MEDDELELSER OM GRØNLAND
UDGIVNE AF
KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND
Bd. 147 · Nr. 5

DEN BOTANISKE EKSPEDITION TIL VESTGRØNLAND 1946

STRUCTURE AND BIOLOGY OF FOUR SPECIES OF THE *STIGONEMATACEAE* FROM A SHALLOW POOL AT IVIGTUT

BY

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WITH 8 FIGURES IN THE TEXT

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1950

Introduction.

During the Botanical Expedition to West Greenland in 1946[1] some samples of freshwater algae were collected in particular in Søndre Strømfjord (lat. 66—67° n.) and at Ivigtut in Arsuk Fjord (61°13′). The material from Ivigtut was particularly interesting by containing some species of the *Stigonemataceae* which could not with certainty be referred to any known species and which furthermore, as regards structure, biology, and variability, revealed a number of new or interesting facts.

Without doubt the great variability of most species among the *Stigonemataceae* creates difficulties for a taxonomical treatment. The majority of the deviating types, however, are connected with the normal ones by numerous transitions. Hence, after a study of a sufficiently large material it will in the great majority of cases be rather easy to decide whether some deviation is the result of environmental changes or differences in age or may be considered a unit which genetically is well separated from the rest. The greatest difficulties arise when closely related but not identical material from two widely different stations is compared. In such cases only cultivation experiments will be able to remove all doubts, but such experiments are only practicable when the same worker has material from both stations at his disposal. In the material from Ivigtut one of the species found in many characters resembles a variety which formerly has been described from tropical Africa only. Here, the diversity may easily be a result of the great differences in habitat, but it may as well be explained as a result of heriditary factors. It is very difficult to get full evidence of the nature of a material of this kind. For the present such efforts must be abandoned and we have to content ourselves with an accurate description and a provisional naming. The taxonomical problems within the *Stigonemataceae* and the *Cyanophyceae* as a whole are furthermore discussed on pp. 17—19.

The four species described in the present paper were collected in the same place. They occurred mainly on old twigs of *Salix* or *Sorbus*

[1] See Vol. 147, No. 1.

in a shallow pool behind the settlement and cryolite mine at Ivigtut in Southwest Greenland. The pool was surrounded by willow-copses and scattered *Sorbus americana*. The algae were covered by 3—15 cm water.

The algal vegetation was dominated by *Tolypothrix Saviczii* Kossinsk., a species which hitherto has only been found in Karelia. Very frequent were the species of *Stigonemataceae*, with the exception of *Doliocatella groenlandica*, which occurred scattered. *Nostoc paludosum* and *Aphanothece microscopica* as well as some species of the genera *Tribonema*, *Characium*, *Zygnema*, *Mougeotia*, *Closterium*, and *Oedogonium* were rather abundant.

The writer is indebted to Mr. TYGE CHRISTENSEN, M. Sc., for the latinizing of the diagnoses given on p. 19—20.

Detailed Account.

An account is here given of the more important observations made during the investigations of the different species. The material was preserved in alcohol. In some cases this treatment had effected a shrinkage of the cells which made the pit-connections more conspicuous.

1. *Stigonema hormoïdes* (Kütz.) Bornet and Flahault var. *subarctica* var. nova.

Main filaments 10—12 μ, branches arising unilaterally and aggregated at right angles to the main filament, 7—9 μ in breadth. The sheaths colourless with smooth exterior. Heterocysts rare, 6—8 μ, intercalary cells 4—10 μ long and 2—9 (mostly 5—8) μ broad. Hormogonia are formed in the apices of the branches and measure 12—25 μ in length. Trichomes consisting usually of a single row of cells, rarely of two rows. In some cases three or more rows indicate incipient branching. Further details will appear from fig. 1 (a—h). See Latin diagnosis on p. 19.

According to GEITLER (1932) *Stigonema hormoïdes* is extremely variable. Seven different varieties are known, some of which have very narrow filaments (breadth 5.5—7 μ), others having comparatively thick ones (10—15 μ). Most varieties occur on wet rocks or wet soil. sometimes on roots or trunks, but aquatic forms have also been found. Thus, the occurrence on old twigs in a shallow pool which occasionally may partially dry up agrees fairly well with formerly known occurrences. *Stigonema hormoïdes* has not been recorded from Greenland before, but it grows in New Hampshire (Collins, see TILDEN 1910) and perhaps in Iceland.

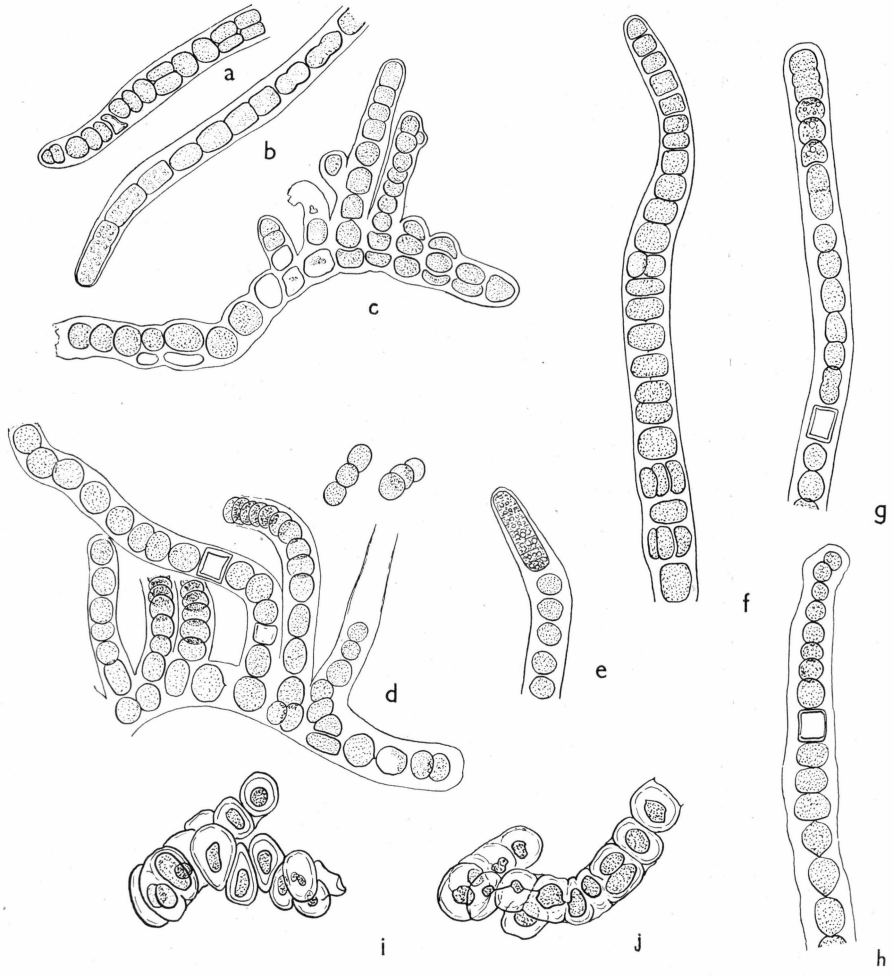

Fig. 1. *Stigonema hormoïdes* var. *subarctica*. *a-b* Apices of branches showing biseriate structure (a) and young hormogonia (b). — *c* Prostrate main filament with unilateral branching and several empty cells. — *d* The same with mature hormogonia. — *e* Young hormogonium. — *f* Branch with some cells in three rows. — *g-h* Branches with young hormogonium (g) and heterocysts. — *i-j* Chroococcoid stage in old filament. × 560.

In the type of branching the material from Ivigtut reminds very much of the *Stigonema hormoïdes* var. *africana* F. E. Fritsch (fig. 303 in Geitler l. c.), but the filaments are narrower, the sheaths not yellowish brown and the cells not surrounded by special, more deeply coloured envelopes. Such envelopes, when present in the material are almost colourless. They are, however, found only in very old filaments, where the plant occurs in a *Gloeocapsa*-like chroococcoid stage (cf. fig. 1 (i—j)). At this stage the cells are generally very small and the pit-connections are withdrawn or retained as thin strands.

On very many points the material from Ivigtut looks like the *Fischerella muscicola* (Thur.) Gom. var. *minor* Boye P. described from Iceland by BOYE PETERSEN (1923, p. 311 fig. 16). The Greenland plants have almost the same dimensions and mode of branching. With regard to the dimensions there is some disagreement between the Latin diagnosis of var. *minor* and the figure. The difference in breadth between the main filament and the branches is not so distinct in the figure, here being only 2—4 μ, while in the description it is said to be 4—6 μ. The differences shown in the figure correspond very well to those found in my material of *Stigonema hormoïdes*, which further agrees in the somewhat tapering apices of the filaments, the sheaths, and the shape and size of the cells. In my opinion *Fischerella muscicola* var. *minor* most probably belongs to the *Stigonema hormoïdes* complex. The differences between the main filament and the branches are hardly so pronounced as in typical species of *Fischerella*. According to BOYE PETERSEN var. *minor* "bears an extremely close resemblance to *Fischerella muscicola*," from which it mainly differs in its smaller dimensions. The typical *Fischerella muscicola*, however, has rounded cells in the prostrate main filaments and these cells are generally arranged in two rows (see figures made by BORNET-THURET and FREMÝ), while var. *minor* seems to be uniseriate.

If the writer's opinion of the systematic position of *Fischerella muscicola* var. *minor* is correct and if this plant is identical or almost so with the material from Ivigtut, we have a special, subarctic type which, if anything, belongs to the *Stigonema hormoïdes* complex. At present I should prefer to term it var. *subarctica*, at the same tine, however, pointing out that future investigations may probably justify an alteration of some of the units within *Stigonema hormoïdes* from variety to subspecies or species, while others may be reduced to modifications caused by terrestrial life.

2. *Stigonema Rosenvingii* species nova.

Filaments (30—)40—70(—100) μ in diameter, decumbent or more or less erect, sometimes creeping, irregularly branched. Trichomes with

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Fig. 2. *Stigonema Rosenvingii*. *a-b* Terminal (a) and subterminal (b) part of young vigorous filament showing apical and lateral hormogonia. In the lower part the sheath is brownish with belts outside the segmental cells. — *c* Erectly growing branch of main filament with formation of hormogonia and the transition zone between the hormogonia and the normal cells. Old sheath brownish, young sheath colourless. — *d* Branch of old filament with terminal hormogonium of small cells and a subterminal hormogonium which germinates *in situ*. — *e* Part of old filament with many empty cells and two empty sheaths formed by developing hormogonia and showing the funnel-like strata. × 560.

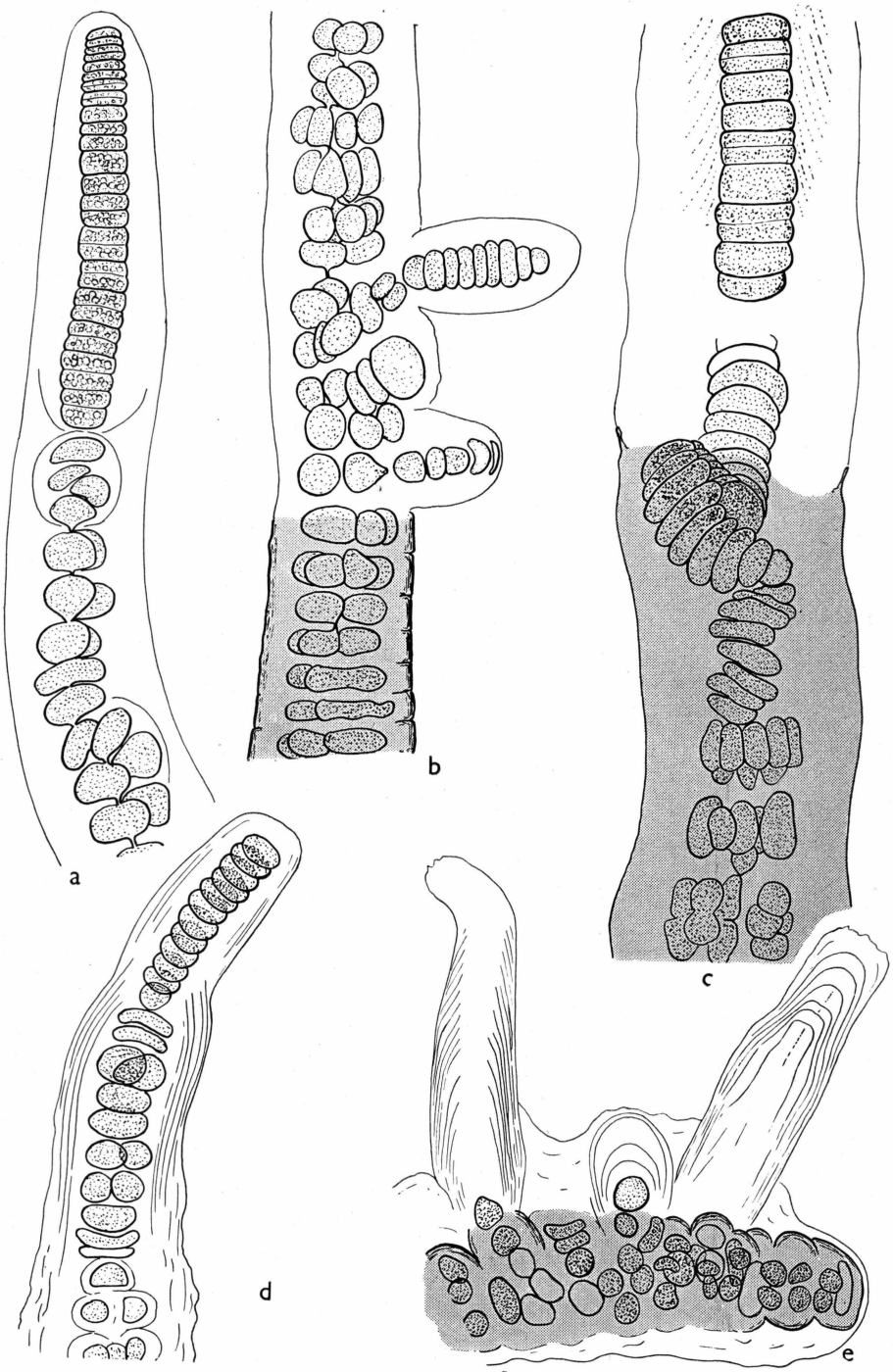

Fig. 2.

4—8 rows of cells. All main filaments and main branches terminating in a large hormogonium or sometimes in a series of homogonia. Short, lateral, mammiliform hormogonia rare, but lateral hormogonia of the same dimensions as the terminal ones are frequent. The large hormogonia are 100—200 μ long, on old, not vigorous plants only 35—60 μ. Diameter of hormogonia 10—17 μ. Normal cells (6—)8—15 μ in diameter. Typical heterocysts not observed, but empty or shrunken cells may sometimes

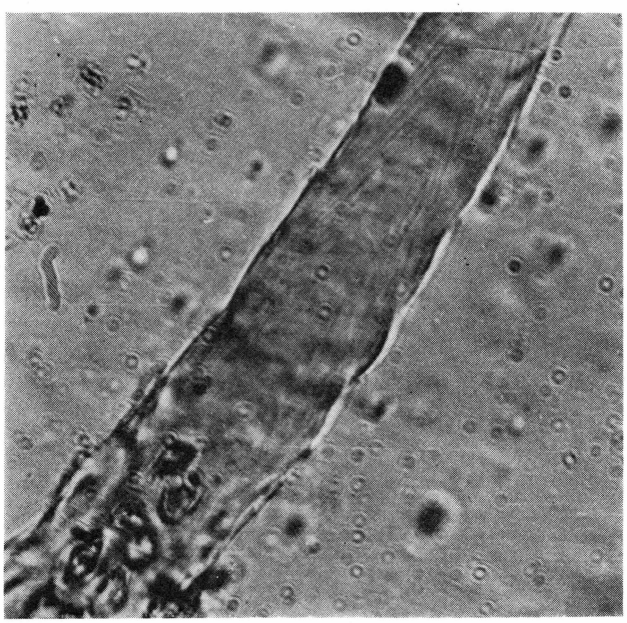

Fig. 3. Empty sheath of terminal hormogonium of *Stigonema Rosenvingii* observed through a phase contrast microscope. × 600. M. LANGE fot.

be placed at the ends of branches or on one or both ends of hormogonia and may look rather like heterocysts. Sheaths very thick, in old filaments yellowish brown. Sheaths of hormogonia colourless and distinctly lamellose. Further details appear from figs. 2 a-e, 3 and 4. For Latin diagnosis see p. 19.

This species is undoubtedly rather closely related to *Stigonema informe* and *S. mamillosum*. From the latter it mainly differs in the terminal, very large hormogonia and the thick sheaths, from *S. informe* in the sheath character, the smaller size of the cells, and the absence of typical heterocysts.

According to GEITLER *Stigonema mamillosum* and *informe* are not clearly separated. Hence, it would perhaps seem justified to operate with a large collective species, *S. mamillosum* s. l., which, as in the case of *S. hormoides*, included a large number of subspecies and varieties.

This may prove to be most correct, though it seems rather doubtful that this collective species should come to include *Stigonema Rosenvingii* described above. The importance of the distinguishing characters—absence of true heterocysts, large sheaths, and hormogonia—have not at present been weakened by the finding of any intermediate type.

The behaviour of the hormogonia is rather peculiar. The sheaths surrounding them are very distinctly lamellose, being composed by funnel-like strata. This structure was in particular very distinct when

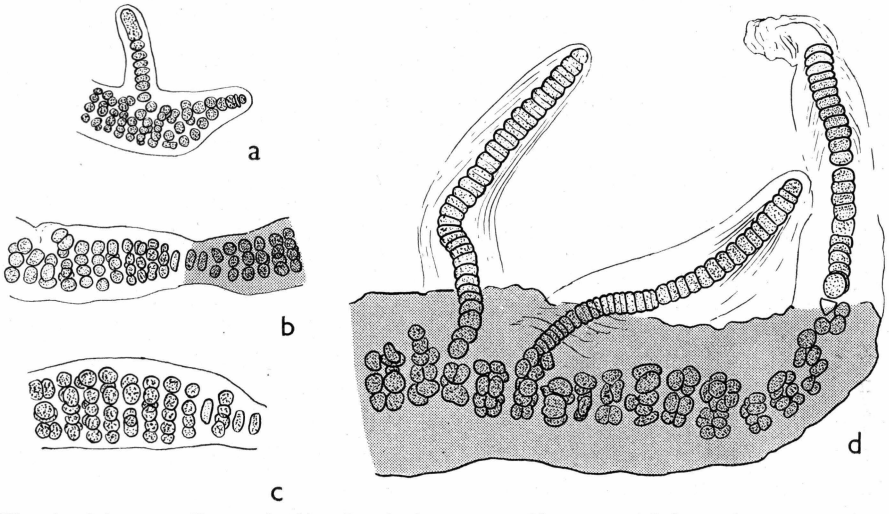

Fig. 4. *Stigonema Rosenvingii*. *a* Deviating young filament with lateral hormogonium of small cells and an apex which does not develop hormogonia. The subterminal cell is shrunken and empty. — *b-c* Pieces of young filaments developing from hormogonia. The heterocyst-like cells are non-divided hormogonium cells. — *d* Part of prostrate main filament with terminal and lateral hormogonia composed of very broad cells, the sheaths of the hormogonia colourless with funnel-like strata, sheath of the main filament yellowish brown without strata. × 280.

the plants were observed in a phase contrast microscope (see fig. 3). The sheath structure reminds very much of that of *Stigonema ocellatum* described and pictured by GEITLER (1932 fig. 307), and may be due to rapid growth of the hormogonia. In the main filaments with 4—6 rows of cells no funnel-like sheath strata were observed, but sometimes a ring was seen surrounding every family of cells in the filaments (fig. 2b).

On creeping or decumbent filaments the hormogonia are formed only on the upper side (figs. 2 e and 4 d). In this character the species reminds of "*Stigonema vermiculare*", which GEITLER (1936, p. 93) pictures beautifully, but the identity of which may not at present be sufficiently elucidated as GEITLER places a mark of interrogation after the name.

New hormogonia undoubtedly are formed in the first part of the summer, in June—July. During the winter the main filaments may

survive protected by the thick brownish sheaths which seem to be formed already in July (fig. 2 b). Biologically such thick and firm sheaths may function as hormocysts. In some cases the hormogonia formed in in the spring may have difficulties in penetrating the old sheaths. In fig. 2 c the coiled basal hormogonium lies where the old brownish sheath continues in the colourless, mucous sheath of the upper hormogonia. In fig. 4 d the terminal part of the old sheath is pushed out by a developing series of hormogonia.

In young vigorous filaments (fig. 2 a-b) the pit-connections between successive segmental cells are very distinct, but in older parts they have generally disappeared and here the cells are arranged in families developed from a single segmental cell in the original uniseriate filament, which had germinated from a hormogonium. The members of a cell family may frequently be connected by pits, but these are not easy to observe. In very old filaments the cells degenerate or diminish and are surrounded by special envelopes (fig. 2 d-e), which sometimes may be rather firm and brownish.

LARSEN (1907), and BACHMANN (1921) record *Stigonema informe* from West Greenland. No other species of this group of the genus are known from Greenland.

Stigonema Rosenvingii is named after the late Danish algologist, Professor L. KOLDERUP ROSENVINGE, the well-known investigator of the marine algae of Greenland.

3. *Doliocatella groenlandica* species nova.

Main filaments fixed to the substratum at the base, erect with plentiful branching. Primary filaments at the base 25—30 μ in diameter with 10—20 μ broad, rounded cells which are surrounded by special envelopes; in the upper parts the primary filaments are 20—25 μ in diameter with 5—10 μ broad cells without special envelopes. Branches numerous, sometimes unilateral, arising at right angles to the primary filaments, later ascending, tapering at the apices, 10—18 μ in diameter with rounded, 4—8 μ broad cells. Main filaments as a rule with two rows of cells, rarely with one or three rows. In the branches the trichomes are uniseriate or locally biseriate. Hormogonia terminal, 40—70 μ long, 8—10 μ broad with short cells. Sheaths rather thick, in the upper part colourless and only lamellose in apices forming hormogonia, at the base of the largest branches or the main filaments yellowish and with parallel lamellae. Cells on short lengths sometimes more or less surrounded by dark brown, almost non-transparent sheath belts which become green in the presence of acids and thus may be due to scytonemine. See further figs. 5—6 and the Latin diagnosis on p. 19.

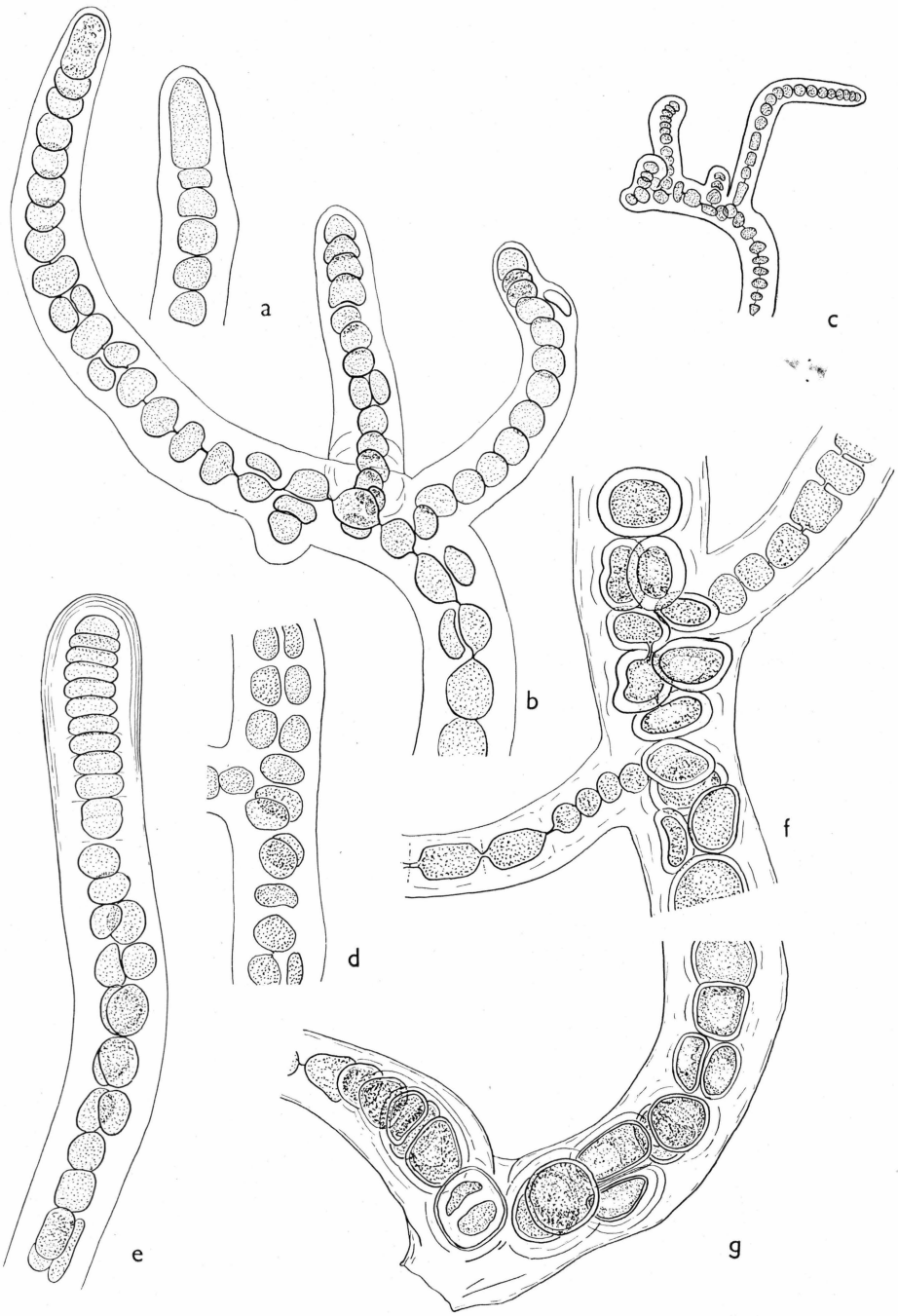

Fig. 5. *Doliocatella groenlandica*. *a* Apex of branch with young hormogonium. — *b* Upper part of plant showing the typical mode of branching. — *c* Branch with unilateral branches. — *d* Piece of the upper part of main filament. — *e* Apex of main filament with hormogonium and lamellose sheath surrounding the hormogonium. — *f—g* Subbasal (f) and basal (g) part of main filament. Cells generally in two rows and surrounded by special envelopes. Fig. c × 280, the rest × 560.

GEITLER and RUTTNER (1936 pp. 427—429) describe the genus *Doliocatella* on material from a waterfall in Sumatra. In a large number of characters the species *Doliocatella formosa* agrees with *D. groenlandica*. The most important accordances are the absence of heterocysts and any heterocyst-like cell, the difference between the basal and the upper

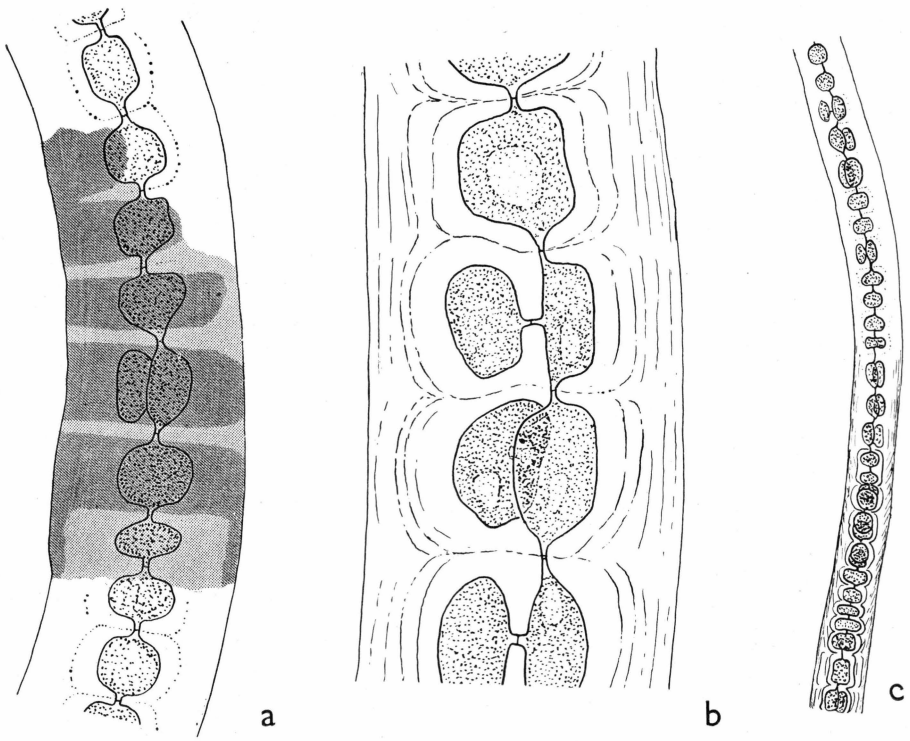

Fig. 6. *Doliocatella groenlandica*. *a* Part of filament showing dark brown sheath belts of scytonemine. × 560. — *b* Basal part of large branch with pit-connections and lamellose sheath. × 1500, — *c* Transition zone between upper and lower part of a plant. × 280.

parts of the plant and the mode of branching. The Greenland material differs from that of Sumatra by the biseriate structure of the primary filaments, the size of the filaments and cells, and the somewhat rarer occurrence of pit-connections in the basal parts (see fig. 5 g).

According to GEITLER and RUTTNER the genus *Doliocatella* is closely related to *Stigonema*, *Fischerella*, and *Hapalosiphon*, from which, apart from the lack of heterocysts, it mainly differs "durch den fast gesetzmässigen Aufbau aus basal unverzweigten, apikal reich verzweigten Fäden." In the material from Greenland the difference in the number of branches between the upper and lower parts is less pronounced, but can in most cases still be observable. This character may be of less import-

ance for the separation of the genus, and thus the total absence of heterocysts will appear to be the best distinguishing character.

The structure of the cells and pits in the upper parts of *Doliocatella formosa* (see figs. 62—64 in GEITLER and RUTTNER's work) is in complete accordance with that of *D. groenlandica*, but in the latter the cells are smaller and much more frequently arranged in two rows. Unfortunately the uniseriate structure of *D. formosa* is mentioned by GEITLER and RUTTNER in the diagnosis of the genus. But after the finding of the ± biseriate *D. groenlandica* the number of cell rows can only be used in the separation of the species. The difference between the two species as regards number of cells is not very pronounced as in *D. formosa*, too, two cells may occassionally occur side by side. According to GEITLER and RUTTNER these cells, however, must be regarded as "Initialen von—oft steckengebliebenen—Ästen." In the upper part of *D. groenlandica* the few longitudinally divided cells are probably in very many cases such initials or suppressed initials of branches, but in the basal parts and vigorous branches the biseriate structure may be independent of branching.

In the basal parts the mode of branching in *Doliocatella groenlandica* resembles that of the genus *Hapalosiphon*, but in its upper parts it reminds very much of *Stigonema* (e. g. *S. dendroideum* Fremý and *S. minutum* Hassal).

The occurrence of the genus *Doliocatella* in Sumatra and Greenland suggests a cosmopolitan distribution of the genus. Undoubtedly it will in future be possible to find other new species which in their occurrences may fill in the gap between the tropical and subarctic stations.

4. *Hapalosiphon hormocystophorus* species nova.

Primary filaments 9—11, most frequently 10 μ in diameter, more or less creeping, generally containing a single row of cells, rarely two. In most cases the occurrence of two rows indicates incipient branching. Cells variable, up to 20 μ long, 5—8 μ broad, sometimes quadrate or somewhat rotund, in old, hibernating parts up to 10 μ broad and wider than long. Most branches arise unilaterally, single, in pairs or in groups of three or four. Diameter of branches at the base 7—10 μ, at the apices 6—7 μ. Branches containing a single row of generally very long, cylindrical and narrow cells. In some of the branches the trichomes are terminated by a dome-shaped, concave, greenish, refractive cell. Hormogonia are formed in the apices of the branches and may vary very considerably in length. Young hormogonia are cylindrical or nearly club-shaped and have indistinct or no transverse walls. Heterocysts scattered, intercalary, oblong, or somewhat quadrate, 8—15 μ long and

4—8 μ in diameter. Sheaths colourless, in old parts becoming yellowish or brownish. Sometimes parts of the sheaths of young filaments are dark brown owing to scytonemine. At the base of branches the sheaths are thickened and proceed into the sheaths of the primary filaments and are quite distinct from the sheath of the latter. In the apices of some of the branches the sheaths are very thick, forming hormocysts which remind of those described in the genera *Westiella* and *Leptopogon*.

This interesting new species is referred to the genus *Hapalosiphon* because its heterotrichy is not so pronounced as in the genus *Fischerella*. Its characters are clearly intermediate between typical *Fischerella* and *Hapalosiphon*. Hence, the maintaining of the genus *Fischerella* may be of very limited value. GEITLER (1932), however, operates with both genera although he writes that the differences are only gradual and that some species only with difficulty or artificially can be referred to one of them. Perhaps it would be much better to use one genus name, *Hapalosiphon*, and regard *Fischerella* as a subgenus. The finding of a *Hapalosiphon* which forms hormocysts, however, makes the separation of *Hapalosiphon* and *Westiella* very difficult, and thus the *Hapalosiphon* s. l. would, if necessary, come to include three subgenera *Fischerella*, "*Eu-Hapalosiphon*", and *Westiella*, which would hardly promote any better survey. Furthermore the whole taxonomical problem in the *Stigonemataceae* has been complicated very much by the above-mentioned *Doliocatella*, which takes an intermediate position between *Hapalosiphon* and *Stigonema*. A further discussion is found on p. 18.

The new species of *Hapalosiphon* seems to be related to *Hapalosiphon hibernicus* W. et G. S. West as well as to *Fischerella Letestui* Fremý. Perhaps it is most closely related to *Hapalosiphon intricatus* W. et G. S. West f. *major* Münster Ström, which according to MÜNSTER STRÖM (1923, p. 137) has cells 10—12.5 μ in diameter and scarcely can be

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Fig. 7. *Hapalosiphon hormocystophorus*. *a* Terminal part with empty and crumpled sheath of earlier hormogonium; the terminal cell dying while the subterminal is developing a branch. — *b* Filament with two branches which after formation and liberation of hormogonia now only consist of the sheaths. — *c* Old main filament with branches which terminate in very long undivided cells. In three of the branches only the basal cells are drawn, these branches contain about 20 long cells and a very long, undivided cell at the apex. — *d* At the heterocyst three longitudinal divided cells (initials of branches). — *e* Germinating hormocyst with young, rapidly growing branches of undivided cells and a slowly growing branch containing three short cells. — *f* Group of four initials of branches. — *g* Rather typical position of branch close to a heterocyst. — *h* A somewhat deviating branch of rather short and broad cells developing from a filament with long and narrow cells. — *i* Main filament with two branches; the terminal cell in the main filament is divided and may now after the cessation of a production of terminal hormogonia develop a short branch (cp. fig. a). × 560.

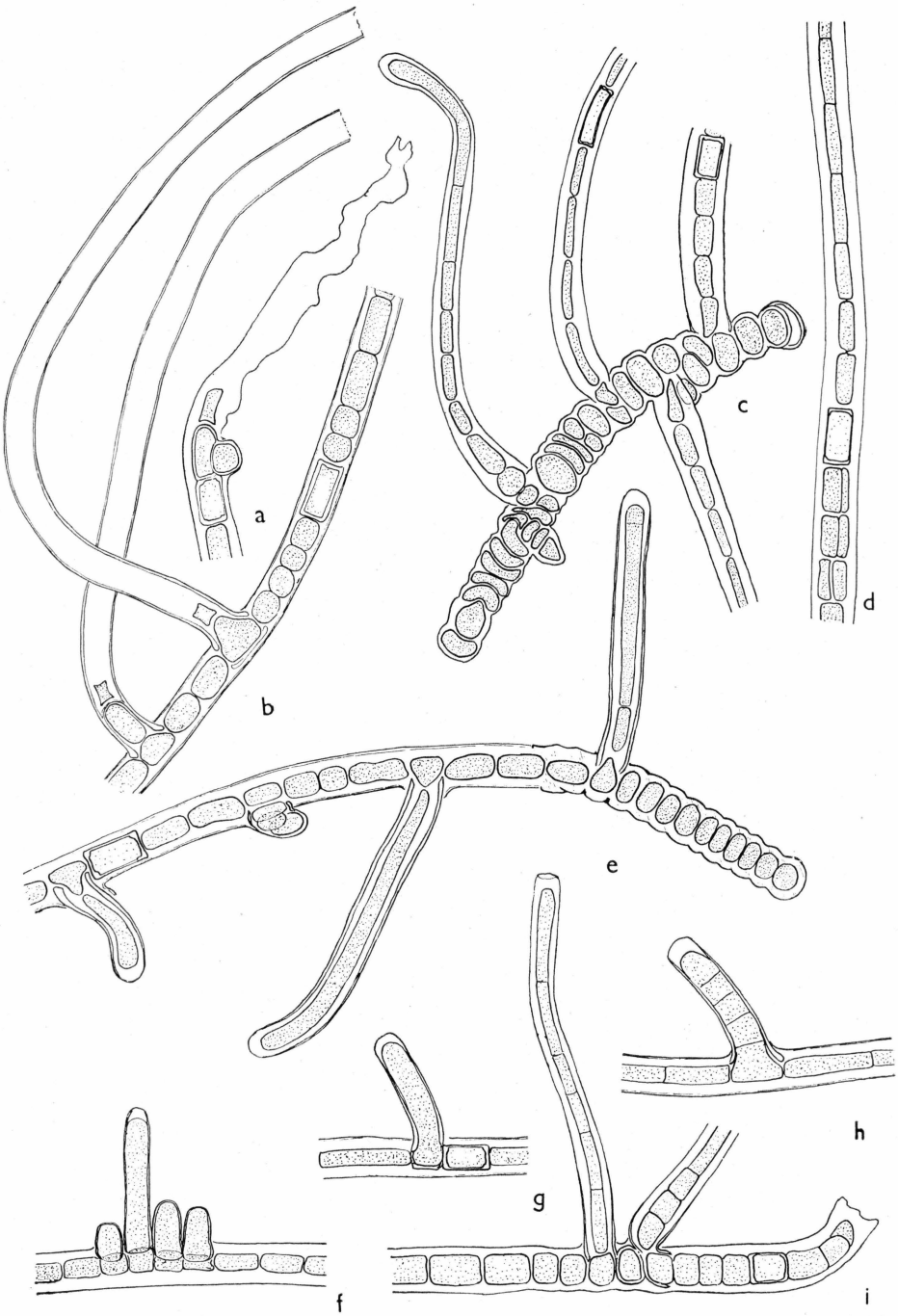

Fig. 7.

distinguished from *H. hibernicus*. MÜNSTER STRÖM's material was collected by NORDHAGEN in the eastern high mountains of Norway. Unfortunately the vary short description and the absence of figures make an adequate comparison with the material from Greenland impossible.

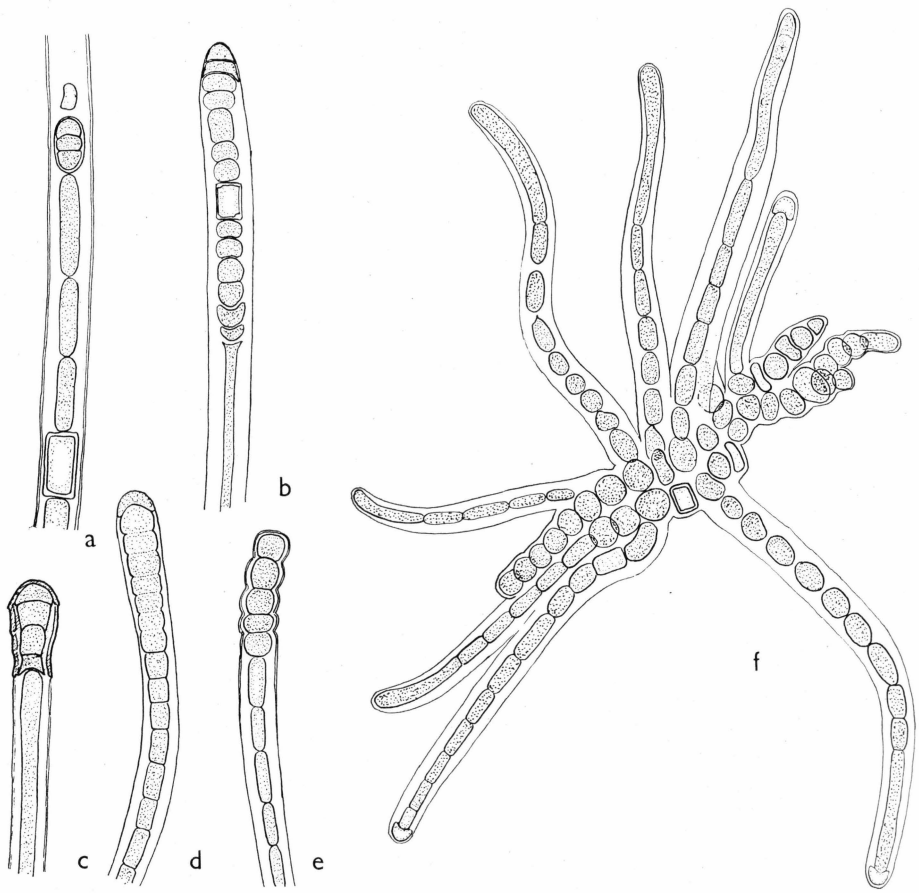

Fig. 8. *Hapalosiphon hormocystophorus*. *a-e* Terminal parts of branches showing subterminal hormocyst-like body (a), a terminal hormogonium or young homocyst with intercalary heterocyst and two refractive cells at the apex (b), hormocysts (c and e), and young hormocyst (d). — *f* A small and rather weak specimen with many branches, some of which have a dome-shaped, concave and refractive cell at the apex. × 560.

Hapalosiphon intricatus has been found in West Greenland by BACHMANN (1921); no other species of *Hapalosiphon* are recorded from Greenland.

In the first part of July, at the time when the collection was made, *Hapalosiphon hormocystophorus* was in a stage of incipient hormocyst formation. Most branches produced hormogonia and in many cases these

were not mature. As far as could be judged from a single collection the species hibernates in the form of hormocysts or old torulate filaments with thick and firm sheaths. From these perennating filaments the new threads grow out (fig. 7 c and e). Branches may arise from the perennating filaments, but most frequently they are formed rather close to heterocysts in primary filaments which have germinated from one end of a hormocyst. In the branches very long undivided cells or chains of long cells may frequently be of importance for the dispersal of the hormogonia or the hormocysts. Through the rapid growth of these cells the reproductive organs are carried somewhat away from the more compact plant mass and may thus have a chance of germinating on favourable spots without competition or where the competition from the old filaments or other algae is less marked. In a number of cases very long branches contained one or two hormogonia in addition to the terminal one. The non-terminal hormogonia were on both sides continued in very long, undivided cells. At the distal point of such hormogonia there was generally a heterocyst which separated the long narrow cells from the broad and constricted cell row of the hormogonium.

The branching very often takes place close to heterocysts. In fig. 7 d, a terminal piece of a primary filament is shown. The heterocyst is between some long narrow cells which may help in the pushing out of hormogonia, and a number of longitudinal divided cells which undoubtedly are initials of branches. The heterocyst may stop or change substances causing the longitudinal polarity of the filament and thus create possibilities for a turning of the plane of cell division by 90°. The position of the heterocyst at the distal point of an intercalary hormogonium may have a similar function by stopping and changing such substances.

Discussion.

In Table 1 the most important characters of the genera and those of the three new species are summarized. Some of the characters of the latter contribute very much to the above-mentioned blurring of the boundaries between the genera.

The difficulties with regard to the delimitation of genera being great, the distinguishing of species may gradually be a still harder problem. At present, when probably only a comparatively small number of species are known, these may in most cases be rather easy to distinguish. But with increasing finding of new species the difficulties in distinguishing will increase correspondingly. Any botanist making collections of blue-green algae in countries or habitats which are not very thoroughly

Table 1.

Characters	Species previously described					New species		
	Westiella	Fisherella	Hapalosiphon	Doliocatella	Stigonema	Stigonema Rosenvingii	Doliocatella groenlandica	Hapalosiphon hormocysto-phorus
Uniseriate	+	+	+	+	(+)			+
Bi- or multiseriate		+	(+)		+	+	+	(+)
Heterotrichous		+	+	+[1]			+[1]	+
Intermediate			+					+
Not heterotrichous	+				+	+		
Hormocysts present	+							+
Hormocysts absent		+	+	+	+	+	+	
Heterocysts present	+	+	+		+			+
Heterocysts absent				+		+	+	

[1]) Main difference between upper and lower part of the plant.

explored will have a fair chance of discovering some new species. Thus, for years ago the two species *Oscillatoria minima* and *O. putrida* seemed to be well separated. Now, after the finding of a form or variety of *O. putrida* with rather short cells and bluish sheen (BÖCHER 1949) the difference between these two species is less conspicuous. The species problem in the *Cyanophyceae* and other groups within the *Monera* is complicated very much through the absence of any kind of sexual reproduction. Every mutation capable of surviving may give rise to a new variety which differs genetically from the original species. A number of such mutations will lead to the formation of a new "species". Such a species, however, is not well established if intermediate mutants exist. In such genera as are progressive and form many new types the variation may be almost continuous and consequently the "species" are rather arbitrary units. The species problem in the *Cyanophyceae* is parallel to that of apomictically propagating flowering plants. Taxonomists may describe new species of *Taraxacum* almost indefinitely and the same may be the case in the progressive groups of the *Cyanophyceae*. Without attempting to underestimate the describing of new species of blue-green algae at the present stage of our knowledge, I cannot help emphasizing that in future we may reach a point where the progressive genera are composed by very numerous "species" forming continuous series or a number of character gradients where no sharp limits can be

demonstrated. If this may be the case, we must try to cut out some groups of types which can serve as species and be used by plant geographers, physiologists, or cytologists who work with the plants in question and need some names in order to express the characters. Perhaps the above-mentioned *Stigonema hormoïdes*-complex is a good example of a "species" of this kind.

Latin Diagnoses.

Stigonema hormoïdes Born. et Flah. var *subarctica* var. nova.

A typo differt ramis unilateraliter emissis, a var. *africana* filis artioribus vaginisque decoloribus.

Hab. in stagno parvo prope Ivigtut Groenlandiae meridiano-occidentalis.

Stigonema Rosenvingii species nova.

Fila (30—) 40—70 (—100) μ crassa, decumbentia vel plus minus veerecta, interdum repentia, irregulariter ramificata, 4—6 (8) cellularum series continentia. Fila primaria ut rami principales hormogoniis longis singulis vel interdum seriatis plerumque terminata. Hormogonia lateralia subsphaerica rara, sed lateralia eiusdem ac terminalia formae et magnitudinis frequentia. Hormogonia maiora 100—200 μ, in filis vetustis, vigore destitutis modo 35—60 μ longa, crassa 10—17 μ. Cellulae ordinariae diametro (6—) 8—15 μ. Heterocystae typicae non observatae. Vaginae percrassae, in filis veteribus fulvae. Hormogoniorum vaginae decolores, lamellis manifestis.

Hab. in stagno parvo prope Ivigtut Groenlandiae meridiano-occidentalis.

Doliocatella groenlandica species nova.

Fila primaria basi substrato affixa, erecta, copiose ramificata, ad basim 25—30 μ crassa, cellulas rotundatas, 10—20 μ latas, tegumentis propriis involutas continentia, sursum 20—25 μ crassa, cellulis latis 5—10 μ, tegumentis propriis carentibus. Rami crebri, interdum unilateraliter emissi, sub angulo recto orientes, deinde surgentes, apicem versus attenuati, 10—18 μ crassi, cellulas rotundatas 4—8 μ latas continentes. Fila primaria de more binas, raro singulas vel ternas cellularum series continentia, rami singulas eas vel passim binas. Hormogonia terminalia 40—70 μ longa, 8—10 μ crassa, e cellulis curtis composita. Vaginae crassiores, superne decolores, lamellis in hormogonia gignentibus modo apicibus manifestis, ad bases vero ramorum principalium et in filis primariis flavescentes, lamellis parallelis manifestis. Cellulae in spatiis brevibus zonis vaginalibus, fuscis, scytonemineis interdum plus minusve obtectae.

Hab. in stagno parvo prope Ivigtut Groenlandiae meridiano-occidentalis.

Hapalosiphon hormocystophorus species nova.

Fila primaria 9—11, plerumque 10 μ crassa, plus minusve repentia, de more singulas cellularum series continentia, raro binas, quod cum contingit plerumque ramificatio instat. Cellulae variae, ad 20 μ longae, latae 5—8 μ interdum quoque quadratae vel satis rotundatae, in partibus veteribus, hieme defunctis usque ad 10 μ latae, latitudine longitudinem superante. Rami plerumque unilateraliter emissi, singuli vel bini — quaterni, ad basim 7—10 μ, ad apicem 6—7 μ crassi, singulas

cellularum series continentes consvetudine artarum, longissimarum, interdum cellulis singulis sursum convexis deorsum cavis, virescentibus, refringentibus terminati. Hormogonia in ramis terminalia, longitudine pervaria, initio cylindrica vel subclavata, septis transversalibus nullis vel haud manifestis divisa. Heterocystae sparsae, intercalariae, oblongae vel subquadratae, 8—15 μ longae, 4—8 μ latae. Vaginae vulgo decolores interdum scytonemino fuscatae, in partibus vetustis colore subflavo vel fulvo infectae, ad bases ramorum incrassatae, in vaginas filorum primariorum projectae, ab illis manifesto discretae. Rami nonnulli ad apicem vaginis percrassis induti, hormocystas ita formantes ad illas revocantes, quae in generibus *Westiellae* et *Leptopogonis* descriptae sunt.

Hab. in stagno parvo prope Ivigtut Groenlandiae meridiano-occidentalis.

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Færdig fra trykkeriet den 16. marts 1950.