative filaments (fig. 72 *E*, *F*). These cells, which were larger than the antheridia and contained a thin chromatophore, might be suggestive of monosporangia; they were however certainly no such organs but probably only checked antheridial branches,

which had not produced antheridia. The case represented in fig. 72 *D* goes to prove the correctness of this interpretation.

The carpogenic filaments are, as stated by SCHMITZ and HAUPTFLEISCH (1896 p. 333), lateral on the assimilative filaments and consist usually of 3 cells, the lowest of which is often wedge-shaped (fig. 71 *D*, *F*), 4-celled carpogenic filaments however also occur (fig. 71 *C*). Only once have I seen a carpogenic filament terminal on a vegetative filament which bore also a 2-celled lateral carpogenic filament (fig. 71 *E*). After fertilization the carpogonium is not divided, as in *Nemalion* and *Helminthora*, by a transverse wall into a stalk-cell and an upper cell producing the sporogenous filaments, but it divides by an oblique wall going from the upper side of the cell to the margin of the basal wall (fig. 73 *B*, *C*) and thereafter follows variously orientated walls, giving as result a cell-complex growing out into numerous radiating, branched sporogenous filaments, the end-cells of which produce carpospores. The succession of the divisions in the carpogonium I have not been able to follow; they seem to take place in such a manner that a number of peripheral cells are cut off while a larger placentar cell remains in the centre (fig. 73 *F*, *a*). The sporogenous filaments are rather long-celled, the mother-cells of the carpospores long and narrow. After the discharge of the carpospore a new mother-cell may be produced by proliferation from the subterminal cell. At the time when the divisions

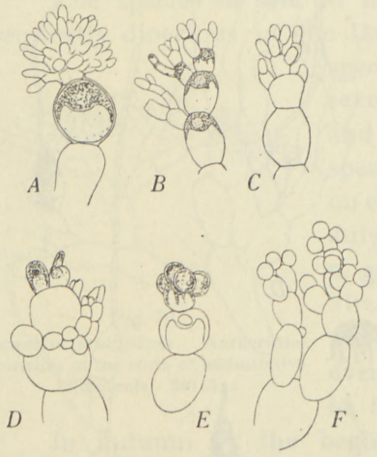

Fig. 72.

Helminthocladia purpurea. *A*—*C*, ends of assimilative filaments with clusters of antheridia. *D*, checked antheridial branches which have developed only very few antheridia. *E*, *F*, ends of filaments bearing globular cells, probably sterile antheridial branchlets. *A*—*D* 560 : 1, *E*—*F* 350 : 1.

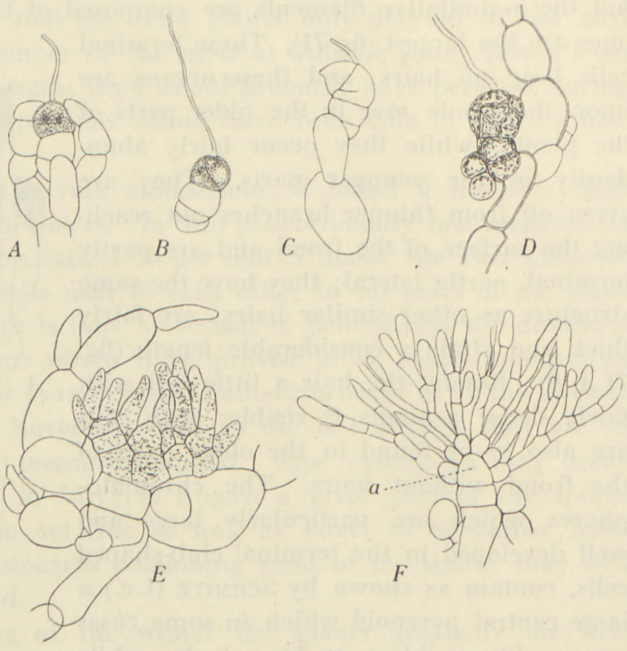

Fig. 73.

Helminthocladia purpurea. *A*, fertilized carpogonium, still undivided but with divided nucleus. *B*, fertilized carpogonium divided by an oblique wall. *C*, similar stage, the one daughter-cell appears about to divide. *D*, more advanced stage. *E*, the sporogenous filaments begin to grow out. *F*, median section of ripe cystocarp. *A*—*D*, *F* 350 : 1, *E* 560 : 1

of the carpogonium begin the sterile cells in the carpogenic filament and the nearest-lying cells in the supporting filament give off branches forming an involucre round the young cystocarp. The ripe cystocarp is a somewhat flattened capitulum, the filaments of which radiate outwards and to the sides.

All the specimens examined were monoecious. The largest specimens were 57 cm. long.

The species has only been found on the Skagerak coast, either washed ashore or in a seine, and no certain information can therefore be given as to the conditions under which it occurs. At Skagen I took it in a seine fishing in ca. 7 to 9 meters depth, and at Løkken I found it on the beach attached to *Lithothamnia* washed ashore. Probably it grows near the land in relatively small depths. It has only been met with in August and the beginning of September.

Localities. **Sk:** Tværsted (M. L. Mortensen), washed ashore; Løkken; 2 miles W. of Skagen, on the beach (Caroline Rosenberg Sept. 1st 1859); in a seine off the Marine Hotel on Skagens Gren, 7—9 met.

Helminthora J. Agardh.

1. **Helminthora divaricata** (Ag.) J. Agardh.

J. Agardh Spec. II p. 416, III p. 507; Bornet et Thuret, Féc. Flor. p. 142 Pl. 11 fig. 7; Janczewski (1877) p. 114 Pl. 3 fig. 4—6; Thuret, Études phycolog. p. 63 Pl. 32.
Mesogloia divaricata Ag. Syst. Alg. p. 51.
Mesogloia Hornemanni Suhr, Flora Dan. tab. 2202 (?).

Of this species, which is easily recognizable from the two foregoing species by its distinctly limited inner axis giving off the assimilative filaments, I have only had very little material from Danish waters; I shall therefore content myself with referring to the above quoted works, in particular those of Janczewski and Thuret.

The species has only been found in one locality and was represented only by two slightly developed specimens; the largest measuring 5,5 cm. in length was not much branched and bore numerous antheridia. They both grew on *Polyides rotundus*[1].

Locality. **Kn:** TL, W. of Nordre Rønner, 4—5,5 meters, September.

Fam. 3. Chætangiaceæ.

Scinaia Bivona.

1. **Scinaia furcellata** (Turn.) Biv.

J. Agardh Spec. I, p. 422, II p. 512; Bornet et Thuret, Not. alg. I p. 18, Pl. VI; Schmitz, Befrucht. 1883, p. 15, Taf. V fig. 5—7; Schmitz and Hauptfleisch, Rhodophyc. p. 337; Oltmanns, Morph. I p. 556.
Ulva furcellata Turner in Schrader, Journal für Botanik 1800 p. 301.
Ginnania furcellata (Turn.) Mont.; Harvey, Phyc. Brit. Pl. 69.

[1] When the printing of this paper was almost finished, L. Kurssanow has published interesting investigations on the cytology of the three last-named genera of Helminthocladiaceæ (Beiträge zur Cytologie der Florideen. Flora 99. Bd., 4. Heft 1909, p. 311), but further reference could not be made to them here.

Two specimens of this widely distributed species, the occurrence of which on the shores of Europe extends from the Mediterranean to Scotland and Helgoland, were found washed ashore at Løkken. As they were quite fresh and were attached to a fragment of an acorn shell, they must undoubtedly have grown near the place where they were found. They attained a length of 6,5 cm. and contained ripe and unripe cystocarps. Small antheridial groups were also found on the surface of the frond. As to the structure of the frond and the structure and development of the fruit I have no new observations; reference may be made to the above quoted papers, in particular those of BORNET and THURET, and SCHMITZ. The species is easily recognizable by its soft, cylindrical, dichotomous frond having a thin solid axis and by the characteristic, immersed cystocarps provided with a dense fruit-wall.

Locality. Sk: Washed ashore at Løkken, August.

CORRIGENDA.

P. 9, l. 9 from top, for "Antithammion" read "Antithamnion", for "Litho-thamion" read "Lithothamnion".
P. 56, l. 8 from top, for "cushon" read "cushion".
P. 80, l. 5 from top, should read "Fam. 2".
P. 88, l. 14 from top, for "egrediunt" read "egrediuntur".
P. 91, l. 11 from top, for "egrediunt" read "egrediuntur".
P. 97, l. 6 from bottom, for "egrediunt" read "egrediuntur".

EXPLANATION OF PLATES.

All figures are photographs after dried specimens, about $^4/_5$ nat. size.

Plate I.

Porphyra umbilicalis (L.) J. Ag.

1. Monoecious specimen showing a longitudinal limiting line between the male and the female part of the frond. (Helsingør, September).
2. Small male specimen (f. *laciniata*); the marginal zone has produced antheridia. (Helsingør, September).
3. Female plant. The fertile zone above shows irregularly ramified spots caused by earlier maturation of the cystocarps here than in the surrounding parts. (Nørre Sundby, Limfjorden, September).

Plate II.

1—3. *Porphyra umbilicalis* (L.) J. Ag. f. *linearis* (Grev.). 1, monoecious, 2, female, 3, male specimen (Frederikshavn, December—January).

4—13. *Porphyra leucosticta* Thur.

4—7. Sexual plants, (harbour of Skagen, April 1905, M. L. Mortensen).

8. Asexual plant, possibly producing gonidia, (harbour of Skagen, July 1907).

9—13. Small specimens being the under part of specimens which have exhausted their spermatia and carpospores, (harbour of Skagen, July 1905).

1

2

3

Porphyra umbilicalis (L.) J. Ag.

1—3 *Porphyra umbilicalis* (L.) J. Ag. f. *linearis*. 4—13 *Porphyra leucosticta* Thur.

Chart of the Danish waters with curves of depths and dredging places.

NORTHERN PART.

● Vegetation of Algæ. × Zostera. (●) Loose Algæ.
⊙ Very scarce Algæ. ✕ Zostera and Algæ. ○ No vegetation.
– Places investigated with algal vegetation near land.

0 - 10 Meter.
10 - 20 „
20 - 40 „
more than 40 Meter.
100 Meter.

8° 9° 10° 11° 12° 13°
30' 57°

JYLLAND
SVERIGE
JYDSKE-REV
Skagen
Höjen
Skiverne
Hirshals
Lönstrup
Lökken
Frederikshavn
Strandby
KRAGESKOV-REV
HERTHAS-FLAK
Vinga
Göteborg
TÖNNEBERG-BANKE
NORDRE-RONNER
TRINDELEN
BÖCHERS-BANKE
Sæby
Læsö
Vesterö Havn
Jegens Dybe
KORBER-GRUND
FLADEN
SVENSKGROVES-FLAK
Mangen
Varberg
Morup Tange
LILLE-MIDDELGRUND
FYRBANKEN
RØDE-BANKE
Anholt
Halmstad
Ertholm
STORE-MIDDELGRUND
Kullen
Gilleleje
Hesselö
LYSEGRUND
HASTENS-GRUND
SCHULTZS-GR.
BRISEIS
LILLE-GRUND
JESSENS-GR.
LYSEGR.
Asaa
Nörre-Sundby
Aalborg
Hals
Aggersund
Thisted
Thisted-Bredn.
Løgstör
Løgstör-Bredn.
Løgö-Bredning
Nibe
AMTOFT-REV
EJERSLEV-RØN
MORS
Nykjöbing
Salling Sund
Tapgöre
Agger
Thyborön-Kanal
Harboöre
Lemvig
Struer
Venö-Bugt
Oddesund
Nissum Bredning
Klitmöller
Hanstholm
Roshage
YDRAGERNE
Hobro
Mariager-Fjord
Alsodde
BOELS-REV
TANGEN
Grenaa Havn
Aarhus
RYES-FLAK
Helm
Begtrup Vig
Kalö
E' Louns-Bredning
Virksund
Frederikshavn
Frydenstrand
Deget
Rönnerne
Hirshalm
Kjölpen
STRANDBY-REV
NV-REV
TYSKERENS-REV
HVIDSTENS-REV
NÖ-REV
Græsholm
BUSSE-REV
TRESTENS-REV
BRUNE-REV
MARENS-REV
BORREBJERG
LAURS-REV

Chr. L'Orange lith. Etabl.

Chr. J. Cato's Lith. Etabl.