

The Norwegian Forms of *Ceramium*.

By

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(With 3 Plates.)

Through the kindness of the late professor dr. F. C. Schübeler and professor A. Blytt I have had the opportunity to examine the collection of Norwegian algæ in the Botanical Museum of the University of Christiania with the purpose of publishing a list of the marine algæ of Norway.

The named collection is brought together principally by Schübeler from the southern and south-western part of the coast and by the late professor M. N. Blytt from different parts of the coast.

Most of the specimens were undetermined. The other ones are determined 40—50 years ago, and all of them want revision. Many, however, are badly preserved or fragmentary and therefore difficult, if possible, to determine.

Some of the larger genus, as *Polysiphonia*, *Callithamnion* and *Enteromorpha* are not yet examined, and as zoological and other labours at the Museum (Scientific Society) here do not allow much work on algæ it is uncertain when the list may be published. I, therefore, want first to describe some of the critical forms found in the herbarium.

The following summary on the forms of *Ceramium* is founded, besides on the above mentioned and my own collections, on a number of algæ brought together by stud. real. H. H. Gran and stud. real. B. Hansteen from the western part of the coast, professor dr. N. Wille from the outer part of the Christiania fjord and a small collection belonging to the Museum of Bergen.

Trondhjem 27. IV. 1893.

Ceramium tenuissimum Lyngb.

Hydr. Dan. p. 120.

f. *arachnoidea* (Ag.) J. Ag.Spec. Alg. 3, p. 94; *Ceramium diaphanum* var. *arachnoideum*. Ag. Syst. Alg. p. 134.*Descr.* *Ceramium tenuissimum* var. *arachnoideum* J. Ag. l. c.

Farl. New. Engl. Alg. p. 138.

Fig. " " " " tenuicorne Kütz. Tab. Phyc. 12, t. 82.f. *typica*.*Descr.* *Ceramium tenuissimum* J. Ag. Spec. Alg. 3, p. 94.

Farl. l. c.

Fig. " " nodosum Harv. Phyc. Brit. t. 90.*Exsicc.* " " tenuissimum Aresch. Alg. Scand. exsicc. nr. 13¹.f. *divaricata* (Cr.) nob.*Ceramium divaricatum* Cr. in J. Ag. Spec. Alg. 2, p. 123.*Descr.* *Ceramium divaricatum* J. Ag. Spec. Alg. 3, p. 94.*Fig.* " " Cr. Fl. Finist. t. 12, fig. 87 bis.

As far as I have seen *Ceramium divaricatum* Cr. is differently understood by different authors. According to the description of J. Agardh l. c. it coincides with *C. tenuissimum* except in ramification and length of the cells, which also may be gathered from the cited figures by Crouan. The tetraspores seem, however, to be more covered by the cortical cells than in *C. tenuissimum*, though the latter is in this respect somewhat varying. Thus the tetraspores in f. *arachnoidea* become almost naked, while in f. *typica* they are frequently a little immersed, or more or less covered by the cortical cells. It is very nearly related to, or probably identic with *C. divaricatum* f. *patentissima* Harv. Ner. Bor. Amer. p. 217, t. 33 B, a form referred by Farlow, New Engl. Alg. p. 138 to *C. tenuissimum*. I therefore regard *C. divaricatum* Cr. only a form of the last named species. Analogous forms are to be found in some other *Ceramie*.

The plant distributed in Holmes, Alg. Brit. rar. exsicc. nr. 29 under the name of *C. divaricatum* is not referrible to the above f. *divaricata* in the sense here taken, nor the plant described under the same name in Reinbold, Rhodoph. d. Kieler Föhrde p.

¹) Areschoug later referred it (in schol. publ.) to the above f. *arachnoidea*, but the specimen in my copy of the exsiccata, though steril, seems to belong to the typical form of the species.

123, according to specimens kindly forwarded to me. Reinbold also sent me a specimen under the mscr. name *C. tenuissimum* f. *radicans* which is very nearly related in ramification to the above f. *divaricata* as I apprehend that form, but unfortunately it is steril. I have seen a similar form from Bohuslen in Sweden. I have also only seen sterile Norwegian specimens that may probably be referred to the plant in question, a fragmentareous one from Bolärene (Wille) and two small specimens from the Christiania-fjord (Blytt), the one of which being an intermediate form between f. *typica* and f. *divaricata*, the other most nearly related to the latter.

Richly tetrasporiferous specimens of f. *arachnoidea* have been collected in the middle of August at Horten (Wille). It has also been found at Svinesund and at Ladegaardsöen near Christiania (Blytt) judging from some fragmentary and sterile specimens in the herbarium, and a small steril specimen in the herbarium of Bergen's Museum is probably also from the Christiania fjord.

The typical form has been found at Bolärene (Wille), bearing numerous tetrasporangia at the end of August, and at different places along the south and south-western part of the coast.

Ceramium gracillimum Harv.

Phyc. Brit. t. 206.

f. *intermedia* nob.

f. ramis lateralibus paucis, interdum simplicibus; thalli parte inferiore 50—80 μ crassa.

In the collection of algæ in the Museum of Bergen I found two specimens of a *Ceramium* collected at Ormöen in the Christiania fjord at the end of July 1834, which in habit resemble a slender form of *C. tenuissimum* and even as to the ramification corresponds better with the latter than *C. gracillimum*. However, the ramification is difficult to follow, as the specimens have been laid out on the paper in interwoven masses and badly preserved, but the lateral branches are few in number and not much thinner than their main axis, sometimes even simple. Although the spe-

cimens are wery slender, in the lower part 50—80 μ thick, I should have referred them to *C. tenuissimum*, but I found a sporocarpium with an involucre composed of long, forked and patent branchlets agreeing with those in *C. gracillimum*. The cells are in the lower part of the frond up to 10 times, generally 5—7 times as long as broad, getting gradually shorter upwards. I therefore suppose it to be an intermediate form between *C. gracillimum* and *C. tenuissimum*, referrible to the former.

Judging from the description of *C. byssoideum* Harv. Ner. Bor. Amer. p. 218 the form seems in some respects to be rather nearly connected with that species, which probably also stands between the two named species.

Ceramium fastigiatum Harv.

in Hook. Journ. p. 303.

Descr. *Ceramium fastigiatum* Harv. Phyc. Brit. t. 255.

„ „ J. Ag. Epicr. p. 96? Cfr. Farlow, New Engl. Alg p. 137.

Fig. „ „ Harv. l. c.

Exsicc. „ „ Wyatt, Alg. Danm. nr. 86.

As Farlow l. c. remarks this species is at present a puzzle. The specimen distributed by Wyatt l. c. may probably be considered the type of the species. But a large and well developed specimen from Ireland communicated by Gilbert Sanders agrees fully with Harvey's description except that the apices are much curved and often rolled inwards, so that, judging also from American specimens, it seems to be a rather varying species and perhaps not an independent one.

I have referred a small Norwegian specimen, which I collected at Kavringen in the Christiania fjord, to the present species, though it does not fully agree with British specimens, and is rather more nearly related to a couple of American ones which I got under the name of *C. fastigiatum*, more slender, not so regularly level-topped and the upper axils rather distant. Unfortunately the specimen is steril and, therefore, the determination rather uncertain.

Ceramium Deslongchampii Chauv.

Alg. Norm. nr. 85.

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| <i>Descr.</i> | <i>Ceramium Deslongchampii</i> | J. Ag. Spec. Alg. 3, p. 97. |
| <i>Fig.</i> | " | Harv. Phyc. Brit. t. 219. |
| <i>Exsicc.</i> | " | Hauck et Richt. Phyc. univ. nr. 506. |
| | " | Aresch. Alg. Scand. exsicc. nr. 209. |
| | " | Wyatt, Alg. Danm. nr. 218. |

Along the coast of Norway have been found two or three forms of the present plant, but I have only seen sterile specimens, and the limits are, therefore, difficult to draw.

A specimen from Talvik in Finmarken collected by Kjellman agrees well with a specimen in my collection from Cherbourg, only less branched and the main filaments slightly coarser.

Some specimens of the present species in the University's herbarium under the name of *C. diaphanum* from Renö near Tromsö (Blytt) are somewhat darker, on one side resembling the above one and on the other side nearly related to the specimens distributed by Hauck et Richter l. c.

I collected some years ago at Lödingen in Nordland in the middle of March some scanty branched specimens of this species living in rock-pools between tides and fastened to other algæ, as *Rhodymenia* and *Furcellaria*. The filaments are slender and nearly uniform in thickness throughout with the lower cells scarcely longer than broad and the upper ones very short. They belong probably to the form distributed by Areschoug l. c. — A specimen communicated by Gilbert Sanders probably from Ireland and a couple of specimens from Dunbar and Joppa in Scotland collected by Geo. W. Traill almost fully coincide with the above one, so that this form seems to be rather widely dispersed. It is rather different from the above mentioned form from Cherbourg and Finmarken, and still more different from the rather coarse form distributed by Wyatt l. c. I have not seen any Norwegian specimen fully agreeing with the latter.

Ceramium diaphanum (Lightf.) Roth

Cat. Bot. p. 154; Conferva diaphana Lightf. Fl. Scot. p. 996,

f. *stricta* (Harv.) nob.

Ceramium strictum Harv. Phyc. Brit. t. 334.

Descr. *Ceramium strictum* J. Ag. Spec. Alg. 3, p. 97.

Fig. " " Harv l. c.

Exsicc. " " Hauck et Richt. Phyk. univ. nr. 104.

" " diaphanum Aresch. Alg. Scand. exsicc. nr. 161 et 210.

f. *patentissima* nob.

f. *segmentis patentibus vel sæpe divaricatis, ceteris f. strictæ persimilis.*

f. *typica.*

Descr. *Ceramium diaphanum* J. Ag. l. c. p. 98.

Fig. " " Harv. Phyc. Brit t. 193.

Exsicc. " " Hauck et Richt. Phyc. univ. nr. 103.

f. *Capri Cornu* (Reinsch) nob.

Hormoceras Capri Cornu Reinsch, Contrib. ad Algol. et Fung. p. 57, t. 47, sec. Farl. New Engl. Alg. p. 138.

Descr. *Ceramium Capri Cornu* Farl. l. c.

Fig. " " " tab. nostr. 1, Fig. 5—8.

Ceramium strictum is a species which has often been confounded with *C. diaphanum* as the only distinction between these two species consists in a difference in ramification and the length of the involucre, which, however, is not constant. They are both much varying, and numerous transitions may be found. I have seen several specimens connecting the two species, and hardly any limit can be drawn between them. I therefore regard the former a form of the latter and elder species. Analogous forms are to be found in 3 or 4 other Norwegian species of *Ceramium*.

I have seen specimens of f. *stricta* from Strand on the west coast (Hansteen), Ljan at Christiania (Gran) with rather numerous side branches and swollen nodes bearing tetrasporangia in the beginning of June, Ladegaardsöen (Blytt), Espevär (Gran) with numerous but short side branches, provided with sporocarps in July and with an elongated involucre, Strand on the western coast (Hansteen) and from Trondhjem (Blytt). Thus it seems to be commonly spread along the southern and western part of the coast.

The typical form seems to be more scarcely dispersed and probably having its proper area of distribution along the western part of the coast. I have collected specimens (not quite typical)

near Svelvig in the outer part of the Drammen fjord, and a couple of small specimens have been taken in the Trondhjem fjord.

In some specimens that I have collected at Svinör near Lindesnes the filaments are slender (100—150 μ) and nearly uniform in thickness throughout as in *f. stricta*, but in ramification and length of the cells they are most nearly related to *f. typica*, though more sparingly branched, and the sporocarps have a short involucre. Another intermediate form has been collected at Stolmen on the western coast (Hansteen). And a specimen from the Trondhjem fjord (Blytt) fully agrees with typical *C. diaphanum* except that the involucre is even more elongated than in the typical *f. stricta*.

The upper specimen in Aresch. Alg. Scand. exsicc. nr. 161 with rather attenuating filaments is also to be regarded as a transition to *f. typica*, though most nearly related to *f. stricta*. The Norwegian forms of *f. stricta* are in general more slender than southern ones and as far as I have seen never so coarse and straight as the form distributed by Hauck et Richter l. c.

I have only seen a single and not quite typical Norwegian specimen of *f. patentissima*, collected by Sommerfelt at Bodö and determined by Lyngbye as *C. diaphanum*. It is most nearly related to *f. stricta*, but separated from it especially by the upper segments being more patent and not seldom strongly spreading, and the cells are shorter, generally about twice as long as broad. It may perhaps be this form quoted in Holmes et Batters Rev. List. of the Brit. Mar. Alg. under the name of *C. strictum f. divaricata* and said to be identic with *C. diaphanum* Cr., but without any description. *C. diaphanum* Cr. Fl. Finist. p. 140 probably also includes other forms of the species.

I do not know whether I may be wrong in the above reference of *C. Capri Cornu*. I found some specimens at Hvalöerne at the south-eastern part of the coast which agree well with the description of *C. Capri-Cornu* in Farl. New Engl. Alg. p. 138. I have not had the opportunity of seeing the description and figure of Reinsch. l. c. The specimens are 2—4 cm high, dichotomous, with partly more numerous dichotomous or subdichotomous

and rather short lateral branches especially in the upper segments. The principal divisions of the frond are in some of the specimens provided with very short incurved or recurved branchlets which arise singly or in two to four nearly at every node, in others these branchlets are few in number and form transitions to small and robust specimens of f. *typica*. The cells in the lowest part of the frond are about as long as broad, in the middle $1\frac{1}{2}$ —3 times longer than broad and again gradually shorter upwards. Pl. 1, Fig. 5—6.

The specimens were richly sporocarpiferous at the end of August, the sporocarps borne in the upper segments or side branches with a short or sometimes elongated involucre of 3—5 branchlets.

In old and more driven specimens of the present plant the branchlets at the nodes are somewhat elongated, and the lateral branches numerous and often forming dense clusters giving it a bushy appearance. Such specimens are sparingly sporocarpiferous. Pl. 1, fig. 7—8.

The colour is somewhat darker than in typical *C. diaphanum*, and the nodes are in general not swollen.

A form from Fredriksvärn (Wille) is most nearly related to the above one from Hvalöerne and bears here and there some few short branchlets at the nodes, and another one from Bolärene (Wille) is more robust, with numerous short lateral branches, resembling small and robust specimens of f. *typica*, also beset with very short branchlets at some of the nodes, and probably referrible to the same form.

Ceramium circinatum Kütz.

Hormoceras circinatum Kütz. Linnæa p. 733.

f. *tenuis* nob.

f. *ramosissima*, ramis lateralibus plerumque numerosis, subdivotomis; thalli parte inferiore 200—300 μ , superiore 100—150 μ crassa, attenuata; interstitiis inferioribus et supremis corticatis, ceteris partim corticatis vel fere nudis. Tab. 2, fig. 2—3.

f. *genuina* nob.

f. ramis lateralibus paucis, conformibus, subdichotomis; interstitiis in parte thalli inferiore et superiore plerumque corticatis, in media parte linea angusta nuda.

f. *rigida* nob.

f. parce ramosa, ramis lateralibus paucis, simplicibus; thalli parte inferiore 400—500 μ crassa; interstitiis inferioribus et superioribus vel corticatis vel linea angusta nuda, in media parte plerumque semicorticatis. Tab. 1, fig. 1—3.

f. *divaricata* nob.

f. segmentis patentibus vel sæpe divaricatis, terminalibus parum forcipatis, ramis lateralibus paucis, plerumque simplicibus; interstitiis thalli parte inferiore fere nudis, apicem versus sensim corticatis. Tab. 1, fig. 4.

f. *borealis* nob.

f. ramis principalibus inferne 450—650 μ crassis, ramis lateralibus subdissimilibus, subdichotomis vel simplicibus obsitis; interstitiis thalli parte inferiore vel tenue corticatis vel linea angusta nuda, superioribus et ramis lateralibus fere nudis. Tab. 2, fig. 1.

This species is like most of the other *Ceramia* rather varying and includes several forms, some of them analogous to those of *Ceramium rubrum*. The above quoted are the most characteristic ones along the Norwegian coast, and rather easily recognised.

In the University's herbarium I found some specimens of the above f. *tenuis* under the name of *C. diaphanum*, collected by M. N. Blytt at Flekkefjord on the southern part of the coast. It somewhat reminds one of more slender forms of that species in habit, but a distinct cortical layer shows it as belonging to *C. circumdatum*. The specimens are 6—8 cm. high, much branched in a subdichotomous manner, with mostly numerous conform side branches, which in the lower part of the frond are thinner than their main axis. It is branched nearly from the hold fast, and has more or less distinct leading branches, sometimes, however, impossible to follow except in the lower part of the frond. Here it has a thickness of 200—300 μ , much attenuating upwards, in the upper part 100—150 μ thick, and from there still attenuating

towards the apex. Pl. 2, fig. 2—3. The cells are in the lower part of the frond 2—3 times as long as broad, getting gradually shorter upwards, and in the upper segments and upper part of the side branches about as long as broad, or shorter. The lower internodes are corticated, or leaving a narrow but rather sharply defined pellucid band, getting less and less corticated towards the middle or upper part, and from there the cortical layer again increases and gets confluent.

The sporocarps are borne in the upper segments or side branches, with an elongated involucre of 2—4 branchlets.

I have collected this form at Svinör in the neighbourhood of Lindesnes, fastened to the leaf of *Laminaria digitata*, bearing sporocarps in the later half of August.

A small and fragmentous specimen from Mandal is less branched with few lateral branches and seems to form a transition to small specimens of f. *genuina*, but it is more slender than typical specimens of that form.

A specimen collected by M. N. Blytt at Nerstrand in the neighbourhood of Stavanger is also most nearly related to f. *tenuis*, but it is a little coarser and the upper segments are here and there much spreading. It is provided with sporocarps which principally are borne on the upper as well as lower side branches with a mostly elongated involucre like that in the typical specimens from Flekkefjord.

I have not seen specimens of f. *tenuis* from other parts of the coast, and it seems to be a southern form of the species.

The form that I have called f. *genuina* is analogous to and reminds one in habit of the form *decurrens* of *C. rubrum*. It is not so regularly dichotomous, now and then with subsimple side branches, in the lower part of the frond 350—500 μ thick, and gradually but feebly attenuating upwards. I have seen a couple of large and well developed but sterile specimens of this form from Alvestrømmen near Bergen growing on a depth of 3—4 fathoms, collected and referred by B. Hansteen to *C. rubrum* f. *decurrens*. It rather resembles that form, though much darker and in my opinion a true *C. circinatum*. The cortical layer is

confluent in the lower and upper part of the frond, in the middle extending upwards and downwards, equal in thickness and only a little thinner than that of the nodes, leaving a very narrow but sharply defined naked band, or at least more distinct than in any form of *C. rubrum* f. *decurrens*. The corticated part has a more or less tun-shaped outline, which seems always to be the case in much corticated forms of *C. circinatum*. In *C. rubrum* f. *decurrens* the cortical layer especially in the upper part of the main branches gradually gets thinner from the nodes to the naked part of the internodes, the corticating cells are arranged in series most often unequal in length, and the uncovered part of the internodes is not translucent but pale or yellowish, so that the limit between the corticated and uncorticated part is rather indistinct except in the younger branches.

A young specimen from Flekkefjord (Blytt) about 4 cm. high is regularly dichotomous, with some few conform side branches, rather slender and in habit closely resembling young individuals of *C. rubrum* f. *decurrens*. Another younger specimen from Medholmen at the south-western coast (*C. circinatum*? Hanst. herb.) has about the same thickness as f. *tenuis* but in ramification it nearly coincides with the last named specimen, though not so regularly dichotomous, and both are most nearly related to f. *genuina* of the present species.

Among the collections brought together by M. N. Blytt I found some coarse and rigid specimens of the present species from Flekkefjord, the above quoted f. *rigida* which seems to be a rather well characterized form. It is 7—10 cm. high, 400—500 μ thick in the lower part and scantily branched in a subdichotomous manner, feebly attenuating upwards, with few, simple but sometimes rather spreading side branches of nearly the same thickness as their main axis. Pl. 1, fig. 1—3. The cells are 2 times as long as broad, getting shorter towards the tip. The cortical layer is in general rather thin, in the lower and uppermost part of the frond confluent or nearly confluent, in the middle extending more upwards than downwards leaving either a narrow but distinctly

marked pellucid band, or sometimes about the half of the internodes naked.

A couple of specimens collected by N. Wille at Bastö and Vallö in the outer part of the Christiania fjord with more or less patent segments, thinner side branches and the upper part of the frond more corticated seem to form a transition to *f. divaricata*, though most nearly related to *f. rigida*.

The form *divaricata* is nearly related to *f. rigida*, of the same size but differs in ramification, generally with strongly spreading segments, a little thinner, more branched and more attenuating upwards. Pl. 1, fig. 4. The lower cells are $1\frac{1}{2}$ —2 times longer than broad, getting gradually shorter upwards. The internodes in the lower part of the frond are sometimes naked, sometimes and more often corticated in about one third of their length, soon getting more and more corticated upwards, so that in the middle there is only a narrow pellucid band, and in the upper part quite corticated, or here and there with a very narrow but sharply defined pellucid band.

The form of the species I met with in the „amt“ of Tromsö and the southern part of West-Finmarken is the above mentioned *f. borealis* living on so-called dead or clayish bottom on a depth of 3—6 fathoms in sheltered places, local but pretty plentiful. It is not much varying, and the same form has been found at different places along the named part of the northern coast. In some respects it corresponds with the form *pedicellata* of *C. rubrum*, and sometimes it approaches to the form *genuina* of the present species. It has stout leading branches, in the lower part 450—650 μ thick, which are beset with lateral simple, forked or subdichotomous and rather elongated branches much thinner than their main axis. The thallus is more or less richly prolificating. Pl. 2, fig. 1. In some of the specimens collected the internodes of the lower leading branches are corticated upwards in about half the length, and the upper part of the branches as well as the lateral ones are scarcely corticated at all. In other specimens the corticating cells also extend downwards from the nodes but never as much as upwards. In others again, and especially old individuals,

the lower half of the main branches have the internodes covered with a thin cortical layer here and there leaving a very narrow but distinct translucent band, and a more or less tun-shaped outline. The cells are in the lower part of the frond 2—3 times longer than broad, getting gradually shorter upwards, and very short towards the apex. Specimens collected in the later half of August and earlier half of September were sterile. This form gets up to 20 cm. in length.

At Lödingen in Nordland I have collected the same form living under the same conditions as farther north. Specimens collected in July and October were sterile. A solitary small specimen taken in the middle of September is provided with some few sporocarps. These are borne on the upper branches, solitary or in pairs, with a more or less elongated involucre of 3—4 branchlets. There I also found another form most nearly related to the last named one with patent or sometimes strongly spreading main branches and the corticating layer of the internodes nearly as dark as that of the nodes, leaving a more or less narrow pellucid band, and confluent in the upper part of the branches.

Some years ago I collected a *Ceramium* at Russemark in the most eastern part of West-Finmarken, fastened to smaller stones or sometimes to other algæ on sandy bottom on a depth of 2—4 fathoms. I thence sent a specimen to J. G. Agardh, who kindly communicated to me, that he supposed it to be a form of *C. strictum*. The specimens had no decurrent cortical layer. It is the form mentioned from West-Finmarken in Contrib. I, p. 38. Later collecting large and well developed specimens at the same place I found, that most of them in the lowermost part of the frond had the internodes covered with a decurrent but not distinctly marked, or sometimes even confluent cortical layer. Most of the specimens were when collected nearly white or yellowish white, getting somewhat darker in drying, but the leading branches often still nearly equal in colour throughout, the nodes, however, become more and more distinct and darker upwards. The larger specimens of this form are 20—25 cm., sometimes even up to 30 cm. long, in the the lower part, or 3—6 cm. from the root, up to

650 μ thick, partly much, partly little attenuating downwards and gradually attenuating upwards. The stout leading branches are beset with in general numerous secondary, subdichotome, forked or simple elongated branches generally much thinner than their main axis. The thallus is often more or less richly prolificating. The cells are 2—3 times as long as broad.

Specimens found in July and August were richly provided with sporocarps or tetrasporangia. The former are mostly borne on the side branches in the upper as well as lower part of the frond with an elongated involucre. The latter are more or less projecting in a single or sometimes nearly double ring around the nodes of the upper segments or side branches.

For the present I refer this form to f. *borealis*, though it in some respects does not fully agree with that one.

Ceramium rubrum (Huds.) Ag.

Disp. Alg. p. 16; *Conferva rubra* Huds. Fl. Angl. p. 600.

f. *decurrens* J. Ag.

Spec. Alg. 2, p. 127.

Descr. *Ceramium rubrum* α *decurrens* J. Ag. Spec. Alg. 3, p. 100.

Exsicc. „ *decurrens* Aresch. Alg. Scand. exsicc. nr. 208.¹⁾

f. *virgata* Ag.

Ceramium rubrum δ *virgatum* Ag. Spec. Alg. 2, p. 149.

Descr. *Ceramium rubrum* δ *virgatum* J. Ag. Spec. Alg. 3, p. 100.

Fig. „ „ *flagelliferum* Kütz. Tab. Phyc. 13, t. 8.

„ „ *rubrum* f. *virgata* tab. nostr. 3, fig. 4.

f. *genuina*.

Descr. *Ceramium rubrum* f. *genuina* Kjellm. N. Ish. Algfl. p. 214.

Exsicc. „ „ Aresch. Alg. Scand. exsicc. Ser. I, nr. 55.²⁾

f. *pedicellata* Duby.

sec. J. Ag. Spec. Alg. 2, p. 128.

Descr. *Ceramium rubrum* η *pedicellatum* J. Ag. Spec. Alg. 3, p. 101.

Fig. „ „ Kütz. Tab. Phyc. 13, t. 4, fig. a—b.

Cfr. *Ceramium rubrum* Harv. Phyc. Brit. t. 181.

f. *prolifera* (Lyngb.) J. Ag.

¹⁾ The specimens distributed in Aresch. Alg. Scand. exsicc. nr. 81 under the name of *Ceramium rubrum* are intermediate forms between f. *decurrens* and the forms *pedicellata* and *prolifera*.

The specimen here distributed is not quite typical f. *genuina*, but forms in some respects a transition to f. *pedicellata*.

Spec. Alg. 2, p. 127; *Ceramium rubrum* β proliferum Lyngb. Hydr. Dan. p. 119.

subf. *botryocarpa* (Harv.)

Descr. *Ceramium rubrum* β proliferum ** proliferum J. Ag. Apec. Alg. 3, p. 100.

Fig. „ *botryocarpum* Harv. Phyc. Brit t. 215.

subf. *secundata* (Lyngb.)

Descr. *Ceramium rubrum* β proliferum * secundatum J. Ag. l. c.

Fig. „ secundatum Lyngb. Hydr. Dan. t. 37 A.

„ „ *rubrum* f. *prolifera* subf. *secundata* tab. nostr. 3, fig. 5.

f. *tenuis* (Ag.) J. Ag.

Spec. Alg. 2, p. 128; *Ceramium rubrum tenue* Ag. sp.

Descr. *Ceramium rubrum* γ tenue J. Ag. Spec. Alg. 3, p. 100.

Fig. „ „ f. *tenuis* tab. nostr. 3, fig. 1.

f. *fasciculata* (Bonnem.) J. Ag.

Spec. Alg. 2, p. 128; *Boryna variabilis* var. *fasciculata* Bonnem. Ess. p. 53.

Descr. *Ceramium rubrum* ϵ *fasciculatum* J. Ag. Spec. Alg. 3, p. 100.

Fig. „ „ f. *fasciculata* tab. nostr. 3, fig. 2—3.

f. *corymbifera* (Bonnem.) J. Ag.

Spec. Alg. 2, p. 128; *Boryna variabilis* var. *corymbifera* Bonnem. Ess. p. 53

Descr. *Ceramium rubrum* ζ *corymbifera* J. Ag. Spec. Alg. 3, p. 101.

Fig. „ „ f. *corymbifera* tab. nostr. 3, fig. 6.

f. *squarrosa* Harv.

Ner. Bor. Amer. 2, p. 214.

Descr. *Ceramium rubrum* θ *squarrosus* Harv. l. c.

Fig. „ „ f. *squarrosa* Kjellm. l. c. t. 15, fig. 7.

Specimens of the present species with a decurrent cortical layer have commonly been referred to the form *decurrens*. It is, however, a rather varying form, and within this limit it includes two or three forms which probably ought to be kept distinct. Thus a specimen in my collection from Svärholt in Finmarken is quite different from typical specimens of the form. It is coarser, not regularly dichotomous, with in general erect segments, numerous simple or forked, more or less elongated, straight and much attenuating, nearly subulate side branches. The main filaments are corticated in the lower half of the frond, and from there the internodes get more and more naked. The internodes of the side branches are mostly naked, or the lower ones provided with a short decurrent cortical layer. The nodes are especially in the upper part of the frond somewhat swollen, with the immersed

tetraspores in a single or sometimes double ring round the nodes. In typical *f. decurrens* the segments are more spreading and the side branches, which often may be numerous, mostly dichotomous.

A slender form from the southern part of the coast is also rather differing from typical specimens in ramification as well as that the filaments are still more attenuating, rather coarse in the lower part and very slender in the upper part of the frond.

The materials at my disposal are, however, too little to draw the limits in a case of so extremely varying forms as those of the present species, and therefore I for the present refer the named ones to the form *decurrens*. This form is common and rather abundant all along the Norwegian coast.

The form *virgata* is thinly corticated and stands in this respect as well as to its colour between *f. decurrens* and *f. genuina*, but also in ramification transitions are to be found. The plant figured in Kütz. Tab. Phyc. l. c. certainly belongs to this form, though less attenuating downwards and upwards. The side branches are in a single specimen from Stavanger, that I have seen and referred to the named form, not seldom dichotomous or sub-dichotomous, but not so numerous as the simple or forked, elongated ones. Cp. pl. 3, fig. 4. They are much attenuating towards the base as well as to the apex. The articular cells are indistinct especially in the lower part of the main filaments, but in the upper segments and in the side branches the nodes form a darker and distinct, but narrow band, rather sharply defined from the internodes.

The most common form of the species along the coast of Norway is *f. genuina*, and it is to be found almost everywhere in a great number of individuals. It is, however, much varying, and transitions are to be found to every one of the other forms here mentioned, but especially to *f. decurrens*, *f. pedicellata* and *f. prolifera*. The form is here taken in a wider sense than the description referred to, and it probably includes forms which ought to be kept distinct. Among these I want to point out an interesting one, of which, however, I have seen only a single specimen from Espevär on the west coast (Hoch). It is much branched

in a nearly subdichotomous manner, with a rounded outline, bearing numerous simple or forked, not seldom subsecund side branches now and then attenuating towards the base. It is rather thinly corticated, but the articular cells are very indistinct in every part of the frond. The tetraspores are mostly half or not seldom more projecting in the upper segments and side branches, rather irregularly scattered or heaped together in greater numbers.

The forms *pedicellata* and *prolifera* are commonly spread except at the most northern part of the coast, where especially the latter is rare. The limit between f. *genuina* and f. *pedicellata* is not sharply defined, and transitions between the latter and f. *prolifera* also are numerous. Of the subform *secundata* (pl. 3, fig. 5) I have only seen a couple of typical Norwegian specimens, but transitions between this one and the subform *botryocarpa* are not seldom met with. A peculiar form of the latter has been found at Lister. The main filaments are scantily branched, but bears numerous verticillate and short, curved branchlets almost at every node, reminding one somewhat of a small and coarse *Spyridia filamentosa*.

A probably very scarce form is f. *tenuis*, of which I have found a solitary specimen at Mandal. Pl. 3, fig. 1¹⁾. It is regularly dichotomous with dichotomous, secund side branches, dark and densely corticated in every part of the frond, the articular cells are distinct, and the nodes form a dark and narrow, but sharply defined band in the elder as well as the younger parts of the frond. It reminds one of f. *prolifera* subf. *secundata*, but is on closer examination easily separated. Cp. pl. 3, fig 1 and 5. The branches are never attenuating towards the base, but rather much towards the apex.

A couple of larger specimens, about 12 cm. long, from Borgevår in Lofoten form a transition between f. *tenuis* and f. *genuina*. They coincide fully with the former, except that the side branches are less regularly secund.

The form *fasciculata* has been found at Fredriksvärn (Wille)

¹⁾ The figure does not give a good idea of the plant, as it is very indistinct and especially the characteristic dichotome side branches are nearly disappeared in the res

together with a specimen forming transition to *f. corymbifera*, and I have collected a couple of specimens at Svinör near Lindesnes and transitions between this form and especially the form *genuina* at Kristiansund. Pl. 3, fig 2-3.

I have referred the plant figured on pl. 3, fig 6 to *f. corymbifera*, and it certainly belongs to this series of forms, but the specimen does not fully agree with Agardhs description l. c. The colour is lighter and the cortical layer not so dense as in *f. fasciculata*, and the articular cells are not quite distinct. It is collected at Sandösund (Schübeler) together with transitions to *f. genuina*. Nearly the same form has been taken at Lillesand (Schübeler), and an intermediate form between *f. corymbifera* and *f. fasciculata* has been found at Langesund (Schübeler). I have collected an intermediate form between *f. corymbifera* and *f. genuina* at Gamvik (Sörö) in West-Finmarken, and a couple of specimens from Syltefjord in East-Finmarken referrible to *f. genuina*, but with the branches especially in the upper part of the frond regularly corymbose-fastigiata also are rather nearly connected to *f. corymbifera*. It seems, however, to be a form rather independent.

I have not seen typical Norwegian specimens of *f. squarrosa*. It has been found at Nordland according to Kjellman l. c. A specimen from Mandal most nearly related to *f. genuina* forms a transition to *f. squarrosa*. The upper segments are strongly spreading except those of the last order which are less spreading and never recurvate as in typical *f. squarrosa*. Another specimen that I have collected at Skorpen in Tromsö amt almost fully coincide with the last one in ramification, but in cortication it resembles typical *f. decurrens*. A specimen from Dröbak most nearly related to *f. genuina* also reminds one of *f. squarrosa* by the segments of the last order being strongly spreading. American specimens of the named form have a dense cortical layer in the elder as well as younger parts of the frond, with a darker and narrow, but rather distinct band at the nodes, most nearly resembling the cortical layer in *f. tenuis*.

Ceramium flabelligerum J. Ag.

Advers. p. 27.

Descr. *Ceramium flabelligerum* J. Ag. Epicr. p. 103.*Fig.* " " Harv. Phyc. Brit. t. 144.*Exsicc.* " " Le Jol. Alg. mar. Cherb. nr. 64.

I have seen a single Norwegian specimen of this alga from Mosterhavn on the western part of the coast. It is 3 cm. long, and the spines are very few in number, in some parts of the plant even quite wanting. The species gets smaller, and the spines seem to decrease in number to the north. Specimens I have collected at the Isle of Wight are provided with spines nearly at every node like fig. 2 in Harv. Phyc. Brit. l. c. — P. Magnus remarks however in Nordseef, p. 68 as to the specimens of the present plant that he collected between Fisherrow and Edinburgh: „Es ist recht bemerkenswerth, dass viele Aeste der hier getroffenen Pflanzen die für die Species so charakteristischen Stacheln entweder gar nicht oder nur vereinzelt anlegten, während wiederum andere Aeste derselben Exemplare die Stacheln zahlreich bildeten“. The plant from Mosterhavn has about the same size as a specimen from Edinburgh collected by Magnus, but the spines appear only scattered here and there in the upper part of the frond.

Ceramium acanthonotum Carm.

in J. Ag. Advers. p. 26.

f. *typica*.*Descr.* *Ceramium acanthonotum* J. Ag. Spec. Alg. 3, p. 103.*Fig.* " " Harv. Phyc. Brit. t. 140.*Exsicc.* " " Aresch. Alg. Scand. exsicc nr. 12.f. *coronata* Kleen.

Nordl. Alg. p. 19.

Descr. *Ceramium acanthonotum* var. *coronata* Kleen l. c.*Fig.* " " " " l. c. t. 10, fig. 5.

As remarked by Kjellman N. Ish. Algfl. p. 217 the form *coronata* is rather little independent, and it can hardly be kept distinct. In most of the Norwegian specimens of the present alga one frequently meets with somewhat irregularly arranged spines, and I have seen every transition to that in the named form.

The species seems to be commonly dispersed along the unsheltered part of the coast at least from Svinör near Lindesnes to Nordland. Specimens have been found at different places provided with tetrasporangia in July and August.

Ceramium ciliatum (Ellis) Ducl.

Ess. p. 64; *Conferva ciliata* Phil. Trans. 57, p. 425.

Descr. *Ceramium ciliatum* J. Ag. Spec. Alg. 3, p. 103.

Fig. " " Harv. Phyc. Brit. t. 139.

Exsicc. " " Hauck et Richt. Phyk. univ. nr. 152.

" " Le Jol. Alg. mar. Cherb. nr. 163.

According to Areschoug Phyc. Scand. p. 322 this species has been found at Stavanger (Blytt).

Ceramium echionotum J. Ag.

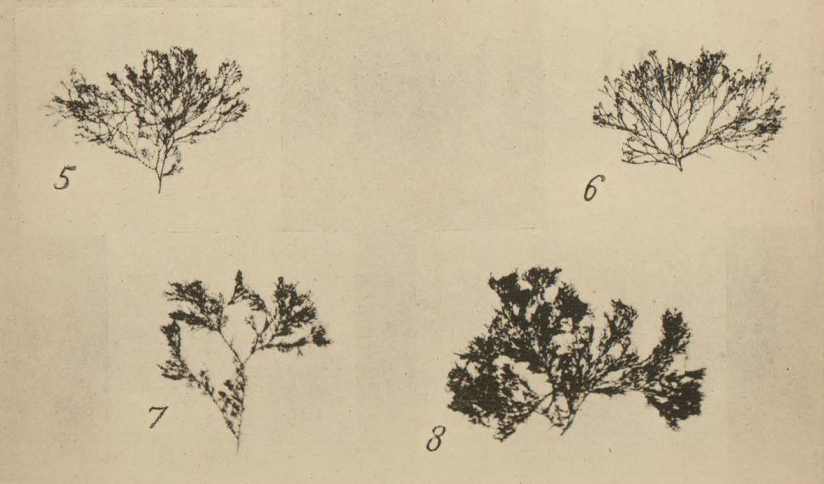
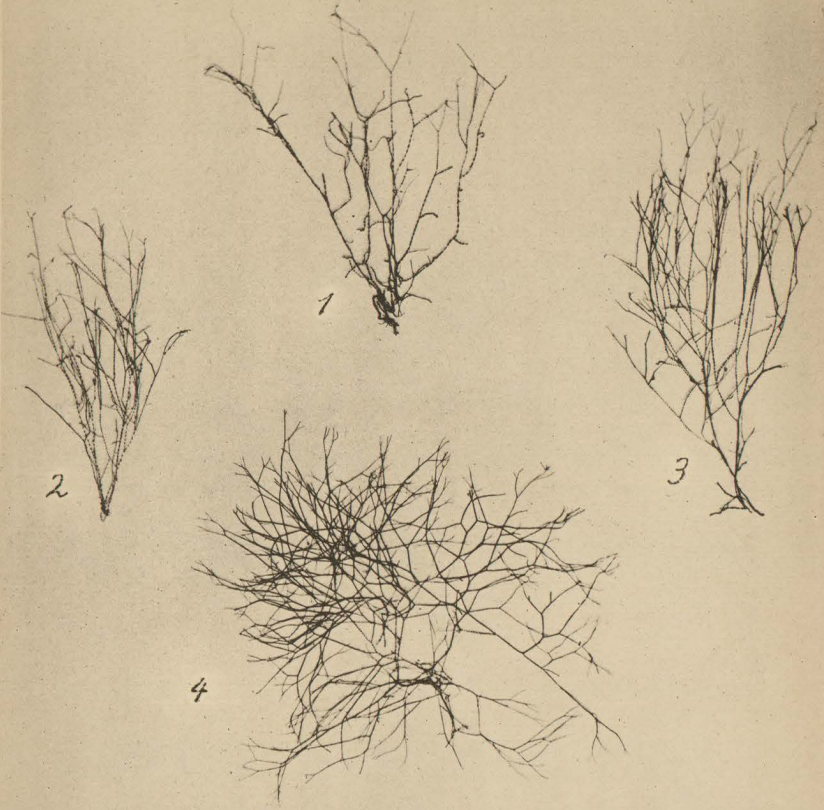
Advers. p. 27.

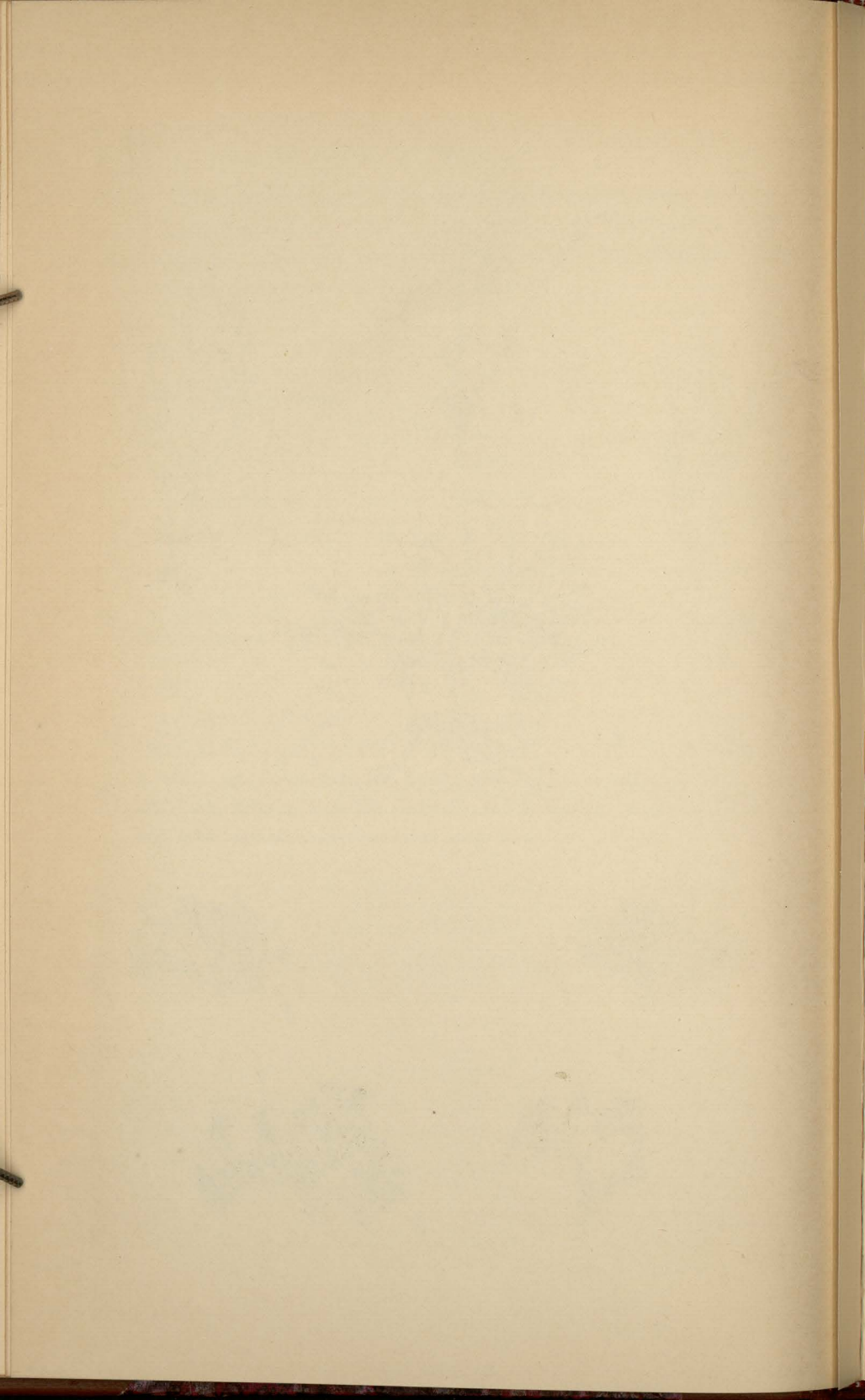
Descr. *Ceramium echionotum* J. Ag. Spec. Alg. 3, p. 102.

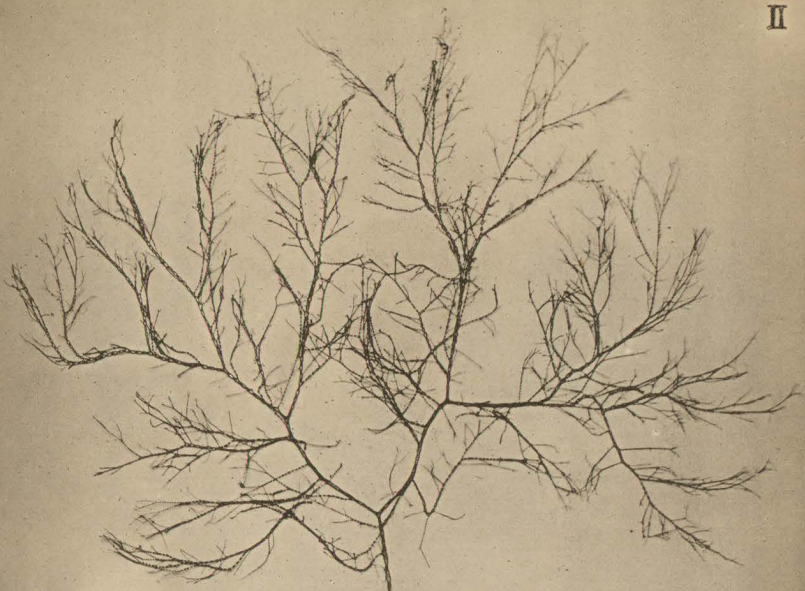
Fig. " " Harv. Phyc. Brit. t. 141.

Exsicc. " " Le Jol. Alg. mar. Cherb. nr. 223.

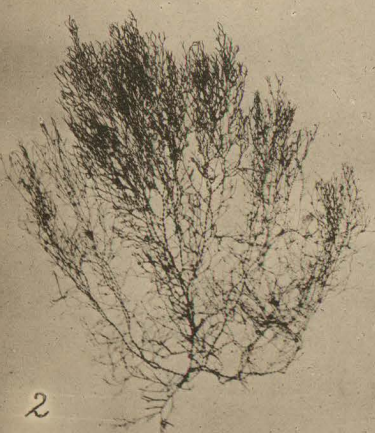
A small specimen of this plant, about 1 cm. high, has been found at Bolärene provided with sporocarps at the end of August. It bears spines only in the upper and younger parts of the frond and even here in a small number, but is on the contrary furnished with rather numerous and long hairs.







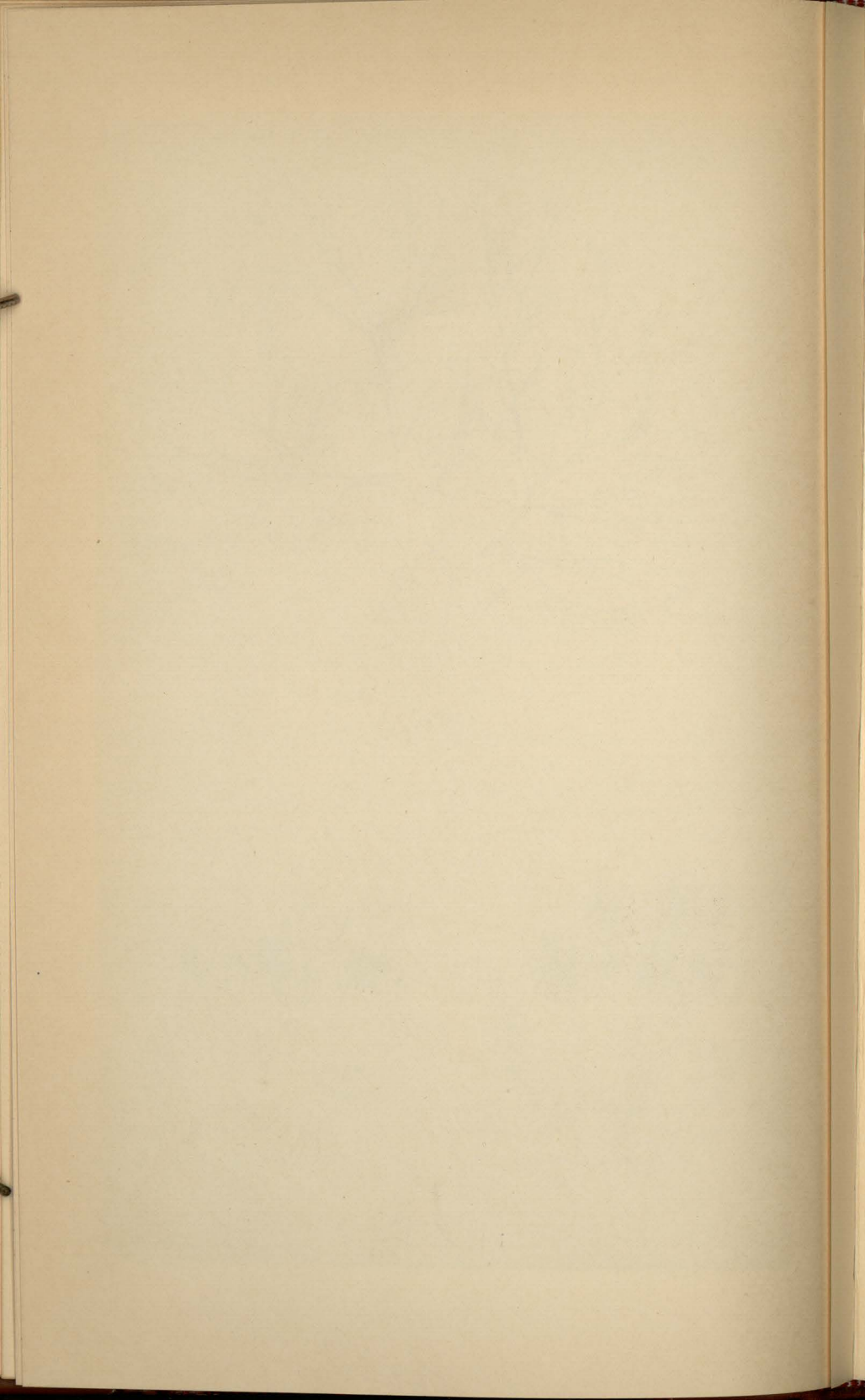
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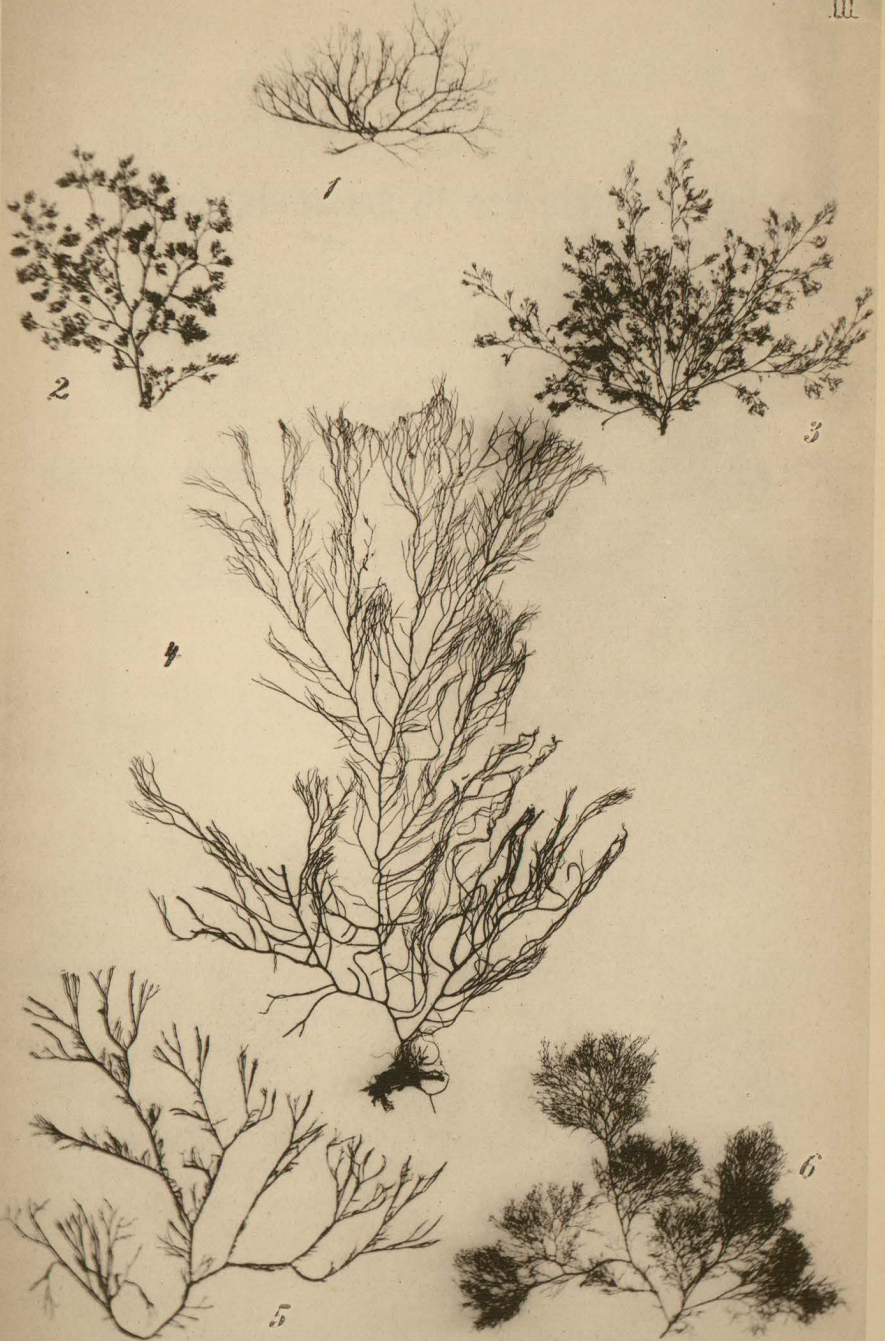


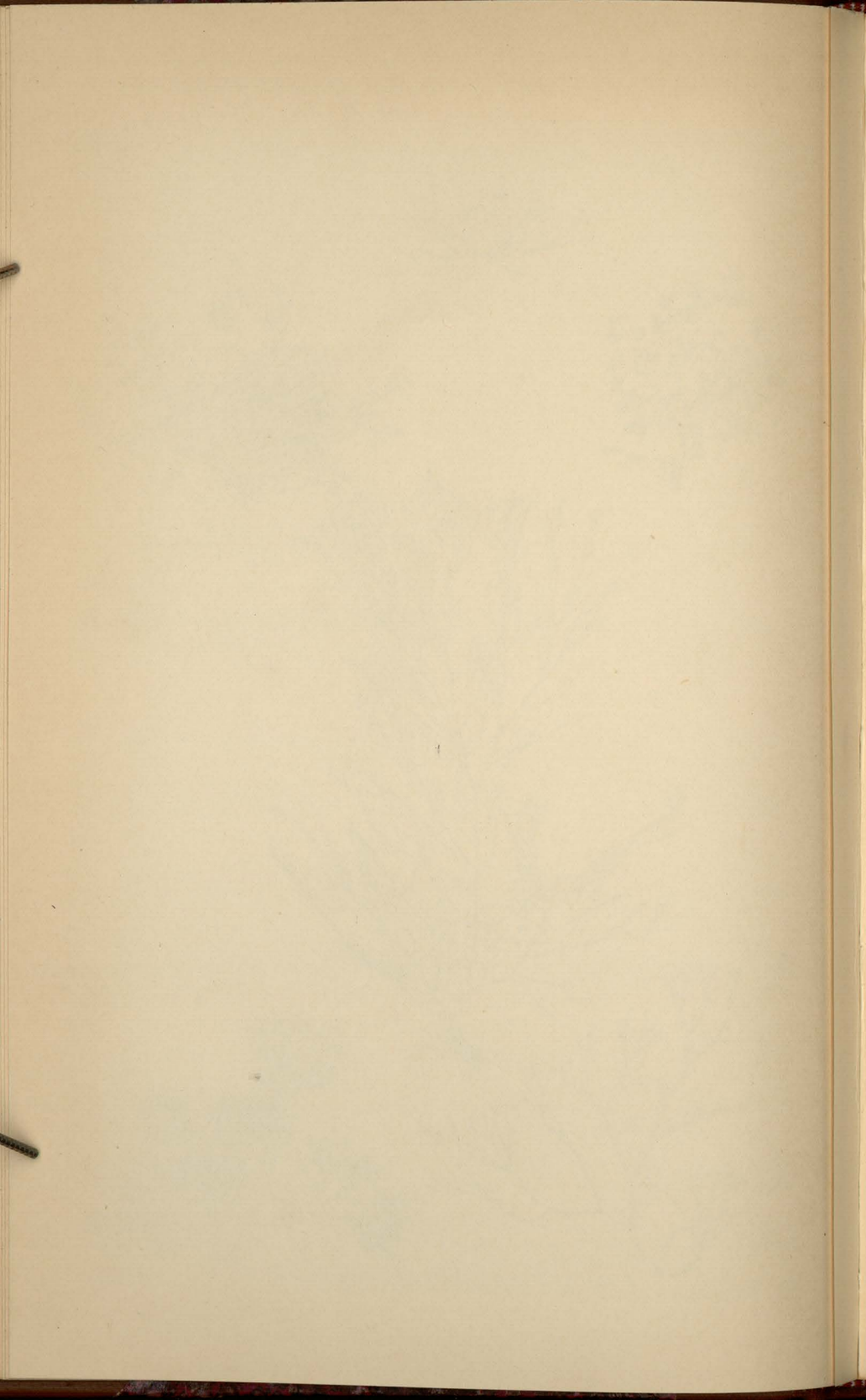
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3







Explanation of the plates.

Pl. 1.

- Fig. 1—3. *Ceramium circinatum* f. *rigida*.
 " 4. " " f. *divaricata*.
 " 5—8. " *diaphanum* f. *Capri Cornu*.

Pl. 2.

- Fig. 1. *Ceramium circinatum* f. *borealis*.
 " 2—3. " " f. *tenuis*.

Pl. 3.

- Fig. 1. *Ceramium rubrum* f. *tenuis*.
 " 2—3. " " f. *fasiculata*.
 " 4. " " f. *virgata*.
 " 5. " " f. *prolifera* subf. *secundata*.
 " 6. " " f. *corymbifera*.
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