

DET KONGELIGE DEPARTEMENT  
FOR HANDEL, SJØFART, INDUSTRI, HÅNDVERK OG FISKERI

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NORGES SVALBARD- OG ISHAVS-UNDERSØKELSER  
LEDER: ADOLF HOEL

# SKRIFTER OM SVALBARD OG ISHAVET

Nr. 41

B. LYNGE AND P. F. SCHOLANDER

LICHENS FROM NORTH EAST GREENLAND

COLLECTED ON THE NORWEGIAN SCIENTIFIC  
EXPEDITIONS IN 1929 AND 1930

I

WITH 7 PLATES AND 1 MAP



OSLO 1932  
JACOB DYBWADS BOKHANDEL

## Results of the Norwegian expeditions to Svalbard 1906—1926 published in other series. (See Nr. 1 of this series.)

The results of the Prince of Monaco's expeditions (Mission Isachsen) in 1906 and 1907 were published under the title of 'Exploration du Nord-Ouest du Spitsberg entreprise sous les auspices de S.A.S. le Prince de Monaco par la Mission Isachsen', in *Résultats des Campagnes scientifiques*, Albert Ier, Prince de Monaco, Fasc. XL—XLIV. Monaco.

ISACHSEN, GUNNAR, Première Partie. Récit de voyage. Fasc. XL. 1912. Fr. 120.00.

With map: Spitsberg (Côte Nord-Ouest). Scale 1:100 000. (2 sheets.) Charts: De la Partie Nord du Foreland à la Baie Magdalena, and Mouillages de la Côte Ouest du Spitsberg. ISACHSEN, GUNNAR and ADOLF HOEL, Deuxième Partie. Description du champ d'opération. Fasc. XLI. 1913. Fr. 80.00.

HOEL, ADOLF, Troisième Partie. Géologie. Fasc. XLII. 1914. Fr. 100.00.

SCHETELIC, JAKOB, Quatrième Partie. Les formations primitives. Fasc. XLIII. 1912. Fr. 16.00.

RESVOLL HOLMSEN, HANNA, Cinquième Partie. Observations botaniques. Fasc. XLIV. 1913. Fr. 40.00.

A considerable part of the results of the ISACHSEN expeditions in 1909 and 1910 has been published in *Videnskapsselskapets Skrifter. I. Mat.-Naturv. Klasse*, Kristiania (Oslo).

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HOEL, A. et O. HOLTEDAHL, Les nappes de lave, les volcans et les sources thermales dans les environs de la Baie Wood au Spitsberg. 1911, No. 8. Kr. 4.00.

GOLDSCHMIDT, V. M., Petrographische Untersuchung einiger Eruptivgesteine von Nordwestspitzbergen. 1911, No. 9. Kr. 0.80.

BACKLUND, H., Über einige Olivinknollen aus der Lava von Wood-Bay, Spitzbergen 1911, No. 16. Kr. 0.60.

HOLTEDAHL, OLAF, Zur Kenntnis der Karbonablagerungen des westlichen Spitzbergens. I. Eine Fauna der Moskauer Stufe. 1911, No. 10. Kr. 3.00. II. Allgemeine stratigraphische und tektonische Beobachtungen. 1912, No. 23. Kr. 5.00.

HOEL, ADOLF, Observations sur la vitesse d'écoulement et sur l'ablation du Glacier Lilliehöök au Spitsberg 1907—1912. 1916, No. 4. Kr. 2.20.

VEGARD, L., L'influence du sol sur la glaciation au Spitsberg. 1912, No. 3. Kr. 0.40.

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With map: Spitsberg (Partie Nord-Ouest). Scale 1:200 000 (2 sheets).

GUNNAR ISACHSEN has also published: Green Harbour, in *Norsk Geogr. Selsk. Aarb.*, Kristiania, 1912—13, Green Harbour, Spitsbergen, in *Scot. geogr. Mag.*, Edinburgh, 1915, and Spitsbergen: Notes to accompany map, in *Geogr. Journ.*, London, 1915.

All the above publications have been collected into two volumes as *Expédition Isachsen au Spitsberg 1909—1910. Résultats scientifiques. I, II.* Christiania 1916.

As the result of the expeditions of ADOLF HOEL and ARVE STAXRUD 1911—1914 the following memoir has been published in *Videnskapsselskapets Skrifter. I. Mat.-Naturv. Klasse*.

HOEL, ADOLF, Nouvelles observations sur le district volcanique du Spitsberg du Nord 1914, No. 9. Kr. 2,50.

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The following topographical maps and charts have been published separately:

Bjørnøya (Bear Island). Oslo 1925. Scale 1:25 000. Kr. 10,00.

Bjørnøya (Bear Island). Oslo 1925. Scale 1:10 000. (In six sheets.) Kr. 30,00.

Chart of Bear Island. (No. S1). Oslo 1929. Scale 1:40 000. Kr. 4,00. (With description.)

Bear Island Waters. (No. S2). Oslo 1930. Scale 1:350 000. Kr. 5,00.

A preliminary edition of topographical maps on the scale of 1:50 000 covering the regions around Kings Bay, Ice Fjord, and Bell Sound, together with the map of Bear Island, scale 1:25 000, is published in:

Svalbard Commissioner [Kristian Sindballe], Report concerning the claims to land in Svalbard. Part I A, Text; I B, Maps; II A, Text; II B, Maps. Copenhagen and Oslo 1927. Kr. 150,00.

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A. W. BRØGGERS BOKTRYKKERI A/S

## Lichenological Research in North East Greenland.

The first scientists, who collected lichens in North East Greenland, were Dr. Pansch and Dr. Copeland, during the Second German Polar Expedition of 1870—71. Their lichens were determined by G. W. Koerber: *Flechten*, in vol. II, p. 75—82.

The lichens were collected between Shannonøya and Franz Josef-fjorden. Koerber enumerates in all 52 species, 17 of them belong to the genera, treated in this paper. Koerber's determinations have in part been criticized, e. g. by Th. M. Fries (Lichens collected during the English Polar Expedition of 1875—76). Koerber's herbarium was bought by the Rijksmuseum in Leiden after his death. Unfortunately the statutes of this museum much restrict the loan of its material to foreign museums. I have therefore been able to study only a few of Koerber's plants, which the director of the museum was kind enough to lend me. I can only confirm Th. Fries's statements.

In 1891 the Danish botanist and geologist N. Hartz worked in North East Greenland. He published a very important paper "*Østgrønlands Vegetationsforhold*", *Meddel. om Grønland*, vol. 18, p. 103—314, København 1895, on his results. In this paper we find many interesting observations on lichens, especially on their biology.

J. S. Deichmann Branth determined the lichens and published a paper on them "*Lichener fra Scoresby Sund og Hold with Hope*", *Meddel. om Grønland*, vol. 18, p. 83—103, København 1894. He writes (l. c. p. 85) that Hartz's collection contained 190 species, or about  $\frac{2}{3}$  of the number of lichens, then known from Greenland. These figures show the quality of Dr. Hartz's work, but they are certainly far from representative. If the lichen flora of South West Greenland were explored by a trained lichenologist, the lichens of Scoresby Sund and North East Greenland in general would certainly rank far below these  $\frac{2}{3}$  of the entire lichen flora of Greenland.

Dr. Hartz worked one day at Kapp Hold with Hope (Kapp Broer Ruys). He spent the rest of his time in Scoresby Sund, where he had his head quarters in Heklahamna on Danmarkøya (Hekla was the name of the expedition ship). From this centre he joined many excursions

to different parts of this enormous fjord, the greatest in the world. He also wintered there, and continued his work the following year, to August 1892.

His results are very important. Firstly for our knowledge of the lichen flora of Scoresby Sund and North East Greenland. But he also made valuable observations on the influence of the snow cover on the lichens, as well as on the other vegetation. He is in reality one of the pioneers of such investigation, which is of enormous importance for the understanding of the plant formations of the arctic, and also in our country. Studies of this kind have been much neglected in the arctic, botanists have so rarely wintered there.

Deichmann Branth records a little more than 60 species of the genera, treated in the present paper. But the number is in reality higher, for Deichmann Branth had a very wide limitation of his species. — Hartz found some relatively southern species, which we did not find in our territory farther north, e. g. *Parmeliopsis ambigua*. There are also some other species, which are rather common in Scoresby Sund, but which we only found in a few places in Davy Sund and Kong Oscarfjorden, in the southern part of our field of investigation, e. g. *Gyrophora vellea* and *Acarospora Schleicheri*. This is easily understood, on account of the valleys and passes between the two fjords.

Dr. Hartz's lichens belong to the Botanical Museum of Copenhagen. They have been accessible to me, and some remarks on them will be found in this paper.

During the Carlsberg Fund Expedition to the East Coast of Greenland, 1898—1902, Ch. Kruuse, collected some lichens, chiefly south of Kapp Brewster: Turner Sund and Kapp Dalton, on the Liverpool Coast, and at Kapp Greg, and in Fleming Inlet north of this ill-famed coast.

This collection, which is much smaller than that of Dr. Hartz, was determined by Edv. A. Vainio: *Lichenes expeditionis G. Amdrup* (1898—1902), *Meddel. om Grønland* vol. 30, p. 123—141, København 1905. Vainio enumerates 30 species from East Greenland, belonging to the genera, treated in this paper. There are also some lichens from Jan Mayen.

In 1899 A. G. Nathorst organized an expedition to East Greenland, in search of André, who had started from Spitsbergen the previous year in his ill-fated balloon. The Nathorst expedition was favoured by exceptionally fine ice-conditions, and they had a long and favourable summer at their disposal. Their topographical results are very remarkable. They mapped the enormous fjord system north of the Liverpool coast. It is incredible, but true that the topographer, P. Dusén, also found time for plant collecting.

His lichens were determined by Gust. O. A:n Malme: *Lavar hemförda av den svenska expeditionen till Jan Mayen och nordöstra*

Grönland 1899 (Lichens brought home by the Swedish Expedition to Jan Mayen and North East Greenland), published in *Arkiv för Botanik*, vol. 22 A, No. 14, p. 1—6.

The expedition worked in the same part of Greenland as we did, and also in Scoresby Sund, and in Jan Mayen. Malme enumerates 37 lichens from North East Greenland, 20 of them belonging to the genera treated in the present paper.

In 1905 the Duc d'Orléans made a "Croisière Océanographique accomplie a bord de la Belgica dans la Mer du Grönland". Members of the expedition also collected some plants, between  $76^{\circ} 39'$  and  $77^{\circ} 36'$  n. Deichmann Branth determined the few lichens, collected by E. Koefoed: Lichens, p. 13, in "Botanique. Plantes, récoltés a la côte nord-est du Grönland", Bruxelles 1907.

Deichmann Branth found 15 lichens and one parasitic fungus on a *Stereocaulon*, in the collection. Eleven of the lichens belong to genera, treated in the present paper. I have not seen these lichens.

The "Danmark"-expedition of 1906—1908, under the command of L. Mylius-Erichsen, worked farther north than the Norwegian expeditions did. Its head-quarters were in Danmarkhamna,  $76^{\circ} 46'$  n. From that place very wide excursions were made. The lichens collected were determined by Olaf Galløe: "Lichens from North-East Greenland, collected by the "Danmark"-Expedition 1906—1908", in *Meddel. om Grønland*, vol. 43, 1810, p. 181—191. According to Galløe l. c. p. 184 the places where the lichens were taken "mainly lie about Danmarks Havn".

The botanist of the expedition was A. Lundager. The number of lichen species amounted to 68, 30 of them belong to genera, treated in the present paper. I have not seen these lichens. The number of lichens is nearly the number, usually brought home from arctic regions by botanists, who are not lichenologists, and who can only devote a very limited time to lichenological collecting. — We may mention that Th. Wulff collected 64 different species of lichens at the northernmost point of Greenland.

We cannot regard these figures as representative of the lichen flora of these regions. On the contrary we can conclude that there is a very considerable lichen vegetation all round the north and north-east coast of Greenland.

This fact is very interesting. For there are several lichens, whose present distribution in the arctic can only be understood if we can suppose a migration along very northern routes.

The lichen flora of North East Greenland is now much better known than that of South East Greenland. In the Copenhagen herbarium there are some lichens from that region, especially from the Angmagssalik district. But these collections are quite insufficient to give

any idea of the lichen flora there. At present we are not able to make any comparison between the lichen flora of the northern and the southern regions on the east coast of Greenland.

In 1921 I joined the Norwegian expedition to Novaya Zemlya, and in 1926 I worked in Bell Sund, Spitsbergen. I have also undertaken the determination of Th. Fries's large arctic collections from Bear Island and Spitsbergen (1868) and West Greenland (1871). It was therefore with the greatest expectations that I joined the Norwegian expedition to North East Greenland in 1929, under the command of Anders Crvin, and organized by Adolf Hoel, leader of "Norges Svalbard og Ishavsundersøkelser".

I hoped to bring home so large collections that I should have a sufficient material for comparison between the lichen flora of Novaya Zemlya, Spitsbergen and North East Greenland. We would then know the lichen flora of the arctic regions surrounding the Scandinavian Peninsula, and could also throw some light on the lichen flora of our southern high mountains, a flora that descends to the level of the sea in our northernmost provinces.

From a systematic point of view there is no excuse for limiting the paper as we have done here. But an increasing fear that I should not be able to complete the determination of all these large collections has forced a decision upon me. I could have concentrated my energy either on the Greenland or on the Spitsbergen collections. But I preferred to work on parallel lines. The genera, which we have treated in this work, are also almost ready in the Spitsbergen collections as well.

The choice of the genera, and limitation of the paper, were decided according to geographical rather than systematic considerations. For if a species of these larger and more conspicuous lichens should be found in the region in question, it was probable that it would also be found in these collections, made by trained and experienced lichenologists. This assumption will look bold to botanists, who are wont to work in regions, where the vegetation is favoured by better conditions of life. And where the conditions of life are less uniform than they are in the arctic.

But every arctic botanist knows that he can bring home a much larger percentage of the existing flora than he could do in the same time at home. This is firstly due to the fact that the number of species is much smaller in the arctic than at home. Secondly the arctic landscape is much more uniform and surveyable than any part of Norway. Large areas are botanically impediments. Barren grounds with only few and scattered plants are very extensive. The favoured places, such as sunny hills, protected against the most destructive winds, are limited in extent, and easily detected.

Undoubtedly the numerous crustaceous lichens would have yielded more "new species" than the larger plants in the present paper. It



was, however, not my chief object to collect such scattered data, however interesting. It was, on the contrary, to elucidate comparable facts, of use to plant geography in general.

From the first day of my field work I was struck with the immense difference in the conditions of life for the lichen vegetation in North East Greenland, as compared with Novaya Zemlya and Spitsbergen.

In the latter regions there are the large bird-cliffs, stocked with countless birds. No words can describe the life in them, no picture, not even the moving pictures, can give any adequate idea of it. Every single bird disappears. We do not see them or hear them individually. But if we place ourselves in the bird-cliffs, we see immense flocks, like clouds of mosquitoes, and we hear their cries incessantly, as we hear the waves of the sea.

In a dry climate the excrements of all these birds would form guano deposits. As it is, they are the condition of a very abundant lichen vegetation, rich in the number of species, and still more so in the number of individuals. There is every degree of concentration, from the white-coloured rocks of the bird-cliffs themselves to places where the birds are less numerous.

Each species of lichen has its own demand for nitrogen. And it finds its place, as near its optimum requirement as the severe competition with other nitrophilous lichens will allow. A study of these things on sociological lines would yield remarkable results in the arctic. Some illuminating remarks, though scattered, will be found in arctic literature. I may perhaps refer to my own paper on the lichens of Novaya Zemlya.

In East Greenland there are no bird-cliffs, stocked with sea-birds, north of the Liverpool Coast. The reason of this will easily be appreciated by every traveller, who has forced his way through the ice-pack east of Greenland in a bad ice year. A bird-cliff can only exist on an open coast, where the birds have free access to their food in the water. In the southern part of the Liverpool Coast there is generally open water during the breeding time of the birds. Here are the bird-cliffs of *Mergulus alle*. A lichenological investigation of the Liverpool Coast would be very interesting. So far we have only a few quite insufficient records in Vainio's paper on the lichens of the Amdrup expedition. Farther north the birds in a bad ice year would be obliged to cover the distance of up to 200 km to reach the open water, and that is of course impossible.

In North East Greenland there are several species of land birds. Their individual charm is greatly appreciated by every traveller in these desolate regions (see the sympathetic descriptions in Achton Friis's book *Arktiske Jagter*, Copenhagen 1925). Many of them have favourite resting places on large stones and on prominent rocks. In these limited places we find a very characteristic coprophilous vegetation, consisting

of species such as *Xanthoria candelaria*, *Parmelia infumata*, *Physciae*, *Caloplaca elegans*, *Lecanora melanophthalma*, *Rinodina Hueana*, and others.

But apart from such rocks there is no association of coprophilous lichens in North East Greenland. Here and there flocks of angry terns defend their castles, but they are not numerous enough to influence the vegetation. I do not think that I ever found the coprophilous *Candelariella crenulata*, which is so common in Spitsbergen, nor *Buellia coniops*, which is ubiquitous and quite inevitable there.

The lichen flora of the maritime rocks is very poor in North East Greenland. In Spitsbergen and in Novaya Zemlya similar rocks are often literally covered with lichens, coprophilous as well as others. I never saw that in Greenland. It has been suggested that it should be due to the heavy ice-pressure. But there is ice enough also in the eastern arctic, it should certainly be enough to remove the maritime lichens.

In Novaya Zemlya and in Greenland I never climbed high mountains. This is in part due to a natural aversion against climbing. But I was not botanically tempted to do so. For the lichen vegetation decreased so much from 3—400 meters upwards that I would not sacrifice time for further ascents. In the short arctic summer every hour of work is of importance. But if I had had known then what I know now of the Greenland lichen vegetation, I should certainly have spent some days on the high alpine lichens.

In North East Greenland I promptly found that the lichens ascend to heights, which I would never have dreamt of in Spitsbergen and in Novaya Zemlya. But unfortunately a severe gout attacked me, and rendered my movements more and more difficult. At last I could only walk with much difficulty, and during the last days I was reduced to find a good place near the ship where I could keep quiet, collecting crustaceous lichens.

I was therefore very glad that we could send a more effective man, stud. med. P. F. Scholander, the following year. He was a trained lichenologist, well acquainted with the larger lichens, and of excellent physique. He was advised to climb the mountains as much as possible and to give the best possible attention to the height limit of the lichens. He spared no effort to do so, and brought home the most valuable information on the alpine lichen vegetation that has ever been received from the arctic. In addition to this he was always actively collecting, wherever he went. The expedition of 1930 had much better ice conditions than we had in 1929, and the collectors had a considerably longer time at their disposal. They also worked more in the relatively rich southern fjords than we did in 1929.

The result was that Scholander brought home a very large collection, containing many interesting lichens that had escaped my attention.

The cause for the high ascent of the lichen vegetation in North East Greenland is easily understood. There is a high atmospheric pressure over the inland ice, and heavy foehns fall down the steep mountain sides. Every traveller has made their acquaintance. Hartz has vividly described them in his book "Østgrønlands Vegetationsforhold". From well known physical reasons the foehns become drier and warmer, as they rush down the mountain sides. The relative moisture must, accordingly, be higher in the highlands than in the lowlands. The temperature is of course lower in the highlands than in the lowlands, but that is no drawback to the arctic lichens, which find their temperature optimum much lower than southern lichens do. From the reason suggested also the highland temperature during the vegetation period is supposed to be much higher in North East Greenland than in corresponding heights of Spitsbergen and Novaya Zemlya.

These things can only be duly appreciated by meteorologists. But whether my premisses be right or wrong, the conditions of life for the lichens are much better in the highlands of North East Greenland than they are in Spitsbergen or in Novaya Zemlya, resulting in a much richer lichen vegetation.

In the lowlands there is practically no downpour during the time of vegetation. In the inland end of the large fjords it is perhaps not much greater than in a southern desert during those months. The moisture of the soil comes from the dissolving snow, which, during the summer, rapidly diminishes, it disappears in the ground or it is evaporated. Towards the end of August the soil is extremely dry, hard and solid, with numerous cracks.

This dryness induces the development of extensive heaths, with *Andromeda tetragona*, the arctic *Vaccinium uliginosum*, *Empetrum nigrum*, *Arctostaphylos alpina*, *Betula nana*. Such heaths are never seen in the eastern arctic on corresponding latitudes. These plants are either lacking, or they are found scattered in specially favoured places. Only in the more continental parts of Advent Bay in Spitsbergen I have seen heaths that could be compared with the East Greenland heaths, though they are much smaller.

In places the dryness is so oppressive that many plants cannot stand it. In Kjerulffjorden I have seen *Betula nana* and *Salix arctica* dying in the middle of August, and the cause was evidently that the soil was too dry. It could not supply the water that was necessary to meet the demands of the large evaporation, caused by the dry winds.

Lichens suffer more from this desert climate than the vascular plants. Some of them cannot live there. Others change their habits. In our mountains *Lecidea rubiformis* is found in well drained places "in fissuris rupium" (Th. Fries Lich. Scand. p. 417). In North East Greenland it grows on the flat soil where it develops large cushions.

In the fjords of Spitsbergen and Novaya Zemlya I generally found a rather poor lichen vegetation along the open coast where fog is more common than sunshine, apart from the bird-cliffs. A much better vegetation is found in the middle part of the fjords. At their inland end it decreases again, if it attains the glaciated regions. We cannot expect a rich vegetation in an ice-box.

In Greenland I never saw a better lichen vegetation than at Kapp Humboldt, the seaward end of Ymerøya, exposed to the open sea. A good lichen vegetation was also found on the chalky sandstones behind the hard diabases of the coast. But that is evidently due to the favourable substratum. Towards the inner end of Frans Josefs Fjord the number of lichen species decreased considerably. But Scholander found a better vegetation in the inner part of the southern fjords, e. g. in Röhssfjorden. I conclude that the relatively rich lichen vegetation of the coast region in North East Greenland is due to the climate, which is more continental than it is on the coasts of Spitsbergen and Novaya Zemlya.

On the whole the lichen flora of North East Greenland is much poorer than it is in Novaya Zemlya on corresponding latitudes. It is also poorer than in Spitsbergen, and yet Spitsbergen lies considerably farther north. Spitsbergen is also more isolated from Europe than Greenland is from the richer centres of plant migration. I would like to suggest that in my opinion Spitsbergen has received a part of its lichens, especially some northern species, from North Greenland.

The reason for the poor lichen flora of East Greenland can in part be general, in part local.

Time is perhaps the most important general factor. But it seems to me that the vascular plant flora suggests an old flora in North East Greenland, very contrary to my results from Novaya Zemlya. The lichen flora south and north of our region is not so well explored that we can make comparisons. But if the flora of vascular plants is relatively old, there is every reason to suppose the same for the lichens. If that be so, age would not explain the poverty of the lichen flora.

An important local factor is the configuration of the country, its immense glaciers, its glaciated interior, and the sea that separates East Greenland from other countries. It is well known that the number of circumpolar plants in general is considerable. A comparison between the enumeration in this paper, the published and unpublished results of the Spitsbergen collections, the lichen flora of Novaya Zemlya, the Russian Siberian investigations, the arctic lichens of the Vega expedition, the Ellesmereland collections of The Second Arctic Expedition in the "Fram", and the West Greenland lichens, provide full evidence that there are lots of circumpolar lichens. I have not exactly compared the percentage of circumpolar lichens with that of circumpolar

vascular plants. But my impression is that the former percentage is the greater one.

On account of their slow growth the lichens have very modest demands of life. And their diaspores<sup>1</sup> are generally smaller than the diaspores of the vascular plants.

It is evident that the dispersal would have been much easier in a country that were not glaciated. But most probably the unglaciated coast must be sufficient for the lichen migration. Considerable distances are barred by glaciers that advance to the coast, especially in South East Greenland and in North West Greenland. But these barriers cannot be insurmountable. They are much shorter than the distance from Spitsbergen to any other country.

There is also a factor, called "chance", including all unknown factors. We do not know the reason, why one species migrates quicker than other species, related or not. We do not know, why some species do not migrate at all. We do not know why some species are so rare, or quite lacking, in North East Greenland, e. g. the *Parmeliae* of the *saxatilis* section, or *Parmelia centrifuga*, which is so common in West Greenland, or *Sphaerophorus globosus*, otherwise an ubiquitous arctic species.

Unknown limiting factors are found everywhere. Why should they be more numerous or more active in North East Greenland than in Spitsbergen or in Novaya Zemlya?

It seems to me that the poverty of the North East Greenland lichen flora must chiefly be due to local factors:

I. The want of nourishment, on account of the absence of sea birds. It is interesting to see how profoundly the conditions of the sea influence the terrestrial vegetation.

II. The continental climate, which is very dry during the time of vegetation.

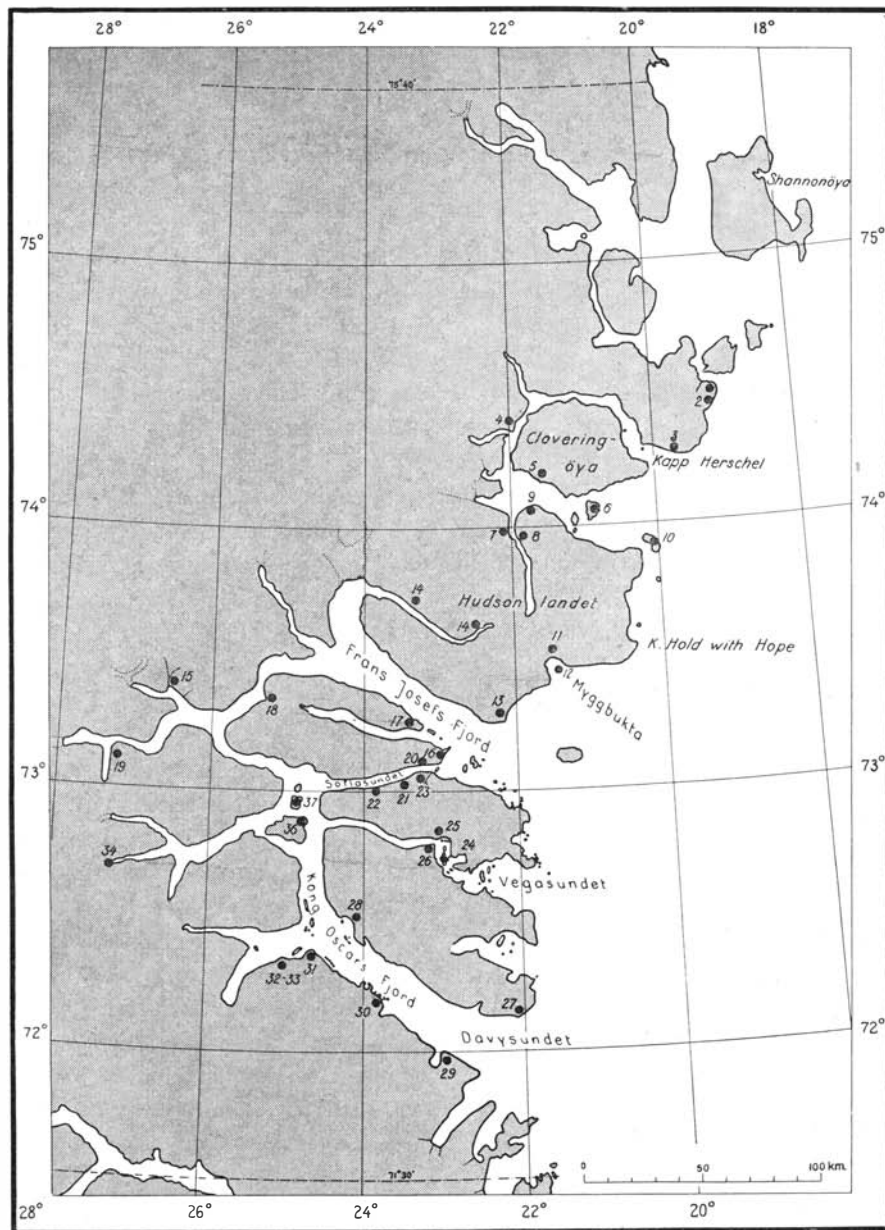
The Norwegian expeditions collected plants in the following places, which will be found on the map in the present paper. The numbers refer to corresponding numbers on the map.

It was difficult to find a satisfactory subdivision of this area into natural parts. A subdivision on geological lines would perhaps be the best. But that would imply a more intimate knowledge of the geology than we have, and could also be misleading, for a boulder, containing more or less chalk, can be found everywhere, and such things must be taken into consideration.

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<sup>1</sup> Diaspore: "Eine Diaspore besteht aus dem Keim oder den Keimen und dem begleitenden Organkomplex, welche eine Pflanze im Dienste der Propagation abtrennt", Rutger Sernander: Zur Morphol. und Biol. d. Diasporen, p. 6. Nova Acta Reg. Soc. Scient. Upsal., vol. extra ordinem. Upsala 1927.

	1929	1930
<b>I. Wollaston Forland and Claveringøya:</b>		
(1). Wollaston Forland: Kapp Wynn .....	-	20.7
(2). —»— : Landingsdalen .....	28.7	21.7
(3). —»— : Kapp Herschel .....	29.7	17—19.7, 21.7
(4). Claveringfjorden: Revet .....	-	22—23.7
(5). —»— : Soppbukta .....	-	27—28.7
(6). Finschøya .....	-	28.7
<b>II. Coast of Hudsonlandet:</b>		
(7). Loch Fyne: Røyevatnet .....	-	25.7
(8). —»— : East side of the fjord .....	-	26.7
(9). —»— : Kapp Stosch .....	-	24.7
(10). Jacksonøya .....	(night) 31.7—1.8	-
(11). Foster Bay: Myggbukta .....	2.8, 16.8, 21.8	30.7—2.8, 20.8
(12). —»— : Terneøya .....	-	1.8
(13). —»— : Kapp Bennett .....	20.8	-
<b>III: Frans Josefs Fjorden:</b>		
(14). North side: Moskusoksefjorden, several places	18—19.8	4—6.8
(15). —»— : Reinbukta .....	14.8	-
(16). South side: Kapp Humboldt .....	3—6.8, 16.8	3.8, 19.8
(17). —»— : Dusénfjorden .....	16—17.8	-
(18). —»— : Blomsterbukta .....	14—15.8	-
(19). —»— : Kierulfjorden .....	13.8	-
<b>IV. Sofiasundet:</b>		
(20). North side: Celsiusberget .....	6.8	-
(21). South side: Rudbeckfjellet .....	-	18.8
(22). —»— : Sanddalen .....	-	19.8
(23). —»— : Five km west of Robertsonøya	-	19.8
<b>V. Vegasundet:</b>		
(24). Scott Keltie-øyane: Gåsøya .....	9.8	-
(25). Geogr. Society-øya: Husbukta, several places	8—10.8	15—17.8
(26). Traill-øya: Veganeset .....	7.8	-
<b>VI. Davysundet, Kong Oscars Fjorden:</b>		
(27). North side: Kapp Simpson .....	12.8	-
(28). —»— : Holmvika .....	11.8	-
(29). South side: Antarktichamna .....	-	11.8
(30). —»— : Mainland near Archerøya .....	-	10.8
(31). —»— : Kapp Petersens .....	-	9.8
(32). —»— : 15 km west of Kapp Petersens ..	-	12.8
(33). —»— : Segelsällskapet's Fjord: Mt. Carmela .....	-	10.8
(34). —»— : Röhssfjorden, two places .....	-	14.8
(35). —»— : Dicksonfjorden .....	-	13.8
(36). Ellaøya: Kapp Elisabeth .....	-	8.8
(37). Mariaøya: Nattvika .....	-	12.8



We could also have attempted a subdivision from the coast to the bottom of the fjords, but the difficulties were so great that we gave it up.

Finally we contented ourselves with a subdivision simply on geographical lines, after the fjords and sounds.

The correct spelling of the geographical names is a great difficulty. British, Danish, German, Norwegian and Swedish travellers have given these names. We have tried to find the names with reliable priority, but we have spelt them after the Norwegian orthography, in order to obtain uniformity.

The correct spelling of the Esquimaux names in other parts of Greenland is a still greater difficulty. We had invaluable help in the map of Greenland, and its geographical index, in the Danish publication of the same name, vol. III, Copenhagen 1929.

Either of the authors of the present paper has determined his own collection. After that we collaborated our results, in order to make the results uniform. The manuscript has been prepared by B. Lyngé.

We wish to express our profound gratitude to many institutions and persons, who have given us valuable help and information. Firstly to "Norges Svalbard og Ishavsundersøkelser" that organized the expedition, to its leader Adolf Hoel, who was in command of the 1930 expedition, to Dr. Anders Orvin, who was in command of the 1929 expedition, and to every member of the expeditions, who facilitated our field work to the utmost of their powers.

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*B. Lyngé.*



## Special Part.

### CALICIACEAE.

#### *Mycocalicium* Vain.

##### *Mycocalicium subtile* (Ach.) Vain.

*Mycocalicium subtile* Vainio Lich. Fenn. III, 1927, p. 81, ubi syn.  
*Calicium subtile* Pers. Zahlbruckner Cat. Lich. I, p. 625, ubi syn.

#### II. Myggbukta.

Very scarce, growing on the thallus of *Peltigera variolosa*.

A very thin black, epruinose stalk carrying a black capitulum. The stalk is brittle and we only secured a few good capitula. The spores vary considerably, oblong or fusiform, with broad rounded ends, or constricted in the middle, they are never globose, size 8—9.5 × 4 μ. They are generally simple, agreeing with the statements of Vainio l. c. and of Harmand Lich. France p. 172. Only in very few of the constricted spores a very indistinct septum was detected.

Vainio writes (on his genus *Mycocalicium*) "ad fungos pertinet" (l. c. p. 79). We think that he is right, at least we can detect no thallus, so we have adopted his name.

The find is interesting. As far as we can see it is the first "*Calicium*" ever found in the arctic islands.

We did not find *Coniocybe furfuracea*, but there are several plants from West Greenland in herb. Copenh. (Deichm. Branth et Grøn. p. 508).

### SPHAEROPHORACEAE.

#### *Sphaerophorus* Pers.

##### *Sphaerophorus globosus* (Huds.) Vain.

#### VI. Antartichamna.

Generally one of the commonest lichens in the Arctic. It was therefore very surprising to find it so extremely rare in this region. It was found in the lowland, almost immersed in the ground, underneath *Andromeda tetragona*.

The plants were tested with J and gave the positive medullary reaction.

In the Arctic this species is very variable. The elongated "typical" plants are not too common. More compact, pulvinate plants are much more frequent, *f. congesta* Lamy, often imbedded in the mosses, with the branches attaining the even surface of the compact mosses, and not higher. Such plants resemble the compact formae of *Sphaerophorus fragilis* so much that we have found it impossible to distinguish between them with certainty after their habitus. Fortunately the reaction of the medulla is a good criterion.

*Sphaerophorus fragilis* has been recorded from Novaya Zemlya as well as from Spitsbergen. But although we have seen hundreds of plants from these regions, we have so far not been able to identify a single *Sphaerophorus fragilis* amongst them. — We have not seen Th. Fries's Spitsbergen plants, leg. Malmgren and Chydenius.

The director of the Botanical museum, Copenhagen, has kindly allowed us to study the large Arctic material of *Sphaerophorus fragilis* in this important herbarium. We tested all the plants with J, and found that 6 Greenland plants gave a positive reaction. But by far the greater part of the material (13 plants) was well determined. The localities were from West Greenland as well as from East Greenland. — The northernmost locality in East Greenland, Kvalrossøya (Walrus Island in Clavering Strait) was found by Dusén, det. Malme (herb. Stockholm).

In the Arctic *Sphaerophorus fragilis* is perhaps a western species. But even in Greenland *Sphaerophorus globosus* is much more common than the former species.

The Copenhagen herbarium contained a considerable material of either species from Iceland. — The Faeroe material was also large, there were only a few plants of *Sphaerophorus fragilis*, but many *S. globosus*.

*Sphaerophorus globosus* is rather common in Scoresby Sund (Deichmann Branth, 1894, p. 101). Galløe records it from Renskæret near Danmarks Havn (G. p. 191).

*Sphaerophorus fragilis* is said to be very common ("M. alm.") in Scoresby Sund (Deichmann Branth, 1894, p. 101). Malme records it from Hvalrossøya (M. p. 4).

*ENDOCARPACEAE.**Dermatocarpon* (Eschw.) Th. Fr.*Dermatocarpon miniatum* (L.) Mann.var. *complicatum* (Lightf.) Th. Fr.

II. Loch Fyne. Myggbukta.

III. Moskusoksefjorden. Kapp Humboldt. Blomsterbukta.

IV. Celsiusberget. 5 km. west of Robertsonøya.

V. Veganeset.

VI. Röhssfjorden. Mariaøya.

The number of localities is quite considerable. But it was always scarce, and we were glad, when we found it.

It ascends to 900 metres above sea-level in Moskusoksefjorden. But these plants are so microphylline that they much resemble a compact *Gyrophora erosa*.

This variety has been recorded from Scoresby Sund: Røde Ø (Red Island), collected by Hartz (Deichm. Branth 1894 p. 101). Hartz also collected it in Hekla Havn. In Copenhagen there are some plants from West Greenland, but not many.

*Dermatocarpon sphaerosporum* Lynge n. sp.

Pl. I, fig. 3.

Thallus foliaceus, rigidus, sed non coriaceus, *in margine valde sinuoso-incisus*, eam ob causam polyphyllus videtur. Lobi marginales plus minusve profunde sinuoso-incisi, varie undulato-crispati et imbricati. Thallus, superne epruinosis, laevigatus vel fere laevigatus, versus marginem fusco-nigrescens, praeterea pallidius coloratus, madefactus distincte in virescentem vergens, subtus lacunoso-rugulosus, fuscescens, *rhizinis omnino destitutus*.

Cortex superior 20—25  $\mu$  altus, superne fuscescens, praeterea incolor, hyphis plectenchymaticis, leptodermaticis contextus. Stratum gonidiale regulare, 60—65  $\mu$  altum, gonidia saepe in seriebus verticalibus dispositae. Hyphae medullares crebre contextae, in parte superiori subplectenchymaticae. Cortex inferior crassus, 40—50  $\mu$  altus, in parte exteriori fuscescens, praeterea incolor, cortex firmus, hyphis plectenchymaticis, pachydermaticis contextus.

Perithecia numerosissima, diam. 200—250  $\mu$ , ostiolum supra thallum elevatum. Excipulum circum ostiolum infuscatum, praeterea incolor. Asci numerosissimi, saccati. *Sporae* octonae, incolores, simplices, *globosae*, diam. 8—10  $\mu$ , vel interdum *subglobosae*,  $11 \times 8-9 \mu$ .

Pycnides non inventae.

Thallus extus et intus KOH immutatus. Nucleus J rubescens.

### III. Moskusoksefjorden, 300 metres above sea-level.

Its entirely naked under side refers it to the section *Entostelia* Stiz. Its habitus is not unlike a *Dermatocarpon aquaticum* with very incised and crisp margins. But it is well distinguished from that species by its globose spores. — “*Endocarpon intestiniforme* Kbr.” = *Dermatocarpon polyphyllum* Dalla Torre et Sarntheim has spores “ex ovoideo globosae, monoblastae, diam. vix longiores”, according to Koerber’s diagnosis in *Parerga Lich.* (1865) p. 42. We have studied Koerber’s *Lich. sel. Germ. No. 397*. Habitually it is very like a *Dermatocarpon miniatum* var. *complicatum*, pruinose bullate lobes with rounded, only slightly crenulate, not incise lobes, perithecia large and prominent, spores globose, diam. 7—8  $\mu$ , or subglobose,  $8-10 \times 7 \mu$ . The spore size agrees with the Greenland plants, but the habitus is too different.

Hasse’s *Dermatocarpon intestiniforme* (Kbr.), in *Lich. South. Calif.* (1913) p. 9, must be another species, for its spores are of the common narrow type of this section:  $12-16 \times 6-9 \mu$ .

### *Dermatocarpon cinereum* (Pers.) Th. Fr.

I. Kapp Wynn.

II. Myggbukta. Kapp Bennett.

III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden.

V. Veganeset.

*Dermatocarpon cinereum* is widely distributed in our region. It is fairly common and in places plentiful. — Unfortunately we can give no information as to its vertical distribution.

Its cracked (rimoso-areolatus) thallus is very characteristic of this species, especially its longitudinal deep fissures, often branched like a fan.

It has been recorded from Turner Sund (Vainio p. 140), and from Scoresby Sund, where it is fairly common. (Deichm. Branth, 1894 p. 101). Curiously enough this species, which is so common in Spitsbergen and in Novaya Zemlya, is entirely lacking in the Copenhagen herb. from West Greenland. Lynge has, however, identified it in Th. Fries’s collection of 1871 from West Greenland. If it had been equally common in West Greenland, it could not have escaped the attention of so many careful botanists. — It was not found in Simmon’s collection from Ellesmereland.

Th. Fries's isolated find is very interesting. But it cannot prevent us from regarding *Dermatocarpon cinereum* to be an eastern Arctic species, common in East Greenland, Spitsbergen and Novaya Zemlya.

*Dermatocarpon daedaleum* (Krempelh.) Th. Fr.

*Dermatocarpon daedaleum*. Th. Fr. Lich. Arct. (1860) p. 255, Deichmann Branth et Grønlund Grønlands Lich. Flora (1888) p. 509, Vainio Lich. Fenn. I (1921), p. 22, ubi syn.

<sup>3</sup>Pl. I, fig. 5.

- I. Landingsdalen.
- II. Myggbukta.
- III. Celsiusberget.

Only a few plants were obtained. It is certainly a rare species which occurs scattered. We have no data as to its vertical distribution.

The first mentioned plant is quite typical. It has rounded, broad (0.7—1.5 mm) lobes, and the thallus is thick (0.2—0.3 mm). Its thallus is not so closely fixed to the substratum as in *Dermatocarpon cinereum*, the margins are almost free near the circumference of the thallus. The other plants were first referred to *Dermatocarpon cinereum*, for they are smaller plants with a thinner thallus (0.1—0.2 mm). But, though small, the lobes are rounded and somewhat convex, and they entirely lack the cracks that are so characteristic of *Dermatocarpon cinereum*.

Having formerly known *Dermatocarpon daedaleum* from literature only, we revised our Arctic material of *Dermatocarpon cinereum*. We found that the Novaya Zemlya plants were correctly determined. Unfortunately this is not the case with the Bear Island plants, collected by Th. Fries in 1868 and determined by Lynge in 1926 (Lynge Lich. Bear Island p. 14). The plant from Mt. Misery must be *Dermatocarpon daedaleum*. The other plants are less typical, but we would now at least have referred the plant from Sørhamna to *Dermatocarpon daedaleum*.

In undetermined collections Lynge has identified it from Spitsbergen: Smeerenberg and Advent Bay, leg. Th. Fries 1868. It is lacking in his own collections from Bell Sund. In Spitsbergen the lichen flora is much richer farther north than it is in Bell Sund.

*Dermatocarpon daedaleum* has been recorded from "Kaiser Franz Joseph Gletscher" by Koerber. (K., p. 82).

Of course it is impossible to say that *Dermatocarpon daedaleum* should be lacking farther east. But the available facts suggest it to be a rare species of rather western distribution in the Arctic.

In the Copenhagen herb. there are also two well identified plants, mentioned by Deichm. Branth et Grønlund p. 509. We might also add a plant from Upernivik, leg. J. Vahl, from the same herb., where it was referred to *Dermatocarpon rufescens*.

*Dermatocarpon hepaticum* (Ach.) Th. Fr.

- I. Kapp Wynn.
- II. Myggbukta.
- III. Kapp Humboldt. Blomsterbukta. Kjerulf fjorden.
- V. Veganeset.
- VI. Dicksonfjorden.

The number of localities is not great, and the species may have been overlooked at some points. At Kapp Humboldt it was very plentiful. — We have no data as to its vertical distribution.

We met the same difficulty in this material as in the Novaya Zemlya collections: the distinction between *Dermatocarpon hepaticum* and *Dermatocarpon lachneum* (*Derm. rufescens*), the former species with adpressed squamules, the latter with ascending, imbricated squamules. In the Novaya Zemlya paper: Lyngé Lich. Nov. Zemlya, 1928, p. 37, Lyngé did not venture the distinction, and named the whole material "*Dermatocarpon*, cfr. *lachneum*". The more we have studied the question the more we have found that the Novaya Zemlya material should be referred to *Dermatocarpon hepaticum*.

Our Greenland material is very like the Novaya Zemlya plants, as was to be expected. Some plants have strictly adpressed squamules, but generally the incrassated margin is more or less free. The same is the case with Malme Lich. succ. No. 711 (*Derm. hepaticum*).

*Dermatocarpon rufescens* has been recorded from "Kaiser Franz Joseph Gletscher" by Koerber (p. 82). Deichm. Branth et Grønl. referred this plant to *Dermatocarpon hepaticum*. We would prefer to do the same with Hartz's plants from Scoresby Sund (Danmarks Ø and Hekla Havn) and from Kapp Hold with Hope, which Deichm. Branth named *Dermatocarpon rufescens* (1894, p. 101). And the same with Wulff's plants from Point Low, North Greenland, which Lyngé referred to *Dermatocarpon rufescens* (Lyngé Lich. North Coast of Greenland, 1923, p. 283). *Dermatocarpon hepaticum* is also found in the Copenh. collections from West Greenland, leg. Vahl.

*Endocarpon* Hedw.

*Endocarpon pulvinatum* Th. Fr.

*Endocarpon pulvinatum* Th. Fr. Lich. Arct. (1860) p. 257, Lich. Spitsb. (1867) p. 47. Vain. Lich. Lapp. II (1883) p. 166, Lich. Exped. Amdrup (1905) p. 140. *Dermatocarpon pulvinatum* (Th. Fr.) Kbr. Parerga (1865) p. 308. *Polyblastia pulvinata* (Th. Fr.) Jatta Sylloge (1900) p. 562.

Pl. I, fig. 4.

- II. Myggbukta, 145 metres above sea-level.
- VI. Röhssfjorden, at the head of the fjord.

It is a rare species, only a few plants were obtained.

It has formerly been recorded from Turner Sund by Vainio, l. c. Furthermore by Th. Fries from Spitsbergen: Stensøya and Low Island (Lich. Spitsb. l. c.). It is also found in Lynge's collections from Bell Sund (1926). There are no other records from the Arctic.

It was first described by Th. Fries from Mortensnes in Finnmark (Norway). We have other Norwegian plants from Storviksnes in Alten, Finnmark, leg. Norman, and Swedish plants from Lule Lappmark: Quickjock, leg. Hellbom, and from Härjedalen: Midtåkläppen, leg. S. Almquist. It has also been collected at Kuusamo in Finland (Vain, l. c.).

There are also a few records from the mountains of Central Europe: Bavaria: Schlosnitz (Kbr. l. c.), Italy: Varallo (Jatta l. c.).

We have not much to add to the knowledge of this very characteristic species. We found globose perithecia, 440—500  $\mu$  in diam., excipulum slightly brownish near the ostiolum, otherwise uncoloured, spores large: 52—70  $\times$  20—28  $\mu$ , hymenial gonidia broad, 5—10 (usually shorter)  $\times$  3.5—4  $\mu$ . The cortex is practically uniformly developed around the fruticulose lobes, 25—30, occasionally up to 45  $\mu$  thick, with plectenchymatous, rather thin-walled cells. The lobes are opaque, epruinose, brown, paler than in the Norwegian plants.

It has been confused with *Acarospora scabrida*, which is fairly common in Greenland.

## COLLEMACEAE.

### *Polychidium* (Mass.) A. Zahlbr.

#### *Polychidium muscicola* (Sm.) S. Gray.

III. Moskusoksefjorden, 375 metres above sea-level.

We were very glad to find this species, which is so rare in Arctic regions.

*Former records.* Scoresby Sund: Røde Ø (Red Island), leg. N. Hartz: det. Deichm. Branth, 1894, p. 103. So far it has not been recorded from West Greenland. Lynge has not identified it in Th. Fries's West Greenland collections from 1871.

In herb. Copenh. there are several finds from Iceland, in all 6 localities. — There is no Spitsbergen plant in the Scandinavian herbaria. I have not identified it in the large (unpublished) Spitsbergen collections of Th. Fries (1868), Lynge (1926) and Høeg (1928). The Oxford Spitsbergen expedition of 1923—1924 records it from Liefde Bay. If this plant is correctly determined, it is found in Spitsbergen, but it is extremely rare there. — There are a few typical plants in Lynge's Novaya Zemlya collection of 1921 (Lynge Lich. Nov. Zeml. 1928, p. 46). Not mentioned in Nylander's Enum. Lich. Freti Behringii.

It is not so inconspicuous that it should have escaped the attention of many trained lichenologists in the Arctic, if it had not been so very rare. Our present knowledge shows that it is a very rare species in the Arctic, distributed from Eastern Greenland and eastwards, at least to Novaya Zemlya.

*Arctomia* Th. Fr.

*Arctomia delicatula* Th. Fr.

I. Landingsdalen.

Very rare and scarce, only found once. But it is so inconspicuous that we cannot conclude much from this single find.

The spores are 7—9 septate,  $45-62 \times 6.2-6.5 \mu$ .

*Arctomia delicatula* is an interesting addition to the lichen flora of Greenland.

*Leptogium* S. Gray.

*Leptogium pulvinatum* (Hoffm.) Cromb.

I. Landingsdalen. Kapp Herschel.

II. Myggbukta.

III. Kapp Humboldt. Blomsterbukta.

V. Gåsøya.

VI. Röhssfjorden. Dicksonfjorden.

This species, which is so common and plentiful in Novaya Zemlya, is rare and sparse in N. E. Greenland. — We have no data on its vertical distribution.

It has formerly been found in South and West Greenland.

*Leptogium lacerum* f. *majus* has been recorded from Kapp Dalton (Vainio p. 135), and

*Leptogium saturninum* from Scoresby Sund: Gåsefjord (Deichm. Branth, 1894 p. 103).

*Leciophysma* Th. Fr.

*Leciophysma finmarkicum* Th. Fr.

II. Myggbukta (? , sterilis).

V. Husbukta.

VI. Holmvika.

There are but a few specimens in our collections. It is easily recognized, though not conspicuous. If it had been common, we could not have overlooked it, and we conclude from our scanty material that it is really rare in this region.

*Leciophysma finmarkicum* is an addition to the lichen flora of Greenland. — It was, however, collected by Th. Fries in West Greenland in 1871 (unpublished).



*Collema* (Wigg.) A. Zahlbr.*Collema arcticum* Lynge.

*Collema arcticum* Lynge Lich. Bear Island, 1926, p. 45, Lich. Nov. Zemlya, 1928, p. 49 et pl. III, fig. 19—20 et pl. XI, fig. 2.

- I. Kapp Wynn. Clavingfjorden: Revet.
- II. Myggbukta.
- III. Kapp Humboldt. Dusénfjorden.
- VI. Holmvika.

Evidently distributed throughout the whole region, but it occurs scattered and sparsely. There are but a few plants in our collections, The plants are not at all so well developed as they are in Spitsbergen and in Novaya Zemlya, where the species is much more common.

*Collema verrucaeforme* from Hold with Hope, leg. N. Hartz, det. Deichm. Branth., 1894, p. 103, is this species. In the Copenhagen herb. there is also a plant from Iceland: Reistárarskarð, leg. Daviðsson, s. n. *Collema verrucaeformis*.

*Collema pulposum* Ach.

- I. Kapp Wynn. Kapp Herschel.
- II. Loch Fyne. Kapp Stosch. Jacksonøya. Myggbukta.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden.
- IV. Celsiusberget.
- V. Veganeset.
- VI. Kapp Petersens. Röhssfjorden.

*Collema pulposum* is common, widespread and often plentiful. Our localities are concentrated along the coast. It is possible that we have overlooked it in the more continental parts of the region, but we suppose that the very arid climate there should be less favourable for it.

It prefers clayey soil, but it is also found between mosses, and though quite exceptionally also on rocks. — It ascends to 700 metres above sea-level (Kapp Petersens).

There is but one fertile plant in our collections, from Loch Fyne. Its spores are muriform, with one longitudinal septum and three transverse septa, size  $26-28 \times 12-15 \mu$ . Asci J blue, hymenial gelatina J ÷, thallus J not red.

In all the other sterile plants the determination must necessarily be less certain. We have ventured the determination on account of the thick, pulpose lobes. They are not corticated, and that character separates it from more thick-lobed formae of *Leptogium pulvinatum*. According to Harmand Lich. de France I p. 82 the thallus shall be J ÷. In the sterile plants that were tested we found a fairly distinct red J

reaction, especially near the surfaces. But the reaction is practically the same in Malme Lich. suec. No. 586, a well determined, fertile plant.

*Collema pulposum* is not well represented in the Greenland collections. There is a fine fertile plant from Tunnugdliarfik, Julianehaab district in South Greenland, leg. J. Vahl, in the Copenhagen herb.

*Collema polycarpum* (Schaer.) Krempelh.

- II. Loch Fyne.
- III. Moskusoksefjorden (etiam terricola). Kapp Humboldt. Dusénfjorden. Blomsterbukta.
- VI. Ellaøya (terricola).

It is fairly common on the calcareous sandstones, and in places plentiful.

Generally *Collema polycarpum* is strictly saxicolous. We were therefore much astonished to find plants on clayey soil, which we could not distinguish from *Collema polycarpum*. These plants are well fertile, as usual. The spores are fusiformi-ellipsoidal,  $22-25 \times 7-8 \mu$ , generally one-septated, only a few three-septated spores were found in each section.

In Moskusoksefjorden it ascends to 900 metres above sea-level, but these plants are small and not well developed.

*Collema polycarpum* is evidently an addition to the lichen flora of Greenland.

We did not find *Collema rupestre*, which has been collected in Scoresby Sund by N. Hartz (Deichm. Branth 1894 p. 103). It is evidently quite common in West Greenland. There are several West Greenland plants in herb. Copenh.; some of them very like a *Nostoc*. A "*Collema nigrescens*" in the same herb. from "Okivisekan", leg. J. Vahl, cannot be that species, we would refer it to *Collema rupestre*.

## PELTIGERACEAE.

### *Solorina* Ach.<sup>1</sup>

#### *Solorina bispora* Nyl.

- I. Kapp Wynn. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet.
- II. Loch Fyne. Kapp Stosch. Jacksonøya. Myggbukta. Kapp Bennett.
- III. Kapp Humboldt. Dusénfjorden. Moskusoksefjorden. Blomsterbukta.
- IV. West of Robertsonøya. Sanddalen. Celsiusberget.
- V. Scott Keltie-øyane. Gåsøya. Veganeset. Husbukta.
- VI. Antarcticamna. Kapp Petersens. Near Archerøya. Holmvika. Dicksonfjorden. Mariaøya.

<sup>1</sup> Cfr. Lynge Peltigeraceae in the Copenh. Arct. Herb., 1928, p. 2-5.

These data are sufficient to show that *Solorina bispora* is a very common lichen all over the region, it is quite plentiful everywhere, as was to be expected.

It ascends as high as any other lichen: Dicksonfjorden 400 m, Kapp Petersens 1130 m, Clavingfjorden 1200 m, Moskusoksefjorden 1350 m.

In this material it was impossible to distinguish it with certainty from *S. saccata* and *S. octospora* after its habitus. It was therefore necessary to examine each plant microscopically. The last mentioned species has the best developed thallus and it is very similar to *S. saccata* in Norway. The genus *Solorina* was eagerly collected, in the hope of finding *S. saccata* in East Greenland. The microscopical examination of the 1929 material gave 36 *S. bispora*, 18 *S. octospora* and 3 *S. saccata*. The 1930 material gave considerably more of *S. saccata*, about the same as *S. octospora*. The conclusion is that *S. bispora* is by far the commonest, and the other two almost equally common.

As a result of very many spore measures from many plants we found the average size in *S. bispora* to be  $86 \times 38 \mu$ , ranging from  $65-115 \times 27-45 \mu$ . Other authors have often found somewhat smaller spores: Nylander Synopsis p. 331:  $65-88 \times 33-42$ , Arnold Lich. Ausfl. X, p. 103:  $100-110 \times 45-50$ , Hue Mon. Solor. p. 29:  $60-98 \times 34-40 \mu$ .

Harmand detected a *Solorina* with very large spores,  $114-124 \times 34-40 \mu$ , vide Hue l. c. p. 43, ubi syn.). The spores are very variable in *S. bispora*. In one apothecium (Myggbukta) we found them varying from  $80-115 \mu$ , and in the 1929-material we measured spores from 7 apothecia, which attained  $100 \mu$  or more. — We have not seen *S. macrospora*, but we are not convinced of its specific rank.

*Solorina bispora* has been recorded from Kong Oscar Fjord: Forsblad Fjord, and from Sabineøya (Vainio p. 134). Further from Sabineøya, Hold with Hope, Forsbladfjorden and Danmarkøya (Lyngé Pelt. Cop. Arct. Herb. p. 2).

### *Solorina saccata* (L.) Ach.

- I. Kapp Wynn.
- II. Loch Fyne. Myggbukta.
- III. Moskusoksefjorden. Blomsterbukta.
- IV. Sofiasundet, two localities.
- VI. Antartichamna. Röhssfjorden. Dicksonfjorden. Ellaøya.

It is widely distributed, but not common and always scarce.

*Solorina saccata* is a lowland plant, the highest plants were collected between 300 and 400 metres above sea-level, Sophiasundet and Dicksonfjorden.

Like several species of this genus it has a wide distribution in the Arctic, but it is always scarce and quite rare. — There was no correctly determined plant in the Copenhagen Greenland herbarium, but Th. Fries found it in 1871 near Disko in West Greenland. Is it perhaps a species of more eastern distribution?

The thallus is not so well developed as in Norwegian plants. Lynges plants from 1929 consist of a narrow annulus (1—2 mm), surrounding the apothecia. Scholander's (1930) plants are better. When Lynges collected it, he took it for *S. bispora*, without hesitation. But the spores prove *S. saccata*, they are 4 in each ascus, and their size is 35—50 × 19—24  $\mu$  (rarely attaining 50  $\mu$ ).

*Solorina saccata* has been recorded from Scoresby Sund (Deichm. Branth 1894 p. 88). But these plants have octosporous asci (*Solorina octospora*). Malme records it from Hurry Inlet in Scoresby Sund. The determination is, of course, very probable. But Malme writes that he has identified it after its habitus, and in this region the two species can hardly be distinguished habitually.

In 1928 Lynges found "*Solorina saccata*" with tetrasporous asci in the Copenh. Greenland herb. Since then he has identified it in Th. Fries's collection from West Greenland (1871) from Nordfjorden and Kuánerssuis.

### *Solorina octospora* Arn.

*Solorina octospora* Arnold. Zahlbruckner Cat. Lich. III p. 414, ubi syn. Lynges Peltig. in the Copenhagen Arctic Herb., 1928, p. 3, Lich. Nov. Zemlya, 1928, p. 58.

- I. Landingsdalen. Claveringfjorden: Revet.
- II. Loch Fyne. Myggbukta.
- III. Kapp Humboldt.
- IV. Sofiasundet, two localities.
- V. Husbukta. Veganeset.
- VI. Antartichamna. Kapp Petersens.

It has much the same distribution as *S. saccata*; it was perhaps more plentiful, where we found it.

*Solorina octospora* attains considerable elevations, the highest being Claveringfjorden (900 metres).

It is quite interesting to trace its distribution in the Arctic. It has been recorded from Ellesmereland, several places on the east coast of Greenland, and from Novaya Zemlya. — It is very rare in Spitsbergen, and we have not seen it in West Greenland collections. Nylander does not record it from the Behring Strait district, and Cummings not from Alaska. Our present knowledge of its Arctic distribution suggests it to be a species, chiefly distributed in the European Arctic sector.

*Solorina octospora* is the largest Arctic *Solorina*, we cannot distinguish these Arctic plants from *S. saccata* as seen in Norway, after their habitus. Arnold also writes "planta *S. saccatae* habitu". We have measured smaller spores than Arnold:  $29-42 \times 13-16 \mu$ , Arnold writes  $50-65 \times 15-20 \mu$ , Hue in Monogr. Gen. Solor. p. 20,  $32-48 \times 14-16$ , immixtis  $34-48 \times 14-16 \mu$ . — In Lyngé's Novaya Zemlya plants he measured  $29-35 \times 13-14 \mu$ . The spores are more bifusiform than in the other species, and less constricted at the septum.

*Solorina octospora* has been recorded from Turner Sund, Scoresby Sund, Danmarkøya and Fleming Inlet (Vain. p. 134, Lyngé p. 3).

### *Solorina spongiosa* (Sm.) Anzi.

- I. Landingsdalen. Kapp Herschel.
- II. Jacksonøya.
- V. Husbukta.

Plentiful and well developed in Wollaston Foreland, otherwise it is rare and sparse. We searched much for it, and we could hardly have overlooked this conspicuous species, if it had been more common.

It is a lowland species, found up to the height of 350 metres, in Loch Fyne.

In our opinion it is a good species, well characterized by its cephalodia. We are a little astonished to find that neither Nylander nor Zahlbruckner has recognized it as a proper species. (Cat. Lich. III p. 418).

*Solorina spongiosa* has been recorded from Scoresby Sund: Danmarkøya (Deichm. Branth 1894, p. 88, Lyngé p. 4).

### *Solorina crocea* (L.) Ach.

- I. Claveringfjorden: Daudmannsøyra and Revet.
- VI. Kapp Simpson. Antartichamna. Mainland near Archerøya. Röhss-fjorden.

In our region it is the rarest *Solorina*.

On the whole a lowland plant, but occasionally it ascends to considerable elevations, in Claveringøya to the height of 900 metres.

In West Greenland it is a very common lichen, there are lots of plants in the Copenhagen herbarium. There are also lots of plants from the east coast as far north as Kong Oscar-fjorden and Davy Sund. It has been collected in North Greenland as far north as Gunnar Andersson Valley ( $82^\circ 28'$ ), but it must be rare in Northern Greenland. On the west coast there is no locality north of  $73^\circ 22'$ , and on the east coast it is rare north of the Davy Sund district.

In East Greenland it is supposed to be common as far north as Scoresby Sund (Deichm. Branth 1894 p. 88, Vainio p. 134, Lyngé p. 3 and Malme p. 4), but north of Kong Oscar-fjorden and Davy Sund it must be rare. In addition to our localities, Galløe has recorded it from Danmarks Havn and Termometerfjellet (p. 186).

[*Nephroma* Ach.

We did not find a single *Nephroma*. But Galløe records *Nephroma papyraceum* from Termometerfjellet near Danmarks Havn.

It will be seen from Lyngé's paper on the Peltigeraceae in the Copenh. Arct. Herb. that the genus *Nephroma* is very poorly represented in East Greenland.]

*Peltigera* Willd.

We are much indebted to dr. Gyelnik of Budapest, for valuable help on this interesting genus that was so well represented in the flora of East Greenland.

In 1928 Lyngé revised the Arctic *Peltigeræ* of the Copenhagen herbarium as far as it could be done without reference to Gyelnik's papers, which were not then accessible to him. A new revision on Gyelnik's lines would certainly be of interest, but it was not in the plan of the present paper to do it. We have only revised the material of *Peltigera erumpens* and *Peltigera leptoderma*.

The literary references to the distribution of the *Peltigeræ* in East Greenland are strictly bibliographical.

*Peltigera variolosa* (Mass.) Gyelnik.

f. *complicata* (Th. Fr.) Lyngé.

*Peltigera variolosa* Gyelnik Einige Peltigeren-Daten aus Japan, Ungar. Bot. Blätter, 1926, p. 252, ubi syn. Anders Strauch und Laubflechten, 1928, p. 41, tab. III, fig. 5 (upper side). Migula Flora, tab. 38, fig. 3—4. *Peltigera aphthosa* var. *variolosa* Mass. Lich. Exsic. Ital. No. 89, Arnold Lich. Exs. No. 619 b (non vidimus Arnold No. 1467).

Vide etiam Zahlbruckner Cat. Lich. III, p. 451 (*P. aphthosa* f. *complicata* et f. *variolosa*) et p. 452 (f. *leucophlebia*).

- I. Kapp Wynn. Landingsdalen. Kapp Herschel.
- II. Loch Fyne, pluribi. Myggbukta. Kapp Bennett.
- III. Kapp Humboldt. Moskusoksefjorden.
- IV. West of Robertsonøya. Sanddalen.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Kapp Petersens. Holmvika. Röhssfjorden. Dicksonfjorden.

*Peltigera variolosa* is one of the commonest lichens of the region and evidently plentiful everywhere. We have perhaps overlooked it in the more continental parts of Franz Josef Fjord. Fertile plants are rare, as usual in the Arctic.

It is chiefly a lowland lichen, found up to 260 metres (Kapp Herschel), and 580 metres (Husbukta).

All our plants are of the *complicata*-type, with crisp, more or less erect or ascending margins, a common type of *Peltigera* in the Arctic. Gyelnik was kind enough to revise some plants of the *variolosa* material. He referred two plants (Landingsdalen and Veganesset) to f. *microphyllina* Gyelnik, one plant from Landingsdalen to f. *pruinosa* (Vain.) Gyelnik, and one plant from Myggbukta to f. *dilacerata* Gyelnik.

To judge from the descriptions by Gyelnik and Anders, the exsiccata, and plants, which Gyelnik has sent us, this species is distinguished from *P. aphthosa* sensu ang. by its distinct, elevated nerves of the under side. They are pale or in age darker. Between them is distinctly seen the deeper parts of the thallus. Gyelnik has compared this venation to that of *P. canina*. In *P. aphthosa* the nerves are not elevated, but confluent, and the whole lower side continuously brownish-black, resembling *P. malacea*.

There were but few plants in the collection where *P. aphthosa* sensu angustiore was possible. All of them were submitted to Gyelnik, who referred them to *P. variolosa*. In one plant (Röhssfjorden) the under side is densely tomentose, with confluent and very indistinct nerves. We would have named it *Peltigera aphthosa* (sensu ang.), but Gyelnik referred it to *Peltigera variolosa* f. *crispa*. After that *P. aphthosa* was not found in our collections. If it should be found in East Greenland in this region, it must be very rare, for our material is convincingly large. This was a little unexpected, for in Central Europe, *P. aphthosa* is more a mountain lichen than *P. variolosa*.

"*Peltigera aphthosa*" has been recorded from Kapp Dalton and Hurry Inlet (Vainio p. 133), Scoresby Sund pluribi (Lyngé p. 7), Kapp Bennett and Lille Pendulumøya (Malme p. 4), and from Danmark Havn (Galløe p. 186).

Our results suggest a difference in the geographical distribution of the two species, a great support of the view that they should be specifically distinct.

### *Peltigera venosa* (L.) Hoffm.

- I. Kapp Wynn. Landingsdalen.
- II. Myggbukta. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt.
- IV. Near Rudbeckfjellet.
- V. Scott Keltie-øyane: Gåsøya. Veganeset.
- VI. Mainland near Archerøya. Röhssfjorden.

Fairly common, but scarce. Collected up to 300 metres, e. g. in Moskusoksefjorden and in Sofiasundet. It is often sterile, but always easily recognized by the nerves of its under side.

*Peltigera venosa* has been recorded from Scoresby Sund (Deichm. Branth 1894 p. 88, Lyngé p. 12), but not farther north.

### *Peltigera Suomensis* Gyelnik.

*Peltigera Suomensis* Gyelnik Lich. Mitteil. No. 45, pl. II, Mag. Bot. Lapok 1930, p. 34.

Pl. I, fig. 1—2.

- I. Kapp Herschel.
- II. Loch Fyne. Kapp Bennett.
- III. Kapp Humboldt.
- IV. Sofiasundet, west of Robertsonøya.
- V. Husbukta.
- VI. Röhssfjorden.

*Peltigera Suomensis* is widely distributed in this region, and evidently not rare. It has a great predilection for human settlements, and it is best developed on the old Esquimaux sites. The same is the case in Norway (and Sweden). The *Peltigera spuria*, which Lyngé has mentioned from the fire-places of the Lapponian tents in Northern Norway, is in reality *P. Suomensis*. (Studies on the Lichen Flora of Norway, 1921, p. 126).

In East Greenland *P. Suomensis* is a lowland plant, not collected higher than 200 metres above sea-level (Husbukta).

*Peltigera Suomensis* is an addition to the lichen Flora of Greenland.

### *Peltigera rufescens* (Weiss) Humb.

- I. KappWynn. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet.
- II. Loch Fyne. Kapp Stosch. Myggbukta.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Blomsterbukta. Reinbukta. Kjerulffjorden.
- IV. Sanddalen.
- V. Scott Keltie-øyane: Gåsøya.
- VI. Antartichamna. Kapp Petersens. Röhssfjorden, pluribi. Dicksonfjorden. Ellaøya.

*Peltigera rufescens* is by far the most common *Peltigera* of the whole region, seen every day, plentiful all over. Fertile plants are not common, but nevertheless there are more fertile plants than usual in Arctic collections.

It ascends to very high altitudes: 650 metres (Kapp Herschel), 1200 metres (Claveringfjorden), 1350 metres, very fine plants (Moskusoksefjorden).



It is always very "complicated", with crisp, erect margins. Gyelnik was kind enough to revise several plants, he referred all of them to *f. incusa* Flot.

Typical plants are easily distinguished from *Peltigera canina*, but I have felt uncertain with respect to their specific difference. Gyelnik is of opinion that they are specifically distinct. He has also detected an anatomical difference: the cell-walls of the cortical hyphae that are perpendicular to the surface are 2—3  $\mu$  thick in *P. rufescens*, but only 1—2  $\mu$  in *P. canina*. (*Peltigera-Studien*, Botanikai Közlemények, 1927, p. 135).

It is a question of no great importance for this material, for there is no plant that can be referred to *P. canina*, *sensu angust.*

All authors agree that *Peltigera rufescens* is common in this region: Kapp Dalton and Kapp Stewart (Lyngé p. 9, leg. Hartz), Scoresby Sund the commonest *Peltigera* (Deichm. Branth 1894 p. 88, Lyngé p. 9, Sabineøya (Koerber p. 76), Hvalrossodden, Basiskær and Danmarks Havn (Galløe p. 186).

There are also several records of "*Peltigera canina*": Kapp Dalton, Turner Sund, Scoresby Sund, Murrayøya, Fleming Inlet, Kapp Borlase Warren, Sabineøya and Kapp Saint-Jacques (Deichm. Branth 1894, p. 88, 1907, p. 13, Vainio p. 134, Lyngé p. 8 and Malme p. 4).

### *Peltigera polydactyloides* Nyl.

#### var. *velebitica* Gyelnik.

*Peltigera polydactyloides* Nyl. Vide Zahlbruckner Cat. Lich. III, p. 482, ubi syn. — Var. *velebitica* Gyelnik Pelt. novae et criticae, Österr. Bot. Zeitschr., 1928, p. 226.

II. Myggbukta. Kapp Bennett.

Evidently rare, only two small, very brittle plants (det. Gyelnik).

It was unexpected to find this species in East Greenland. It was described from West Africa. Gyelnik writes that it "ist in Europa ziemlich verbreitet, aber selten. Viele Exemplare habe ich aus Schleswig-Holstein gesehen (leg. Erichsen), var. *velebitica* habe ich aus der Velebit — in Croatia — beschrieben, ich habe noch ein Exemplar aus Frankreich."

#### *f. canariensis* Gyeln.

VI. Antartichamna, very scarce.

*Peltigera polydactyloides* is an addition to the lichen flora of Greenland.

*Peltigera polydactyla* (Neck.) Hoffm.

V. Husbukta.

It was detected only once, as a very scarce plant. — Even if we include *Peltigera polydactyloides* under *Peltigera polydactyla* sensu latiore the species is rare and very sparse in the fjord districts of N. E. Greenland.

Malme records *Peltigera polydactyla* from Hurry Inlet in Scoresby Sund (p. 5).

*Peltigera malacea* (Ach.) Fr.

I. Landingsdalen. Kapp Herschel.

IV. Sanddalen.

V. Husbukta.

VI. Mainland near Archerøya. Kapp Petersens. Röhssfjorden. Dicksonfjorden.

*Peltigera malacea* was overlooked in 1929, but in 1930 Scholander found it in so many localities that it must be fairly common, at least in the southern parts of the region. In Röhssfjorden he collected fine, fertile plants.

It ascends to 360 metres (Husbukta), 400 metres (Dickson Fjord).

*Peltigera malacea* is "fairly common" in Scoresby Sund (Deichm. Branth 1894, p. 88).

*Peltigera erumpens* (Tayl.) Vain.

I. Landingsdalen. Kapp Herschel.

II. Myggbukta. Terneøya. Kapp Bennett.

III. Kapp Humboldt.

V. Veganeset. Husbukta.

VI. Röhssfjorden, pluribi.

Common and in places quite plentiful, as in many other Arctic regions. Collected up to the height of 350 metres (Kapp Herschell), but it is not so common in these elevations as many other lichens.

The usual variation is seen in this material, but on the whole the East Greenland plants are much larger and much better developed than the other Arctic plants in our herbarium. In East Greenland we frequently find the larger, plane, pale plants, the darker, more involuted plants are more common in Novaya Zemlya and Spitsbergen. At Röhssfjorden Scholander collected plants that covered 12—13 sq. cm, evidently composed of several confluent individual thalli.

It has much the same variation as *Peltigera rufescens*.

Deichm. Branth records a "*Peltigera canina* f. minor soreumatica, sorediis caesiis et tomentosa", from Danmarksoy and Gåsefjorden in Scoresby Sund (1894, p. 88), which we suppose to be this species.

Lyngé found the following Greenland plants in the Copenh. herb.: West Greenland: Upernivik at Tasiussaqa, leg. Wulff, and Holsteinsborg, leg. Hartz. East Greenland: Kap Stewart, leg. Hartz, and Danmarksø, leg. Hartz.

*Peltigera leptoderma* Nyl.

- I. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet and Soppbukta. Finschøya.
- II. Myggbukta.
- III. Moskusoksefjorden. Kapp Humboldt. Kjerulffjorden.
- V. Veganeset. Husbukta.
- VI. Kapp Petersens. Antartichamna. Röhssfjorden.

In 1929 a considerable material of "*Peltigera erumpens*" sensu lat. was collected, and *P. leptoderma* was identified in it. But the material was insufficient for suggestions as to their relative frequency. Much attention was therefore devoted to these plants in 1930. The result is that either of them is common and plentiful, *P. leptoderma* is evidently the commonest of them.

In East Greenland *P. erumpens* is a larger plant than *P. leptoderma*.

*Peltigera leptoderma* ascends to very considerable elevations: 375 metres above sea-level (Moskusoksefjorden), 650 metres (Kapp Herschel), 1200 metres (Claveringøya).

We have revised our Arctic material of *P. erumpens* s. l., and found the following plants to be *P. leptoderma*:

Arctic America: Herschel Island, leg. Lindström.

Iceland: leg. Galløe.

Spitsbergen: *P. erumpens* s. l. is very common, at least from Bell Sund and northwards. By far the greater part of the material belongs to *P. erumpens* s. ang., *P. leptoderma* is much less common.

Novaya Zemlya: Gribovii Fjord, north side. Matotchkin Shar: east of Cape Jouravlev, Belushii Bay and east side of the Shar at the Kara Sea entrance. Serebryanka Fjord. Mashigin Fjord: Mt. Dietrichson, Strømsnes Bay, Sol Bay. Northern Kristovii Island. — Lyngé's Novaya Zemlya duplicates have been distributed, but to judge from the material in our own herb. *P. leptoderma* must be the commoner species by far in Novaya Zemlya. Only 5 plants were left as *P. erumpens* s. ang., and some of them are almost glabrous.

In the Copenh. herb. Lyngé found two plants of *Peltigera leptoderma*: West Greenland: Upernivik at Tasiussaqa, leg. Wulff; East Greenland: Danmarksø, leg. Hartz.

*Peltigera leptoderma* is an addition to the lichen flora of Greenland.

*Peltigera lepidophora* (Nyl.) Bitter.

- I. Landingsdalen. Kapp Herschel.
- II. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt.
- VI. Ellaøya. Röhssfjorden.

Scattered over the whole area, but nowhere plentiful. It ascends to very considerable elevations: 650 metres (Kapp Herschel), 900 metres (Moskusoksefjorden).

*Peltigera lepidophora* has never been recorded from East Greenland, and we have seen no plants from West Greenland, and none from Ellesmereland. We have never identified it in Spitsbergen collections, but there are several finds from Novaya Zemlya. Plants of this kind are easily overlooked. But our available knowledge suggests it to be a species of eastern distribution in the arctic.

We did not find *Peltigera scabrosa*. It has been collected in Scoresby Sund: Røde ø and Gåseland, by Hartz (Deichm. Branth 1894, p. 88, Lyngé p. 11). In West Greenland it is quite common.

## CLADONIACEAE.

### *Cladonia* (Hill) Vain.

The genus *Cladonia* is very poorly represented in N. E. Greenland. There are but a few species that are common or even plentiful. By far the greater number of species are rare and they were especially very scarce, only detected in a few specimens.

The *Cladoniae* suffer more from the severe Arctic conditions of life than many other lichens. If they live in protected places, under a good cover of snow during the winter, or protected by the shrubs, they develop podetia as usual. But if they live in more exposed situations, the tops of the podetia are easily destroyed, and the whole habitus of the lichen is deformed. The podetia evidently have an apical growth. If the apex is destroyed new podetia may regenerate. This results in dense colonies of low podetia, not elevated above the surrounding protecting mosses. If the plant does not regenerate new podetia, we find short podetia with quite abnormal upper parts, often only a thin tap.

In the Arctic we find these "Kümmerformen" in practically all the "needle-lichens", *Cladoniae* with podetia of the *Cl. gracilis* type. They have often received systematical names, e. g. *Cladonia cyanipes* var. *Novajae-Semljae* Savicz.

In my opinion this is not justified, for they are clearly due to climatic causes, and not to individual variation. It happens that a man

loses his ears from frost, but we do not attribute a new systematical name to him for that reason.

These "Kümmerformen" are often difficult to recognize on account of the parallel deformation of different species. — We are much indebted to the German expert, Dr. H. Sandstede, for valuable help with their determination.

### *Cladonia mitis* Sandst.

III. Kapp Humboldt.

V. Scott Keltie-øyane: Gåsøya. Husbukta pluribi.

VI. Antarctichamna. Mainland near Archerøya.

The *Cladinae* are poorly represented in the Arctic, but it was unexpected that the subgenus should only be represented by one species in the fjord district of N. E. Greenland. In Novaya Zemlya there are 5 *Cladinae*. *Cladonia mitis* is the most common species of this subgenus in the Arctic.

In N. E. Greenland it was only found between the mosses or between the stones of the rock-falls quite near the sea.

Deichm. Branth writes that *Cladonia rangiferina* is fairly common in Scoresby Sund, chiefly var. *silvatica* (1894, p. 94). Vainio records *Cladonia sylvatica* modif. *spumosa* from Kapp Dalton (p. 135). The *Cladinae* are extremely poorly represented in N. E. Greenland. — In the Copenhagen herb. *Cladonia rangiferina* is found from a few West Greenland localities. There are also some *Cladonia alpestris* localities, also from West Greenland. The *Cladina* of Greenland is *Cladonia mitis*, here as in other Arctic regions.

### *Cladonia uncialis* (L.) Web.

III. Kapp Humboldt.

V. Scott Keltie-øyane: Gåsøya. Husbukta.

VI. Mainland near Archerøya. Röhssfjorden. Dicksonfjorden.

*Cladonia uncialis* is rare and scarce, found only in the lowlands between mosses, *Stereocaulons*, and the like.

Our localities suggest it to be a southern species in the fjord district.

Recorded from Scoresby Sund where it is more common than *Cladonia rangiferina* (Deichm. Branth 1894, p. 94). In the Copenhagen herb. there are many fine plants from West Greenland, but very few from East Greenland.

*Cladonia coccifera* (L.) Willd.var. *stematina* Ach.

- I. Landingsdalen. Claveringfjorden: Daudmannsøyra and Revet.
- II. Myggbukta. Terneøya.
- III. Kapp Humboldt.
- IV. Sofiasundet: Sanddalen.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antarcticamna. Mainland near Archerøya. Kapp Petersens. Röhssfjorden. Dicksonfjorden.

One of the few *Cladoniae* that are common and in places plentiful. In the locality Revet it was collected as high as 1200 metres. This is remarkable so far north, for all the other plants were found in the lowlands.

Fertile plants with red apothecia were never found, but small pale apothecia are fairly common, suggesting f. *ochrocarpia* Flk. We find that our entire material must be referred to var. *stematina*, var. *pleurota*, which is on the whole rare in the Arctic, was never seen.

This common species has repeatedly been recorded from N. E. Greenland. — Scoresby Sund: Hekla Havn (Deichm. Branth 1894, p. 94), Danmark Havn: Renskæret (Galløe p. 189); its var. *stematina* from Kapp Dalton, Turner Sund and Hurry Inlet, and its var. *pleurota* from Turner Sund, in the Scoresby Sund district (Vainio p. 135 and 136).

In the Copenhagen Greenland herb. there are many plants of either variety from West Greenland, and also a few from East Greenland. I was a little astonished to find var. *pleurota* so well represented there, otherwise it is much less common than var. *stematina* in Arctic collections.

*Cladonia squamosa* (Scop.) Hoffm.

- V. Scott Keltie-øyane: Gåsøya.

One of the rarest lichens in N. E. Greenland. It was only detected once, and it was very scarce.

The plants are well squamulose. In the lower parts the podetia are corticated, but the upper part is destroyed, which it so often is in Arctic podetia of this type, and granular or more or less sorediate. It is hardly possible to refer these plants to any of the southern formae.

A rare plant in Greenland, hitherto only detected in a few places in S. W. Greenland.

*Cladonia cenotea* (Ach.) Schaer.

Pl. II, fig. 2.

V. Scott Keltie-øyane: Gåsøya. Husbukta.

*Cladonia cenotea* is almost as rare as *Cladonia squamosa*, but it is not so scarce, at least we found several plants of it. — It was only found in the lowland, near the beach.

All the plants have destroyed and deformed podetia. We sent the plants to Sandstede, who confirmed our determinations.

A very rare species in Greenland, formerly only detected once, at Ameralik in the Godthåb district, S. W. Greenland, by J. Vahl. These plants are well identified.

*Cladonia cariosa* (Ach.) Spreng.

Pl. II, fig. 4—5.

- I. Kapp Herschel, pluribi. Claveringfjorden: Revet.
- II. Myggbukta.
- III. Moskusoksefjorden. Kapp Humboldt.
- IV. Sofiasundet: Sanddalen.
- VI. Antartichamna. Holmvika. Röhssfjorden.

*Cladonia cariosa* is scattered all over the region. It cannot be called common, but many species are less common. It is always scarce. — Generally a lowland plant, but well developed alpine plants were collected far north: Kapp Herschel 650 metres above sea-level, Revet up to 1200 metres.

The squamules of the primary thallus are larger and coarser than in the common Norwegian plants. They are ascending to erect, and often involute, the white under side is then more visible than the brownish upper side. — Podetia are extremely rare, only in one plant, from Kapp Humboldt, there are a few short, stoutish, squamulose podetia. This suggests var. *pruniformis* Norm.

Habitually the plants are much more like *Cladonia symphyrcarpia* than *Clad. cariosa*, but the chemical reaction decides for the latter species, the upper side of the squamules is KOH yellow, their apices are never KOH orange red.

We have Norwegian plants of the same forma, i. a. from Maci in Finnmark, Arctic Norway, in our herb.

Vainio records *Cladonia cariosa* f. *pruniformis* Norm. from Turner Sund (p. 136). Hartz collected a plant in Hekla Havn, Scoresby Sund, which I would refer to *Cladonia cariosa* (Herb. Copenh., s. n. *Cladonia pyxidata*).

Our present knowledge suggests it to be an eastern species in the flora of Greenland. But in this case we cannot conclude too much from its known distribution. Its podetia are so rare, and botanists, who are not well acquainted with Arctic lichens, might take it for a deformed *Cladonia pyxidata*, they would either overlook it or fail to collect it.

*Cladonia acuminata* (Ach.) Lynge comb. nov.

var. *foliata* (Arn.) Lynge comb. nov.

Pl. II, fig. 1.

- I. Kapp Wynn.
- III. Kapp Humboldt.
- V. Husbukta. Veganeset.
- VI. Mainland near Archerøya. Holmvika.

Evidently not of the rarest lichens in this part of East Greenland, though far from common and always scarce. All the plants were found in the lowlands, the highest locality (Husbukta) being only at the height of 200 metres.

It is an interesting find. Lynge did not detect it in Novaya Zemlya, and he has so far not identified it in Spitsbergen collections. He supposes it to be lacking there. But in the far East the Vega expedition found it at Port Clarence (Nyl. Lich. Freti Behringii, p. 255). The available facts suggest it to be a western species in the Scandinavian flora.

In the Greenland plants the podetia are ecorticate, but they are so densely covered with squamules that the squamules are almost contiguous. The squamules are more greyish than white, and considerably coarser than in Norwegian plants. Soredia are practically lacking, as usual in Arctic plants. The habitus is therefore not a little different from the common Norwegian plants with their long white sorediate podetia. The Greenland plants are more like *Suza Lich. Bohem. slov. No. 102*.

Their colour suggests *Cladonia alpicola* rather than *Cladonia acuminata*. But the former species has much more cariose podetia, larger and coarser basal squamules, and another reaction,  $\text{KOH} \div$ , in all our plants the reaction is  $\text{KOH}$  "e flavo rubescens".

The specific value of the chemical reaction with  $\text{KOH}$  has been contested by Savicz (*Clad. Kamtschatkas*, p. 359). He unites *Cladonia acuminata* and *Clad. decorticata* s. n. *Cladonia decorticata* (Flk.) Sav. — We have also found that the chemical reaction can change with the age of the plants. *Cladonia alpicola* is  $\text{KOH} \div$  in living plants, but not always in old plants (e. g. Norrl. et Nyl. No. 68, collected in 1874, is distinctly yellow with  $\text{KOH}$ ).

On the other side we cannot ignore the fact that *Cladonia decorticata* and *Clad. acuminata* have different geographical areas, which is, in my



opinion, of considerable importance. I do not think it possible to unite these two species.

But I am not convinced of the specific difference between "*Cladonia Norrlinii* Vain." and "*Cladonia acuminata* (Ach.) Arn." in Vain. Lich. Fenn. II, 1922, p. 86—87.

There is considerable confusion about the synonymy of the *Cladoniae* of this section. If the two species *Clad. Norrlinii* and *Clad. acuminata* (sensu Vain., l. c.) are regarded as specifically distinct, we must reserve the species name *acuminata* (Norrl.) for the former species, which Vainio names *Clad. Norrlinii*, for according to Vainio (Lich. Fenn. II, p. 86) it was used as a species name for this species as early as in 1875. (Herb. Lich. Fenn. No. 57 a) Acharii *Cenomyce pityrea* b. *acuminata*, Syn. Lich., 1814, p. 254 (identical with Vainio's *Clad. acuminata*) is not a species name. The oldest species name for it is *Cladonia foliata* Vain. Mon. Clad. II, 1894, p. 79.

If these two species are united into one species, which I do, *Cladonia acuminata* (Ach.) Lyngé should be the species name, and var. *Norrlinii* (Vain.) Lyngé and var. *foliata* (Arn.) Lyngé the variety names for the plants with the reaction "KOH flavescens", resp. "KOH e flavo rubescens".

*Cladonia acuminata* is an addition to the lichen flora of Greenland. — Galløe records a *Cladonia decorticata* from Renskæret near Danmark Havn (p. 189). Is it this *Cladonia acuminata* or *Cladonia alpicola*?

### *Cladonia elongata* (Jacq.) Hoffm.

II. Myggbukta. Kapp Bennett.

III. Kapp Humboldt.

V. Scott Keltie-øyane: Gåsøya. Husbukta.

VI. Antarcticamna. Mainland near Archerøya. Röhssfjorden. Dicksonfjorden.

We are wont to find this species common and plentiful in Arctic regions. In this part of N. E. Greenland it is neither common nor plentiful. Its known localities suggest a plant of chiefly southern distribution in the district. — In accordance with this it was only found in the lowland and in moderate elevations, in and near Husbukta up to 360 and 580 metres.

Some of the plants are so slender that we had to consider the possibility of *Cladonia gracilis* var. *chordalis*, in the Arctic a much more southern species than *Cladonia elongata*. But all the plants gave the typical yellow reaction with KOH. In dark plants this colour is not always quite distinct.

All the plants are low, the long coarse cornute plants, which we know so well from the Norwegian mountains, were quite lacking. In these Greenland plants the apices of the podetia are often destroyed, looking like thin dead taps. The podetia regenerate freely from their lower parts, resulting in low, densely caespitose plants. — Old podetia have a very uneven, often quite verrucose cortex.

In several plants we found that the medullary hyphae grew out through destroyed parts of the cortex, forming pseudosoredia. Sandstede called them "Markausbrüche" (in litt.).

This species has not been recorded in the literature from East Greenland, but according to the herbarium of Copenhagen Hartz collected it in Gr. austr.: "Malerssorniarfik" (Scoresby Sund?). In Copenhagen there are some West Greenland plants named *Cladonia elongata*. In reality *Cladonia elongata* is a common species, at least in West Greenland, for by far the greater part of the "*Cladonia gracilis*" material in the Copenhagen herb. belongs to that species.

Deichm. Branth (1894, p. 94) records *Cladonia gracilis* var. *hybrida* from Danmarks Ø.

### *Cladonia cornuta* (L.) Schaer.

Pl. II, fig. 3.

V. Husbukta.

IV. Mainland near Archerøya. Dicksonfjorden.

This species is rare and scarce, only found in a few lowland localities in the southern part of the region. — In Norway it is a forest lichen that also grows considerably above the tree line. But in the Arctic it is very rare. It has never been found in Novaya Zemlya, and never in Spitsbergen or in Bear Island. Deichmann Branth and Grønlund record it from Egedesminde in West Greenland, about 68° 20', south of Disko. These East Greenland localities are therefore an interesting extension of its known range.

As usual with Arctic plants the soredia are miserably developed, in some of them almost lacking. We had to compare such plants with *Cladonia elongata*. But Sandstede confirmed our determinations.

In N. E. Greenland *Cladonia cornuta* lives in protected places, between mosses and *Stereocaulons*, or in protection of the shrubs.

*Cladonia cornuta* is certainly rare in Greenland. We have found one record of it: Egedesminde in West Greenland (Deichm. Branth et Grønl., p. 486), the plant is evidently lacking in the Copenh. herb., so the determination cannot be checked.

*Cladonia lepidota* Nyl.var. *stricta* (Nyl.) DR.

Du Rietz Flechtensystematische Studien III, Bot. Not. 1924, p. 66—68, ubi syn. Lynge Lich. Nov. Zemlya, 1928, p. 159.

Pl. V, fig. 3—4.

- I. Landingsdalen. Claveringfjorden: Revet.
- III. Kapp Humboldt.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Mainland near Archerøya. Röhssfjorden.

It is widespread throughout the region, but not so common as in other Arctic regions, i. g. in Novaya Zemlya and in Spitsbergen. This is perhaps due to the extremely arid climate of the Greenland fjord district. The best plants are found along brooklets and in places that are occasionally moistened by cold water. In such places it was plentiful in N. E. Greenland, as elsewhere.

In N. E. Greenland it is a lowland plant, like so many other *Cladoniae*; we did not find it higher than 300 metres, at Kapp Humboldt.

The podetia are very squamose, we found the f. *hypophylla* in Landingsdalen and at Kapp Humboldt, but all other plants are f. *pterophora*.

In a plant from Husbukta we suspected *Cladonia degenerans*. It was submitted to Sandstede, who found it "unsicher; ganz Habitus der *Cladonia degenerans* var. *cladomorpha*". — Its cortex is, however, distinctly KOH yellow.

var. *gracilescens* (Flk.) DR.

- III. Moskusoksefjorden.
- V. Husbukta.

The scyphose var. *gracilescens* is very rare and very scarce in N. E. Greenland as in other Arctic regions.

*Cladonia degenerans* has been recorded from several localities in Greenland. Most probably a considerable part of this material should be referred to *Cladonia lepidota*.

*Cladonia lepidota* has not been recorded from East Greenland, but in the Copenhagen herb. Lynge found plants from Scoresby Sund, leg. Hartz (referred to *Cladonia furcata*), and from "Kapiorfikøen", leg. Sylow (referred to *Cladonia degenerans*).

*Cladonia cervicornis* (Ach.) Flot.

III. Kapp Humboldt.

VI. Mainland near Archerøya.

*Cladonia cervicornis* is one of the rarest lichens of the region. It is very scarce, and only found in the lowland.

The plants are KOH ÷.

There is no record of it from N. E. Greenland. — In the Copenhagen herb. Lyngé found the following Greenland plants: 1. Sukkertoppen (Fylla-Exp.), 2. Ameralik (Vahl, det. W. Nyl.), 3. Tasermiut (Vahl, det. Th. Fr., "drawn for the Flora Danica"), and from "Inger Kajarfik" in East Greenland (Eberlin). It must be a rare plant in Greenland.

*Cladonia fimbriata* (L.) Fr.

V. Husbukta.

VI. Röhssfjorden.

Quite as rare and scarce as many other *Cladoniae*, found only in the lowlands of the southern part of the region.

It is hardly possible to refer the plants to any of the described formae. The former plant may be a deformed f. *major*, in the latter the podetia are so deformed that we do not venture any suggestion.

There are several records of *Cladonia fimbriata* from East Greenland: Turner Sund, f. *minor* (Vain. p. 136), Scoresby Sund: Hekla Havn (Deichm. Branth 1894, p. 94), and Danmark Havn (Galløe p. 189).

*Cladonia pyxidata* (L.) Fr.

var. *chlorophaea* Flk.

II. Loch Fyne. Myggbukta.

III. Kapp Humboldt.

IV. Sofiasundet: West of Robertsonøya. Sanddalen.

V. Husbukta. Veganeset.

VI. Antartichamna. Mainland near Archerøya. Kapp Petersens. Röhssfjorden. Mariaøya.

The localities distinctly concentrate in the southern parts of the region, var. *chlorophaea* is fairly common there and not scarce. All the plants were found in the lowlands, there are only a few plants, that were collected higher than 100 metres.

var. *neglecta* (Flk.) Mass.

I. Claveringsfjorden: Revet.

II. Loch Fyne.

VI. Kapp Petersens. Mainland near Archerøya. Dicksonfjorden.

Certainly a rare plant, chiefly of southern distribution. This is not due to climatic causes, for at Revet it ascends to 1200 metres.

The plants are not always well developed. We are therefore much indebted to Heinr. Sandstede for valuable help with the determinations.

var. *pachyhallina* (Wallr.) Vain.

- I. Kapp Wynn. Kapp Herschel. Claveringfjorden: Revet. Kapp Stosch.
- II. Loch Fyne. Jacksonøya. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Blomsterbukta. Reinbukta. Kjerulf fjorden.
- IV. Sofiasundet: Celsiusberget. West of Robertsonøya. Sanddalen.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antarcichamna. Kapp Petersens. Holmvika. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.

Var. *pachyhallina* is without any comparison the commonest *Cladonia* in this part of N. E. Greenland. It was found plentifully in practically every locality. Most probably we have simply overlooked it in the few localities, where we did not collect it.

It is much more common in the lowlands than in the mountains, but it ascends as high as any other lichen: Kapp Herschel 650 metres, and in Moskusoksefjorden Scholander collected fine plants up to 1350 metres.

The *pachyhallina* was first described by Wallroth in Naturgesch. der Säulchenflechten, 1829, p. 127. Wallroth simply cites Acharii *Pocillum* as a synonym. *Pocillum* Ach. was described in Ach. Meth. Lich., 1803, p. 336 et pl. VIII, fig. 6.

Wallroth's diagnosis emphasises the "phyllis crassioribus, margine turgido nunc adscendentibus nunc depressis et in unum quasi effiguratum confluentibus" etc. Acharius describes a "thallo cartilagineo lobato, laciniis imbricatis inciso-crenatis, podetiis brevibus crassis subcylindricis caesio-virescentibus verrucosis pulverulentis, scyphis cylindraceutis clausis subcrenatis" etc. And in his "Obs." Acharius repeats "scyphi sparsi . . . . extus una cum diaphragmato . . . . pulverulenti".

It is evident from this description that Acharii type of the *Pocillum* has pulverulent (sorediate) short podetia on an imbricate crusta of cartilagineous primary squamules.

In Wallroth's arrangement, which is not too surveyable, we find no mention of eventual sorediate or pulverulent podetia. But he refers to Floerke Deutsche Lichenen No. 200 as a synonym. In our specimen of that plant (*Cenomyce neglecta* b. *Pocillum*) the podetia are covered with adpressed phyllocladia. Their cortex is in places rubbed off, but the podetia are not sorediate. Vainio has enumerated this plant under the head of *Cladonia pyxidata* \**Pocillum* (Ach.) Flot. in his Mon. Clad. II, p. 243.

In Mon. Clad. II, p. 245 Vainio writes: “\**δ. pachyhallina* (Wallr.) Vain. a *γ. pocillo* distingui potest ob scyphos plus minusve granuloso-sorediosos”. He bases this statement on Wallr. Crypt. Exsic. No. 402 in the Berlin herbarium. — This suggests that the type plant of Acharii var. *Pocillum* in Helsingfors is not sorediate, in contradiction to Acharii description.

In Lich. Fenn., 1922, p. 105 Vainio attributes specific rank to *Cladonia chlorophaea*. He describes the *pachyhallina* as a var. of *Cl. chlorophaea* and var. *Pocillum* as a var. of *Cl. pyxidata*. — Sandstede has been kind enough to send me a proof-sheet of his *Cladonia* monography in the new edition of Rabenhorst's Kryptogamen Flora. He follows Vainio. In his Busk- och Bladlavar, 1929, p. 61, Magnusson prefers to refer the *pachyhallina* to var. *Pocillum*.

Our very large Greenland material is very conformous with respect to the squamules of the thallus primarius. They are always very coarse, cartilagineous. The brownish nitidous cortex is often destroyed, exposing the white medulla. If the cortex is largely destroyed, as it often is, the whole plant looks white, almost as in the Arctic *Cladonia cariosa*. The margin of the squamules is incised or crenated, often rather irregularly. It is always more or less ascending and imbricate. The quite adpressed crustiform squamules, which are occasionally seen on calcareous rocks in Norway, are hardly represented in our collections. This may be due to the substratum, for all our plants were found on mosses, an uneven substratum, and never on rocks.

The podetia are always short, shorter than in var. *chlorophaea*, often dispersed on the squamules, and sometimes quite lacking. They vary from narrow, almost cylindrical (young podetia?) to the broad scyphi of the common *pyxidata* type.

In a few plants the cortex of the podetia is well developed and more or less covered with phyllocladia, usually adpressed, sometimes divergent, often granular. In some plants the cortex is simply lacking, resulting in pale podetia, more or less translucent when moistened (*costata* type). But if well developed the podetia are more or less granular or sorediate, at least as sorediate as we can expect in arctic plants.

Some doubtful plants were submitted to Sandstede, who referred all of them to var. *pachyhallina*, also some plants, where we could detect no soredia. We conclude from this that our entire Greenland material should be referred to var. *pachyhallina*. — But we are obliged to confess that we can find no specific distinction between the Arctic *pachyhallina* and *Cladonia pyxidata* var. *Pocillum* (Ach.) Flot.

*Cladonia pyxidata* is said to be very common in the heath in Scoresby Sund (Deichm. Branth 1894, p. 94); it has also been recorded from Basiskær, Termometerfjeld and Varde Ridge near Danmark Havn

(Galløe p. 189), and from Cap Saint-Jacques (Deichm. Branth 1907, p. 13). Its var. *neglecta* from Kapp Borlase Warren, and its var. *chlorophaea* from Fleming Inlet (Vain. p. 136).

In the Copenhagen herb. Lynge found var. *pachythallina* from Liverpoolkysten (Kruuse), it is quite common in Greenland; and var. *chlorophaea* from Hold with Hope (Hartz). To judge from the herb. material var. *chlorophaea* must be more common in Greenland than elsewhere in Arctic regions.

### *Cladonia cyanipes* (Somrft.) Vain.

V. Husbukta. Veganeset.

VI. Antartichamna. Mainland near Archerøya. Röhssfjorden. Dicksonfjorden.

*Cladonia cyanipes* is a rare and scattered species, found in the lowlands of the southern part of the region.

All the plants are stouter and coarser than *Cladonia cyanipes* in Norway. Some of the plants are quite magnificent, others are of the deformed type ("f. *Novajae-Semljae*" Savicz). It is only found between the mosses.

There is only one literary record of Greenland plants: "etiam in Groenlandia (Rink)" (Th. Fries Lich. Arct. p. 153). This plant is perhaps found in Upsala, there is no such plant in the Copenhagen herb. — But in the *Cladonia pyxidata* material Lynge detected one small plant from Egedesminde (Fylla Exped.). It is one of the rarest Greenland *Cladoniae*.

### *Notes on Greenland Cladoniae*

We did not find the following *Cladoniae*, which have been recorded from N. E. Greenland.

*Cladonia alpicornis*. Galløe records this species from Danmarks Havn (p. 189). We have not seen his plants, but so far we have never seen a correctly determined Arctic *Cladonia alpicornis*, but many incorrectly determined. It is common along the southern coasts of the Scandinavian Peninsula, but neither Magnusson nor Lynge has seen a plant, collected north of Hordaland in Norway or north of Upland in Sweden.

*Cladonia amaurocraea*. Deichm. Branth records it from Danmarks Ø in Scoresby Sund (1894, p. 95). Lynge has seen these plants in Copenhagen, and he can only see *Cladonia uncialis* in them.

*Cladonia decorticata*. Galløe records this species from Rensskæret near Danmarks Havn. We have not seen his plants.

*Cladonia degenerans*. Galløe records it from a locality near Danmarks Havn. The plants should be compared with *Cladonia lepidota*, we have not seen them.

*Cladonia digitata*. Deichm. Branth records it from Kobberpynten (Scoresby Sund?). (1894, p. 94). We have not seen his plants.

*Cladonia furcata* var. *racemosa*. Deichm. Branth records it from Scoresby Sund, leg. Hartz, it should be fairly common ("Temmelig almindelig"). But this plant is *Cladonia lepidota* var. *stricta*, which is certainly common in that fjord.

The Copenhagen Arctic herbarium contains many interesting *Cladoniae*. Lyngé has made some notes on them:

*Cladonia alcicornis*. There are 3 plants, referred to this species, viz:

1. Jakobshavn in Diskofjorden, leg. Hastrup. It is a mixtum of *Cladonia coccifera* and *Cladonia pyxidata*.

2. Ameralik in the Godthåb district. In my opinion undeterminable. It is perhaps *Cladonia pyxidata* var. *pachythallina*, but certainly not *Cladonia alcicornis*.

3. Tunugdliarfik in the Julianehåb district. Almost undeterminable, perhaps in part *Cladonia pyxidata*, anyhow not *Cladonia alcicornis*.

There is no reason to suppose that *Cladonia alcicornis* should be found in Greenland.

*Cladonia alpicola*. It has never been recorded from Greenland, but there is a plant from Godhavn, leg. L. Smith, which Lyngé would refer to this species.

*Cladonia amaurocraea*. There are many finds, in all 15, from Greenland. But by far the greater part of them are *Cladonia uncialis*. Lyngé has found good plants of *Cladonia amaurocraea* from the following places: "Greenland", leg. Holbøll, Wormskiold, Upernivik, leg. Wulff, Ameralik, leg. Vahl, and from "Karssissagdlik" (?) in East Greenland, leg. Hartz. — If this is correct, *Cladonia amaurocraea* is much less common than we would have supposed from the large herb. material.

*Cladonia bellidiflora*. There are so many plants from West Greenland as far north as Disko that it must be common there. From East Greenland we only know 2 localities: Serketnoua and Kekertatsiak, leg. Eberlin, most probably on the southern coast. It is rare enough in Spitsbergen and Novaya Zemlya, perhaps more common in Bear Island. Nylander has 3 localities in Enum. Lich. Freti Behringii. It is a circumpolar species, but rare in the European sector. Its frequency in S. W. Greenland may be due to favourable climatic causes, but we cannot find that probable. It is perhaps a western immigrant in Greenland, but this suggestion cannot be proved.

*Cladonia deformis*. It is equally frequent in West Greenland as far north as Disko, as the former species is. These plants are really fine, proving good conditions of life. But Lyngé has not detected a single East Greenland plant in the collections. In Spitsbergen and Novaya Zemlya it is a rare species, hitherto only detected in the northern



parts of either region. Nylander records it from Port Clarence in Behring Strait. It was also found in the Gjøa-collection (Roald Amundsen) from the Canadian arctic. Its distribution is very like that of *Cladonia bellidiflora*.

*Cladonia degenerans*. There are four sheets labelled *Cladonia degenerans*:

1. One sheet with three good plants of this species. There is no locality, not even Greenland.

2. One sheet with two plants. One of them from Tasermiut, det. W. Nylander: *Cladonia degenerans*. But this plant has perforated scyphi, Deichm. Branth has suggested *Cladonia cenotea*. But according to Sandstede it is *Cladonia furcata* f. *truncata*. — The other plant from “Grønland”, leg. Rink, has distinct scyphi with central proliferation, it is *Cladonia lepidota*.

3. One sheet with two plants. One of them, from Kekertatsiak (= Queqertarssuaq, Julianehåb), is practically undeterminable, only squamules, probably *Cladonia coccifera*, nothing suggests *Cladonia degenerans*. The other plant, from East Greenland: “Kapiorfik”, leg. Sylow, has hardly any podetia, but its habitus as well as its distinct yellow reaction with KOH decide for *Cladonia lepidota* var. *stricta*.

4. Several plants, one from Tasermiut, same plant as on sheet 2. Another plant from Godhavn, leg. Olrik. It is very like *Cladonia degenerans*. A third plant from Tasiussaq near Upernivik, leg. Wulff. I can find no central proliferation and no yellow reaction with KOH, it can be *Cladonia degenerans*.

*Cladonia degenerans* is a very rare species in Greenland. We cannot conclude anything from these few finds. But I should like to know whether it is could be found in Hayes Peninsula or in Ellesmere Land.

*Cladonia digitata*. There are three plants from the S. W. coast of Greenland, first labelled *Cladonia digitata*, later changed to *Cladonia deformis*. The podetia are rather long, as in *Cladonia deformis*, but the scyphi are narrow, with incurved margins, and the basal squamules large. I would regard *Cladonia digitata* to be the correct determination.

*Cladonia furcata*. Deichm. Branth writes “frequens sub variis formis”. (Grønland. Lich. Fl. 1887, p. 488). In the material I have identified *Cladonia elongata*, *uncialis* and *lepidota*, but I could not detect a single *Cladonia furcata*. This species must be very rare in Greenland (vide supra).

*Cladonia gracilis*. By far the greater part of the material is *Cladonia elongata*, now generally regarded a distinct species. — Plants from Ivigtut, leg. Schiødte, and from Godhavn, leg. Smith, are var. *chordalis*.

*Cladonia papillaria*. There is only one plant, from Kekertatsiak in South Greenland (Queqertarssuaq?, Egedesminde district). The colour

of the plant differs much from *Cladonia papillaria*, but the habitus is more like that species. The colour is very like that of *Cladonia elongata*. A comparison between these two species is unexpected, but in the arctic the plant sometimes develop quite short papillate podetia, if the apices are destroyed. I cannot contest the determination, but there is but one plant, and better plants are much desired.

### *Stereocaulon* Schreb.

The Arctic species of *Stereocaulon* are very difficult of determination, especially if they are sterile. The Arctic material is much in need of a careful revision. Now that we have Magnusson's excellent monograph Boreal Stereocaula (Göteborg. Kgl. Vetensk. och Vitterh.-Samh. Handl. Ser. IV, Vol. 30, No. 7, 1926) a revision is possible, but it is not in the plan of the present paper to do so.

We can only say that we look with distrust on Arctic records of *Stereocaulon coralloides* and *Stereocaulon tomentosum*. A *Stereocaulon coralloides* var. *conglomeratum* from Amaralik in herb. Copenhagen is *Stereocaulon denudatum*. In Arctic collections the name *Stereocaulon tomentosum* generally covers plants of the *Stereocaulon alpinum* section. — The same is the case with "*Stereocaulon paschale*". But the true *Stereocaulon paschale*, as limited by Magnusson, is found in Greenland. Plants from Godthaabfjorden, collected by Porsild in July 1927, are quite typically that species, the determination was verified by Magnusson. Eberlin collected a *Stereocaulon* at "Kara Akunguak" in East Greenland (it is difficult to find Eberlin's localities on the map), which I would also refer to *Stereocaulon paschale*. — Arctic plants of "*Stereocaulon evolutum*" should be compared with *Stereocaulon fastigiatum*, which Th. Fries united with *Stereocaulon evolutum*. — *Stereocaulon rivulorum*, so common in the Arctic, is often found under the head of *Stereocaulon alpinum*.

### *Stereocaulon alpinum* Laur.

- I. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet and Daudmannsøyra. Finschøya.
- II. Loch Fyne. Kapp Stosch. Myggbukta. Terneøya. Kapp Bennett.
- III. Kapp Humboldt. Dusénfjorden. Moskusoksefjorden. Reindalen.
- IV. Sophiasundet: Sanddalen, and west of Robertsonøya.
- V. Scott Keltieøyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Mainland near Archerøya. Kapp Petersens. Holmsvika. Röhssfjorden. Dicksonfjorden. Ellaøya.

*Stereocaulon alpinum* is one of the commonest and most plentiful lichens in the whole region. — It ascends to the highest altitudes, which Scholander climbed: Husbukta 580 metres, Kapp Herschel 650 metres and

Moskusoksefjorden to 1350 metres. It is, however, considerably more common in the lowlands than in alpine localities.

Apothecia are rare. — Fertile plants and plants of the elongated type, which are found between mosses and the like, are easily identified. But plants of the compact type, which are found in more exposed situations, are difficult of distinction from *Stereocaulon rivulorum*, sometimes it is quite impossible. A. H. Magnusson, the monographer of the genus, has been kind enough to revise several critical plants of this section. He referred the greater part of this material to *Stereocaulon alpinum*, which is, on the whole, the more common of the 2 species.

*Stereocaulon alpinum* has been recorded from Henry Land (840 metres) and Kapp Greg (Vainio p. 128) and from Pendulumøya and Sabineøya (Koerber p. 76).

### *Stereocaulon rivulorum* H. Magn.

Magnusson Boreal Stereocaula, 1926, p. 23 and 63. Lyng Lich. Nov. Zemlya 1928, p. 164, pl. VI, fig. 5—6.

- I. Kapp Wynn. Landingsdalen. Kapp Herschel. Clavingøya: Revet.
- II. Loch Fyne. Jacksonøya (?). Myggbukta. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Reindalen. Kjerulffjorden.
- IV. Celsiusberget. West of Robertsonøya. Sanddalen.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Kapp Simpson. Mainland near Archerøya. Kapp Petersens. Röhssfjorden. Dicksonfjorden. Mariaøya.

*Stereocaulon rivulorum* is distributed all over the region from the coast to the head of the fjords. It is almost as plentiful as *Stereocaulon alpinum*. It ascends to 1200 metres (Revet).

Its name was well chosen, it expresses its localities: depressions in the soil that are often irrigated by streaming cold water. In favourable places it expands into large colonies with low podetia, often crowned with large terminal plane apothecia. Its low podetia are very fragile.

The parasite, *Scutula Stereocaulorum* is more common on this species than on other *Stereocaulons*.

*Stereocaulon rivulorum* is an addition to the lichen flora of Greenland. But it has repeatedly been collected, and it is found in the herbaria under other names.

### *Stereocaulon fastigiatum* Anzi.

- III. Kapp Humboldt. Moskusoksefjorden.
- V. Scott Keltie-øyane: Gåsøya. Husbukta.
- VI. Mainland near Archerøya.

var. *dissolutum* H. Magn.

Magnusson Boreal *Stereocaula*, 1926, p. 36.

III. Kapp Humboldt.

VI. Antartichamna. Mainland near Archerøya. Röhssfjorden.

*Stereocaulon fastigiatum* is not so common in East Greenland as it is in Novaya Zemlya and in the Norwegian mountains. Our localities suggest it to be more common in the southern part of the region than in the northern, it is also possible that we have overlooked it northwards.

It ascends to 580 metres in Husbukta, and to 900 metres in Moskusoksefjorden. — Fertile plants are rare; they were obtained at Kapp Humboldt. Some of the plants are infested with the *Stereocaulon* parasite *Scutula Stereocaulorum* Kbr.

There is no great difference between the *dissolutum* and Vainio's var. *spathuliferum*.

As far as we can see it has not formerly been recorded in the literature on the lichen flora of Greenland. But "*Stereocaulon evolutum*" has been recorded from N. E. Greenland: Kapp Dalton (Vainio p. 128), Varde Ridge and Danmarks Havn (Galløe p. 189). Should that be *Stereocaulon fastigiatum*?

In the Copenhagen herb. there are several Greenland plants of *Stereocaulon fastigiatum*: Upernivik: Nutarmiut (Ryder Exped., correctly determined), East Greenland: Kutek (Eberlin 1885, s. n. *Stereocaulon paschale*), and Scoresby Sund: Danmarks Ø (Hartz, 1882, s. n. *Stereocaulon denudatum*).

*Stereocaulon denudatum* Flk.

f. *pulvinata* (Schaer.) Flot.

VI. Kapp Simpson.

In Novaya Zemlya and in Spitsbergen this species is supposed to be the commonest *Stereocaulon*, and one of the commonest of all lichens, common and plentiful everywhere. The same is the case in Jan Mayen. — Deichmann Branth writes that it is the commonest *Stereocaulon* in Greenland ("Den hyppigst forekommende", Grøn. Lich. Flora, p. 486).

But in the part of N. E. Greenland where we worked, it is certainly very rare. Our plants are low, densely pulvinate. The phyllocladia are closely contiguous, almost crustiform. If they decay, a thin, striped, often morbose podetium is seen.

*Stereocaulon denudatum* is said to be fairly common ("temmelig almindelig") in Scoresby Sund, which is probable (Deichmann Branth, 1894, p. 94), var. *pulvinatum* is the commonest forma, var. *capitatum*

has been recorded from Danmarks Ø (D. B. l. c.), var. *pulvinatum* from Hold with Hope (Malme p. 5).

There are many plants of *Stereocaulon denudatum* in the Copenhagen Greenland herbarium. It must be common in West Greenland and also in East Greenland as far north as Scoresby Sund.

Some *Stereocaula*, not detected by us, have been recorded from N. E. Greenland:

*Stereocaulon coralloides*: Varde Ridge and The Bay, near Danmarks Havn (Galløe p. 189). See the present paper p. 48.

*Stereocaulon evolutum*: Kapp Dalton (Vainio p. 128) and Varde Ridge and Danmarks Havn (Galløe p. 189). Cfr. *Stereocaulon fastigiatum*.

*Stereocaulon paschale*: Scattered in Scoresby Sund (Deichm. Branth, 1894, p. 94), Franz Josef Fjord, "fraglich" (Kbr. p. 76), Dove Bugt, Danmarks Havn, Kapp Bismarck, Varde Ridge, The Bay, Basiskær ("seems to be very common", Galløe p. 189).

*Stereocaulon tomentosum*: Scoresby Sund: Danmarks Ø and Gåselandet, fairly common (Deichm. Branth, 1894, p. 94).

## GYROPHORACEAE:

### *Gyrophora* Ach.

#### *Gyrophora virginis* (Schaer.) Frey.

Pl. III, fig. 1—2.

Frey Beiträge zur Biologie, Morphologie und Systematik der Umbilicariaceen, Hedwigia, 1929, p. 248.

*Gyrophora rugifera* (Nyl.) Th. Fr., vide Zahlbruckner Cat. Lich. IV, p. 684, ubi syn. Lynge Lich. Nov. Zemlya, 1928, p. 168.

- I. Kapp Wynn. Landingsdalen. Kapp Herschel. Clavingøya: Revet and Soppbukta.
- II. Loch Fyne. Kapp Stosch. Jacksonøya. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt. Blomsterbukta.
- IV. Near Robertsonøya. Celsiusberget. Sanddalen.
- V. Husbukta.
- VI. Antartichamna. Kapp Petersens. Holmvika. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.

*Gyrophora virginis* is one of the most common and most plentiful of all lichens in this region.

It ascends as high as any other lichen. The localities more than 500 metres are: Husbukta (580), Kapp Herschel (650), Clavingøya (700), and Moskusoksefjorden (900 and 1350).

In Lyngé's Lich. Nov. Zemlya l. c. he suggested it to be a lichen of western Arctic distribution, and all later investigations can only support that suggestion. It was not mentioned by Vainio (Lich. Pittek.), not by Nylander (Lich. Freti Behr.), and not by Cummings (Lich. Alaska).

Du Rietz has written on its distribution (Flechtsyst. Stud. VI, Bot. Not., 1925, p. 362. The type of this species was described from Switzerland by Schaerer, and then it was described by Nylander from "Siberia orientalis". We do not know where this "Siberia orientalis" is, but all known Arctic localities range from Novaya Zemlya and Franz Joseph Land to Ellesmere Land. In Novaya Zemlya Lyngé found it quite scarce, though plentiful in one locality. In Franz Joseph Land it is evidently more plentiful — has it had a northern route of distribution? — In Spitsbergen it is common enough. But we have never seen it so plentiful as in East Greenland. — To judge from Herre (The Gyrophoraceae of California, p. 317) it is supposed to occur "on all mountains in the west, which arise to a height of 2000 m or more". We have not seen Herre's plants, but his description agrees well with this species.

In Europe it is a high alpine species, evidently more common than formerly supposed in the Scandinavian mountains, and found in the Pyrenees, Alps and Caucasus.

It has been confused with other species (*Gyrophora cylindrica* var. *Delisei* and also *G. hirsuta*), so we cannot trust all literary records.

It is a variable plant especially with respect to its size. According to Du Rietz l. c. Nylander's type is "sehr klein". In Norway it is one of our largest and coarsest *Gyrophorae*, attaining more than 25 cm in our largest plants. Some of the Ellesmereland plants are of the same type. Lyngé's largest Novaya Zemlya plant is 10—11 cm. But our Greenland plants are of a very modest size, they only exceptionally exceed 6 cm. There are perhaps geographical races hidden in these remarkable differences of size. Anyhow, we have not seen specific differences.

It has repeatedly been stated (Lång in Schedae ad Krypt. Exsic. No. 1956, Du Rietz l. c.) that the only, but sufficient character of distinction against *G. cylindrica* var. *Delisei* is the disk of the apothecia, gyrose in the latter species and agyrose in *G. virginis*. The apothecia of *G. virginis* are at first appressed, quite plane, with a thin, sharp margin. Later they become a little convex, and the margin sometimes disappears, usually it is persistent. In the centre of the disk there is occasionally a papilla, oftener a depression or even a perforation in old apothecia. In full-grown apothecia the growing part of the margin often dies away here and there, resulting in a more or less crenate circumference. If this necrosy occurs in young apothecia, they get a pseudo-gyrose appearance in old age, such plants should be distinguished from the *Delisei* with some care. The same is the case if the old hymenium degenerates and

is substituted by a number of initiating hymenia, covering the old disk, as is often seen.

The director of the Rijksherbarium, Leiden, has allowed us to study a plant of *Gyrophora Tramnitziana* Koerber. The type is a very miserable plant, the same is the case with a cotypus in Upsala. But in our opinion it is identical with *G. virginis* (Schaer.) Frey. Du Rietz is of the same opinion. Deichmann Branth and Grønlund suggest that *G. Tramnitziana* should be a synonym of *G. cylindrica* var. *simplex* (Grønlands Lichen-Flora, 1888, p. 491). Either of the two plants above mentioned is fertile, and the apothecia are distinctly agyrose.

We had suspected some of our smallest plants to be identical with *G. Hulténii* DR. Du Rietz has allowed us to see his type plant. But even our smallest plants are coarser than that species, they are more or less stipitate, and their under surface is smooth, *G. Hulténii* must be out of the question.

*Gyrophora virginis* is not well represented in the Copenhagen Greenland herb. But it has repeatedly been recorded from N. E. Greenland: Turner Sund (Vainio p. 125, s. n. *Umbilicaria rugifera*), Hekla Havn (Deichm. Branth, 1894, p. 95, s. n. *Gyrophora stipitata*), Danmarks Ø (Deichm. Branth, 1894, p. 95, s. n. *Gyrophora hirsuta* var. *papyria*), Kapp Borlase Warren and Sabineøya (Malme, p. 5, s. n. *Gyrophora cylindrica* var. *simplex*). — We have not seen all these plants, the references are bibliographical.

In the Copenhagen herb. Lynge found plants from Danmarks Ø in Scoresby Sund (Hartz), Disko (Porsild) and Onanaks Ø (Umanaq?, leg. Rink).

### *Gyrophora decussata* (Vill.) Zahlbr.

Pl. III, fig. 3—4; VI, fig. 5.

*Gyrophora decussata* (Vill.) Zahlbr. Cat. Lich. IV (1927) p. 678. Lynge Lich. Nov. Zemlya (1928) p. 168, Lich. Franz Josef Land (1931) p. 15. *Gyrophora anthracina* (Wulff.) Th. Fr. Lich. Arct. (1860) p. 163 p. p. *Gyrophora anthracina*\* *discolor* Th. Fries Lich. Spitsb. (1867) p. 31. *Gyrophora discolor* Th. Fr. Lynge Lich. North Coast Greenland (1923) p. 23. *Gyrophora reticulata* (Schaer.) Th. Fr. Du Rietz Europ. *Gyrophora anthracina* Arten (1925) p. 2 et 9. (A full bibliography will be found in Zahlbr. Cat. Lich. and in Du Rietz's paper).

- I. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet and Soppbukta.
- II. Jacksonøya. Myggbukta. Terneøya. Kapp Bennett.
- III. Kapp Humboldt. Dusénfjorden. Moskusoksefjorden. Blomsterbukta. Kjerulf fjorden.
- IV. Sofiasundet pluribi.

V. Gåsøya. Husbukta. Veganeset.

VI. Antartichamna. Kapp Petersens. Mainland near Archerøya. Holmvika. Röhssfjorden. Dicksonfjorden. Ellaøya.

*Gyrophora decussata* is perhaps the commonest *Gyrophora* of this region and one of the commonest of all lichens here. — It ascends as high as any other lichen, its finds higher than 500 metres above sea-level are: Vegasundet 580 m, Kapp Herschel 650 m, Clavingfjorden 640 and 1200 m, Moskusoksefjorden 900 and 1350 m.

It is a species of enormous distribution, especially in the Arctic. We can hardly think of a large Arctic collection, where it should be lacking. As far as we can see, Bear Island is the only Arctic region, where it is supposed to be lacking. Du Rietz has written on its distribution on the American continent (l. c.). — We were much interested in receiving a plant from Asia Minor, collected by dr. Szatala. It suggests a wider distribution, it should be looked after in the collections from Himalaya. A distribution of this kind must suggest ideas of its high age.

We were much interested in finding its "var. *reticulata*" with the positive  $\text{CaCl}_2\text{O}_2$  reaction. In Lynges's vast material from Novaya Zemlya and Spitsbergen this plant is a rare, coprophilous plant. In this part of East Greenland there is hardly a real bird-cliff, but there are numerous bird-stones. We tested plants from all our localities, but we found a positive reaction in one single plant only, from Terneøya near Myggbukta. We could not find any morphological character in this plant that distinguished it from the numerous other plants from the same find, where no positive reaction could be obtained.

We conclude from these observations that it is impossible to use the chemical reaction with  $\text{CaCl}_2\text{O}_2$  in this species as a distinguishing character. We must leave it to the chemists and physiologists to clear up this intricate question.

The western plants are much more variable than the Norwegian *Gyrophora decussata*.

In Norway it is a small plant, generally about 2 cm in diam., rarely surpassing 3 cm. In the Greenland collections several plants attain as much as 7—8 cm. These plants are so large and rigid that they are easily mistaken for *Gyrophora rigida* DR. = *Gyrophora anthracina* in Th. Fries. Lich. Scand., p. 165. We did not find that species, though it was much searched for, but Koerber has recorded it from Walrus Island, Shannon Island and Kaiser Franz Josef Fjord. We have not been able to see these plants, so we cannot check the determination. But we think it highly probable that Koerber's *Gyrophora reticulata* is the larger formae of *Gyrophora decussata*.

The large plants often developed epiphyllous squamules. The squamules are sometimes so large that the plants look polyphyllous, a very strange habitus for *Gyrophora decussata*.



Several plants are erose and perforate: f. *perforata* Lyng. Stud. Lich. Flora Norway (1921) p. 91. Its variations can be thus arranged:

*F. typica* Lyng.: thallus parvus, diam. 2—3 cm, rarius usque ad 4—5 cm, fere semper sterilis.

*F. maxima* Lyng.: thallus multo major, diam. usque ad 7—8 cm, rigidus, coriaceus, imperforatus, interdum lobis epiphyllinis ornatus, interdum fertilis. Typus: Kapp Humboldt.

*F. perforata* Lyng. l. c.: thallus magnus vel maximus, tenuior, in margine plus minusve lacerato-incisus, in lamina varie erosus vel (usque crebre) perforatus. Apothecia ignota. Typus: Ellesmereland: Goose Bay, leg. Simmons 1901, det. Darbishire: *Gyrophora anthracina*.

*F. perforata* is not rare. It is found all over the area visited by the Norwegian expeditions, at least in the more maritime parts. It ascends to 1350 metres. (Moskusoksefjorden). We found typical plants in the following localities: I. Landingsdalen. Kapp Herschel. III. Moskusoksefjorden. VI. Kapp Petersens. Mainland near Archerøya. Dicksonfjorden.

Intermediate plants between all the three formae are quite common.

We found a considerable number of fertile plants: Apothecia haud rara, saepe abortiva, stipitata, omnino aterrima, epruinosa. Discus diam. vulgo ca. 1, rarius usque ad 2 mm, planus et margine tenui circumdatus vel margine elevato involuto plus minusve cupuliformis. Discus laevigatus et agryosus vel in centro rima flexuosa instructus (ut in *Gyrophora polaris*). Pedicellus usque ad 150  $\mu$  longus, gonidiis destitutus. Excipulum incolor, in parte exteriori corticis solum obscure fuscens. Cortex excipuli 100—50  $\mu$  altus, marginem versus attenuatus, hyphis pachydermaticis, refractivis, dense contextis, in omnes partes currentibus, formatus. Medulla arachnoidea, hyphae medullares 5—6  $\mu$  crassae. Hypothecium subincolor (dilutissime fuscens), a hymenio non bene limitatum. Hymenium in parte superiori solum obscure fuscens, ca. 80  $\mu$  altum. Paraphyses cohaerentes, satis validae, in apice non incrassatae, indivisae, indistincte septatae. Asci late pyriformes, usque ad 25  $\mu$  crassi, asci evacuati angustiores. Sporae octonae, oblongo-ellipsoideae, rarius leviter fabaceae, indivisas solum vidimus, 13.2—16  $\times$  7—8  $\mu$ . — Hymenium J e caeruleo mox sordide rubescens.

A section shows that the cortices are not plectenchymatous in the same sense as the cortex of *Leptogium*. If a section is placed in water, the hyphae of the upper cortex make the impression of a palissade arrangement. But if cleared up with lactic acid and stained with chlor zinc iodide, we find that the hyphae are much branched, we can see their lumina as reticulated lines. There is no clear line of distinction between the upper cortex and the medulla, and none between the medulla and the lower cortex. The medulla is arachnoid, but of varying density. Near the surface the hyphae of the lower cortex swell, and numerous

black rounded balls, 6—8  $\mu$  in diam. are detached from them, these black balls are the cause of the black under side of the thallus.

The Greenland plants are very variable in thickness. The fairly thin plants have strong reticulated rugi around the centre. They are rugose to the very margin, but towards the margin the rugi are lower and less distinct. The central part of the thallus is also minutely reticulato-rimose, with small verrucose angular areolae, 0.2—0.4 mm large. They are whitish, on account of a cover of pyramides of an amorphous substance (dead collapsed hyphae?). Towards the circumference the rimae are indistinct (use a lens of high power,  $\times 20$ ), and the said pyramides low and little developed, the colour of the thallus is therefore more or less intensely black (the colour of the upper part of the cortex). — Other plants, and they are very common, are much thicker, and whitish over the whole upper surface. The rugi are developed over the whole thallus, and the rimose and verrucose structure extends from the centre to the margin. The amorphous substance is developed over the areolae all over the upper surface.

The habitus of these types is very different, and some botanists would have assigned different names to them. But if the above view is correct, the types only represent the extremes of the variation of a very common species, living under different conditions, and we are not inclined to name such "formae".

Scholander is inclined to attribute a greater importance to these types than Lyngé. He found the thick plants on the bird-stones, the others could be found everywhere. This observation also agrees with Lyngé's former observations from Novaya Zemlya and Spitsbergen. It either suggests a genotypic difference: a coprophilous type, name it species or forma, living on the bird-stones. Or it suggests the adaptation of a common and variable species to a different supply of food.

Curiously enough this common species has not been much collected by former botanists. Malme records *Gyrophora discolor* from Hold with Hope and from Kapp Borlase Warren (p. 5). Koerber's *Gyrophora anthracina* is also supposed to be this species. If it had been *Gyrophora rigida* DR., we do not understand how that large and conspicuous species could have escaped us. Koerber records it from Hvalrosøya (Wallross Insel), Shannonøya, Franz Joseffjorden and "Gipfel des Berges am Fjord", — chiefly f. *tesselata* Ach. (Koerber p. 76).

The Copenhagen herb. contains several plants of *Gyrophora decussata* from all parts of Greenland: West Greenland: Upernivik: Tasiussaq (Wulff), Egedesminde (Sørensen); North Greenland: Low Point, Lemmingfjorden and Centrumøya (Wulff), Inglefieldfjorden (Gust. Olsen); East Greenland: Scoresby Sund, many plants (Hartz).

*Gyrophora polaris* Scholander n. sp.

Pl. IV, fig. 1—4.

Thallus vulgo monophyllus, *parvus vel parvulus*, diam. 1—5, vulgo 2—4 cm., saepe pulvinatus, *ob cortices rigidos firmus vel etiam coriaceus*, in centro rugis elevatis irregularibus reticulatis vel flexuosis percursus, versus peripheriam rugae minus distinctae sunt. Thallus numquam perforatus, cortex superne in centro rimis profundis reticulatis areolato-verrucosus, versus peripheriam praecipue supra rugas minute vel minutissime rimoso-areolatus, subtus undulato-rugosus vel versus centrum rugoso-plicatus, *omnino pruinosus*, ob rimas minutas creberrime reticulatas. *Lamina superior obscure cinerea vel fusco-cinerea, rugae centrales interdum decoloratae, thallus subtus versus peripheriam cinereo-fuscescens, versus centrum pallidius fuscescens vel carneus*, in ipso umbilico saepe magis obscuratus.

Cortex superior extus (15—20  $\mu$ ) infuscatus, praeterea incolor, crassitudine valde varians, in centro in rugis usque ad 250  $\mu$  altus, praeterea multo tenuior. Hyphae corticis 5—8  $\mu$  crassae, *valde pachydermaticae*, cellulis elongatis, *in parte interiori subparalleles et superficiei perpendiculares*, in parte exteriori obscuratae et magis ramosae, in omnes partes currentes. Gonidia dense conglomerata, saepe in seriebus verticalibus disposita. Stratum gonidiale usque ad 70  $\mu$  altum, continue vel hinc inde interruptum. Hyphae medullares 5—6  $\mu$  crassae, leptodermatae, laxae contextae, a cortice inferiori bene limitatae. Cortex inferior in parte exteriori obscure fuscescens, praeterea incolor, in parte centrali thalli usque ad 100  $\mu$  altus, praeterea tenuior. Hyphae *valde pachydermaticae*, in parte exteriori crebre ramosae, subplectenchymatae.

*Apothecia numerosissima*, supra totum thallum, saepe etiam in rugis centralibus, adspersa, in aetate interdum contigua et thallum omnino fere tegentia, diam. 1—2, rarius usque ad 3 mm, sessilia vel interdum breviter stipitata. *Discus ater, diu vel persistenter planus*, plus minusve gyrosus, margine subpersistenti circumdatus. Discus juvenilis in centro rima flexuosa instructus, deinde circum hanc rimam maculis immersis et rimis brevioribus, rugis circumdatis, plus minusve inaequalis. Gyrae elongatae, undulatae (ut in *Gyrophora proboscidea*) numquam evolutae. Excipulum sub hypothecio fuscum, ut in thallo hyphis valde pachydermaticis corticatum. Hypothecium incolor. Hymenium 70—80  $\mu$  altum, in parte superiori fuscum, fuligineum, praeterea dilutissime fuscescens. Paraphyses arcte cohaerentes, in apice haud incrassatae. Asci late clavatae, circiter 50 $\times$ 15—20  $\mu$ . Sporae late ellipsoideae, incolores, simplices vel haud raro uniseptatae, 8—12 $\times$ 5—8  $\mu$ .

Pycnides frequentes, globosae vel ad ostiolum protractae, diam. vulgo circiter 2—300  $\mu$ . Perifulcrum fuscescens. Pycnoconidia recta, cylindrica, 2.5 $\times$ 0.5  $\mu$ .

Medulla  $\text{CaCl}_2\text{O}_2$  immutata, etiam cum cortice. Hymenium J e caeruleo intense fusco-rubescens.

It is easily distinguished from *Gyrophora decussata* by its pale under side and by its numerous apothecia.

It resembles *Gyrophora proboscidea*, but its affinity is with the *Agyrophorae*. It is distinguished from that species by its thick rigid thallus, due to the very firm cortices, formed of thick-walled palissade hyphae, near the surfaces the hyphae are more ramose, forming a more plectenchymatous tissue. *Gyrophora proboscidea* has a much thinner and softer cortex, cfr. Frey's description in his Beitr. zur Biol., Morph. und Systematik der Umbilicariaceen, Hedwigia, 1929, p. 222–223 and figs. 2–3.

The gonidia of *Gyrophora proboscidea* are more dispersed, and not placed in vertical series. If a section of *Gyrophora polaris* is stained with Chlor zink iodide, numerous dead (digested?) gonidia are seen in the cortex. It looks, as if they are actively brought to the surface, where they are detached from the thallus. The upper cortex of *Gyrophora proboscidea* is sometimes destroyed and decolorated near the margin of the thallus. This is never seen in *Gyrophora polaris*. But the lower cortex of that species is occasionally destroyed, resulting in a recurved thalline margin. — *Gyrophora proboscidea* is  $\text{CaCl}_2\text{O}_2$  red, *Gyrophora polaris* unchanged.

*Gyrophora proboscidea* is always well fertile. Its apothecia are concentrated in the more peripheral parts of the thallus. The central strongly wrinkled part is generally elevated and surrounded by a depressed broad ring. These parts of the thallus are destitute of apothecia. In *Gyrophora polaris* the apothecia are still more numerous and more crowded, often quite covering the thallus. Their black disks give the thallus a darker colour than the greyish-brown cortex. In *Gyrophora polaris* the apothecia are also found on the central wrinkles.

The gyri of the apothecia are essentially different in the two species:

I. *Gyrophora polaris*. In the centre of the young apothecia we first find a central, often ramose fissure, limited by an elevated margin. Later on there originate in the primary hymenium (between this fissure and the margin of the disk) secondary fissures, more or less ramose, often broad, even elliptical, limited by a margin, built up of proliferating hyphae (paraphyses?). The ascogenous hymenium is found between this system of margins.

If these secondary fissures are scarce, or if the primary hymenium grows faster than the fissures are formed, the apothecia are practically "agyrose", as in the section *Agyrophora*.

II. *Gyrophora proboscidea*. The terminus gyrus is defined as the elongated walls with an ascogenous hymenium immersed along its upper mid-line. When a gyrus and its hymenium has attained a certain width,

a (paraphyse?) proliferation along its middle line separates the hymenium in two new ones. These two hymenia are lined with one half part of the old gyrus wall on the outer sides, and between them is the above mentioned proliferation. This forms a new wall, ultimately splitted by a new fissure. In this manner the gyri branch.

The width of the ascogenous hymenium is accordingly strictly limited, but not its length. We therefore only find long, narrow, undulated, often concentric, more or less ramose gyri in *Gyrophora proboscidea* and other species with the same type of apothecia.

*Gyrophora proboscidea* has larger spores ( $11-18 \times 5-8 \mu$ ) than *Gyrophora polaris* ( $8-12 \times 5-8 \mu$ ).

Distribution:

*North Greenland*: Low Point (Wulff).

*West Greenland*: Near Disko, several finds: Blåfjell, Mellemfjorden, Atanikerdluk and Ujaragssuk (Th. Fries 1871). Godhavn (Th. Fries).

*East Greenland*: I. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet.

II. Jacksonøya. Myggbukta. Terneøya. Kapp Bennett.

III. Moskusoksefjorden. Kapp Humboldt. Kjerulf fjorden.

IV. Sofiasundet: 5 km west of Robertsonøya.

V. Husbukta, pluribi.

VI. Röhssfjorden. Dicksonfjorden.

*Spitsbergen*: Advent Bay (Lynge 1926), Magdalena Bay (Vahl 1839). Spitsbergen, leg. A. E. Nordenskiöld, without locality (hb. Ups.).

*Franz Josef Land*: Kap Forbes (leg. O. Hanssen 1930, named *Gyrophora proboscidea* in Lynge Lich. Franz Jos. Land, 1931, p. 16).

In North East Greenland *Gyrophora polaris* is widespread and common, but perhaps not so plentiful as many other lichens. It ascends to very considerable elevations: Husbukta 580 metres, Kapp Herschel 650 m, Revet 1200 m, Moskusoksefjorden 900 and 1350 m.

In Spitsbergen it is certainly rare. We have a large material of *Gyrophora proboscidea* from Spitsbergen in our herbarium. Lynge has also examined the collections in Stockholm and Upsala. Only three Spitsbergen plants were identified: — Franz Josef Land is its eastern outpost, as far as we know. — In Novaya Zemlya *Gyrophora proboscidea* is one of the commonest lichens, but there was not a single plant of *Gyrophora polaris* in Lynge's material. — In Stockholm and Helsingfors there are a great deal of *Gyrophora proboscidea* from the whole Siberian coast, but not a single *Gyrophora polaris*. — All the plants which Simmons collected in Ellesmereland, are typically *Gyrophora proboscidea*.

To judge from the Copenhagen herb. *Gyrophora proboscidea* must be common in Iceland and the Faeroes, *Gyrophora polaris* is not found in the material. *Gyrophora proboscidea* is very common in Norway, but *Gyrophora polaris* is lacking here.

The available material suggests *Gyrophora polaris* to be a high-arctic species of western distribution. It has perhaps migrated eastwards by a very northern route as far east as Franz Josef Land. It is not the only lichen of this distribution. We may refer to the notes on *Usnea sulphurea* in Lynge's paper on Franz Josef Land (p. 24).

The anatomy was studied on microtome sections, obtained in a very simple manner. A sufficiently moistened thallus was placed in the microtome between two thin slices of cork and cut. The sections were caught on a needle, which was dipped in 60% alcohol, and placed in 60% alcohol, where the cork was removed. After 5 minutes the section was transferred into glycerine, and from the glycerine to the slide. If curled the section was adjusted and then mounted in glycerine gelatine, which should first be applied on the cover glass. When ready it must be protected from evaporation by a ring of Canada balsam or some other substance.

### *Gyrophora proboscidea* (L.) Ach.

Pl. IV, fig. 5—7.

- I. Claveringfjorden: Revet.
- V. Vegasundet: 15 km west of Husbukta.
- VI. Kapp Simpson. Antartichamna. Mainland near Archerøya. Röhssfjorden.

It is not one of the common lichens in N. E. Greenland. We have more localities from the southern part of the territory than from the northern, but this cannot be due to climatic causes, for it ascends to 580 metres in Husbukta, and even to 1200 m at Revet.

The Greenland records of this species also cover *Gyrophora polaris*, which see.

"*Gyrophora proboscidea*" has been recorded from N. E. Greenland by nearly all authors: Scoresby Sund, var. *deplicans* (Deichm. Branth, 1894, p. 95), Hvalrossøya (Malme p. 5), Kapp Bismarck (Deichm. Branth, 1907, p. 13), Danmarks Havn, Termometerfjell and Varde Ridge (Galløe p. 190).

By far the greater part of the Copenhagen Greenland material of *Gyrophora proboscidea* belongs to *Gyrophora decussata*. The rest of the genuine *Gyrophora proboscidea* suggests a really rare species: Diskofjorden: Christianshåb (Vahl), Julianehåb: Tunugdliarfik (Vahl), Scoresby Sund: Hekla Havn (Hartz).

*Gyrophora hyperborea* (Hoffm.) Ach.

- I. Landingsdalen. Kapp Herschel. Claveringøya: Soppbukta. Finschøya.
- III. Kapp Humboldt. Moskusoksefjorden.
- IV. Sofiasundet: west of Robertsonøya.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Kapp Simpson. Antarctichamna. Mainland near Archerøya. Holmsvika. Röhssfjorden.

It is widely distributed and fairly common, but hardly plentiful. We have more localities from the coast regions than from the inland end of the fjords. — It is a lowland species more than most other lichens, not collected higher than 250 metres at Kapp Herschel, and 360 m at Husbukta.

There are numerous records of *Gyrophora hyperborea* from North East Greenland: Turner Sund (Vainio p. 125), Scoresby Sund pluribi (Deichmann Branth, 1894, p. 95), Kapp St. Jacques (Deichmann Branth 1907, p. 13), Kapp Borlase Warren and Hvalrossøya (Malme p. 5), and Termometerfjell near Danmark Havn (Galløe p. 190).

There are so many plants in the Copenhagen Greenland herbarium that it must be common all over Greenland. One of the most interesting finds is from a moraine on the ice-sheet inland from Ugtli in the Thule district (leg. L. Koch).

*Gyrophora arctica* Ach.

- I. Kapp Wynn. Finschøya.
- II. Jacksonøya.
- III. Kapp Humboldt. Dusénfjorden.
- V. Scott Keltie-øyane: Gåsøya.
- VI. Antarctichamna. Kapp Petersens.

*Gyrophora arctica* is scarce and not common, found only on bird-stones in the lowlands along the coast.

The rigid, large and magnificent plants are strictly coprophilous, they are entirely lacking in our collections. — Practically all our plants should be referred to Nylander's var. *subarctica*, which he included under *Gyrophora hyperborea* (Lich. Lapp. orient. p. 23 (123), see also Herb. Lich. Fenn. No. 256). Th. Fries prefers to refer this variety to *Gyrophora arctica*, on account of the lower side, which is pale with a dark spot around the umbilicus, and laevigate (not lacunose), and minutely chagrinose. The chemical reaction is  $\text{CaCl}_2\text{O}_2$  faintly red in the stratum gonidiale.

*Gyrophora arctica* has repeatedly been recorded from North East Greenland. Scoresby Sund pluribi (Deichm. Branth, 1894, p. 95), Fleming Inlet (Vainio p. 125), "Fjordgletscher sehr häufig" (Koerber p. 76), Hvalrossøya and Murrayøya (Malme p. 5).

There are many plants in the Copenhagen Greenland herbarium. It must be very common on the whole west coast as far north as Inglefeldfjorden (Gust. Olsen). There are also many plants from East Greenland (Sylow, Eberlin, Hartz). Vahl collected it in 1828 "ad saxa ruinarum norwegicarum Upernaviarsuk".

*Gyrophora torrefacta* (Lightf.) Cromb.

- II. Myggbukta.
- III. Moskusoksefjorden. Kapp Humboldt.
- V. Husbukta.
- VI. Röhssfjorden. Dicksonfjorden.

*Gyrophora torrefacta* has almost the same distribution as *Gyrophora erosa*, but the plants are less perforated, sometimes habitually not unlike *Gyrophora hyperborea*, from which it is easily distinguished by the trabeculated under side. All the plants have been tested with  $\text{CaCl}_2\text{O}_2$ , they gave a positive red reaction.

It ascends quite as high as *Gyrophora erosa*, in Moskusoksefjorden right up to 1350 metres above sea-level.

*Gyrophora torrefacta* (Lightf.) Cromb. was not found in 1929, but in 1930 Scholander succeeded in finding it.

There is no literary record of *Gyrophora torrefacta* from North East Greenland.

In the Copenhagen herb. Lyngé found three Greenland plants with a positive  $\text{CaCl}_2\text{O}_2$  reaction: Groenlandia (Wormskiöld), Sakkane (Vahl), and Disko (Porsild). *Gyrophora torrefacta* is widely distributed in Greenland, but it is hardly common.

*Gyrophora erosa* (Web.) Ach.

- I. Landingsdalen. Clavingfjorden: Revet. Finschøya.
- II. Jacksonøya. Myggbukta.
- III. Kapp Humboldt. Dusénfjorden. Moskusoksefjorden.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Mainland near Archerøya. Kapp Petersens.

Common, in places plentiful, at least along the coast. There is not a single plant from the more continental part of the fjords, have we overlooked it there, or is it really lacking?

Like so many other lichens it ascends to considerable elevations: Kapp Petersens 400 metres, Husbukta 580 m, Clavingøya 1200 m.

Generally small, densely conglobate. More flat, expanded plants, attaining 3 or even 4 cm in diameter, are rare. The East Greenland plants are so brittle that it was often difficult enough to collect them, for water to moisten them is not always to hand in this arid climate.



Nylander's *Gyrophora sclerophylla* from Greenland (Holsteinsborg, leg. J. Vahl), was compared with *Gyrophora polyrrhiza* by Nylander himself (Ad Lichenogr. Groenl. quaedam addenda, Flora, 1862, p. 81).

But *Gyrophora sclerophylla* is a plant of the *Gyrophora erosa* section. It is KOH ÷ and CaCl<sub>2</sub>O<sub>2</sub> ÷. It has just the same trabeculate under surface that is so common in our Greenland plants (as well as in the Spitsbergen material), it is thick and rigid, almost pulvinate, as many of our plants are. *Gyrophora sclerophylla* is fairly common in East Greenland, we would prefer to call it *Gyrophora erosa* var. *sclerophylla* (Nyl.) Lyng. comb. nov.

*Gyrophora erosa* has been recorded from Scoresby Sund "perhaps the commonest *Gyrophora*" (Deichm. Branth, 1894, p. 95), Kapp St. Jacques (Deichm. Branth, 1907, p. 13), Danmarks Havn, Renskæret (Galløe p. 190).

Lyng. only found *Gyrophora erosa* from 6 localities in the Copenhagen Greenland herbarium, as far north as Disko. But there are so many plants in Th. Fries's collection from West Greenland that it must be common there.

*Gyrophora Koldeweyii* Kbr. from Shannon Island is only a *Gyrophora erosa* with destroyed cortex. Th. Fries has shown that (Lich. coll. . . . Engl. Pol. Exped. p. 355). Lyng. has seen Koerber's plant and he entirely agrees with Th. Fries.

### *Gyrophora deusta* (L.) Ach.

#### VI. Röhssfjorden.

This species is quite as rare as *Gyrophora vellea*.

It is one of the rarest lichens in Greenland. It has formerly never been collected in East Greenland. Vahl collected it at Sukkertoppen in West Greenland, the only find in the whole island. The isidia of this plant are badly developed, but the determination is evidently correct.

### *Gyrophora vellea* (L.) Ach.

#### VI. Röhssfjorden.

*Gyrophora vellea* is one of the rarest lichens of the region. It was found in two localities in this southern fjord, one of the richest places for lichens.

Deichm. Branth writes that it is fairly common in Scoresby Sund, and well developed in protected places, but rarely fertile (D. B. 1894, p. 95).

There are many plants in the Copenhagen herb.; from the west coast as far north as Upernivik, from the east coast as far north as Scoresby Sund.

In the Copenhagen herb. there is a "vera *spodochroa* Nyl. spor. 0.018—23 mm" from "Groenl.", leg. Wormskiold. Can this locality be correct?

*Gyrophora cylindrica* (L.) Ach.

- I. Landingsdalen. Claveringfjorden: Revet.
- II. Myggbukta.
- III. Kapp Humboldt.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Kapp Simpson. Antartichamna. Mainland near Archerøya. Kapp Petersens. Segelsällskapets fjord: Monte Carmela. Röhssfjorden. Dicksonfjorden.

Not common, and quite scarce. Only at Kapp Simpson it was plentiful. These plants are var. *Delisei* (Despr.), magnificent, rigid plants up to 11 cm in diameter. All the other plants approach var. *fibriata* Ach., even if they are somewhat coarser and more rigid than this forma generally is in Norway.

It ascends to 1200 m at Revet, and to 1600 m in Monte Carmela, with *Parmelia minuscula*. The plant from 1600 m is a fine plant. It was unexpected to obtain lichens from these altitudes, in Novaya Zemlya and in Spitsbergen only few lichens are found higher than 500 m.

*Gyrophora cylindrica* has been recorded from North East Greenland by all authors: Kapp Dalton and Turner Sund, var. *Delisei* (Vainio p. 125); Scoresby Sund, common, especially var. *Delisei* (Deichm. Branth, 1894, p. 95); Franz Joseph Fjord and Shannonøya (Koerber p. 76), Murrayøya and Hvalrossøya, var. *Delisei* (Malme p. 5), Danmarks Havn, Termometerfjeld, Pustervig, Basiskær, Varde Ridge (Galløe p. 190).

*Gyrophora cylindrica* is better represented than any other *Gyrophora* in the Copenhagen Greenland herb. Most probably it is found all over the coasts of Greenland, where a *Gyrophora* can live, though not equally common everywhere.

*Gyrophora cylindrica* is widespread and fairly common, though not plentiful, in Novaya Zemlya. But it was neither mentioned by Vainio in his Lich. Pitlek., nor by Nylander in his Enum. Lich. Freti Behr. Should it be a western species?

[*Gyrophora Wenckii* Müll. Arg.

Müller Argoviensis described his *Gyrophora Wenckii* in Flora 1867 p. 433 (Lichenum species et varietates aliquot novae) from Greenland.

Deichmann Branth supposed it to be a forma of no importance of *Gyrophora arctica* (Grönlands Lichen-Flora (1888) p. 451 and 490).

Du Rietz saw a cotypus of *Gyrophora Wenckii* in Uppsala and immediately noticed that it contained two different species, viz. *Gyrophora proboscidea* Ach. and *Gyrophora fuliginosa* Havås (Havås Lich. Norv. Exsic. No. 237, Lyngé Stud. Lich. Flora Norway (1921) p. 96, Häyrén

*Gyrophora fuliginosa* Havås aus Finnland (1930) p. 180), cfr. Du Rietz Die Europäischen Arten der *Gyrophora* "anthracina"-Gruppe (1925) p. 12.

With his usual generosity Chodat has allowed me to study the type plant of Müller. This type consists of four plants. Two of them are typically *Gyrophora proboscidea* Ach., well fertile, the two others are quite as typically *Gyrophora fuliginosa* Havås, sterile, as usually. They agree entirely with Norwegian plants. — The name "*Wenckii*" must accordingly disappear as a species name, being based on a mixtum.

Wenck collected it at "Umanak". There is an Umanaq in East Greenland at about 63° N, but most probably Wenck's locality is Umanaq in West Greenland, at 71° N, north of Disko.<sup>1</sup> — Du Rietz writes that there are typical American plants in the Upsala herb. from Labrador and from Hudson Bay. He concludes from this that it is a western "Arctic" species.

In Norway we have now very many finds from the high mountains above the tree line, from Northern Sætersdalen in the south to Dovre and Romsdalen in the north. — In 1926 Häyrén collected it in Petsamo in Northern Finland. We do not know anything on its distribution between Dovre and Petsamo. But our present knowledge places it with the bicentric plants of the Scandinavian Peninsula.

Curiously enough there is not a single plant from Greenland in the large Copenhagen herbarium. And there is no plant in Th. Fries's Greenland collections, though he collected extensively about Disko. — We did our best to find it in the fjord district of North-East Greenland, but it was all in vain.

There has been some confusion with respect to the chemical reaction with  $\text{CaCl}_2\text{O}_2$  in *Gyrophora fuliginosa*. In Lyngé: Studies l.c. the reaction "uncoloured by KOH as well as by  $\text{CaCl}_2\text{O}_2$  and by KOH +  $\text{CaCl}_2\text{O}_2$ " was attributed to it.

Th. Fries found a *Gyrophora* in Drivdalen, Dovre, near Kongsvoll (Norway), which he identified with *Gyrophora reticulata* (Lich. Scand. p. 166). The reaction of these plants was  $\text{CaCl}_2\text{O}_2$  +. Du Rietz has shown that Th. Fries here found *Gyrophora fuliginosa* Havås, Lyngé can only confirm his determination, as well as Th. Fries's record of the reaction. In order to clear up that question, Lyngé has again examined the reaction of our whole Norwegian material of *Gyrophora fuliginosa*, and found that it contains two types: One with a very distinct positive red reaction with  $\text{CaCl}_2\text{O}_2$  and a still more distinct reaction with KOH +  $\text{CaCl}_2\text{O}_2$ , and another type with no reaction with these reagents. Lyngé is unable to detect any morphological difference between them. — This is an interesting analogon to the *Gyrophora decussata* reaction.

<sup>1</sup> Dr. Porsild suggested a Labrador locality; he knew no Greenland traveller of that name.

Müller's *Gyrophora Wenckii* (the "*fuliginosa*" plants) is  $\text{CaCl}_2\text{O}_2 \div$ , and  $\text{CaCl}_2\text{O}_2 + \text{KOH} \div$ . The type plant of Havås (Lich. Norv. Exsic. No. 237) in our herbarium has a very distinct reaction with  $\text{CaCl}_2\text{O}_2$ . We can do justice to these facts by reserving the name *Gyrophora fuliginosa* var. *typica* Lyngé for the plants with a positive reaction with  $\text{CaCl}_2\text{O}_2$ , and the name *Gyrophora fuliginosa* Havås var. *Wenckii* (Müll. Arg. p. p.) Lyngé for the plants with a negative reaction.

The distribution in Norway is:

	var. <i>typica</i>	var. <i>Wenckii</i>
Aust-Agder:	Berdalsskaret (M. N. Bl.).	Berdalsskaret (M. N. Bl.)
Hordaland:	Granvin: Nesheimshorgje (Havås)	Svartegilet (Lid).
	Hardangervidda: Hårteignuten	Finsehøgen (B. L.).
	and Håkåhelleren (Havås).	
	Torfinnsdalen (Lid).	
	Lønehorgje (B. L.).	
	Finse, pluribi (Samuelsson, B. L.).	
Sogn og		
Fjordane:	Gloppen (Krogh).	
Møre:	Gruvedal: Lågtunga (Havås).	
	Romsdal: Slettafjell (Havås).	
Sør-		
Trøndelag:	Drivdalen pluribi, common	
	(Th. Fr., Du Rietz, B. L.).	
Opland:	Jotunheimen: Sjøkholelet and	Jotunheimen: Sikkils-
	Sikkilsdalen (Lid).	dalen (Lid) and Grjotli
		(Jebe).
Buskerud:		Haugastøl (B. L.)

It will be seen from this enumeration that there is no difference with respect to their geographical distribution, either of them can be identified in the same find. But var. *typica* is the commoner type in Norway. The Finnish plant of Häyrén is  $\text{CaCl}_2\text{O}_2 \div$ .]

### [*Gyrophora rigida* Du Rietz.

*Gyrophora rigida* Du Rietz Die Europ. Arten d. *Gyrophora* "anthracina"-Gruppe, Arkiv f. Botanik, vol. 19, No 12, p. 3, Stockholm 1925.

Syn. *Gyrophora anthracina* (Wulf.) Kbr. Th. Fries Lich. Scand. I, 1871, p. 165. Deichmann Branth et Grønlund Grønlands Lichen-Flora, 1888, p. 490.

We did not find this conspicuous species, though we were very eager to find it. We therefore suppose that Koerber's plant from East Greenland should be *Gyrophora decussata*. The large East-Arctic plants of that species are easily confused with *Gyrophora rigida*, (see the present paper, p. 56).

There are many fine and typical plants in the Copenhagen Greenland herbarium. Deichmann Branth writes "S. Gr.: hist og her indtil 4000 F." ("South Greenland: here and there up to 4000 feet"). All known Greenland localities are situated from the Julianehaab to the Holsteinsborg districts, with a distinct predominance of the former southern district. Its northern limit is Kangerdluarssuk in Holsteinsborg, about 67° N. There is not a single plant from the east coast<sup>1</sup>.

It would be of the greatest interest to study its distribution in the high American mountains. Its present distribution in Greenland is best explained by a southern immigration over Davis Strait.

It has neither been found in Spitsbergen, nor in Novaya Zemlya.

In the Scandinavian mountains it is typically a nunatak plant, found only in the high mountains that must have been nunataks during the ice age. It is common, in places plentiful, in our southern mountains, rarer northwards. It is found in the Scottish Grampians, but in the European Alps it is substituted by related species.

As shown by Du Rietz it is typically a western plant in the Scandinavian mountain flora.

It seems to us that in Scandinavia it must either be a plant of western immigration or a relic species from a widely distributed flora of old times. In accordance with the views, which we have repeatedly expressed in the present paper, we would give preference to the latter possibility.]

*Gyrophora hirsuta*. Lyngé has seen many Greenland plants, named *Gyrophora hirsuta*. All of them belonged to other species. Lyngé has seen no correctly determined Arctic plants. The climatic conditions in the Julianehaab district should not be too severe for it, to judge from its distribution in Norway.

*Parmeliopsis ambigua*. Hartz found it on *Betula* in Danmarks Øy and Røde Øy in Scoresby Sund, also on *Parmelia saxatilis*. (Deichmann Branth, 1894, p. 89). We did not find it.

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<sup>1</sup> During the reading of the proofs we received a few East Greenland plants, collected by the Norwegian botanist Bjørlykke at Umanak in South East Greenland.

*PARMELIACEAE.**Parmelia* Ach.*Parmelia subobscura* Vain.

Vainio Lich. Pitlek., 1909, p. 33. Lynge Lich. Nov. Zemlya, 1928, p. 191.

- I. Kapp Herschel. Claveringfjorden: Revet.
- II. Myggbukta.
- III. Moskusoksefjorden.
- IV. Sofiasundet: Rudbeckfjellet.
- V. Husbukta.
- VI. Dicksonfjorden.

It is widespread, found in all the fjords. But it is not at all plentiful, at Myggbukta it was fairly common on prominent stones and rocks (is it nitrophilous?), but otherwise it was quite scarce..

It ascends as high as a plant can live: Moskusoksefjorden up to 900 metres, and at Rudbeckfjellet it was found at 1600 metres by Brocchieri, F. Devold and Richter, certainly the highest record of an Arctic lichen.

The plants are often small and compact. Towards the centre of the thallus the lobes are sometimes so small that they are almost papillate. There are quite a number of such small, almost isidioid excrescences on the thallus. These exposed points are easily destroyed, and the decorticated parts of the thallus are very like soredia. In some plants they are so like real soredia that it is almost impossible to say whether they have originated as such or not.

Vainio himself writes "Utrum *P. physodes* var. *obscurata* Ach. . . ad hanc speciem, an ad *P. austerodem* . . . pertineat, incertum est". The 1929-material was more like *P. obscurata*, for the soredia or soredioid formations were small and scattered. Scholanders's 1930-material was much larger and better, and the said formations so well developed and in some plants so extensive that he simply refers his plants to *P. austerodes*.

*Parmelia intestiniformis* (Vill.) Ach.

Pl. V, fig. 2.

- I. Claveringfjorden: Revet and Daudmannsøyra.
- II. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt.
- IV. Sofiasundet, west of Robertsonøya.
- V. Husbukta. Veganeset.
- VI. Kapp Simpson. Kapp Petersens. Röhssfjorden. Dicksonfjorden.

It is widely distributed, quite common, and in places plentiful. It is best developed on the flat stones of the strand-wall, but it ascends as a fairly common species up to moderate elevations: Moskusoksefjorden 300 metres, Husbukta 360 metres, Kapp Petersens 400 metres, Clavingingøya 450 metres.

The variation is quite the same in this material as formerly described for Lynges's Novaya Zemlya material. — Only sterile plants were found.

We are quite convinced that it is specifically distinct from the *Parmelia encausta*  $\alpha$ . *multipuncta* (Ehrh.) Th. Fr. Lich. Scand. p. 118, but we have been unable to clear up the intricate question of their correct names. Miss A. L. Smith, London, has been kind enough to examine the type of *Lichen encaustus* Smith from Montauvert near Chamonix, described in Transact. Linn. Soc. 1791, p. 83. She refers this plant to the *intestiniiformis*. Our efforts to get to sight the type of *Lichen intestiniiformis* of Villars from Dauphiné or to get some information on it have been entirely without results.

Deichmann Branth records "*Parmelia encausta*" from Hekla Havn and var. "*intestiniiformis*" from several places in Scoresby Sund, e. g. the summit of Runde fjeld, "5000 feet" (D. B. 1894, p. 88). Galløe writes that "*Parmelia encausta*", with the var. *intestiniiformis*, occurs very frequently at Termometerfjeld, Danmarks Havn and Basiskær (p. 186). All the Greenland plants, which Lynges has seen, must be referred to *Parmelia intestiniiformis* (Vill.) Ach.; he has never seen *Parmelia multipuncta*.

Lynges has been unable to locate two of Vahl's localities in herb. Copenh.: Annutarsuk and Annuliarsuk. Some plants were removed to other species. There are many plants from South Greenland (Julianehaab district), from East Greenland, and also from the northernmost part of Greenland (leg. Wulff). It is not lacking in West Greenland north of the Julianehaab district, for it has been collected by Vahl as well as by Th. Fries. But if it had been common in West Greenland, we would have expected a richer material of this conspicuous species, which non-lichenological botanists could not have overlooked.

It is not improbable that it should be a species of more eastern distribution in Greenland. It was not found in Simmon's collection from Ellesmereland. The American continent west of Davis Strait is lichenologically a terra incognita, a most deplorable fact. — There are a few northern localities in Spitsbergen, *Parmelia intestiniiformis* is one of the lichen species that have presumably migrated to Spitsbergen by a very northern route. — It is common all over western Novaya Zemlya. We should expect it from Franz Josef Land, but it has not yet been collected there. — Common on the coasts of the Taimir Peninsula, but not recorded by Nylander in Enum. Lich. Freti Behringii.

*Parmelia pubescens* (L.) Vain.

I. Landingsdalen.

VI. Kapp Simpson. Antartichamna. Kapp Petersens. Holmvika.

Practically our whole material of the *P. pubescens* section is *P. minuscula* and not *P. pubescens*. The latter species was only found in a few localities, it is a rare species.

*P. pubescens* is a lowland species in our material, not found higher than 100 metres. It is a more southern type than *P. minuscula*.

Our plants are somewhat compact, as usual in the Arctic, but otherwise they are quite typical. — Several species of the *P. pubescens* section have been described from the eastern Arctic, viz. *P. Almqvistii* Vain., *P. nigra* Vain., and *P. striata* Lyng. We did our best to find these species in East Greenland, but we did not succeed. So far they have neither been found in Greenland nor in Spitsbergen.

*Parmelia pubescens* (or *lanata*) has repeatedly been recorded from North East Greenland: Kapp Dalton and Fleming Inlet (Vainio p. 128), Scoresby Sund, very common (Deichmann Branth, 1894, p. 89; Kapp Stewart and Hold with Hope (Malme p. 6); Shannonøya and "Fjordgletscher" (Koerber p. 76); Koldeweyøya, Termometerfjellet, Danmarks Havn and Basiskær (Galløe p. 187). — Several of these records are supposed to be based on plants of the related species *Parmelia minuscula*, which is more common in North East Greenland.

The number of Greenland plants in the Copenhagen herb. is very considerable, suggesting a common and widespread species. There are also plants from a nunatak (not named, leg. Kornerup 26. 7. 1878). — Hartz's plants from Danmarkøya in Scoresby Sund are this species, not *Parmelia minuscula*.

*Parmelia minuscula* Nyl.

Pl. VI, fig. 1—3, 6.

*P. minuscula* Nyl. — Vain. Lich. Pitlek., 1909, p. 29, ubi syn. Lyng. Lich. Nov. Zemlya, 1928, p. 193.

I. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet. Finschøya.

II. Loch Fyne. Jacksonøya. Myggbukta. Terneøya. Kapp Bennett.

III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Blomsterbukta. Reinbukta. Kjerulffjorden.

IV. Celsiusberget. Sanddalen.

V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.

VI. Antartichamna. Holmvika. Segelsällskapets fjord: Monte Carmela. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.



A species cannot possibly be more common and more widespread than *P. minuscula* is in these fjords. We have certainly seen it every day ashore. It is equally abundant everywhere. — It is usually sterile, but a few fertile plants were found.

*Parmelia minuscula* ascends as high as any other lichen: Kapp Herschel 650 metres, Clavingøya 1200 metres, Celsiusberget 1250 metres, Moskusoksefjorden 1350 metres, Monte Carmela 1600 metres.

The type of *P. minuscula* is a small plant with very short internodia, rarely surpassing 0.5 mm, divaricately and intricately branching, but yet so "macra" that the substratum is more or less distinctly seen between the branches. The branches are more or less nodulose, but if they are very thin, a good lens is necessary to see it.

Such plants have been distributed in Krypt. Exsic. Vindob. No. 1971, collected by Lång in Northern Finland: Enontekis. They are very common in our Greenland material: f. *aperta* Lyngé n. f.

In more luxuriant plants the branching may become so intricate that the underlying stone is quite covered and hidden by the plant: f. *luxurians* Lyngé n. f. Typus from Kjerulffjorden.

These formae have terete branches. In a large part of our Greenland material the branches are more or less flattened. The substratum is hidden by the connivent branches. At the margin there are the torulose, divaricate, applanate branches, spreading in a flabelliform manner. Towards the centre the applanate lobes often decay, but they abundantly regenerate thin, much branched and very intricate shoots. This regeneration is very characteristic of *P. minuscula*. We have never seen it in *P. pubescens*. The name f. *applanata* Lyngé n. f. might be appropriate for this forma. The type from Kjerulffjorden.

The applanate branches are sometimes so connivent that they fuse into an almost crustaceous thallus towards the centre : f. *crustacea* Lyngé n. f. The centre is ultimately quite areolated, with broad and deep fissures. A regeneration of new branches is often seen. The type from Jacksonøya.

*Parmelia Almquistii* Vain. Lich. Pitlek., 1909, p. 32, Lyngé Lich. Nov. Zemlya, 1928, p. 196 et pl. II, fig. 23, has the same crustaceous areolated thallus, but it is a coarser plant and its rigid marginal branches have the branching of *P. stygia* more than that of *P. minuscula*.

We have carefully attempted a specific distinction between the terete and the applanated formae, but it was in vain. They are too confluent. Our colleagues might, however, be of another opinion on that point. In order to facilitate future studies a very substantial material has been reserved for the Oslo herbarium.

The diagnoses of the above mentioned formae might be thus arranged:

Lobi torulosi-teretes

Lobi aperte ramosi . . . . . f. *aperta* Pl. VI, fig. 2.

Lobi valde intricate ramosi . . . . . f. *luxurians* Pl. VI, fig. 1.

Lobi applanati, in centro saepe ramis  
secundariis tecti vel substituti

Lobi centrum versus subconniventes . . . f. *applanata* Pl. VI, fig. 3.

Lobi centrum versus subcrustiformiter

confluentes . . . . . f. *crustacea* Pl. VI, fig. 6.

*Parmelia minuscula* has been recorded from Hold with Hope (Malme p. 6).

There are remarkably few plants in the Copenhagen Greenland herbarium. We cannot conclude from this that it should be rare anywhere in Greenland. More probably botanists, who are not trained lichenologists, have neglected it, regarding it as young or badly developed *Parmelia pubescens*.

### *Parmelia stygia* (L.) Ach.

#### III. Moskusoksefjorden.

It is a very rare species, detected only once. The locality is in the lowland.

Recorded from Scoresby Sund, "very common" (Deichmann Branth 1894, p. 89), "Fjordgletscher" (in Franz Josef Fjord?) and Shannonøya (Koerber p. 76), and Varde Ridge (Galløe p. 186).

In reality it is a rare, perhaps a very rare species in Greenland. It has largely been mistaken for other species. I have seen many plants of *Parmelia granulosa* named *Parmelia stygia*. The same is the case with the broadly lobed Arctic formae of *Parmelia minuscula*. In the Copenhagen herb. Lynge found typical plants only from Nanortalik near Kapp Farvel (Vahl) and from Holsteinsborg (Vahl). Wulff's plants from Northern Greenland (I. P. Kochfjorden and Centrumøya) are small and very compact. Lynge referred them to *Parmelia stygia* (Lich. North Coast of Greenl., 1923, p. 286). He will do the same now, although with considerable doubt. But the third plant, from Low Point, is *Parmelia minuscula*.

### *Parmelia alpicola* Th. Fr.

#### VI. Kapp Simpson.

It is quite as rare as *P. stygia*, found only once, near the beach. In the Arctic *P. sorediata* is often very little soerdiate. It can then be confused with *P. alpicola*. Arctic records of the latter species should be cited with some caution.

*Parmelia alpicola* has been recorded from Scoresby Sund: Summit of Rundefjell, and Rødeøya (Deichmann Branth, 1894, p. 88), "Fjord-gletscher" (in Frans Josefs Fjord?, Koerber p. 76), Hold with Hope (Malme p. 6), Danmarks Havn (Galløe p. 186). In Arctic herbaria Lynge has seen *Parmelia intestiniformis* determined as *Parmelia alpicola*. In the Copenhagen herbarium Lynge only found few plants of *Parmelia alpicola* genuina: Rittenbenk (Vahl), Umanak (Eberlin), Fiskerneset (Vahl), Nanortalik (Eberlin). A plant from Scoresby Sund: Danmarksøya (Hartz) is *Parmelia granulosa*.

*Parmelia groenlandica* Lynge n. sp.

Pl. V, fig. 1.

*Thallus parvus*, 3 cm. non superans, *mollis*, cortex superior fissuris crebris irregulariter ruptus et eam ob causam minute granulato-areolatus et subcorrosus. *Thallus in parte juniore marginali* (1 cm.) *pallide sulphureus*, centrum versus emortuus et magis cinerascens. Lobi substrato adpressi, depresso-convexi, breves, sublineares, crenato-sinuosi, mox arcte confluentes, isidiis sorediisque destituti, sed ob corticem corrosum spurie sorediati videntur.

Gonidia diam. 12—14  $\mu$ , in glomerulis dispersis disposita. Medulla alba, hyphae medullares adpersae et valde indistinctae. Cortex inferior 15—20  $\mu$  altus, hyphae articolatae, articulae exteriores infuscae.

Medulla J  $\div$ , KOH  $\div$ .

Apothecia et pycnides desunt.

VI. Röhssfjorden, pluribi.

The upper cortex is so soft and so destroyed by the numerous cracks that it looks like dispersed soredia. The gonidia, which are exposed to the air, die and the whole thallus is destroyed, resulting in a centrifugal manner of growth. Sporulation in the gonidia was often seen.

The plants differ from *Parmelia centrifuga* by their pale sulphur colour, *Parmelia centrifuga* is "virescenti-ochroleucus" (Th. Fr. Lich. Scand. p. 128). The colour agrees fairly well with that of *Parmelia Birulae*. But that species has another branching, with divaricately furcate, discrete lobes. The branching of *Parmelia groenlandica* is more like that of *Parmelia centrifuga*. I have been unable to get to sight a plant of *Parmelia separata* (Th. Fr. Lich. Engl. Polar Exped. 1879, p. 353). There is no such plants in the London museums.

As no pycnides are present we cannot exclude the possibility of a *Parmeliopsis*. Its colour is in reality nearer to *Parmeliopsis ambigua* than to any other plant, known to us. But there is not a trace of the globular soredia, which are so characteristic of that species. We sent

a plant to A. H. Magnusson, Göteborg, who did not know it. He also rejected the possibility of a *Parmeliopsis ambigua*.

There are, then, only two possibilities: either a new variety of *Parmelia centrifuga*, differing from the type in the colour and the reduced size, or a new species. Scholander found absolutely identical plants in two places, on the north side of the head of the fjord, and on the south side of the fjord, three km from the head. This is in favour of the latter view.

In the Copenhagen herbarium *Parmelia centrifuga* is one of the best represented *Parmeliae* from the west coast of Greenland as far north as Disko. But there is not a single plant that can be compared with *Parmelia groenlandica*. All the plants are quite typical.

### *Parmelia sorediata* (Ach.) Th. Fr. p. p.

Pl. VI, fig. 7.

*Parmelia sorediata* (Ach.) Th. Fr. Lich. Arct. (1860) p. 56 p. p.  
*Parmelia sorediata* var. *borealis* Lyng. Lich. Nov. Zemlya (1928) p. 199.

Thallus isidiis dispersis, bene limitatis, globosis, deinde sorediose fatiscentibus et tum albidis, in apicibus ramorum evolutis et saepe distincte stipitatis, instructus. Lobi magis discreti, saltem in arcticis interdum distincte pinnato-ramosi, subopaci, fusci vel obscure fuscescentes.

Apothecia nobis ignota.

II. Myggbukta.

III. Kapp Humboldt.

VI. Kapp Petersens.

In North East Greenland it is a rare lowland plant. It prefers low depressions in the rocks that are occasionally irrigated. It has no distinct coprophilous tendency.

In the Copenhagen Arctic herbarium Lyng. found this species, collected in Scoresby Sund, Rødeøya, by N. Hartz, named *Parmelia olivacea* var. *sorediata* (Deichmann Branth, 1894, p. 88).

See *Parmelia granulosa*.

### *Parmelia granulosa* Lyng. n. sp.

Pl. VI, fig. 4.

*Parmelia sorediata* var. *coralloidea* Lyng. Lich. Nov. Zemlya (1928) p. 200.

Thallus isidiis magis confluentibus, depresso granuloso-verrucosis, deinde interdum crateriformibus, instructus. Lobi magis contiguae, vulgo plus minusve imbricati, fusco-nigrescentes, nitiduli.

Apothecia in Groenlandia rarissima; vide Lyng. Studies Lich. Flora Norway, 1921, p. 161.

- I. Kapp Herschel. Claveringfjorden: Revet. Finschøya.
- II. Loch Fyne. Jacksonøya. Myggbukta. Terneøya.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Blomsterbukta. Reinbukta.
- IV. West of Robertsonøya. Sanddalen.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Kapp Petersens. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.

This species is quite as common as the former is rare. It is found practically all over the district on large stones and prominent rocks. It is somewhat nitrophilous, but it is not a member of the typically nitrophilous associations of the bird-stones. It has a distinct predilection for dry localities. — By far the greater part of the material was collected in the lowland, but it ascends to very considerable elevations, in Moskusoksefjorden to 1350 metres above sea-level.

Scholander was fortunate enough to find a fertile plant in Röhssfjorden.

Practically the whole Novaya Zemlya material is *Parmelia sorediata*; we have again revised the material, and we can only find three good plants of *Parmelia granulosa*. It was therefore very astonishing to find the inverse relation in East Greenland. In the Arctic the latter species is evidently chiefly a western species, the former chiefly an eastern.

In addition to the morphological difference there is, accordingly, a geographical difference. That has resolved me to give them specific rank. I have also taken the opportunity to change the name *coralloidea* into the more appropriate *granulosa*.

In the Copenhagen herb. Lynge found the following Greenland plants: West Greenland: Holsteinsborg and Qaqortoq (Julianehaab), leg. Vahl. East Greenland: Scoresby Sund: Hekla Havn and Danmarkøya, leg. Hartz.

It is very probable that "*Parmelia olivacea* var. *prolixa*" in Deichmann Branth, 1894, p. 88 is this species (from Kapp Stewart). Its soredia are often so poorly developed that a confusion is possible.

### *Parmelia infumata* Nyl.

Pl. III, fig. 5.

Nylander Addenda Nova, Flora, 1875, p. 539, Zahlbruckner Cat. Lich. IV, 1930, ubi syn. Lynge Lich. Nov. Zemlya, 1928, p. 201, Lich. Franz Josef Land, 1931, p. 20.

Exsic.: Krypt. Exsic. Vindob. 2964, Magnusson Lich. sel. Scand. 10, Suza Lich. Bohem.-slov. 109.

- I. Landingsdalen. Kapp Herschel. Claveringfjorden: Soppbukta and Revet.
- II. Loch Fyne. Kapp Stosch. Jacksonøya. Myggbukta. Terneøya.
- III. Moskusoksefjorden. Dusénfjorden. Blomsterbukta. Kjerulffjorden.

IV. Sofiasundet: west of Robertsonøya and Sanddalen.

V. Husbukta. Veganeset.

VI. Kapp Petersens. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.

Found all over the region as one of the commonest and most characteristic lichens on bird-stones and prominent rocks, where birds like to rest. Other characteristic members of this ornithocoprophilous association are *Xanthoria candelaria*, *Physcia tribacia*, *Lecanora melanophthalma*, *Caloplaca elegans* and, on the vertical sides of the stones, *Rinodina Hueana*, (the *Rinodina oreina* in Greenland literature).

In suitable localities it is equally common at the head of the fjords as along the coast. It ascends to very considerable elevations, Kapp Petersens 400 metres, Clavingøya 600 m, Moskusoksefjorden 1350 m.

In the Arctic it is a species of western distribution, as repeatedly stated in Lyngé's above mentioned papers. — We do not know whether it is found in Brenner's collections from Yenisei.

*Parmelia infumata* has only once been recorded from Greenland (J. P. Kochfjorden, leg. Wulff, in Lyngé Lichens North Coast Greenland, 1923, p. 285. It is practically certain that Koerber's *Imbricaria olivacea* from Sabineøya (p. 76), and *Parmelia olivacea* var. *fuliginosa*, Deichmann Branth, 1894, p. 88) are this species.

In the Copenhagen herb. Lyngé has found plants from Disko: Godhavn, leg. L. Smith, Scoresby Sund: Danmarksø, leg. Hartz, and from J. P. Koch fjorden, leg. Wulff. It is evidently a northern plant in Greenland, at least there are no plants from South Greenland. — There is also a plant from Iceland: Hof (Daviðsson).

#### *Parmelia saxatilis* (L.) Ach.

VI. Röhssfjorden.

The whole *Parmelia saxatilis* section is very poorly represented in East Greenland in the fjord district. This species was found only once, in the lowland in one of the southernmost fjords. The few plants are large and well developed, covered with isidia.

Deichmann Branth writes that it is very common in Scoresby Sund, which is probable. Our record is supposed to be its northern limit of distribution in East Greenland.

In the Copenhagen herb. there are many plants from the whole coast between Upernivik in West Greenland and Scoresby Sund in East Greenland. It must be common all over this region. Many of them are very isidiate, referred to var. *sphaerophoroidea* Linds.

*Parmelia omphalodes* (L.) Ach.

## I. Landingsdalen.

Quite as rare as *Parmelia saxatilis*, found only once.

Recorded from North East Greenland by Deichmann Branth: common in Scoresby Sund (DB. 1894 p. 88), and by Galløe from Termometerfjeld near Danmarks Havn (G. p. 186).

In the Copenhagen herb. there are several plants, some of them referred to *Parmelia saxatilis*, from East Greenland, also from South West Greenland and — more scarcely — also farther north, at Disko, leg. Porsild, and Upernivik, 1887, leg.?

*Parmelia sulcata* Tayl.

## V. Veganeset.

## VI. Röhssfjorden.

Fairly plentiful, where we found it. The plants are fine and typically developed. — But it is almost as rare as the other two species of this section. — Here as elsewhere in the Arctic a coprophilous species.

*Parmelia sulcata* is remarkably rare in Greenland. In the Copenhagen herb. Lyngé only found it from Davis Sund, locality not stated. (Vahl) and from the Julianehåb district in South Greenland: Nanortalik (Eberlin) and Tunugdliarfik (Vahl). Our localities represent an interesting extension of its known range in Greenland.

Notes on Greenland *Parmeliae* in the Copenhagen herb.

*Parmelia aspidota*. It is lacking in the Greenland herb., but there are several plants from Iceland.

*Parmelia centrifuga*. It is one of the best represented species of its genus from the west coast as far north as the Disko district. But there is not a single plant from the east coast. All the plants are absolutely typical, within the known limits of variation of this common northern species. *Parmelia Birulae* is not found in the collection. *Parmelia separata* is so far a mystery. There is a minute fragment in Upsala, and nothing in London, neither at Kew nor in the British Museum.

*Parmelia conspersa*. Lyngé has seen four plants, three of them from the Julianehåb district in South Greenland, and one from the Godthåb district (64° N.). All of them are typically *Parmelia conspersa*, with coarse isidia, excluding *Parmelia stenophylla*.

*Parmelia incurva*. It is also a southwestern plant in Greenland; there are three plants from the Julianehåb district, leg. Vahl, and one from Disko, leg. Margr. Smith.

*Parmelia olivacea* (L.) Nyl. There are two typical plants from South West Greenland: Tunugdliarfik in the Julianehåb district, ad cort. *Betulae albae*, and "Baals Revier", ad cort. *Alni repentis*, either of them collected by Jens Vahl, who has done more for the exploration of the Greenland lichen flora than any other botanist.

*Parmelia physodes* (L.) Ach. There are two plants: Nanortalik in the Julianehåb district, leg. Eberlin, and Ameralik in the Godthåb district farther north, leg. Vahl. The plants are of the common alpine type, well known from our own mountains, not much sorediated, but otherwise typical.

### *Cetraria* Ach.

#### *Cetraria hepatizon* (Ach.) Vain.

- I. Claveringfjorden: Revet.
- II. Myggbukta: Terneøya.
- III. Kapp Humboldt. Moskusoksefjorden.
- V. Scott Keltie-øyaner: Gåsøya. Veganeset.
- VI. Kapp Simpson. Antartichamna. Mainland near Archerøya. Kapp Petersens. Röhssfjorden.

Fairly common, in places almost plentiful. It is more a lowland species than many other lichens, at Husbukta it was found at 360 metres, Kapp Petersens 400 m, 500 metres in Claveringfjorden. It was not collected higher than 900 metres, in Moskusoksefjorden.

Fertile plants are very rare, only a few were detected.

It varies much. Some plants are very incise, they may be referred to Nylanders f. *polyschiza*. Th. Fries writes that this is only a forma "varietatis nomine vix digna", we have also found it little significant.

The lobes are sometimes almost plane, especially in old plants. Such formae call to mind small *Parmelia omphalodes* or *P. stygia*, if they are nitidous. But young lobes are always more or less concave, and some papillae are always seen.

We were both much interested in finding *Cetraria fahlunensis* (L.) Vain, but did not succeed. All the plants were blackish beneath, apart from some ascending marginal lobes. It is not always possible to determine the plants habitually with absolute certainty, accordingly the pycnoconidia were always examined. In a few plants they were not found, in all the others they were of *hepatizon*-type: "tenuia, elongata, utrumque versus apicem incrassata" (Th. Fries Lich. Scand. p. 108).

Lynge has examined the pycnoconidia of several hundreds of Arctic plants, which he has collected, but he has never been able to find *Cetraria fahlunensis* (L.) Vain. = *C. commixta* (Nyl.) Th. Fr. The hyphae of this species are very adspersed, and the small granules that are



detached from the hyphae, can be mistaken for pycnoconidia. Only pycnoconidia seen in the act of ejaculation are quite convincing.

We wish to mention that Scholander found pollen of *Pinus silvestris* on the thallus of one plant (Mainland near Archerøya, which he examined for pycnoconidia in the Botanical Museum, Oslo. But we do not venture to suggest that the plant had received the pollen in Greenland. It is more probable that it had been transferred from the paper used for the drying of the plant.

The Botanical Museum of Copenhagen has allowed us to study its Arctic material of "*Cetraria commixta*". We found good pycnoconidia in each plant, and the result was:

*Cetraria hepatizon*. Greenland: Danmarks Ø (Hartz 1892), Kangarsuk (Kolderup Rosenvinge 1888). Iceland: Skagafjörður: Viðvík (Zofoniasson).

*Cetraria fahlunensis*. Greenland: Sukkertoppen (Warming 1884), Karsak (Eberlin 1885), "Grønland" (Borck).

It is evident that *Cetraria fahlunensis* is not lacking in the Arctic, if we can call Sukkertoppen Arctic (West Greenland between 65° and 66°.) We have been unable to trace the position of "Karsak".

*Cetraria hepatizon* has been recorded from Turner Sund (Vainio p. 127). "*Parmelia fahlunensis* (L.)" is "very common" in Scoresby Sund (Deichmann Branth p. 89). Deichmann Branth further records "*Parmelia commixta* (Nyl.)" from Danmarks Ø: "spermatia ellipsoidea, unum alterumve apice incrassatum" (l. c. p. 89). Vainio records "*Cetraria fahlunensis* var. *Groenlandica* Vain." from Kapp Dalton, with description (Vain. p. 127).

### *Cetraria nivalis* (L.) Ach.

- I. Landingsdalen. Kapp Herschel. Claveringfjorden, pluribi. Finschøya.
- II. Loch Fyne. Kapp Stosch. Myggbukta. Terneøya. Kapp Bennett.
- III. Kapp Humboldt. Moskusoksefjorden. Blomsterbukta.
- IV. Sofiasundet, pluribi.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Mainland near Archerøya. Kapp Petersens. Holmsvika. Röhssfjorden. Dicksonfjorden. Ellaøya.

One of the commonest and most widespread lichens of this region. Sometimes it is so plentiful that real lichen heaths are developed, e. g. in Myggbukta, but such places are not numerous.

It is common in all elevations, and ascends to the highest points attained: Kapp Herschel 360 m, Loch Fyne 360 m, Dicksonfjorden 400 m, Claveringøya 500 m, Husbukta 580 m, and Moskusoksefjorden 1350 metres above sea-level.

In this region *Cetraria nivalis* is well developed, though never large. Fine plants were collected up to 1350 metres. — Apothecia were never found.

As was to be expected, all authors on North East Greenland lichens have found this species in their collections: Scoresby Sund, apothecia are not rare (Deichmann Branth, 1894, p. 88), Henry Land (840 metres), Kapp Greg, Kapp Dalton (Vainio p. 127), Hvalrosøya, and Sabineøya (Koerber p. 76), Kapp Bismarck (Deichmann Branth, 1907, p. 13), Termometerfjell, Danmarks Havn, "The Bay", Snenes (Galløe p. 186).

### *Cetraria cucullata* (Bell.) Ach.

- I. Claveringfjorden: Revet.
- II. Loch Fyne. Myggbukta. Terneøya. Kapp Bennett.
- III. Kapp Humboldt. Moskusoksefjorden.
- IV. Sofiasundet: west of Robertsonøya.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Mainland near Archerøya. Kapp Petersens. Holm-vika. Röhssfjorden. Dicksonfjorden.

Common and widespread, but generally not plentiful (e. g. Veganeset). It is a lowland lichen that rarely ascends as high as 400 metres. (Kapp Petersens).

Often found between the shrubs (*Dryas*, *Andromeda tetragona* and others). We have only found sterile plants which generally are small and slender, much smaller than in Norway. On Terneøya there are many birds, and the plants are coarse and overfed, as usual in such localities.

Recorded from Scoresby Sund, scattered ("hist og her", Deichmann Branth 1894, p. 87), Kapp Greg (Vainio p. 127).

### *Cetraria crispa* (Ach.) Nyl.

- I. Landingsdalen. Claveringfjorden: Revet.
- II. Loch Fyne. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt.
- IV. Sofiasundet, pluribi.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Mainland near Archerøya. Kapp Petersens. Röhssfjorden.

Common and widespread all over the region. It is more a lowland than an alpine plant, but it was found as high as 600 metres (Claveringøya) and 900 metres (Moskusoksefjorden).

Often smaller and more slender than in Norway.

All the plants of the *Cetraria islandica-crispa* section are narrow, with more or less connivent margins, as usual in the Arctic. Formerly Lyngé unhesitatingly called such plants *Cetraria crispa*. But Magnusson has called my attention to Vainio's diagnosis in Lich. Pitlek. (1909) p. 21: *Cetraria islandica*: "Thallus laciniis . . . . . maculis decorticatis albidis inspersis in latere inferiore instructus", and *Cetraria crispa*, his *Cetraria islandica* var. *tenuifolia*: "Thallus laciniis . . . . . maculis decorticatis albidis fere solum sub margine recurvo lateris inferioris instructus".

After that he referred some of Lyngé's *Cetraria crispa* plants from Novaya Zemlya to *Cetraria islandica*. I would also do the same (e. g. plants from the Admiralty Peninsula). A few of our East Greenland plants have these laminar "maculae" and they are named *Cetraria islandica* in this paper. But the "maculae" are very small and easily overlooked, and the plants are crisp, with more or less connivent margins, at least towards the apices. The specific difference is much less distinct in the Arctic than in southern regions. The same is the case with some plants of other genera also, e. g. *Dermatocarpon hepaticum* and *Dermatocarpon lachneum* (= *Dermatocarpon rufescens*).

*Cetraria crispa* has been recorded from Kapp Stewart (Malme p. 6). and from Scoresby Sund (Deichmann Branth, 1894, p. 87).

*Cetraria islandica* has been recorded from Scoresby Sund, common, it ascends to the summit of Runde Fjell, 5000 feet s. m. *F. platyna* is rare in Scoresby Sund. (Deichmann Branth, 1894, p. 87). Kapp Bismarck (Deichmann Branth, 1907, p. 13). Termometerfjell (Galløe p. 185).

### *Cetraria islandica* (L.) Ach.

I. Claveringøya: Daudmannsøya.

V. Scott Keltie-øyane: Gåsøya. Husbukta.

A rare lowland species, found only up to 360 metres. In the Arctic it is perhaps more nitrophilous than *Cetraria crispa*, which see.

### *Cetraria Delisei* (Bory) Th. Fr.

I. Landingsdalen. Claveringfjorden: Revet and Daudmannsøya. Finschøya.

II. Loch Fyne. Myggbukta. Kapp Bennett.

III. Moskusoksefjorden. Kapp Humboldt.

IV. Sofiasundet pluribi.

V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganaset.

VI. Kapp Simpson. Antarctichamna. Kapp Petersens. Mainland near Archerøya. Holmvika. Röhssfjorden. Dicksonfjorden.

Certainly the commonest *Cetraria* in this district, and one of the most plentiful lichens, here as elsewhere in the Arctic. It is no alpine lichen.

There are few localities higher than 250 metres, e. g. Claveringøya: 260 m, but in favourable places it ascends to 900 m. (Moskusoksefjorden).

*Cetraria Delisei* is less variable here than in many other Arctic regions. Practically all our plants are pulvinate and very lacerate, the ends of the branches are often so acute that the plant resembles *Cornicularia aculeata*. Hardly a single plant has so broad thalli that it can be referred to another forma than the "*Cetraria hiascens* var. *Delisei* (Bory) Vain." The colour is dark, brownish, paler plants are very rare.

*Cetraria Delisei* has been recorded from Scoresby Sund: Hekla Havn and Nordvestfjorden (Deichmann Branth, 1894, p. 87), Henry Land (840 metres), Skjærgårdshalvøya, Turner Land, Kapp Dalton (Vainio p. 127), Hold with Hope and Kapp Parry (Malme p. 6).

*Cetraria nigricans* has been recorded from Hold with Hope (Deichmann Branth, 1894, p. 87). In Norway it is strictly a north-eastern species.

### *Cornicularia* Ach.

#### *Cornicularia aculeata* (Schreb.) Ach.

Du Rietz Vorarbeiten zu einer Synopsis Lichenum, 1926, p. 35, ubi syn.

- I. Kapp Herschel. Daudmannsøya.
- II. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt. Kjerulfjorden.
- IV. Sofiasundet.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Mainland near Archerøya. Kapp Petersens. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.

Most probably found all over our region as a common species. It is common all over the arctic, found in practically every arctic collection.

It ascends to very considerable elevations: Dicksonfjorden 480 metres, Claveringøya 500 m, Husbukta 580 m, Moskusoksefjorden 1350 m. Scholander says that it is common up to the highest mountains, which he climbed. The plants from Moskusoksefjorden (1350 metres) are fine plants, more spinulose than usual.

*Cornicularia aculeata* is common in Scoresby Sund, near the sea as well as in the more continental parts of the fjord (Deichmann Branth, 1894, p. 87). Termometerfjell (Galløe p. 185).

It is evident from the herb. material, as well as from literary records, that this species is common all over the coasts of Greenland, from the southernmost to the northernmost point.

*Cornicularia racemosa* Lynge n. sp.

Pl. VII, fig. 2.

*Cetraria aculeata* var. *sorediata* DR. Die Sored. und Isid. d. Flechten, Svensk Bot. Tidsskr., 1924, p. 387.

Thallus fruticulosus, usque ad 2 cm altus, divergenter racemosus, versus apicem crebre divergenter furcatus, rami tereti, minute lacunosi, ad angulos plus minusve dilatati et profundius lacunosi. *Rami sorediis capitatis, albidis, diam. 0.5—0.7 mm, rarius usque ad 1 mm, terminati, graciles* (praecipue rami sorediiferi), nitidi, epruinosi, obscure castanei, versus basin pallidius colorati, magis fusco-rubentes.

Thallus fistulosus: extus stratum chondroideum, intus cavus vel hyphis laxissime arachnoideis pro parte repletus. Stratum chondroideum extus anguste fusco-nigrescens, praeterea incolor, hyphae chondroideae valde pachydermaticae, 15—20  $\mu$  crassae, refractivae, in parte exteriori (25—50  $\mu$ ) axi plus minusve perpendiculares (cortex, sec. Hue Lich. Extra-Eur, No. 169), praeterea axi magis paralleles vel in omnes partes currentes (medulla, sec. Hue l. c.). Stratum chondroideum crassitudine valde varians, 90—175  $\mu$  (in eodem sectione). — Gonidia infra stratum chondroideum sparse adsunt, plus minusve glomerata, diam. 10—15  $\mu$ . — Hyphae arachnoideae granulis adspersissimae, pachydermaticae, 5—7  $\mu$  crassae.

Stratum chondroideum J fere immutatum (leviter rubescens), KOH colorem non mutat.

II. Myggbukta, 145 metres (typus).

V. Husbukta, 15 km west of the Bay, 360 metres.

If well developed its branches with the capitate apical soredia are not unlike the racemes of *Vitis*.

Du Rietz has described a sorediate variety of *Cornicularia aculeata*, which I have not seen. It seems to me that the very characteristic soredia of the Greenland plants justify a specific distinction. If they had only been found once, the question would have been more doubtful, but Scholander found it in two localities, though very sparingly. — Many branches are sorediate as described, but some branches in the same plants are not sorediate. This fact is perhaps against a specific explanation, and in favour of a mutation of some branches.

*Cornicularia divergens*, "formae minores", has been recorded from Scoresby Sund by Deichmann Branth, 1894, p. 87.

We did not find it, Scoresby Sund is, perhaps, its northern limit of distribution in East Greenland. There are many fine plants in the Copenhagen Greenland herb. But some of the plants, named "*divergens*" should be compared with *Alectoria nitidula*, which is evidently a western species in the Scandinavian flora.

*Cornicularia odontella* has been recorded from Scoresby Sund (Deichmann Branth, 1894, p. 87) and from several places as far north as Danmark Havn: Termometerfjell, "The Bay", Snenes, Stormkapp and Danmarks Havn (Galløe p. 185).

We have not seen these plants. In the Scandinavian peninsula it is strictly an eastern lowland species. There is only one find from Norway: Kolsås near Oslo. The plants from Visted in Våge (Th. Fries Lich. Scand., p. 100) are *Cornicularia aculeata*.

## USNEACEAE.

### *Evernia* Ach.

#### *Evernia mesomorpha* Nyl.

#### var. *gracilis* Lynge nov. var.

Pl. VII, fig. 5.

- II. Myggbukta, at the cairn on a mountain near the Norwegian radio station, 220 metres above sea-level.

*Thallus pallide flavescens, decumbens, brevis*, 3 cm non superans, satis rigidus, crebre, versus apicem intricate divergenter furcatus, longitudinaliter lacunosus, hinc inde granulosis vel ramulis secundariis, brevibus instructus, *deinde sorediose fatiscentibus*. Caules primarii compressi, vulgo circiter 1 mm lati, rarius usque ad 2 mm, versus apicem magis teretes.

Differt a typo thallo minore, magis intricate ramoso et minus intense soredioso.

*Thallus radialis, undique corticatus*. Cortex 25—50  $\mu$  crassus, hyphae corticis indistinctae, 12—18  $\mu$  crassae, adpersae, connexo-ramosae, valde pachydermaticae, in parte exteriori flavo-fuscescentes, in parte interiori pallidius coloratae. — Hyphae medullares adpersae, 5—8  $\mu$  crassae, pachydermaticae. Medulla arachnoidea, axes chondroidei omnino desunt. — Gonidia glomerata, glomeruli diametro 50—70  $\mu$ , dispersi vel suis locis magis approximati.

Medulla J ÷, CaCl<sub>2</sub>O<sub>2</sub> ÷, KOH ÷.

This is one of our most interesting finds, for *Evernia mesomorpha* has never been found in Greenland. As far as we know it has only once been found in the arctic. (Konyam Bay and Port Clarence).

It differs from *Evernia esorediata* (Müll. Arg.) DR. and from *Evernia arctica* (Elenk. et Sav.) Lynge by the presence of soredia. But these isidioid soredia are never so well developed as in European plants. We are not astonished at this, for in the arctic soredia are never so well developed as in the same species, when growing farther south.

In *Letharia vulpina* we found one or two main axes, surrounded by an indefinite number of thin axes. We would regard that structure

as generically different from the single central axis of the genus *Usnea*, as we have seen it in our northern species.

But the texture of the axes is the same in *Letharia vulpina* as in *Usnea*: refractive, corneous strangs, which readily separate from the surrounding layers. — The so called axes of *Letharia mesomorpha* are quite different. In cross sections the few and thin "axes" are hardly more refractive than the surrounding medullary hyphae, and they are only formed of common medullary hyphae that unite, forming more compact strangs than the surrounding arachnoid medulla.

It seems justified to use the genus name *Letharia* for the few species that have "axes chondroideos plures vel pro parte unitos", as Zahlbruckner (Natürl. Pflanzenfam., Flechten, 1926, p. 239), and Du Rietz (Om släktene Evernia (Ach.), Letharia (Th. Fr.) Zahlbr. etc., 1926, p. 90) have done it.

The habitus of the small Greenland plants is so different from the European plants that many authors would hesitate to refer them to the same species, and with good reason.

If a cross section is placed in lactic acid, heated and stained with chlor zinc iodide, the air will be removed from the adspersed medullary hyphae, and the medulla and the gonidia can be studied. — The gonidia are seen in small glomeruli, scattered in the medulla, they are not numerous. — The hyphae of the firm cortex are very indistinct. To make them more visible, clear the section with KOH, remove the KOH with water and stain with chlor zinc iodide. Their cell lumen is then seen as very thin, much branched lines. Near the surface they are more parallel, suggesting a palissade parenchyme.

These slender Greenland plants are very like the figure of *Evernia mesomorpha* in Gunnar Nilsson's Lichen. bidrag III (1930), p. 353. Nilsson's plants are northern, collected in Lule Lappmark in Sweden.

*Dufourea ramulosa* Hook. = *muricata* Laur. has been recorded by Galløe from Snenes near Danmarks Havn, about 76° 40' on the East coast (G., p. 190). It was an addition to the lichen flora of Greenland. Since then it has been collected by Th. Wulff at Lemming Fjord and Centrum Island in the northernmost part of Greenland. (Lyng Lich. North Coast Greenland, p. 283. — There is a lapsus in my note on this species: the name *ramulosa* has been written instead of *madreporiformis*. — There is an unpublished Greenland locality in Th. Fries's collections from 1871: Disko: Nordfjorden. — We did not find it. In Greenland it is accordingly a strictly northern species.

It is an almost circumpolar species. In Spitsbergen there are several localities, but only from the northernmost parts. In addition to Th. Fries's records in Lich. Spitsb., p. 10 (Wijde Bay, Treurenberg Bay, Lovéns Berg, Lomme Bay) we can mention the following localities: Liefde Bay (Th. Fries 1868) and Red Bay (Høeg 1928). We should

expect it from the eastern Svalbard region, but so far it has not been found there.

It has not (yet) been detected in Franz Josef Land, but I collected it in 6 places in Novaya Zemlya. — Nylander records it from Konyam Bay (Vega Expedition, Enum. Lich. Freti Behr., 1888, p. 214).

From the Canadian arctic coast we have a plant from Gjøa Havn, collected by Lindström (Roald Amundsen North West Passage Expedition). Simmons collected lots of plants in Ellesmere Land and in North Devon.

This information from our own herbarium could easily be supplied; but it is sufficient to show its circumpolar distribution, in part by very northern routes of migration.

It is a great problem, why this species is entirely lacking in the Scandinavian peninsula. For it is a well known plant from the European High Alps to the Carpathians (see e. g. Anzi Cat. Lich. Sondriensi, 1860, p. 18; Anzi Lich. Lang. Exsic. No. 18; Arnold Lich. Exsic. No. 485; Jatta Sylloge Lich. Ital., 1900, p. 61; Dalla Torre et Sarntheim Flechten von Tirol, 1902, p. 23). We are unable here to trace its American distribution. But we have in our herb. a plant from Alberta: Pipestone Creek, collected by John Macoun, det. by J. K. Merrill: *Cetraria madreporiformis* (Canadian Lichens No. 230), which can hardly be distinguished from *Dufourea ramulosa*. Tuckerman writes that it is found in Arctic America, Rocky Mountains, and in the islands of Behring's Strait (Synopsis Amer. Lich. I, 1881, p. 30).

Can we regard these southern European and American plants as relics from a pre-glacial flora? We should then have to suppose a post-glacial migration from the American mountains (or from Altai? or Ural?) first to the coasts of the Arctic Ocean, and next, in part by very northern routes, to its present circumpolar distribution. Can also the present arctic plants be relics, which have persisted from pre-glacial times on ice-free coasts?

Plant geographers have perhaps not sufficiently remembered the short distance between North East Greenland and Spitsbergen, from the Eastern Spitsbergen Islands to Franz Josef Land and to Novaya Zemlya.

If we knew the high alpine lichen flora of Rocky Mountains, Ural and Altai, we would certainly be able to understand the distribution of many arctic plants better than we can today.

*Dufourea madreporiformis* has never been collected in Greenland. But according to Tuckerman (Synopsis Amer. Lich. I, 1881, p. 30) it has been found in Rocky Mountains. In Europe it has a wide distribution in the High Alps from Spain to Transsylvania. Like the former species it has never been collected in Northern Europe. It is widespread and generally abundant all over the west coast of Novaya Zemlya. We



have only one find from Spitsbergen: Wijde Bay: Kartdalen (Høeg 1928). It is a more Eastern species than *Dufourea ramulosa* in the arctic, but the parallelism of their distribution is remarkable.

### *Alectoria* Ach.

#### *Alectoria ochroleuca* (Ehrh.) Nyl.

##### III. Kapp Humboldt.

In 1929 it was found in great abundance between the stones about 3—400 metres, in 1930 it was found in the lowlands. Deichmann Branth et Grønlund write that it is "meget almindelig i hele Landet", but in this part of East Greenland it is certainly one of the rarest lichens.

Fertile plants were not found.

The only record from North East Greenland is Deichmann Branth, 1894, p. 87: Scoresby Sund.

There are a lot of plants from the west coast, right up to the northernmost part: Low Point, leg. Wulff. Several of these plants approach *Alectoria cincinnata*. Found also on the nunataks of the continental ice sheet (locality not specified, leg. lieutenant Jensen). At Julianehåb, so rich in interesting lichens, Vahl found fertile plants. But it must be rare on the east coast.

#### *Alectoria nigricans* (Ach.) Nyl.

I. Landingsdalen. Claveringøya: Daudmannsøyra.

II. Myggbukta.

IV. Sofiasundet west of Robertsonøya.

V. Husbukta.

VI. Kapp Simpson. Antartichamna. Near Archerøya. Dicksonfjorden.

We found it in the greatest abundance about Myggbukta, otherwise it is not too common and generally quite scarce. The same is the case in West Greenland, to judge from Deichmann Branth et Grønlund Grønlands Lichen-Flora, p. 465: "Hist og her i alle Egne" (scattered all over).

In Vegasundet it was collected up to 580 metres, but it is no highland lichen, it is much more common in the lowlands.

It varies as usually: some plants are pale (var. *Thulensis* (Th. Fr.)), but the darker plants are more common (var. *Tschuctschorum* Vain.).

*Alectoria nigricans* is common in Scoresby Sund (Deichmann Branth, 1894, p. 87), recorded also from Danmarks Havn and Termometerfjell (Galløe p. 185).

To judge from the Copenhagen herb. it is distributed along the whole coast of Greenland, as was to be expected.

*Alectoria jubata* (L.) Nyl.  
var. *chalybeiformis* (L.).

- I. Landingsdalen. Kapp Herschel. Claveringsfjorden: Revet.
- II. Myggbukta.
- III. Kapp Humboldt. Moskusoksefjorden.
- IV. Sofiasundet.
- V. Husbukta. Veganeset.
- VI. Antarctichamna. Kapp Petersens. Röhssfjorden. Dicksonfjorden.

Fairly common and in places quite plentiful. It ascends as high as any other lichen: Vegasundet 360 metres, Kapp Petersens 400 m, and in Moskusoksefjorden up to 1350 m, the last plants are quite as fine as any other.

The distinction between this species and *Alectoria nigricans* requires some attention in arctic plants. The latter species is often quite dark, in such plants the white maculae are not so distinct as usual in southern plants. But even if the plant is very dark, some pale parts can be detected near the base. — On the other hand the soredia of *Alectoria jubata* are always poorly developed, as soredia generally are in the arctic.

*Alectoria jubata* is more intricately branched up to the very apices of the stems, giving it sometimes almost the habitus of *Parmelia pubescens*. The apical branches of *Alectoria nigricans* are thinner and more elongated, fixed on stouter branches. *Alectoria nigricans* is more opaque (but not always).

The red reaction of *Alectoria nigricans* with  $\text{CaCl}_2\text{O}_2$  is little intense.

Arctic plants of *Alectoria nigricans* have been confused with *Alectoria bicolor*, which should not be necessary. We have never seen correctly determined plants of the latter species from the arctic.

*Alectoria jubata* has been recorded from Scoresby Sund (Deichmann Branth, 1894, p. 87), and from Kapp Bismarck (D. B., 1907, p. 13).

Galløe records *Bryopogon jubatus*  $\beta$ . *nitidulum* from Danmarks Havn and Termometerfjell (p. 185). This is very interesting, for there are several plants of *Alectoria nitidula* in the Copenhagen herb. (intercalated s. n. *Alectoria divergens*), and Lyngø also found it in Th. Fries's collection from West Greenland (1871). These facts suggest *Alectoria nitidula* to be a western species in the Scandinavian flora. — We did not find it.

*Alectoria cincinnata*. Deichmann Branth writes that *Alectoria ochroleuca* . . . is very common in the whole country, especially var. *rigida*, *cincinnata* a little less common ("meget almindelig i hele Landet, især var. *rigida*, *cincinnata* noget sjeldnere"). In the Copenhagen herb. Lyngø found the following plants of *A. cincinnata* from West Greenland:

Grønland (Holbøll), Holsteinsborg: Isortoq (Vahl), Godthaab: Sermilik (Kold. Rosenvinge), Baals Revier (Vahl), Julianehåb (Vahl): Qagssiarsuk (Vahl) and Ivigtut (Schjødte). — Hartz collected a plant, only labelled "Grønland", perhaps from East Greenland.

### *Thamnotia* Ach.

#### *Thamnotia vermicularis* (Sw.) Ach.

- I. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet.
- II. Loch Fyne. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt.
- IV. Sofiasundet: west of Robertsonøya and Sanddalen.
- V. Husbukta. Veganeset.
- VI. Antartichamna. Near Archerøya. Kapp Petersens. Röhssfjorden. Ellaøya.

*Thamnotia vermicularis* is common all over the region, but perhaps not so plentiful as it generally is in the arctic.

It ascends as high as any other plant: Kapp Herschel 360 metres, Vegasundet 360 m, Moskusoksefjorden 1350 m.

It is not so variable as in Norway, the plants are generally small, all of them of the common appressed type, var. *taurica* was never seen.

*Thamnotia vermicularis* has been recorded from Scoresby Sund, where it is common (Deichmann Branth, 1894, p. 87), Hurry Inlet (Vainio p. 128), Danmarks Havn and Hvalrosodden (Galløe p. 190).

It is certainly common along the whole coast of Greenland.

### *Usnea* (Dill.) Pers.

#### *Usnea sulphurea* (König) Th. Fr.

- I. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet.
- II. Myggbukta.
- III. Dusénfjorden. Moskusoksefjorden.
- IV. Antartichamna.

It is fairly common at our northernmost localities, in sight of Sabine and Shannon Islands, where it was found by the 2nd German polar expedition. Farther south it is not at all common, we may perhaps call it rare.

Even in this arctic region it is typically an alpine lichen, found in the upper part of the rock-falls and in the precipices and prominent high alpine rocks. Collected at Kapp Herschel 650 metres, Claveringøya at 1200 m, and in Moskusoksefjorden as high as 1350 m.

Vainio has described a f. *granulifera*, but that is superfluous, for it is always "granuliferous".

Its distribution is very interesting. It has never been found east of the Novaya Zemlya — Franz Josef Land region. It is rare and scarce in Novaya Zemlya, but plentiful in Franz Josef Land. It is equally frequent in the northern part of the Svalbard region, North East Land and Spitsbergen proper, but it has never been found in Bear Island. It was first described from Iceland. In the Copenhagen herbarium there are a lot of plants from Iceland, in all from 11 localities. It is plentiful in Jan Mayen. It is found in Northern Greenland, on the east coast down to the Scoresby Sund district, as well as on the west coast as far south as Disko Bay. It is lacking in South Greenland. It was collected by Simmons in the islands west of Northern Greenland.

It is much more difficult to trace its distribution along the Canadian coast. It was not collected by Roald Amundsen's Gjøa expedition, but that does not signify much, for the plants were collected by the expedition's cook, famous as such, but not interested in lichens.

Recorded from Kapp Dalton (Vainio p. 126), Lille Pendulumøya (Malme p. 6), "Fjordgletscher", Sabineøya and Shannonøya (Koerber p. 76), Kapp Bismarck and Danmarks Havn (Galløe p. 185).

## THELOSCHISTACEAE.

### *Xanthoria* Th. Fr.

#### *Xanthoria candelaria* (Ach.) Arn.

Du Rietz Lich. Fragm. III, Svensk Bot. Tidsskr. 1921, p. 185, ubi syn. Lynge Lich. Nov. Zemlya, 1928, p. 238; Lich. Franz Josef's Land, 1931, p. 25. *Xanthoria lychnea* (Ach.) Th. Fr. autorum.

- I. Kapp Wynn. Kapp Herschel. Claveringøya: Soppbukta.
- II. Loch Fyne. Kapp Stosch. Jacksonøya. Myggbukta. Terneøya.
- III. Moskusoksefjorden. Dusénfjorden. Kjerulf fjorden.
- IV. West of Robertsonøya. Sanddalen.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Kapp Petersens. Röhssfjorden.

It is a highly ornithocoprophilous species, restricted to large stones and prominent rocks, where birds like to rest. In such places it is quite inevitable, with *Parmelia infumata*, *Physcia tribacia*, *Lecanora melanophthalma*, and some other species. — It is a saxicolous species, but also occasionally found on old bones and reindeer horns, more rarely on mosses. We have also seen it on the excrements of an owl.

The arctic plants are less lacerated at the margins, they often resemble the southern species *X. fallax* (Hepp) Du Rietz. = *X. substellaris* (Ach.) Vain.

It ascends to the highest bird-stones, in Moskusoksefjorden Schölander found it up to 1350 metres, in suitable localities it is equally common in all elevations.

Recorded from Kapp Dalton (Vainio p. 130), Scoresby Sund (Deichmann Branth, 1894, p. 89), Termometerfjell and "The Bay" near Danmarks Havn (Galløe p. 187).

There are 13 Greenland localities in the Copenhagen herb., from the west coast as far north as Upernivik; there are also some plants from the east coast. We have no plants from North Greenland between Upernivik and Danmarks Havn, but there is no reason to suppose that it should be lacking there.

To judge from the herb. material it is quite common in Iceland.

Koerber recorded *Physcia parietina*  $\gamma$ . *ectanea* from Sabineøya (K. p. 76). There is no reason to suppose that this determination should be correct (Cfr. *Caloplaca elegans*).

## PHYSCIACEAE.

### *Physcia* (Ach.) Vain.

#### *Physcia tribacia* (Ach.) Nyl.

Pl. VII, fig. 3.

- I. Kapp Herschel. Claveringfjorden: Revet and Soppbukta.
- II. Kapp Stosch. Jacksonøya. Myggbukta. Terneøya.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Blomsterbukta. Kjerulffjorden.
- IV. Sofiasundet, west of Robertsonøya, and Sanddalen. Celsiusberget.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Kapp Petersens. Holmvika. Röhssfjorden. Ellaøya. Mariaøya.

In East Greenland, as in other regions, *Physcia tribacia* is a strictly nitrophilous species, which is here the same as an ornithocrophilous species. It is therefore found on the bird-stones, along the coast as well as in the fjords to their inland end, together with other species of the same kind, e. g. *Xanthoria candelaria*, *Caloplaca elegans*, *Lecanora melanophthalma*, *Rinodina Hueana*, a. o. It is common, in places quite plentiful on such stones. — Occasionally it is also found on old bones, e. g. at the old esquimaux colony in Kjerulffjorden.

It ascends up to 1350 metres in Moskusoksefjorden, and it is evidently common in all elevations, if there are birds.

In this species the soredia are generally badly developed in the arctic, as usual with arctic lichens. They are sometimes almost lacking, or more or less corticated, we wonder whether they are effective. Habitually

arctic *Physcia tribacia* is often difficult of distinction from *Ph. caesia*, where the same is the case, and occasionally the dark plants of *Physcia tribacia* are very like *Ph. sciastra*, for the colour of *Physcia tribacia* is very variable in these arctic plants.

We can distinguish the following "colour-formae":

*F. typica* Lyngé: thallus albidus vel albido-cinereus.

*F. cinereus* Lyngé n. f.: thallus obscure cinereus vel etiam cinereo-nigrescens. Cum *f. typica* confluit.

Typus: Jacksonøya.

In East Greenland *f. cinereus* is more common than the white *f. typica*.

*Physcia tribacia* has been recorded from Kapp Dalton and from Turner Sund by Vainio (p. 132). — Deichmann Branth writes on *Physcia stellaris* (1894, p. 89) that in Scoresby Sund the "ascendent forma is less common than the adpressed forma, which is found on stones, wood, branches, bones, soil and Gyrophorae, generally somewhat darker than usually (*f. subobscura* Nyl.). The formae *aiPOLIA* Ach. and *albinea* Ach. are common and approach *Physcia caesia*". It is highly probable that his "ascendent forma" is *Physcia tribacia*. "*Physcia stellaris*" from Scoresby Sund, leg. Hartz 1892, is one of the usual arctic formae of *Physcia caesia*. A plant from Sydvestfjorden (Scoresby Sund), leg. Hartz 1892, and referred to "*Physcia stellaris f. subobscura*" is no *stellaris*, but *Physcia muscigena*, on account of its large apothecia. — In his paper from 1907, p. 13, Deichmann Branth records "*Physcia stellaris*" from Ilot Maroussia, which we have been unable to locate. It is very probable that this plant is a little sorediated *Physcia caesia*.

In the Copenhagen herbarium there are several plants of *Physcia tribacia*, intercalated under the name *Physcia stellaris*: Disko, leg. L. Smith; Egedesminde, leg. ?; Strømfjorden, leg. J. A. D. Jensen, and Igalikfjorden, leg. Kolderup Rosenvinge. G. Lång has seen *Physcia subobscura* in some of these plants, in my opinion they are *Physcia tribacia f. cinereus*. — Wulff collected *Physcia tribacia* in North Greenland: J. P. Kochfjorden.

### *Physcia tenella* Bitter.

#### III. Moskusoksefjorden.

In this fjord Scholander found a remarkable *Physcia*, no less than 1350 metres above sea-level. It has a white colour. Its narrow, elongated lobes are free from the substratum, ascending like *Physcia tenella*. The lobes have long spreading marginal rhizinae, and they are sorediate with soredia of the *Physcia tenella* type.

These characters distinguish the plant from *Physcia tribacia*, as well as from *Physcia teretiuscula* and *Physcia intermedia*. We found

that it could only be referred to *Physcia tenella*. It was with much hesitation that we arrived at this conclusion, for *Physcia tenella* is very rare in the arctic. Du Rietz agrees with us on the determination.

It is evident from Acharii description in Lich. Univ. p. 498 that his "*Borrera tenella*" is the same as Bitter's *Physcia ascendens*, and not Bitter's *Physcia tenella*: "laciniis . . . apice adscendentibus dilatatis fornicatis". — In herb. Acharius in Helsingfors Acharius has mounted 6 plants s. n. "*Borrera tenella* Svecia". One of them is typically Bitter's *Physcia tenella*, the other five typically Bitter's *Physcia ascendens*.

Acharius has, accordingly, not distinguished specifically between these plants. — It will avoid much confusion, if we can use Bitter's names. And as he was the first to treat them as two different species, we think that we are justified in doing so.

It has formerly not been recorded from Greenland. But there is a plant from "Segliviarsuk Groenlandiae", undated, leg. J. Vahl, which is *Physcia tenella*, p. m. p. We have not been able to locate that place. Should it be Sagdlaruseq (= Storøya), in the Godthaab district?

### *Physcia muscigena* (Ach.) Nyl.

- I. Kapp Wynn. Landingsdalen. Kapp Herschel. Claveringfjorden: Revet.
- II. Loch Fyne. Finschøya. Kapp Stosch. Jacksonøya. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Blomsterbukta. Reinbukta. Kierulffjorden.
- IV. Sofiasundet: Celsiusfjellet, Sanddalen and Rudbeckfjellet.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Kapp Petersens. Holmvika. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.

A lichen cannot be more common and widespread than *Physcia muscigena* in this region. We have certainly seen it every day.

It also ascends as high as a lichen can live: Kapp Herschel 650 metres, Moskusoksefjorden 900, Claveringøya 1200 and Rudbeckfjellet 1600 metres.

Fertile plants are more common than usual in the arctic. — It is not necessary to repeat the description of its variation, it is the same as in Norway and in Novaya Zemlya, which I have formerly described.

Recorded by all the authors, who have published on the lichens of North East Greenland: Kapp Dalton (Vainio p. 132), Scoresby Sund very common (Deichmann Branth, 1894, p. 89), Bontekoe Island, Kapp Franklin and Lille Pendulumøya (Malme p. 6), Kapp Borlase Warren (Koerber p. 76), Kapp Bismarck (Deichmann Branth, 1907, p. 13), Danmarks Havn, Termometerfjell, Basiskær, and Snenes (Galløe p. 187).

It is evident from the Copenhagen herb. that it is found along the coasts of whole Greenland. This material also supports the opinion that fertile plants are more common in Greenland than in other arctic regions.

*Physcia constipata* (Nyl.) Norrl. et Nyl.

Lynge Mon. Norw. Phyc., 1916, p. 60, ubi syn.

Exsic. Magnusson Lich. sel. Scand. 38, Norrl. et Nyl. Herb. Lich. Fenn. 218, Suza Lich. Bohemoslov. 119.

- I. Kapp Herschel. Claveringøya: Soppbukta.
- II. Myggbukta. Terneøya.
- III. Moskusoksefjorden.
- IV. Sofiasundet, west of Robertsonøya.

This species has formerly never been recorded from the arctic, and it is one of the most interesting finds of the expedition. The species is very scarce, but it was found in 6 localities. — It ascends to considerable elevations: Kapp Herschel 650 metres, and Moskusoksefjorden to 650 m.

*Physcia sciastra* (Ach.) Du Rietz.

- I. Landingsdalen. Claveringfjorden: Soppbukta and Revet.
- II. Loch Fyne. Kapp Stosch. Myggbukta. Terneøya. Kapp Bennett.
- III. Moskusoksefjorden. Kapp Humboldt. Blomsterbukta.
- IV. Sofiasundet, west of Robertsonøya, and Sanddalen. Celsiusberget.
- V. Scott Keltie-øyane: Gåsøya. Veganeset.
- VI. Holmvika. Röhssfjorden, c. fr. Dicksonfjorden. Ellaøya. Mariaøya. Mainland near Archerøya.

Widely distributed, common and plentiful all over the region, though not so plentiful as *Physcia muscigena* and *Ph. caesia*.

Several other species are more alpine than *Physcia sciastra*, but nevertheless it ascends to 900 metres in Moskusoksefjorden.

As usual in the arctic the plants are generally very sparingly isidiate. Some plants are quite naked, habitually they resemble poorly soresiated *Physcia caesia*. Plants with marginal isidia are the commonest. *F. typica* Lynge = *Physcia lithotea* autorum with densely isidiate surface is very rare. Hardly ever fertile, Scholander detected a fertile plant in Röhssfjorden.

Recorded from Scoresby Sund: Danmarksøya, "also with soredia" (Deichmann Branth, 1894, p. 89).

I was a little astonished to find so few Greenland plants in the Copenhagen herb., only 8 plants, found between Disko Bay and Julianehaab.



*Physcia caesia* (Hoffm.) Nyl.

- I. Kapp Herschel. Claveringøya: Soppbukta. Finschøya.
- II. Loch Fyne. Kapp Stosch. Myggbukta. Terneøya.
- III. Moskusoksefjorden. Kapp Humboldt. Dusénfjorden. Blomsterbukta. Reinbukta. Kjerulffjorden.
- VI. Sofiasundet: west of Robertsonøya and Sanddalen. Celsiusberget.
- V. Scott Keltie-øyane: Gåsøya. Husbukta. Veganeset.
- VI. Antartichamna. Kapp Petersens. Röhssfjorden. Dicksonfjorden. Ellaøya. Mariaøya.

*Physcia caesia* is one of the commonest and most widespread lichens of the whole region, from the coast to the inland end of the fjords. In accordance with its nitrophilous demands it is chiefly found on the bird-stones, as a faithful companion of *Caloplaca elegans* and *Parmelia infumata*. *Physcia tribacia* and *Xanthoria candelaria* are, perhaps, still more coprophilous.

It is found on the bird-stones in practically all elevations: Kapp Petersens 400 metres, Kapp Herschel 650 m, Moskusoksefjorden 1350 m.

The Greenland plants have the same variation as the Norwegian and the Novaya Zemlya material. If the soredia are poorly developed, as they usually are, this species should be distinguished from *Physcia tribacia* with some attention. The chemical reaction of the medulla is, of course, a good character, but the arctic plants are often very dark, and the yellow colour is not so conspicuous as in paler plants.

There are some quite typical plants of var. *ventosa* Lynge, from Kapp Herschel, Myggbukta, Kapp Petersens and Ellaøya, in addition to them several plants that approach this variety more or less.

Hartz collected *Physcia caesia* in Scoresby Sund: Danmarks øy (herb. Copenhagen). In Greenland collections *Physcia caesia* has often been named *Physcia stellaris*, on account of the poorly developed soredia. *Physcia caesia* is undoubtedly common along the whole coast of Greenland, though there are not so many plants in the herbaria. It has been collected from Julianehaab (Vahl) to Low Point (Wulff), and from Disko in west (Porsild) to all the eastern localities, recorded in this paper.

*Physcia intermedia* Vain.

Pl. VII, fig. 1 et 4.

Vainio Lich. Vib., 1878, p. 51. Lynge Mon. Norw. Phyc., 1916, p. 97.

- I. Landingsdalen.
- II. Myggbukta. Kapp Bennett.
- III. Kapp Humboldt.
- VI. Sofiasundet: Celsiusberget.
- V. Scott Keltie-øyane: Gåsøya. Veganeset.

The plants vary with respect to their colour: 1. Some very pale, greyish-white or almost white plants. They differ from *Physcia caesia* in their chemical reaction, which is  $\text{KOH } \pm$ , their very narrow, slender and much more branched lobes, (often) with crenate margins, and their soredia: more granular, almost isidioid soredia; 2. Other plants are darker, greyish-black, of the *Physcia sciastra* colour. They are, however, easily distinguished from that species by their distinctly yellow cortical reaction with KOH.

The distinction from *Physcia teretiuscula* is more difficult. There are several Finnish plants of *Physcia intermedia* in our herbarium, determined by Vainio himself. Their habitus is very like *Physcia stellaris*, as stated by Vainio l.c. Their marginal lobes are appressed to the substratum, but they differ from *Physcia stellaris* in their grey colour. Their soredia are laminar, globoso-granular, almost isidioid, in *Physcia caesia* they are more globoso-farinose. Occasionally also the apices of the lobes are attacked by soredia of the same type, but these sorediated apices are not incurvated as in *Physcia tribacia* or in *Physcia tenella*.

But that is just the case with Acharii typus of "*Parmelia caesia*  $\beta$  *P. teretiuscula*", Lich. Univ. 1810, p. 479: "thalli laciniis cinerascensibus ramosis discretis margine recurvis subteretibus apice dilatatis convoluto-subturbinatis".

*Physcia intermedia* has formerly not been recorded from Greenland. But in the Copenhagen herb. there is a plant, collected at Ameralik in the Godthaab district by J. Vahl in August 1830. This eminent observer is the founder of our knowledge of the Greenland lichen flora, and down to the present day no other botanist has done so much to increase our knowledge on it, as he did.

var. *marginata* Lynge var. nov.

Pl. VII, fig. 4.

Thallus parvus, diam. 2—3 cm, satis obscure caesio-cinereus, fragilis, lobi convexiusculi, conniventes vel imbricati, sed non placodiiformes, in lamina sorediis rotundatis granulosis instructi, etiam secundum marginem sorediati. Thallus adpressus, etiam lobi sorediati, rhizinis marginalibus destitutus, subtus decolor, rhizinis concoloribus adfixus.

Apothecia desunt.

Thallus extus KOH flavescens, intus immutatus.

III. Myggbukta.

VI. Moskusoksefjorden.

VI. Antartichamna.

Evidently a rare plant, only these 3 plants were obtained. They were collected in the lowlands, up to 350 metres in Moskusoksefjorden.

Habitually the thallus resembles *Physcia caesia*. It has the same maculate upper side and the same laminar soredia, these soredia are very low, often on the level of the thallus. But it differs from *Physcia caesia* in the marginal soredia, the lobes are narrower and more apiculated, at least at the circumference of the thallus, and not so placodiiform as in *Physcia caesia*. On account of the dark colour of the thallus the yellow cortical reaction with KOH is not quite distinct on the surface, but just above the stratum gonidiale it is distinct enough. At first no reaction is seen in the medulla but after some time the yellow colour diffuses from the cortex to the medulla. This reaction should also exclude *Physcia caesia*.

*Physcia teretiuscula* ("*Physcia caesia* var. *teretiuscula*") in herb. Acharius has very convex, almost semi-cylindrical lobes, much branched, and quite discrete. The soredia are apical, not laminar, on incurvated branches that are but slightly incurvated. Vainio has added a herb. note " $K_{\pm}$ ". He evidently found a yellow reaction of the medulla as well as the cortex. Now either of them is red, where he made the test.

*Physcia dubia* ("*Physcia caesia*  $\beta$  *dubia*") is found on the same sheet in the herb. Acharius. Vainio found the reaction " $K_{\pm}$ ", now the cortex is red, and the medulla faintly yellow where he made his test. The plant is small, the lobes are flat, broad, imbricate, irregular, not radiating as in *Physcia teretiuscula*. On the soft margin there are small granular soredia, in one place I saw good soredia of the *Physcia tribacia* type. On the whole the habitus is that of a poorly developed *Physcia tribacia*.

*Physcia albinea* ("*Parmelia albinea*") in herb. Acharius has no soredia whatever, the colour is purely white, the nitidous lobes are convex.

*Physcia tribacia* has apical soredia (in the Greenland plants they are also marginal), and the sorediated lobes are broad and more or less ascending.

We have referred these plants to *Physcia intermedia* in part per exclusionem, but also on account of the conformable colour and laminar soredia, the reaction, and the narrow apiculated lobes. The normal soredia of *Physcia intermedia* are small laminar soredia of the *Physcia caesia* type, often more granular. But we have also seen some inconspicuous marginal soredia in plants determined by Vainio himself. In our Greenland plants these marginal soredia are quite as conspicuous as the laminar soredia.

If this plant had been found only once I would hardly have ventured to mention it. But Scholander found it in 3 different places. The plant from Antarcticamna is larger and the soredia almost confluent, otherwise the 3 plants agree well.

*Notes on Physciae from the Copenhagen arctic herbarium.*

*Physcia aipolia*. Vahl collected a plant in the Julianehaab district, at Tunugdliarfik, Sept. 1828, determined as "*Parmelia aipolia cercidia*". This determination is correct. The plant is well fertile, with narrow paraphyses. The reaction is distinctly KOH  $\pm$  yellow. There is no indication of soredia. — He collected another plant "ad muros templi Kukortokensis, Juli 1828" (= Qaqortoq, in the Julianehaab district), referred to *Parmelia aipolia*. This determination is also correct.

The presence of *Physcia aipolia* in the Julianehaab district is accordingly well established. This district is the Riviera of Greenland; a careful exploration there by a trained lichenologist would certainly yield remarkable results.

*Physcia melops* (Duf.) Nyl. Vahl collected a plant at Ameralik, Godthaab district, which he referred to "*P. aipolia*". I cannot distinguish it from the Norwegian Dovre plants of *Physcia melops* (Lyngé Mon. Norw. Physciaceae, 1916, p. 99).

*Physcia stellaris*. Deichmann Branth writes that *Physcia stellaris* as fairly common ("temmelig almindelig") throughout all Greenland (Grönl. Lich. Flora, 1888, p. 472). The genuine *Physcia stellaris* Nyl. is not found in the Copenhagen Greenland herb. But under the name *Physcia stellaris* we find almost all the *Physciae*, that have been collected in Greenland, cfr. notes on *Physcia tribacia*, *tenella*, *aipolia*, and *caesia* in this paper. *Physcia sciastrâ* and *muscigena* are also represented in this material.

*Anaptychia ciliaris* var. *melanosticta* must be common in the Faeroes, as well as in Iceland, to judge from the rich material in the Copenhagen herb. But no *Anaptychia* has so far been collected in Greenland.

In 1889 Hartz collected a very remarkable *Physcia* at Tasermiut, near Nanortalik, in the Julianehaab district. It was named *Physcia pulverulenta* f. *microcarpa*. The Finnish lichenologist Lång has added a herb. note "sit *Physcia Aquila*". Habitually it is so like that species that the note is justified. But a section showed a cellular cortex, and the spores are too small for any northern *Anaptychia*:  $19-21 \times 9-10 \mu$ . These spores suggest *Physcia muscigena* rather than *Physcia pulverulenta*, which has broader spores. The plant has narrow convex pointed lobes, a strange habitus for *Physcia muscigena*. But if it is not an American species, unknown to us, we can find no other determination.

### Summary.

In the following list we have enumerated all the lichens of certain genera, which we found in North East Greenland in 1929 and 1930. We have also added some lichens, detected in North East Greenland by other botanists. They are designated by brackets. But we have not ventured to include all records of critical species, which we have not seen, such as *Cladoniae* and *Stereocaulons*. We have compared their distribution there with their distribution in other Arctic regions and in the Scandinavian peninsula. It is, accordingly, not a comparison between the Arctic, resp. the alpine, floras of these regions. For each of them also contain lichens, which are lacking in East Greenland and therefore not mentioned in the present paper.

We have chosen to compare the North East Greenland lichen flora with the Arctic floras of Spitsbergen, Novaya Zemlya and Eastern Siberia for the reason that these floras are sufficiently known, while our knowledge of the lichen flora of the American Arctic coast is extremely deficient. We hope that American botanists will give attention to that question as soon as possible.

The Spitsbergen enumeration is chiefly based on the unpublished results of Lynges determination of several collections (Th. M. Fries, Lynges Lid, Høeg a. o.), in addition to literary records. It does not include the Bear Island lichens. — The Novaya Zemlya enumeration is based on Lynges book *Lichens from Novaya Zemlya*, Norw. Nov. Zeml. Exped., 1921, No. 43, Oslo 1928. — The East Siberian (Behring Strait) enumeration is based on the results of the Vega expedition (W. Nylander *Enumeratio Lichenum Freti Behringii*, 1888, and Edv. A. Vainio: *Lichenes prope Pitlekai collecti*, Arkiv för Botanik, Stockholm 1909). The Behring Strait region is about 180° and East Greenland about 20° west of Greenwich. We hoped that a comparison between these two areas would help us to find the circumpolar lichens of North East Greenland.

We have also considerable collections from Jan Mayen, but they are not yet determined.

The figures in front of the enumeration indicate the highest altitude where the lichen was found.

If there is no such figure, it either indicates that it is a lowland lichen, or that we have no information on it.

		N. E. Greenland	Scandinavia	Spitsbergen	Novaya Zemlya	Behring Strait
1	<i>Mycocalicium subtile</i> (Ach.) Vain. ....	+	+			
2	<i>Sphaerophorus globosus</i> (Huds.) Vain. ....	+	+	+	+	+
[3	— <i>fragilis</i> .....	+	+	+ <sup>?</sup>		]
4	<i>Dermatocarpon miniatum</i> (L.) Mann. .... 900	+	+	+	+	
5	— <i>sphaerosporum</i> Lyngé ..... 300	+				
6	— <i>cinerum</i> (Pers.) Th. Fr. ....	+	+	+	+	+
7	— <i>daedaleum</i> (Krempelh.) Th. Fr. ....	+	+	+	+	+
8	— <i>hepaticum</i> (Ach.) Th. Fr. ....	+	+	+	+	+
9	<i>Endocarpon pulvinatum</i> Th. Fr. ....	+	+	+		
10	<i>Arctomia delicatula</i> Th. Fr. ....	+	+	+		+
11	<i>Leptogium pulvinatum</i> (Hoffm.) Cromb. ....	+	+	+	+	
[12	— <i>lacerum</i> f. <i>majus</i> .....	+	+		+	]
[13	— <i>saturninum</i> .....	+	+		+	]
14	<i>Leciophysma finmarkicum</i> Th. Fr. ....	+	+	+	+	
15	<i>Collema arcticum</i> Lyngé.....	+	+	+	+	
16	— <i>pulposum</i> Ach ..... 700	+	+	+	+	
17	— <i>polycarpum</i> (Schaer.) Krempelh. .... 900	+	+	+	+	
[18	— <i>rupestre</i> .....	+	+	+	+	]
19	<i>Solorina bispora</i> Nyl. .... 1350	+	+	+	+	
20	— <i>saccata</i> (L.) Ach. .... 3—400	+	+	+	+	+ <sup>1</sup>
21	— <i>octospora</i> Arn. .... 900	+	+	+	+	
22	— <i>spongiosa</i> (Sm.) Anzi. .... 350	+	+	+	+	+
23	— <i>crocea</i> (L.) Ach. .... 900	+	+	+	+	+
[24	<i>Nephroma laevigatum</i> .....	+	+			]
25	<i>Peltigera variolosa</i> (Mass.) Gyelnik ..... 580	+	+	+	+	+ <sup>?</sup>
26	— <i>venosa</i> (L.) Hoffm. .... 300	+	+	+	+	+
27	— <i>Suomensis</i> Gyelnik ..... 200	+	+			
28	— <i>rufescens</i> (Weiss) Humb. .... 1350	+	+	+	+	+
29	— <i>polydactyloides</i> Nyl. ....	+				
30	— <i>polydactyla</i> (Neck.) Hoffm. ....	+	+	+	+	+
31	— <i>malacea</i> (Ach.) Fr. .... 400	+	+	+	+	+
32	— <i>erumpens</i> (Tayl.) Vain ..... 350	+	+	+	+	+
33	— <i>leptoderma</i> Nyl. .... 1200	+	+	+	+	
[34	— <i>scabrosa</i> Th. Fr. ....	+	+	+	+	]
35	<i>Cladonia mitis</i> Sandst. ....	+	+	+	+	+ <sup>?</sup>
36	— <i>uncialis</i> (L.) Web. ....	+	+	+	+	+
37	— <i>coccifera</i> (L.) Willd. .... 1200	+	+	+	+	+
38	— <i>squamosa</i> (Scop.) Hoffm. ....	+	+	+		+
39	— <i>cenotea</i> (Ach.) Schaer. ....	+	+			+
40	— <i>cariosa</i> (Ach.) Spreng. .... 1200	+	+	+	+	+
41	— <i>acuminata</i> (Ach.) Lyngé. .... 200	+	+	+		+
42	— <i>elongata</i> (Jacq.) Hoffm. .... 580	+	+	+	+	+
43	— <i>cornuta</i> (L.) Schaer. ....	+	+			
44	— <i>lepidota</i> Nyl. .... 300	+	+	+	+	+
45	— <i>cervicornis</i> (Ach.) Flot. ....	+	+		+	
46	— <i>fimbriata</i> (L.) Fr. ....	+	+			+

Cfr. Notes on Greenland Cladoniae, p. 45.

<sup>1</sup> "*Cladonia sylvatica*", a species of that section.    <sup>2</sup> Perhaps *Solorina bispora*.

		N. E. Greenland	Scandinavia	Spitsbergen	Novaya Zemlya	Behring Strait
47	<i>Cladonia pyxidata</i> (L.) Fr.....	1350	+	+	+	+
48	— <i>cyanipes</i> (Somrft.) Vain.....		+	+	+	
49	<i>Stereocaulon alpinum</i> Laur.....	1350	+	+	+	+
50	— <i>rivulorum</i> H. Magn.....	1200	+	+	+	+
51	— <i>fastigiatum</i> Anzi.....	900	+	+	+	
52	— <i>denudatum</i> Flk.....		+	+	+	+
53	<i>Gyrophora virginis</i> (Schaer.) Frey.....	1350	+	+	+	
54	— <i>decussata</i> (Vill.) Zahlbr.....	1350	+	+	+	
55	— <i>polaris</i> Scholander.....	1350	+	+	1	
56	— <i>proboscidea</i> (L.) Ach.....	1200	+	+	+	+
57	— <i>hyperborea</i> (Hoffm.) Ach.....	360	+	+	+	+
58	— <i>arctica</i> Ach.....		+	+	+	+
59	— <i>torrefacta</i> (Lightf.) Cromb.....	1350	+	+	+	+
60	— <i>erosa</i> (Web.) Ach.....	1200	+	+	+	+
61	— <i>vellea</i> (L.) Ach.....		+	+	+	
62	— <i>deusta</i> (L.) Ach.....		+	+	+	+
63	— <i>cylindrica</i> (L.) Ach.....	1600	+	+	+	
[64	<i>Parmeliopsis ambigua</i> (Ach.) Nyl.....		+	+	+	]
65	<i>Parmelia subobscura</i> Vain.....	1600	+	+	+	+
66	— <i>intestiniformis</i> (Vill.) Ach.....	450	+	+	+	
67	— <i>pubescens</i> (L.) Vain.....		+	+	+	+
68	— <i>minuscula</i> Nyl.....	1600	+	+	+	+
69	— <i>stygia</i> (L.) Ach.....		+	+	+	
70	— <i>alpicola</i> Th. Fr.....		+	+	+	+
71	— <i>groenlandica</i> Lyngé.....		+	+	+	
72	— <i>sorediata</i> (Ach.) Th. Fr.....		+	+	+	+2
73	— <i>granulosa</i> Lyngé.....	1350	+	+	+	
74	— <i>infumata</i> Nyl.....	1350	+	+	+	
75	— <i>saxatilis</i> (L.) Ach.....		+	+	+	+
76	— <i>omphalodes</i> (L.) Ach.....		+	+	+	+
77	— <i>sulcata</i> Tayl.....		+	+	+	+
78	<i>Cetraria hepaticum</i> (Ach.) Vain.....	900	+	+	+	+
79	— <i>nivalis</i> (L.) Ach.....	1350	+	+	+	+
80	— <i>cucullata</i> (Bell.) Ach.....	400	+	+	+	+
81	— <i>crispa</i> (Ach.) Nyl.....	900	+	+	+	+
82	— <i>islandica</i> (L.) Ach.....	360	+	+	+	+
83	— <i>Delisei</i> (Bory) Th. Fr.....	900	+	+	+	+
84	<i>Cornicularia aculeata</i> (Schreb.) Ach.....	1350	+	+	+	+
85	— <i>racemosa</i> Lyngé.....	360	+	+	+	
[86	— <i>divergens</i> .....		+	+	+	]
87	<i>Evernia mesomorpha</i> Nyl.....	220	+	+	+	+
[88	<i>Dufourea ramulosa</i> Hook.....		+	+	+	]
89	<i>Alectoria ochroleuca</i> (Ehrh.) Nyl.....	400	+	+	+	+
90	— <i>nigricans</i> (Ach.) Nyl.....	580	+	+	+	+
91	— <i>jubata</i> (L.) Ach.....	1350	+	+	+	
[92	— <i>nitidula</i> Th. Fr.....		+	+	+	]
93	<i>Thamnolia vermicularis</i> (Sw.) Ach.....	1350	+	+	+	+
94	<i>Usnea sulphurea</i> (König) Th. Fr.....	1350	+	+	+	
94	<i>Xanthoria candelaria</i> (Ach.) Arn.....	1350	+	+	+	+
96	<i>Physcia tribacia</i> (Ach.) Nyl.....	1350	+	+	+	+
97	— <i>tenella</i> Bitter.....	1350	+	+	+	
98	— <i>muscigena</i> (Ach.) Nyl.....	1600	+	+	+	+
99	— <i>constipata</i> Nyl.....	650	+	+	+	
100	— <i>sciastra</i> (Ach.) Du Rietz.....	900	+	+	+	+
101	— <i>caesia</i> (Hoffm.) Nyl.....	1350	+	+	+	+
102	— <i>intermedia</i> Vain.....		+	+	+	

1 Found in Franz Josef Land. 2 Plants not seen, perhaps *Parmelia granulosa*.

In Novaya Zemlya 1921 Lyngé found 117 species of the same families as are treated in this paper, the species limited in the same manner, against 90 in our Greenland collections. In Novaya Zemlya he was the only botanist, and had to devote much time to the Vascular plants also. In Greenland we worked two summers. In 1929 Lyngé could give all his time to the lichens, Jakob Vaage was in charge of the Vasculares. In 1930 Vaage also joined the expedition, and Scholander collected lichens. In Novaya Zemlya Lyngé had 62 days at his disposal; in Greenland we had 25 days in 1929 and 35 in 1930. All the three expeditions were favoured by exceptionally fine weather during the work. The lichenological exploration in Greenland was accordingly equally intense as in Novaya Zemlya.

If the crustaceous lichens, not treated in this paper, were present in Greenland in the same proportion as in Novaya Zemlya, we should reckon about 315 different species in all in our Greenland collections. But we do not expect to find so many.

There is a great lack of Pyrenocarpous lichens in North East Greenland, perhaps on account of the dry climate. Many of them are found along brooklets and in other places, which are at times irrigated, and such places are quite scarce in North East Greenland. Some genera are well represented, e. g. *Rinodina*. But other large genera are poor in the number of species. There were 26 species of *Rhizocarpon* in the Novaya Zemlya collection. Our Greenland *Rhizocarpons* from 1929 are almost definitively determined, and so far we have recorded only 8 species.

We do not expect to find much more than 250 different species of lichens in our Greenland collections. We shall be glad if there are 275. The comparisons, which we have made in this paper between the lichens of North East Greenland and some other Arctic regions, are, therefore, not quite representative of the whole lichen flora.

The North East Greenland lichens, which we have treated in this paper, only represent the modest number of 91 different species. But no less than 27 of them were collected as high as 1350 metres. And 38 were found up to 900 metres. We had no station just a 1000 metres and, naturally, our investigations in these heights are anything but exhaustive. It can safely be said that as much as half the 90 species ascend to 1000 metres or more.

This result is really astonishing. And it is the more so if we remember the latitude of this highly Arctic region, covered by snow by far the greater part of the year, and surrounded by a broad zone of the mightiest polar ice, which is found in the Arctic sea. In the preface we have suggested that this is due to the warm foehn winds. The duration of the snow cover is perhaps an important factor. And that is again determined by many causes, downpour, temperature, evaporation and the configuration of the country.



We know that the species of *Solorina*, *Stereocaulon*, *Peltigera* and *Cetraria* depend on a good snow cover during the winter time. They reach very considerable heights. On the other hand the *Gyrophorae*, *Parmelia minuscula* and *P. granulosa*, *Thamnolia vermicularis* and all the coprophilous bird-stone lichens prefer very exposed places, and they reach quite as great heights. The eventual influence of the snow cover on the height limit of the lichens must be examined for each species.

It will be seen from the above enumeration that of these 101 North East Greenland lichens there are only seven, which are not found in the Scandinavian mountains. Three of them are described as new species. Two of these (*Dermatocarpon sphaerosporum* and *Parmelia groenlandica*) are species of unknown distribution. It is probable that we shall find *Peltigera polydactyloides* (is it a good species?) in Scandinavia, on account of its distribution in other countries.

The other four species (*Gyrophora polaris*, *Usnea sulphurea*, *Parmelia subobscura* and *Dufourea ramulosa*) have a very interesting distribution. They are even for Arctic plants very northern species. The two firstly mentioned are distinctly western. Their probable route of migration is (from the Rocky Mountains?) north of Greenland over the northern part of Spitsbergen to Franz Josef Land (*Gyrophora polaris*) or to Novaya Zemlya (*Usnea sulphurea*). — The two last mentioned species (*Parmelia subobscura* and *Dufourea ramulosa*) have a very wide Arctic distribution. Though the former has not (yet) been found in Spitsbergen, either of them is perhaps a circumpolar species.

Two of these East Greenland species (*Gyrophora polaris* and *Usnea sulphurea*) are common or fairly common. The other five are rare or little common. Even a trained lichenologist should be very active, and have good luck, if he would find all of them in one summer in North East Greenland.

The similarity between the North East Greenland lichen flora and the Scandinavian alpine flora is in reality so great that it approaches identity. The same is the case if we compare it with the Spitsbergen flora.

We have so far found 82 species in the Spitsbergen collections of these 102 North East Greenland lichens. It should be remembered that the determination of the Spitsbergen collections is not yet ready. It is quite probable that some of the missing 20 will be found later.

If we discuss the distribution of these missing 20 species, we find that only a single species of them (*Peltigera Suomensis*) is common in North East Greenland. Further there are the two new species of unknown distribution (*Dermatocarpon sphaerosporum* and *Parmelia groenlandica*). The next five species which we did not find are, some of them, southern species from Scoresby Sund (*Leptogium lacerum*

and *L. saturninum*, *Nephroma laevigatum*, *Parmeliopsis ambigua* and *Alectoria nitidula*). There are other eight species, which we only found once, and very sparingly. We can safely say that we have more plants of one middle-common species in our North East Greenland collections than we have of these 20 species combined.

Among the 20 Greenland species that are missing in Spitsbergen six are distinctly southern (*Leptogium saturninum*, *Cladonia cenotea*, *cornuta* and *fimbriata*, *Gyrophora deusta* and *Parmeliopsis ambigua*). We would hardly believe our own eyes, when we found these *Cladoniae* so far north, but these six species are rare or very rare. It is not improbable that they have migrated from the forest district in South West Greenland (the Julianehaab district) northwards along the east coast. Hartz found the northernmost plants of *Leptogium saturninum* and *Parmeliopsis ambigua* in Scoresby Sund, and we the northernmost plants of the other four species farther north. We cannot expect to find such plants in Spitsbergen, which is destitute of forest regions.

There is evidently the greatest possible conformity between the natural vegetation of North East Greenland and Spitsbergen.

Apart from the disappearing, more or less "relic" species others will multiply and spread in country and form its natural flora. — There are lichens that cannot find their demands satisfied in North East Greenland, e. g. southern species, and coprophilous maritime species. They are either entirely lacking or they are very rare.

It is a striking fact that the "natural lichen flora" of North East Greenland has this wide distribution. It may be suggested that they are plants of minimum requirements and that they multiply easily and spread intensely, as such plants generally do.

But the uniformity of this flora in such widely distant regions is so great that another explanation is more probable, namely that they should be plants of high antiquity in their present areas (or in adjoining areas), perhaps even preglacial or interglacial relics. It is a well established fact that the tertiary flora was very uniform, and that many of the displacements of the present day are due to the disturbances of the ice age.

We have tried to make this explanation probable for one species, *Dufourea ramulosa* (see p. 85—86 of the present paper). We cannot of course suggest this "relic" hypothesis for the whole "natural" lichen flora of North East Greenland. There may be rapid wanderers and recent immigrants amongst them. But if it is probable for *Dufourea ramulosa* it is possible for other species also.

When we have rambled about the Norwegian high mountains we have often tried to picture to ourselves this country when glaciated. There are some species, which are very characteristic of the old nunataks, e. g. the alpine *Gyrophorae*, as *Gyrophora virginis*, *fuliginosa* and

*rigida*, and *Parmelia minuscula*. We may include *Gyrophora proboscidea* and *Biatorrella coracina* that also descend to lower altitudes.

We know that several lichens can live on the nunataks, cfr. Deichmann Branth and Grønlund, Grønlands Lichen-Flora, 1888, p. 461—462.

Our knowledge on that important point is, however, still very insufficient. Scholander will this year (1931) join the Swedish-Norwegian Spitsbergen expedition (to Eastern Svalbard), under the command of H. W:son Ahlman, and it is much to be hoped that he will be able to devote some time to an examination of the nunataks.

Warming and Nathorst have discussed the origin of the Greenland flora of vascular plants. Warming was of opinion that the flora of Greenland was very old, and that a large part of it must have persisted through the ice age. He found that the Denmark Strait between Greenland and Iceland separated a mainly western Greenland flora, including also some eastern plants, from the eastern European flora. Nathorst on the contrary was of opinion that the large ice cap of Greenland was the important line of division between the eastern and western flora, and that Greenland was so entirely glaciated during the last ice age that only very few plants could have survived.

It is impossible for a botanist to argue on so intricate geological questions. But I may venture to call attention to the well known fact that the extent of a glaciation is influenced by many local factors, as precipitation, temperature and evaporation. Can the geologists really prove the existence of a synchronous glaciation, extending over every part of Greenland? We have today one of the largest ice-free regions of Greenland in its northernmost part. And here, only 7 degrees from the North Pole, Th. Wulff collected 64 different species of lichens, though he worked under such difficult conditions that he lost his life. Wulff was an experienced Arctic botanist, but he was not a lichenologist. If a trained lichenologist could have worked quietly there during a summer, he would certainly have found twice as many species of lichens, or perhaps still more.

In 1921 Lynge collected more than 200 different species of lichens along a narrow coast of an intensely glaciated region in Novaya Zemlya (Arkhangel Bay district). I had only 9 days at my disposal there, and I had to collect vascular plants also. I have also seen beautiful flower-clad hills and a rich lichen vegetation closely surrounded by very large glaciers. Every Arctic traveller has seen the same.

It is evident that we agree with Warming on the great age of a large part of the Greenland flora, as far as lichens are concerned. We are not entitled to give an opinion on the vascular plants, not having sufficiently studied their distribution.

But it is quite as evident that we do not agree with him on the other point. The Greenland Sea (the Denmark Strait) is certainly on

line of division between a western and an eastern lichen flora. On the contrary the natural lichen flora of North East Greenland is also found in the Scandinavian mountains and in Spitsbergen, with few exceptions.

It is more probable that there is a greater difference between the floras on either side of the great Greenland ice cover. But that may also be due to different conditions of life, which must be more favourable in the Disko district than in North East Greenland.

Warming as well as Nathorst operated with a "Greenland flora". Greenland is more a continent than an island. It extends 23 degrees from Kapp Farvel (Cape Farewell) to the northernmost point. It equals the distance from Oslo to Sicily, from London to Sahara, from New Foundland to Cuba, from the southern part of Hudson Bay to New Orleans. The "Greenland flora" is a statistical notion. We are not convinced that the "Greenland flora" is a unity, with which plant geography can operate.

The lichen flora of North East Greenland has in common with Novaya Zemlya 82 species of the genera treated in the present paper. Twenty of these Greenland lichens have so far not been found in Novaya Zemlya, and of these 20 we only know 5 with certainty from Spitsbergen (*Dermatocarpon daedaleum*, *Endocarpon pulvinatum*, *Cladonia squamosa*, *Cladonia acuminata* and *Gyrophora polaris*). One is a doubtful citizen of Spitsbergen (*Sphaerophorus fragilis*), and no less than 14 are also so far unknown in Spitsbergen. We find the most interesting distribution in the two western species, *Gyrophora polaris*, which is lacking in Novaya Zemlya, but known from Franz Josef Land, and *Usnea sulphurea*, which is extremely rare in Novaya Zemlya, but very common in Franz Josef Land.

Of these 20 species there is but one, *Gyrophora polaris*, which is common in North East Greenland. All the others are "rari nantes in gurgite vasto". Apart from this species the natural home lichen flora of North East Greenland is also found in Novaya Zemlya, in its entirety.

Though the common species of North East Greenland have this remarkably wide distribution, 3 of them are much more variable in our Greenland material than they are in Scandinavia or in the eastern Arctic, viz. *Gyrophora decussata*, *Gyrophora erosa* and *Parmelia minuscula*. Our Greenland material is really so variable that we have seriously considered whether we could separate them into different species. Some other lichenologists would have done so. Perhaps this variability indicates the development of geographical races. Will they develop into distinct species?

We cannot expect the same conformity with the lichen flora of the distant Benring Strait region. Of these 102 North East Greenland lichens only 61 are known from the Eastern Siberian coast, just west of the Strait.

The Siberian coast west of the Strait must be very Arctic. The "Vega" was frozen up on Sept. 28th, 1878, and it could not start again before July 18th of the following year. The winter snow began in the last days of September, and persisted till June. Although the landscape is a monotonous tundra, the lichen flora is incredibly rich. That shows the high importance of the Behring Strait as a gateway of plant immigration. It also shows the modest demands of very many lichens with respect to the duration and the temperature of the period of active vegetation.

Botanists are not wont to include the Scandinavian peninsula in the Arctic region. To find the circumpolar lichens we should therefore compare the lichen floras of North Greenland, Spitsbergen, Novaya Zemlya and the Siberian coast near the Behring Strait. The following lichens are common to all these regions:

- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1. <i>Spaerophorus globosus</i> .  | 26. <i>Gyrophora arctica</i> .      |
| 2. <i>Dermatocarpon cinerum</i> .  | 27. — <i>torrefacta</i> .           |
| 3. — <i>hepaticum</i>              | 28. — <i>erosa</i> .                |
| 4. <i>Arctomia delicatula</i> .    | 29. <i>Parmelia pubescens</i> .     |
| 5. <i>Solorina saccata</i>         | 30. — <i>minuscula</i> .            |
| (or <i>S. bispora</i> ?).          | 31. — <i>alpicola</i> .             |
| 6. — <i>spongiosa</i> .            | 32. — <i>sorediata</i>              |
| 7. — <i>crocea</i> .               | (or <i>granulosa</i> ?).            |
| 8. <i>Peltigera variolosa</i>      | 33. — <i>saxatilis</i> .            |
| (or <i>P. apthosa</i> ).           | 34. — <i>omphalodes</i> .           |
| 9. — <i>venosa</i> .               | 35. — <i>sulcata</i> .              |
| 10. — <i>rufescens</i> .           | 36. <i>Cetraria hepatizon</i> .     |
| 11. — <i>polydactyla</i> .         | 37. — <i>nivalis</i> .              |
| 12. — <i>malacea</i> .             | 38. — <i>cucullata</i> .            |
| 13. — <i>erumpens</i> (s. l.).     | 39. — <i>crispa</i> .               |
| 14. — <i>scabrosa</i> .            | 40. — <i>islandica</i> (?).         |
| 15. <i>Cladonia mitis</i> .        | 41. — <i>Delisei</i> .              |
| 16. — <i>uncialis</i> .            | 42. <i>Cornicularia aculeata</i> .  |
| 17. — <i>coccifera</i> .           | 43. <i>Alectoria ochroleuca</i> .   |
| 18. — <i>cariosa</i> .             | 44. — <i>nigricans</i> .            |
| 19. — <i>elongata</i> .            | 45. <i>Thamnolia vermicularis</i> . |
| 20. — <i>lepidota</i> .            | 46. <i>Xanthoria candelaria</i> .   |
| 21. — <i>pyxidata</i> .            | 47. <i>Physcia tribacia</i> .       |
| 22. <i>Stereocaulon alpinum</i> .  | 48. — <i>muscigena</i> .            |
| 23. — <i>denudatum</i> .           | 49. — <i>sciastra</i> .             |
| 24. <i>Gyrophora proboscidea</i> . | 50. — <i>caesia</i> .               |
| 25. — <i>hyperborea</i> .          | [51. <i>Dufourea ramulosa</i> .]    |

We find that 51 species of these 102 North East Greenland lichens are circumpolar species. This is a remarkably high figure, and most probably

it is still higher. It is very probable that species such as *Stereocaulon rivulorum* and also some others are circumpolar, though we cannot prove it today.

We do not know anything about the rapidity of the migration of the lichens. But this very wide distribution of so many species along the whole Arctic sea is to us another argument in favour of their great age. — Is it improbable to suggest that the rich local flora of the Siberian coast near the Behring Strait should contain many newcomers?

We cannot expect these figures to be representative of the whole lichen flora of North East Greenland. The crustaceous lichens from our Greenland expeditions are still largely undetermined, and so are the Spitsbergen collections. We cannot make definite conclusions, before solid facts are more available, but the determined material suggests a greater regional difference between the crustaceous lichens than between the larger lichens, treated in this paper. It seems to us that the difference is too great to be explained by insufficient investigation. Unfortunately we are unable to discuss these questions yet.

Which are the possible means of propagation of these lichens? Let us first discuss the circumpolar lichens.

A few of them have soredia: *Peltigera erumpens*, the sorediated varieties of *Cladonia coccifera* and *pyxidata*, if these varieties really are circumpolar; further *Parmelia granulosa*, *Parmelia sulcata*, *Xanthoria candelaria*, *Physcia tribacia* and *Physcia caesia*. With the exception of the sorediated *Cladoniae* these species are common.

But their soredia are always poorly developed. The *Cladoniae* are generally much less sorediate than they are in southern countries. The soredia are often corticated in all these species, and thus they can hardly be effective.

Apothecia are never found in Arctic *Peltigera erumpens*, *Parmelia sulcata*, *Xanthoria candelaria* and *Physcia tribacia*. In the other species the apothecia are so extremely rare that they are of no importance whatever. A lichenologist is glad if he can find one apothecium in any of them during a summer's work.

In the Arctic we would regard propagation by thallus fragments as more important than propagation by soredia for all these lichens.

We will then in the left column (beneath) enumerate the circumpolar lichens where apothecia are well developed and common, with spores present in sufficient quantity for propagation. Whether they really are effective means of propagation is another question. In the right column we have enumerated the lichens where apothecia are either entirely lacking or so rare that spores must be out of the question for normal propagation. A few species are intermediate, apothecia are either not common, or they are rather common in some regions, while very rare or lacking in others. We do not know whether this is due to the

development of local races, or to the local conditions of life. These few species are enumerated in either column.

*Apothecia well developed:*

- Dermatocarpon cinerum.
- hepaticum.
- Arctomia delicatula.
- Solorina saccata (bispora?).
- spongiosa.
- crocea.
- Peltigera venosa.
- Gyrophora proboscidea.
- hyperborea.
- arctica.
- torrefacta.
- erosa.
- Parmelia pubescens.
- alpicola.
- saxatilis.

*Apothecia lacking or very rare:*

- Sphaerophorus globosus.
- Peltigera variolosa.
- rufescens.
- polydactyla.
- malacea.
- scabrosa.
- Cladonia mitis.
- uncialis.
- coccifera.
- cariosa.
- elongata.
- lepidota.
- pyxidata.
- Stereocaulon alpinum.
- denudatum.
- Parmelia pubescens.
- minuscula.
- alpicola.
- sorediata.
- (granulosa?)
- saxatilis.
- omphalodes.
- sulcata.
- Cetraria hepatizon.
- nivalis.
- cucullata.
- crispa.
- islandica.
- Delisei.
- Cornicularia aculeata.
- Alectoria ochroleuca.
- nigricans.
- Thamnolia vermicularis.
- Physcia muscigena.
- sciastra.

The three last mentioned species of the left column have only been placed there with much hesitation, they are but rarely fertile.

We consider that by far the greater number of the circumpolar lichens multiply by means of thalline fragments, some of them develop

spores in sufficient number, and a few develop soredia, but we do not know whether the latter are efficient or not.

An examination of the East Greenland lichens that are not circum-polar, gives the following result:

*Apothecia common:*

*Mycocalicium* subtile.  
*Dermatocarpon* miniatum.  
 — *sphaerosporum*.  
 — *daedaleum*.  
*Endocarpon* pulvinatum.  
*Leciophysma* finmarkicum.  
*Collema* arcticum.  
 — *polycarpum*.  
*Peltigera* venosa.  
 — *Suomensis*.  
*Stereocaulon* rivulorum  
 (often sterile).  
 — *fastigiatum*  
 (often sterile).  
*Gyrophora* virginis.  
 — *polaris*.  
 — *cylindrica*.

*Soredia developed:*

*Peltigera* leptoderma.  
*Cornicularia* racemosa.  
*Evernia* mesomorpha.  
*Physcia* tenella.

*Apothecia lacking or very rare:*

*Sphaerophorus* fragilis.  
*Leptogium* pulvinatum.  
*Collema* pulposum.  
*Peltigera* variolosa.  
 — *polydactyloides*.  
*Cladonia* squamosa.  
 — *cenotea*.  
 — *acuminata*.  
 — *cornuta*.  
 — *lepidota*.  
 — *cervicornis*.  
 — *fimbriata*.  
 — *pyxidata*.  
 — *cyanipes*.  
*Gyrophora* decussata.  
 — *vellea*.  
 — *deusta*.  
*Parmelia* subobscura.  
 — *intestiniformis*.  
 — *stygia*.  
 — *groenlandica*.  
 — *infumata*.  
*Alectoria* jubata.  
*Usnea* sulphurea.  
*Physcia* constipata.  
 — *intermedia*.

The results are the same: — very few (four) lichens with soredia — and these four sorediate lichens are quite rare —, many lichens with only thalline reproduction, and a smaller, though considerable number, with apothecia and spores.

We find almost the same proportion for the widespread circum-polar lichens as for the less widespread and local species. We cannot conclude that any one of these manners of multiplication is more effective for the migration than another.

The number of species is not so large that a comparison between the percentages would be of interest. And even if it were larger, statistical considerations should be used with great care in biology. They easily conceal the causality.



---

But let us compare those species, which are always, or nearly always, sterile in the Arctic, with the same species, when growing under more favourable conditions in southern regions.

We find that the greater number are sterile under all conditions of life, they are genotypically sterile. But there are also some species, which we could not have placed in that category if we had been examining the lichen flora of a southern country, e. g. *Peltigera polydactyla*, *Peltigera malacea* and *Peltigera variolosa*, several *Cladoniae*, and *Parmelia stygia*.

If we had extended this study to the crustaceous lichens also, the result would have been very different. For there are relatively few sterile crustaceous lichens in the Arctic, at least they are not collected.

But we can safely conclude that in some lichens the Arctic conditions of life make the formation of apothecia difficult, perhaps impossible. If such lichens had no other means of propagation they would be quickly eliminated from the Arctic flora. But on account of the easy thalline multiplication the Arctic climate is not so disastrous to lichens as it is to seed plants.

The result is not astonishing. We know that in *Pinus Abies* (= *Pinus silvestris*), perhaps also in *Betula*, the formation of effective seeds is a limiting factor northwards.

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## PLATES

On the plates the size of the plants is shown by a measuring scale under each figure. On this scale the interval between the vertical lines represents 1 mm in all cases.

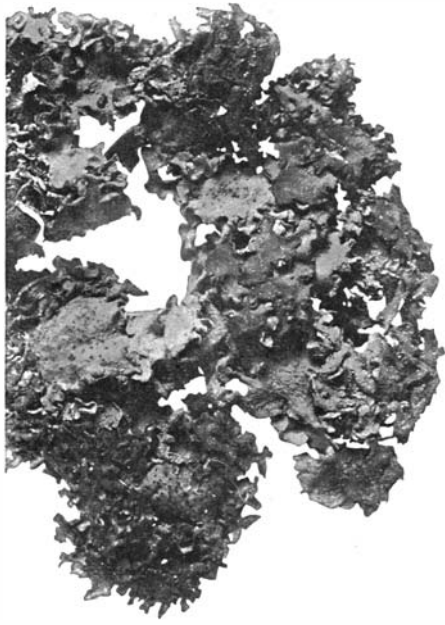
**Plate I.**

- Fig. 1. *Peltigera Suomensis* Gyeln., upper side. Sofiasundet <sup>19</sup>/8 1930.  
· 2. Same plant, lower side.  
— 3. *Dermatocarpon sphaerosporum* Lyng. Moskusoksefjorden <sup>5</sup>/8 1930.  
· 4. *Endocarpon pulvinatum* Th. Fr. Myggbukta <sup>1</sup>/8 1930.  
- 5. *Dermatocarpon daedaleum* (Kremplh.) Th. Fr. Between Kapp Wynn  
and Flache Bay <sup>28</sup>/7 1929.





1.  mm



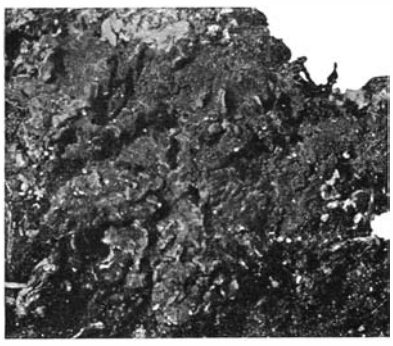
3.  mm.



2.  mm



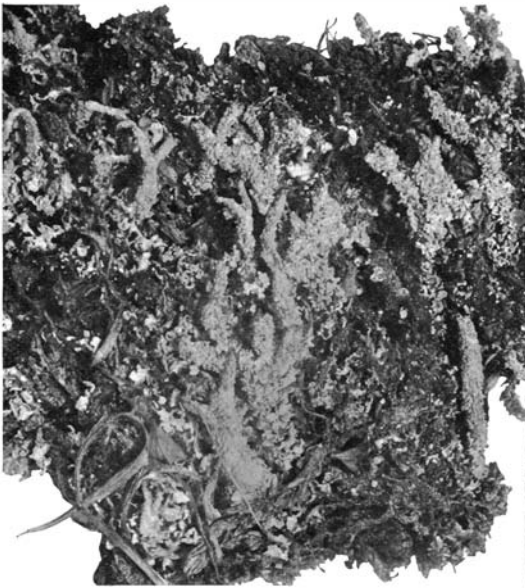
4.  mm.



5.  mm.

**Plate II.**

- Fig. 1. *Cladonia acuminata* var. *foliata* (Arn.) Lyng. Veganeset 7/8 1929.  
— 2. *Cladonia cenotea* (Ach.) Schaer. Husbukta 8/8 1929.  
— 3. *Cladonia cornuta* (L.) Schaer. Mainland near Archerøya 10/8 1930.  
— 4. *Cladonia cariosa* (Ach.) Spreng., with apothecia. Kapp Humboldt 3/8 1930.  
— 5. *Cladonia cariosa* (Ach.) Spreng., without apothecia. Röhssfjorden 14/8 1930.



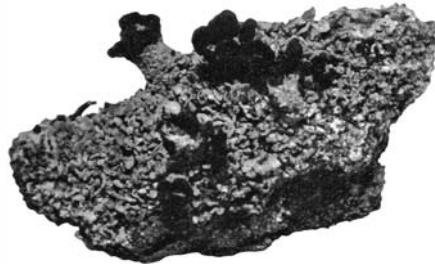
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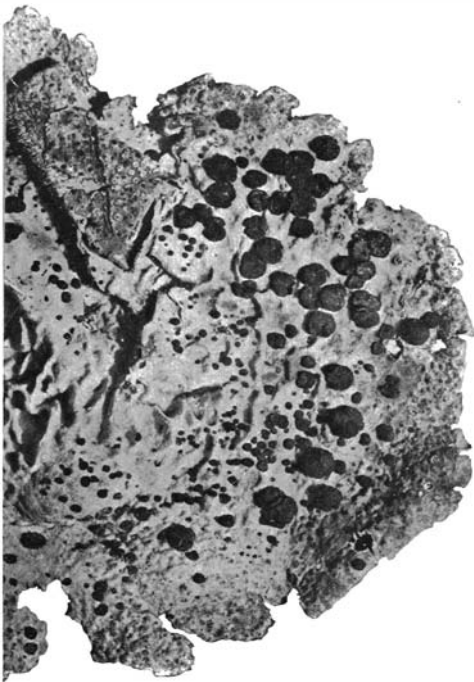
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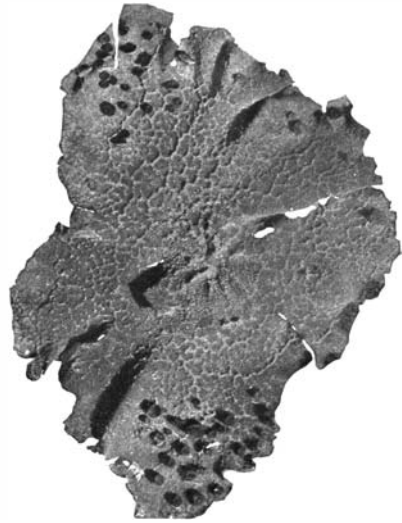
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**Plate III.**

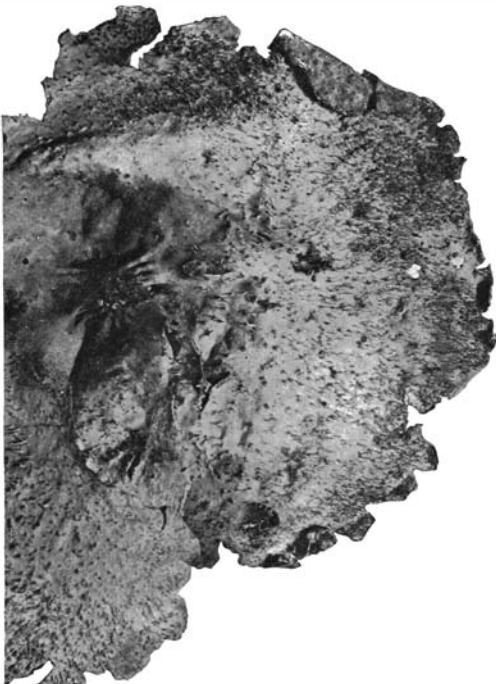
- Fig. 1. *Gyrophora virginis* (Schaer.) Frey, upper side. Myggbukta <sup>31</sup>/<sub>7</sub> 1930.  
..... 2. Same plant, lower side.  
— 3. *Gyrophora decussata* (Vill.) Zahlbr., upper side. Kapp Humboldt  
<sup>3</sup>/<sub>8</sub> 1930.  
· · · 4. Same plant, lower side.  
· · · 5. *Parmelia infumata* Nyl. Kjerulffjorden <sup>13</sup>/<sub>8</sub> 1929.



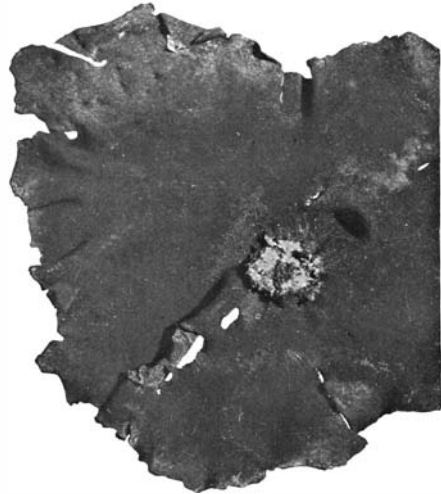
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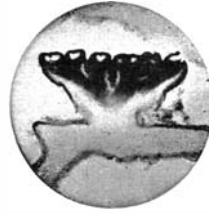
5.  mm.


**Plate IV.**

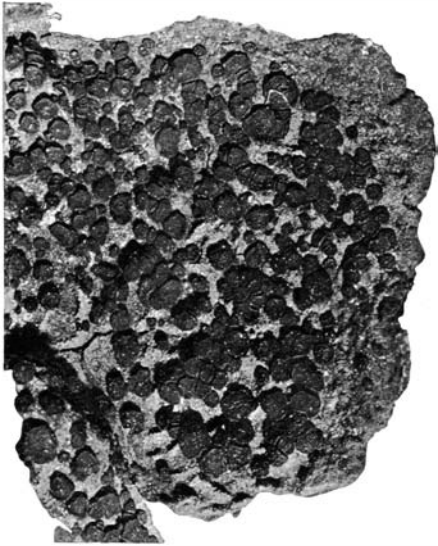
- Fig. 1. *Gyrophora polaris* Schol., lower side, Myggbukta <sup>31</sup>/7 1930.  
--- 2. Same plant, upper side.  
— 3. *Gyrophora polaris* Schol., apothecia.  
— 4. *Gyrophora polaris* Schol., section of apothecium.  
--- 5. *Gyrophora proboscidea* (L.) Ach., section of apothecium.  
--- 6. *Gyrophora proboscidea* (L.) Ach. Röhssfjorden <sup>14</sup>/8 1930.  
--- 7. *Gyrophora proboscidea* (L.) Ach., apothecia.




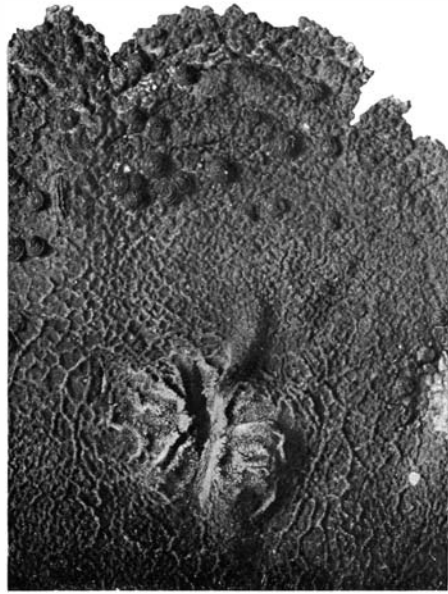
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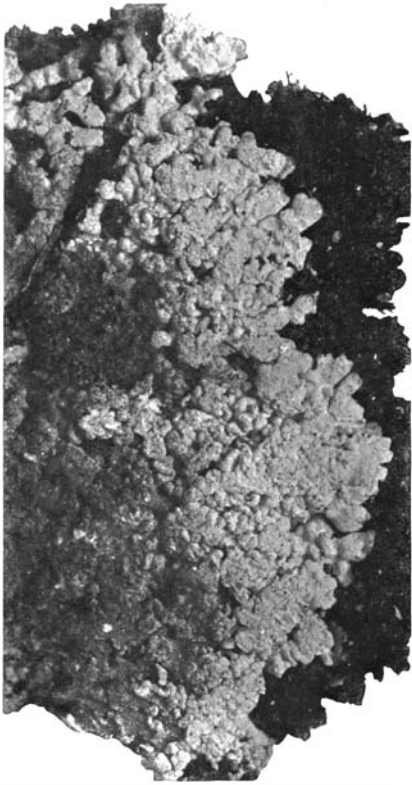


7.

**Plate V.**

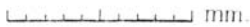
- Fig. 1. *Parmelia groenlandica* Lynge. Röhssfjorden 17/8 1930.  
— 2. *Parmelia intestiniformis* (Vill.) Ach. Dicksonfjorden 13/8 1930.  
— 3. *Cladonia lepidota* var. *stricta* f. *hypophylla* (Nyl.) Vain. Kapp  
Humboldt 5/8 1929.  
— 4. *Cladonia lepidota* var. *stricta* f. *pterophora* Vain. Veganeset 7/8 1929

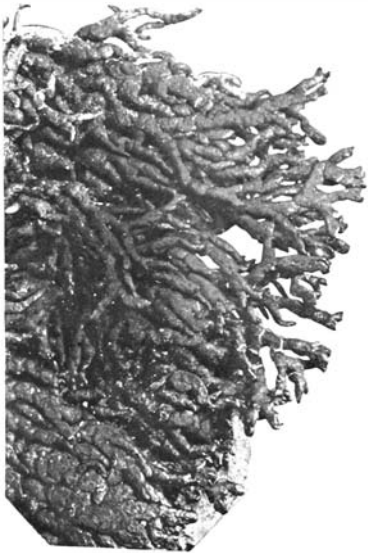




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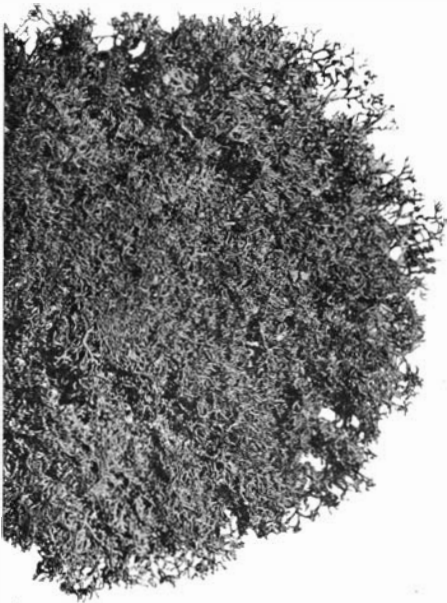
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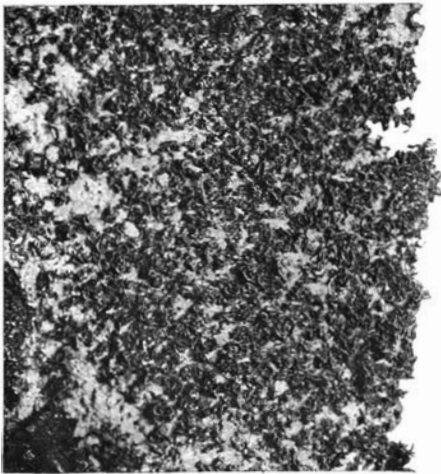
4.  mm.

**Plate VI.**

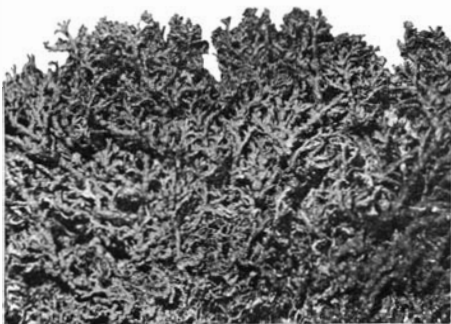
- Fig. 1. *Parmelia minuscula* f. *luxurians* Lyng. Kjerulffjorden <sup>13</sup>/<sub>8</sub> 1929.  
— 2. *Parmelia minuscula* f. *aperta* Lyng. Kapp Humboldt <sup>3</sup>/<sub>8</sub> 1929.  
— 3. *Parmelia minuscula* f. *applanata* Lyng. Kjerulffjorden <sup>13</sup>/<sub>8</sub> 1929.  
— 4. *Parmelia granulosa* Lyng. Ellaøya <sup>8</sup>/<sub>8</sub> 1930.  
— 5. *Gyrophora decussata* f. *perforata* Lyng. Dicksonfjorden <sup>13</sup>/<sub>7</sub> 1930.  
— 6. *Parmelia minuscula* f. *crustacea* Lyng. Jacksonøya <sup>31</sup>/<sub>7</sub>—<sup>1</sup>/<sub>8</sub> 1929.  
— 7. *Parmelia soreciata* Th. Fr. Myggbukta <sup>1</sup>/<sub>8</sub> 1930.

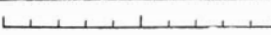


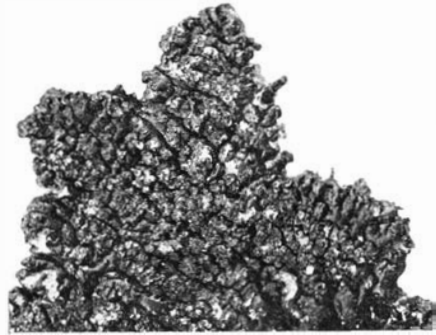
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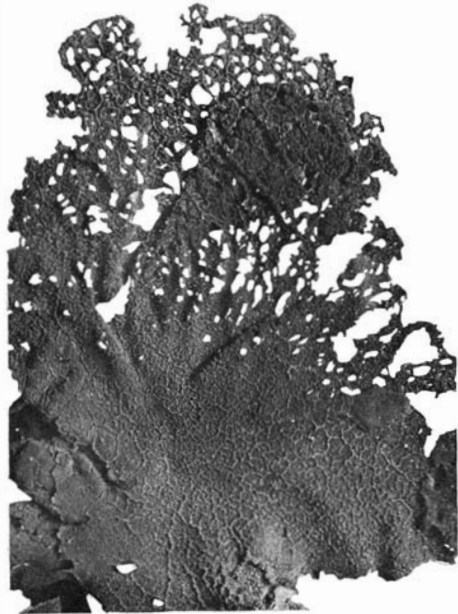
2.  mm.



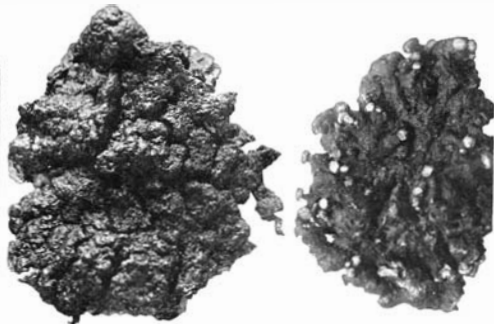
3.  mm.



4.  mm.



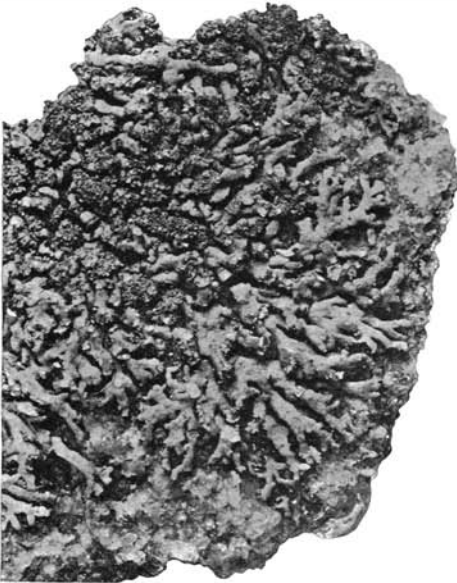
5.  mm.



6.  mm. 7.  mm.

**Plate VII.**

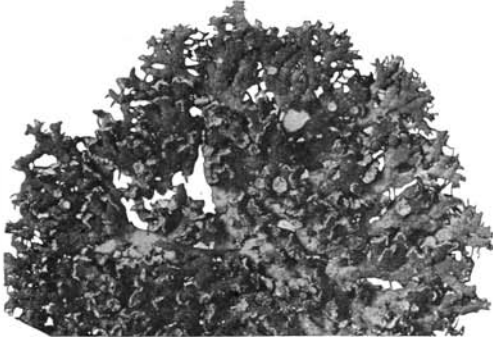
- Fig. 1. *Physcia intermedia* Vain. Finnish plant: Åbo: Stockudd, on a bird-stone, leg. Ernst Häyrén (vidit Vainio).  
— 2. *Cornicularia racemosa* Lyng. Myggbukta <sup>31</sup>/<sub>7</sub> 1930.  
— 3. *Physcia tribacia* (Ach.) Nyl. Gåsøya <sup>9</sup>/<sub>8</sub> 1929.  
— 4. *Physcia intermedia* f. *marginata* Lyng. Myggbukta <sup>31</sup>/<sub>7</sub> 1930.  
— 5. *Evernia mesomorpha* var. *gracilis* Lyng. Myggbukta <sup>3</sup>/<sub>7</sub> 1930.




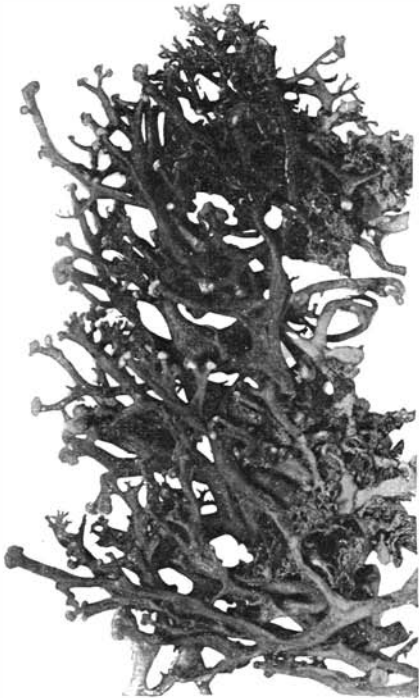
1.  mm.



3.  mm.



4.  mm.



2.  mm.



5.  mm.



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 " 30. ORVIN, ANDERS K., *Beiträge zur Kenntnis des Oberdevons Ost-Grönlands*. HEINTZ, ANATOL, *Oberdevonische Fischreste aus Ost-Grönland*. 1930. Kr. 4,00.

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