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Family : Cladophora Kützing 1843: type: C. oligoclona (Kützing) Kützing 1845.

The thallus is bushy or filamentous, consisting of threads arranged in a single row, densely or sparsely branched and constructed from multinucleate cells. Numerous laminated chromatophores are concentrated in parietal layers of protoplasm going to the central part of the cell, or assembling in reticular outgrowths in harmony with the foamy layer of parietal protoplasm. Some chromatophores have lenticular pyrenoids, around which there is an accumulation of starch. The filaments grow by terminal or intercalary division of the cells. Cell division is independent from that of the nucleus, although almost simultaneously mitosis accompanies formation of the cross walls, which in the form of a diaphram develop from the lateral walls towards the interior of the cell, thus dividing it into two. Branches are attached laterally either below or at the end (apically) of the cell, at which the lateral cell is separated by an inclined wall from its maternal filament. The thalli are attached to the substratum by branching rhizoids (fig. 295a), growing out from the basal cell or that nearest to the base of the thallus. Sometimes the filaments are attached by holdfast discs at the side of the basal cell. In some species there are no attaching organs while in others a complete layer of branching rhizoids forms, from which develop vertical green filaments.

Sexual reproduction is with the aid of biflagellate isogametes, asexual through bi - or quadriflagellate zoospores. A regular change of the sexual and asexual generation exists. In many species reproduction is observed only through the fragmentation of the thallus. Thick walled akinetes are created when conditions are unfavourable for growth. The rhizoids and basal parts of the thallus can also thicken before producing new filaments.

The Cladophoraceae (Cladophora family) contains almost 300 species, but the majority of these are inaccurately described. Therefore Printz presumed that there are no more than 150-160 true species. However it is very difficult to differentiate species since it is not always clear what influences the various features.

Morphology:

1. Acropetal organisation, when the thallus grows by division of the terminal cells which then lengthen. In this manner branches can vary.

2. Acropetal-basipetal organisation, when the upper thallus grows at the ends, while below it grows by intercalary divisions towards the base.

3. Intercalary organisation, filaments develop solely by dividing in the central parts. Branches are lateral or pseudodichotomous. Branching types are outlined in fig. 255.

In some case the definition of Cladophora is not even clear. There are several similarities between the following families: Cladophora, Rhizoclonium, Chaetomorpha and Basicladia. A view exists that these families lie within the Cladophora. Undoubtedly further research is needed, the main difficulty is the need to study all data about the species but due to the lack of herbarium material it is impossible to make comparisons. Cladophora is known throughout the world, in polar regions as well as the tropics. A greater number of species are marine forms, out of 38 species in Europe 27 are marine, 11 are freshwater. Freshwater species occur in both flowing and still waters. Connected with still waters are; C. cornuta, C. fracta var fracta and C. glomerata var crassior. Above all others C. glomerata is quoted from flowing waters. In particular the

occurence of Cladophora is related to eutrophic, neutral or slightly alkaline waters. In eutrophic conditions plants attain a very large mass.

Taxonomic criteria

1. The thalli and branches are a variety of shades, from pale yellow to dark green. For some species the colour is at least characteristic and have a narrow margin of variation. Colours will remain after drying. Variations of colour are dependent on light, plants are always darker in conditions of low light.

2. The type and density of the branches is of taxonomic value. Attention should be paid to the number of branches in a clump, the insertion (branching point on a thread), stiffness or feebleness and the bending at the ends.

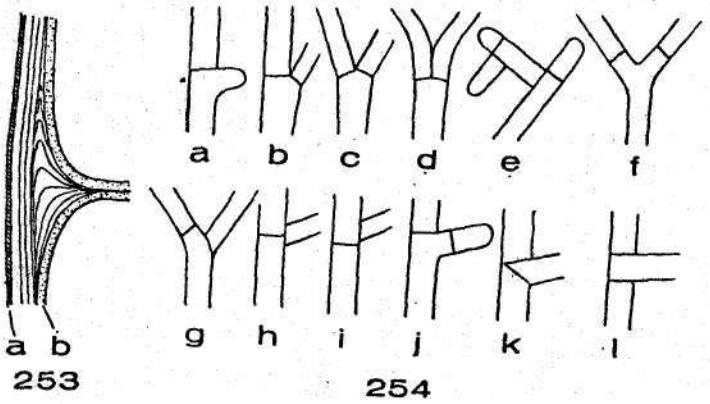
3. Appearance and cell dimensions: Cells are cylindrical, swollen, narrowed at the crosswalls. The width of the cells and the relationship of the width to the length. Cell dimensions are important at the end of the branches whereas those of the main thread are not a reliable distinguishing mark.

4. The general appearance of the plant: bushy, pulvinate, spherical, etc.

5. Attaching organs: primary rhizoid and secondary rhizoids.

6. The shape of the zoospores, presence or absence of an eye spot.

Herbarium materials. Dried Cladophorae in the form of herbarium specimen are adaptable for research after wetting in water with a little added detergent. Add 10 ml of a saturated solution of some good staining agent to some of distilled water and heat a piece of the thallus for a given time, but do not boil.



253 254

Fig. 253 - The cell wall structure of Cladophora: a. outer layer, cuticle. b. internal wall, joining to the protoplasm.

Fig. 254 - Branching system (after Brand)
a. The bud of a typical lateral branch.
b. Lateral branch carried upwards by the unchanged direction of the main filament.
c. Lateral branch causing a change in the direction of the growth of the main filament.
d. Coalescence between the bases of the branch and filament.
e. Development of a falcate branch.
f. Dichotomy.
g. Apparent dichotomy.
h. Partial displacement
i. Total displacement.
j. Crosswall of the lateral cell shifted forwards.
k. Crosswall of the lateral cell partially shifted backwards.
l. Crosswall of the lateral cell totally shifted backwards.

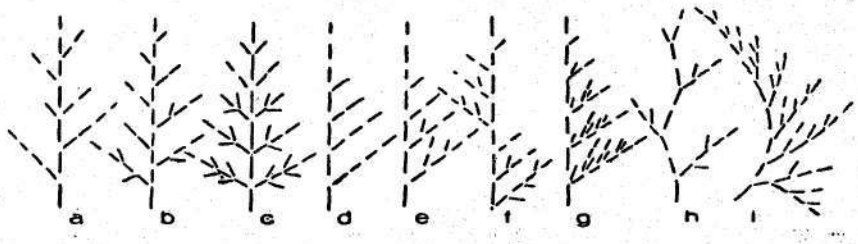
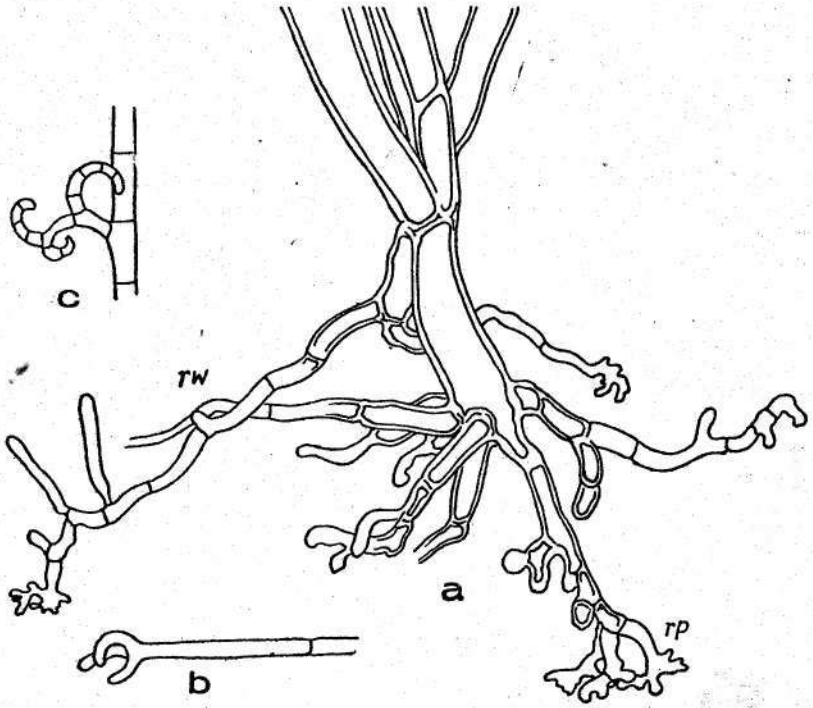


Fig. 255 - Types of branches.
a. Irregular b. Alternate c. Opposite d. Unilateral
e. Unilateral with secondary branches. f. Unilateral and variable.
g. Unilateral and even h. zigzag. i. Falcate (bostrychoidal).



Rys. 295. a — Ryzoidy pierwotne (rp) i ryzoidy wtórne (rw) u *Cladophora glomerata*, b — ryzoid chwytny u *Pithophora*, c — cirroidy u *Spongomorpha*

pp 231-3 **Cladophora basiramosa Schmidle 1897.**

(= C. glomerata (L) Kützing var. petraea Hansgirg; C. petraea (Hansg.) Brand)

fig. 256

Thalli are up to 7 cms high and dark green. The long and almost unbranched filaments develop by intercalary divisions. They are attached to the substratum by rhizoids produced through the wall of the lower part of the basal cell. Branches are attached laterally, usually concentrating at the base of the filaments, are often bent and sometimes terminated with a constricted rhizoidal cell. The filaments widen gradually towards the end and produce chains of barrel-shaped zoosporangia from which zoospores escape through an opening at the centre of the oblong wall. Cells are cylindrical but less swollen nearer to the top.

Terminal cells are 27-54μ wide, l/b = 1-4

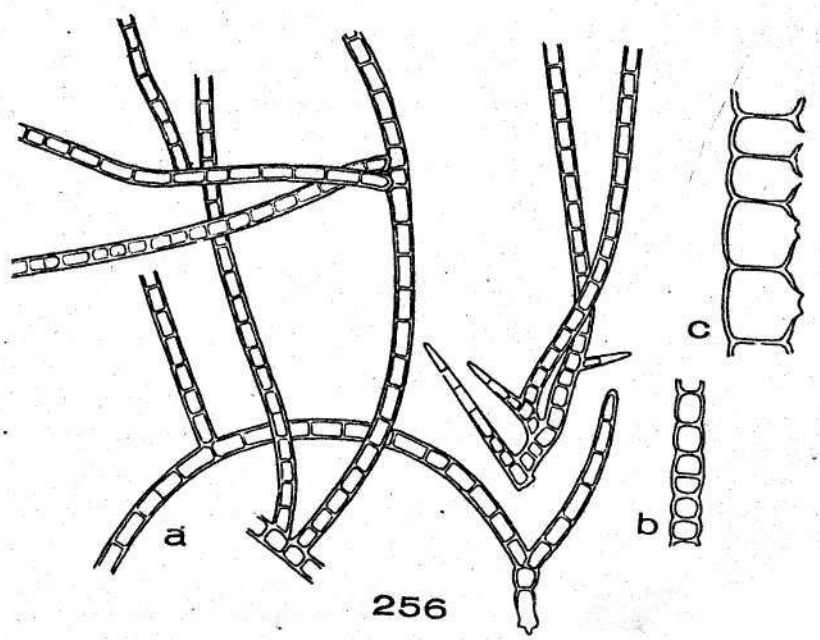
Cells in Subterminal branches are 27-55μ wide, l/b = 0.5-3

Main filaments are 38-120μ wide, l/b = 0.5 -2

In the uppermost branches the thickness of the cell walls is 2.5 - 8μ, in the main filaments 3-14μ.

Occurs in lakes and reservoirs of Western Europe.

This species is similar to Rhizoclonium and closely resembles C. alpina and C. humida.



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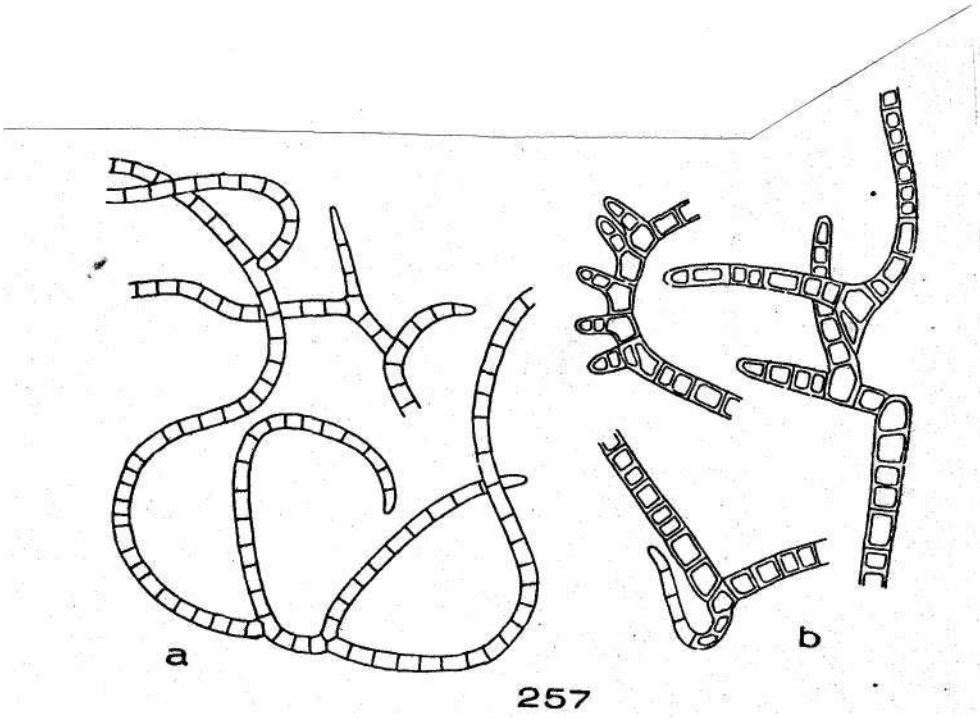
pp. 233 Cladophora alpina Brand 1899 fig. 257.

The filaments are tangled amongst the branches of water mosses, where sometimes they form oval shaped mats. Rhizoids are sparse and only secondary; unsegmented rhizoids develop from a broken filament, segmented from the corners of cells. For the most part cells are unbranched, or have sparse branches leaving the main filament subterminally and later pushing aside at a right angle. Sometimes displacement is visible. Filaments are uneven, averaging 50µ wide. The cell walls are thick and comparitively short, being 1-2 longer than broad. Filaments develop mainly by intercalary divisions. Its reproduction and biology is unknown.

This species was found amongst the mosses in Alpine rivers, along with Hydrurus foetidus.



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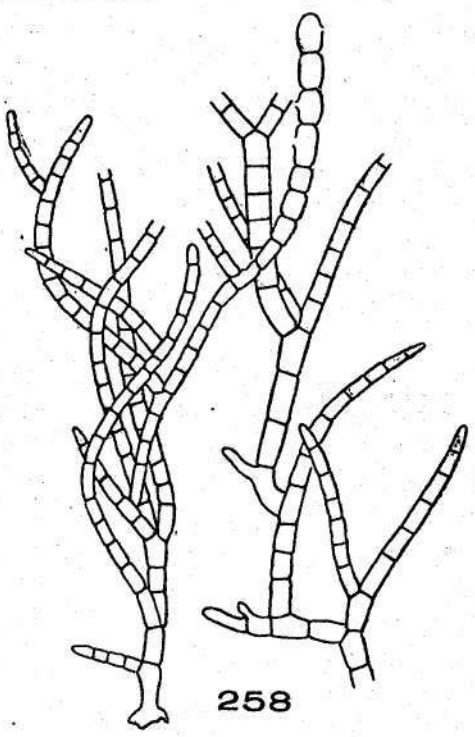
pp. 233-4 **Cladophora humida Brand 1913** fig. 258

Forms bunches or wads scarsely one or two millimetres high, is attached strongly to the substratum, is a dull grey green colour with a shade of blue and its own greasy lustre. The main filament is fastened to the bottom by a disc like dermoid. The filaments are mostly 20-50 μ wide, growth being both terminal and intercalary. Branches are racemose and falcate, however the filaments are sometimes unbranched over a large area. Normally cells are cylindrical, about 0.5-3 times longer than broad, in places they are barrelshaped. At times the whole filament consists solely of barrelshaped cells which eventually become sporangia. For the most part a single sporangium contains 16 zoospores, which emerge through an opening more or less in the centre of the cell wall. The zoospores are pear shaped with a colourless spout at the front, into which the flagellae are set (number not given). A chromatophore is enveloped in the central part of the zoospore, its posterior is again colourless and contains several granules. The zoospores, are 13μ long and 9μ wide. Sometimes single zoospores do not escape from the sporangia, they get surrounded by a thick wall and probably undergo a longer resting stage. During germination the first tubular holdfast develops. Zoospores are produced between May and September. Later the zoosporangia fall away and the remainder of the filament regenerates to form branches, a little sharpened at the ends.

The species was found first in small rock pools and the walls of waterfalls in Elbe, and then later on damp wall in Sweden.



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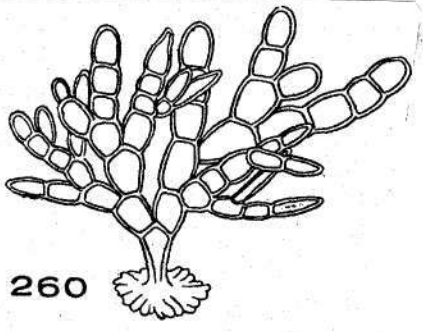
pp. 235 **Cladophora pygmaea Reinke 1888** fig.260.

Minute thalli, usually 1-1.5 mm high, dark green and grow mainly by intercalary divisions by which a lateral branch develops at the top of each new cell, making the organisation of the thallus irregular. The insertion of branches with the help of oblique walls leads to apparent dichotomy. Thalli are attached on the substratum by a holdfast disc produced through the wall on the lower part of the basal cell. Older filaments broaden towards the end and form a row of barrel-shaped cells which eventually become sporangia. Zoospores are released through an opening in the centre of the cell wall; little is written about zoospores. Terminal cells are 19-40 - (65) µ wide, 1/b = 1.5-3.5; terminal branches are 24-46 - (65) µ wide, 1/b= 1-3; the width of the main branch is usually greater than 65 µ, 1/b= 1-2. In the uppermost branches cell walls are 2-2.5 µ thick, whereas in the main branches are up to 6 µ thick. This alga occurs in the Baltic attached to rocks at depths from 2-20 metres, and often alongside Fucus. Not quoted from Polish beaches, this is the smallest amongst marine species.



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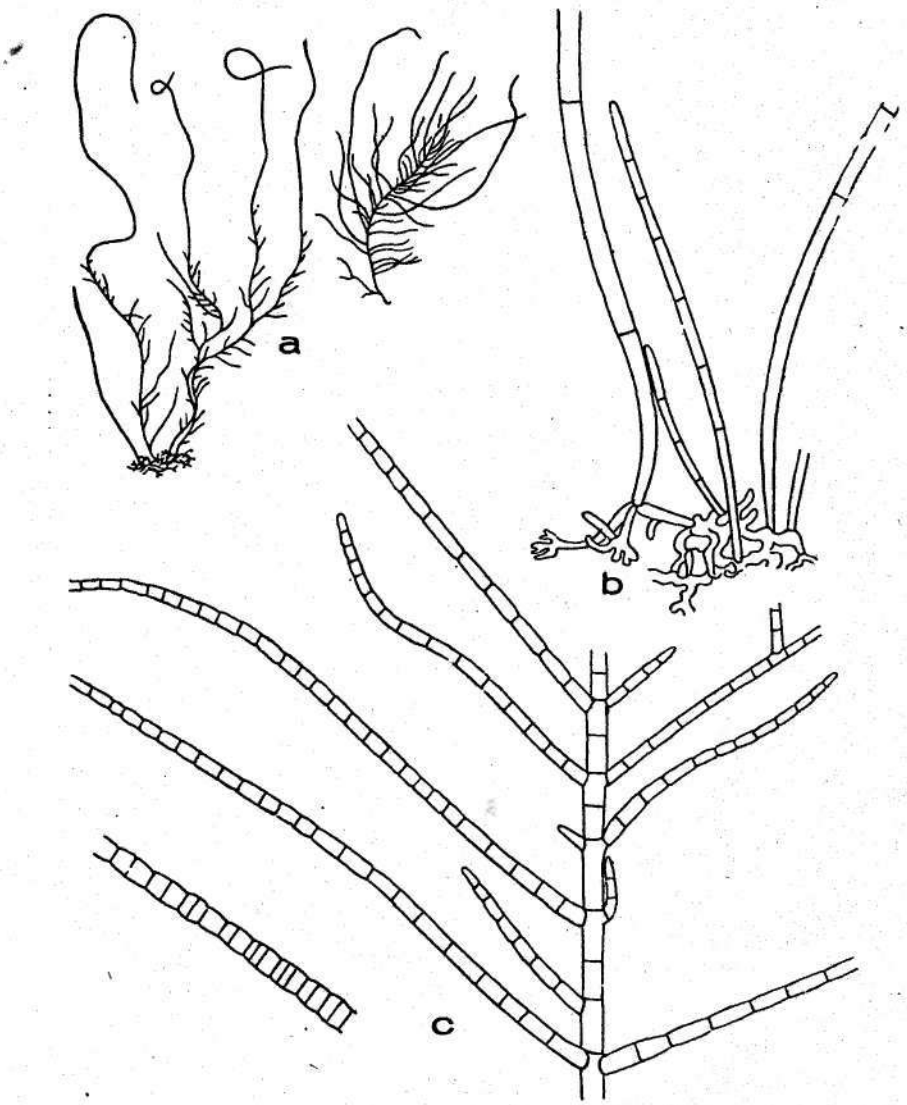
pp. 235-6 **Cladophora Kosterae Hoek 1963** fig. 261

Dark green thallus with a strongly developed layer of branching and radiating rhizoids at the base. Shoots grow vertically from these by intercalary divisions, and branching starts to form in the upper parts of the cells. The branches are alternately arranged, often in the same plane. The basal cell is long, with a thick cell wall. Older branches and main filaments broaden towards the ends to form bead-like zoosporangia, which will open in one or two places. At the ends young branches are a little pointed. Branches and main filaments have a tendency to grow vertically but rhizoids grow either horizontally or downwards. Chromatophores are densely concentrated in the cells. Reproduction is through bi or quadri-flagellate zoospores or biflagellate gametes.

Terminal cells are 27-42 μ wide, l/b = 1.5-5; upper branches are 30-60 μ wide, l/b = 1.5-4; main filaments are up to 85 μ wide, l/b = 1-3. Zoosporangia are up to 130 μ wide, l/b = 0.3-1. Quadriflagellate zoospores are 18-21 μ long and 11-12 μ wide; biflagellate gametes are 9-12 μ long, and 6.5 - 8.5 μ wide. The thallus grows up to 2.5 cms. This species is found together with C. glomerata on the stones of an artificial caskade in the Botanical Gardens in Paris. It was investigated thoroughly in pure culture by Van Hoek.

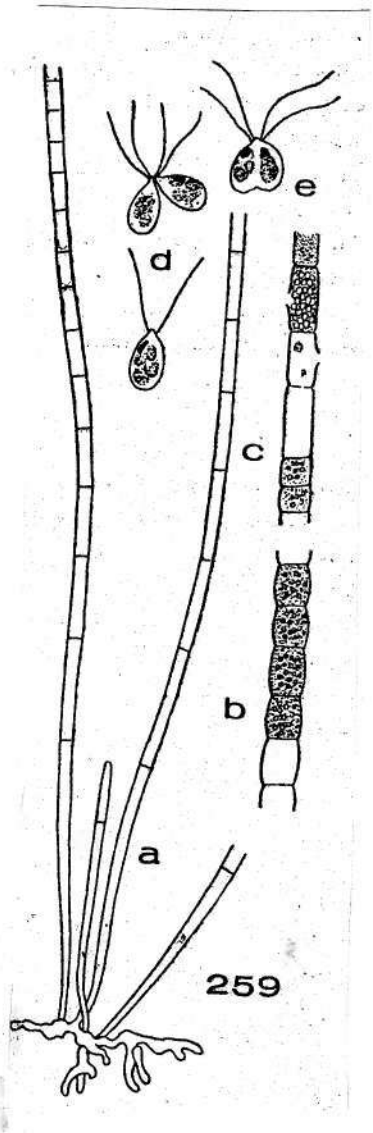


Rys. 261. *Cladophora Kosterae* (według Van Hoeka)

pp. 237 **Cladophora Okamurai (Ueda) Van Hoek 1963 (= Chaetomorpha Okamurai Ueda 1932) fig. 259.**

At the base the thallus has branched rhizoids, from which most sparingly branched verticle shoots arise. They have thick walled basal cells, and grow by intercalary divisions. The oldest shoots produce barrel shaped zoosporangia, opening at two or three places positioned more or less in the centre of the cell wall. The chromatophores are densely concentrated and dark green. Erect shoots are 27 µ wide and older shoots are up to 130 µ wide. Towards the base shoots are joined. In basal shoots 1/b = 1 - 13, in sporangia 1/b = 1 - 2. The thalli are 10 - (15) cms long. Quadriflagellate zoospores are 16 - 21.5 µ long and 11 - 12 µ wide. Biflagellate gametes are 8 - 11 µ long and 5.5 - 8 wide.

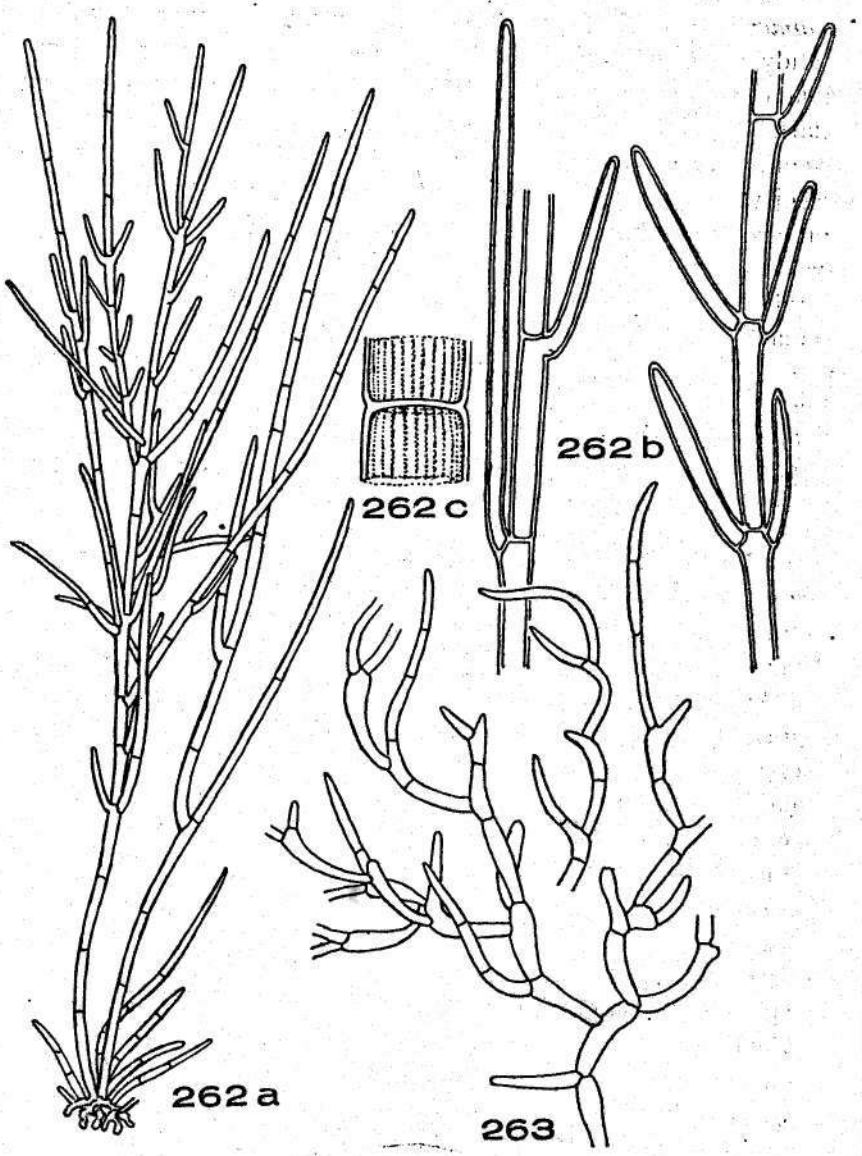
This species is quoted from Japan and in Europe from the Seine in Paris and the Rhein Delta in Holland.



pp. 237 **Cladophora sterrocladia Skuja 1949** fig. 262

Thallus is up to 1.5 cms high, is fastened to the substratum by primary and secondary rhizoids, monopodly branched. For the most part individual branches in the upper parts of the thallus are short, in the lower parts between 1 and 5 cells longer. The axis part of the thallus is 8 - 120 - (131) µ wide at the base and 40-60 µ wide at the top. Branches are 27 - 42 µ wide. Basal cells of the thallus are a little constricted at the crosswalls, are cylindrical or slightly clublike, and 4 - 5 times longer than broad. Branching cells are cylindrical and up to 25 times longer than broad. The terminal cell is slightly drawn out and rounded at the end. The cell walls are parallel, about 6 µ wide at the base of the thallus, colourless or pale yellow and in the branching cells about 1 µ wide. Reproduces through zoospores developing in the upper cells of the thallus.

Is found on the shells of snails in ponds in Burma.



pp. 237 - 242.

Cladophora aegagropila (L) Rabenhorst 1868

(= C. profunda Brand 1895; Aegagropila profunda (Brand) Heering 1921; Ae. Sauteri (Nees von Eisenbeck ex Kützing) Kützing; Ae. Linnaei Kützing; Ae. Martensii Kützing; Ae. holsatica Kützing; Ae. armeniaca (Wittr) Heering; and others) fig. 264-7.

The thallus is compact or loose, dense, irregularly branched, composed from filaments with intercalary growth and forming new branches at every crosswall. Each new cell produced by the division of a terminal cell develops into a new branch at the end. Simultaneously however intercalary divisions take place up to the uppermost parts of the filaments and obscure the appearance of acropetal organisation. Branches are often produced independently of the rhythmic cell division. They can arise at the end of a cell, below the end or laterally. With age, cells produce between 2 - 5 branches, in different positions. At basal parts of the thallus, cells are clubshaped and short. The tendency exists to change direction. Rhizoids are produced evenly at the base like lateral branches in the upper thallus. They can entwine around branches or attach themselves to the substratum with the aid of holdfasts. New green shoots may arise from the rhizoids. Usually cell walls are thick, in the uppermost branches 2.5 - 8 µ, on average up to 20 µ. The plants have a coarse texture. The thallus is always dark green since the chromatophores are densely concentrated. Branches either radiate from the base of the thallus or develop as irregular, creeping filaments. The plant exists as a mat-like covering on the substratum, occasionally free floating, or as compact ball-like structures up to 21 cms diameter. Cell dimensions are most variable; terminal cells are 30 - 70 µ wide, l/b = 5 - 24; uppermost branches are 30 - 100 µ wide, = 1.5 - 15. Reproduction occurs through the fragmentation of the thallus. Data concerning zoospores are uncertain. Occurs frequently in both brackish waters and eutrophic freshwater lakes. The wide distribution of this genus together with the heterogeneous form of the plant has led to a series of species under a separate genus, Aegagropila. Brand (1902, 1905) and later Heering (1921) gave a series of species which differed by the shape of the thallus and cells, thickness of cell walls, ramification and position of branches, and the formation of holdfasts.

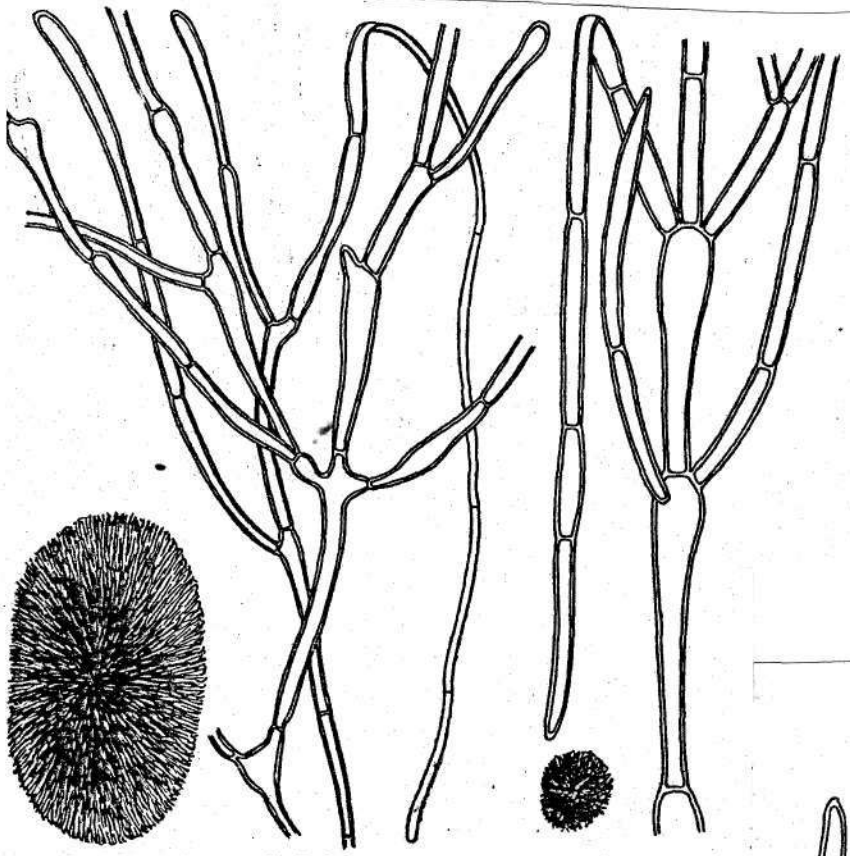
They are:

Ae. Linnaei Kützing, Ae. Martensii Kützing, Ae. holsatica Kützing; Ae. armeniaca (Brand) Heering; Ae. Sauteri (Nees) Kützing; Ae. profunda (Brand) Nordst.

However the features of all these species can easily be attributed to growth under different environmental conditions. So Waern (1938, 1952) returned to the former name of Linneus (Conferva aegagropila) and C. Agardh (Cladophora aegagropila)

One of the most characteristic features of this species is the formation of compact, cushion-like wads or balls which are released from the substratum or roll freely about the bottom waters. The formation of these ball like plants by the water currents, can be attributed solely or together with the characteristic growth of the species, to the mechanics of torn-off plants rolling around the bed of a lake. The combination of the two seems more reasonable. Angular growth of branching filaments results when spherical balls of algae are rolled freely about a sandy substractum, by which growth over the whole spherical surface is more or less proportional. Some amounts of stone, large sand grains or even

shells which have formed a substratum for young attached plants, have been seen at the core of these algal balls. Older plants will often have an empty core because the oldest, inner threads may die off. They also have concentrated lighter and darker layers which indicate the yearly growth and so the age of the plant. Of course the plants are not always spherical, on the contrary they have whirled threads overgrown with rhizoids and growing in different directions. Also plants can be loose or attached to the substratum. The group Aegagropila contains the species Ae. pigmaea C. Meyer (1927) endemic to Lake Baikal, as is Cladophora flocculosa C. Meyer (1927).



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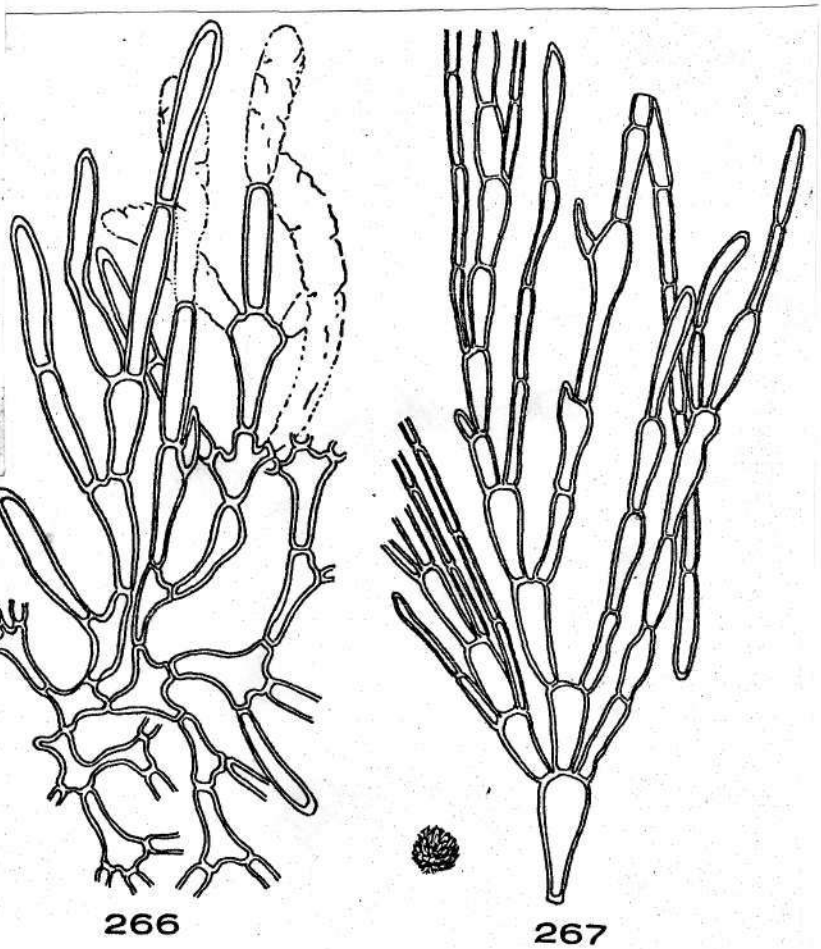


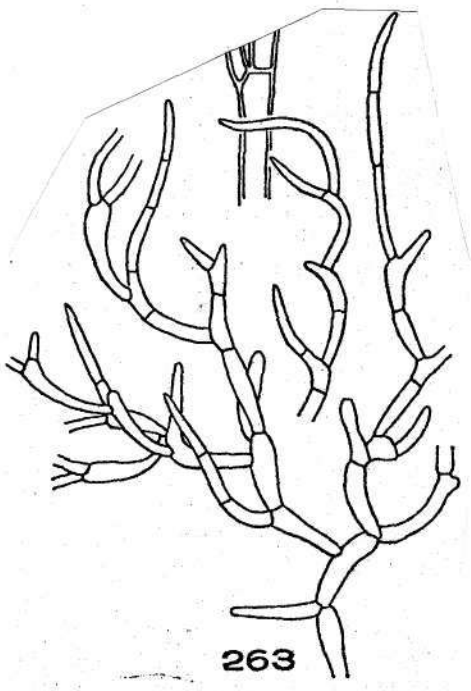
266 267

pp. 242. Cladophora cornuta Brand 1895 (= Aegagropila cornuta (Brand). Heering 1921) fig. 263

Densely branched thalli form irregular and sometimes spherical agrigates up to 4 mms. wide. Filament growth is either terminal or intercalary. Branches are directed forwards and arched, the attachment of branches is often lateral. Rhizoids exist but without holdfast organs at the ends. The thalli are usually loosely entangled among other algae, notably Cladophora aegagropila and secured in the shape of a hook by the bent branches. The cells walls are fairly thick, 2.5 - 8μ in cells of the uppermost branches, and up to 11μ in the main filaments, making the plants rigid. The terminal cells are constricted. The thallus is dark green. Reproduction is by the fragmentation of the filaments: as yet zoospores are unknown.

Terminal cells are 35-54μ wide, l/b = 3.5-7.5; cells in the uppermost branches are 41-56μ wide, l/b = 4-6; and cells in the main filament are up to 75μ wide, l/b = 2-5.

Occurs in lake Würm in Bavaria. The main feature of this plant is the shortness of its thallus, caused by the bending of the branches.



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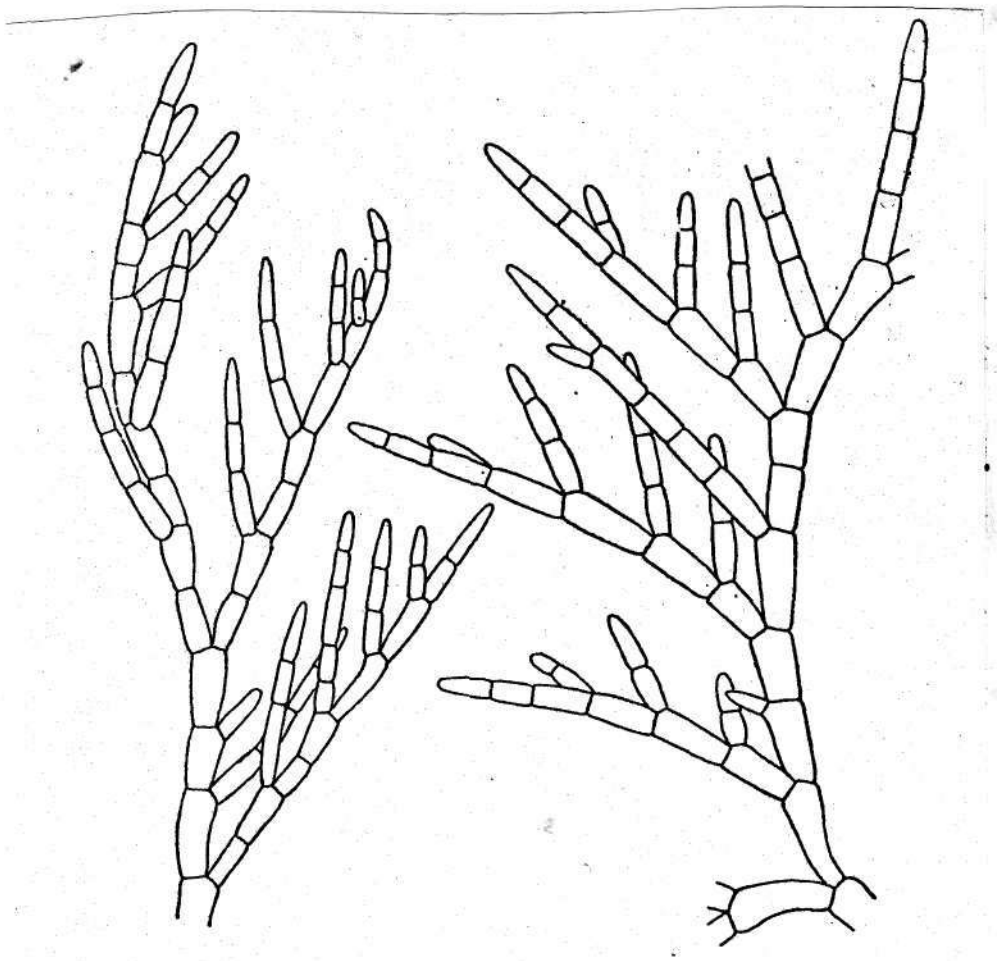
pp. 242-4 Cladophora Hutchinsiae (Dillw.) Kützing 1845. fig. 268

Thallus up to 35 cms high, composed from pseudodichotomous branched threads, forming lateral branches of diverse length. Growth is mainly intercalary, nevertheless young branches grow at the ends. From the same cell 2 or 3 branches develop obliquely to the thread from which they form. The terminal cell is cylindrical or slightly conical. Zoosporangia develop in a row from the top towards the base of the filament. After the formation of zoospores the branches fall away and the main filaments develop by intercalary divisions or produce proliferations and build primary bunches of branches. The terminal cells are (90-140) - (160-195) μ wide, l/b = 1-4; subterminal branches are (100-150) - (170-325)μ wide, l/b = 1-4; main filaments are 240-400 μ wide, l/b = 1-3.5.

Biflagellate zoospores were only once observed.

Occurs on beaches of the Atlantic, and in the opinion of Van Hoek it does not occur in brackish waters. However A. Rumek (1951) quotes it being in the Gulf of Gdańsk, but this requires verification. A characteristic feature of this Cladophora is the large cell width in relation to the length.



Rys. 268. *Cladophora Hutchinsiae* (z Van Hoeka)

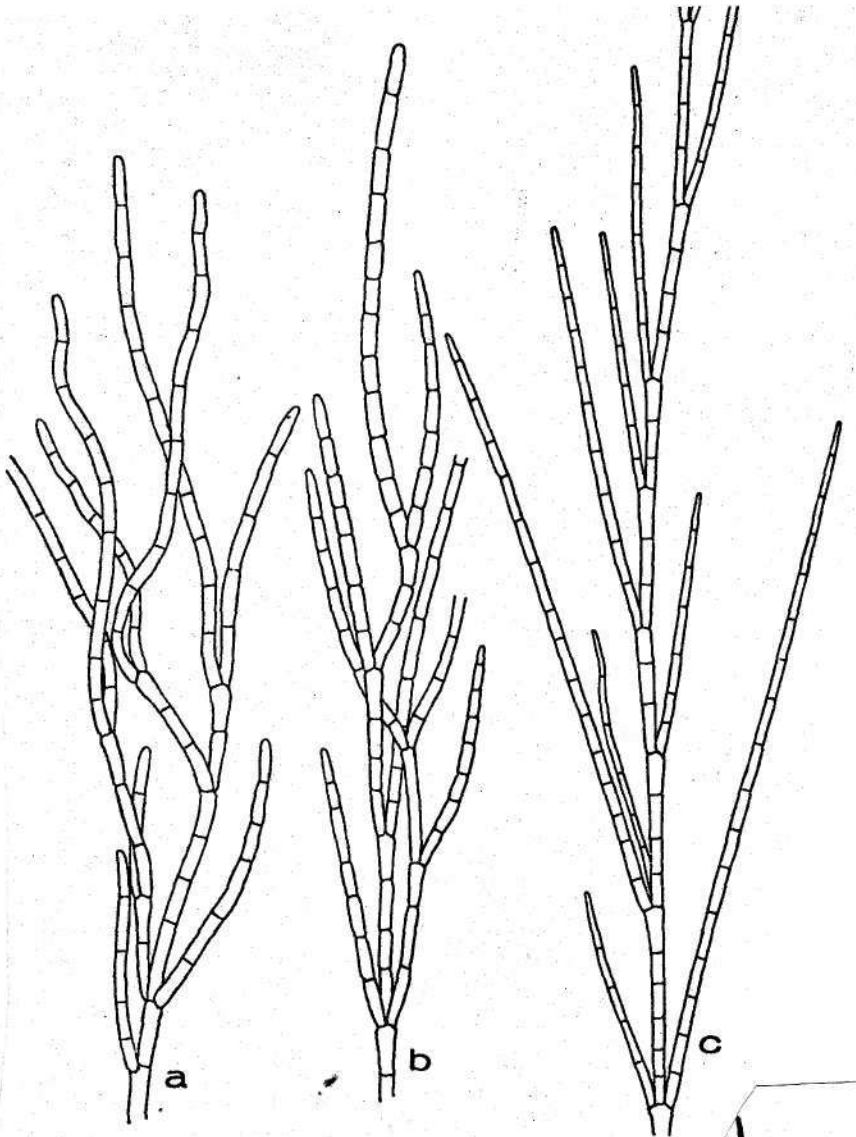
pp. 244 Cladophora rupestris (L) Kützing 1843 fig. 269.

Thallus is composed from apparent dichotomous branched filaments, due to which the length of the lateral branches varies. Growth is mainly intercalary. Many newly created cells produce lateral branches at the end, through which there becomes a mixture of different aged branches: young amongst the old. Branches are adjacent and weakly parted at the base. Branches are obliquely attached at the ends, giving the impression of apparent dichotomy. Sometimes older cells produce between 3 to 6 lateral branches. Terminal cells are cylindrical but narrow somewhat towards the end, which is blunt. Sporulation commences at the terminal branches and progresses towards their base. Sporangia from vegetative cells are thick and usually somewhat swollen. After the release of zoospores, the terminal branches fall apart, and the thallus is reduced to main branches which gradually regenerate, forming proliferations, usually densely branched. The cells are dark green and contain densely concentrated chromatophores. The plants are stiff due to the thick (5-10μ) layered cell walls; however in young branches the cell walls are about 2.5μ thick.

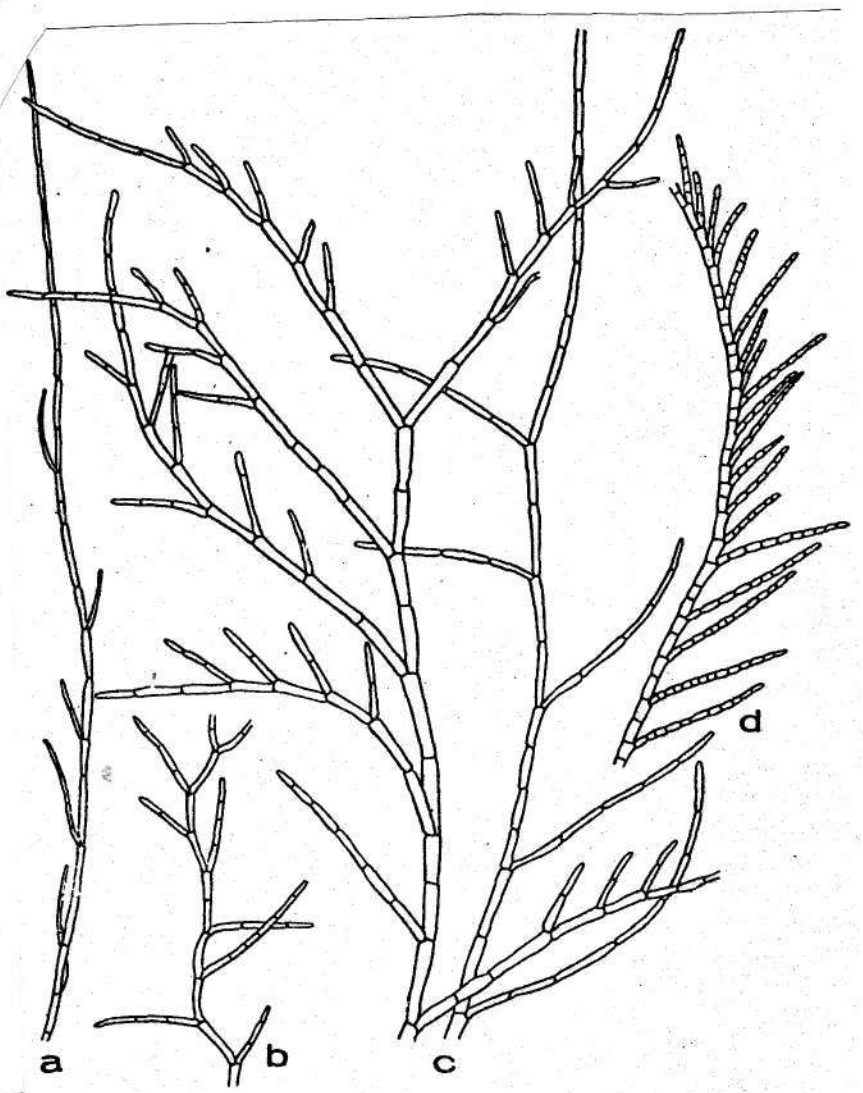
The width of the terminal cells is 40-50 or 65-80 μ, l/b = 2-6; subterminal cells are 40-75 or 65-100 μ wide, l/b = 1.5-6; and the width of the main filaments is 90-220 μ, l/b = 1.5-7.

Reproduces with the aid of quadriflagellate zoospores and biflagellate gametes. Number of chromosomes = 12. Zoospores are 11-15.5 μ wide and 17-25 μ long; gametes are 7.5 - 10.5 μ wide and 10.5 - 15 μ long.

Grows in exposed places and strong undulating waters where it reaches a length of 8 cms. On the other hand in quiet waters it attains up to 20 cms. Found in seas of different salinities, often epiphytically with Fucus.



Rys. 269. *Cladophora rupestris*:



Rys. 270. *Cladophora sericea*, różne kształty plech, przy d — typ określany jako *Cladophora hirta* (z Söderströma)

pp. 246-7 Cladophora sericea (Hudson) Kützing 1843. (=C. Flexuosa (Müller) Kützing 1843) fig. 270.

Thallus is composed from apparent dichotomous branched filaments, through which branches vary in length and are densely arranged side by side. Growth is mainly intercalary. Each cell develops attached branches obliquely (at an angle of 45°) at the end, or even perpendicular. Older filaments produce 2-3 new branches per cell. Terminal cells are more or less pointed and sometimes form short branches like thorns, which is noticable in plants growing abundantly. During sporulation cells divide profusely and become barrel shaped, while the terminal cells are often bulbous. After sporulation the terminal branches fall away, and the filaments regenerate producing new and rather rigid branches. The walls of the terminal and subterminal cells are about 1 - 2.5 μ thick. Width of terminal cells is either 15-21.5 or 50-60 μ, l/b= 3-16; width of terminal branches is (16.5 - 38) - (55 - 100) μ l/b = (7-5) - (1-4); and the width of the main threads is 55-170 μ l/b = 5-10 or 2-3.

Var. sericea. Reproduces with the aid of quadriflagellate zoospores and biflagellate isogametes. The zoospores are (6) - 8 - 12 - (14) μ wide, and (13.5) - 17 - 24 - (27) μ long. The flagellise are 17 - 18 μ long, and the eye spot is 3 - 4 μ wide.

The gametes are (4) - 5 - 8 - (9.5) μ wide, (8) - 10 - 16 - (18) μ long; flagellae are about 17-18 μ long and the eye spot is 2-3 μ wide.

The zoospores and gametes have positive phototactic reactions, whereas planozygotes are negative. A regular metagenesis exists.

Var. biflagellata Van Hoek. Reproduces only through vegetative biflagellate zoospores which are (6.5) - 8.5 - 11 - (16)μ wide, (16) - 18 - 24 - (27)μ long, with flagellae 16-17 μ long and eye spots 3-4 μ wide. Positive phototactic reactions.

The above species is found together with varieties throughout shores from the Arctic to the Mediterranean, as well as in brackish waters. Söderström quotes the number of chromosomes as 24. Some algologists connect this species with C. glaucescens, C. obliterata and also C. fracta and C. glomerata, which newer research (Van Hoek, Söderström) does not recommend.

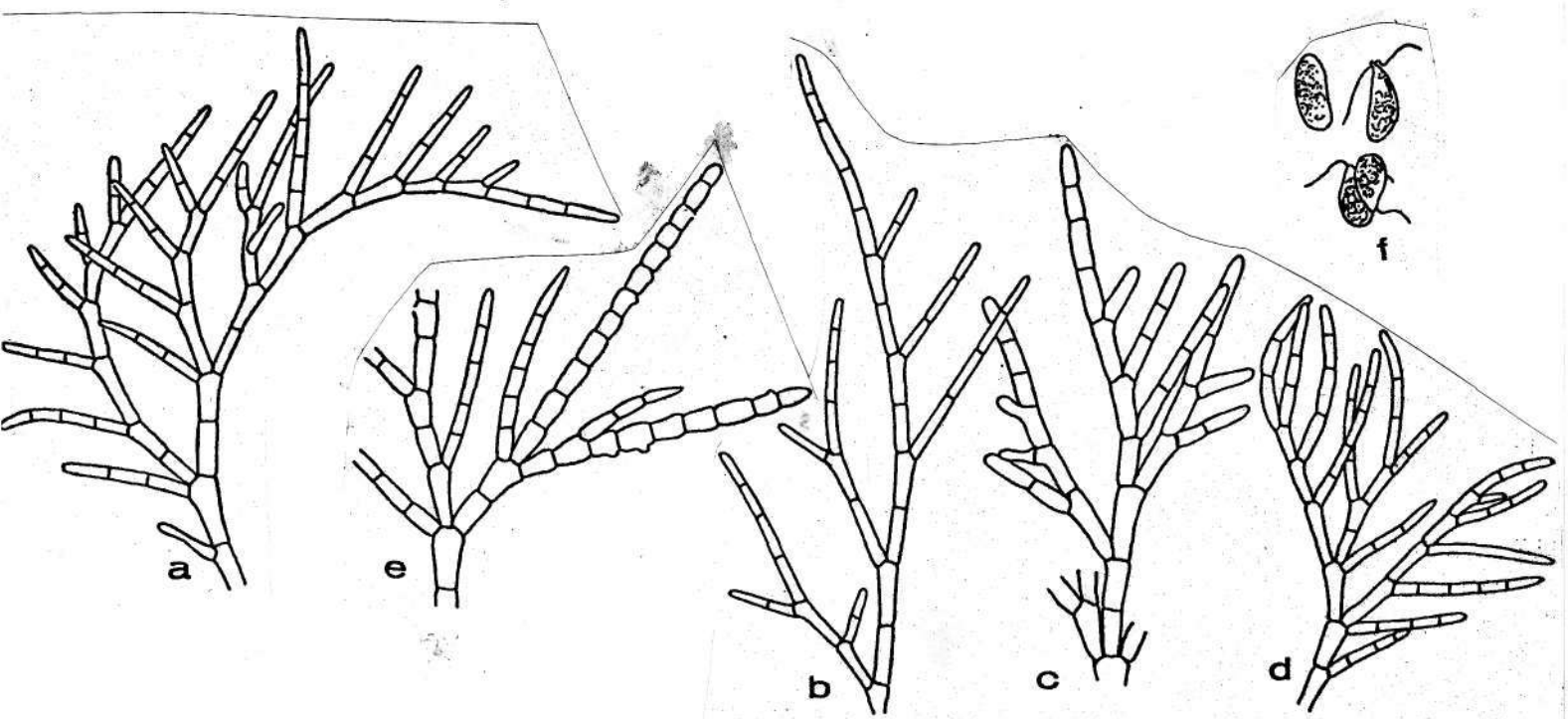
pp. 247-9 **Cladophora albida (Hudson) Hützing 1843** (=C. refracta (Roth.) Kütz; C. hamosa (Kütz) Kütz?) fig. 271

The thallus is composed of densely pseudodichotomous branched filaments, with lateral branches of uneven length. Growth is mainly intercalary. Inclined or perpendicular, lateral branches develop at the ends of the cells; 2 - 3 lateral branches can develop from each cell. The terminal cells are predominently cylindrical. Cells in branches producing zoospores become barrel shaped. Sporulation always begins at the top and commences towards the base of the branch. Following the release of the zoospores, the terminal branches fall away, after which the remaining threads regenerate. Thalli developing in zones of strong undulating water are short (about 5 cms), have acropetal organisation and the end branches are either folded downwards or bend like a sickle. Consequently filaments are broken by the wave action and form thalli of a dense and spongy consistency. In calm waters the thalli reach 50 cms in length and have terminal branches which are straight or only slightly bent at the ends. Width of the terminal cells is (8-11) - (32-50)μ, l/b = (11-19) - (1.5 - 3); width of the terminal branches is (9.5 - 19) - (32-54)μ, l/b = (4-10) - (1.5-3); width of the main filaments is 22 - 90 μ, l/b = (4 - 8) - (1.5 - 3).

The number of chromosomes, n = 12. Metagenesis exists (Bliding 1936). Van Hoek gives two varieties: var. albida with quadriflagellate zoospores and bi-flagellate gametes, and also var. biflagellata with only vegetative biflagellate zoospores.

This species occurs under many ecological conditions on the shores of the Atlantic, Mediterranean and the Baltic. Grows on the ground, rocks and other substrates.

Van Hoek included in this species C. hamosa and C. glaucescens, which does not seem correct, certainly relating to C. glaucescens. After Söderström Cladophora hamosa Kützing 1843 has a stiffer thallus and is more compact than C. albida. Cells of the outer branches are 20-50 μ wide, 60-165 μ long; branches at the ends of filaments grow to this same size.



Rys. 271. *Cladophora albida*: a, b, c — różne wykształcenie gałązek, d — typ gałązek, *C. hamosa*, e — fragment plechy z zoosporangiami, f — zoospory (z Söderströma)

pp. 249-50 **Cladophora glaucescens (Griffiths ex Harvey) Harvey 1849.** Fig.272

Completely developed thalli are dense and grey green; filaments are slender and abundantly branched; branches are rigid, straight, relatively short and also with short cells. The complete thallus varies moreover depending on the conditions where it exists. Dimensions of cells change with the age of the plant and also with conditions of habitat, so it is difficult to give exact measurements. The end cells of outer branches are 30-80 µ wide, 50 - 240 µ long, in basal parts of plants they are 50-150 µ wide and 100 - 685 µ long. Cells wider than 100 µ are rare however, the length is mostly 5 times the width.

Occurs in well illuminated habitats and in waters of various salinities. Reproduces only by biflagellate zoospores. Number of chromosomes n = 22.

(above was written after Söderström).

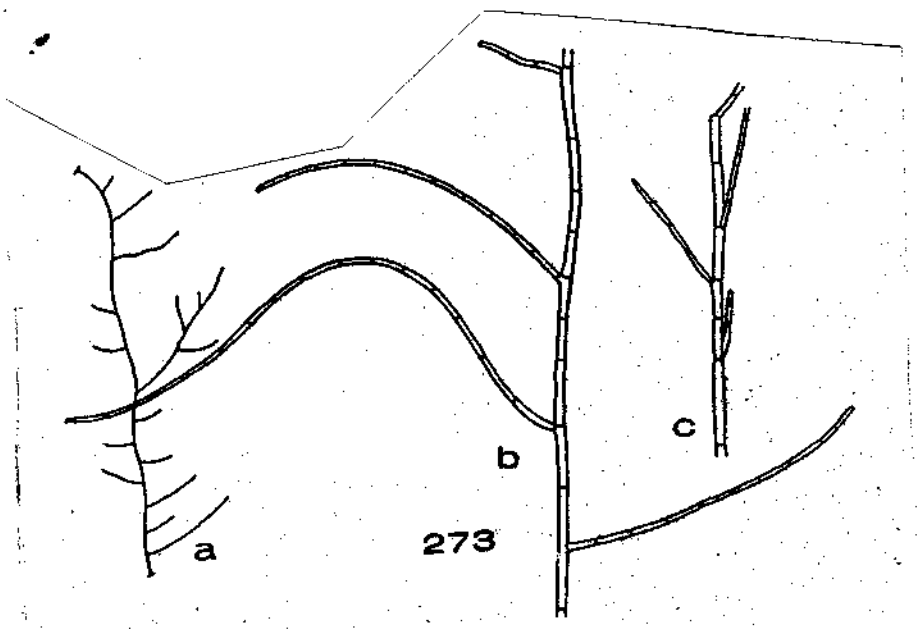
pp 251. **Cladophora rivularis (L) Van Hoek 1963**

(=C. fracta var rivularis (L) Brand; C. crispata (Roth) Kützing; C. glomerata var. fluitans (Kütz) Rabenh; C. oligoclona (Kütz) Kützing; C. insignis (C. Ag.) Kützing)

fig. 273

The thallus is composed from long, unbranched or sparsely branched, filaments, self-tangled and connected with lateral branches, often with proliferations. Growth is almost completely intercalary. The existance of sporangia and spores is uncertain. Plants are either attached to the bottom or free floating, at the same time the parallel structure of the threads in bouyant wads is characteristic. The width of a filament is very variable: terminal cells are 19-30 or 30-45μ wide, l/b = 8-15 or 2-5, the main filaments are 30-175μ wide, l/b 3-10. In the case of a single population however, the width of a filament is similar.

Occurs in Europe.

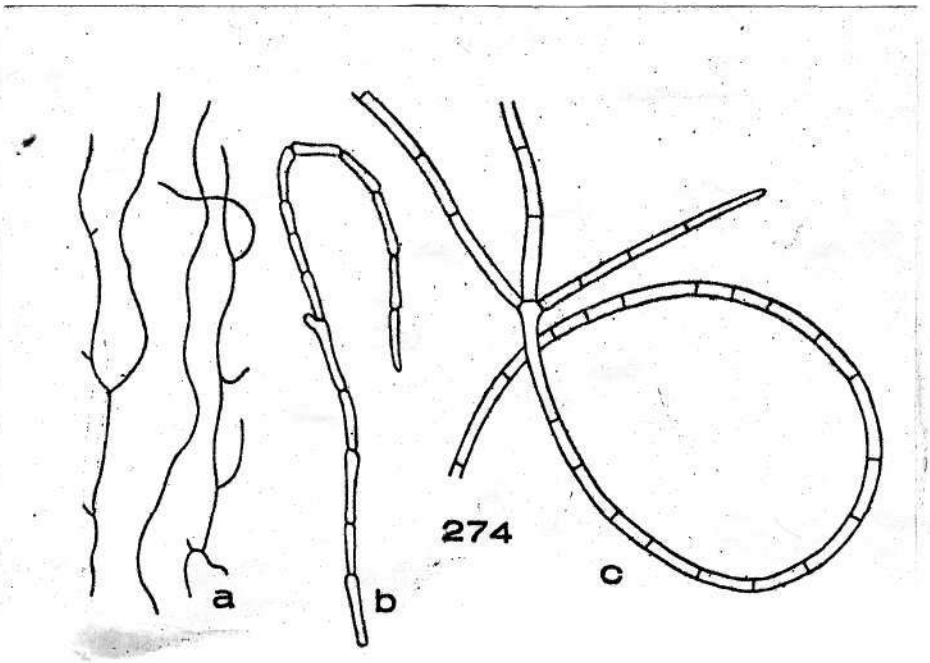


pp. 251-2 **Cladophora globulina (Kützing) Kützing 1845. (=C. lacustris Kützing; C. fracta var. lacustris (Kütz) Brand) fig. 274.**

Thalli composed delicate filaments, unbranched or sparingly branched, sometimes only a single bunch of branches, mainly in places where they develop akinetes after a quiet period. Young plants are usually densely branched, later however a long, unbranched filament will develop from a bunch of branches. The branches are lateral, subapical and rarely pseudodichotomous. Cross walls of branches are often displaced to the base of the branches. Growth is mainly intercalary. Plants are attached to the substratum by rhizoids or develop floating mats through the intertwining of their own filaments.

The width of the main filaments is 16-- 27 - (38) μ, l/b= 3-11.
The width of the terminal cells is 13 - 14 or 16 - 21.5μ, l/b= 3-8.
The width of the subterminal branches is 13.5 - 16 or 16.5 - 30 μ l/b = 2 - 7.

Occurs in flowing and still water, scattered throughout Europe.



Rys. 274, 275. 274 — *Cladophora globulina*, pokrój i fragmenty plechy (z Van Hoeka i Kützinga);

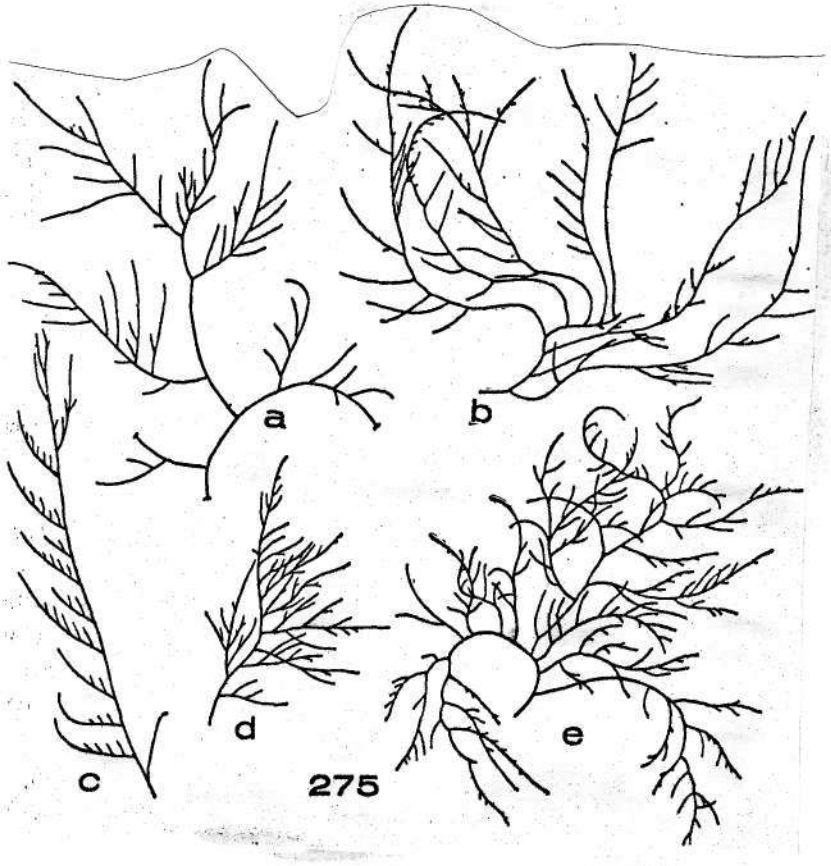
pp. 252 **Cladophora vadorum (Areschoug) Kützing 1849 (= Aegagropila biasolettiana Kützing 1845; Ae. corynarthra Kützing 1845.) Fig. 275-6**

Thallus attached or free floating. The attached thalli, as met by all in flowing waters, are densely branched laterally, and pseudodichotomously, with terminal growth and a distinct acropetal organisation. In the older parts of the thallus growth is also intercalary, by which secondary branches are formed some distance for the end. In free floating thalli intercalary growth is predominant. During intensive sporulation the terminal branches fall away following the release of zoospores, then the principle branches will develop through intercalary divisions. Lateral branches develop obliquely from the end of the basal cell; however with further growth they shift upwards as far as possible, becoming seemingly dichotomous. Sometimes 3 - 4 branches form simultaneously from one basal cell. The terminal cells are usually long and pointed at the end, when however they transform into sporangia or akinetes, they are shorter and very bunched.

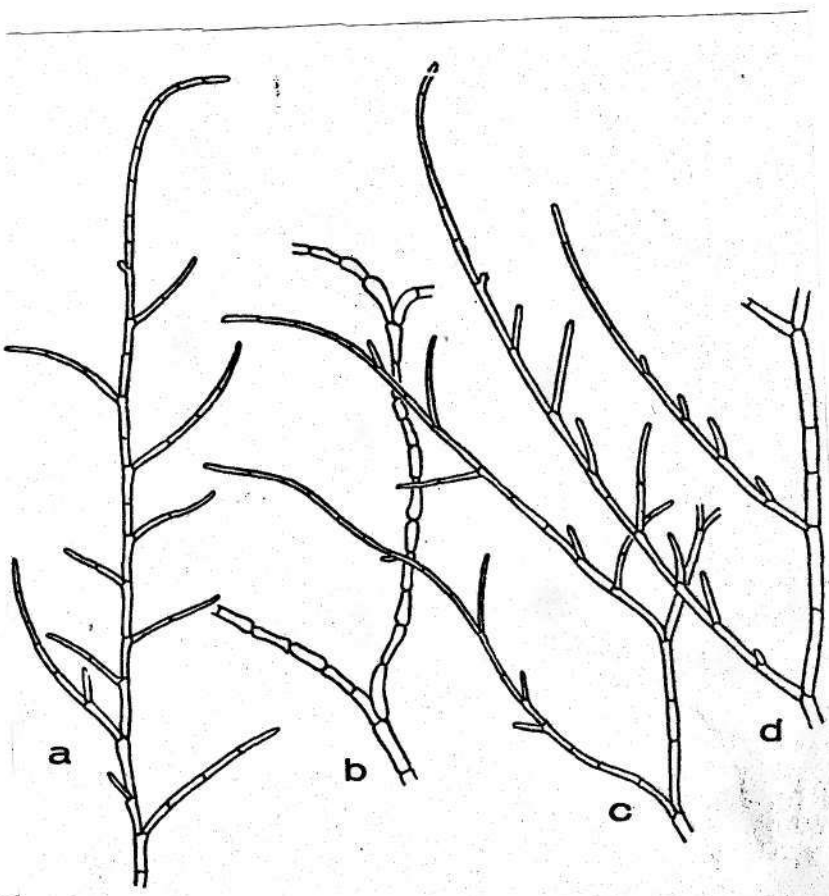
The width of cells in the terminal branches is (27 - 32) - (50 - 65)μ, l/b = 2.5 - 24; the width of cells in the subterminal branches is (27 - 51) - (55 - 88) μ l/b= 3 - 15, and the width of the main filaments is 120 - 200 μ, l/b= 2-11.

The quadriflagellate zoospores are 11 - 23 μ long and 8 - 10 μ wide, with the flagillae 16 - 17 μ long. The eye spot is an annular shape roughly 3 - 4.5 μ diameter. The thallus is between 2 and 50 cms high.

Occurs mainly in brackish waters, as well as in shallow pools and ponds. The thalli are attached or free floating, when rolled about the bottom by wave action they break up into a ball-like composition of the type Aegagropila.



275 — *C. vadorum*, różne pokroje plech (z Van Hoeka)



Rys. 276. *Cladophora vadorum*, różne fragmenty plech, przy b — stara roślina z pogrubionymi ściankami komórek (z Van Hoeka)

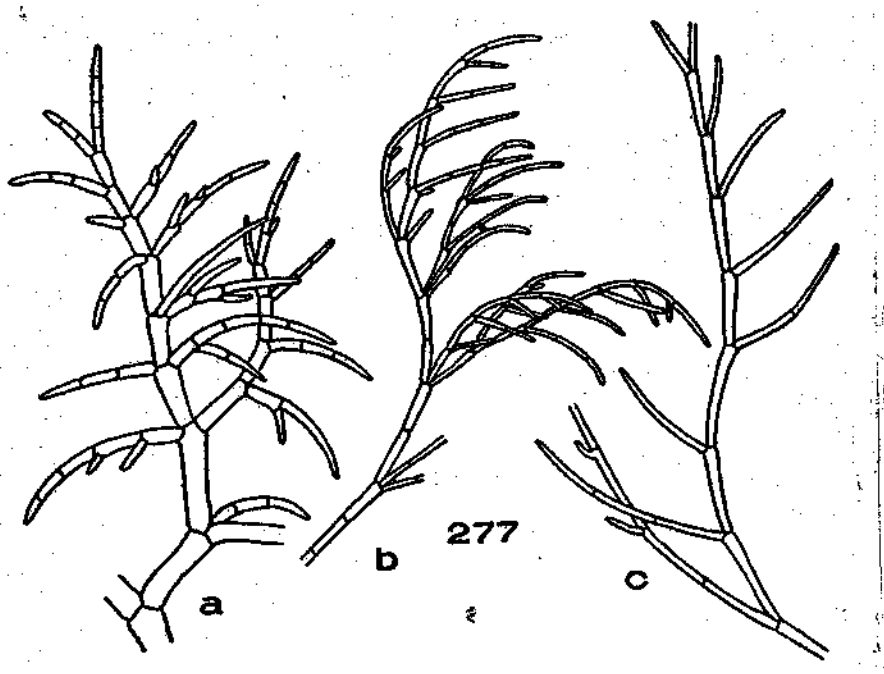
pp. 254-6 **Cladophora vagabunda (L) Van Hoek 1963** (=**C. expansa (Mertens) Kützing; C. ceratina Kützing; C. fracta f. marina Hauck; Aegagropila flaccida (Kütz) Kützing**) fig. 277.

The thallus is up to 50 cms long, is composed of threads branching pseudodichotomously, branches sickle shaped (arcuate) or folded. The filaments grow mainly at the ends (acropetal organisation), intercalary divisions are only visible at a certain distance from the end. At sporulation the branches often fall away after the release of the zoospores, but the remaining threads develop through intercalary divisions, however unbranched shoots do not form at length. Free floating plants produce more or less lateral, wide angled branches. The terminal cell is slightly pointed, but when zoospores form it is clubshaped.

Terminal cells are (17 - 23) - (55 - 85)μ wide, l/b = (8 - 23) - (1,5 - 3); subterminal branches are (18 - 30)- (70 - 130) μ wide, l/b = (9 - 14)- (1 - 2.5); The main filaments are between 80 - 300 μ wide, l/b = (5 - 14) - (1.5 - 3). Quadriflagellate zoospores are (11) - 16 - 20 - (22.5) μ long, (6) - 8 - 9 - (14) μ wide, the flagellae are about 16 - 17 μ long, and the eyespot about 1.5 - 2.5 μ wide.

Biflagellate gametes are (7.5) - 10 - 12 - (15) μ long, (4.5) - 6 - 8 - (11) μ wide, flagellae are 16 - 17 μ long and the eye spot between 1 - 1.5 μ wide.

Grows in salt and brackish waters. The gametes and zoospores produce separate plants, suggesting the occurence of genetic transformations.



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pp. 256-8 Cladophora glomerata (L) Kützing 1843 (= Conferva glomerata Linnaeus 1753)

The plants have clear acropetal organisation and with predominently more terminal than intercalary growth, and are attached or free floating. Branches are attached obliquely and rarely laterally. The width of the terminal cells ranges from (19-24) - (58-91)μ, with the main filaments up to 150μ wide. Reproduction is through biflagellate asexual zoospores. The number of chromosomes is 96, so C. glomerata is octoploid, since the fundemental number of chromosomes in Cladophoraceae is 12.

There are two distinct varieties.

Var. glomerata (= C. glomerata (L) Kützing) fig. 279.

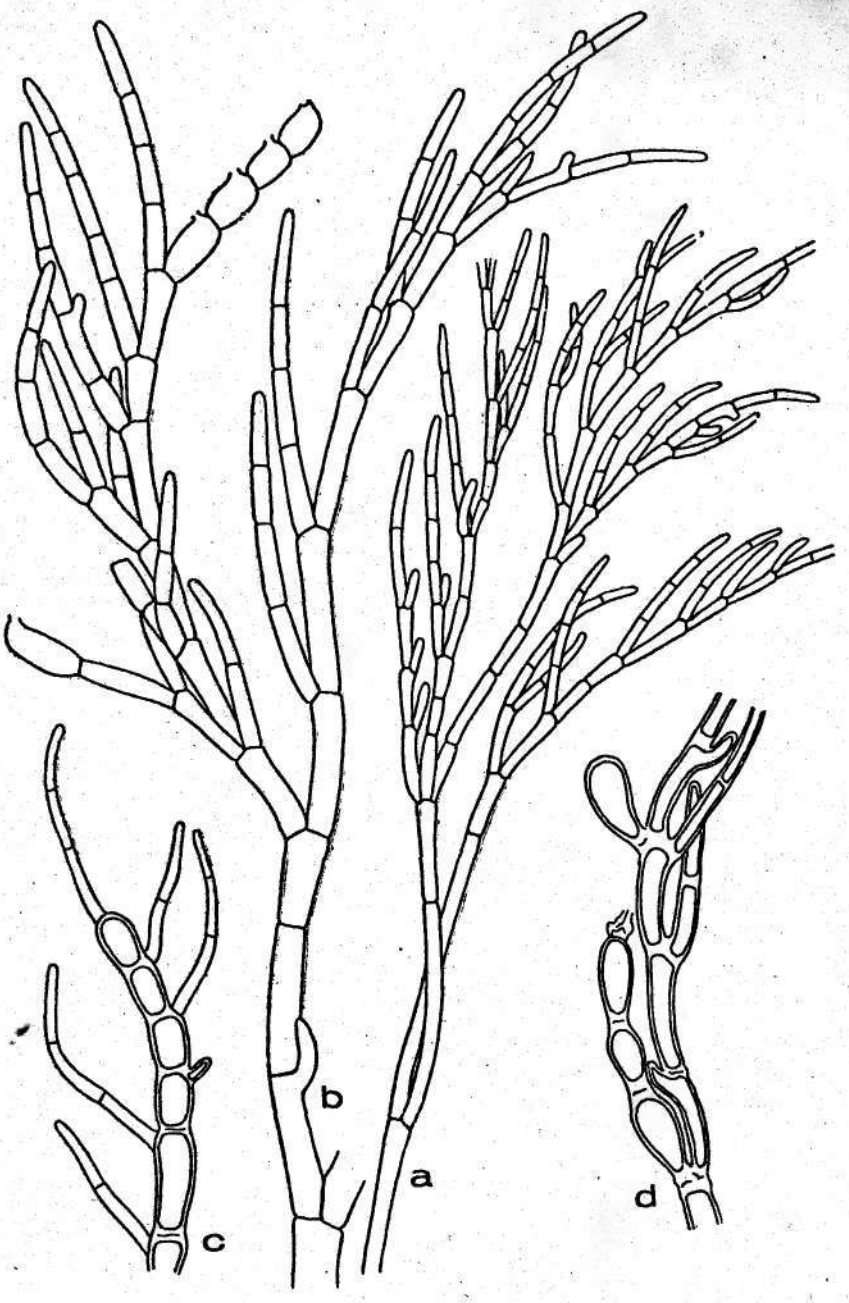
The length of the thallus is very variable, as shown by the observed change in size and shape of thalli throughout a year in the R. Skawa (fig. 280). In rivers the thalli approach 1 metre in length, whereas in quiet waters they attain several metres. In flowing water plants have pseudodichotomous branching. The main filaments have a terminal bunch of branches, which are often arcuate. Intercalary growth takes place at a given distance from the apex and in the basal parts of the thallus. At the time of abundant sporulation the terminal branches fall away reducing the thallus to main filaments which grow considerably lengthwise due to intercalary divisions. In still water the main filaments grow almost identically to the genus Chaetomorpha, producing very long, laterial or terminal branches. In principle branches are arranged obliquely but there is much diversity due to external condition, particularly the water movements. The terminal cells are slightly pointed, however where they are transformed into zoosporangia they become cylindrical, spherical or even curved. Reproduces with the aid of biflagellate zoospores. Terminal cells are (22-34) -(58-91)μ wide, l/b = 6-13 or 1.5-5; cells of uppermost branches are (22-34) -(68-100)μ wide, l/b = 5-10 or 1.5-3.5; dominant shoots are 100-275μ wide, l/b = 7-12 or 1.5-5.

Common in both flowing and still water throughout the Northern Hemisphere, in fresh and brackish water.

Var. crassior (ag.) Van Hoek (=Conferva crispata var. crassior, C. ag. 1824. C. callicorma Kützing in Prescott 1962.

Has a greater tendency to intercalary growth than var. glomerata, with reduced branching and sparse sporulation. Attached plants have acropetal organisation, however the system of branches is weakly formed. Reproduces with the aid of biflagellate asexual zoospores. Terminal cells are (19-24) - (30-55) μ wide, l/b = 9-21 or 2.5-8; in the uppermost branches cells are (19-32) - (38-70)μ wide, l/b = 6-12 or 2-5.

Common throughout Europe.



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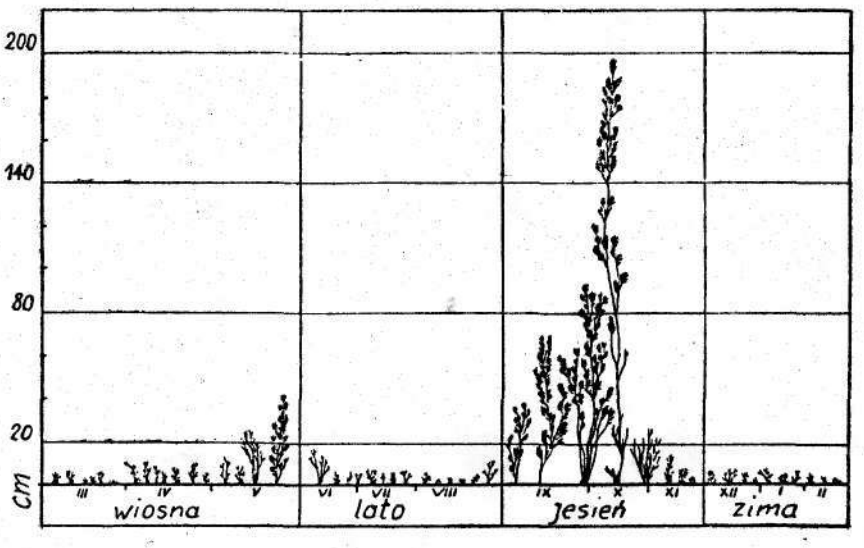


Rys. 280. Zmienność pokroju i wielkości plech *Cladophora glomerata* w ciągu roku w rzece Skawie (według Chudyby)

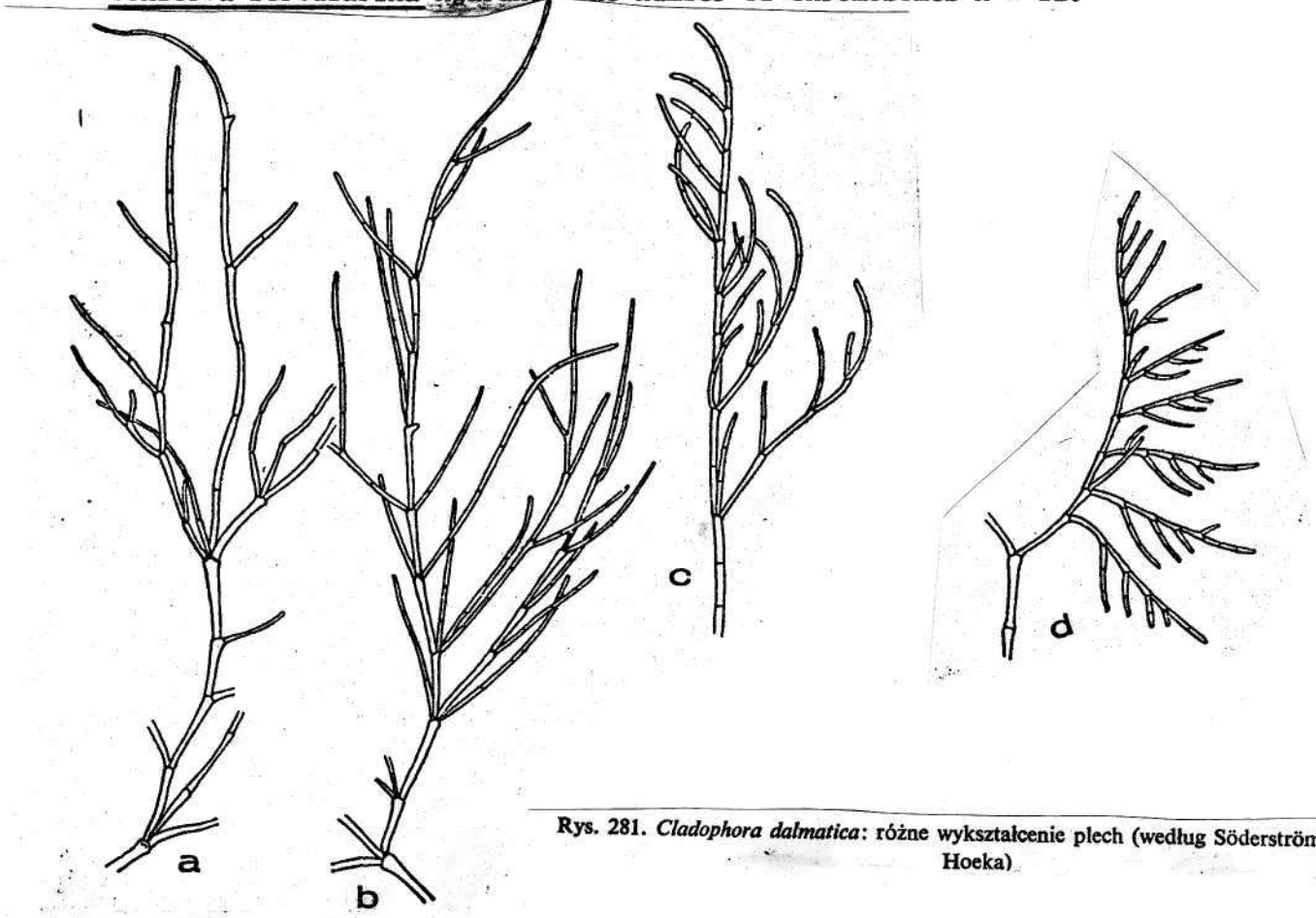
pp. 258 - 60 Cladophora dalmatica Kützing 1843. (=C. obliterata Söderström 1963; C. plumula Kützing; and others) fig. 281.

Growth of the thallus is mainly terminal, with pseudodichotomous branching and branches either bent or folded at the ends. Intercalary divisions are visible near to the base of the thallus. Secondary branches form at some distance from the end. At the time of abundant sporulation the branches fall away following the release of spores. Only the principle filaments remain, in which however the more prominent intercalary growth is not observed, instead recreating proliferations establishes a primary system of branches. Lateral branches are situated obliquely in relation to branching filaments. However, in free floating plants they come off at a greater angle. The terminal cells are cylindrical, not pointed at the end, but are club shaped if producing zoospores.

The terminal cells are (13.5 - 19) - (47 - 74) μ wide, l/b = (13 - 30) - (1 - 3); width of cells in subterminal branches is (13.5 - 30) - (47 - 60) μ, l/b = (7 - 15) - (1.5 - 3); the width of the principle branches is 60 - 150μ, l/b = 2.5 - 20. Quadriflagellate zoospores are (15) - 17 - 20 - (24) μ long and 7 - 10 - (13) μ wide. The flagellates are 16 - 16.5μ long, the eye spot is approximately 1.5 - 2 μ wide. Biflagellate gametes are 8 - 12 μ long and (4) - 4.5 - 6.5 - (7) μ wide, the eye spot approximately 1 - 1.5 μ wide and the flagellae between 16 - 16.5 μ long. The plants range from 1 - 50 cms high.

Regular genetic changes exist betwsen the plants produced from gametes and asexual zoospores.

Occurs in the coastal zones of the Western Baltic. Quoted sometimes as C. hamosa, C. glaucescens, C. albida or C. crystallina. Söderström named it C. obliterata, accepting for type specimen, plants specified in the herbarium Agardh as Conferva sertularina. However Van Hoek knew this species to be similar to C. dalmatica described by Kützing (1843) and identical with Conferva sertularina Agardh. The number of chromosomes n = 12.



Rys. 281. *Cladophora dalmatica*: różne wykształcenie plech (według Söderströma i Van Hoeka)

pp. 262-3 Cladophora fracta (Müller ex Vahl) Kützing 1843 fig. 282

Depending on the conditions of their settlement and genetic holdfasts, the plants are either attached and have acropetal organisation with a predomination of terminal growth or have an irregular structure with predominently intercalary growth. Reproduces through biflagellate asexual spores, fragmentation of filaments or akinetes. Generally terminal cells are 16 - 28 μ wide, l/b = 3.5 - 25. Two species exist.

Var fracta (= C. crispata (Roth) Kützing; C. sudetica Kützing; C. fracta var. sudetica (Kütz) Wittrock et Nordstedt, Alg. Exic. 125)

Irregular thalli are free floating or lying loosely about the substratum. They are compound with filaments branching pseudochotomously, and growing mainly intercalary. Branches push outwards obtusely. There also exists a secondary and tertiary order of branching. The terminal cells are cylindrical or slightly conical. Zoospores are unknown. Reproduces by akinetes or fragmentation of the filament.

The terminal cells are 16-27 μ wide, l/b = 3.5 - 25; cells in the upper branches of the thallus are 17.5 - 38 μ wide, l/b = 3-17; and cells in the main filaments are 45 - 85 μ wide, l/b = 1.5 - 14.

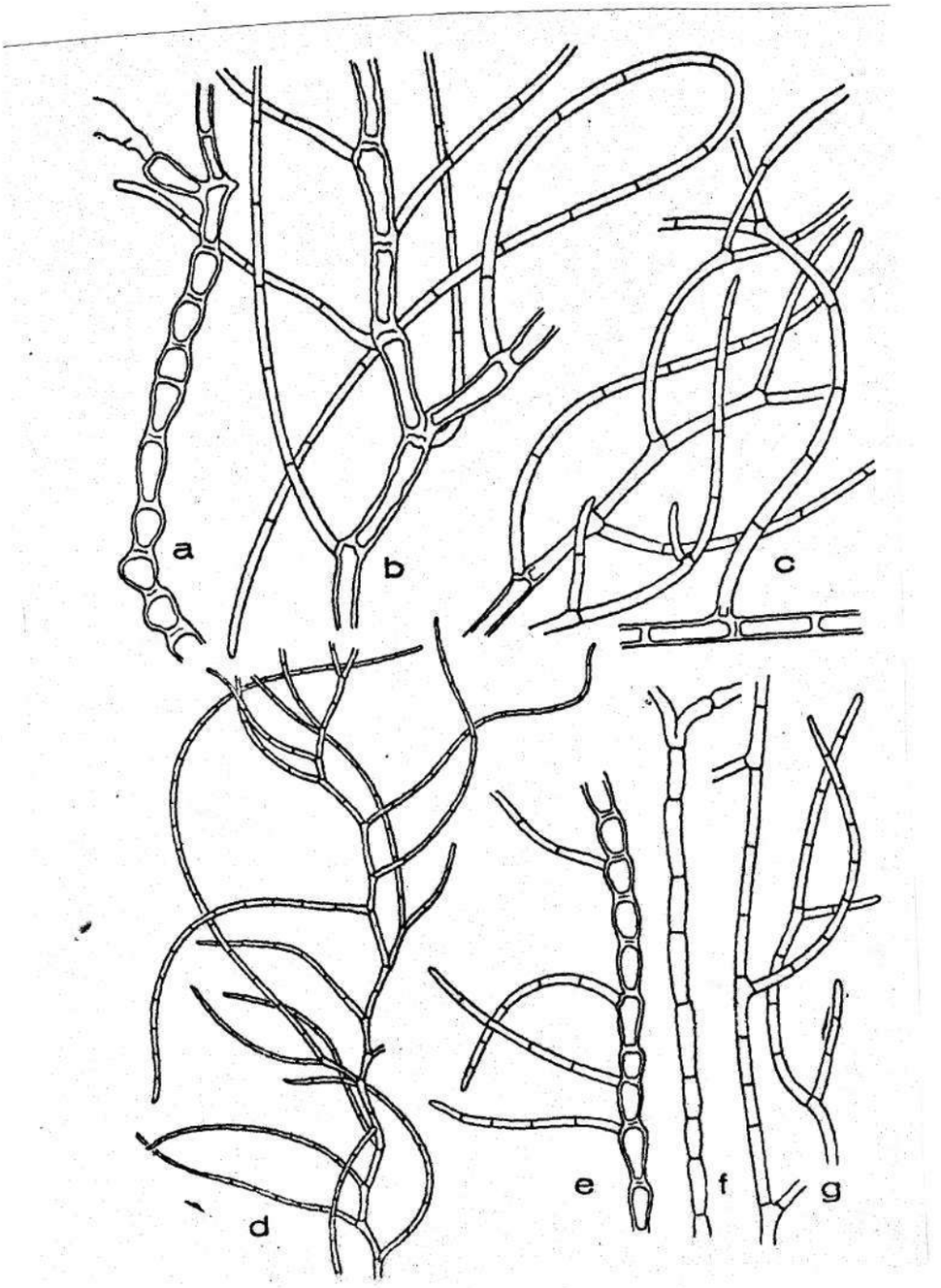
The akinetes have thick walls and are relatively short, l/b = 1.5 - 2.5. Common throughout Europe in salt and brackish waters. It differs from the variety intricata by the absence of sporulation. A feature is the formation of swollen akinetes at the same time as proliferations of the lateral branches.

Var. intricata (Lyngbye) Van Hoek. (=C. regularis Kützing; C. crispata var. vitrea (Kützing) Rabenhorst.)

The young thalli are attached to the bottom, have their main shoots branched pseudochotomously and concluded with a system of acropetal organisation. Older plants, separated from the bottom, have irregular branching. The terminal cells are slightly conical, if however they are developing into sporangia then they become clublike. Reproduces by the fragmentation of the filament or bi-flagellate vegetative zoospores. Terminal cells are 17.5 - 32 μ wide, l/b = 6 - 15; cells in the upper branches are 17.5 - 38μ wide l/b = 3 - 14; and cells in the principle filaments are 50 - 80 μ wide l/b = 4 - 10.

Common throughout Europe.

Plants adhering to the bottom are somewhat similar to C. glomerata, but it is possible to distinguish it by the larger cells as well as a little more lateral insertion of the young branches. Plants with acropetal organisation are similar to C. dalmatica, however C. fracta has more frequent intercalary divisions.



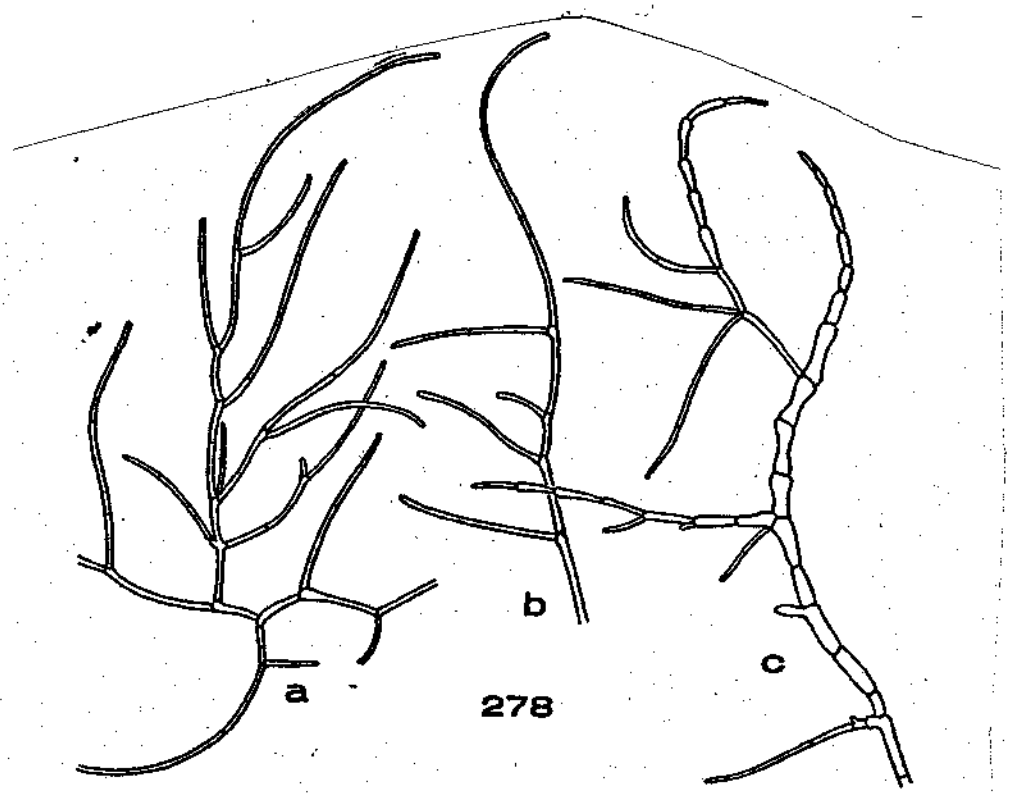
Rys. 282. *Cladophora fracta*: a — status hiemalis, b — status frondescens, proliferacje na nici, która przezimowała, c — status ramosus, nici obficie rozgałęzione (czerwiec), d — typowy pokrój rozgałęzionej plechy, e — proliferacje, f, g — status subsimplex, skąpe rozgałęzienia, niektóre rosną w przeciwnych kierunkach (według Branda i Söderströma)

pp. 263.

Cladophora Pariaudii Van Hoek 1963 fig. 278

Thalli are coarse and often branched. Branches have terminal and irregular growth. Terminal cells are 14 - 20 µ wide, l/b = 12 - 30; cells in upper branches are 16 - 22 µ wide, l/b = 12 - 20; cells of the main filaments are up to 55µ wide, l/b = 6 - 10.

This species occurred in fish ponds in France.



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Notice

Please note that these translations were produced to assist the scientific staff of the FBA (Freshwater Biological Association) in their research. These translations were done by scientific staff with relevant language skills and not by professional translators.