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ON *LITHODERMA FATISCENS* ARESCHOUG AND *L. FATISCENS* KUCKUCK

BY

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WITH 7 FIGURES IN THE TEXT

KØBENHAVN
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The crust-shaped phaeophycean genus *Lithoderma* was founded by Areschoug (1875, p. 22). It is especially characterised by its plurilocular sporangia, which issue laterally from free filaments arising from the apical cells of the vertical cell threads of the crust. It is further i. a. characterised by having unilocular sporangia formed by transformation of the apical cells proper of the vertical cell threads of the crust.

Areschoug founded two species, *L. fatiscens* and *L. fluviatile*, of which the latter, however, i. a. on account of its plurilocular sporangia, has proved not to belong to *Lithoderma* (Svedelius 1930, p. 915). The former species, *L. fatiscens*, has been described in detail and figured by Kjellman (1883, p. 255, Tab. 26, figs. 6—7; 1890, p. 17, fig. 2 (same figure)) and by Hauck (1885, p. 402, fig. 177). In addition a figure is found in the paper by Kuckuck (1894, fig. 12).

In 1894 (p. 237) Kuckuck gave a revised diagnosis of the genus, after finding individuals with plurilocular sporangia arising by transformation of the apical cells of the vertical cell threads of the crust. It is said in the diagnosis: "Unilokuläre Sporangien ... direkt aus den Oberflächenzellen entwickelt; plurilokuläre Sporangien ... ebenfals direkt aus den Oberflächenzellen entwickelt" (l. c.).

Kjellman and Bornet do not believe that the new form with plurilocular sporangia belongs to Areschoug's species with plurilocular sporangia. In letters to Kuckuck, Kjellman wrote as follows: "... ist entweder Ihre Pflanze der Gattung *Lithoderma* nicht zuzuzählen...; oder die Gattung *Lithoderma* gehört zu den *Phaeosporeen*, bei denen, wie z. B. bei *Giraudia*, zweierlei in ihrer Form und Entstehung verschiedene mehrfächerige Fortpflanzungsorgane sich finden ...". "... Es ist folglich meine Meinung, dass, wenn sich die Gründung einer neuen Gattung als notwendig herausstellt, diese nicht auf *L. fatiscens* sondern auf die von Ihnen gefundene Pflanze zu gründen wäre". (See Kuckuck 1894, p. 239).

Bornet wrote to Kuckuck: "... Il ne me paraît pas douteux que vous avez découvert les véritables sporanges pluriloculaires de ce *Lithoderma*. N'était il pas étrange que, dans un genre caractérisé essenti-

ellement par la formation terminale des sporanges, les sporanges pluriloculaires fussent latéraux". (see KUCKUCK 1894, p. 240).

Although KUCKUCK himself does not think, either, that ARESCHOUG's form with plurilocular sporangia belongs to that described by him, he nevertheless applies the designation "*Lithoderma fatiscens* ARESCHOUG verändert" to his plant (1894, p. 238). He states, however: "Dass die Areschoug'sche *Lithoderma* c. sp. plur. eine zweite Fruchtform der *L. fatiscens* darstellt, wäre denkbar" (l. c. p. 239) and "während jetzt immerhin die Möglichkeit offen bleibt, dass sie eine zweite plurilokuläre Sporangienform dieser Art repräsentiert..." (1912, p. 169).

KYLIN (1907, p. 46) is unable to decide whether or not ARESCHOUG's and KUCKUCK's species are identical. If they should differ specifically, KYLIN assumes that KUCKUCK's plants with unilocular sporangia belong to ARESCHOUG's species.

SVEDELIUS (1911, p. 175) does not think either that ARESCHOUG's species is identical with that of KUCKUCK. He founds a new genus, *Pseudolithoderma*, on the basis of KUCKUCK's form with plurilocular sporangia in contradistinction to ARESCHOUG's *Lithoderma*. SVEDELIUS's procedure of distinguishing between *Pseudolithoderma* with terminal plurilocular sporangia and *Lithoderma* with lateral plurilocular sporangia was later adopted by SCHMIDT (1938, p. 214).

Finally it may be mentioned that OLTMANNS (1922, p. 14), too, is of opinion that the two forms belong to different species.

Other authors, however, seem to unite the two forms in one. Thus for instance SETCHELL and GARDNER (1925), who state under *Lithoderma fatiscens* ARESCHOUG: "gametangia... formed by transformation of terminal cells or borne on short, almost colorless branches from the terminal cells" (p. 501).

The same is evidently the case with NEWTON (1931, p. 127), who mentions ARESCHOUG as the author, although the plurilocular sporangia figured are terminal.

Besides in 1894 (p. 238, fig. 11) *Lithoderma fatiscens* KUCKUCK was described in detail and very beautifully figured by KUCKUCK in 1912 (p. 165; Taf. VII (18), figs. 1—19). Furthermore, figures and descriptions of it are given by KYLIN (1907, p. 45, fig. 12), LAKOWITZ (1907, p. 34, fig. 23), PRINTZ (1926, p. 144, Taf. I, figs. 6—9), NEWTON (1931, p. 127, fig. 75), and HAMEL (1935, p. 110, fig. 26 E, sub nom. *L. extensum*).

In order to ascertain whether ARESCHOUG's form with plurilocular sporangia and KUCKUCK's form with plurilocular sporangia actually belong to the same species, or are to be regarded as two different species, it will be necessary — as already suggested by KUCKUCK (1894, p. 239) —

first to study the chromatophores. As regards the former, no information about this point is found in the literature; as regards the latter, the chromatophores are figured by KUCKUCK (1912). They are lens-shaped and several together occur in each cell. If the cells in ARESCHOUG's form with plurilocular sporangia also possessed several discoid chromatophores, and the vegetative thallus was otherwise of the same structure, the identity of the two forms might perhaps be fairly probable.

However, if ARESCHOUG's form with plurilocular sporangia should turn out to have only a single plate-shaped chromatophore in each cell, as in *Ralfsia ovata* (K. ROSENVINGE 1893, p. 900; 1898, p. 94; JÓNSSON 1903, p. 142), K. ROSENVINGE's hypothesis (1898, p. 94), that ARESCHOUG's form with plurilocular sporangia and *Ralfsia ovata* belong to the same species, will seem highly probable. This hypothesis is approved by JÓNSSON (l. c.), and it must be admitted that his fig. 1 shows a great resemblance to ARESCHOUG's form with plurilocular sporangia.

In a very large material of *Lithoderma* collected by me in different places in East Greenland between about 70° and 73° N. lat. in the summer of 1933, I found in a few localities — partly in company with plants with unilocular sporangia and crust threads with plurilocular sporangia of the KUCKUCK-type — individuals corresponding entirely to ARESCHOUG's form with plurilocular sporangia. As my plants were preserved in alcohol, it was possible to study the chromatophores. It proved, then, that several small disc-shaped chromatophores were found in each of the cells of the crust; in the cells of the free filaments, however, as a rule only a single chromatophore was found. As the structure of the vegetative thallus corresponds excellently with the structure of the crust in KUCKUCK's form with plurilocular sporangia — apart from a minor deviation in the dimensions of the cells —, it would perhaps seem a natural supposition that ARESCHOUG's form with plurilocular sporangia and KUCKUCK's form with plurilocular sporangia actually belonged to the same species, *Lithoderma fatiscens* ARESCHOUG, which should then exhibit dimorphism as regards the position of the plurilocular sporangia.

In the following pages my plants will be described in more detail. Subsequently individuals with plurilocular sporangia of KUCKUCK's type and individuals with unilocular sporangia will be mentioned for comparison.

Lithoderma fatiscens ARESCHOUG c. spor. plur.

Material from East Greenland: Mouth of Dusén Fjord (west side of westernmost Vinter Island in about 73°15′ N. lat., 23° 10′ W. long.), depth 21—22 m, dredged August 8, 1933; and Scoresby Sound (Hurry Inlet near the southernmost Fame Island in about 70° 50′ N. lat., 22° 30′ W. long.), depth 4—6 m, dredged July 14, 1933.

The following account is chiefly based on an examination of individuals from Dusén Fjord.

The fructifying parts of the plants are as a rule of a rather light colour. Below a sporangia sorus the vertical cell threads of the crust

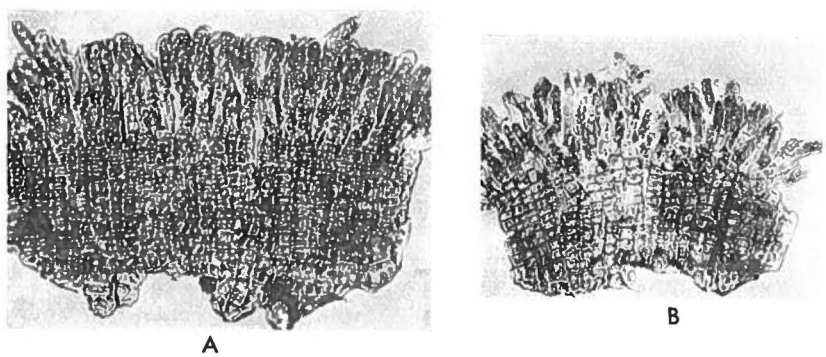

Fig. 1. *Lithoderma fatiscens* ARESCHOUG with plurilocular sporangia, from Dusén Fjord. Longitudinal section through the thallus. In B chromatophores are seen in several of the crustal cells. About 200:1. Photographs by K. M. ERIKSEN.

observed in longitudinal section through the plant (fig. 1.) consist of thick-walled cells probably generally somewhat broader than high (height as a rule = $^1/_2$—1 × the breadth). However, several cells are a little higher than broad. The height mostly varies between (5—) 6.5 μ and 10 μ (—14 μ), the breadth between 7 μ and 14 μ. As a rule the threads are somewhat thinner at the top than farther down. Thus in one case the apical cell of a thread had a thickness of 11 μ; cell No. 6 downwards was even 21 μ thick. The height of the cells was 5.5 μ in both cases.

Otherwise the dimensions of the cells depend upon the bifurcation of the threads. When a bifurcation has just taken place, the cells are rather narrow, while just before the bifurcation they are broad. In one case the cells just before a bifurcation were 10.5 μ high and 15.5 μ broad; the cells of the two newly formed threads were 7 μ high and 8.5 μ broad.

Bifurcations are of common occurrence in the vertical cell threads of the crust. Below a sorus with plurilocular sporangia sometimes only

the uppermost cell is divided longitudinally (cf. fig. 3 G). Each of the two new cells then carry a free fertile filament.

Each of the crustal cells contains several small disc-shaped chromatophores (figs. 1 B, 2 C, 3 A, B), as a rule 2—3 to 5. The uppermost cells below a plurilocular sporangia sorus generally contain only 2—3 (4), the cells a little farther down often 5 (—6) chromatophores. The uppermost cells of the sterile part of the thallus, on the other hand, often contain 5—6 chromatophores.

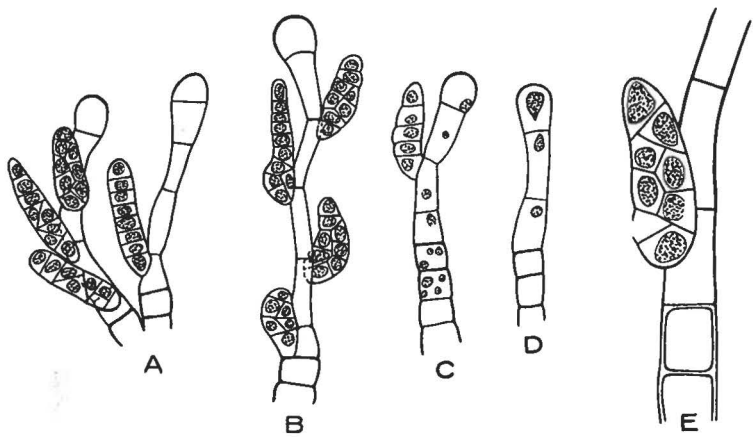

Fig. 2. *L. fatiscens* Areschoug with plurilocular sporangia, from Dusén Fjord. From a crushed preparation. A—C, free filaments with plurilocular sporangia. D, free filament still sterile. In C and D chromatophores are seen. E, plurilocular sporangium of which the lowermost spore but one has been exhausted. A—D, about 500:1, E, about 1000:1.

The height of the vertical cell threads of the crust under a plurilocular sporangia sorus is rather variable. In some of my preparations it amounts to about 60—100 μ only.

In a preparation from Scoresby Sound the vertical threads of the crust contained fairly long cells some way down (fig. 3 G). Both above and below these cells the cells of the threads had the usual dimensions. Possibly these long cells indicate the boundary between two growth periods (cf. Printz 1926, p. 145).

The plurilocular sporangia are situated laterally on special fertile shoots, free filaments issuing from the apical cells in the vertical cell threads of the crust. As a rule only one free filament issues from each apical cell, more rarely two (fig. 3 F). In some cases the vertical cell threads of the crust pass evenly into the fertile shoots, in other cases the boundary between the crust and the fertile shoots is sharper.

Over a larger or smaller part of the thallus each apical crustal cell sends out one fertile shoot (in some cases two, as stated above). In this way the plurilocular sporangia come to form a sporangia sorus

(fig. 1, A, B). The fertile shoots consist of 4—6 cells (fig. 2 A—C), and carry an abundance of plurilocular sporangia. However, in the Scoresby Sound-plants the fertile shoots consisted mostly of 3 (2—4) cells only (fig. 3). Probably these plants were still young; this assumption is supported by the fact that plurilocular sporangia were present in small numbers only.

The cells of the fertile shoots are elongated (figs. 2, 3) and more thin-walled than the crustal cells (though the apical cells of the fertile

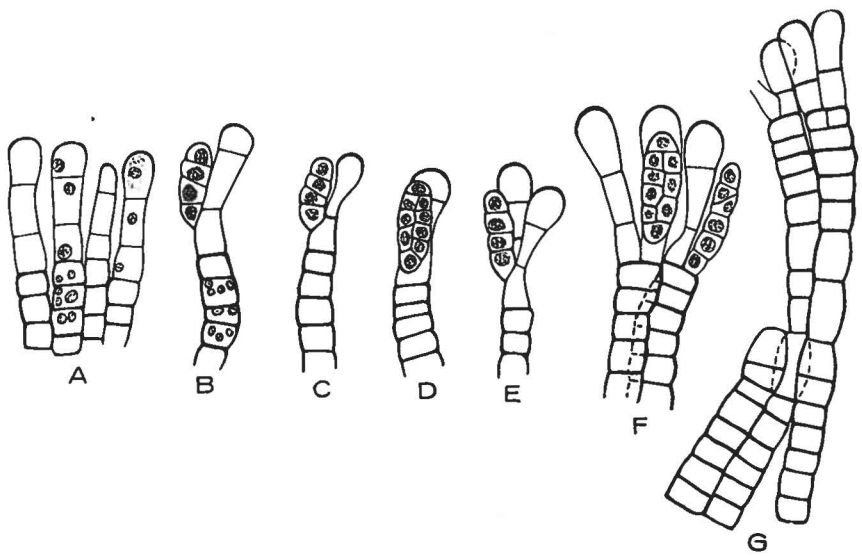

Fig. 3. *L. fatiscens* ARESCHOUG with plurilocular sporangia, from Scoresby Sound. From a crushed preparation. A, a fragment of the crust with free, still sterile filaments. B—F, crustal cell threads with free, fertile filaments. In E the free filament is branched. In F two free filaments issue from the same crustal cell. G, crustal threads, part of which consists of long cells, with young free filaments. Chromatophores are seen in A and B. About 500:1.

shoots are thick-walled at the top). They are very poor in content, and as a rule possess only a single chromatophore (figs. 2 C, D, 3 A), which, however, now and then seems to be a little larger than those of the crustal cells (fig. 2 D). At any rate this seems often to be the case in the apical cell, probably especially as long as it is young; the chromatophore is then often somewhat plate-shaped.

The fertile shoots are as a rule thinnest at the middle, whence they increase in thickness, so that the uppermost part of the shoot will be club-shaped (figs. 2, 3). The uppermost cell is rather semispherical. As a rule the fertile shoots are unbranched, more rarely branched (fig. 3 E).

In my preparations the height of the plurilocular sporangia sori varies from 53 μ to 74 μ. In the material from Scoresby Sound the height is only 28—45 μ.

The plurilocular sporangia are situated on the uppermost part of the cells of the fertile shoots (figs. 2, 3). Only one plurilocular sporangium issues from each cell. The lowermost cell of the fertile shoots is nearly always connected throughout its whole length with a plurilocular sporangium. This sporangium is further connected with the apical cell of the vertical cell threads of the crust (fig. 2 B). Several plurilocular sporangia seem to be inserted on apical crustal cells (fig. 3 F).

The plurilocular sporangia vary fairly much in shape, being cylindrical, spindle-shaped or ovoid; often they are of a somewhat irregular shape and may terminate rather acutely (fig. 2 B). In some cases they are thickest at the middle, in other cases in the lowermost part. Some contain only one row of spores, others two rows in part of the sporangium. The length is as a rule 30 μ (21—35 μ), the thickness 7—8 μ (—12 μ).

Usually the spores contained a large vacuole (not shown in my figures). Presumably sporangia with such spores were not mature.

As regards the emptying of the sporangia I have no certain data. Only very few plurilocular sporangia had been emptied. However, in a plurilocular sporangium with several rooms the greater number of the spores had been exhausted, only the uppermost and the lowermost remained, while the uppermost but one was about to be exhausted through a lateral hole of exhaustion. Another plurilocular sporangium was partially emptied and had several lateral openings of exhaustion. I an third sporangium only the lowermost spore but one had been exhausted (fig. 2 E).

These observations might indicate that each room has its own opening of exhaustion, as in Kuckuck's form with plurilocular sporangia. However, since the observations described above were observed in crushed preparations, it would seem natural to assume that we may be concerned with sporangia whose spores had been driven out by mechanical force.

L. fatiscens Kuckuck c. spor. plur.

Material from East Greenland: Dusén Fjord, depth 21—22 m, dredged August 8, 1933; and Denmark: Taarbæk Rev in the Sound, depth 6 m, dredged February 25, 1938.

In a crushed preparation from Dusén Fjord, which consisted almost entirely of crustal threads with unilocular sporangia, there occurred in addition some few crustal threads with plurilocular sporangia of the Kuckuck type. These plurilocular sporangia occurred partly in special sori partly in sori containing unilocular sporangia

also (fig. 4 A). The plurilocular sporangia of the former were still fairly young and had a thick cuticula, about 16—17 μ thick, at the top (fig. 4 B). Often two occurred together on the same cell. The plurilocular sporangia of the latter were older.

As the plurilocular sporangia mentioned were present in small numbers only, and only a small part of the crust inside was included in the preparation, it is unfortunately impossible to describe the structure of the crustal cells in more detail. However, it has been necessary to mention these plants; for even though it may be possible that the sori having exclusively plurilocular sporangia of the KUCKUCK type were

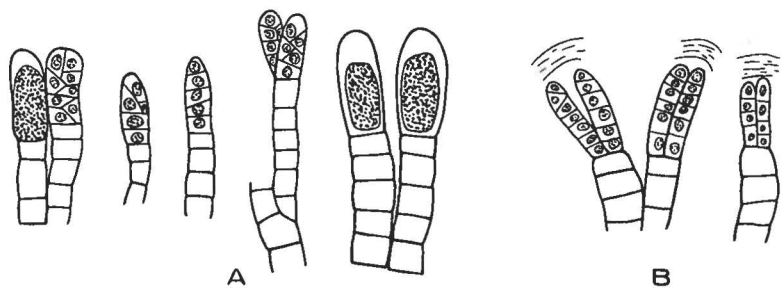

Fig. 4. *L. fatiscens* KUCKUCK with plurilocular sporangia, from Dusén Fjord. From a crushed preparation. A, plurilocular and unilocular sporangia from the same sorus. B, young plurilocular sporangia from a sorus probably exclusively with plurilocular sporangia. Above, the cuticula. About 500:1.

not derived from the same plant as carried unilocular sporangia, it is beyond dispute that plurilocular sporangia of this type may occur on the same plant as the unilocular ones, even in the same sorus, and thus it must be taken as a proof that plurilocular sporangia of the KUCKUCK type and terminal unilocular sporangia belong to the same species (cf. KUCKUCK 1894, p. 238).

In plants from the Sound longitudinal sections through the fructifying part of the thallus (fig. 5 A) show that the crust — as in ARESCHOUG's plants with plurilocular sporangia — consists of branched, vertical threads formed by thick-walled cells. However, the latter seem to be generally just as high as broad, or a little higher; though a good many are not as high as broad. The height as a rule varies between 7 and 13 μ, the breadth between 8 and 13 μ. The vertical threads are thinnest at the apex; in the deeper cell layers of the crust the cells are generally much broader.

Bifurcation is of common occurrence, and the dimensions of the cells depend upon them.

The cells of the crust contain several small disc-shaped chromato-

phores (fig. 5 D), most frequently 2—4. In the deeper-lying cells their number is often higher.

The plurilocular sporangia have their position in sori (fig. 5 A); each apical cell of the vertical cell threads of the crust within a greater or smaller part of the thallus is converted into a sporangium (fig. 5 B). However, now and then two plurilocular sporangia may be met with on the same cell (fig. 5 D), viz. when the apical cell of the crustal cell thread has divided longitudinally immediately before the formation of the sporangia. In many cases only the uppermost cell below the sorus

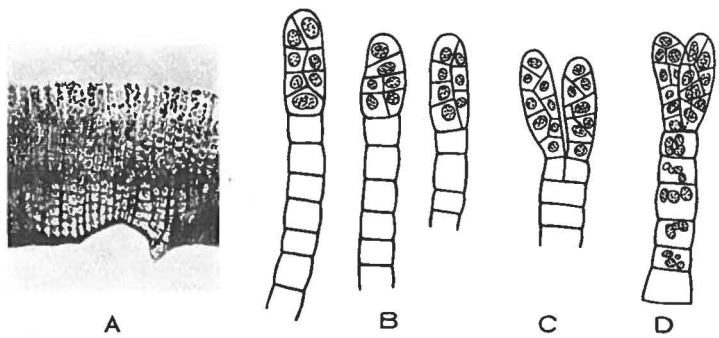

Fig. 5. *L. fatiscens* Kuckuck with plurilocular sporangia, from the Sound. A, longitudinal section through the thallus. B—D, crustal filaments with plurilocular sporangia. The uppermost cell in C is divided lengthwise, and each of the two new cells thus formed issues a plurilocular sporangium. In D two plurilocular sporangia are seen to issue from the same crustal cell. In D chromatophores are seen in the cells of the crustal thread. A, about 200:1, B—D, about 500:1. A, photograph by K. M. Eriksen.

is divided longitudinally; in this way the two newly formed cells come to carry a plurilocular sporangium each (fig. 5 C).

The plurilocular sporangia are mostly cylindrical, though somewhat thinner in their upper part. In some cases they are rather oblong-ovoid. Usually they contain two rows of chambers in the middle part only, but in some cases two rows are found in the uppermost and lowermost part also. They are mostly about 30 μ long (25—33 μ) and 8.5—11 μ thick. Each room is emptied separately.

L. fatiscens c. spor. unil.

Material from East Greenland: Dusén Fjord, depth 21—22 m, dredged August 8, 1933; and Denmark: Taarbæk Rev in the Sound, depth 6 m, dredged February 25, 1938.

In plants from Dusén Fjord the crust also consisted of vertical cell threads, occasionally branched (fig. 6 F) — though probably less

frequently than in plants with plurilocular sporangia. The thickness of the cells, which are generally broader than high, varied fairly much in sections through different sori. In some cases the cell threads of the crust below a unilocular sporangia sorus consisted of cells which were mostly only 7—10 μ thick. In sections through other sori, however, the crustal cells near the sori were generally 17—18 μ broad. When the crustal cells are as broad as in the latter case, the cells as a rule have a brownish-yellow to darkbrown homogeneous content (cf. the ascocysts of *Ascocyclus* and the

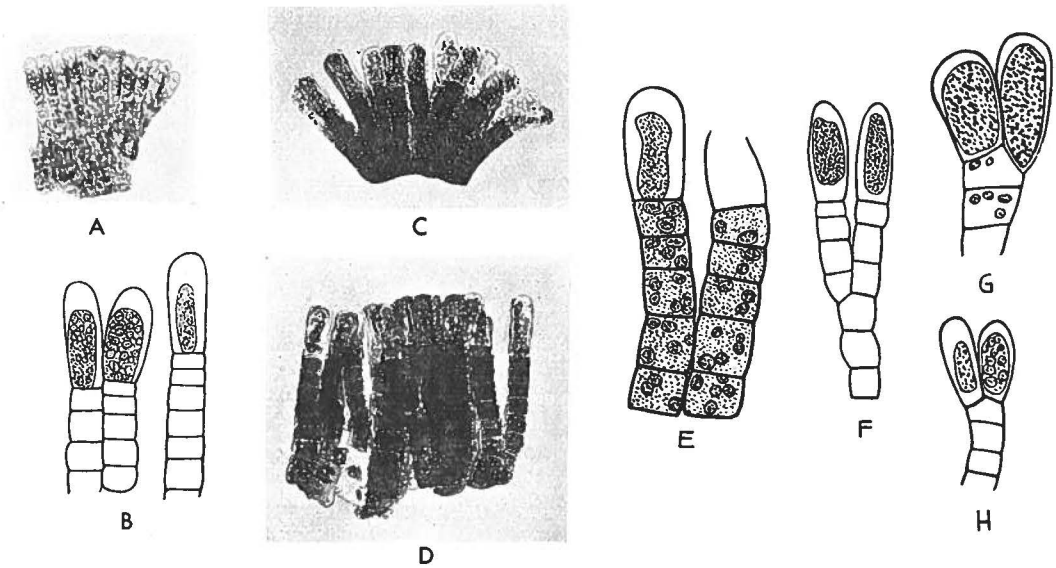

Fig. 6. *L. fatiscens* with unilocular sporangia, from Dusén Fjord. From a crushed preparation. A and B, unilocular sporangia on crustal filaments without brown contents in the cells. C, D, and E, unilocular sporangia on thick crustal cell threads, the cells with brown contents (in E indicated by dots). F, branched crustal cell thread with unilocular sporangia. G and H, two unilocular sporangia issuing from the same cell. In E and G chromatophores are seen in some of the crustal cells. A, C, and D, about 200:1; B, E—H, about 500:1. A, C, and D, photographs by THORV. SØRENSEN.

refractive cell in *Symphyocarpus*). Fig. 6 C, D, and E show such broad crustal threads, whose cells were entirely dark-brown. The thin crustal cells represented in fig. 6 A and B had no brown content.

All transitions between these two categories occur, various sections showing different thickness of the crustal cells as well as different amounts of the aforementioned brownish substance in the cells. The colour of the individuals, which is often very dark, depends on this. The thin-celled crusts do not contain this substance, and such plants are accordingly of a light colour (fig. 6 A).

The crustal cells contain several disc-shaped chromatophores (fig. 6 E, G), the greatest number in the brownish cells, in which it may rise

at any rate to 8. In such cells the chromatophores may be fairly large, attaining a diameter of 2.5—4 μ.

The unilocular sporangia are as a rule cylindrical, short or long, often somewhat thicker in the upper part. In some cases they are rather oval. They usually occur singly at the apex of the vertical cell threads of the crust (fig. 6, A—F), more rarely two together (fig. 6 G, H). The latter is evidently the case when the formation of sporangia has taken place immediately after the longitudinal division of an apical cell. In some cases only the uppermost cell below a sporangia sorus is divided longitudinally; the two new cells will then carry a unilocular sporangium each. Four sporangia situated together, as mentioned by K. Rosenvinge (1898, p. 97), were not observed by me.

The unilocular sporangia vary greatly in size according as they are situated on thin or thick crustal cells. However, the unilocular sporangia in the same sorus seem to be alike — at any rate in part of the sorus. In the case mentioned above, where the crustal cells were as a rule 7—10 μ thick, the sporangia were rather small and thin-walled, 21—25 μ long and 8.5—10 μ high (cf. fig. 6 A). Remnants of cuticula were seen here and there on top of the sporangia.

In the other of the above-mentioned two cases, where the crustal cells were 17—18 μ broad, the sporangia were coarse and thick-walled, 32—46 μ long and 18—22 μ thick (cf. fig. 6 C, D, E).

Between these two extremes in the size of the sporangia several intermediate stages occur, sporangia whose dimensions are proportionate to the thickness of the crustal cells on which they are situated.

Whether these different unilocular sporangia may occur on the same plant, I am unable to decide. It is true that sporangia of all sizes were found in the same crushed preparation; but since the individual crusts grow across and between each other, it is quite possible that more than one individual is represented in the preparation. Moreover a large number of the sporangia of all size classes in this preparation were emptied; others had differentiated spores, while others again were immature.

Since the thick brownish vertical crustal cell threads with the large thick-walled unilocular sporangia are decidedly much older than the corresponding thin light-coloured threads with the small thin-walled unilocular sporangia, it must be assumed that the same thallus is capable of producing unilocular sporangia more than once (cf. Kuckuck 1912, p. 174).

Individuals with unilocular sporangia from the Sound occurred in company with the plants with terminal plurilocular sporangia mentioned at p. 10. In contrast to the latter, which were fairly light-coloured

in fructifying places, they were of a rather dark colour. They seem to correspond entirely to the East Greenland crusts, whose cells were very broad and had a brownish content and carried coarse thick-walled unilocular sporangia. The crustal cells are generally broader than high; the breadth usually varies between 11 and 17 μ, the height between 8.5 and 11 μ. The cells as a rule had a brownish content (fig. 7 A).

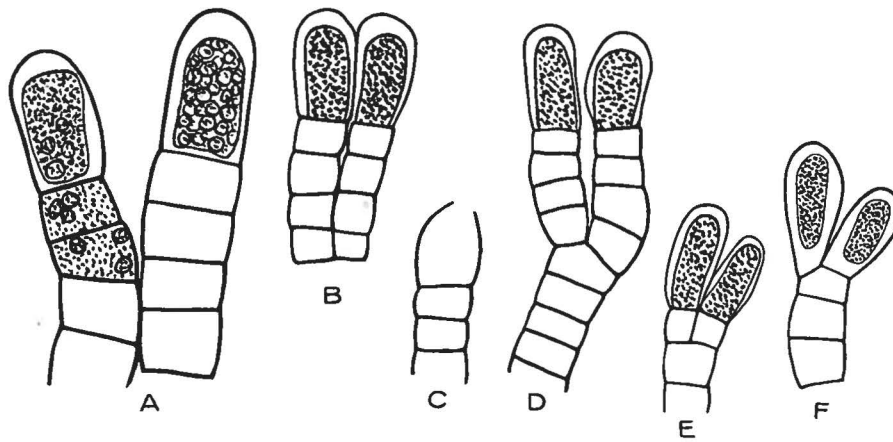

Fig. 7. *L. fatiscens* with unilocular sporangia, from the Sound. Crustal filaments with unilocular sporangia. From a crushed preparation. A, coarse unilocular sporangia on thick crustal threads with brown contents in the cells (indicated by dots in two of the cells). Chromatophores are seen in a couple of the cells. D and E show branched crustal cell threads; in E the uppermost cell only is divided longitudinally. F shows two unilocular sporangia on the same crustal cell. About 500:1.

The unilocular sporangia (fig. 7 A—F) are often cylindrical, corresponding to those from East Greenland, being 28—37 μ long and 11—16.5 μ thick; several were rather ovoid-spherical, 18—28 μ long and 14—18 μ thick.

It will appear from the above that the structure of the crust below a sorus, as observed in longitudinal section through the plant, seems to be precisely the same in an East Greenland plant with plurilocular sporangia of ARESCHOUG's type and in a plant with unilocular sporangia (whether East Greenlandic or Danish). In both cases the vertical threads are occasionally branched; their cells are as a rule a little broader than high. In both cases several disc-shaped chromatophores occur in the cells. It would accordingly seem fairly probable that the two kinds of plants were identical (cf. KYLIN 1907, p. 46).

Since, now, the relationship between plants with unilocular sporangia and such with plurilocular sporangia of the Kuckuck type has been proved by the fact that unilocular and plurilocular sporangia have been observed in the same sorus, the consequence then would be that individuals with plurilocular sporangia of the Areschoug type and individuals with plurilocular sporangia of the Kuckuck type likewise were identical. And actually a longitudinal section through an East Greenland plant with plurilocular sporangia of the Areschoug type shows the same structure of the crust as a corresponding section through a Danish plant with plurilocular sporangia of the Kuckuck type. However, the cells of the former are usually a little broader than in the latter, and furthermore, they are generally a little broader than high in Areschoug's form, while in Kuckuck's form their breadth is mostly equal to their height. However, the last-mentioned difference is the same as was observed between plants with unilocular sporangia and plants with plurilocular sporangia of the Kuckuck type, and accordingly it should not be of any great significance.

While, thus, vegetatively there seems to be nothing to prevent Areschoug's form and Kuckuck's form with plurilocular sporangia from being identical, on the other hand the development and position of the plurilocular sporangia in the two forms differ so considerably that on account of this fact I do not think they are identical. Areschoug's form with plurilocular sporangia here behaves like K. Rosenvinge's *Ralfsia ovata* since the sporangia issue laterally from free filaments.

Apart from the fact that the latter species, unlike Areschoug's form with plurilocular sporangia, contains only a single chromatophore in the crustal cells, the vegetative structure seems otherwise to be the same in these two forms: vertical combined crustal threads, now and then branched, consisting of cells which are mostly broader than high.

The thickness, also, of the crustal threads seems to agree, judging from a couple of Jónsson's Icelandic original preparations of *Ralfsia ovata* which I have had the opportunity to examine. In both cases the threads were 7—13 (14) μ thick, probably mostly about 10 μ.

However, it will only be possible to regard the two forms as identical on the assumption that we are here concerned with a species which exhibits dimorphism in regard to the chromatophores. This would in itself probably not be inconceivable either, such case having previously been observed. Thus Pringsheim (1873, Taf. XI) figures cells of *Ectocarpus granulosus* with disc-shaped chromatophores (fig. 6) and cells with ribbon-shaped branched chromatophores (figs. 7, 8).

It should also be remembered that my plants with plurilocular sporangia of the Areschoug type actually exhibit a dimorphism. For

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