

RARE OR OTHERWISE INTERESTING MARINE ALGAE FROM THE NETHERLANDS

BY

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Thanks to many collaborators, C. BRAKMAN, C. DEN HARTOG, Dr P. KORRINGA, J. A. W. LUCAS, A. MULDER, J. G. SLOFF, B. J. J. R. WALRECHT a.o. who sent Algae for identification to the Rijksherbarium and gave information about habitats, it is possible now to add new data to VAN GOOR's work on the Netherlands marine Algae. However, a complete review of the larger marine Algae occurring in that country can only be given after such genera as *Enteromorpha*, *Monostroma*, *Ceramium*, *Callithamnion* and *Ectocarpus* will have been revised for the Netherlands.

A *Rhodophyceae* unknown from the Netherlands up to that time was collected by C. DEN HARTOG and A. MULDER in 1950. It was identified by the first collector. This Alga, *Dasya pedicellata* (Ag.) Ag. (syn. *D. elegans* (Mart.) Ag.), *Dasyaceae*, was collected in one of the canals in Zeeland, which contain seawater "Kanaal door Zuid-Beveland", Island of Zuid-Beveland. It was found growing in a great abundance in the same canal by several collectors in 1951. This locality is remarkable, for the species usually occurs in warmer regions: Mediterranean, Atlantic from southern Spain to Canaries (FELDMANN p. 94), Antilles (BØRGESEN p. 317), Atlantic coast of North America from Florida to Massachusetts (TAYLOR p. 355) and Pacific coast of Baja California (DAWSON p. 56). In Zuid-Beveland the species was found growing at a depth of 1—1½ m. TAYLOR records a depth of 1—4 m and FELDMANN dragged it from 25—30 m in the Mediterranean; FUNK (p. 456—457) also records this species at a great depth in the Mediterranean, though occasionally he found it at a depth of 10 m and even in one case near the water-mark.

Another *Rhodophyceae*, unknown for the Netherlands up to this time, was collected by J. A. W. LUCAS (1950) in Schouwen, south coast near Zierikzee outside the dike, on the base of *Codium*, $\pm \frac{1}{2}$ m below low-tide mark. It was given to the author for identification and appeared to be *Phyllophora membranifolia* (Good et Woodw.) J. Ag., *Phyllophoraceae*. Its distribution is: Iceland, Norwegian west coast (Levring p. 110), Swedish west coast (KYLIN, 1944, p. 57), Danish coast (K. ROSENINGE p. 521), British coasts (NEWTON p. 410),

Atlantic coast of Belgium, France and Spain (CHALON p. 140) and of North America (TAYLOR p. 298).

A *Phaeophyceae* previously unknown from the Netherlands, which came to the author's hands, appeared to be ***Leathesia difformis*** (L.) Aresch., *Leathesiaceae*. It was collected by K. SWENNEN (1950) on a shallow in the Balgzand (Wadden), east of Den Helder, growing on *Chaetomorpha linum*. Its gelatinous-fleshy, at first globose and solid, afterwards irregularly shaped, lobed and often hollow globules are $\pm 3-15$ mm in diam. in the Netherlands specimens. A good picture of this species is to be seen in Kylin, 1947, fig. 46, T. 3 fig. 12. The distribution of this annual species is: Northern Ice-sea, Norwegian west coast (LEVRING p. 50), North Sea, Swedish west coast (KYLIN p. 53), Baltic (LAKOWITZ p. 268), British coasts (NEWTON, p. 141), Atlantic coast of Belgium, France and Spain (CHALON p. 86) and of North America (TAYLOR p. 145), Japan, South Australia (A. H. S. LUCAS, p. 102), New Zealand (CHAPMAN, p. 63-68). *Leathesia difformis* is epiphytic on Algae and also on *Zostera* leaves, or grows on rocks; it is detached afterwards. It occurs in exposed places, at a depth of 0-1 m, in the littoral and higher part of the sublittoral zone.

Another *Phaeophyceae*, up to this time unknown from the Netherlands is ***Chaetopteris plumosa*** (Lyngb.) Kütz., *Sphacelariaceae*, collected and identified by J. A. W. LUCAS (1950). The Alga was abundantly growing on stones of the dike on the south coast of the Island of Schouwen, ± 1 m below low-water mark. Its distribution is: Northern Ice-sea, northern part of Atlantic (TAYLOR p. 133) and Pacific (REINKE p. 69), Norwegian coast (LEVRING p. 53), Swedish west coast (KYLIN, 1947, p. 31), Baltic (LAKOWITZ p. 235), British coasts (NEWTON p. 193) and here and there along the Atlantic coast of France and northern Spain (CHALON p. 100). The Alga grows on stones and shells or is epiphytic; it occurs in the sublittoral zone.

In 1947 after an unusually hot summer, during which time no strong winds had been blowing, Dr P. KORRINGA collected a number of seaweeds in the oyster-basins constructed on the tidal flats near Yerseke, north coast of the Island of Zuid-Beveland, Oosterschelde, where, according to the collector, the salinity is 27 ‰. At low-tide the water in these basins still stands ± 1 m high. The collected seaweeds were sent to the author. Among them a number of species appeared to be rare in the Netherlands, while others were not collected before in this country. According to Dr KORRINGA, it is not possible to ascertain, whether or not these species have been transported on oysters, originating from abroad. It is true that between 1936 and 1940 fairly great numbers of oysters have been imported from France, the Gulf of Morbihan (Brittany) and from Arcachon, to the Oosterschelde. In 1944 again oysters have been imported from Brittany and in 1947 from Arcachon. The oysters there are not covered with water during some hours a day. The transport of these oysters packed in sacks lasts 4-5 days, sometimes in a rather high temperature. Though a few species of Algae might

be imported from France, most of them surely are autochthonic. So far extends Dr KORRINGA's information.

An enumeration of the most interesting of the Algae from the oyster-basins follows here.

Fairly rare in the Netherlands is **Dictyota dichotoma** (Huds.) Lamour., *Dictyotaceae*. VAN GOOR (p. 68) records only one locality of this species, the Island of Tholen (on an oyster-shell). Among the Algae from the oyster-basins sent by Dr KORRINGA this species was represented; there was also a very narrow form (2 mm broad).

Dr KORRINGA informed the author that at one time this species had been fairly abundant in the oyster-basins, to the extent of being a nuisance then, but in 1947 it was rare. In 1950 and 1951 it was again very common there, and it has been collected in narrow as well as in broader forms. It was also found growing on the sea-dike near Wemeldinge, north coast of the Island of Zuid-Beveland (1951) and on the south coast of the Island of Schouwen (1950).

Later on a *Phaeophyceae* was collected by C. DEN HARTOG (1950) in an oyster-basin at Yerseke, attached to a stone, and identified by the collector. It was a species unknown for the Netherlands up to that time, **Taonia atomaria** (Woodw.) J. Ag., *Dictyotaceae*. The species has the following distribution: British coasts (NEWTON p. 214), Atlantic coast of Belgium and France (CHALON p. 124), Mediterranean (HAUCK p. 308, FELDMANN, 1937, p. 179), Canaries (FELDMANN, 1937, p. 179).

Sphacelaria fusca (Huds.) Ag., *Sphacelariaceae*, was collected by Dr KORRINGA in 1937 in an oyster-basin near Bergen-op-Zoom. In 1951 it was collected by C. DEN HARTOG in an oyster-basin, Yerseke, at low-tide mark. It was also found growing on the south coast of the Island of Tholen on stones and on *Fucus serratus* (1951) and on the sea-dike of the Island of Texel, south of Oudeschild, on *Chaetomorpha* shortly above low-tide mark (1950). The thallus of the last mentioned specimen is only 7 mm long, whereas the Zeeland specimens are up to 3 cm long. *Sph. fusca* was kept separate from *Sph. cirrosa* (Roth) Ag. by HAMEL (1931—1939, p. 261), who followed in this SAUVAGEAU (1902, p. 393—399), on account of the shape of its propagules and the faint ramification. The species was not known for the Netherlands before. According to SAUVAGEAU (1902, p. 399) it occurs on the British coasts, the coast of Brittany and in Australia.

Gracilaria confervoides (L.) Grev., *Sphaerococcaceae*, recorded for the "Wadden", tidal flats, and the former Zuiderzee, near Medemblik, by VAN GOOR (p. 26), has been collected in the following islands: Schouwen, Zierikzee, mole (1939); Walcheren, "Arnemuidsch kanaal", at a depth of $\frac{1}{2}$ — $1\frac{1}{2}$ m (1941, 1942); Zuid-Beveland, harbour of Goes (1942), oyster-basins near Yerseke (1937, 1951), and "Kanaal door Zuid-Beveland" (1951). In 1884 A. A. WEBER—VAN BOSSE collected the species on the sea-dike of the Island of Texel, but it is not known, whether or not it was autochthonic there. The same holds for a specimen collected in the Oosterschelde by VAN DEN

BOSCH (1842). *Gr. confervoides* usually occurs at low-tide mark, attached to stones and shells.

Hypoglossum woodwardii Kütz., *Delesseriaceae*, was also represented among the Algae from the oyster-basins, sent by Dr KORRINGA. VAN GOOR (p. 28) records the species for the Eendracht near the Island of Tholen growing on an oyster-shell, which was the only known autochthonic locality in the Netherlands then. A *Rhodophycea* sent to the author by B. J. J. R. WALRECHT (1951) from Yerseke appeared to be this species too; it occurred at the base of *Codium* and on an oyster-shell. From the material sent to the Rijksherbarium for identification it appears that *Hypoglossum woodwardii* was likewise collected in other parts of the north coast of Zuid-Beveland, between Katse Veer and Sas van Goes on a stony slope in the lower part of the littoral zone (1948) and on the sea-dike near Wemeldinge (1951). It was also collected on the south coast of Schouwen (1941, 1950), where according to J. A. W. LUCAS it was common in the lower part of the littoral and in the upper part of the sublittoral zone in 1950.

The species of *Polysiphonia*, *Rhodomelaceae*, collected in the oyster-basins have been treated by H. VELDKAMP. After publication of his paper *P. violacea* (Roth.) Grev. and *P. nigra* (Huds.) Batt. were collected in an oyster-basin near Yerseke by J. A. W. LUCAS and A. MULDER (1951). The first collector collected *P. nigra* also on Zeehondenplaat (Wadden), a shallow, east of the Island of Texel (1950).

Two species of *Chondria*, *Rhodomelaceae*, were among the Algae from the oyster-basins: **Ch. dasyphylla** (Woodw.) Ag. and **Ch. tenuissima** (Good. et Woodw.) Ag. Up to that time no localities of that genus were known for the Netherlands. Both species appeared to be still there in 1950, and also in 1951 they were collected again in the oyster-basins. *Ch. tenuissima* was found growing even luxuriously in 1951. *Ch. dasyphylla* has the following distribution: west coast of Sweden (rare, KYLIN p. 88), Danish coast (K. ROSENINGE p. 406), British coasts (common, NEWTON p. 342), Atlantic coast of France (CHALON p. 164), Mediterranean, Antilles (BØRGESEN p. 259), Atlantic coast of North America from Florida to southern Massachusetts (TAYLOR p. 360); it is found growing on stones and shells below low-tide mark. Distribution of *Ch. tenuissima*: British coasts (NEWTON p. 342), Atlantic coast of France (CHALON p. 164), Mediterranean (HAUCK p. 212), Atlantic coast of North America from Florida to Massachusetts (TAYLOR p. 359); it grows on stones and shells, shortly below low-tide mark and in the littoral zone.

Among the Algae from the oyster-basins at Yerseke there was also **Griffithsia devoniensis** Harv., *Ceramiaceae*, which is closely allied to *Gr. corallinoides* (L.) Batt. (syn. *Gr. corallina* (Lightf.) Ag.). Both species have the tetrasporangia arranged in the same way, i.e. in clusters surrounded by short incurved branches, situated near the common wall of two cells of a branch. Tetrasporangia are usually frequent and abundant in *Gr. corallinoides*, but rare and

few in *Gr. devoniensis*. Rhizoids are always present up to the higher branches in *Gr. devoniensis*, they are less frequent and usually less numerous in *Gr. corallinoides*. The cells of *Gr. devoniensis* are cylindrical and slightly attenuate at the ends, they are about 130—335 μ wide and 4—9 \times as long as broad. The higher cells of *Gr. corallinoides* are pyriform or ellipsoid, the ultimate ones are nearly globular; the higher cells (not the ultimate) are about 600—1100 μ wide and 2—4 \times as long as broad. The upper part of the branches is moniliform. *Gr. devoniensis* was collected in 1841 by R. B. VAN DEN BOSCH in Zuid-Beveland, along the Zandkreek, drifted ashore. But the species was not recognized. It was described by KÜTZING under the name of *Callithamnion interruptum* β *setaceum* Kütz. and figured under the name of *Callithamnion setaceum* Kütz., Tab. Phyc. XI, 1861, p. 20 t. 63. Three specimens are preserved in the herbarium KÜTZING, which is incorporated in the Rijksherbarium, Leiden. The organ figured by KÜTZING as a cystocarpium (t. 63 fig. c) appeared to be a cluster of young tetrasporangia, after examination of the type. *Callithamnion interruptum* β *setaceum* Kütz. as well as *C. setaceum* Kütz. are thus synonyms of *Griffithsia devoniensis* Harv. KÜTZING described and depicted the last-named species in Tab. Phyc. XII, 1862, p. 9 t. 26, with tetrasporangia.

Gr. devoniensis is known in the Netherlands from Zeeland only. It was collected in the following islands: Schouwen, south coast near Zierikzee (1938, 1950); Walcheren, "Kanaal door Walcheren", not very rare (1940); Zuid-Beveland, Yerseke, oyster-basins (1947, 1950), "Kanaal door Zuid-Beveland" (1950, 1951) and Wemeldinge, sea-dike (1951). It was found growing in the littoral and sublittoral zones on stones. C. BRAKMAN stated that it prefers a shady place, but occasionally it occurs in a sunny place. In 1951 it was found growing in great abundance and bearing tetrasporangia.

Among the Netherlands specimens there are two from Schouwen (1938) and Zuid-Beveland (1950), in which the ultimate cells of the branches are nearly globular like in *Gr. corallinoides*. However, because of the possession of numerous rhizoids, the lack of pyriform cells and the slenderness of the cells, these specimens seem to belong to *Gr. devoniensis*. It is not impossible, that *Gr. devoniensis* is an ecological form of *Gr. corallinoides*. In favour of this idea are specimens bearing a fairly great number of tetrasporangia, but having long and thin cells.

Gr. devoniensis has the following distribution: southwest-point of England (NEWTON p. 368), Normandy and Brittany, Channel-Islands (Chalon p. 178).

Another species of *Griffithsia*, already known from the Netherlands before, *Gr. barbata* (Sm.) Ag. (VAN GOOR p. 38) was found again and recognized by C. DEN HARTOG (1950). VAN GOOR records the species for the Eendracht, whereas DEN HARTOG collected it in the oyster-basins near Yerseke.

A *Rhodophycea*, collected in the oyster-basins near Yerseke by several collectors in 1951, appeared to be *Antithamnion cruciatum* (Ag.) Naeg., *Ceramiaceae*. This species was known by VAN GOOR

(p. 42) from the "Wadden" and the northern part of the former Zuiderzee. It was also among the Algae collected by C. BRAKMAN in the Island of Walcheren, "Kanaal door Walcheren" (1940). In the Island of Zuid-Beveland it has been collected on a few more localities by several collectors: south coast near Ellewoutsdijk (1941), "Kanaal door Zuid-Beveland" (1951) and north coast near Wilhelminadorp (1951), thus along Westerschelde, Zandkreek and Oosterschelde. According to C. BRAKMAN the species occurs in shady places; it is always covered with water and is found attached to stones or posts between the stones of the dikes.

A *Chlorophycea*, among the Algae collected in the oyster-basins, **Bryopsis plumosa** (Huds.) Ag., *Bryopsidaceae*, was recorded by VAN GOOR (p. 131) only for Nieuwediep, the harbour of Den Helder, and Vlissingen, growing on posts. Later on the species appeared to be not so rare. It has been collected on the dike of the south coast of Texel (1950) and in Zeeland in the following islands: Schouwen, south coast, sea-dike (1949, 1950); Walcheren, "Kanaal door Walcheren" (1940, 1943); Zuid-Beveland, north of the Sloedam, abundant (1940), "Kanaal door Zuid-Beveland" (1951). It occurs at low-tide mark. C. BRAKMAN (1940—1943) found the species growing on sandstone and also on shells of *Mytilus* (living) in the soil of a creek, in places where the water remains, when tide is low, and slowly flows to and fro with the tide. The habitat may be shady or exposed to the sunlight.

A *Chlorophycea*, given to the author for identification by B. J. J. R. WALRECHT and collected by him at Yerseke (1950), outside an oyster-basin attached to a stone, shortly below low-tide mark, appeared to be **Cladophora arcta** (Dillw.) Kütz., *Cladophoraceae*, belonging to the section *Spongomorpha* Kütz., which is sometimes considered a separate genus. The species may be told by its broom-like, often semi-orbicular habit, its bright yellowish green colour, and its branches having long top-cells with dark green tips. A *Cladophora* very often collected by C. DEN HARTOG and J. A. W. LUCAS (1949—1951) in the harbour of Den Helder attached to wood, especially to rafts, was recognized by the author as to belong to the same species. The collectors saw the species only in the first months of the year, and after June it had disappeared everywhere. A. F. G. SLOOTWEG in his revision of the Netherlands Marine *Cladophora*'s mentions this species from Den Helder-Nieuwendiep only. For the first time it was collected in the Netherlands by A. A. WEBER—VAN BOSSE (1884), Durgerdam near Amsterdam, "het IJ", in that time brackish water.

Another *Cladophora* given to the author for identification appeared to be a species which was not included in the paper mentioned above. It is **Cladophora cristata** Kütz. found growing on the "Wadden", east of Texel (1950) and west of Terschelling (1951). Previously it was collected along the Zuiderzee by W. F. R. SURINGAR in 1854, near Hoorn and near Stavoren, on a sandy soil, in brackish water. This species is allied to *Cl. penicillata* Kütz., but differs in the characteristic habit: the more or less numerous main

branches having distantly placed lateral branches 1—4 together, which are slightly branched at the lower part, but penicillate at the top; the ultimate ramifications are often pectinate. All cells are cylindrical. KÜTZING (1849, p. 404) based his description on *Conferva cristata marina* Roth. The director of the "Staatliches Museum für Naturkunde und Vorgeschichte", OLDENBURG, kindly gave the information, that the herbarium in 1926 was presented to the Botanical Museum, Berlin, where it has been destroyed during the war. Consequently the specimen from Norderney in herb. KÜTZING, preserved in the Rijksherbarium, Leiden, is the type-specimen now. The cells in this specimen are 120—130 μ in diam. and 4 \times as long in the main branches, 50—65 μ in diam. and 1—5 \times as long in the lateral branches, and 25—40 μ in diam. and 4—7 \times as long in the ultimate branches; the top-cells are usually longer than the lower cells. In the Netherlands specimens the cells of the main branches are 140—270 μ in diam. and 3½—4 \times as long, of the lateral branches 100—130 μ in diam. and 4—6 \times as long, of the ultimate branches 30—100 μ in diam. and 4—10 \times as long. HAUCK (p. 461) with a question-mark reduces this species to the synonymy of *Cl. glaucescens* (Griff.) Harv., of which the isotype, WYATT alg. Danm. n. 195, and a specimen in herb. KÜTZING which came from GRIFFITH have a different habit. *Cl. cristata* is very much alike certain forms of *Cl. glomerata* (L.) Kütz., a freshwater species. It may be a marine forma of that species. In herb. KÜTZING another specimen of *Cl. cristata* is present, which originates from the coast of Normandy.

Laminaria saccharina (L.) Lamour, *Laminariaceae*, was known to occur on stones of the sea-dike near Den Helder (VAN GOOR p. 71). It has been collected on the coast of Texel (1884, ? attached), Oudeschild, sea-dike (1950) and on the north coast of Zuid-Beveland, Kattendijke (1951). It was always found growing sublittoral.

Lithothamnion lenormandii (Aresch.) Fosl., *Corallinaceae*, was recorded for Den Helder (VAN GOOR p. 53). It has been collected on the north coast of Zuid-Beveland (1940, 1941, 1949, 1951), on the south coast of Schouwen (1950), and on the south coast of Tholen (1951). It occurs mostly on stones and sometimes on shells, at low-tide mark, often together with *Hildenbrandia prototypus* Nardo, *Ralfsia verrucosa* (Aresch.) J. Ag., a.o.

The marine **Bangia atropurpurea** (Roth) Ag. f. **fuscopurpurea** (Dillw.) Ag. (syn. *B. fuscopurpurea* (Dillw.) Lyngb.), *Bangiaceae*, was known by VAN GOOR (p. 15) from IJmuiden only. On reference to the collection of the Rijksherbarium this Alga can be recorded for the following localities now: Island of Texel, seadike (1950); Den Helder (1948, 1949, 1950); Callantssoog (1949); Hondsbosse zee-wering (1950)¹; IJmuiden (1893, 1950); Zandvoort (1946); Katwijk (1950); Noordwijk (1945); Hoek van Holland (1938, 1948, 1949); De Beer (1949); Island of Schouwen, south coast (1950); Island of Zuid-Beveland (1951), and near Cadzand, Zeeuwsch-Vlaanderen (1950)¹.

¹ according to C. DEN HARTOG.

The substratum on which the marine *Bangia* occurs is mostly a wooden post or another wooden object, but also Algae and stones, usually in the upper part of the littoral zone, though in a few cases lower down, or in the spray zone.

HAMEL (1924, p. 446—447) saw no other difference between *B. atropurpurea* (Roth) Ag. and *B. fuscopurpurea* (Dillw.) Lyngb. than the environmental condition; yet he kept them separated, because *Bangia* was never found growing in water of low salinity in France. The same fact was stated for Denmark by KOLDERUP ROSENVINGE (p. 56), and KYLIN (1944, p. 10) had also the same opinion as HAMEL. However, LAKOWITZ (p. 297, p. 408), and M. WAERN (Exc. guide, Seventh Internat. Bot. Congr. Stockholm, 1950, 34) record *B. fuscopurpurea* for the Gulf of Bothnia, where the salinity is only 3—7 ‰.

In the Netherlands *Bangia* is likewise known from water of low salinity. It was collected in the former Zuiderzee, only near Kampen, where according to VAN GOOR (p. 10) the salinity was less than 10 ‰, on a stony slope (1855) and attached to a barrel (1931), the last mentioned locality according to HOCKE HOOGENBOOM (1936, p. 1). After the enclosure of the Zuiderzee in 1932, *Bangia* was collected in several places along the shores of what after that time is called "IJsselmeer", now an oligohaline lake (REDEKE, p. 21): Hindeloopen (1935), Lemmer (1935), Vollenhove, harbour (1932), Elburg, pier (1934), dike near Putten (1941), Den Oever (1950, 1951). According to A. VAN DER WERFF (Correspondentieblaadje Zuiderzee-Onderzoek VII, 1948, p. 5—9) *Bangia* occurred nearly everywhere on the dikes of the IJsselmeer in 1948. C. DEN HARTOG collected *Bangia* along the shore from Amsterdam to Hoorn in 1951.

The *Bangia* specimens collected in the Netherlands inland-waters up to now originate from Noord- and Zuid-Holland, and nearly all from waters called oligo- and mesohaline by REDEKE (p. 21). The first record, which is also mentioned in the Prodrromus Fl. Bat. (p. 212) under the name of *B. atropurpurea* Ag., concerns abundant material growing on mosses along the river Merwede near Dordrecht (1843, 1844, 1856). Later on *Bangia* was collected in Leimuiden, Westeinderplas, on roots of Phanerogams (1941) and in Voorschoten, Vliet (1950). C. DEN HARTOG saw this species in several places in Noord-Holland (1951): Amstelmeer, Noord-Hollandsch Kanaal, Noordzeekanaal, Amsterdam (Amstel) and surroundings. It often occurs on stones at the water mark.

As *Bangia fuscopurpurea* (Dillw.) Lyngb. occurs in brackish water too, we may follow AGARDH (p. 76) and DE TONI (p. 3) in regarding the marine *Bangia* as a forma of the freshwater *Bangia*. In that case the name of the marine *Bangia* must be *B. atropurpurea* (Roth) Ag. f. *fuscopurpurea* (Dillw.) Ag. However, DILLWYN (T. 103) and afterwards AGARDH (p. 76) did not strictly separate the marine and the freshwater formae of *B. atropurpurea* (Roth) Ag., for in this species they combine specimens from marine localities as well as from mill-wheels. *B. atropurpurea* (Roth) Ag. was described from specimens growing upon mill-wheels in the vicinity of Bremen. It is true that

the salinity of this locality is unknown, but it certainly tends to a freshwater locality rather than a marine one.

Though the freshwater *Bangia* may be regarded as reduced from the marine one (FRITSCH p. 397), the rule of priority does not allow to consider the freshwater *Bangia* as a forma of the marine one.

The freshwater *B. atropurpurea* (Roth) Ag. f. *atropurpurea* occurs in strongly moving water. PASCHER and SCHILLER (p. 159) mention mill-wheels, cataracts and weirs for the habitats of the freshwater *Bangia*. According to these authors it is mostly attached to wooden objects. C. DEN HARTOGH collected *B. atropurpurea* (Roth) Ag. in the "Loosdrechtsche plassen" (broads, 1951) on stones in a place, where waves were perceptible. It is the only strictly freshwater locality known in the Netherlands up to this time.

Though he does not use the feature for his key HAMEL notes that the freshwater *Bangia* has thinner filaments. PASCHER and SCHILLER (p. 159) record a diameter of the filaments of 13—60 μ for the freshwater *Bangia*, whereas HAMEL mentions for the marine *Bangia* a diameter of 20—150 μ and TAYLOR (p. 218) of 20—220 μ . FRITSCH (p. 426) records for *B. atropurpurea* as well as for *B. fuscopurpurea* an equal diameter up to 200 μ , but he mentions estuarine parts of rivers as the habitat of *B. atropurpurea*. In the Netherlands *Bangia* material the diameter of the filaments from the inland-waters is 24—78 μ , from the marine localities 40—130 μ , from the Zuiderzee collected before the enclosure 20—90 μ and after the enclosure (IJsselmeer) 25—65 μ .

Dumontia incrassata (Müll.) Lamour. (syn. *D. filiformis* (Fl. Dan.) Grev.), *Dumontiaceae*, was mentioned from the Netherlands by VAN GOOR (p. 52) only from Den Helder, where the species was collected several times up to now (Vangdam and sea-dike). The Rijksherbarium possesses specimens collected in 1852 along the north and northwest coast of Friesland. Further *D. incrassata* was collected near the Island of Terschelling and on its coast, narrow specimens, $\frac{1}{2}$ —1 mm broad (1938, 1948, 1949); on the coast of Vlieland (1950); on the southeast coast of Texel, thallus up to 7 mm broad (1949); on the south coast of Schouwen, in creeks (1947, 1950); along the Oosterschelde between Noord- and Zuid-Beveland, narrow thallus, less than $\frac{1}{2}$ —3 mm broad (1948); on the north coast of Zuid-Beveland (1951). It was found growing in the littoral zone, on dikes and shallows, often attached to stones, sometimes to shells. C. BRAKMAN saw the species in 1942 in great numbers in the Island of Walcheren, "Arne-muidsch Kanaal", to a depth of $\pm 1\frac{1}{2}$ m; according to this collector the salinity is very low there, in winter down to 6 ‰. In the same year he saw the species in the harbour of Goes also in great numbers.

Cystoclonium purpureum (Huds.) Batt. (syn. *C. purpurascens* (Huds.) Kütz.), *Rhodophyllidaceae*, recorded for the Netherlands only from Den Helder (VAN GOOR p. 24), was collected moreover along the coast of Friesland, Barradeel, Dijkshoek (1852) and Harlingen (1904—1906), on the sea-dikes of the Islands of Texel (1887, 1950,

1951) and the Island of Schouwen, south coast (1939). The species was found growing attached to stones.

Rhodochorton rothii (Turt.) Naeg., *Ceramiaceae*, was recorded for the Netherlands from Den Helder (VAN GOOR p. 51), where it was collected again in 1948, 1949 and 1950 and from Delfzijl (1885), where it was collected again in 1950. This species has also been collected along the north coast of Friesland, Holwerd (1852), along the Zuiderzee, at that time brackish water (salinity $\pm 10\text{‰}$, according to VAN GOOR p. 10), near Amsterdam (1884, 1885), on the sea-dike of Texel (1950) and it appears to be common in Zeeland, where it was collected in the following islands: Schouwen, south coast (1939, 1950); Tholen, south coast (1951); Noord-Beveland, south coast (1941); Walcheren, southeastern part and between Veere and Sloedam (1940), Sloedam, north side (1940); Zuid-Beveland, in many places along the coast (1940, 1941, 1950, 1951), and along the Oosterschelde (1845). The last-mentioned find was already recorded in the Prodr. Fl. Bat. (p. 178). *Rhodochorton rothii* is growing very often on posts, also on stones or clay between stones of dikes and breakwaters and on *Balanus*, in sheltered and shady places, from mean high- to mean low-tide mark; it has been collected in the *Fucus spiralis* zone as well as in the *Ascophyllum nodosum* zone.

Pelvetia canaliculata (L.) Decne et Thuret, *Fucaceae*, which, according to VAN GOOR (p. 67), occurred in one place in the harbour of Den Helder has disappeared since. VAN GOOR recorded this species also from IJmuiden, pier, and from Zeeland: Schouwen, Zandkreek and Oosterschelde. At present many more localities in Zeeland have been discovered: the coasts of Walcheren, Noord- and Zuid-Beveland along Oosterschelde, Westerschelde, Veersche gat, Zandkreek and Sloe. Moreover it was collected on the coast of Noord-Brabant, Steenberg, de Heen. According to J. G. SLOFF the species is wanting near Bergen-op-Zoom and the southern part of the Island of Tholen. According to C. BRAKMAN (1940—1943) *Pelvetia canaliculata* often grows $\frac{1}{2}$ — $\frac{1}{4}$ m below high-tide mark in Zeeland, above and sometimes in the *Fucus spiralis* zone; during spring tide it is sometimes immersed 1 m below the water mark; it occurs on the stones of the dikes and sea-walls, in rather shady places, exposed to the north or northwest. The *Pelvetia*-zone is sometimes short in Zeeland, but it can reach a height of 1 m. Other information from C. BRAKMAN concerns the colour of *Pelvetia canaliculata* being dark brown to black in a dry state, but pale brownish yellow and swollen during rainy weather. *Pelvetia canaliculata* stands the frost in Zeeland.

C. BRAKMAN (1940—1943) noticed on the north side of the Sloedam, between Walcheren and Zuid-Beveland the following zonation from top downwards. *Pelvetia canaliculata*, exposed, growing on the stones, among which species **Catenella repens** (Lightf.) Batt. (syn. *Catenella opuntia* (Good. et Woodw.) Grev.), *Rhodophylladaceae*, in the holes between the stones, more or less sheltered. The zone of *Catenella*, however, is much longer than that of *Pelvetia* and continues lower

down. Below this zone of *Pelvetia* and *Catenella* and partly mixed with it follows a zone of *Fucus spiralis* L. and lower down a zone of *Ascophyllum nodosum* (L.) Lejol. mixed with *Rhodochorton rothii*.

Near Rammekens (Ritthem), south coast of Walcheren along Sloe and Westerschelde C. BRAKMAN (1940—1943) saw the following zonation from top downwards: an *Enteromorpha* zone, a *Fucus spiralis* zone, an *Ascophyllum nodosum* zone and lower down *Fucus vesiculosus* L., *Fucus serratus* L., *Rhodochorton rothii*, *Hildenbrandia prototypus*, other *Rhodophyceae* and *Ralfsia verrucosa*. The zone of *Catenella repens* had its extension in the *Enteromorpha* zone to fairly high above that zone and lower down in the *Fucus spiralis* zone. In places where the *Ascophyllum nodosum* zone was less dense, *Catenella repens* was found growing to 1 m downwards in the *Ascophyllum nodosum* zone. In contradiction to *Rhodochorton rothii*, which can stand even the densest vegetation of *Ascophyllum nodosum*, *Catenella repens* disappears, when the *Ascophyllum nodosum* zone is too dense. On the other hand, C. BRAKMAN got the impression that *Catenella repens* avoids too much sunlight and prefers shady habitats. Three days continuous rain did no harm to *Catenella repens*.

This species was most often seen in the *Ascophyllum nodosum* zone and even lower down, but also many times in the *Fucus spiralis* zone and higher up in the *Pelvetia canaliculata* zone. It occurs on dikes, in cracks, in holes between the stones, filled with mud or sand, on wooden posts between the stones, on sandstone and bricks, but also on muddy saltings (schorren) in very shallow holes. In the last mentioned habitats the thallus is elongated and more or less filiform. VAN GOOR (p. 25) records this species from Oosterschelde and Westerschelde. Afterwards it has been collected in Schouwen, south coast (1941, 1948, 1950); Walcheren, south coast (1940, 1941); Sloedam, north and south side (1940); Zuid-Beveland, north coast (1941) and south coast (1940); Noord-Beveland, south coast (1941); thus along Westerschelde, Sloe, Veersche gat, Zandkreek and Oosterschelde. In no other province than Zeeland it has been collected up to now.

A *Rhodophyceae*, which usually grows on muddy saltings is ***Bostrychia scorpioides*** (Gmel.) Mont., *Rhodomelaceae*. VAN GOOR (p. 36) only records this species for the Oosterschelde, as cited in the Prodr. Fl. Bat. (p. 171). He omits the locality on the shore of Friesland, also recorded in the Prodr. since it is uncertain. Among the Algae sent by C. BRAKMAN from Zeeland (1940—1943) this species was not rare.

At present *Bostrychia scorpioides* has been collected in Zeeland: Schouwen, south coast, high up on the sea-dike (1950); Tholen, east coast (1949); Noord-Beveland, west coast (1931, 1949) and south coast (1940—1943); north of the Sloedam on the Walcheren side as well as on the Zuid-Beveland side, very numerous (1940—1943); Zuid-Beveland, southwest point, Kaloot (1940—1943), along Oosterschelde (1842) and Zandkreek (1840); in Noord-Brabant: Woensdrecht (1948, 1949). Thus *Bostrychia scorpioides* has been collected along Eendracht, Oosterschelde, Zandkreek, Veersche gat and Sloe. WEST-

HOFF (p. 227—228) saw the species in Terschelling, West, harbour. According to Post (p. 38) the distribution on this species is the following: Mediterranean, Atlantic coasts of Spain, France, Belgium, England, Scotland, Ireland and South, Central and North America up to Florida.

C. BRAKMAN (1940—1943) observed this species in the Zeeland habitats. He noticed that it grows on the basal part of Phanerogams

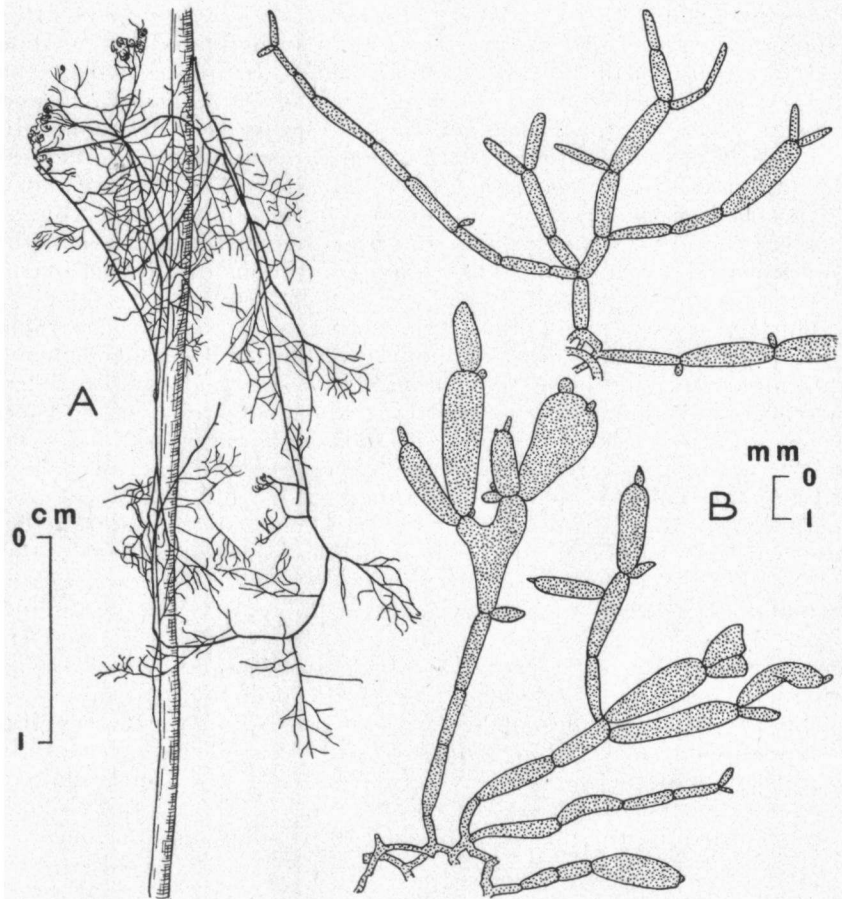


Fig. 1. A. *Bostrychia scorpioides* (Gmel.) Mont.; B. *Catenella repens* (Lightf.) Batt.

on the muddy saltings, pressing its thallus closely against the stem and branches hard by the soil. Among the Phanerogams of the saltings *Bostrychia scorpioides* clearly prefers *Obione portulacoides* (L.) Moq. the base of which is densely covered by *Bostrychia*, when the *Obione* plants stand closely together. Where sheep are grazed, *Obione* disappears and so does *Bostrychia*. *Bostrychia* cannot stand an excess of sunlight. Where the habitat is too sunny, BRAKMAN found the colour

of *Bostrychia* bronze-green, in more shady places dark purplish red. WESTHOFF and BEEFTINK (p. 128) record that *Bostrychia* turns brownish green in very shady places and purplish to reddish brown in lighter habitats.

When not growing on *Obione* the *Bostrychia* plants often remain small. Other Phanerogams on which, according to C. BRAKMAN, *Bostrychia* is found growing are *Spartina townsendii* H. et J. Groves, *Limonium vulgare* Mill., *Suaeda maritima* (L.) Dum., *Aster tripolium* L., *Puccinellia* and *Festuca*. Only once it was found growing on *Pelvetia canaliculata*. The species also occurs on the mud and, according to C. BRAKMAN, sometimes on smooth stones. It can be found along the creeks, where the Phanerogams stand closely together and also in very shallow holes on the saltings. Sometimes *Bostrychia* is immersed only 2—3 hours a day. On the other hand, three days of incessant rain did no harm to *Bostrychia*. In spite of intense search of fructifications, none were found.

On muddy saltings there occurs also a remarkable *Phaeophyceae*, ***Fucus vesiculosus* L. var. *lutarius* Chauv.** (syn. *Fucus lutarius* (Chauv.) Kütz.), *Fucaceae*. It has been collected along the Eendracht on the Noord-Brabant side (1939) as well as on the east coast of Tholen (1949, 1951), on the northeast coast of Duiveland, along the Grevelingen (1949), along the Oosterschelde (1841) and along the northern part of the Sloe in great quantities (1936, 1941, 1943). *F. vesiculosus* L. var. *lutarius* Chauv. was found along the Atlantic coast of Belgium, France (HAMEL 1931—1939, p. 370; DAVY DE VIRVILLE et DIZERBO), Spain (SAUVAGEAU p. 110—123), Portugal (LAMI p. 178), and Morocco (DAVY DE VIRVILLE et DIZERBO, p. 33).

According to C. BRAKMAN (1936) this *Fucus* forms a fine and crisp brown covering on the soil. It occurs in shallow holes as well as in creeks, sometimes where Phanerogams are wanting. The salinity of this habitat changes very much, owing to alternate desiccation and rains. The *Fucus* also penetrates into the mud or entwines the base of stems of Phanerogams. It grows among *Spartina stricta* and even higher, almost reaching freshwater. J. G. SLOFF saw this *Fucus* also among *Triglochin maritima*. In some habitats the Alga is regularly immersed, in others this is not every day the case. C. BRAKMAN saw the smallest specimens and the narrowest thallus in nearly always dry spots.

CHAUVIN (1831) discovered this alga in shallow pools in the mud, in the Island of Chausey. He considered it a variety of *Fucus vesiculosus*, but KÜTZING (1860) regarded it a separate species, in which he finally was followed by SAUVAGEAU (1908), and LAMI (1938—1939). However, the latter admits that in Portugal it is difficult to recognize this Alga as a separate species, because of its great variability. SAUVAGEAU indicates the following features of the species: the creeping habit, the ribbon-shaped, often spirally twisted thallus, the numerous cryptostomata, the lack of vesicula and attaching disc and the mostly sterile condition. LAMI saw the normal *Fucus vesiculosus* among *Fucus lutarius* without transitions and sometimes even attached on *Fucus*

lutarius, otherwise growing in the mud. Moreover, he found a difference in colour between both Algae, being olive-brown in *Fucus vesiculosus* and more reddish brown in *F. lutarius*.

In some of the Netherlands specimens of *Fucus lutarius*, collected by J. G. SLOFF, a few vesicula were present, as was also the case in specimens from the northern coast of Spain.

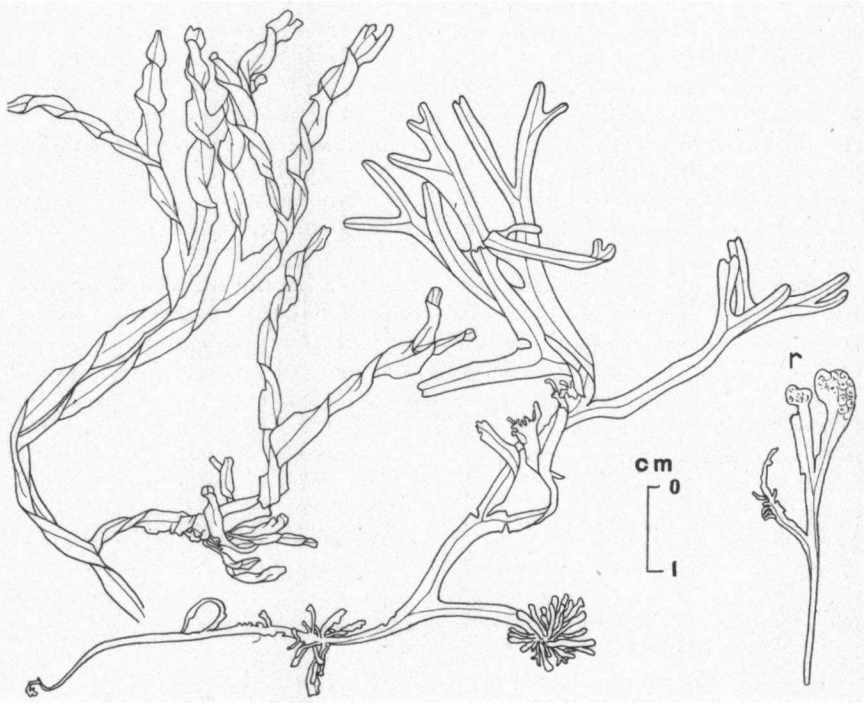


Fig. 2. *Fucus vesiculosus* L. var. *lutarius* Chauv.; r — receptacle.

Receptacula are rare indeed in *Fucus lutarius*. SAUVAGEAU and CHEMIN saw only female receptacula, but LAMI saw female as well as male receptacula. Among the material from Tholen collected by J. G. SLOFF (1949) there was one specimen with a few poorly developed female receptacula. The present author prefers to follow CHAUVIN in considering *Fucus lutarius* as a variety of *Fucus vesiculosus*, because of the transitional forms having a few vesicula and the others bearing receptacula.

In the Prodr. Fl. Bat. (p. 180) this *Fucus* was described from specimens originating from the Oosterschelde, but it has been called *Fucus vesiculosus* L. f. *linearis* Ag., which is different from *Fucus lutarius*, according to Agardh (p. 276).

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