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# BOTANICAL INVESTIGATIONS IN THE PÄLTSA REGION OF NORTHERNMOST SWEDEN

## WITH AN ACCOUNT OF ITS GEOLOGY AND GEOMORPHOLOGY

BY

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# Contents.

# Preface.

By Axel Nygren.

In the far North of Sweden, in the corner between Norway and Finland, lies the Pältsa mountain district, many troublesome miles away from the nearest Swedish dwelling, and swept by icy winds from the Arctic Ocean. Each of its three main peaks has its own characteristic shape, the South Peak like the Matterhorn, the Middle Peak its »table-top» plateau, and the High Peak its lumpy form. For us, late investigators of the little explored mountains in Lapland, Pältsa was always a symbol of the unknown. When we heard of the plants discovered there in the last thirty years by some of the botanist pioneers of the Scandinavian mountains, Alm, Nordhagen, Smith, and Tengwall, we were eager to go there ourselves and explore.

Botanically and geologically, Scandinavia is probably one of the best known parts of the world. As early as a century ago it became evident that the peninsula had been covered by a great layer of ice at a recent stage of its geological history. At first it was generally supposed that the entire biota must have been eradicated by the ice, and that the animals and plants now occupying the peninsula must all have immigrated from the regions south and east of the glaciated parts of Europe. The mountain plants were supposed to have endured close to the ice edge, while the lowland plants had grown at a greater distance from it. It was early recognized, however, that some Scandinavian mountain plants occur also on Greenland, in North America, and Siberia, but not in Europe outside Fennoscandia. It was later suggested that these species had survived the last glaciation in Scandinavia. The theory of glacial survival of plants on our peninsula was firmly established by the classical work by Thore C. E. Fries in 1913, where he demonstrated that a number of rare alpine plants occur only in restricted areas, which are more or less the same for many species. These areas or centres were considered to have been situated close to the glacial refuges,

where the plants had survived the last glaciation. Later investigations have increased our knowledge of these centres, and the theory of glacial survivors has also received strong support from taxonomical revisions of certain critical groups, e.g. *Arenaria ciliata* coll., *Papaver radicatum* coll., and *Poa arctica,* etc. In some of these groups vicarious races could be distinguished, which had obviously survived the last glaciation in different refuge areas. The approximate position of the glacial refuges in Scandinavia has been established by inspection of the centres for those rare alpine plants that presumably lived there and afterwards spread inland, an idea especially advocated by NORDHAGEN, who has stressed the importance of the unglaciated areas along the coast, which are now covered by the sea.

The Pältsa district in northernmost Sweden is situated close to the Norwegian Balsfiord and not too far from the famous Lyngenfiord area, known for a long time for the occurrence of several supposed glacial survivors. During the last century, visitors to the Pältsa mountains have discovered there *Armeria scabra* ssp. *sibirica, Carex holostoma, Sagina caespitosa, Stellaria crassipes,* and, above all, the endemic *Papaver laestadianum,* together with some viviparous *Poa pratensis* forms for which this is the only locality on the European continent. Accordingly, it was considered important that our knowledge of the botany of this district should be extended. It was also thought desirable to study the geology of the area, in case there might be some evidence that there had been a nunatak during the last glaciation, for in such a case it would be the only one in Sweden. The two best experts on the botany of the Scandinavian mountains in our day, Professor ROLF NORDHAGEN, Oslo, and Dr. HARRY SMITH, Uppsala, have both urged, verbally and in writing, that a botanical and geological exploration of the Pältsa mountains should be undertaken. We have made our attempt, and we hope that it will stimulate other botanists and zoologists to spend summers in this area among snow, ice, and mosquitoes, because there are, no doubt, many interesting things still to be found in the Pältsa wilderness.

Chapter 1.

# A brief account of botanical exploration in the Pältsa area.

By O. MÅRTENSSON.

In spite of its inaccessible position, the Pältsa-Måskokaise district has frequently been visited by botanists. As early as 1800, the 20-year old GÖRAN WAHLENBERG and his companion JOHAN ERIK FORSSTRÖM passed through the area during their journey through the provinces of Lappland and Finnmark. A detailed description of the hardships and delights of the expedition is to be found in the diaries of the two travellers (F. 1917; W. 1800); the versatile FORSSTRÖM tells us about everything, while WAHLENBERG consistently keeps to the subject, botany. They travelled from Karesuando by small river-boats, still the most important means of transport in this part of Sweden, and reached Åggovare by way of Kummaeno, whence they continued on foot. When the river runs high in the spring, it is possible to go by water all the way up to the Nirjijokk (Kummajoki) waterfall.[1] After the journey up Kummaeno, they camped by Lakonkoskijoki (Lakkonjoasjåkko) on the night of the 3rd of July (according to W., the 4th), close to Pausavare. Next day they followed the old Lapp track which here runs along the esker, as it does farther down the valley. Probably they did not follow the track exactly, because if they had done so, they would have had no reason to climb Njärravaara (Nirjivare). The two of them seem to have made eager use of every stop to collect plants and anything else of interest. When they passed Njärravaara their botanical interest became so strong that, as WAHLENBERG says, »we turned to our companions and most urgently requested them that they should wait there for an hour, which they agreed to do». W. continues, »this was the

[1] Regarding names, the reader is referred to the map (Fig. 1) and »Some remarks on the geographical names» (p. 198 ff.).

southern part of the mountain, which was completely free from snow at this time, though there was scarcely a bare spot to be seen on the surrounding mountains. *Dryas* was abundant there with fruit, and *Andromeda tetragona* grew everywhere in large tufts with the flowers just opened». They went on from Njärravaara up somewhere between Gapovare and Tjårrokaise, and along Omasesjoki to Omajses Fjord.[2] Thus they did not have an opportunity to botanise on Pältsa itself.

LARS LEVI LAESTADIUS may possible have journeyed past Pältsa during his stay at Karesuando. I have not been able to trace any positive proofs of such a journey among his botanical papers, however. The localities he gives for the material he collected are very brief, and do not provide any information in this respect. We know that L. collected *Papaver Laestadianum* in 1832 on Paras, but we do not know what route he took on that occasion. It does seem very unlikely, however, that L. did not on some occasion follow the old Lapp track on one of his many journeys in the parish. It is possible that accounts of such journeys exist in the form of official reports among documents in the care of the dioceses of Härnösand or Lule. C. P. LAESTADIUS's visit to the district was in all probability undertaken on the recommendation of his brother, so it is quite likely that the latter was acquainted with the flora of the district.

C. P. LAESTADIUS (1860, p. 4) spent the summer of 1859 in Torne Lappmark, his botanical studies being on this occasion mainly confined to the Karesuando district. He did make a journey up to Pältsa and Måskokaise, but the visit appears to have lasted only two days (the 29th and 30th of July). He mentions several localities from these two mountains in his doctor's thesis (1860) »Bidrag till kännedomen om växtligheten i Torneå lappmark» (Contribution to Our Knowledge of the Vegetation of Torne Lappmark). His species list includes some higher fungi as well as vascular plants.

It seems that after C. P. LAESTADIUS no botanist visited Pältsa until 1909, when TH. FRIES and S. MÅRTENSSON undertook a journey to that region at the request of the 1909 Renbeteskommission (Commission on Reindeer Grazing Lands). Their »Floristiska anteckningar från de alpina och subalpina delarna av Karesuando och Jukkasjärvi socknar norr om Torne Träsk» (Notes on the Flora of the Alpine and Subalpine

[2] The Lappish names for the Signal valley and the Storfjord valley are Tjiekngalvagge (the Deep Valley) and Omas-vuoddve (HELLAND, 1899, p. 17); on P. A. MUNCH's »Kart over Norge» 1852, the river is called Omasijoki.

Regions of Karesuando and Jukkasjärvi Parishes to the North of Torne Träsk), published in 1910, records many finds of vascular plants from the Pältsa-Måskokaise district. FRIES included data from his visit in his comprehensive work on the alpine and subalpine vegetation of Torne Lappmark. His »Botanische Untersuchungen im nördlichsten Schweden» (1913) contains much that is of interest with regard to the Pältsa area, including several test-square analyses. It is difficult to judge from the works mentioned how long FRIES and his companions stayed in the district, although they were certainly there from the 18th to the 21st of August, and the localities reported suggest that they visited those parts of the region most interesting from the botanical viewpoint.

The activity of the 1909 Renbeteskommission led to other visits to Pältsa and Måskokaise. According to the report of the commission for the 29th and 30th of August 1910 (signed V. TANNER, J. ROSANDER, Y. HALONEN, A. MONTELL and G. LÅNG), the region around Kummajärvi and Gåbnetjåkko was visited, and an excursion undertaken to Pältsavagge, through the pass between Pältsa and Måskokaise, and afterwards down by Nirjijaure and Lassivare. The report includes several observations of general geographical and botanical interest. One of the members of the party, LÅNG, was interested in lichens, of which he collected a number.

The members of the various parties sent out by the Renbeteskommission probably made unofficial excursions in the neighbourhood, besides the official recorded ones. Thus, to judge by some of his lichen labels, B. LYNGE travelled in the district in July 1910. J. HOLMBOE probably accompanied him on this journey, which crossed parts of the Råsto area. There is nothing to indicate that they reached the Pältsa-Måskokaise massif, and it is unlikely that they did so.

In 1912, HJ. MÖLLER travelled in Karesuando parish, and visited Pältsa. He was the first to visit these mountains solely or mainly for bryological purposes. His route up the Kummaeno valley may be traced quite easily from the labels on the mosses he collected. He stayed only one day at Pältsa itself (18th July), probably just roaming over the steep slopes of South Peak and Lassivare. He returned the same way as he had come. His findings were published (MÖLLER, 1913—1936) in the series »Lövmossornas utbredning i Sverige» (The Distribution of Musci in Sweden).

Pältsa (presumably Måskokaise is meant) is mentioned by J. E. ROS-

BERG (1916, p. 173) in a way which suggests that he was in that neighbourhood, probably in 1914 or 1915.

In the summer of 1919 the area was visited by C. G. ALM and T. Å. TENGWALL, who reached the confluence of Pältsajokk and Nirjijokk on the 26th of July. They had started from Laimolahti at the eastern end of Torne Träsk, crossed the Råsto area to reach Kummavuopio, and made their way to Pältsa after an excursion up to the Tuipal massif. Despite the fact that they had no tent, they stayed there two days, the first of which they employed in wandering through Pältsavagge, and the second for excursions to the adjacent parts of Måskokaise and the higher parts of Pältsa. The journey continued along the slopes of Pältsa above Nirjijokk and Nirjijaure. At the upper end of the lake they crossed the river and climbed Tjårrokaise. Afterwards, they continued on down the Signal valley. This short visit yielded a large number of vascular plants, of which they gave an account in a paper »Floristiska bidrag från Karesuando och norra delen av Jukkasjärvi socknar» (Contribution to the botany of Karesuando and the northern part of Jukkasjärvi parish), published in 1920. A more detailed report of the journey, written by ALM, is to be found in S.T.F.'s Årsbok (Year Book of the Swedish Touring Club) for 1921 (pp. 281—288).

T. E. HASSELROT and H. WEIMARCK made a botanical excursion to the northernmost part of Sweden in July and August of 1929. They travelled to the Pältsa district by river boat from Karesuando. They paid most attention to the Tuipal massif, but also undertook a 3—4 day visit to Pältsa. The main places they visited seem to have been South Peak, Pältsavagge, and the adjacent parts of Måskokaise. In a paper called »Bryologiska undersökningar i nordligaste Sverige» (Bryological Investigations in Northernmost Sweden), published in 1937, WEIMARCK has given an account of the mosses they found, many of which came from the above-mentioned parts of the Pältsa area. The species list includes mosses of all groups.

In a publication called »Bidrag til fjellet Pältsas flora. Ett nytt funn av *Stellaria longipes*» (Contribution to the flora of Mount Pältsa. A new find of *Stellaria longipes*), R. NORDHAGEN (1939, pp. 691—700) gives some results of his two visits to Pältsa, both of which were made from the Signal valley. The first was on the 24th of July 1930, and the second on the 14th of August 1934. On both occasions it was the slopes above Nirjijaure, so rich in species, which were of particular interest to NORDHAGEN.

H. SMITH made two journeys to the Pältsa-Måskokaise district in the thirties, proceeding by way of the Signal valley on both occasions. The first visit was from the 20th to the 31st of July 1933, in the company of S. JUNELL, visiting the region round Gapojaure and Nirjijaure, as well as Pältsa and the slopes of Måskokaise to the north-east.

SMITH's second visit was from the 2nd to the 6th of August 1939, and he roamed over the slopes above Nirjijaure from Middle Peak to High Peak. S. was accompanied on this occasion by S. ARNELL, who devoted his attention to the liverworts. ARNELL (1941) published an account of these in a paper entitled »Bidrag till kännedomen om levermossfloran i Norrbotten och Torne lappmark» (Contribution to Our Knowledge of the Liverworts of Norrbotten and Torne Lappmark). A third visit by H. SMITH will be mentioned later.

The Finnish road between Torneå and Lyngen, which was completed during the Second World War, has made it much easier to travel to these northern parts, and Siilastupa near Kilpisjärvi has been used several times as the starting place for botanical excursions. A group from the University of Helsingfors visited the area in July 1946 for study and research, spending the period from the 11th to the 19th of July on an excursion to the Pältsa-Måskokaise massif. J. JALAS (1949, pp. 90—96) reports the more important finds of vascular plants in »Floristisches aus Lapponia enontekiensis, Lapponia tornensis und Troms Fylke», many of them originating from the Pältsa district.

The following year, H. ROIVAINEN set out from the same starting point for the Pältsa district. The journey lasted from the 25th to the 29th of July, and followed a route Gapovare—Nirjijokk—the Pältsa hut—the slopes of Måskokaise towards the southern parts of Pältsa-Nirjijaure. The visit was mainly devoted to the Eriophyid fauna, but some fungi and vascular plants were also collected. R. is a bryologist, amongst other things, and he describes the journey as unique, in that he did not collect a single moss.

The Pältsa hut was built during the war. It suffered from the frequent visits of refugees, but was restored and reequipped by S.T.F. in 1949, and it is now in their care. Thanks to this hut, it is now possible to make longer and more effective stays in the district, and the hut is now the usual place of departure for excursions to Pältsa.

The same route by way of Siilastupa was chosen in 1948 by a party from Uppsala consisting of T. E. HASSELROT. A. NYGREN, H. SMITH and myself. This was for SMITH his third visit and for HASSELROT his second. They continued with their collecting of vascular plants and

lichens respectively. The party arrived at the Pältsa hut on the afternoon of the 25th of July. HASSELROT and SMITH returned on the morning of the 6th of August to Siilastupa, while NYGREN and I went down the Signal valley three days later on our way home.

Another expedition from Uppsala started by plane from Abisko on the 11th of July the following summer. But the plane did not go farther than to Råstojaure (the bay east of peak 809.9) on account of the bad weather, the party continuing to Pältsa on foot. Thus nothing became of the original plan to land on Kummajärvi or Måskojaure. However, the main part of the expedition was able to return by plane as planned on the 17th of August, from Måskojaure. The unusual amount of snow still remaining and the unfavourable weather that year, which meant that the vegetation was retarded at least fourteen days, forced the botanists of the expedition to remain about one week longer than the month originally intended. S. RUDBERG studied the general geological aspects of the area, and on the 25th of July went on down the Signal valley to Lyngen Fjord to continue his exploration. O. HEDBERG devoted himself to the flora and vegetation of the area, and he left Pältsa on the 7th of August by way of the Signal valley on his way home for military training. A. NYGREN continued with his collecting of botanical-genetical material which he had begun the preceding summer. I continued with mosses. Besides the main part of the Pältsa-Måskokaise massif, some nearby mountains, including Paras, were visited. HEDBERG and NYGREN also made a journey to Baadkjeipen, a Norwegian mountain about 10 km west of the north-west end of Råstojaure. The expedition was financed by a grant from Kungliga Svenska Vetenskapsakademien's (the Royal Swedish Academy of Sciences) Hierta-Retzius fund for scientific research.

Miss A.-M. ÖHLIN visited the area in the summer of 1950 (July 15—31) and collected some phanerogams and pteridophytes.

That seems to complete this summary of the history of botanical exploration in the Pältsa district. Visits from the Norwegian side have been few, and Norwegian flora reveal large gaps in the knowledge of the vegetation of the region to the west of Pältsa. It is, of course, quite possible that some visit to the district or to nearby areas has escaped my notice — it is probable, for instance, that some amateur botanists have been in the region. However, if anyone had made some sensational discovery there, it would have come to the ears of at least one of the many botanists I have asked.

In conclusion, I should mention that most of the botanists who have

visited Pältsa and Måskokaise have made one or more sensational finds. I have not found it desirable to burden this summary with a lot of specific names, but details may of course be found in the published works of the various botanists mentioned here. Regarding vascular plants, that sharp-eyed observer H. SMITH deserves special mention, especially as there is no published account of any of his three visits. A special account of Pältsa's bryological exploration is given in connection with the species list for mosses.

Chapter 2.

# Some observations on the geology and morphology of the Pältsa area.

By S. RUDBERG.

(With a separate list of references.)

The name Pältsa,[1] well-known to botanists, has few associations for geologists and geographers. Apart from some details, the area has remained unknown. The idea that some part of Pältsa might have projected as a nunatak above the inland ice is due to botanists, with botanical reasons. It has never been discussed in a geological connection. The hypothesis is interesting, since it has not hitherto been possible to establish with any degree of certainty that there are summits in Sweden which stood out above the surrounding ice surface for any considerable length of time.[2] The nunataks generally accepted are all situated farther to the west.

So I considered that my task in the predominantly botanical investigation of the Pältsa area was in general to extend in some degree our knowledge of the geology and morphology of the Pältsa area, and in particular to examine from the geological point of view the question of whether some of the peaks had been free from ice or not. Unfortunately, the time available for examination of the area was no more than 14 days, and the weather in July 1949 was unusually bad. In addition, the problem is scarcely one which promises a solution before-

[1] The place names in this part of Sweden are all Finnish (f) or Lappish (l). The following common words signify in English: järvi (f) and jaure (l) = lake, joki (f) and jokk (l) = river, kaise (l) = high mountain, tjåkko (l) = mountain, vagge (l) = valley, vaara (f) and vare (l) = mountain, hill.

[2] In his profile constructions for different stages of the last glaciation, LJUNGNER (1949, p. 20) puts Norra Storfjället in Västerbotten above the ice surface in all the stages, but without commenting on the fact.

hand, since it appears to be difficult to formulate decisive criteria for a mountain area of the Pältsa type to have been ice-free. The following opinions are therefore presented with due reservations.

Pältsa is our m o s t n o r t h e r l y h i g h m o u n t a i n, situated in Karesuando parish in the northernmost tip of Sweden. The 69th parallel intersects the middle of the mountain massif. A sketch map of the area is reproduced here to facilitate orientation (Fig. 1). The map is compiled from Swedish and Norwegian map material.[3] Personal field surveys have contributed some details (e.g. cirque valleys); they are only approximately correct with regard to extent and position.

The broad extensive Kumma valley runs diagonally across the map, its floor at a height of 500—650 m. It is the northernmost of the westerly branch valleys of the Muonio-Könkämä valley. The river Kummaeno runs through the valley; it is formed by the junction of the Nirjijokk from the N and the Pältsajokk from the NW. Just S of their junction, near the Pältsa hut, the Kummaeno falls over a sharp declivity in the valley bottom in a fine waterfall. To the NE of the valley is Tuipal, an undulating mountain of gradual slopes somewhat above 1000 m. To the S, above the more level rolling terrain at a height of 6—700 m, some low mountain ridges stand out, of which Gapovare and Pausavare are the most prominent, with their steep escarpments facing the valley. The summits reach heights of 900 m. W of the Kumma valley lies the steep, horse-shoe shaped massif, open to the SE, of which Pältsa is the lesser and northern branch and Måskokaise the southern. Fig. 2 gives an idea of the main features of the massif (it was taken from the esker 1 km south of the Pältsa hut). Pältsa has two main peaks, that to the S steep and conical, 1425 m in height,[4] and separated by a partly demolished cirque form the almost flat-topped Middle Peak, 1448.0 m. Farther to the NW are one larger (Low Peak) and several smaller culminations towards the upper end of the valley Pältsavagge, where the

[3] The Norwegian map (»province» map) is very old and extremely generalised, the Swedish less so, though even that is often incorrect in its details. The sheets used are the topographical sheets no. 1 Rostojaure and no. 2 Naimakka, together with Norwegian province maps. The map was drawn at the Geographical Department of Uppsala University by Captain W. Tiit.

[4] The heights are partly taken from the topographical map, and partly measured with an altimeter made by Thommen. The check point chosen was S.T.F.'s (Swedish Tourist Association) Pältsa hut, at 600 m. This value was arrived at after comparison with the lakes Torneträsk, Kummajärvi and Nirjijaure. The margin of error for this value is reckoned to be ± 10 m. Some of the altimeter readings are based on only a single observation.

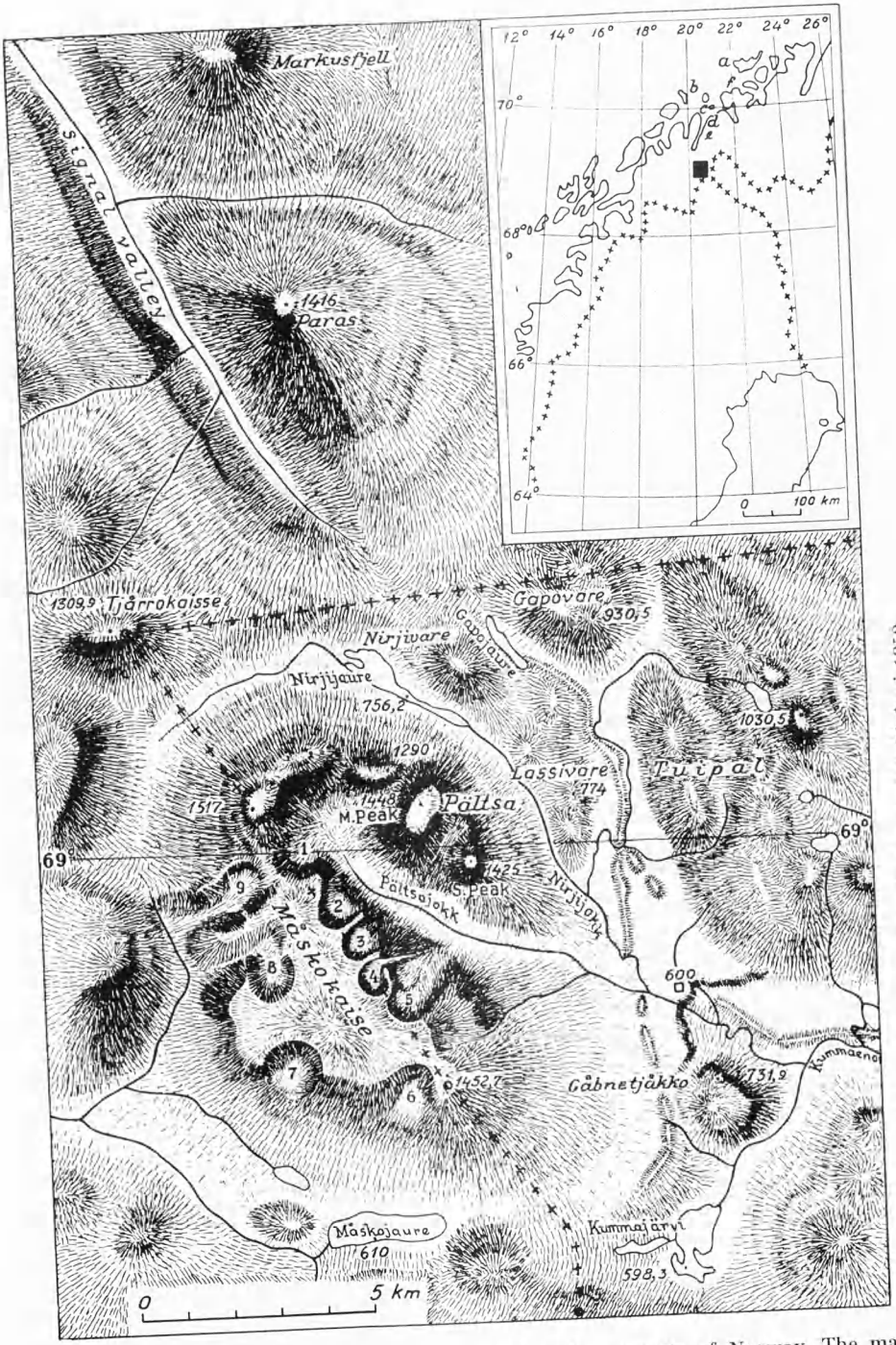


Fig. 1. Sketch map of the Pältsa region with adjacent parts of Norway. The map is compiled from Swedish and Norwegian official maps. The cirque valleys — numbered 1 to 9 — have been drawn approximately after a field survey by the author. The same applies to the Kumma esker. Altitudes in metres. The small square with the altitude figure 600 marks the site of the Pältsa hut.

Fig. 2. Måskokaise and Pältsa from SE. The photo was taken by the author (18/7 1949) from the esker 1 km S of the Pältsa hut, which is seen to the right over the middle one of the three snow patches. In the centre is the waterfall formed where Kummaeno flows over a sharp declivity in the valley bottom. The snow cover on the mountains is partly due to the snow storms of the preceding days.

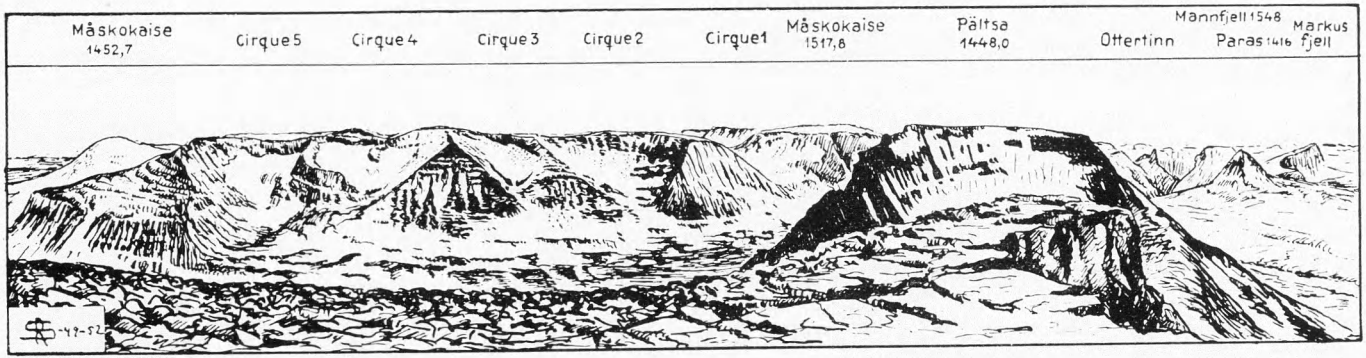


Fig. 3. View from the S Peak of Pältsa towards S, W, and N. Vertical scale somewhat exaggerated. Notice the slightly undulating top surface of Måskokaise and the Middle Peak of Pältsa, the ideal shaped cirques with terminal moraines, and the truncated spurs. To the right the Signal valley in Norway. — Drawn after photos taken by the author 18/7 1949.

curved mass of Måskokaise commences at the lowest point of the ridge. Opposite the upper end of the valley is the highest point, at 1517.8 m, the site of frontier cairn 209 B.[5] The broad southern ridge of Måskokaise is fairly level, varying in height between 1300 and 1500 m. The top, which is often flat, is sharply bounded by cirques.

## Petrology and tectonics.

Only a few data about the petrology and tectonics of the Pältsa area have been published hitherto. There are some partly incorrect details given by FRIES (1913, p. 4 ff.) and some scattered observations mentioned by TH. VOGT (1918, pp. 262, 265) without distinct localization. The Swedish Geological Survey has unpublished material from the immediate surroundings of the Pältsa-Måskokaise massif and I have been permitted to include some of it in this paper.[6] My own observations are confined to a few profiles, which were mainly taken from places that had not previously been visited by Swedish geologists. At some distance from the Pältsa area we have old observations from the neighbourhood of Kilpisjärvi on the Finnish border published by SVENONIUS (1880, pp. 56 ff., 61) and TANNER (1907, p. 5). A modern investigation by H. HAUSEN (1942) in the Finnish part of the Caledonian overthrust region treats a strip on the Swedish side of the frontier as well. The adjacent parts of northern Norway have been dealt with in numerous papers by K. PETTERSEN, and, more recently, by TH. VOGT and others. The following outline of the Pältsa area is based mainly on my own incomplete material.[7] It is not sufficient for a geological map.

The higher parts of the Pältsa-Måskokaise massif are built up of a thick sheet of amphibolites, sometimes garnet-bearing. The amphibolites usually lie rather flat, with westerly dip and varying strikes mostly to the N or NE. On the east side of Pältsa's S peak and Middle peak the amphibolite extends down to a height of 1200 m. Towards Pältsavagge it reaches a lower level, and in the southern part of Måskokaise goes down to about 900 m on both sides of the ridge.

[5] The frontier cairn has been so placed that the actual highest point — it is a question of a couple of metres — is some tens of metres inside the Norwegian border.

[6] The observations have mainly been collected by Professor O. ÖDMAN, Stockholm.

[7] A collection of rock specimens, unfortunately incomplete owing to difficulties of transport, has been inspected by the government geologist Dr. O. KULLING, and by Fil. lic. N. MARKLUND. I would like to thank them for the advice and references they have given me.

The thickness there is thus about 500 m, and somewhat more than 200 on Pältsa. Towards the upper end of Pältsavagge the lower limit of the amphibolite is again somewhat higher — 1150—1200 m in the col between Pältsa and Måskokaise; in the col S of the highest peak the amphibolite is interrupted at a height of 1300 m by a short stretch of schists of various kinds. On the high peak, 1517.8 m, the amphibolite is intruded to a considerable extent by light muscovite and garnet bearing granites, reminiscent of trondhiemite. These granites also occur farther souht as separate dikes on the Måskokaise ridge.

A series of sharply varying Caledonian schists lies under the amphibolite, with on the whole the same strike to the NNW and the same shallow dip to the W. There are grey and green mica schists, with and without garnet, sometimes soft, sometimes harder, white medium-grained marbles and dense blue quartzites. The thickness on the E-slope of the S-Pältsa is about 300 m, that is, with the lower limit at 900 m. The thickness is about the same on the upper parts of Pältsavagge, but considerably less on the southern part of Måskokaise. There seems to be some alternation between amphibolites and schists and marbles. Thus a bed of marble occurs at a high level within the amphibolite (Måskokaise's S-peak, 1175 m). In some places in the N and S of the massif, amphibolite outcrops were observed in the schists, at a low level, 7—800 m. If we consider that the layer of schists probably thins out on Måskokaise, it seems that there may be a certain repetition of beds on Pältsa, and that the tectonics of the area are more complicated than this account is able to show directly. The moderate metamorphism of the schists seems to exhibit certain layers, suitable for correlations with similar layers at some distance. Strike and dip in the schist series are little different from those of the amphibolite.

This series may be distinguished — though not quite certainly — from a lower series of dense grey rock types, occasionally mica schists or »hard schists» like those of the Torneträsk region or northern Finland (according to H. HAUSEN 1942). These rock types, which may show traces of considerable tectonic changes, occur with minor variations in the area around Pältsa and Måskokaise, in the slight slopes up to the mountains, and in the surrounding low mountains, from Lake Gapojaure in the N, down through the slopes of Tuipal, to the edge of the map in the E and S. Strike and dip vary, but no important differences with respect to the superior series of schists have been observed. The petrographical variations may be greater than the few observations indicate.

Under the lower sheet of schists, the thickness of which may be estimated at 2—300 m around the Kumma valley, there is at least 130—140 m of flat-lying grey, blue and green quartzites (locality: the stream 3 km E of the hut, at the eastern edge of the map), in which there are frequent beds of slate and phyllite. The variation is perhaps more frequent in the lower part of the series than in the upper. There is a tectonic disconformity with the superior »hard schist» layer. There are also traces of crushing within the series, as well as a certain mylonization near the bottom. The greater part of the valley escarpment at the water fall and the Pältsa hut should probably be included in this series, but the relevant observations are few. To judge from boulders, a very impure crushed limestone occurs at the bottom of this series. We get the impression that this is a somewhat d i s t u r b e d a n d m e t a m o r p h i s e d H y o l i t h u s s e r i e s.

This proposed Hyolithus series is in some way similar, though not identical, with some of the many localities from northern Finland described by HAUSEN (e.g. the »blue quartz»). According to him the Hyolithus series is often tectonized, especially the uppermost layers. Parts of the series have been »tectonically» eroded away by the overthrust sheet (HAUSEN 1942, p. 49) — for instance almost totally on the Swedish side of Kilpisjärvi. The Hyolithus series from the northern shore of Torneträsk have also been somewhat disturbed (KULLING 1930, p. 653 ff.). The partly mylonitized and perhaps incomplete Hyolithus series in the Kumma valley profile resembles only in some respects the well preserved series described previously by different authors; it is more like the complex on Kuobletjåkko in the Torneträsk area (HOLMQVIST 1910, p. 936), not so much like the so-called Dividals series of K. PETTERSEN and many of the localities described by HAUSEN. The normal Hyolithus series in Norrbotten (according to G. KAUTSKY, 1949, p. 598) is also different in some respects.

The inferior stratum was not discernible in our profile in the Kumma valley, nor was any outcrop found in the flat valley bottom below the valley declivity. There are archean boulders everywhere, but not of sufficiently uniform type for any definite conclusions about the basement rock.

It may be that a locality farther down the Kumma valley gives an indication in this respect, however. This locality lies off the sketch map, on the southern slope of Ladnevare, at a height of about 700 m.

There is a terrace about 1 km long in the slope,[8] and at its western end is an impure limestone, folded but not recrystallised. At the other end is a light-coloured aplite granite, which predominates in the boulder material between the outcrops. If this is the archean rock, a rough estimation of the slope of the basement toward the foot of the valley declivity at the Pältsa hut gives a fall of 1 : 30—1 : 40. HOLMQVIST found the slope of the archean basement in the Torneträsk area relative to the geosyncline to be 1 : 40 (1919, p. 914), and TH. VOGT gives the mean value for Troms as 1 : 23 (1918, p. 263).[9] H. HAUSEN (1942, p. 80) has for the Caledonian mountain region in northern Finland 3—4°, (1 : 14—1 : 19). It therefore seems not improbable that the basement rock appears at the surface near the above mentioned declivity in the Kumma valley. According to ÖDMAN's observations from the terrain S of the Kumma valley and in the areas towards Kilpisjärvi, the archean rock appears at several places in the valley bottoms (for instance, near Kummajärvi), while »Caledonian rock types» occur as far down as Keddevare and Yli Termäsvaara, 20 km ESE of the Pältsa hut. This also indicates that the dip of the archean surface is relatively slight.[10]

If it is correct to compare the lower series with the Hyolithus series, and the amphibolites together with the underlying schists with the »Seve-köli» overthrust sheet, the different Caledonian complexes are to be found not far from each other: 14 km between the archean rock and the upper overthrust sheet along the valley, and 15—18 km along the adjacent ridges.

## Morphology.

From the morphological point of view, the occurrence of amphibolite in the upper parts of the Pältsa-Måskokaise massif further confirms the idea that most of our high mountains are built up of amphibolite (the Abisko peaks, Kebnekaise,

[8] At a distance this terrace looks like a shore terrace. There is a block terrace 20 m below it. It is somewhat uncertain whether the terraces in question are really shore terraces, however, in view of the fact that the upper terrace is an important rock contact. It was not possible to determine the slope with the altimeter, because of a disturbance in the atmospheric pressure.

[9] The results of TH. VOGT have more recently been discussed by ROSENDAHL (1945).

[10] TH. VOGT (1918 p. 265) supposes that there is a local unevenness — probably a fault — in the archean surface in the Kumma valley. I have found no definite proofs on it. — In other parts of the mountain chain more exact examinations have shown the existence of disturbances in the archean surface (cf. LJUNGNER 1943).

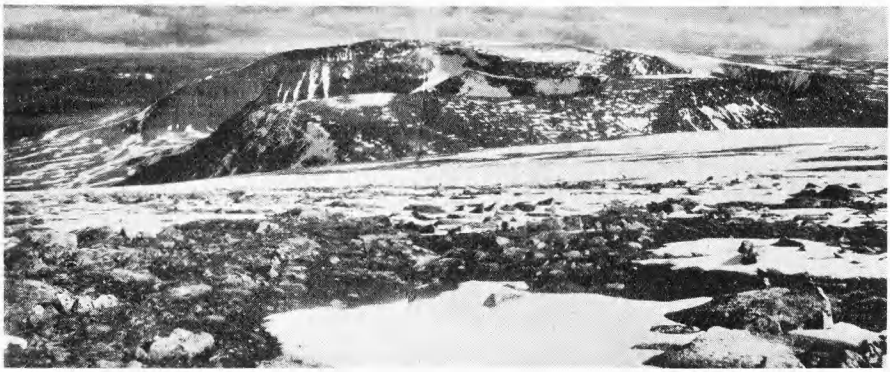

Fig. 4. The plateau-like summit of Måskokaise, viewed from the peak 1517,8. It is an erosion surface of slow relief, but not a true peneplain. — Photo by the author.

Sarek, and so on). The general shape and the relative height also recur in many other amphibolite mountains, as appears in the steep abrupt form of the peaks, compact and almost bastion-like, and the scattered glacier cirques which sometimes approach the ideal form of the text-books.

Otherwise, the most striking feature at first sight is perhaps the p l a t e a u - l i k e s u m m i t (cf. Fig. 3), which often seems to be quite level when seen from below. It soon becomes clear that this impression is mistaken when the top is viewed from some high point, e.g. from the summit 1517.8. There is never really any question of a level summit; instead, the terrain is undulating, with height differences of 100—150 m and gradual slopes (cf. Fig. 4). The impression of evenness is strengthened by the abrupt transition to the steep cirque walls and the valley facettes of Pältsavagge and the Norwegian side. However, a V-shaped valley with steep sides, which cuts into Måskokaise from the Norwegian side,[11] indicates that the contrast between the more level summit and the steep sides is not merely due to local glaciation and steepening by the action of ice streams. Similar valleys, little affected by glacial action, occur in other amphibolite massifs, e.g. Tarrekaise (to judge by photographs) and Ammarfjäll, whose high extensive amphibolite bastions are very like those of the Pältsa-Måskokaise massif.

[11] Tanner (1938, Fig. 238) has a photograph of Moskogaisse, and another (Fig. 243) of Moskovarre, both of which seem to represent Måskokaise seen from the Norwegian side. Both pictures show a valley which may be the V-valley described, but it is not possible to orient the pictures more precisely.

Although the plateau surface is not a fully developed peneplain, it is yet an unusually fine example of the remains of a high situated erosion surface. The fact that the flatness is not one of structure is shown by the angle between the upper surface of the amphibolite and the plateau surface, which is sometimes clearly apparent (e.g. on the Middle Peak of Pältsa clearly visible on Fig. 3). The difficult question of whether this more or less flat terrain has undergone several cycles of erosion (a problem which also occurs in the Northern Calcareous Alps, for instance) will not be taken up here, and the term erosion surface will be applied to this surface, well isolated by the steep sides surrounding it.

The same erosion surface occurs to a considerable extent on the nearby Norwegian mountains to the NW, N and NE, e.g. Tjårrokaise, the unnamed mountains W of Tjårrokaise, Mansfjell, and Markusfjell. The infrequent height figures of the Norwegian maps, and the general poor standard of them, make it impossible to give a more thorough description and connotation, but it seems that few other parts of Scandinavia can provide such good examples of high elevated erosion surfaces as the inland Troms area. It is from these districts that TANNER has taken his numerous examples of fragments of the palaeic surface.[12] Nor is it surprising that it was here and up towards Kvænangen that W. WRÅK found some of the most important evidence for his theory of the cyclic erosion surfaces arranged in steps in the Scandinavian mountains.[13] The international term »Piedmont-Treppe» was introduced in 1928 for WRÅK's area, when GUSTAV BRAUN carried out a new field investigation and endeavoured in several papers to extend the explanation associated with the term to the whole of the Scandinavian highlands — in the main along the same lines as WRÅK. The summit surface of Måskokaise-Pältsa belongs to WRÅK's »Likka cycle». In the next cycle comes the low mountain formation Tuipal, 900—1000 m, which also contributed the name to the cycle in WRÅK's scheme. The low 7—800 m ridges along the Kumma valley are said to have been valley bottoms in the next cycle — the »Borsu cycle», — and the valley bottom is reckoned as the latest feature of this area (the »Muddus cycle»). The hypotheses of WRÅK and BRAUN have not been proved, but they do not conflict directly with the field observations

[12] TANNER 1938, Figs. 237—252. Many of TANNER's illustrations are taken from a paper by ROSBERG (1916, pp. 163 ff.). ROSBERG does not give any detailed explanation of the peneplain, however.

[13] WRÅK (1908, pp. 166 ff.) describes the areas referred to here.

that have been made. It is especially worthy of note that the undulating plains at a height of 7—800 m are undisturbed except in small details by the boundary between the Caledonian and archean rock — a matter which may be decided more easily now than when WRÅK wrote his paper. This fact may be important here, where the various overthrust sheets of the mountain chain appear to be represented within a shorter distance horizontally than elsewhere. However, it may be advanced against WRÅK that the lower erosion surfaces are not always well preserved in this area; instead, they are rather less clear than in other mountain sections.

Apart from the cycles of erosion — especially the earliest — t h e f o r m s o f t h e l o c a l g l a c i a t i o n are the most important typical feature of the landscape. 9 cirques have been included in the sketch map (Fig. 1), after my own observations, and all more or less well preserved. Those on the western side of Måskokaise (Nos. 6—9) are rather approximate, both in situation and number. There was a great deal of snow in cirques 3 and 4, and this may possibly cover glacial ice,[14] but the others are certainly free from glacial ice (cf. Fig. 3). There are terminal moraines in cirques 2—7, more than one system in some cases. This fact is noteworthy, since terminal moraines occur rather seldom in empty cirques in Scandinavia. The small amount of material in the terminal moraines here leads us to the same conclusion as in similar cases elsewhere, that the cirques were formed essentially before the climax of the last ice age, during the preliminary mountain glaciation — or possibly during the mountain glaciation of a previous ice age. The most favourable direction for cirque formation was towards the east and the same seems to be true for the nearest parts of Norway (e.g. Markusfjell). According to investigations at present in progress, it is also true for the southern parts of Lappland.[15] This is the same orientation tendency that ENQUIST has arrived at for Sweden's present-day glaciers (1916 p. 4). I will return to this question of the cirques and their age in another connection later. The cirques are remarkably

[14] The inner terminal moraines were more recent in appearance here than elsewhere, steep, with boulders lying in unstable positions, and completely devoid of vegetation. The streams were clear water, although the air temperature was about 0°. In his general description, FRIES mentions nothing of glaciers here, although he visited the area at a period when there was little snow (cf. 1913. pp. 2, 5). ROSBERG (1916, p. 173) says that there is still cirque erosion on Pältsa, but since there are no distinct cirques on Pältsa, it must have been Måskokaise he meant.

[15] Unpublished investigations which are at present being carried on at the Geographical Department, Uppsala University.

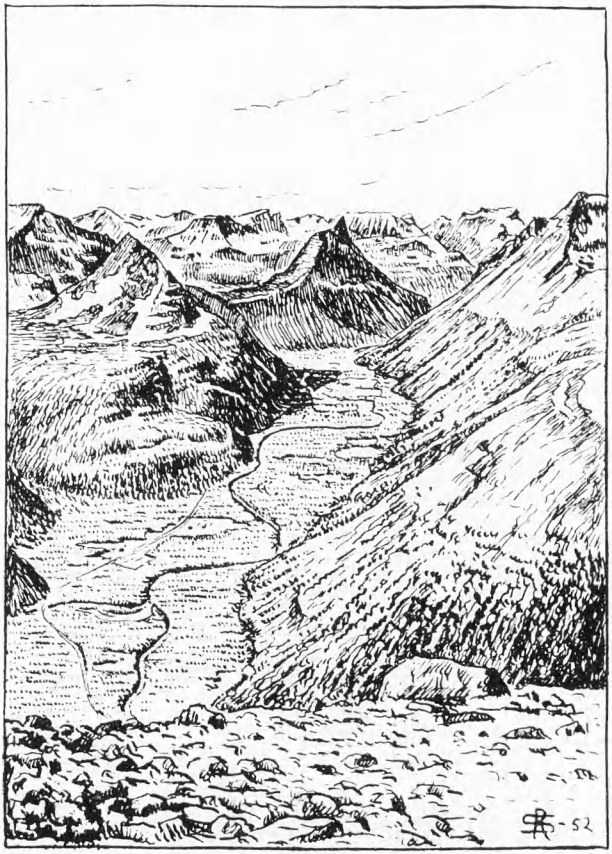

Fig. 5. The Signal valley northward from Paras. The nunatak-shaped Otertinn in the centre. At middle distance Polvartinn to the left and Mannfjell to the right. The valley is reformed into an almost perfect trough valley. In the background the gabbro mountains of the Lyngen peninsula. — Drawn after a photo taken by O. Hedberg.

well preserved, and sharply demarcated; this is undoubtedly due in part to the lack of a tendency to rock slides in the almost horizontal layers of the surrounding amphibolite. The terrain is a typical grooved upland.

Another strikingly well preserved detail from the preliminary glaciation, though from a somewhat later stage than the »cirque stage», is the sharp t r i a n g u l a r f a c e t t e s on the southern side of Pältsavagge. There are particularly good examples near cirque 3 (cf. Fig. 3). The side erosion of the valley glacier which formed in Pältsavagge

during the intensification of the glaciation truncated the old spurs between the cirque-valleys, and where the lateral erosion was most marked the cirques lie highest above the present valley bottom (cf. the sketch map Fig. 1). This is an unusually good example of complete formation of trough valleys, which is seldom observed in the Swedish mountains. The general case is an incomplete reformation of the fluviatile valleys by glacial lateral erosion truncating some of the most projecting spurs. There are examples further down the Kumma valley — Gapovare, the granite hill Åggovare, the gneiss hill Karanesvare, for instance, — although the rather shallow Kumma valley has otherwise been subject to little glacial reformation in its lower reaches. In some places, e.g. Åggovare, it is clear from the ice-plucking forms that the movement of the eroding ice was from the NW. The only ice movement indicated by glacial striae is from the S (cf. below), and therefore indicates a later stage. The ice-stream which came from the NW was a more powerful eroder, as is shown by several formations similar to those at Åggovare.[16] The signal valley on the Norwegian side of the boundary was completely changed to a glacial trough valley (cf. Fig. 5).

The area investigated thus provides us with a clear example of the common contrast in glacial erosion between the eastern and western sides of a mountain chain.

## The quarternary deposits.

The quarternary deposits in the area are more interesting than it is possible to indicate in this paper. The whole of the Kumma valley, from the Könkämä valley to Gapojaure, is filled with sediment. The large Kumma esker[17] winds through the entire valley, commencing as a small boulder esker, interrupted in some places by erosion zones in the pass at Gapojaure, but soon after developing into a coherent ridge, with a maximum height of 50 m, and in the main of a »hog's back» type. Especially at the sharper bends of the ridge the esker is at some localities replaced by glacio-fluvial deposits, of which the surfaces are sometimes gently undulating and sometimes exhibit a kettle topography. The side of the ridge at the inner curves often lies in the maximum angle of repose down to a flat marsh, or sometimes

[16] I hope soon to be able to treat these problems in a wider context and with examples taken from other, larger regions of our mountain chain.

[17] TANNER 1915, pp. 410 ff., map Nos. 112 and 111.

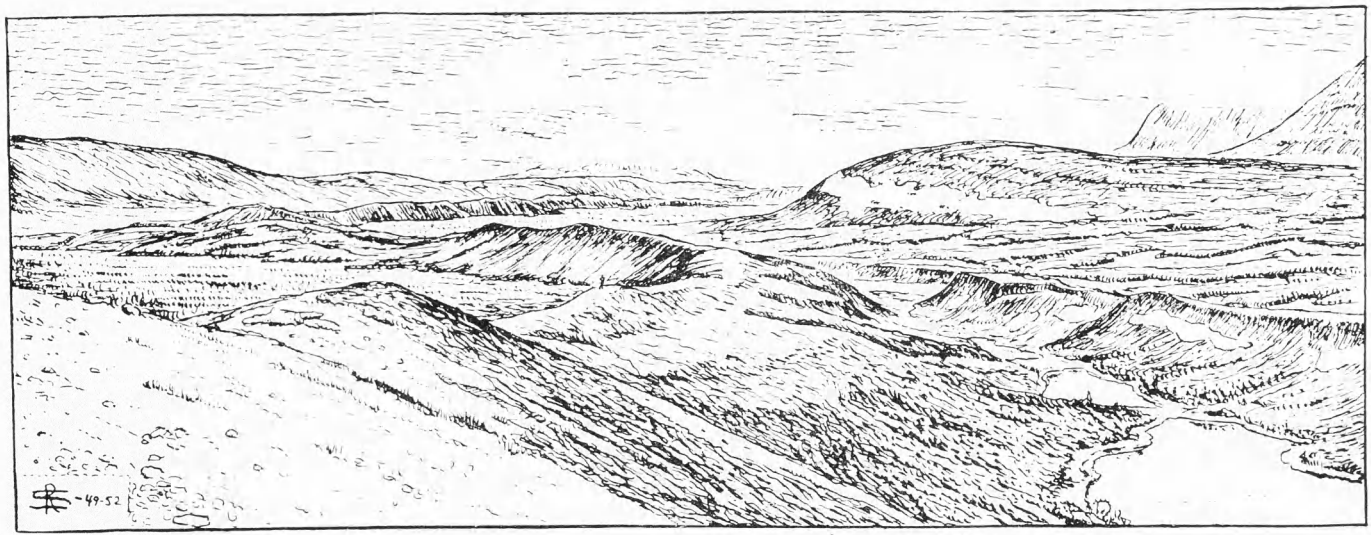

Fig. 6. The Kumma esker S of Gapojaure. Lassivare and Pältsa to the right, Tuipal to the left. The »meandering» esker has steep slopes on the inner curves and gradual, irregular slopes on the outer curves. To the right is a row of waterfilled kettles, breaking the gradual slope. The esker is 50 m high in the foreground. Drawn after photos taken by the author.

a water-filled kettle. There is a marked contrast with the flatter outer curve. The ridge becomes flatter and more interrupted between Lassivare 774 and the Pältsa hut. It branches into a smaller ridge, which runs in the direction of Kummajärvi and the district S of there, and a larger ridge which follows the river Kummaeno to the SSE, a ridge of considerable proportions in many places. At Mount Yli Njauko the ridge leaves the valley in a remarkable way, to climb the southern side. I do not know how it continues after that. It is possible that one arm of the ridge continues under the large sand delta at Kummavuopio, as TANNER supposes (1915, p. 411). The direction followed by the ridge after Kummaeno is perhaps noteworthy, in view of the striae. According to TANNER's observations (1915, sketch map) and my own, the main direction of these is from S to N, or, in some cases, SSE—NNW.[18] The angle with the direction of the striae is therefore considerable, although it is not impossible that there are more recent striae than those hitherto observed. Striae from the SSE (in one case, SE) have been found, but the age order could not be determined with certainty.

The Kumma esker lies within the area where TANNER found instances of a special type of esker, formed subaerially in open channels in the ice.[19] A detail which is most easily, though not necessarily, explained in terms of TANNER's esker theory is the abovementioned contrast between the steep ridge slopes on the inner curves and the gradual, irregular slopes on the outer curves. The circumstance occurs with a fair degree of regularity. The ridge taken as a whole may be said to give the impression of a meandering river course in an even, slightly sloping tongue of slow-moving or immobile ice, and on this basis the lack of symmetry in the profile of the ridge may be explained by the assymmetrical sedimentation in a meander bend, which erosion forced out sideways into the ice. Inbedded ice blocks have thus exercised a greater effect in the thinner sediment of the outer curves (cf. Fig. 6).

On both sides of the ridge, the Kumma valley is filled with flat beds of sediment, of granular size varying from fine sand to silt (ocular determination), the sediment extending in many places to the valley sides. The more sandy deposits are sometimes in the form of flat tongues near the ridge. The sediment lies in two main plains,

[18] My own observations were few, owing to lack of time. However, it should be easy to find striae for detailed examination on Tuipal's ridges.

[19] The theory in its final form is given in 1938 pp. 504 ff., and different stages of its development in earlier publications.

one below the waterfall at the Pältsa hut, and one above it, extending to the southern tip of Gapovare 930.5. The surface is sometimes quite flat, in some places intersected by shallow channels, sometimes slightly uneven. The soil has been subjected to a great deal of frost action (hummocks of mineral earth). TANNER thinks that there was an ice-dammed lake in the Kumma valley as far as the overthrust escarpment at the Pältsa hut (1915, p. 508 ff., and the sketch map). Without attempting to give any other explanation, we may doubt whether the plain of sand and silt was really the bottom of an ancient ice-dammed lake. The stratification is not always horizontal, and the height of the freely eroded sediment plateaus varies. TANNER also finds traces of an ice-dammed lake in Pältsavagge (1915, p. 510), a finding which I can neither confirm nor contest. However, in the upper part of Pältsavagge there is a large area of slight mounds of the »dead-ice moraine» type, with some orientation of the ridges at right angles to the valley.

There are comparatively marked signs of g l a c i o - f l u v i a l e r o s i o n in the passes, N and S of Gapojaure, and a large erosion channel of the »Kursu valley» type S of Gapovare. Since both are associated with the course of ice rivers, it is not necessary to explain them by means of outlets from an ice-dammed lake. Many so-called Kursu valleys are directly associated with the primary glacio-fluvial streams, and, in projecting parts of the basement, sometimes replace the esker, as »superposed valleys» (RUDBERG, 1949, pp. 474, 471).

W i n d e r o s i o n has done more in the flattish mountain terrain than in the more southern parts of the mountains, and it is now active down to 600 m or even lower. Solifluction has created some extreme forms in a few places. The fronts of the solifluction terraces W of Nirjijaure reach a height of 3 m (cf. Fig. 9).

It may have appeared from the above general survey that the geology and morphology of the Pältsa area are in many respects quite distinctive, and deserving of further investigation.

### The nunatak problem in the Pältsa area.

The problem of whether or not the Pältsa peaks have been ice-free may refer to both ice-ages, or to the later one, or to a final phase of the later one. The first of these questions, or the first two, could be definitely answered in the negative if striae or erratic boulders had been observed on the peaks. No striae have been observed, but in my experience striae in amphibolite at considerable height are very rare.

A search for erratic boulders on the Pältsa peaks was without result. The only boulders were pieces of amphibolite outcrops broken off by frost, and others who have been up there have not seen any erratic boulders. Obvious erratic material is not encountered until 3—400 m below the summits, but the sides are characterised by talus and marked solifluction. A continuation of the search for erratic boulders on Måskokaise did lead to positive results. Such boulders were found over the whole southern slope of Måskokaise 1452.7, right up to within a few metres of the summit cairn, though with decreasing frequency and not at all on precipitous slopes. The boulders were of red-white granite, gneisses with bornblende, quartzites, and in one case, red leptite. The boulder from the summit was of fine-grained microline granite, in places somewhat porphyric, a rock which is definitely archean.

An investigation of Måskokaise's highest peak gave the same result. There were frequent boulders from outcrops of the light Caledonian granite and migmatites between this and the amphibolite, types resembling archean gneisses; but among these was a large boulder of coarse gneiss with potassium felspar, blue quartz, and a dense grey rock which appeared to belong to the lower schists. On the 1385 peak, between the two just mentioned, a fine-grained red granite was found. The summit outcrops on peak 1517.8 were rounded, without distinct stoss and lee sides.

These finds, despite their small number, show clearly that the whole of Måskokaise was covered by the inland ice, moving from the S or SSE. The ice surface must have had a rather strange configuration if the neighbouring, lower Pältsa ridge was not covered at the same time. As to the absence on Pältsa of boulders transported a long way, it is a quite common experience that such boulders seem to constitute a very small fraction of the material found on other peaks in Lapland.[20]

The next question to be answered is whether the boulders were transported to the peaks during the most recent ice age or during an earlier one. It is not possible to give a definite answer to this question, but the first alternative appears to be the more likely, if we consider how

[20] Cf. GÖSTA LUNDQVIST's observation on the general infrequency of moraines at steeper summits (1943 p. 17). Cf. also the same author's discussion of the results of prospecting among manganese-bearing glacial boulders from Ultevis, where he finds that the boulders, which have been transported some distance, have accumulated in groups with spaces between (1947, p. 89).

improbable it is that the granite boulder a few metres from the summit 1452.7 should have remained there on the exposed surface of the summit, despite the intense frost action and the strong solifluction which must have prevailed there during the peri-glacial conditions of a long nunatak stage. None of the boulders show any sign of unusual weathering. But in this respect it must be admitted that there was not especially coarse weathering material on Pältsa's Middle Peak and even in a few places here and there on Måskokaise's plateau ridge. The boulders were not large, and sometimes there was remarkably fine sharp gravel between them. If experience suggests that there should be coarser weathering material at this height, it should be remembered that the terrain is remarkably flat, so that the rate of movement must have been slow, and the re-exposure of the basement rock to weathering must consequently have been slow. Furthermore, there are frequent joints in the outcrop rock.

The direct evidence therefore suggests that all the peaks were most probably covered during the last ice age.

ENQUIST reports far-transported material at the considerably greater height of 1800 m on the nearest group of Swedish high mountains to the S, the Abisko mountains (1919, p. 7).

The archean boulders on Måskokaise do not perhaps constitute an absolute proof,[21] and the possibility that Pältsa was not covered during the last glaciation will therefore be considered from other points of view.

The limits of the different ice streams and the height of the surface in North Norway during different stages of the glaciations have for some time been the subject of discussion in important Norwegian works.[22] An essential part of this discussion has been the explanation and age determination of the terminal moraines in the fjords, as well as the search for regions which could be assumed to have been ice-free during all the glaciations, or just the latest, or some stationary stage of long duration. The views on the

[21] Thus LJUNGNER (1949, p. 51) considers that it is not possible to decide whether a boulder was left by the »great glaciation» or by the last. GRØNLIE (1940, p. 5) mentions boulders on the summit of Værøy which he thinks have survived the last ice age.

[22] In this discussion of the Norwegian literature on the subject I refer usually to more recent Norwegian works, and do not pretend to give any complete list of references.

latter problem vary between that of TANNER on the one hand, according to which there is no terrain of any significance which was ice-free during the climax of the last ice age (1930, pp. 415, 434), and on the other those of a number of Norwegian geologists who, writing both before and after the publication of TANNER's main work, have expressed the opinion that there were ice-free areas of varying size in the coastal region and near to the area we are considering, in Lofoten-Vesterålen and Vest-Finnmark with nearby parts of Troms. A kind of compromise is found in GRØNLIE's opinion (1940, pp. 2 ff.) that the distribution of moraines and the glacial sculpture forms allow us to differentiate between the great glaciation which covered the whole land mass with possible insignificant exceptions, and the last glaciation which left important areas above the ice sheet (GRØNLIE 1940, pp. 20 ff.). Primarily from a study of maps, GRØNLIE calculates that the height of the ice surface on the border between Troms province and Sweden was 12—1300 m. The figure is a rough estimate, and is based in part on the idea that the existence of well-preserved cirques on a peak is a proof that the inland ice did not cover the peak after the formation of the cirque, an idea which hardly accords with Swedish experience. It therefore seems that GRØNLIE's calculations are insufficiently accurate for us to draw conclusions from them in this case. In spite of this objection, the alternative offered by the Norwegian views about ice-free terrain in the coastal region deserves our attention. This does not imply any criticism of TANNER, however, in a discussion to which the present investigation contributes nothing new.

It appears that the nearest more certain instances of ice-free terrain are in Vest-Finnmark, where UNDÅS (1939, in particular pp. 181 ff.), GRØNLIE (1941, pp. 12 ff.) and NORDHAGEN (e.g. 1941, pp. 124 ff.) have devoted special attention to the island of Sørøy (a)[23] and its immediate surroundings. Some of its highest plateau surfaces must have projected above the ice, with ice-streams flowing round them. The reasons given for this are: the signs of an ice limit along the steep slopes, the absence of erratic boulders, terminal moraines, and (treated in greatest detail by NORDHAGEN) vestiges of supposedly preglacial relief and thick layers of fine-grained weathering soil. I myself can confirm the faintness of the glacial sculpture on the western sections of Sørøy. UNDÅS and GRØNLIE have combined their morphological data with shore line observations. Taken as a whole, there seem to be strong reasons in

[23] The localities in the following section are indicated by a letter in the inset in the corner of the sketch map, Fig. 1.

favour of their opinions. However, Sørøy lies 70—80 km E of the mouth of Lyngenfjord, which, together with Balsfjord, is of interest for us as one of the possible outflow channels for the ice masses passing Pältsa-Måskokaise. It is difficult to say which of these alternative channels is the more probable. Striae indicate the Lyngen alternative,[24] whereas the way to Balsfjord is more at right angles to the apparent ice borders.[25] It seems most likely that both paths were used simultaneously, and that even when the ice was thickest, they accomodated most of it in preference to the high plateaus on either side (cf. GRØNLIE 1931, p. 272).[26]

There have also been attempts to determine the elevation of the ice surface at places nearer than Sørøy, although the evidence adduced is not so convincing. GRØNLIE (1940, p. 22) estimates the maximum height of the ice surface on the islands in northern Troms as 300 m, partly on a basis of map information, and in Tromsøysund at 350—400 m. During the climax of the last glaciation the ice moved in deep ice-rivers along the fjord arms, to unite into a single ice sheet outside the mouths of the fjords. In any case, the less certain values given for Troms do not seem improbable if they are compared with those for Vest-Finnmark and Lofoten-Vesterålen, which are based on better evidence.

The opinions about the position of the ice front during important stationary stages of the melting period vary less than the opinions about the maximum extent. In a paper written in 1910, J. H. L. VOGT describes two terminal moraines, which occur with a certain regularity in almost all the north Norwegian fjords, and explains them from general morphological similarities as parallels to the ra-moraines in Southern Norway and Salpauselkä in Finland. The same explanation of them is also given by more recent writers; the most detailed as far as our area is concerned being GRØNLIE (1931,

[24] According to observations of striae by TANNER (1915), and a few by myself.

[25] For instance, on GRØNLIE's map.

[26] In his maps showing the probable directions of movement of the inland ice, TANNER (1915, pp. 140—141) gives the direction during the earlier part of the glaciation as by way of Balsfjord, and during the period of regression by way of Lyngen. The maps are based on the transport of boulders from distant mother rocks and glacial detail forms (pp. 52—53). But in the Pältsa-Måskokaise region TANNER has no material for the construction of lines of flow, so the directions he gives for this area are interpolations.

1940) and UNDÅS (1940).[27] But there is still a certain lack of unanimity about the position of the important moraines. UNDÅS (1938, p. 117), with some hesitancy, puts his moraine III, which is assigned a date in the ra-period on a basis of comparisons with shore lines, at the mouth of Lyngenfjord (*c* in the map Fig. 1). The moraines which GRØNLIE (1931 p. 286, 1941 pp. 45 ff.) associates with the Tromsö-Lyngen stationary stage are situated farther up Lyngenfjord at Rotsund (*d* in the map), which conforms with VOGT's placing for the lower ra-line (1910, pp. 5 ff.). The Tromsö-Lyngen stage corresponds (with some reservations in the more recent work) to the ra-period. GRØNLIE has still further stationary periods, marked by a series of moraines farther up Lyngenfjord and above the fjord. VOGT has his second ra-lines 25—30 km S of the first, a little S of the mouth of Kåfjord (*e* in the sketch map).[28] None of these authors gives any estimate of the length of the stationary period.[29]

GRØNLIE (1931, p. 276) tries to follow the Tromsö-Lyngen stage inland towards the frontier, with the help of lateral moraines and the upper limit of the glacial trough which is supposed to have been formed during the Tromsö-Lyngen stage. His conclusion is that the ice surface was at a height of 800 m at the frontier passes. This height applies to the border 50 km S of Pältsa, so the 800 m figure should be regarded as an extreme maximum value for the height of the ice-surface at Pältsa during the ra-period — assuming that GRØNLIE's estimate is valid. However, the ice in Lyngenfjord received ice from the frontier passes during the various stationary periods after the ra-period (GRØNLIE, 1940, p. 49), which means that the minimum height of the ice surface at Pältsa must have been 800—850 m (assuming the ice stream to have been at least 50 m deep — a value which is probably to low). It is scarcely possible to reconcile the two estimates. GRØNLIE's calculation in the former case is open to the objection that the upper edge of a trough valley is not necessarily accepted as a sign of the height of the ice-stream surface.

[27] TANNER (1915 p. 434 and previously) gives a similar construction; ENQUIST (1918 p. 82) likewise, although his front is more southerly, and there is considerably more ice-free terrain.

[28] Both UNDÅS and GRØNLIE also give ice borders for different stages in the Tromsö region, i.e. along Balsfjord. For the sake of convenience, it is mainly the Lyngen alternative which is discussed in the following.

[29] SAURAMO estimates that the ra-period in southern Finland lasted 700 years — but it is not certain that a parallel with the Salpauselkä period is justified here (1942, Figs. on pp. 226, 227).

In spite of the lack of agreement between the Norwegian conclusions, it was decided to make some experimental constructions of ice surfaces based on the hypothetical ice borders, in order to consider the problem from yet another point of view. Such experiments have been described previously, together with a discussion of the most suitable procedure.[30] In our experimental construction we used several alternatives in a set of diagrams for a profile in the direction of Lyngenfjord. Similar diagrams were drawn for the Balsfjord direction, but they are not included here. The indication in that case was of the same sort as in the Lyngenfjord diagram, although somewhat more unfavourable towards the idea that Pältsa was an ice-free area. In constructing the curves, the difference in the depression of the land surface at the end-points of each diagram has been taken into account.[31] A sea-level, different from the present one, has not been taken into consideration, since the ice is assumed to have extended to the bottom everywhere where it made terminal moraines.[32] The choice of reference points for the curves in the three diagrams is explained by what has been said previously. In Diagram 1 GRØNLIE's value of 300 m for the height of the ice surface in northern Troms has been applied at Fugløy, which lies furthest out on the Lyngenfjord gap (*b* in the map). The other two diagrams have been referred to the ra-lines of UNDÅS and GRØNLIE, respectively.

Curve no. 1 (in the different diagrams) has been constructed from

[30] As far as I know, ENQUIST made the first experiment (1916, p. 35). TANNER's construction (1930 p. 415) is the most thorough from the theoretical point of view. The construction given by G. LUNDQVIST (1935 p. 288) is in the form of a straight line of slope 1 : 550, which is, according to him, a mean value for the Greenland ice; the value appears to be too low, especially in view of the relatively short profile. In a paper about Helgeland, GRANLUND compares the distribution of nunatak sculpture with a curve corresponding to KOCH-WEGENER's curve for the Greenland ice. He finds good agreement (1937 p. 13). My own impression from the same region is that the ice sculpture reaches a greater height — even on some of GRANLUND's localities, e.g. Tomma, Sjona — so that the agreement with the Greenland curve is not so good. MANNERFELT (1945 p. 112) criticises LUNDQVIST's values, and himself arrives at a steeper slope, 1—2 : 100, according to strictly lateral terraces and channels (1949 p. 197). Whereas the slope on the lower sections of the ice is estimated at 1—3 : 100, the slope higher up on the free surface is taken to be 1 : 100. G. FRÖDIN's values (1915 p. 159) are on an average slightly lower.

[31] Extrapolation from UNDÅS's and GRØNLIE's tables and GRØNLIE's shore line diagrams (1941, Fig. 2), in Diagram 1 compared with TANNER's profile (1930 p. 415).

[32] Information about the bathymetrical conditions has been taken from HOLTEDAHL (1940, Fig. 2), UNDÅS (1939 p. 117) and J. H. L. VOGT (1913 p. 6).

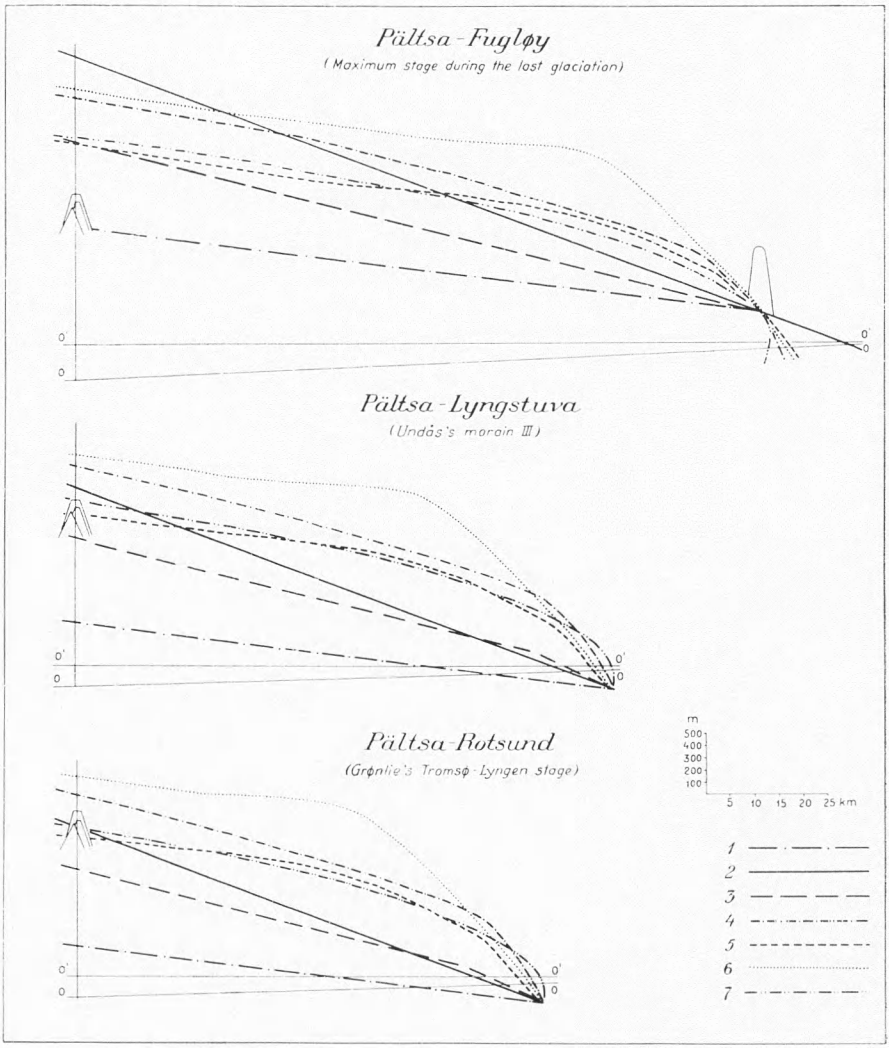


Fig. 7. The different profile lines signify: 1) Undås's ice surface slope 1 : 200, 2) Mannerfelt's 1,5 : 100, according to strictly lateral forms, 3) Mannerfelt's 1 : 100 for the free ice surface, 4) Koch-Wegener's Greenland ice curve, 5) de Quervain's Greenland ice curve, western part, 6) de Quervain — eastern part, 7) Meinardus's average curve for the Greenland ice.

O—O = Depression of the present O-line, O′—O′ = O-line in the different stages. The symbol to the left signifies Måskokaise 1517,8, Middle Peak of Pältsa (1448,0) and S Peak (1425).

UNDÅS's (1939 pp. 190, 200) value of 1 : 200 for the slope of the ice surface between Sørøy (200 m) and Silda (340 m, *f* in the map). The same slope is given for Vesterålen. The construction is entirely theoretical, as it is a straight line. We do not know what curvature corresponds to UNDÅS's slope. The same applies to line no. 2, which is based on MANNERFELT's mean value 1.5 : 100 for the gradient of strictly lateral forms (drainage channels, lateral terraces), corresponding to the most reliable values of the slope of the ice surface we have for Scandinavia. Curve no. 3 corresponds to MANNERFELT's estimate for the slope of the free ice, 1 : 100, with an approximate correction of 3 : 100 for the lower ice tongue. Profile curve no. 4 corresponds to KOCH-WEGENER's route across the broadest part of Greenland between the 76th and 77th parallels during the 1913 expedition (1930, Tafel III and the tables in the text). It is the more even western part of the profile which has been used. The total length of the profile is 1000 km, and the culmination is 400 m from the western end-point. Profiles nos. 5 and 6 correspond to the western and eastern parts of DE QUERVAIN's profile from the ice expedition of 1912. The culmination of the ice surface is 400 km from the western end-point and 250 from the eastern. The profile does not intersect the isohypses at right angles (1925 p. 108), so it is too flat; but the error is less than 50 m.[33] Profile no. 7 is theoretical, corresponding to the average curve calculated by MEINARDUS (1926 pp. 97 ff.) for the inland ice of Greenland.[34]

[33] Only the Greenland curves have been used for comparison with present-day glaciers. There are curves, both from actual measurements and from average values for North-east Land on Spitsberg, for instance (AHLMANN 1933 pp. 291 ff.). These curves have not the rounded steepening near the front, which is found in most of the Greenland curves. According to DE QUERVAIN (1925 p. 106), and others, the parabolic shape of the Greenland curves indicates that the ice tends to find its own form, regardless of the underlying terrain. On Spitsberg it is a question of thin ice-caps (according to AHLMANN), so that the underlying rock has more effect. On account of the magnitudes involved, experience from Greenland seems to be more applicable to our case. According to MEINARDUS (1926 p. 97 ff.), the Antarctic inland ice gives a similar curve to that of Greenland, though somewhat flatter. Cf. also the curves of the German Antarctic Expedition (RITSCHER 1942, p. 297).

NANSEN's profile (reproduced for comparison in DE QUERVAIN's publication) has not been included. It is steeper than no. 4. RASMUSSEN's profiles from North Greenland 1912 (1915, Fig. XII) seem to be less applicable because of the position relative to the height curves.

[34] The hypsographic curve which MEINARDUS has constructed for Greenland is parabolic in appearance. He represents it by an ellipsoid of rotation of cross section corresponding to the average profile of the inland ice.

The constructions speak for themselves. All that will be added is the following. The shape of the ice surface seems to depend on the extent to which the ice is free to develop, and at any particular place it therefore depends on the terrain and the distance from the ice-divide (the culmination of the ice surface). Only a rough estimate of the distance to the ice-divide can be given in our case. Between the outermost ice front and the last ice-divide, it is 300—400 km in a direct line [35] — and this figure is perhaps too high for the ra-period. The relation between the curvature of the ice surface and the glacial climatological conditions is another factor, for which we are not in a position to give an estimate. Profile no. 1 in Diagrams 2 and 3 cannot be correct, since the ice surface is lower than the passes on the watershed. Profiles 2 and 3 refer to the stage of rapid regression, and need not apply to the stagnation of the ra-period. As regards the Greenland curves, we do not know whether they can really be applied in our case. The fact that UNDÅS's low value for the slope is not attained until a height of 1000 m may be a warning in this respect. But it may be mentioned that the angle of slope for the lower parts of the inland ice on Greenland varies to such an extent, that UNDÅS's value need not be taken as representative for North Norway.[36]

Among the numerous difficulties encountered, one of the foremost is that of obtaining a correct reference point for the profiles. The lower part of the profile is dotted on the original curve where it deviates from the ideal form. The slope of the very lowest section may be less steep than the rounded curves indicate, or it may be steeper, if the front is shaped like an ice cliff.

In this connection the theories of E. DAHL (1946, pp. 161 ff.) are of interest. He puts the question whether a total glaciation is possible in an area, where high mountains are situated near a deep ocean. He finds that this is not the case, because the ice cannot extend farther than to the border of the deep ocean, where it can have no considerable thickness. If the gradient of the ice surface is estimated to 1 : 100—1 : 200, all summits higher than 1000 m within a range of 100 km from the border of the shelf would not be totally glaciated. The shortest distance from the Pältsa area to the shelf border — towards WNW — is more than 150 km.

If the constructed profiles which come below the peaks of Pältsa and Måskokaise reflect the actual conditions, and if the period of stagnation at the ra-moraines was sufficiently long, it should be possible to

[35] Cf. G. LUNDQVIST 1943, Table 1.

[36] Cf., e.g., DE QUERVAIN 1925, pp. 109 ff.

observe some morphological boundary between an upper region of fainter ice-sculpture and a lower more worn by the ice. The same applies to a yet higher degree if some part of the area investigated was free of ice during the whole of the last glaciation — despite evidence to the contrary.

Unfortunately, the investigation has provided little material for the illumination of this question. There are no convincing nunatak forms within the Pältsa-Måskokaise area. The plateau shapes are not suitable for the formation of the typical »dorsal fin forms». Pältsa's S Peak is, of course, a steep cone, but there is no difficulty in explaining the shape from the petrology and tectonics and undermining by ice-streams in the initial stage of glaciation — there are other forms resulting from mountain glaciation which are notably sharp. No evidence of weathering of more extreme type than those found in other mountain areas of similar rock type and height have been observed, with the possible exception of a small locality on Pältsa's S Peak. The Pältsa-Måskokaise massif does not in itself provide any evidence of a long nunatak stage. Of the peaks farther N, the steep cone of Paras, 1416 m, 10 km from Pältsa, is a possible nunatak form, while the sharp peak of Otertind at the lower end of the Signal valley appears to be convincing. Mandfjellet, midway between these two peaks, exhibits remarkable weathering in the form of a kind of large rock pillars on the summit (as described to me by Dr. H. SMITH). The height is 1548 m.[37] Because of bad weather, I was unable to make any observations on possible nunatak boundaries during a journey along Lyngenfjord.[38] The negative evidence assembled here does not, of course, constitute any definite proof that there were no nunatak regions within the Pältsa area.

Another interpretation of the Norwegian material, which includes the possibility of a longer ice-free period than the ra-period, is provided by LJUNGNER's explanation of the course of the glaciations (1949 pp. 20, 58, 71). According to him, when the mountain glaciation of the last ice age, — which means the maximum stage of the glaciation of this ice age on the western side of the mountain chain, and corresponds to

[37] Perhaps this may be a feature resembling the »tors», recently described by LINTON (1952).

[38] v. KLEBELSBERG (1949 p. 415) warns against ascribing too much value as evidence to nunatak forms, partly on the grounds of results from the German Antarctic expedition of 1938—39. Peaks of extreme nunatak form sometimes prove to have emerged when covering ice melted. »Schlifformen» first appear a little below the previous ice surface. TANNER also questions the decisive value of nunatak forms as proof (1930 p. 379).

GRØNLIE's great glaciation — changed to the continental stage, with an ice-divide situated far to the SE, a stage which we usually regard as the climax of the last ice age, less ice was available to the peripheral areas in the W and N, and the ice surface there may have sunk so that ice-free peaks and local glaciation appeared. It is also evident that there may have been local glaciation on quite a large scale, with cirque glaciers or ice-caps, in the case of the ra-moraine alternative mentioned above. It is of particular importance whether the low slope value given by UNDÅS is correct, at least to the extent that the lower profile constructions are to be preferred.

The latter point, local glaciation, gives rise to yet another question: have we any evidence that there were local glaciers on the Måskokaise massif during the ra-period of GRØNLIE or UNDÅS or the continental stage of LJUNGNER? As already mentioned, we have here an instance of something which is not so common: empty cirques with terminal moraines.[39] The glaciers which have disappeared may have been active during one of the periods mentioned, or during the most recent glacial maximum, about which we have no local information, but which, on the basis of analogies, may be supposed to have occurred about 1750 (THORARINSSON, summary 1940, p. 139) or 1800 (ENQUIST 1918 p. 133). In most cases the terminal moraines are well settled and covered with vegetation, in cirques 5, 6 and 7 with the same heath rich in herbaceous plants as the surrounding ground. The general impression is not one of recent formation. However, in cirques 3 and 4, where there is possibly still ice, or was ice until recently, there are moraine ridges of a very recent type: boulders loosely piled in unstable heaps, without any vegetation whatsoever. These terminal moraines must be of very recent origin, and indicate that the limit of glaciation at present, or until recently, was about 1400 m. It is not necessary to assume any great depression of the limit of glaciation to explain any local glaciers, which may occur in the many shaded cirques of Måskokaise. There is unfortunately insufficient comparative data for the assignment of a definite date to the well-established vegetation in some of the other cirques.[40] The occur-

[39] Empty cirques with terminal moraines have been observed by MANNERFELT (1941 pp. 35 ff.) and others in Central Norway, as well as in adjacent parts of Sweden (1945 pp. 203 ff.). According to LJUNGNER, Tarrekaises glacier has disappeared completely during modern times (1949, p. 38).

[40] FAEGRI's investigations (1933) of the vegetative colonisation of abandoned cirque valleys on Jostedalsbræen provide us with the best comparative material in this

rence of archean boulders on the surface of some of the terminal moraines or in the abandoned glacier bottoms — boulders which were previously carried up by the inland ice and have now been taken back a little way — indicate a more recent and less intense glaciation, and not a cirque glacier during the ra-period or earlier. If all the terminal moraines are to be interpreted as recent, the glaciers have disappeared more quickly during modern climatic improvements than I have been able to ascertain in more southernly mountain regions (Southern Lappland) for glaciers of similar size.[41] Therefore, t h e e m p t y g l a c i a l c i r q u e s w i t h t e r m i n a l m o r a i n e s c a n s c a r c e l y b e t a k e n a s a p o s i t i v e p r o o f o f a h y p o t h e t i c a l n u n a t a k s t a g e o f l o n g d u r a t i o n i n t h e P ä l t s a a r e a.

As was expected, the examination from a general geological viewpoint of the possibility that Pältsa and Måskokaise included some nunatak regions has led to no conclusive result. The conclusions which may be drawn from GRØNLIE's observations criticised above, p. 33) and from the low value of UNDÅS for the slope of the ice surface cannot be entirely refuted, but it seems very probable that our area was completely covered by ice during the climax of the most recent ice age. However, the curves constructed show that there might conceivably have been a nunatak stage during the ra-period of stagnation. If this is so, Pältsa-Måskokaise was the southernmost and farthest inland of a long line of nunataks stretching from the northern tip of Lyngen peninsula. But even this possibility does not imply that Måskokaise was not covered by a local ice-cap during that period.

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case. However, on account of the considerably lower elevation, the environments are not completely comparable.

[41] Information given to me by cand. real. TOR RASMUSSEN, Oslo, indicate that there has been unusually rapid glacial shrinkage in some nearby Norwegian localities. The glacier on Russetinn at the upper end of Balsfjord extended in recent times (according to local people and field observations) about 200 m lower in height than it does at present. The covering of snow or ice (which the province map from the 1870's shows) on Njallavarre 1530 m on the Lyngen peninsula no longer exists. The former existence of an ice-cap on Njallavarre is confirmed by ROSBERG (1916 p. 176).

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Chapter 3.

# Vegetation.

By O. Hedberg.

## Vegetation belts.

The vegetation of northern Scandinavia has commonly been divided into three main belts: 1) the conifer forest belt, 2) the birch forest belt, and 3) the alpine belt. Since the alpine belt extends over such a large vertical range it has been considered necessary to subdivide it. There has been some disagreement about the details of this division, however. It therefore seems appropriate to give some attention to it here.

On ascending from the forest line towards the highest summits we encounter a number of changes in the flora and vegetation, as well as in the geological substrate and in climatic conditions. Some of these changes are of only local significance, whereas others occur more or less regularly on all or most mountains of sufficient height in a certain district. Opinions have differed as to which changes are the more important from the phytogeographical point of view. Before surveying the limits which have been used for a subdivision of the alpine belt, it may be worth while to state some principles for such a division. They may be formulated as follows: 1) The division should be based only on the vegetation itself and not on edaphical or climatical qualities or historical factors. The different zones so delimited should, however, reflect the general climatic deterioration towards higher altitudes rather than local edaphical conditions. 2) It should be possible to recognize the different zones in the field without detailed analysis, i.e., they should be delimited according to physiognomically important plants or plant communities. From this follows: 3) The division should preferably be based on the highest stratum present. — Cf. Schröter 1926 p. 2, Du

RIETZ 1930a, p. 352, BRAUN-BLANQUET 1932 p. 347, DAUBENMIRE 1943 p. 330, HEDBERG 1951 p. 163.

One of the most important borders within the alpine belt was considered by WAHLENBERG (1812) to be the »snow line», which apparently he considered to be more or less fixed. Later investigations have shown that this »snow line» is difficult or impossible to locate owing to the uneven snow cover in the alpine belt (cf. HAMBERG 1907 p. 46), and accordingly is of little interest from botanical point of view (cf. HEINTZE 1913 p. 18). Another of the border-lines first used for the subdivision of the alpine belt was the upper limit of willow shrubs (cf. NORMAN 1851), to which WAHLENBERG also seems to have attached considerable importance (cf. TENGWALL 1920 p. 282). VESTERGREN (1902) showed, however, that the vertical distribution of willow shrubs is very different on different mountains, evidently being influenced more by edaphic than by climatic factors (cf. also HÖGBOM 1906 p. 310 and FRIES 1917 p. 36).

It was early recognized that the lower part of the alpine belt has a considerable number of species in common with the subalpine belt. The occurrence of these so-called »subalpine» species was attributed by FRIES (1917) to the higher position of the forest limit during the postglacial warm period, and he suggested that the former position of the forest limit during the climatic optimum should be used as a phytogeographical border-line. This suggestion has been criticized by, int. al., TENGWALL (1920 p. 285), SMITH (1920 pp. 27—28), and DU RIETZ (1925 b, p. 35), and has not been taken up since.

Attempts have also been made to draw a boundary in accordance with the change from dominant dwarf-shrub heaths in the lower part of the alpine belt to more or less dominant grass heaths higher up, by, int. al., VESTERGREN (1902), HEINTZE (1913), and G. SAMUELSSON (1916, 1917). Their »dwarf-shrub limits» are apparently not homologous, however. This border-line was rejected by FRIES (1917), who pointed out that the dwarf-shrub *Dryas octopetala* ascends far above it in our calcareous mountain districts, and that *Cassiope tetragona* does the same in the northern part of the Scandes.[1] He considered it impossible to make a zonal border here based on plant communities. DU RIETZ (1925 b, etc.) found that at a certain level there is rather a marked border zone, where some »low-alpine» communities stop and are succeeded by others of more »middle-alpine» type. The most im-

[1] = the Scandinavian mountain range, cf. LJUNGNER 1948.

portant of the former plant communities is the *Vaccinium myrtillus* heath. This border is usually rather distinct and has been commonly used since. A thorough investigation of it in the E part of the southern Scandes was recently published by KILANDER (1950). On strongly calcareous ground the border in question is very difficult to trace, since *Vaccinium myrtillus* and its companions become extremely sparse. SELANDER (1950 a, pp. 52—56) thus found it impossible to trace it in the Virihaure district of Lule Lappmark, and the present author encountered the same difficulties on Pältsa and Måskokaise.

In the higher parts of the alpine belt most of the ground is usually covered by a layer of large and irregular stones, detached from the underlying bedrock mainly by frost cracking (cf. SVENONIUS 1909, FRIES 1917, TENGWALL 1920). Patches of ordinary soil, suited to phanerogamic plants, are very scarce. The lower limit of this »boulder-terrain» is usually rather sharp and has been used for zonal divisions, e.g. by FRIES 1917 and TENGWALL 1920. B. NILSSON (1907) subdivided the alpine belt according to the lichen flora into one lower zone with predominant earth lichens and one higher with mainly epilithic lichens; the border between them of course coincides exactly with the topographical border just mentioned. — As stressed by FRIES (op. cit.) the lower limit of the boulder-terrain also coincides more or less with the upper limit of closed vegetation. The latter is of course largely dependent on the former, which is mainly edaphically conditioned and not climatically; its altitude may vary between 1100 and 1500 m on adjacent mountains (TENGWALL op. cit.), and boulder-terrain may sometimes occur considerably lower (SMITH 1920 p. 25). It therefore seems preferable to use the upper limit of (more or less) closed vegetation in this case (SMITH loc. cit.). DU RIETZ (1925 a and b) showed, that this vegetational limit could be improved by using instead the qualitative change from dwarf-shrub heath and grass heath to open communities of *Salix herbacea, Luzula arcuata* coll., and *Ranunculus glacialis* with abundant mosses and lichens (cf. also HEINTZE 1913). Even if the boulder-terrain descends far down the slope, there will usually be some patches of soil that can support enough vegetation for such a classification (DU RIETZ 1925 a).

Of the border-lines within the alpine belt we thus find essentially two that can be used with advantage, namely (1) the upper limit of the bilberry heath (*Vaccinium myrtillus*) and some other plant communities (DU RIETZ 1925 b, pp. 36, 42), and (2) the limit where dwarf-shrub heaths and grass heaths are succeeded by open communities of

*Ranunculus glacialis, Salix herbacea,* etc. (Du Rietz 1925 a, p. 71). Using these two borders we get a division of the alpine belt into three zones of equal rank. Such a division was first introduced by Du Rietz (1928 b, 1930 a and b, etc.), and it has been widely accepted by Scandinavian phytogeographers (cf. e.g. Arwidsson 1943, Björkman 1939, Gjaerevoll 1950, Kalliola 1939, Kilander 1949, 1950, Lagerberg 1940, Nordhagen 1936, 1943, Rune 1945, and Sandberg 1938). The subdivisions were originally termed »the low-alpine region», »the middle-alpine region», and »the high-alpine region» (Du Rietz 1928 b, orig. Swedish). Other authors have preferred the latin translations »regio alpina inferior», »r. alp. media», and »r. alp. superior» (cf. Björkman 1939, Arwidsson 1943). In later publications Du Rietz united these vegetation regions of the Scandes with corresponding regions of the Alps into vegetation belts (German: Vegetations-stufen), viz. the l o w - a l p i n e b e l t, m i d d l e - a l p i n e b e l t, and h i g h - a l p i n e b e l t (Du Rietz 1930 a and b).

In some respects it might have been better to reserve the concept belt for altitudinal divisions of highest rank, which can easily be identified on all mountains of sufficient height in a definite part of the world, such as those used for diverse high mountains by Schimper (1898), for the Alps by Schröter (1926), for the high mountains of Tropical East Africa by Hedberg (1951), etc. As mentioned above, the border between the low-alpine and middle-alpine belts of the Scandes is sometimes very difficult to find (cf. also Kalliola 1939 p. 309). The subdivisions of the alpine belt might then be given the more neutral denomination »zones» (cf. Hedberg op. cit., p. 163). As the nomenclature proposed by Du Rietz has now been widely accepted, however, it serves no good purpose to introduce new names for purely terminological reasons.

The high-alpine belt was again sub-divided by Du Rietz (1925 a and b) into three zones, called (from below) the *Salix herbacea* zone, the *Ranunculus glacialis* zone, and the Cryptogamic zone.

As is evident from the facts mentioned above, the demarcation of the low-alpine and middle-alpine belts presents considerable difficulties in the Pältsa district. On the S slope of Mt Paras the upper limit of the low-alpine belt was found at 970 m. Its altitude on Pältsa and Måskokaise, where bilberry heath is very scarce, may probably be about 950—1000 m. The upper limit of such plants as *Melandrium apetalum* and *Astragalus frigidus* might possibly be used to indicate it instead of *Vaccinium myrtillus*. Further investigation of this limit on soil rich in lime is badly needed, however. The upper limit of the middle-alpine belt was found on Mt Paras (S slope) at 1175—1200 m.

On Pältsa and Måskokaise it seems to be situated usually between 1150 and 1250 m. The limit between the *Salix herbacea* zone and the *Ranunculus glacialis* zone of the high-alpine belt is situated in the Pältsa district at c. 1425—1450 m, while no summit here is high enough to reach above the *Ranunculus glacialis* zone.

## Habitat factors.

The higher parts of our mountains provide unique opportunities to study natural vegetation and its response to different habitat factors. This may largely be attributed to the following facts: (1) The topography of the alpine belt is usually broken, creating a variety of different habitats. (2) Wind conditions are much more extreme than in the lowlands, causing considerable microclimatic differences between the habitats just mentioned. (3) The alpine flora is comparatively poor in species, and some of its members have narrow ecological amplitudes. (4) Above the forest limit the disturbing influence of man is almost negligible. — Since the time of LINNAEUS (1737, cf. DU RIETZ 1942 c) and WAHLENBERG (1812) a great number of contributions have been made to the knowledge of Scandinavian alpine vegetation, though certainly much remains to be done, not least as regards the ecology of alpine plants. It is not possible here to give a comprehensive review of the results so far obtained in that field, but before turning to the alpine plant communities we may give some consideration to their environment.

The actual habitat factors of plants may be arranged in 3 groups: climatic, edaphic, and biotic. A number of more elaborate classifications have been proposed (cf. e.g. SCHIMPER 1898, BRENNER 1927, DU RIETZ 1928 a, 1929, and EKLUND 1931), but the different factors are interrelated in such a complicated manner, that in practice it seems impossible to attain a clean-cut and comprehensive system. The simple division mentioned will be satisfactory for the present purpose. Broadly speaking, climatic factors cause the altitudinal differentiation into vegetation belts, whereas edaphic factors influence the distribution of different plant communities within these belts. Of course the interplay between vegetation and environment can never be completely analysed; one has to choose in each case one or a few variables for study, preferably under conditions where other variables are constant. In this paper most attention will be given to a few edaphic factors, while climatic and biotic factors will only be briefly touched upon.

The climate of this part of northern Sweden has been treated by FRIES (1913 pp. 10—27), from whom we may quote a few details. The length of the vegetation period is estimated at 2 $^1/_2$—3 months in the subalpine belt, c. 2 months in the lower part of the alpine belt, and 1—1 $^1/_2$ month in the upper part of the alpine belt. Of course, these are generalized values; the annual variations are quite considerable, and so are the local variations caused by differences in snow cover (cf. below). During the summer, temperature and light conditions are fairly uniform; the sun stays above the horizon for 2 months without interruption (loc. cit.). Occasional night frosts may occur, however, which are certainly of some importance to the flora. Thus in the middle of July 1949 a heavy frost occurred in the district, killing young shoots of a number of plants, such as *Trollius, Papaver laestadianum,* and *Armeria scabra* ssp. *sibirica,* etc., over wide areas. The average annual precipitation is not known from any place in the district, but we may get some rough idea of it by comparing with the district W of Lake Torneträsk (e.g., about 100 km SW of Pältsa), where meteorological observations have been made for a number of years. Here the annual precipitation averages 1005 mm (35 years) at Riksgränsen close to the Norwegian border, 718 mm (6 years) at Björkliden 25 km to the E, and 295 mm (37 years) in Abisko, another 7 km towards the SE on the leeward side of Mt Njulja. On the W parts of Pältsa and Måskokaise the amount of precipitation is probably comparable to that at Riksgränsen, whereas it certainly shows a marked drop eastwards on the leeward side of those mountains. Exact figures would be of disputable value in judging the moisture available, since the major part of the precipitation falls as snow during winter, and the snow is extensively re-deposited in the alpine belt. Whereas the precipitation is usually highest on the W sides of the mountains, the snow deposits are larger on the E sides (ENQUIST 1916 pp. 3—4). On the higher parts a considerable fraction of the precipitation occurs as rime (cf. e.g. HAMBERG 1907 p. 21). For further details regarding the influence of wind see FRIES (loc. cit.), ENQUIST (op. cit.), and C. SAMUELSSON (1926).

The most obvious of the biotic factors is no doubt grazing by reindeer, which are regularly kept here in considerable number (cf. »Renbeteskommissionen 1912», MANKER 1947). Their grazing is usually not intense, however (cf. SELANDER 1950 a, p. 36), and their influence on the vegetation is probably rather small in comparison with the edaphic factors.

Among the edaphic factors we may select four which seem to be of

paramount importance for the distribution of the alpine plant communities of North Scandinavia, viz. (1) Snow cover, (2) Irrigation, (3) Soil, and (4) Solifluxion and Frost-heaving.

As a result of snow drifting, which in the alpine belts proceeds unhindered by trees, the winterly snow-cover is here very uneven. When falling in calm weather the snow may for some time form an even cover, but as a rule it is soon swept away from elevations and windward slopes, and accumulates in hollows and on leeward slopes. Thus hilltops and ridges are practically free from snow, whereas in hollows the snow drift may be several metres thick (cf. Fig. 8). Although the total amount of snow varies considerably from year to year, its distribution pattern is remarkably constant (cf. esp. VESTERGREN 1902 p. 265, SERNANDER 1905 p. 67, HAMBERG 1907 p. 6, HELLAND-HANSEN 1915 p. 136, and NORDHAGEN 1943 p. 229). This uneven snow-cover leads to a number of edaphic and micro-climatic divergences within a limited area. Where winterly snow-cover is lacking, the vegetation is exposed to the full strength of the winter cold, and to the mechanical and desiccating influence of the wind, which is especially severe during winter and early spring, when water losses cannot be replaced from the frozen ground (cf. KIHLMAN 1890 p. 87). The abrasive action of drifting snow is certainly also of importance here. On the other hand, the vegetation period is longer than in snow-sheltered localities (cf. HUSTICH 1940 p. 39). On slopes with moderate snow-cover, the vegetation is protected against the abrasive and desiccating influences of the wind, and the temperature of the surface layer of the soil is kept fairly uniform and not much below the freezing point (cf. HELLAND-HANSEN op. cit., p. 162, HUSTICH op. cit., p. 36, NORDHAGEN 1943 p. 230, GEIGER 1950 p. 169). Nevertheless, the snow melts away rather early, and the vegetation period is not seriously shortened (cf. HUSTICH op. cit., p. 39). With increasing thickness of snow-cover the vegetation period becomes shorter, some patches in the »snow-beds» being free from snow only for some weeks in favourable years. The mechanical pressure of heavy layers of snow may also be important. Observations on the uneven snow distribution above the forest line in Scandinavia have been published by, int. al., KIHLMAN (1890), NORMAN (1894), and especially HAMBERG (1907). Its full importance for our mountain vegetation was first clearly recognized by VESTERGREN (1902). Later contributions have also been given by, int. al., FRIES (1913, 1925 a), TENGWALL (1925), NORDHAGEN (1928, 1943), KALLIOLA (1939), DU RIETZ (1942 a and b), and GJAEREVOLL (1949, 1950).

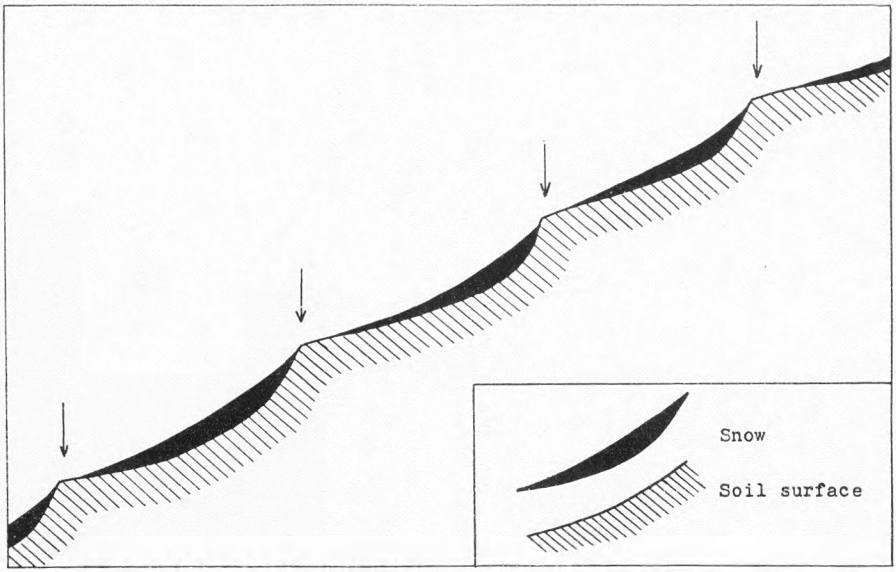


Fig. 8. Schematic profile through part of the N slope of Low Peak, Pältsa, in winter. The arrows indicate places with little or no snow-cover in winter and irrigation from melting snow in summer. The vegetation of these parts often belongs to the *Tomenthypno-Dryadetum* association (cf. text).

A considerable part of the water supply of the alpine plants is derived from melting snow. Hence i r r i g a t i o n is a very important factor. The moisture available on hill-tops with no winter snow and no irrigation must of course be much less than on leeward slopes below large snow-beds, where the ground is kept continuously wet all summer by trickling water. Of course there are all gradations between these extremes, with irrigation during part of the summer. — Though irrigation is dependent on snow accumulation, there is of course no strong correlation between thickness of winter snow and irrigation in the same spot. Thus in the upper part of snow-beds the irrigation stops when the snow on the same spot is finished, whereas on steep mountain slopes we often get considerable irrigation on terraces and ridges which are practically snow-free in winter (cf. Fig. 8). — The importance of irrigation for the diversity of our alpine plant communities has been stressed e.g. by HULT (1887), VESTERGREN (1902), FRIES (1913), G. SAMUELSSON (1916), DU RIETZ (1942 a and b, 1950), and GJAEREVOLL (1950).

The reverse aspect of the water economy of the soil concerns

d r a i n a g e. Good drainage is promoted by markedly sloping ground with permeable soil. In such places there is hardly any solifluxion, whereas on more or less flat ground, where drainage is impeded owing to a frozen substratum in early summer or to impermeable soil, solifluxion phenomena are usually very pronounced (cf. below). As some plants and plant communities are very sensitive to frost-heaving, they are excluded from soil with poor drainage (cf. below p. 71—72 regarding *Myrtillion*).

One of the most significant properties of the s o i l is its l i m e c o n t e n t, depending upon the nature of the parent rock, and influencing the pH of the soil and a number of other properties. It was early recognized that the nature of the parent rock has a profound influence on the vegetation, the flora on schists or limestone being (in Scandinavia) usually much richer than on gneiss and granite (cf. e.g. Chr. Smith 1817, Blytt 1871, and Cleve-Euler 1912). Since the fundamental work of Th. C. E. Fries (1913), the relations between the lime content of the soil and the composition of the vegetation have been treated in a considerable number of publications. A method for estimation of the lime content of the soil was found in pH-measurements, since in Scandinavian soils high pH-values are usually caused by high lime content (cf. e.g. Brenner 1930). Such measurements have been published from our mountains by, int. al., Christophersen (1925), Nordhagen (1928, 1943), Kalliola (1939), Du Rietz (1942 a), and Gjaerevoll (1949, 1950). The mountain plants have been classified according to their relation to lime into groups such as »calcicoles», indifferent plants, and »calcifuges» (the names of the groups and their number have been rather variable, cf. e.g. Selander 1950 a). This simple classification does not seem to be satisfactory in all cases, however. Attempts have also been made to resolve the complex »lime factor» (»Kalkfaktorenkomplex», Brenner 1930) into a number of simple variates, such as Ca content, base status, pH of soil solute, soil texture, etc., and to decide the relative importance of these variates. That question cannot be further dealt with here, but the subject was treated by, e.g., Salisbury (1921), Tengwall (1925), Fries (1925 b), Brenner (op. cit.), Lindroth (1949), and Coombe & White (1951). It will be sufficient for our present purpose if we bear in mind that the flora on soil rich in lime (and accordingly with circumneutral reaction) is very different from that on more acid soils.

Another important characteristic of the soil is its t e x t u r e. Most soils of the district are of morainic origin, and therefore contain par-

Fig. 9. Front of large solifluxion terrace on the N slope of Mt Pältsa W of Nirjijaure. Note the man to the left of the centre. Photo S. Rudberg July 1949.

ticles of several size classes in various fractions. Very often they have been moved and changed by solifluxion (cf. below). Along the esker at Nirjijokk about 1—2 km NW of the Pältsa hut there are considerable areas of glaciofluvial material with rather uniform, sandy soil (cf. Tab. 3 and Fig. 11), the vegetation of which will be described below (p. 69). The direct importance of soil texture for the alpine vegetation has not been much studied hitherto, and is certainly difficult to estimate. Interesting results as to the importance of soil texture for the vegetation have recently been obtained by WALDHEIM (1947) in S Sweden, however.

Almost everywhere in the alpine belt we come across different kinds of »frost pattern soils» (cf. TROLL 1944 p. 547), such as stone polygones, stone stripes, and solifluxion terraces. These owe their formation to the cooperating forces of f r o s t - h e a v i n g and s o l i f l u x i o n. Owing to the property of the freezing soil surface that it attracts water from lower strata, and to the different thermic properties of stones and fine-grained soil, the former gradually accumulate on the surface (cf. e.g. BESKOW 1930). On thawing, the soil is very rich in water, and conditions are favourable for solifluxion, especially when the ground is

sloping, if the soil contains much of the finer size-classes, and if there is a frozen stratum below, impermeable to water. A high moisture content is essential, so irrigation is very important. Solifluxion seems to be most intense on the NE side of the mountains, where the snow-cover is considerable (cf. above p. 50) and where the ground is not warmed and dried out by sunshine to the same extent as on the S slopes. The solifluxion phenomena often produce large terraces, slowly moving downhill, the fronts of which sometimes attain a height of 2—3 m. Such terraces are very prominent on the NE slopes of Pältsa and Måskokaise (cf. Fig. 9). The vegetation on such ground is of course strongly influenced by its habitat. The frost-heaving destroys the root systems of many plants, and on those surfaces where the movements are most intense very few species can live. On the other hand, solifluxion causes mixing of the soil, thus counteracting the process of leaching. The surface layer of solifluxion soil has about the same base content and the same pH as the subsoil (cf. Tab. 4 and Fig. 12). Solifluxion may in this way provide suitable substrate for »calcicoles» even if the soil is not very rich in lime (cf. p. 53). For further details as to frost-heaving and solifluxion see SERNANDER 1905, B. HÖGBOM 1914, FRÖDIN 1914, BESKOW 1930, LUNDQUIST 1944, and TROLL 1944.

A fifth factor of considerable importance is the relief of the ground, influencing irrigation (drainage) and microclimate. The *Tomenthypno-Dryadetum* association described below (p. 60) is, for instance, almost entirely confined to N-slopes with irrigation and cool, moist microclimate.

Most of the accounts of North-Scandinavian alpine vegetation so far published seem to give the impression that the alpine vegetation has reached a very stable equilibrium (cf. SELANDER 1950 a, p. 114). It must be remembered, however, that this equilibrium is a dynamic one, governed by the environment, and that both environment and vegetation are subject to changes, often to an astonishing extent. The present climatic amelioration, which has caused glaciers all over the world to diminish in size, has thus caused the appearance of much fresh soil available for colonization. At the same time, the irrigation conditions have changed markedly on some mountains, initiating new successions of plant communities. Short-term fluctuations, such as a winter with unusually little snow, may cause temporary shifts in the position of such borders between plant communities as are determined by snow-protection. These changes in the alpine vegetation have hitherto not been much studied, but they would certainly merit further investigation.

## Plant communities.

In early Scandinavian alpine plant sociology, plant communities more or less corresponding to what are now called associations were described under the name of »formations» by HULT (1887), SERNANDER (1898. 1905), and others. A. NILSSON (1902) suggested an arrangement of plant formations according to the vegetation of the field layer into 4 »series», namely (1) the heath series, (2) the meadow series, (3) the fen series, and (4) the bog series. This system was adopted by SYLVÉN (1904), FRIES (1913) and a number of later authors. In conformity with the development of international nomenclature, FRIES (op. cit.) changed the term »formation» into »association», defined as »a vegetation type of mainly uniform physiognomy and floral composition» (op. cit., orig. German; cf. DU RIETZ, FRIES & TENGWALL 1918). The »associations» described from Scandinavian mountains by various authors in the next few years differed considerably as regards the principles for delimitation. Some authors took their associations in a comparatively wide sense, e.g. FRIES (1917), SMITH (1920), TENGWALL (1920), and SAMUELSSON (1916, 1917). DU RIETZ (1924, 1925 b, etc.) and NORDHAGEN (1928) used a narrower association concept, requiring a high degree of homogeneity both in field and bottom layer. At the Botanical Congress of 1935 it was agreed to follow the proposition by RÜBEL (1927) and DU RIETZ (1930 a and b) to call the »micro-associations» based upon dominance *sociations*, whereas units of higher rank, *associations* and *alliances*, were delimited according to characteristic and differential species (cf. DU RIETZ 1936). Since then, the interest of Scandinavian plant sociologists working with mountain vegetation has mainly been concentrated on alliances and sociations.

A survey of the main alpine alliances of Scandinavia has been given by NORDHAGEN (1928, 1936, and 1943). Other treatises have been published by DU RIETZ (1930 b, 1942 a and b, 1950), KALLIOLA (1939), and GJAEREVOLL (1949, 1950). It is not possible here to give a survey of the alpine alliances, but the reader may refer to the publications mentioned. As to nomenclature the present communication follows DU RIETZ (1950) and GJAEREVOLL (1950).

Since most of my time in the Pältsa district was devoted to a survey of the flora, the vegetation studies performed were rather fragmentary. Accordingly the general features of the vegetation must be treated quite briefly. However, a few of the alpine alliances will be dealt with in more detail.

One of the main division lines in the system of alpine plant communities in Scandinavia has been drawn according to the occurrence or non-occurrence of calcicoles. In most parts of the Pältsa region the soil is more or less rich in lime, and accordingly most of the surface is covered by vegetation belonging to the calcicole series. The most important alliance of that series is the *Dryadion,* occurring in places with no or moderate snow cover in winter and with no or moderate irrigation in summer. This alliance is very important in the low-alpine and middle-alpine belts on the slopes of Pältsa towards Pältsavagge and on the upper parts of its northern slope. On Måskokaise it occurs, among other places, on the SE slope of the 1517 m summit and on the W slope below cirque 7 (cf. map Fig. 1). Its differentiation will be discussed below. Most of the lower parts of the N slope of Pältsa are extensively irrigated, and hence covered by fens, often with a shrub layer of grey-willows. The heaviest snow-deposits of the district occur on the NE slopes of Måskokaise towards Pältsavagge, as evidenced by the 5 glacial cirques occurring there. Accordingly, most parts of this slope are covered by snow-bed vegetation. In Pältsavagge meadows and mires, and (in the lower part) willow-scrub are important. Unfortunately, the time available did not permit analysis of these other communities, but meadows and late snow-bed communities seemed to be of the same type as described from other parts of Torne Lappmark by Du Rietz (1942 a and b, 1950) and Gjaerevoll (1950). Porous soil poor in lime along the esker (cf. map Fig. 1) supports »poor heath»-communities (cf. Du Rietz 1950 p. 11), which will later be further discussed.

## Differentiation of Dryadion.

The *Dryadion* alliance has been treated by, i.a., Nordhagen (1928, 1936), Kalliola (1939), and Du Rietz (1942 a). It seems to be rather variable and to have a comparatively wide ecological amplitude. Its subdivision into associations is no easy matter, however. Some suggestions regarding such a division were given by Du Rietz (op. cit., pp. 130—131). The present author has been studying this question for a few years, and finds it possible to distinguish tentatively three different associations within the *Dryadion* alliance of Torne Lappmark, viz.: (1) *Nardino-Dryadetum,* (2) *Tetragono-Dryadetum,* and (3) *Tomenthypno-Dryadetum.* The names of these associations were agreed upon after discussions with G. E. Du Rietz, O. Gjaerevoll, and E. Dahl. (The first two associations were treated by Du Rietz 1950 as

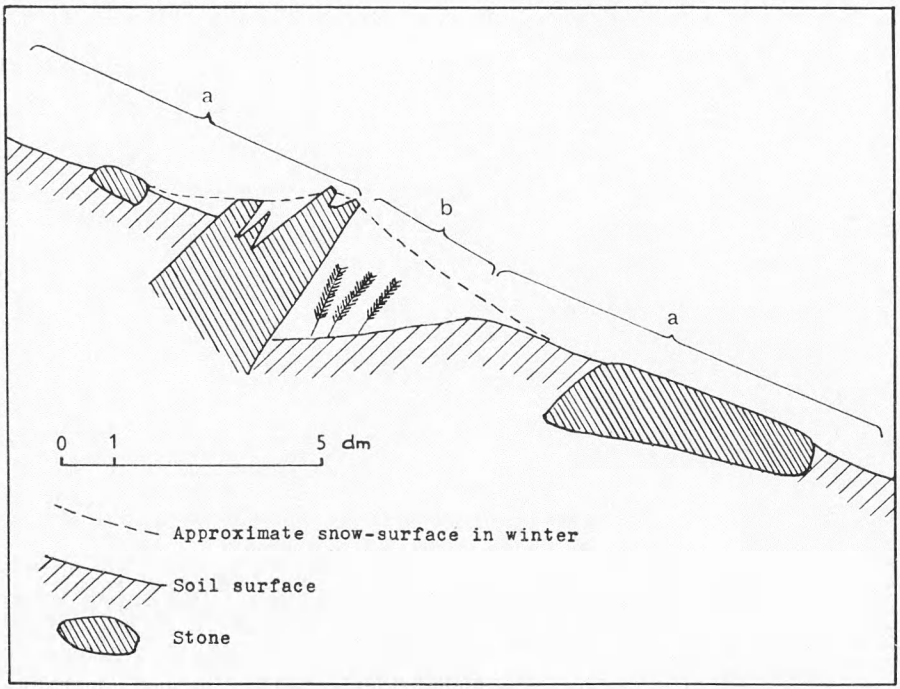


Fig. 10. Pältsa: Low Peak W slope, 1100 m. Schematic profile of part of a wind-exposed hill on soil rich in lime. Most of the surface is covered by *Nardino-Dryadetum* (a), but in the shelter of a big stone, where snow accumulates in winter, there occurs a patch of *Tetragono-Dryadetum* (b).

sub-alliances.) — A list of the species annotated in each of these associations on Pältsa is given in Tab. 1, column 1—3. The fourth column represents the species found in *Tomenthypno-Dryadetum* on Mt Njulja (Torne Lappmark). The lists are far from complete, and the tentative characteristic and differential species enumerated below require further study. The lists of cryptogams were too fragmentary to be useful in this connexion, and have accordingly been omitted.

The three associations of *Dryadion* may be briefly described as follows:

1) *Nardino-Dryadetum.* Most of the soil is usually bare, the field layer consisting of small patches of *Dryas octopetala, Carex nardina, Kobresia myosuroides, Silene acaulis, Saxifraga oppositifolia,* and stray specimens of a number of other plants, mostly calcicoles. Where solifluxion is apparent one often finds *Carex misandra.* In the bottom layer mosses are scarce, whereas lichens are important, being largely

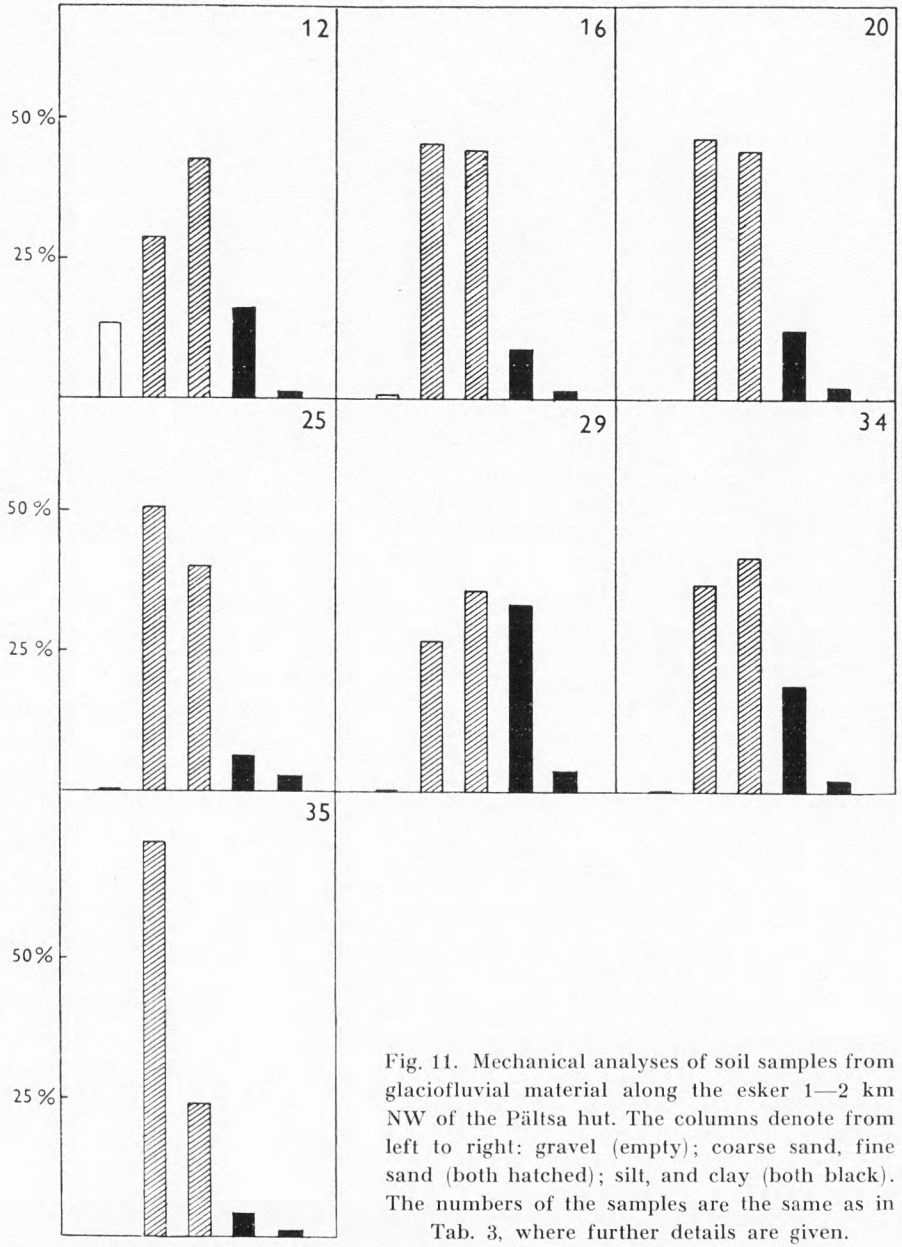


Fig. 11. Mechanical analyses of soil samples from glaciofluvial material along the esker 1—2 km NW of the Pältsa hut. The columns denote from left to right: gravel (empty); coarse sand, fine sand (both hatched); silt, and clay (both black). The numbers of the samples are the same as in Tab. 3, where further details are given.

represented by crustaceous species. Characteristic species:[2] *Carex nardina, C. glacialis.* Differential species as against the other two associations: *Diapensia lapponica, Poa glauca, Potentilla nivea*(?), *Arnica alpina*(?). — This association is confined to wind-swept hills and ridges on calcareous soil in the low-alpine and middle-alpine belts, where snow cover is practically absent in winter, the vegetation thus being fully exposed to the winter cold and to the mechanical and desiccating influence of the winter storms (cf. p. 51). Wind erosion makes the soil unstable and the vegetation more or less open and discontinuous.

2) *Tetragono-Dryadetum.* Field layer closed, largely dominated by *Cassiope tetragona,* together with *Dryas, Silene acaulis,* etc., and containing a large number of calcicoles (cf. Tab. 1). The bottom layer is better developed than in the preceding association, containing lichens such as *Cetraria nivalis, C. cucullata, C. islandica, Alectoria spp., Thamnolia vermicularis,* etc., and of mosses in the first place *Hylocomium splendens, Rhytidium rugosum, Ptilidium ciliare,* and *Dicranum spp.* — Differential species as against *Nardino-Dryadetum*: *Cassiope tetragona, Poa arctica, Antennaria carpathica*(?), *Saxifraga aizoides,* and *Carex vaginata*(?). — Like one of its main dominants, *Cassiope tetragona,* this association requires some snow-protection in winter. Furthermore, it seems to be confined to dry ground, being replaced on irrigated soil by the following association. Isolated segments of *Tetragono-Dryadetum* sometimes occur in *Nardino-Dryadetum* in places where protruding boulders cause some snow accumulation in winter (cf. Fig. 10). Similar observations were made under late winter conditions in the mountains S of Lake Torneträsk. — *Cassiope tetragona* plays about the same rôle in *Tetragono-Dryadetum* as *Vaccinium myrtillus* in *Myrtillion,* though it seems to need less snow-protection in winter than the latter.

3) *Tomenthypno-Dryadetum.* The field layer is rather similar to that of the preceding association, but contains in addition some species requiring high moisture content of the soil, such as *Armeria sibirica, Astragalus frigidus, Carex parallela, Melandrium apetalum,* and *Luzula arctica,* which may be regarded as differential species as against the preceding two associations. In the bottom layer lichens are scarce

[2] The term »characteristic species» is used here, as suggested by Du Rietz (1942 a, etc.) in a more restricted sense than by Braun-Blanquet (1932 etc.).

**Table 1. List of vascular plants observed in the 3 associations of Dryadion in Torne Lappmark.**

1) = Nardino-Dryadetum, Pältsa; 2) = Tetragono-Dryadetum, Pältsa; 3) = Tomenthypno-Dryadetum, Pältsa; 4) = Tomenthypno-Dryadetum, Mt Njulja. D = dominant; + = regular occurrence; (+) = sporadic occurrence.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Andromeda polifolia | — | — | — | + |
| Arctostaphylus alpina | — | — | + | + |
| Betula nana | + | — | — | D |
| Cassiope hypnoides | + | — | + | — |
| C. tetragona | — | D | + | + |
| Diapensia lapponica | + | — | — | — |
| Dryas octopetala | D | D | D | D |
| Empetrum hermaphroditum | + | + | — | + |
| Rhododendron lapponicum | + | — | — | + |
| Salix hastata | — | — | — | + |
| S. herbacea | + | — | — | — |
| S. lanata | — | — | — | + |
| S. polaris | + | + | + | + |
| S. reticulata | + | + | + | + |
| Vaccinium uliginosum | + | + | — | D |
| V. vitis-idaea | + | + | — | + |
| Antennaria alpina | + | — | — | — |
| A. carpathica | — | + | — | — |
| Armeria scabra ssp. sibirica | — | — | + | — |
| Arnica alpina | + | — | — | — |
| Astragalus alpinus | + | + | + | + |
| A. frigidus | — | — | — | + |
| Bartsia alpina | + | + | — | + |
| Campanula uniflora | + | — | — | + |
| Cardamine bellidifolia | — | — | + | — |
| Cerastium alpinum | + | — | + | — |
| C. edmondstonii | + | — | + | — |
| Chamorchis alpina | + | — | — | + |
| Draba lactea | + | — | — | — |
| Equisetum arvense | — | — | — | + |
| E. pratense | + | — | — | (+) |
| E. scirpoides | — | — | + | + |
| E. variegatum | — | + | + | + |
| Euphrasia frigida | + | — | — | (+) |
| Gentiana nivalis | + | — | — | — |
| Melandrium apetalum | — | — | — | + |
| Minuartia biflora | — | — | + | + |
| M. stricta | + | — | — | + |
| Oxytropis lapponica | + | — | — | + |
| Parnassia palustris | — | — | — | (+) |
| Pedicularis lapponica | — | — | — | + |
| Pinguicula alpina | — | — | — | + |
| P. vulgaris | + | — | — | — |
| Platanthera parvula | — | — | — | + |
| Polygonum viviparum | + | — | + | + |
| Potentilla crantzii | + | + | — | + |
| P. nivea (s. str.) | + | — | — | — |
| Ranunculus glacialis | (+) | — | — | — |
| Saussurea alpina | + | — | + | + |
| Saxifraga aizoides | — | + | + | + |

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| S. groenlandica | + | — | — | — |
| S. nivalis | (+) | — | — | — |
| S. oppositifolia | + | + | + | + |
| Sedum rosea | (+) | — | — | — |
| Selaginella selaginoides | — | — | — | + |
| Silene acaulis | D | + | D | + |
| Thalictrum alpinum | + | — | + | + |
| Tofieldia pusilla | + | + | — | + |
| Viola biflora | — | — | — | + |
| Calamagrostis lapponica | — | — | — | + |
| Carex bigelowii | — | + | + | + |
| C. capillaris | + | — | — | + |
| C. glacialis | + | — | — | — |
| C. misandra | + | — | + | + |
| C. nardina | D | — | — | — |
| C. norvegica | — | — | — | + |
| C. parallela | — | — | + | + |
| C. rupestris | + | + | + | + |
| C. vaginata | — | + | — | + |
| Festuca ovina | + | — | + | + |
| F. vivipara | + | + | + | + |
| Juncus trifidus | + | — | — | — |
| Kobresia myosuroides | + | — | — | + |
| Luzula arcuata + L. confusa | + | — | + | + |
| L. arctica | — | — | + | — |
| L. spicata | — | — | — | + |
| Poa alpina | (+) | — | — | — |
| P. alpina var. vivipara | — | + | — | (+) |
| P. arctica | — | + | + | + |
| P. glauca | + | — | — | — |
| Trisetum spicatum | + | — | — | — |

whereas mosses are abundant, often forming a continuous carpet. The most important species are *Tomenthypnum nitens, Aulacomnium palustre, A. turgidum, Hylocomium splendens,* and *Sphagnum warnstorfianum.* For further details see Tab. 2. — This association requires the combination of moderate snow-cover in winter (early melting) with considerable irrigation in summer. It is thus mainly found on N-exposed slopes, as on the N parts of Pältsa and Mt Njulja (cf. Fig. 8).

On similar localities in the upper part of the middle-alpine belt there occurs a community related to *Tomenthypno-Dryadetum,* but with an open field layer containing some of our rarest mountain plants, such as *Stellaria crassipes, Luzula arctica, Papaver radicatum et al., Sagina caespitosa,* etc. This community, named by NORDHAGEN (1936 p. 44) Luzulion nivalis (= arcticae, GJAEREVOLL 1950), and further described by NORDHAGEN (1939 p. 693 ff.) from Pältsa and by GJAERE-

**Table 2. Vegetation analyses from Tomenthypno-Dryadetum.**

1/4 m² squares. — 1) Pältsa: Low Peak, N slope 1050 m, inclination 10°—15° N, irrigated. 2) D:o 1100 m, faint signs of solifluxion. Below the vegetation 5 cm Dryas-peat, then a sandy, dark-coloured mineral soil (pH = 6.5). 3) D:o 1070 m, inclination 10° N, irrigated. 4) D:o 1100 m, incl. 15° N, irrigated. 5) D:o 1070 m, incl. 20° N, along a small rill. 6) Pältsa: Low Peak, W slope 1100 m, incl. 20° SW, irrigated. 7—9) Torne Lappmark: Mt Njulja, N slope 500 m, incl. 10°—20° NE, more or less irrigated. 10) Norway, Troms: Jauroåive, N slope, low-alpine belt. 11—12) Torne Lappmark: Mt Allespuolta, E slope, irrigated. The figures 1, 2, 3, 4 and 5 in the table denote the degree of cover acc. to the HULT-SERNANDER scale (cf. DU RIETZ 1930 a p. 396). — Analyses by O. HEDBERG, mosses largely determined by O. MÅRTENSSON.

| Number of square | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arctostaphylus alpina | — | — | — | — | — | — | — | 4 | 1 | — | — | — |
| Cassiope hypnoides | — | — | — | — | — | 1 | — | — | — | — | — | — |
| C. tetragona | — | — | — | — | 1 | — | — | — | — | 2 | — | — |
| Dryas octopetala | 4 | 4 | 4 | 4 | 2 | 3 | 2 | 2 | 5 | 4 | 5 | 5 |
| Rhododendron lapponicum | — | — | — | — | — | — | — | 1 | — | — | — | — |
| Salix hastata | — | — | — | — | — | — | 1 | 1 | — | 1 | — | — |
| S. cfr. hastata × lanata | — | — | — | — | — | — | — | — | — | — | 1 | — |
| S. polaris | 2 | 2 | 2 | 2 | 1 | 1 | — | — | — | — | — | — |
| S. reticulata | 3 | 3 | 2 | 3 | 1 | — | 1 | 1 | 1 | 1 | — | 1 |
| Vaccinium uliginosum | — | — | — | — | — | — | — | 3 | — | — | — | — |
| V. vitis-idaea | — | — | — | — | — | — | — | — | — | 1 | — | — |
| Armeria scabra ssp. sibirica | — | — | — | — | 1 | — | — | — | — | — | — | — |
| Astragalus alpinus | — | 3 | — | 2 | — | 1 | — | — | 1 | 1 | — | 1 |
| A. frigidus | — | — | — | — | — | — | — | 1 | — | — | — | — |
| Bartsia alpina | — | — | — | — | — | — | 1 | 1 | 1 | 1 | — | — |
| Campanula rotundifolia | — | — | — | — | — | — | — | — | — | 1 | — | — |
| C. uniflora | — | — | — | — | — | — | 1 | — | — | — | — | — |
| Cardamine bellidifolia | 1 | — | — | — | 1 | — | — | — | — | — | — | — |
| Cerastium alpinum | — | — | — | — | — | 1 | — | — | — | — | — | — |
| C. edmondstonii | — | — | 1 | — | — | — | — | — | — | — | — | — |
| Chamorchis alpina | — | — | — | — | — | — | 1 | — | — | — | — | — |
| Equisetum arvense | — | — | — | — | — | — | — | — | — | — | — | 1 |
| E. scirpoides | 1 | — | 1 | — | — | 1 | 1 | 1 | — | — | — | 1 |
| E. variegatum | 1 | 1 | — | — | — | — | — | — | — | — | — | — |
| Gentianella tenella | — | — | — | — | — | — | — | — | — | — | — | 1 |
| Minuartia biflora | — | 1 | — | — | — | — | — | — | — | — | — | — |
| Oxytropis lapponica | — | — | — | — | — | — | 1 | — | 2 | — | — | — |
| Parnassia palustris | — | — | — | — | — | — | 1 | — | — | 1 | — | 1 |
| Pedicularis hirsuta | — | — | — | — | — | — | — | — | — | 2 | — | — |
| P. lapponica | — | — | — | — | — | — | — | 1 | — | — | — | — |
| Pinguicula alpina | — | — | — | — | — | — | 1 | — | 1 | 1 | — | — |
| Platanthera parvula | — | — | — | — | — | — | — | 1 | — | 1 | — | — |
| Polygonum viviparum | 2 | 3 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Potentilla crantzii | — | — | — | — | — | — | — | — | — | — | 1 | 1 |
| Saussurea alpina | 1 | — | 1 | — | — | 1 | 2 | 1 | — | — | 1 | 1 |
| Saxifraga aizoides | — | 1 | — | — | 1 | — | — | — | 1 | — | — | — |
| S. oppositifolia | 1 | 1 | 1 | 1 | 2 | — | — | — | 1 | 1 | — | — |
| Selaginella selaginoides | — | — | — | — | — | — | 1 | — | — | — | 1 | — |
| Silene acaulis | — | — | 3 | 2 | 3 | 3 | — | — | — | 1 | — | — |
| Thalictrum alpinum | — | — | 1 | 1 | — | — | 1 | 1 | 1 | 1 | 1 | 1 |
| Tofieldia pusilla | — | — | — | — | — | — | — | 1 | 1 | 1 | — | — |
| Viola biflora | — | — | — | — | — | — | 1 | 1 | — | — | 1 | 1 |

| Number of square | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carex atrata | — | — | — | — | — | — | — | — | — | — | — | 1 |
| C. bigelowii | 1 | — | — | 1 | — | 1 | — | — | — | — | 2 | — |
| C. capillaris | — | — | — | — | — | — | — | — | 1 | — | 1 | 1 |
| C. misandra | 1 | — | 1 | — | 1 | 1 | — | — | — | — | — | — |
| C. norvegica | — | — | — | — | — | — | — | — | — | — | 1 | — |
| C. parallela | 1 | — | — | — | — | — | — | — | — | — | 1 | 1 |
| C. rupestris | — | — | 1 | — | — | — | 1 | — | 1 | 1 | 1 | — |
| C. vaginata | — | — | — | — | — | — | — | — | — | — | 2 | — |
| Festuca ovina | — | 1 | 1 | 1 | — | 1 | 1 | 1 | 1 | — | 1 | 2 |
| F. vivipara | — | — | — | — | — | — | — | — | — | 2 | — | — |
| Kobresia myosuroides | — | — | — | — | — | — | 4 | 1 | — | — | — | — |
| Luzula arctica | — | 1 | — | — | 1 | — | — | — | — | — | — | — |
| L. arcuata coll. | — | 1 | 1 | 1 | 1 | — | — | — | — | — | — | — |
| L. spicata | — | — | — | — | — | — | — | — | — | — | — | 1 |
| Poa arctica | — | — | — | — | — | 1 | — | — | — | — | — | — |
| P. pratensis ssp. alpigena | — | — | — | — | — | — | — | — | — | — | — | 1 |
| Abietinella abietina | — | — | — | — | — | 1 | — | — | — | — | — | — |
| Arnellia fennica | — | — | — | — | — | — | — | 1 | — | — | — | — |
| Aulacomnium palustre | — | — | — | — | — | — | — | — | — | — | 1 | 1 |
| A. turgidum | — | 1 | 1 | — | — | 1 | — | — | — | — | — | — |
| Blepharostoma trichophyllum | — | — | 1 | — | 1 | — | — | — | 1 | — | — | — |
| Bryum sp. | — | — | — | — | — | 1 | 1 | — | — | — | — | — |
| Campylium stellatum | — | — | — | — | — | — | 1 | 1 | — | — | — | — |
| Climacium dendroides | — | — | — | — | — | — | — | — | — | — | 3 | 1 |
| Dicranum cfr. majus | — | 1 | 2 | 2 | — | — | — | — | — | — | — | — |
| D. cfr. scoparium | — | — | — | — | — | 1 | — | — | — | — | — | — |
| D. sp. | — | — | — | — | — | — | — | 1 | — | — | — | 1 |
| Distichium capillaceum | — | — | 1 | 1 | 1 | — | 3 | — | 1 | — | — | — |
| Ditrichum flexicaule | — | 2 | 3 | 2 | 1 | — | — | — | — | — | — | — |
| Drepanocladus uncinatus | — | 2 | — | 1 | — | 1 | — | 1 | 1 | 1 | — | — |
| Hylocomium splendens | 5 | 3 | 3 | 3 | 1 | 3 | — | 3 | 1 | 1 | 1 | 2 |
| Hypnum bambergeri | — | 1 | 1 | 1 | 1 | — | — | — | — | — | — | — |
| Leiocolea arctica | — | 1 | 1 | — | 1 | — | — | — | — | — | — | — |
| Mnium cfr. blyttii | — | 1 | — | — | 1 | — | — | — | — | — | — | — |
| Mn. hymenophylloides | — | — | — | — | — | — | — | — | 1 | — | — | — |
| Mn. hymenophyllum | 1 | 1 | 1 | 1 | — | — | — | — | — | — | — | — |
| Mn. orthorrhynchum | — | — | — | — | — | — | 1 | 1 | 1 | — | — | — |
| Mn. rugicum | 2 | — | 1 | 1 | — | 1 | — | 1 | — | 1 | — | — |
| Myurella tenerrima | — | — | — | — | — | — | 1 | — | — | — | — | — |
| Odontoschisma macounii | — | — | 1 | — | — | — | — | — | — | — | — | — |
| Orthocaulis quadrilobus | — | 1 | — | — | — | — | — | — | — | — | — | — |
| Cfr. Orthothecium chryseum | — | — | — | 1 | — | — | — | — | — | — | — | — |
| Orthothecium intricatum | — | — | — | — | 1 | — | — | — | — | — | — | — |
| Polytrichum alpinum | 1 | 1 | 1 | 1 | — | 1 | — | — | — | — | — | — |
| P. cfr. strictum | — | — | 1 | — | — | — | — | — | — | — | — | — |
| Ptilidium ciliare | 1 | — | — | — | — | 2 | — | 1 | — | 1 | — | — |
| Rhacomitrium lanuginosum | — | — | — | — | 1 | — | — | — | — | — | — | — |
| Rhytidiadelphus triquetrus | — | — | — | — | — | — | — | 1 | 1 | — | — | — |
| Rhytidium rugosum | — | — | — | — | — | 1 | — | 2 | — | — | — | — |
| Scapania gymnostomophila | — | — | — | — | — | — | — | — | 1 | — | — | — |
| Tetraplodon pallidus | — | — | 1 | — | — | — | — | — | — | — | — | — |
| Timmia cfr. norvegica | — | — | — | 1 | — | — | — | — | — | — | — | — |
| Tomenthypnum nitens | 4 | 5 | 4 | 5 | 2 | 4 | — | 1 | 1 | 3 | 3 | — |
| Tortula norvegica | — | — | — | — | — | 1 | — | — | — | — | — | — |
| Tritomaria quinquedentata | 1 | 1 | — | 1 | 1 | 1 | — | — | — | — | — | — |

| Number of square | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cetraria cucullata | — | 1 | — | 1 | 1 | 1 | — | 1 | 1 | — | — | — |
| C. islandica | 1 | 1 | — | 1 | 1 | 1 | — | 1 | 1 | — | — | — |
| C. nivalis | — | — | — | — | 1 | — | — | — | 1 | — | — | — |
| Cladonia cfr. elongata | — | — | — | — | — | — | — | 1 | 1 | — | — | — |
| Nephroma expallidum | — | — | — | — | — | — | — | 1 | — | — | — | — |
| Ochrolechia cfr. frigida | — | — | — | — | 1 | — | — | — | — | — | — | — |
| Peltigera cfr. canina | — | — | — | 1 | — | — | — | — | — | — | — | — |
| P. leucophlebia | — | — | — | — | — | 1 | — | — | — | — | — | — |
| Stereocaulon cfr. denudatum | — | 1 | — | — | — | 1 | — | — | — | — | — | — |

VOLL (op. cit.) from Mt Nissontjårro in Torne Lappmark, seems to be entirely confined to irrigated ground on N-exposed slopes with moist local climate (cf. also HEDBERG 1947 p. 178).

## The Empetrion — Myrtillion complex.

On undulating morainic soil poor in lime in the low-alpine belt of Scandinavia the vegetation usually consists of a mosaic of four alliances, the distribution of which seems to be chiefly dependent upon the distribution of winter snow (cf. p. 51), namely: 1) The *Empetrion* alliance, on wind-swept hills and plateaus with little or no snow-protection in winter. 2) The *Myrtillion* alliance, on slopes with moderate snow-cover in winter, which melts away in the early part of the summer. 3) The *Deschampsio-Anthoxanthion* alliance, in places with thick winter snow, melting away too late in the summer to allow the development of *Myrtillion*. 4) The *Herbaceon* alliance, in late snow-beds. On irrigated ground still other alliances occur (cf. GJAEREVOLL 1950). This zonation was first clearly described by VESTERGREN (1902), and has later been treated especially by FRIES (1913), TENGWALL (1925), NORDHAGEN (1928), KALLIOLA (1939), and DU RIETZ (1942 a and b).

It will be evident from the above, that the »*Empetrion - Myrtillion* complex» occurs only on more or less well-drained soil without perceptible irrigation. Even then the character of the soil may often change within a short distance, and it often seems rather uncertain which changes in the vegetation are to be ascribed to differences in snow-cover alone. The short survey of habitat factors given above (p. 49 ff.), though sketchy, may have been sufficient to show how completely inter-related the different factors are, and how difficult it may be to find out which is the »primary factor» causing a certain change in the vegetation. However, we may sometimes find one or more habitat fac-

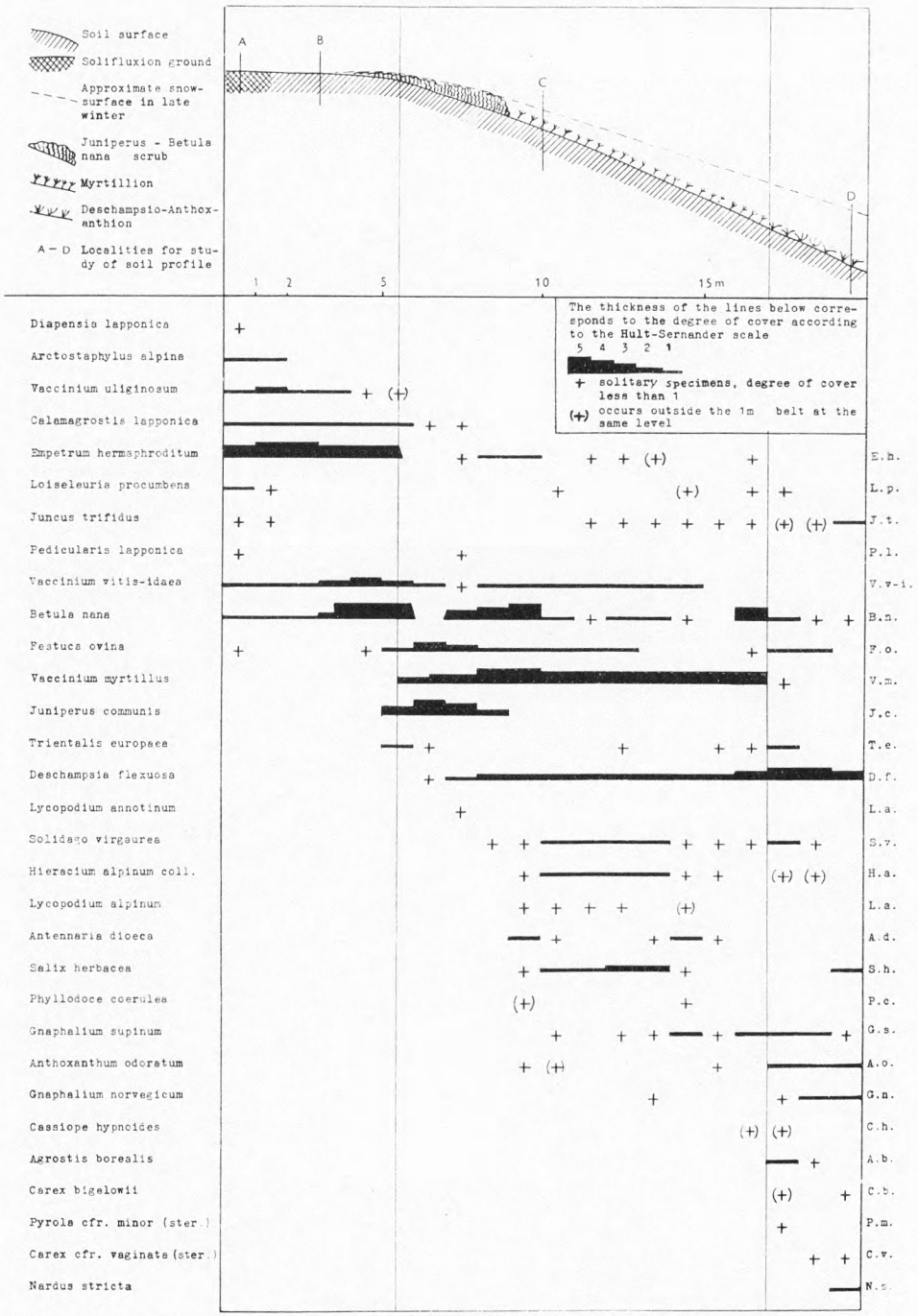


Fig. 12. Belt transect (1 m broad) of vegetation on a S-exposed hill-slope c. 1 km NW of the Pältsa hut. Altitude c. 600 m. The inclination is drawn approximately to scale. The two vertical linies indicate the upper and lower limits of *Myrtillion*.

**Table 3. Mechanical analyses and pH-determinations of soil samples from glaciofluvial material along the esker 1—2 km NW of the Pältsa hut (cf. Fig. 11).**

| Sample | Gravel > 2 mm | Coarse sand 0.2 — 2 mm | Fine sand 0.02 — 0.2 mm | Silt 0.002 — 0.02 mm | Clay < 0.002 mm | pH |
|---|---|---|---|---|---|---|
| 12. *Empetrion*, surface of solifluxion terrace (at A in Fig. 12) | 13.4 % | 28.7 % | 42.6 % | 16.0 % | 1.3 % | 5.5 |
| 16. *Empetrion*, subsoil at 35 cm depth (at B in Fig. 12) | 0.6 % | 45.2 % | 44.1 % | 8.8 % | 1.3 % | 5.5 |
| 20. *Myrtillion*, subsoil at 35 cm depth (at C in Fig. 12) | 0.0 % | 46.4 % | 39.4 % | 12.1 % | 2.1 % | 5.1 |
| 25. *Deschampsio-Anthoxanthion*, subsoil at 50 cm depth (at D in Fig. 12) | 0.2 % | 50.6 % | 40.0 % | 6.3 % | 2.9 % | 5.4 |
| 29. *Betula nana* association, subsoil at 80 cm depth (cf. Fig. 13) | 0.2 % | 26.8 % | 35.9 % | 33.3 % | 3.8 % | 5.5 |
| 34. Meadow-willow-scrub, subsoil at 40 cm depth (cf. p. 71) | 0.1 % | 36.9 % | 41.8 % | 19.0 % | 2.2 % | 5.4 |
| 35. D:o, subsoil at 80 cm (cf. p. 72) | 0.0 % | 70.9 % | 23.8 % | 4.2 % | 1.1 % | 5.7 |

**Table 4. Soil profiles in the belt transect of Fig. 12.**

| | B | C | D |
|---|---|---|---|
| Raw humus | 6.5 — 10 cm<br>pH = 3.9 | 7 — 8 cm<br>pH = 4.1 | 8 — 9 cm<br>pH = 4.4 |
| $A_2$ — horizon (ash-grey) | 0.5 — 3.5 cm, irregular<br>pH = 4.7 | 1 — 2 cm<br>pH = 4.6 | 1.5 — 3 cm<br>pH = 4.8 |
| B — horizon (faint reddish brown) | 10 — 12 cm<br>pH = 4.7 | c. 15 cm<br>pH = 5.0 | c. 20 cm<br>pH = 4.8 |
| C — horizon (subsoil) | pH = 5.5<br>(at 35 cm depth) | pH = 5.1<br>(at 35 cm depth) | pH = 5.4<br>(at 50 cm depth) |

The letters B—D at the top of the table denote the points where the soil profile was studied (B = *Empetrion*, C = *Myrtillion*, D = *Deschampsio-Anthoxanthion*, cf. Fig. 12). On solifluxion ground in *Empetrion* (A in Fig. 12) no podzolization occurred, the soil being more or less uniform throughout the profile with a pH of 5.5. — When the soil profile was studied, soil samples were taken from the different layers of each profile. The samples were kept in waxed cartons, and were air-dried at once after collecting. For the pH-determinations part of each sample was taken in a glass-bottle (Pyrex) and $CO_2$-free distilled water was added until the volume of the mixture was 3 times that of the soil. The mixture was kept slowly rotating for 20 hours and then left to sediment. After a few hours the pH of the supernatant liquid was measured by means of a glass electrode.

tors more or less constant over a large area, and it may then be easier to study the effect of the others. Such a case was found on glaciofluvial material along the esker c. 1—2 km NW of the Pältsa hut, where the geological substratum is rather homogeneous over a considerable

**Table 5. List of vascular plants in communities occurring on the esker 1 km NW of the Pältsa hut (cf. text).**

1) = Empetrion; 2) = Myrtillion; 3) = Betula nana association on flat ground; 4) = Deschampsio-Anthoxanthion; 5) = Meadow willow-scrub on flat ground. D = dominant; + = regular occurrence; (+) = sporadic occurrence.

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Arctostaphylus alpina | D | (+) | — | — | — |
| Betula nana | D | D | D | — | D |
| B. tortuosa (young shrubs) | — | + | — | — | — |
| Cassiope hypnoides | — | — | — | + | — |
| Diapensia lapponica | + | — | — | — | — |
| Empetrum hermaphroditum | D | + | D | (+) | — |
| Juniperus communis | (+) | D | + | — | + |
| Loiseleuria procumbens | D | + | — | (+) | — |
| Lycopodium alpinum | — | + | — | + | — |
| L. annotinum | — | (+) | + | — | — |
| Phyllodoce coerulea | — | + | + | — | — |
| Rhododendron lapponicum (on solifluxion terrace) | (+) | — | — | — | — |
| Rubus chamaemorus | — | — | + | — | — |
| Salix glauca | (+) | + | D | — | D |
| S. herbacea | + | + | — | + | — |
| S. phylicifolia | — | — | + | — | D |
| Vaccinium myrtillus | — | D | — | — | — |
| V. uliginosum | D | + | D | — | — |
| V. vitis-idaea | D | + | D | + | + |
| Antennaria alpina | (+) | + | — | — | — |
| A. dioica | (+) | + | — | + | + |
| Botrychium lunaria | — | — | — | — | + |
| Cerastium alpinum | — | — | — | — | + |
| C. fontanum ssp. scandicum | — | — | — | — | + |
| Chamaenerion angustifolium | — | + | — | — | + |
| Euphrasia frigida | — | — | — | — | + |
| Geranium silvaticum | — | — | — | — | + |
| Gnaphalium norvegicum | — | + | — | + | + |
| G. supinum | — | + | — | + | — |
| Hieracium alpinum coll. | (+) | + | — | + | — |
| Pedicularis lapponica | + | + | + | — | + |
| Polygonum viviparum | — | (+) | — | — | — |
| Potentilla crantzii | — | — | — | — | (+) |
| Pyrola minor | — | (+) | — | + | + |
| Rumex acetosa ssp. lapponicus | — | + | — | + | — |
| Saussurea alpina | — | — | — | — | (+) |
| Sibbaldia procumbens | — | (+) | — | + | — |
| Solidago virgaurea | (+) | + | + | + | D |
| Stellaria calycantha | — | + | — | — | — |
| Taraxacum croceum coll. | — | — | — | — | + |
| Thalictrum alpinum | — | — | — | — | (+) |
| Trientalis europaea | — | + | + | (+) | + |
| Trollius europaeus | — | — | — | — | + |
| Veronica alpina | — | — | — | — | + |
| Viola biflora | — | — | — | — | + |
| Viscaria alpina | + | + | — | — | — |
| Agrostis borealis | — | — | — | + | — |
| Anthoxanthum odoratum | — | + | — | D | + |

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Calamagrostis lapponica | + | — | + | — | — |
| Carex bigelowii | + | + | — | + | — |
| C. brunnescens | — | — | — | + | + |
| C. vaginata | — | — | — | — | + |
| Deschampsia flexuosa | — | + | + | D | D |
| Festuca ovina | + | + | + | — | + |
| Hierochloë alpina | + | — | — | — | — |
| Juncus trifidus | D | + | — | + | + |
| Luzula multiflora ssp. frigida | — | — | + | — | + |
| L. spicata | + | — | — | — | — |
| Nardus stricta | — | + | — | D | — |
| Phleum commutatum | — | — | — | + | — |

area, consisting of loamy sand (cf. Tab. 3 and Fig. 11). Disregarding the topmost layer of the soil, which has been affected by weathering (podzolization) to a varying extent according to the vegetation growing on it, the soil must therefore be considered fairly uniform. The observed differences in the vegetation must then in the main be ascribed to topographically conditioned differences in winterly snow-cover and in drainage. The different types of vegetation occurring in this area were briefly analysed, and an attempt was made to evaluate the apparent differences of their environment as far as possible. The approximate level of the snow-surface in winter could in many places be estimated from an inspection of the topmost branches of *Betula nana, Juniperus communis, Salix glauca,* etc., which in the alpine belt are regularly killed off if they protrude above the snow surface in mid-winter (cf. KIHLMAN 1890 p. 71, VESTERGREN 1902 p. 274, FRIES 1913 pp. 183 ff., HELLAND-HANSEN 1915 p. 170, KALLIOLA 1939 p. 239). In other cases the time of melting of the snow, and hence the approximate amount of snow-cover, could partly be judged from the development of the plants.

To furnish an example of the normal zonation on a hill slope a belt transect was made through a typical *Empetrion - Myrtillion - Deschampsio-Anthoxanthion* - slope (Fig. 12). The soil profile was investigated in each of the three alliances present (Tab. 4). As shown in the table there is a weak podzolization in the sloping part of the profile, whereas on flat ground without snow-protection in *Empetrion* the soil has been mixed by solifluxion, giving to the surface layer the same reaction as the subsoil (Tab. 4). The occurrence of solifluxion here may probably be ascribed to bad drainage in early summer, when the subsoil is frozen. On sloping ground the drainage is of course better. The composition of the mineral soil is, as previously mentioned, about the same (Tab. 3),

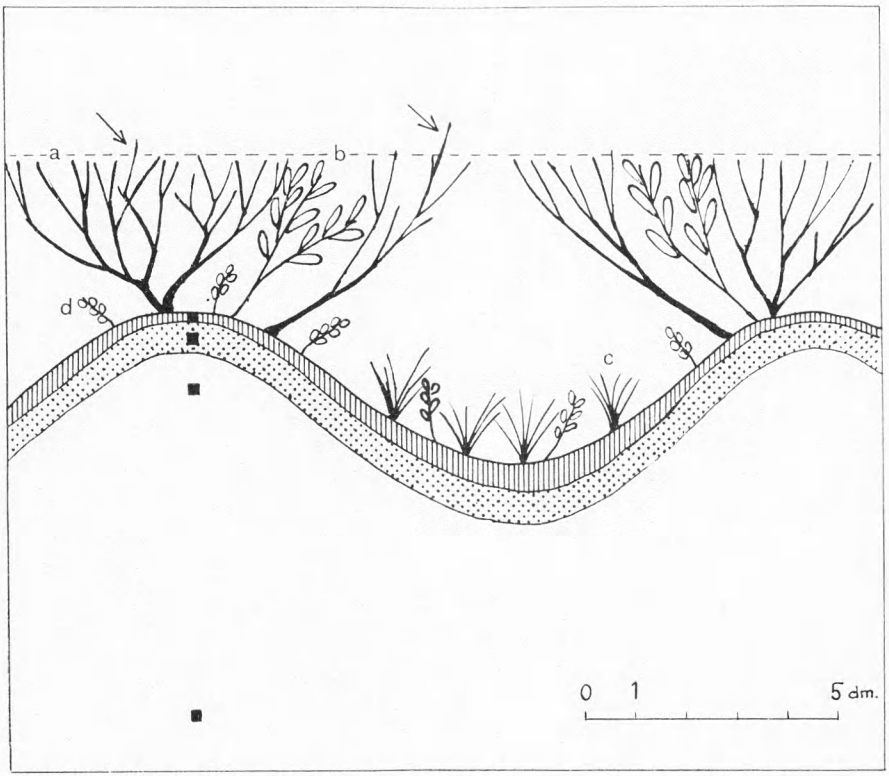


Fig. 13. Schematic profile through *Betula nana* association on level ground c. 1 km NW of the Pältsa hut at 600 m. The symbols used are meant to illustrate *Betula nana* (a), *Salix glauca* (b), *Deschampsia flexuosa* + *Festuca ovina* (c), *Vaccinium vitis-idaea* + *Empetrum hermaphroditum* (d). The small black squares indicate places where soil samples were taken. — Soil profile: 1) Humus layer 2—5 cm thick (vertical hatching), pH = 4.2. 2) Dark-coloured mineral soil with plant roots, 6—7 cm thick (stippled), pH = 4.4. 3) Compact solifluxion soil without plant roots, pH = 5.2 in its upper part and 5.5 at a depth of 8 dm (cf. Tab. 3 sample 29). The arrows indicate dead branches of *Betula nana*, which had probably protruded above the snow surface in winter. The approximate position of the winter snow surface is indicated by a dotted line. — Cf. Fig. 14.

and the distribution of the three alliances mentioned is apparently dependent on the distribution of winter snow (Fig. 12). — I also made lists of the vascular plants occurring in each of the three alliances mentioned (Tab. 5: 1, 2, 4). They seem to agree well with the description given by Du Rietz (1942 a) from the central part of Torne Lappmark.

The zonation just described naturally occurs only on undulating

Fig. 14. *Betula nana* association on level ground c. 1 km NW of the Pältsa hut at 600 m. The topmost branches of the shrubs all reach the same level, indicating the normal position of the snow-surface at mid-winter (cf. Fig. 13). Photo O. HEDBERG Aug. 1949.

ground, where the amount of snow-cover shows considerable variation within short distances. On level ground with uniform snow-cover in winter one might expect to find one or other of the same communities prevailing over large areas. A closer study showed, however, that most of the communities found on such ground could not easily be fitted into the same system. One of them is a *Betula nana* association occurring on ground with moderate snow-cover in winter (cf. Figs. 13 and 14). It contains about the same stock of species as the *Myrtillion* alliance but lacks *Vaccinium myrtillus* (cf. Tab. 5:3; sample area 100 $m^2$). — The flat ground must promote bad drainage during the snow-melting period, when the subsoil is frozen and thus impermeable to water. The soil surface forms densely spaced small hummocks, which have probably been caused by frost-heaving. The soil profile also gives evidence of this (cf. Fig. 13). Thus plant roots only occur in the humus layer and the topmost 5—7 cm of the mineral soil. The root-carrying layer can be lifted almost like a blanket from the hard and compact underlying soil (cf. the figure). — The shrubs of *Betula nana, Salix glauca* etc. are

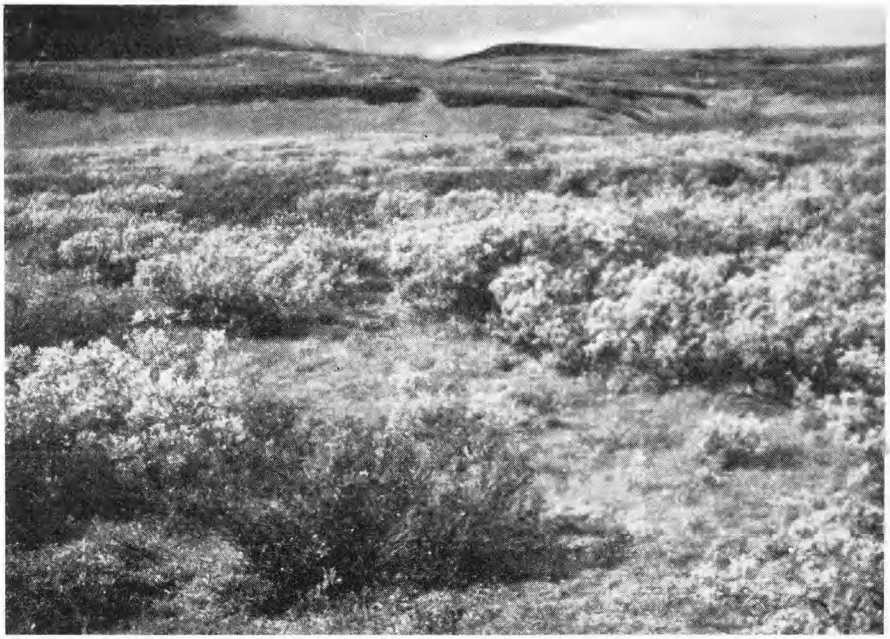

Fig. 15. Meadow willow-scrub along the esker c. 1 km NW of the Pältsa hut. Also in this case the topmost branches of the shrubs end at the same level, apparently determined by the position of the upper snow surface in mid-winter (cf. text). Photo O. HEDBERG Aug. 1949.

mostly confined to the hummocks, whereas *Deschampsia flexuosa, Festuca ovina,* etc. are more important in the hollows. The absence of *Vaccinium myrtillus* in this community may partly be ascribed to the bad drainage (cf. DU RIETZ 1925 d, p. 340 regarding similar conditions in coast forests of Central Sweden), partly to the solifluxion phenomena. — All the same this community seems to be closely associated with the *Myrtillion* alliance.

Another plant community occurring on the same geological substrate is an open willow-scrub with a field layer of meadow type containing mesophilous grasses and herbs (cf. Fig. 15). A list of the species occurring in it is given in Tab. 5: 5. This community also occurs on level ground, but here the surface is almost flat and shows no marked signs of solifluxion or frost-heaving. The willow-scrub of the investigated area (comprising 100 $m^2$) was rather open and about 1 m high, indicating a winter snow-cover of that depth. The soil profile showed a topmost blackish »humus

layer» c. 5 cm thick (pH=4.9); then brownish A-horizon 5 cm (pH=4.8): blackish-brown B-horizon 5 cm (pH=4.8); and then the C-horizon, showing pH=5.1 at a depth of 20 cm, 5.4 at 30 cm, and 5.7 at 80 cm. The subsoil showed stratification with alternating layers of coarser and finer sand (cf. Table 3), which were apparently not distorted by solifluxion, whereas the B-horizon contained some faint kryoturbate structures. The moisture content did not change perceptibly from the surface down to 90 cm below it. — This community is reminiscent of some of the »meadow willow-scrubs» described earlier (FRIES 1913, SMITH 1920, TENGWALL 1920, etc.). It seems to be conditioned by a fairly considerable snow-cover in winter, occurring on flat ground with porous soil. It might of course be influenced by the ground water level as well, but on that point no evidence is available. At any rate, the ground water did not come very close to the surface at the time of investigation.

Chapter 4.

# List of Vascular Plants.

By O. HEDBERG.

The botanical nomenclature in this list follows in the main HYLANDER (1941, 1945 b). The geographical names used are in agreement with the map Fig. 1, cf. also p. 199 ff. The different parts of Pältsa and Måskokaise called »S Peak», »Middle Peak», »Low Peak», and »High Peak», are those marked on the map with the altitudes 1425 m, 1448 m, 1290 m, and 1517 m, respectively. The localities on Måskokaise have been referred to the glacial cirque valleys, which are numbered on the map. »Pältsavagge» is the big valley between Pältsa and Måskokaise. »SW of Måskojaure» means the flat country between the W end of Måskojaure and the river Råsto elv. »Upper birch-forest» means the birch-forest along Nirjijokk immediately E of the Pältsa hut. Unspecified localities of earlier collectors, such as »Pältsa» and »Måskokaise» have been omitted where more detailed data were available. When a species has been reported by more than one author from the same locality, only the first record has usually been quoted.

The list is based on the herbarium material preserved at the Botanical Museum of the University of Uppsala, which was largely collected by Dr. H. SMITH (cf. p. 11 ff.); on the collections of H. ROIVAINEN at the herbarium of Botaniska Avdelningen, Riksmuseum, Stockholm; on the relevant literature, and on my own field notes. As regards the genus *Carex*, the private herbarium of Mr. C. G. ALM, Uppsala, has also been consulted. (As his collections will be deposited at the Botanical Museum of Uppsala, the specimens contained therein have been given the same reference). A number of unpublished data have also been furnished by Dr. H. SMITH, Dr. A. NYGREN, Mr. C. G. ALM, Mr. T. E. HASSELROT, and Miss A.-M. ÖHLIN. The account of the genus *Poa* was made in collaboration with Dr. A. NYGREN. The following abbreviations have been used for collectors, herbaria and publications.

A = C. G. Alm
AN = A. Nygren
CPL = C. P. Laestadius
F = Th. C. E. Fries
F & M = Th. C. E. Fries & S. Mårtenson
J = S. Junell
H = O. Hedberg
Ht = T. E. Hasselrot
R = H. Roivainen
RK = »Renbeteskommissionens af år 1909 Handlingar»
RN = R. Nordhagen
S = Herbarium of Botaniska Avdelningen, Riksmuseum, Stockholm.
Sm = H. Smith
T & A = T. Ä. Tengwall & C. G. Alm
Ö = A.-M. Öhlin
U = Herbarium of the Botanical Museum, Uppsala.

Where no collector or publication is quoted, the observations have been made by the present author in the summer of 1949.

For each species enumerated the altitudinal range and habitat preferences in the district of investigation have been given as far as possible. It was intended to try to establish the upper altitudinal limits of all vascular plants observed during my field work, but lack of time prevented any extensive investigation. Several of the »top values» given may thus be too low. The altitudes reported by the author have been measured by a »Thommen altimeter», using the Pältsa hut and Nirjijaure as base points, and the error is probably not greater than ±15 m. As conditions were more favourable for obtaining good values for the upper limits of some plants on Mt Paras in Norway about 10 km N of the Pältsa hut, my notes from that mountain have also been given in the list, though no attempt was made to include all earlier collections from that area. Altitudes given by other collectors are usually given in round hundreds of metres, and will probably have an error of up to at least ±50 m. — The term »calcicole» is here necessarily used in rather a wide sense (cf. p. 53 above).

Whereas the rare species of the district have been much collected, the common ones have earlier been largely neglected. During the field work of the present author it was attempted to annotate common species as well as rare ones, and it is hoped that the number of localities given for each species below will give some idea of its frequency.

**Lycopodium selago** L. var. **appressum** DESV.

Occurs as stray specimens throughout the alpine belts to the highest summits (610—1517 m). One of the most important vascular plants of the high-alpine belt; appears to be indifferent to lime. — SW of Nirjijaure; S Peak; Middle Peak 1448 m (Sm: U); Low Peak; High Peak summit 1517 m; upper Pältsavagge; Måskokaise SE slope; SW of Måskojaure 610 m; Paras summit 1416 m; Veigematto E slope.

**Lycopodium annotinum** L.

All material seen belongs to var. *alpestre* HARTM. (cf. FRIES & MÅRTENSON 1910 p. 66). — Subalpine and lower part of low-alpine belt (550—700 m). Occurs mainly in dwarf-shrub heaths, especially those belonging to *Myrtillion* (cf. p. 65). — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut; S Peak SE slope 700 m (Sm: U); SW of Måskojaure.

**Lycopodium alpinum** L.

Low-alpine and lower middle-alpine belt (600—1100 m), in grass heaths and dwarf-shrub heaths on more or less acid soil (especially in *Deschampsio-Anthoxanthion* and *Myrtillion*). Seems to require snow-protection in winter. — On the esker 1 km NW of the Pältsa hut at 600 m; S Peak SE slope; upper Pältsavagge 900 m; Måskokaise below cirque 5 at 930 m; Måskokaise cirque 7; SW of Måskojaure; Paras S slope 1100 m.

**Selaginella selaginoides** (L.) LINK.

Low-alpine belt (610—930 m) in *Dryas*-heaths and meadows with moderate to good snow-protection in winter. — SW of Nirjijaure; S Peak SE slope; Måskokaise below cirque 5 at 930 m; Pältsavagge (Ht: U); SW of Måskojaure 610 m.

**Equisetum arvense** L.

Subalpine and low-alpine belts (550—930 m). — Upper birch-forest 550 m; SW of Nirjijaure; Måskokaise below cirque 5 at 930 m; SW of Måskojaure.

**Equisetum silvaticum** L.

Only recorded from the upper birch-forest 1 km E of the Pältsa hut.

**Equisetum pratense** EHRH.

Subalpine and low-alpine belts (550—915 m). Appears to be indifferent to lime content of the soil and to snow-protection in winter. — Upper birch-forest 550 m; SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope 875 m in *Nardino-Dryadetum*; Pältsavagge 900 m (Sm & J: U); SW of Måskojaure.

**Equisetum palustre** L.

Subalpine and low-alpine belts (550—800 m). — Upper birch-forest in a fen; Måskokaise NE slope 800 m (Sm: U).

**Equisetum fluviatile** L.; EHRH.

On shores of shallow lakes and streams in the subalpine belt and the lower part of the low-alpine belt. — N of Gåbnetjåkko (FRIES 1913 p. 126); Kummajärvi (FRIES & MÅRTENSON 1910 p. 63); Nirjijaure 756 m (Sm: U).

**Equisetum variegatum** SCHLEICH.

Low-alpine and middle-alpine belts to 1100 m, calcicole. — At Nirjijokk NE of Pältsa (Sm: U); SW of Nirjijaure; S Peak SE slope; Low Peak NE slope 1100 m; Pältsavagge (FRIES & MÅRTENSON 1910 p. 64); Måskokaise NE slope; Paras S slope 915 m.

**Equisetum scirpoides** L. C. RICH.

Subalpine to middle-alpine belt (550—1100 m), calcicole. Seems to prefer moist soil, being common in *Tomenthypno-Dryadetum* (cf. Tab. 2). — Upper birch-forest; SW of Nirjijaure; S Peak SE slope 850 m (Sm: U); Low Peak W slope 1100 m; Low Peak NE slope 1100 m; Pältsavagge (FRIES 1913 p. 73); Måskokaise cirque 5; Måskokaise cirque 7 on terminal moraine at 800 m; SW of Måskojaure.

**Botrychium lunaria** (L.) SW.

Low-alpine and middle-alpine belts (600—1100 m), in meadows with good snow-protection in winter. — On the esker 1 km NW of the Pältsa hut; S Peak SE slope (Ht); Pältsa E slope (JALAS 1949 p. 92); Pältsavagge (Ht: U); Måskokaise SE slope 1100 m (Sm: U).

**Botrychium boreale** MILDE

Only recorded from the upper part of Pältsavagge (Ht: U).

**Asplenium viride** HUDS.

Low-alpine belt in crevices of calcareous rock. — S Peak SE slope 850 m (Sm: U).

**Athyrium alpestre** (HOPPE) MILDE

Low-alpine belt to 915 m, not common. Occurs mainly along small rills etc. with good snow-protection in winter (cf. GJAEREVOLL 1949 p. 80 etc.). — Lassivare, Pältsa (FRIES & MÅRTENSON 1910 p. 68); Måskokaise (CPL: U); SW of Måskojaure; Tjårrokaise (TENGWALL & ALM 1920 p. 237); Paras S slope 915 m.

**Cystopteris fragilis** (L.) BERNH. ssp. **eu-fragilis** A. & G.

Subalpine and low-alpine belts (550—900 m), in rock crevices. — Upper birch-forest; S Peak E slope 900 m (Sm: U).

**Cystopteris fragilis** ssp. **Dickieana** (SIM) HYL.

In a ravine E of Gapovare (Sm: U).

**Cystopteris montana** (LAM.) BERNH.

S Peak SE slope 900 m (Sm: U).

**Woodsia ilvensis** (L.) R. BR.

Gåbnetjåkko N slope (Ht: U).

**Woodsia alpina** (BOLTON) S. F. GRAY

Subalpine and low-alpine belts, in rock crevices. — Upper birch-forest close to Nirjijokk (Sm: U); Pältsa (LAESTADIUS 1860; FRIES & MÅRTENSON 1910 p. 75); SW of Måskojaure 600 m.

**Woodsia glabella** R. BR.

Low-alpine and middle-alpine belts (900—1400 m), in rock crevices, calcicole. — S Peak 1200 m (TENGWALL & ALM 1920 p. 238, A & T: U); S Peak E slope 900 m (Sm: U); S Peak c. 1400 m (AN: U); Pältsa NE slope (JALAS 1949 p. 92).

**Dryopteris austriaca** (JACQ.) WOYNAR ssp. **dilatata** (HOFFM.) SCH. & TH.

In a ravine E of Gapovare c. 700—800 m (Sm: U).

**Polystichum lonchitis** (L.) ROTH

Måskokaise, easternmost part (Ö).

**Lastrea phegopteris** (L.) BORY

Occurs mainly in the subalpine belt, but sometimes ascends into the lower part of the low-alpine belt, growing in rock crevices. — Pältsa (FRIES & MÅRTENSON 1910 p. 68); in the ravine E of Gapovare 800 m (Sm: U); in a small ravine at Råsta elv SW of Måskojaure at 600 m.

**Lastrea dryopteris** (L.) BORY

As the preceding. — Upper birch-forest (Sm: U); Pältsa (FRIES & MÅRTENSON 1910 p. 68); SW of Måskojaure 600 m.

**Polypodium vulgare** L.

Mainly in the subalpine belt, sometimes reaching the low-alpine belt. — Gåbnetjåkko N slope 700 m (FRIES & MÅRTENSON 1910 p. 69; Ht: U).

**Juniperus communis** L.

Subalpine and low-alpine belts to 1050 m; above the forest limit probably only ssp. *nana* (WILLD.) BRIQ. Above the forest limit it requires snow-protection in winter. Prefers S-exposed slopes and needs good drainage of the soil, being one of the main dominants in the early snow-free part of *Myrtillion* (cf. p. 66). — Upper birch-forest; on the esker 1 km NW of the Pältsa hut; S Peak SE slope 850 m; SW of Måskojaure; Paras S slope 1050 m.

**Pinus silvestris** L.

A solitary specimen 1/2 m tall was found in 1949 on the S side of Nirjijokk SW of the Pältsa hut and near the stream. — The upper border of the conifer forest belt in Sweden is situated about 90 km to the SE. Isolated pine forest districts occur in Norway at Signaldal c. 25 km toward NW and Överbygden c. 30 km westwards (cf. FRIES 1913 p. 342).

**Sparganium angustifolium** MICHX

In a small pool near the stream W of Nirjijaure c. 760 m (Sm: U).

**Triglochin palustre** L.

In a fen in the upper birch-forest 1 km E of the Pältsa hut at 550 m (H: U).

**Anthoxanthum odoratum** L.

All material found within this district probably belongs to the 10-chromosomic race named by LÖVE and LÖVE (1948 p. 105) *A. alpinum*. The morphological differences between this race and the 20-chromosomic lowland race, and their distribution are yet too imperfectly known to allow a proper judgment of their taxonomic value (cf. ÖSTERGREN 1942). Another 10-chromosomic type of *Anthoxanthum odoratum* (coll.) has been described from Corsica (cf. TISCHLER 1950 p. 209, Footnote 3). — Low-alpine belt (600—970 m). Requires moderate to good snow-protection in winter, being one of the main dominants of *Deschampsio-Anthoxanthion* (cf. p. 68). — On the esker 1 km NW of the Pältsa hut; SW of Nirjijaure; lower Pältsavagge (RK p. 320); Pältsa S part (Sm: U); S Peak SE slope 850 m; Måskokaise cirque 7 at 800 m; SW of Måskojaure.

**Hierochloë odorata** (L.) PB.

Low-alpine to middle-alpine belt (600—1050 m), in meadows and grass heaths with moderate snow-cover in winter. — Lassivare (J: U); E of Lassivare where the stream cuts through the esker (Sm: U); S Peak S slope 900 m (Sm: U); High Peak E slope 1050 m; SW of Måskojaure 600 m.

**Hierochloë alpina** (SW.) R. & S.

Low-alpine to high-alpine belt (600—1380 m), on wind-open places with little or no snow-cover in winter. Seems to be indifferent to lime. — On the esker 1 km NW of the Pältsa hut; Low Peak 1290 m; Pältsavagge (RK p. 321; Sm: U); High Peak E slope 1285 m; High Peak N slope 950 m (Sm: U); Måskokaise on the ridge between cirque 3 and 4 at 1380 m; Måskokaise cirque 7; SW of Måskojaure; Veigematto E slope 750 m; Paras S slope 1240 m.

**Milium effusum** L.

W slope of the mountain E of Gapovare c. 800 m (Sm: U).

**Phleum commutatum** GAUD.

Low-alpine belt, in grass heaths and meadows with good snow-protection

in winter, esp. *Deschampsio-Anthoxanthion* (cf. p. 69). — Upper birch-forest; on the esker 1 km NW of the Pältsa hut; SW of Nirjijaure; Pältsavagge, Lassivare (FRIES & MÅRTENSON 1910 p. 68); S Peak SE slope (Sm: U); Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 237); SW of Måskojaure.

**Phleum pratense** L.

A few culms at the Pältsa hut 1946 (JALAS 1949 p. 93).

**Alopecurus aequalis** SOBOL.

Kummajokk (=Nirjijokk) below Pältsa (TENGWALL & ALM 1920 p. 234).

**Agrostis tenuis** SIBTH.

On a path in the upper part of the birch-forest E of the Pältsa hut (Sm: U).

**Agrostis borealis** HARTM.

Low-alpine belt in grass-heaths with good snow-protection in winter, especially in *Deschampsio-Anthoxanthion* (cf. Tab. 5 and Fig. 12). — On a path at the forest limit E of the Pältsa hut (Sm: U); on the esker 1 km NW of the hut; SW of Nirjijaure (Sm: U); SW of Måskojaure.

**Calamagrostis purpurea** TRIN.

Lower part of low-alpine belt, in meadows, rarely flowering. — SW of Måskojaure c. 600 m.

**Calamagrostis neglecta** (EHRH.) G., M. & SCH.

Subalpine and low-alpine belts, on moist ground. — Upper birch-forest c. 500 m (Sm: U), S Peak SE slope (Sm: U); lower Pältsavagge (RK p. 321).

**Calamagrostis lapponica** (WG) HARTM.

Low-alpine belt (600—930 m), on wind-exposed ground with little or no snow-protection in winter (cf. Fig. 12). — Sand-hills at the Pältsa hut 600 m (Sm: U); on the esker 1 km NW of the hut; SW of Nirjijaure; S Peak (Sm: U); Pältsa W slope (FRIES 1913 p. 92); lower Pältsavagge (RK p. 321); Måskokaise cirque 5 at 930 m; SW of Måskojaure.

**Deschampsia alpina** (L.) R. & S.

Low-alpine and middle-alpine belts (800—1150 m), on irrigated soil with open vegetation along rills etc., often melting out late. — Kummajärvi, Gåbnetjåkko, Tjuosmir and Lassivare (FRIES & MÅRTENSON 1910 p. 62); SW of Nirjijaure; S Peak SE slope 800 m (Sm: U); Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); Low Peak N slope 900 m (Sm: U); Måskokaise below cirque 5 at 830 m; Tjårrokaise (TENGWALL & ALM 1920 p. 232).

**Deschampsia caespitosa** (L.) PB.

Subalpine belt and lower part of low-alpine belt, moist ground on shores of lakes and streams. — Fen in the upper birch-forest; Kummajärvi, Gåbnetjåkko, Pältsa (FRIES & MÅRTENSON 1910 p. 62); SW of Måskojaure.

**Deschampsia flexuosa** (L.) TRIN.

Subalpine and low-alpine belts (550—970 m). Requires moderate to good snow-protection in winter and seems to avoid soil rich in lime. One of the most important species in *Myrtillion* and *Deschampsio-Anthoxanthion* (cf. p. 66). — Upper birch-forest; on the esker 1 km NW of the Pältsa hut; S Peak SE slope 850 m; SW of Måskojaure; Paras S slope 970 m.

**Deschampsia atropurpurea** (WG) SCHEELE

Low-alpine belt, in grass heaths and meadows. — In willow scrub near the Pältsa hut (AN); S Peak E slope (Sm: U); lower Pältsavagge (RK p. 321).

**Trisetum spicatum** (L.) RICHT.

Subalpine to high-alpine belt (550—1430 m). Seems to prefer soil rich in lime; indifferent to snow-protection in winter. Common. — Upper birch-forest; S Peak SE slope 850 m; Low Peak 1290 m; Low Peak W slope 1080 m in *Nardino-Dryadetum*; lower Pältsavagge (RK p. 321); upper Pältsavagge (Sm: U); Måskokaise E slope (Sm & J: U); Måskokaise on the ridge between cirque 3 and 4 at 930—1430 m; Måskokaise cirque 7; SW of Måskojaure; Veigematto E slope; Paras summit 1415 m.

**Melica nutans** L.

In the upper birch-forest.

**Poa pratensis** L. ssp. **eu-pratensis** HIITT.

Upper birch-forest; at the Pältsa hut (H: U); S Peak E slope 800 m (AN: U). Probably not indigeneous.

**Poa pratensis** ssp. **alpigena** (FR.) HIITT.

Low-alpine and middle-alpine belts to 1100 m. — S Peak S slope on old camp site (Sm: U); S Peak NE slope 1100 m (Sm: U); S Peak E slope 900 m (Sm: U) and 800 m (AN: U); Middle Peak NE slope 800 m (AN: U); Middle Peak SE slope (Sm: U); Low Peak 900 m (AN: U, a non-viviparous type morphologically similar to the viviparous form mentioned below); Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); Pältsa NE slopes c. 900—1000 m (Sm: U); Måskokaise cirque 5 at 930 m. Chromosome number within the area varying between 2n=48 and 2n=92, cf. NYGREN 1950 pp. 29—30.

**Poa pratensis** ssp. **alpigena,** viviparous forms (cf. SCHOLANDER 1934, p. 89).

Low-alpine and middle-alpine belts (800—1200 m). — S Peak (NYGREN 1950 p. 34); Middle Peak 800 m (AN: U); Middle Peak N slope 1100 m (Sm: U); Low Peak 800—1000 m (AN & Sm: U); Low Peak NE slope 1050 m (H: U); Pältsa NE side 900 and 1000 m (Sm: U) and 1100 m (RN: U); Pältsa N slopes of N part 950 and 1000 m (Sm: U); High Peak N slope 900 m (Sm: U); Måskokaise cirque 5 at 1200 m (NYGREN loc. cit.). Chromosome number varying from 2n=(38?) 52 to 79, cf. NYGREN loc. cit.

**Poa pratensis** ssp. **irrigata** (LINDM.) LINDB. FIL.

Middle Peak N slope 1000 m (AN No. 4814: U, cf. NYGREN op cit., p. 31). Somatic chromosome number 84.

**Poa arctica** R. BR. ssp. **microglumis** NANNF.

S Peak 900 m (AN: U). Somatic chromosome number=64, cf. NYGREN op. cit., p. 21.

**Poa arctica,** various forms.

Low-alpine to high-alpine belt (700—1415 m). Occurs mainly on slightly moist soil rich in lime. — Maselvare 700 m (AN & Sm: U); S Peak 900 and 1100 m (NYGREN op. cit., pp. 25, 27); S Peak N slope 1200 m (Sm: U); Middle Peak 900—1000 m (AN: U); Pältsa NE slopes 1300—1400 m (Sm: U); Low Peak 900 m (AN: U); Low Peak N slope 950—1290 m; Low Peak W slope 1080 m; High Peak NE slope 1300—1400 m (Sm: U); Måskokaise (TENGWALL & ALM 1920 p. 237); Måskokaise cirque 5 at 1050—1300 m (NYGREN op. cit., pp. 25—27); Måskokaise cirque 5 at 1000 m (AN: U); Tjuosmir (FRIES & MÅRTENSON 1910 p. 68); Paras summit 1415 m. Chromosome number 2n= 56—88 (NYGREN loc. cit.).

**Poa alpina** L.

Subalpine to high-alpine belt (550—1250 m). Seems to prefer moderate to good snow-protection in winter and to need soil rich in lime. — Upper birch-forest 550 m; S Peak E slope 900 m (Sm: U); S Peak SE slope 850 m; col between Middle Peak and Low Peak 1100 m (Sm: U); Low Peak NE slope; lower and upper Pältsavagge (RK p. 321); High Peak N slope 900—1000 m (Sm: U); High Peak NE slope 1050 m and 1250 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope 1150 m.

**Poa alpina** f. **vivipara** L.

As the preceding, though perhaps more common at higher altitudes (900—1415 m). Tjuosmir, Gåbnetjåkko, Lassivare and Nirjivare (FRIES & MÅRTENSON 1910 p. 68); SW of Nirjijaure; S Peak E slope 900 m (Sm: U); col between Low Peak and Middle Peak 1100 m (Sm: U); Low Peak W slope 1080 m; Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); Pältsavagge (FRIES 1913 p. 115); High Peak N slope 950—1000 m and NE slope 1100 m (Sm: U); Måskokaise cirque 5 at 930 m; Paras summit 1415 m.

**Poa alpina** var. **vivipara** × **Poa arctica**

Måskokaise cirque 5 at 1250 m (AN No. 4867: U). Chromosome number 2n=54, NYGREN op. cit., p. 38.

**Poa alpina** var. **vivipara** × **P. pratensis** ssp. **alpigena**=**P. herjedalica** H. SM. (cf. SMITH 1920 p. 159).

Low-alpine and middle-alpine belts (800—1200 m). — S Peak 900 m (AN: U); Middle Peak 900 m (AN: U); Low Peak 800—900 m and Måskokaise cirque 5

at 850—1200 m (NYGREN op. cit., p. 40). Chromosome number varying between 2n=52 and 2n=80, NYGREN loc. cit.

**Poa glauca** VAHL

Subalpine to middle-alpine belt (550—1200 m). Rather polymorphous. — Upper birch-forest in S-exposed slope 550 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 68); in the ravine E of Gapojaure (Sm: U); S Peak E slope (AN: U); S Peak E slope near Nirjijokk (Sm: U); S Peak SE slope 850 m; S-Pältsa 1200 m (R: S); Middle Peak S slope on wind-exposed scree at 875 m; Low Peak on wind-exposed ridges in *Nardino-Dryadetum* 1180 m (H: U); High Peak E slope 1050 m; Måskokaise cirque 5 at 930 m; Måskokaise E slope 1200 m (Sm: U); SW of Måskojaure 600 m.

**Poa nemoralis** L.

Subalpine and low-alpine belts. — Upper birch-forest in S-exposed slopes, e.g. on the E side of Nirjijokk below the water-fall; Lassivare (FRIES & MÅRTENSON 1910 p. 68).

**Phippsia algida** (SOL.) R. BR.

Low-alpine to high-alpine belt (900—1490 m), in irrigated late snow-beds. — Gåbnetjåkko, Nirjivare (FRIES & MÅRTENSON 1910 p. 68); col between Middle Peak and Low Peak (Sm: U); High Peak N slope 1100 m along streamlet from melting snow (Sm: U); Måskokaise (CPL: U, cf. LAESTADIUS 1860); Måskokaise E slope 900 m (Sm: U); Måskokaise SE slope 1000 m (Sm: U); Måskokaise on the SE part of the summit plateu at 1490 m (H: U).

**Festuca ovina** L. ssp. **vulgaris** (KOCH) SCH. & K.

Subalpine to middle-alpine belt (550—1160 m). Appears to be indifferent to lime and to snow-protection in winter. — Upper birch-forest; on the esker 1 km NW of the Pältsa hut in *Empetrion, Myrtillion* and meadow willow-scrub (cf. p. 69); SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope 875 m; Low Peak NE and W slopes 1100 m in *Tomenthypno-Dryadetum*; lower Pältsavagge (RK p. 319); upper Pältsavagge 900 m; High Peak E slope 1060 m; Måskokaise cirque 5 at 930 m; Måskokaise below cirque 7 at 800 and 1000 m; SW of Måskojaure; Paras S slope 1160 m.

**Festuca vivipara** (L.) SM.

Low-alpine to high-alpine belt (700—1415 m). Seems to need moister conditions than the preceding. — Gåbnetjåkko, Tjuosmir (FRIES & MÅRTENSON 1910 p. 64); SW of Nirjijaure; Pältsa N slope 950 m (Sm: U); Low Peak NE slope (NORDHAGEN 1939 p. 694); Low Peak W slope 1080—1290 m; Måskokaise on the ridge between cirque 3 and 4 at 930 and 1300 m; Paras summit 1415 m.

**Festuca rubra** L. (mainly as var. **mutica** HARTM.).

Low-alpine belt (600—1000 m), not common. — At the Pältsa hut, apophytic (H: U); S Peak NE side 900 m (Sm: U); Pältsavagge (FRIES 1913 p. 115); Måskokaise 1000 m (Sm: U).

**Nardus stricta** L.

Low-alpine belt (600—915 m); in grass heaths, mainly *Deschampsio-Anthoxanthion* (cf. p. 69). Requires good snow-protection in winter and seems to avoid soil rich in lime. — On the esker 1 km NW of the Pältsa hut; Pältsa S part (Sm: U); at Nirjijokk below Pältsa, Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 236); Pältsavagge (FRIES & MÅRTENSON 1910 p. 67); SW of Måskojaure; 5 km E of Gapovare (Sm: U); Paras S slope 915 m.

**Roegneria borealis** (TURCZ.) NEVSKI (cf. MELDERIS 1950 p. 161).

Reported from Pältsa and Måskokaise by TENGWALL & ALM (1920 p. 238, sub nom. *Triticum violaceum* HORN.).

**Eriophorum vaginatum** L.

Low-alpine belt, in mires. — SW of Nirjijaure; at the stream W of Nirjijaure (Sm: U); Middle Peak NE slope 800 m (Sm: U); High Peak N slope 850 m (Sm: U).

**Eriophorum brachyantherum** TRAUTV. & MEY.

Kummavare (=the mountain E of Gåbnetjåkko) near Kumma eno (A & F: U).

**Eriophorum medium** ANDS.

Pältsa N slope in a fen between the Norwegian border and Nirjijaure at 850 m (Sm: U).

**Eriophorum scheuchzeri** HOPPE

Low-alpine belt. — At Nirjijaure (FRIES & MÅRTENSON 1910 p. 64); Pältsa, Måskokaise (TENGWALL & ALM 1920 p. 236); High Peak N slope along stream 850 m (Sm: U).

**Eriophorum angustifolium** HONCK.

Low-alpine belt, in mires. — Gåbnetjåkko (FRIES 1913 p. 126); SW of Nirjijaure; SW of Måskojaure.

**Scirpus caespitosus** L. ssp. **austriacus** (PALLA) BRODD.

Subalpine and lower part of low-alpine belt, in mires. — Kummajärvi (FRIES & MÅRTENSON 1910 p. 73); fen in the upper birch-forest; Pältsa, Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 238); SW of Måskojaure 600 m.

**Kobresia myosuroides** (VILL.) F. & PAOL.

Low-alpine and middle-alpine belts (600—1200 m); on wind-exposed places with little or no snow-cover in winter. Calcicole. Occurs mainly in *Nardino-Dryadetum* and the most wind-exposed parts of *Tomenthypno-Dryadetum*. — S Peak SE slope 850 m (A & T: U); Middle Peak S slope 875 m; col between S Peak and Middle Peak at 1200 m (Sm: U); col between Low Peak and High Peak (RK p. 321); Pältsavagge (Ht: U); High Peak E slope 1060 m;

Måskokaise SE slope (Sm: U); Måskokaise cirque 7 at 900 m; SW of Måskojaure 600 m.

**Carex dioeca** L.

Occurs sparsely in rich fens together with the following species. — Pältsa SE slope 850 m (Sm: U).

**Carex parallela** (LAEST.) SOMF.

Subalpine to middle-alpine belt (550—1100 m). On irrigated ground in rich fens and in *Tomenthypno-Dryadetum* (cf. p. 60). — Fen in the upper birch-forest 550 m; SW of Nirjijaure; Pältsa E slope 900 m (Sm: U); Middle Peak NE slope 850 m (Sm: U); Low Peak NE slope in *Tomenthypno-Dryadetum* at 950 and 1100 m; Pältsavagge (Ht: U); Måskokaise in »*Dryas*-heath» 1100 m (CPL: U; A & T: U); Måskokaise cirque 5 at 930 m.

**Carex microglochin** WG

Pältsavagge (?) (E. BERGSTRÖM acc. to FRIES & MÅRTENSON 1910 p. 61).

**Carex nardina** FR.

Low-alpine and middle-alpine belts (850—1200 m); on wind-exposed ridges without snow-protection in winter. Calcicole. Characteristic species of *Nardino-Dryadetum* (cf. p. 60). — S Peak SE slope 850 m (A & T: U; Ht: U); Pältsa S slope (Sm: U); in the W part of the col between S Peak and Middle Peak at 1200 m (Sm: U); Low Peak W slope 1080 and 1180 m (H: U); Pältsa NE side (RN: U); Pältsa N slopes 1200 m (Sm: U); Måskokaise 1100 m (A & T: U; cf. TENGWALL & ALM 1920 p. 235).

**Carex arctogena** H. SM. (cf. SMITH 1940)

Low-alpine belt, to 1000 m. — Kumma eno (CPL: U); S Peak SE slope 850 m (Sm: U); Måskokaise SE slope 1000 m (Sm: U, type!); Tjårrokaise S slope 1000 m (J: U).

**Carex rupestris** ALL.

Low-alpine and middle-alpine belts (750—1200 m); on wind-exposed soil rich in lime and with little snow-protection in winter; mainly in *Dryadion* (cf. p. 62). Common. — S Peak SE slope (Ht); S Peak SW slope 1200 m (Sm: U); Middle Peak S slope 875 m; Low Peak NE slope 1100 m in *Tomenthypno-Dryadetum*; Low Peak W slope 1080 m in *Tetragono-Dryadetum*; Low Peak W slope 1080 and 1180 m in *Nardino-Dryadetum*; High Peak E slope 1050 m; Måskokaise on the ridge between cirque 3 and 4 at 930 and 1050 m; Måskokaise cirque 7 at 800 and 1050 m; Veigematto E slope 750 m on dolomitic limestone; Tjuosmir (FRIES & MÅRTENSON 1910 p. 61); Tjårrokaise (TENGWALL & ALM 1920 p. 235; J: U).

**Carex macloviana** D'URV.

Subalpine to high-alpine belt, mainly along reindeer tracks and foot-paths (cf. ALM 1944). — At the path a little E of the Pältsa hut (Ö); Gapovare

(Fries & Mårtenson 1910 p. 60); Pältsa (A & T: U, cf. Tengwall & Alm 1920 p. 235); S-Pältsa 900 m (R: S); ESE of S Peak at Nirjijokk (Sm: U); S Peak E slope 1300 m (Sm: U).

**Carex lachenalii** Schkuhr

Low-alpine and middle-alpine belts (600—1200 m), mainly in snow-beds. — SW of Nirjijaure (A & T: U); Pältsa S slope 900 m (R: S); Pältsa N slopes of N part 1100 m (Sm: U); lower Pältsavagge (RK p. 319); Måskokaise 1200 m (Sm: U); Måskokaise cirque 5 at 930 m; SW of Måskojaure 600 m.

**Carex lachenalii × parallela**

Pältsavagge 900 m (Sm & J: U); Måskokaise NE slope (Sm: U).

**Carex brunnescens** (Pers.) Poir.

Low-alpine belt, in grass heaths and meadows with good snow-protection in winter. — Gåbnetjåkko (J: U); on the esker 1 km NW of the Pältsa hut at 600 m; S Peak S slope 700 m (Sm: U); SW of Måskojaure 600 m.

**Carex brunnescens × lachenalii**

Pältsa N slope at Nirjijaure (R: S).

**Carex canescens** L.

Upper birch-forest (Sm: U).

**Carex caespitosa** L.

At Nirjijokk a little NW of the Pältsa hut (Sm: U); Måskokaise NE slope near Pältsajokk at 700 m (Sm: U).

**Carex juncella** Th. Fr.

Subalpine and low-alpine belts, on moist ground in fens and along streams and lake-shores. — Gåbnetjåkko (Fries 1913 p. 126); in a fen in the upper birch-forest; SW of Måskojaure 600 m.

**Carex bigelowii** Torr.

Low-alpine to high-alpine belt (600—1410 m). Indifferent to lime and to snow-protection in winter (though apparently absent from the most wind-exposed ridges with *Nardino-Dryadetum* etc.). Very common. — On the esker 1 km NW of the Pältsa hut in *Empetrion, Myrtillion* and *Deschampsio-Anthoxanthion*; Lassivare (RK p. 320); SW of Nirjijaure; S Peak SE slope 850 m; Low Peak N slope in *Tomenthypno-Dryadetum* at 950 and 1100 m; Low Peak W slope in *Tetragono-Dryadetum* 1080 m; lower Pältsavagge (RK p. 319); upper Pältsavagge 900 m; Måskokaise cirque 5 at 930 m; Måskokaise SE slope 1000 m and 1100 m (Sm: U); Måskokaise cirque 7 at 800 and 1000 m; SW of Måskojaure 600 m; Paras S slope 1410 m.

**Carex aquatilis** Wg

Subalpine and low-alpine belts. — Gåbnetjåkko, subalpine belt (Fries 1913 p. 126); Nirjijaure (Sm: U); Måskokaise NE slope near Pältsajokk at 700 m (Sm: U).

**Carex aquatilis** var. **stans** Drej.

Between Nirjijaure and the Norwegian border in marshes 800 m (Sm: U); Pältsa N slope of N part in a fen 900 m (Sm: U).

**Carex vaginata** Tausch.

Subalpine to middle-alpine belt (550—1080 m). Appears to be indifferent to lime and to snow-protection in winter. — Upper birch-forest; on the esker 1 km NW of the Pältsa hut; Pältsa (CPL: U); S Peak SE slope; Low Peak W slope 1080 m; Måskokaise cirque 5 at 930 m; Måskokaise cirque 7 at 800 m; SW of Måskojaure; Veigematto E slope 750 m.

**Carex magellanica** Lam.

Upper birch-forest along Nirjijokk (Sm: U).

**Carex rariflora** (Wg) Sm.

Low-alpine belt, to 850 m, in fens. — Kummajärvi, Nirjijaure (Fries & Mårtenson 1910 p. 61); near the outlet from Nirjijaure (Sm: U); along Nirjijokk (R: S); Pältsa SE slope 850 m (Sm: U); High Peak N slope 850 m (Sm: U); Måskokaise (CPL: U; A & T: U).

**Carex adelostoma** V. Krecz.

Pältsa, lower part of N slope (Jalas 1949 p. 93); Gapojaure (R: S); in the ravine E of Gapovare (Sm: U).

**Carex holostoma** Drej.

On the mountain between Tuipal and Gapovare (and two more Swedish localities further eastwards, Jalas 1949); NW-Tuipal 700 m (R: S); Paras S part (Sm: U). Cf. also Nygren 1936.

**Carex norvegica** Retz.

Low-alpine and middle-alpine belts, to 1200 m. — Lassivare (J: U); Gåbnetjåkko, Pältsa (Fries & Mårtenson 1910 p. 60); S Peak SE slope near Nirjijokk (Sm: U); Low Peak W slope 1100 m in *Polygonum viviparum - Potentilla Crantzii* meadow (H: U); at Kummajokk (=Nirjijokk) below Pältsa, Måskokaise, Tjårrokaise (Tengwall & Alm 1920 p. 235); Måskokaise SE slope 800 m and 1200 m (Sm: U).

**Carex atrata** L.

Low-alpine belt, in meadows. Seems to need good snow-protection in winter and soil rich in lime. Lassivare (J: U); S Peak SE slope 850 m; S Peak SE slope near Nirjijokk (Sm: U); Pältsa (CPL: U); Pältsavagge 900 m (Sm &

J: U; Ht: U); Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 235); Måskokaise below cirque 7.

**Carex atrata × norvegica**

Lassivare (J: U); between Gapojaure and Nirjivare (Sm: U); at Nirjijokk (R: S); S Peak SE slope at an old camp site near Nirjijokk (Sm: U); Pältsavagge (FRIES & MÅRTENSON 1910 p. 60; A & T: U); S part of the col between High Peak and Low Peak at 1100 m (H: U).

**Carex bicolor** ALL.

SW part of the col between S Peak and Middle Peak at 1200 m (Sm & J: U); Pältsa N slopes of N part (Sm: U).

**Carex misandra** R. BR.

Low-alpine and middle-alpine belts (850—1200 m). Calcicole. Needs no snow-protection in winter, occurring in *Nardino-Dryadetum* (cf. p. 58), but seems to require some irrigation. — SW of Nirjijaure; S Peak E slope 1200 m (A & T: U; Sm: U); S Peak SE slope 850 m; Middle Peak (Sm: U); Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak NE slope (NORDHAGEN 1939 p. 694); Low Peak W slope 1100 m in *Nardino-Dryadetum* and *Tomenthypno-Dryadetum*; Pältsavagge (Ht: U); Måskokaise cirque 5 at 930 m; Måskokaise below cirque 7 at 850 m.

**Carex atrofusca** SCHKUHR

Less common in the district than the preceding; calcicole. — Pältsa (CPL: U; A & T: U); Pältsavagge (Ht: U; Sm: U); Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 236).

**Carex glacialis** MACK.

Low-alpine belt to 875 m, on wind-swept ground with little or no snow cover in winter, calcicole. Characteristic species of *Nardino-Dryadetum* (cf. p. 60). — S Peak SE slope 800—850 m (A & T: U; Sm: U); Middle Peak S slope 875 m; Måskokaise (TENGWALL & ALM 1920 p. 235).

**Carex capillaris** L.

Low-alpine belt (800—930 m). Calcicole, needs no snow-protection in winter, often occurring in *Nardino-Dryadetum* (cf. p. 62). Appears to benefit from slight irrigation. The taxonomic position of this alpine ecotype is insufficiently known (cf. SELANDER 1950 b, p. 9). — S Peak SE slope 850 m (Sm: U); Middle Peak S slope in *Nardino-Dryadetum* 875 m; Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 800 m; Tjårrokaise (TENGWALL & ALM 1920 p. 235).

**Carex rostrata** STOKES

Kumma eno, Pältsa (TENGWALL & ALM 1920 p. 235).

**Carex rotundata** Wg

Gapovare E slope in mires (Sm: U).

**Carex saxatilis** L.

Low-alpine belt, in fens. — Gåbnetjåkko, Pältsa (Fries & Mårtenson 1910 p. 61); SW of Nirjijaure (Sm: U); Måskokaise SE slope 800 m (Sm: U); Tjårrokaise (Tengwall & Alm 1920 p. 235).

**Carex vesicaria** L. var. **alpigena** Fr.

The taxonomic position of this plant is yet insufficiently known, cf. e.g. Selander 1950 b, p. 10). — In the birch-forest at Nirjijokk below Pältsa (Tengwall & Alm 1920 p. 235); Pältsa (Fries & Mårtenson 1910 p. 61); Måskokaise (Jalas 1949 p. 74); Mt Paras S slope 800 m (Sm: U).

**Juncus arcticus** Willd.

Upper birch-forest below the waterfall in Nirjijokk (Ö).

**Juncus filiformis** L.

S Peak S slope (Ö).

**Juncus triglumis** L.

Pältsa 1000 m (A & T: U); Måskokaise (Tengwall & Alm 1920 p. 236).

**Juncus biglumis** L.

Low-alpine and middle-alpine belts to 1150 m. Mostly on wet soil rich in lime. — SW of Nirjijaure; Low Peak NE slope 1050—1150 m (Nordhagen 1939 p. 694); Low Peak NE slope 1100 m; Pältsavagge (Fries 1913 p. 115); Måskokaise on the ridge between cirque 3 and 4 at 930 m.

**Juncus trifidus** L.

Low-alpine and middle-alpine belts (600—1080 m). Appears to be indifferent to lime and to snow-protection in winter. — Gåbnetjåkko E slope (Wahlenberg's diary 4.7.1800); on the esker 1 km NW of the Pältsa hut in *Empetrion, Myrtillion* and meadow willow-scrub (cf. p. 66); S Peak SE slope 850 m; Low Peak W slope 1080 m in *Nardino-Dryadetum*; upper Pältsavagge 900 m; Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope 1050 m.

**Luzula pilosa** (L.) Willd.

Subalpine belt. — In the upper birch-forest E of the Pältsa hut.

**Luzula parviflora** (Ehrh.) Desv.

Subalpine and low-alpine belts to 950 m; on moist ground. — Gåbnetjåkko in the subalpine belt (J: U); S Peak NE side 850 m (Sm: U); Pältsa NE slopes 950 m (Sm: U); Pältsavagge along streamlet in a fen (Sm: U).

**Luzula wahlenbergii** RUPR.

Low-alpine and middle-alpine belts to 1100 m, on moist ground. — Pältsa N slopes of N part 900 m (Sm: U); Måskokaise (CPL: U); Måskokaise 1000 m (Sm: U); Måskokaise E slope 1100 m (Sm: U).

**Luzula arcuata** (WG) SW. (including L. **confusa** LINDEB.)

Low-alpine to high-alpine belt (to 1517 m). One of the most important vascular plants of the high-alpine belt, reaching the highest summits. Seems to be indifferent to lime and to snow-protection in winter. — Gapovare, Tjuosmir (FRIES & MÅRTENSON 1910 p. 66); SW of Nirjijaure; Low Peak NE slope 950—1290 m in *Tomenthypno-Dryadetum, Nardino-Dryadetum* etc.; Pältsavagge (FRIES 1913 p. 118); High Peak NE slope 850 m (Sm: U); High Peak at the summit 1517 m; Måskokaise E slope 1100 and 1300 m (Sm: U); Måskokaise SE slope 930—1495 m; Måskokaise below cirque 7 at 1000 m; Tjårrokaise (J: U); Paras S slope at 1100 and 1415 m.

**Luzula arctica** BLYTT

Mainly in the middle-alpine belt (900—1200 m). Calcicole, on irrigated soil, preferably on N-exposed slopes (cf. p. 62 above and SELANDER 1950 b, p. 62). — S Peak E slope 1100 m (Sm: U); Middle Peak NE slope 1000 m (Sm: U); Low Peak N slope 1100 m (RN: U) and 1030 m (H: U); Low Peak N slope 900—1100 m in *Tomenthypno-Dryadetum*; Pältsa N slopes of N part at 1100 and 1200 m (Sm: U; R: S); Måskokaise (LAESTADIUS 1860; A & T: U).

**Luzula multiflora** (RETZ.) LEJ. ssp. **frigida** (BUCH.) V. KRECZ.

Low-alpine belt (600—900 m). — Nirjivare (Sm: U); on the esker 1 km NW of the Pältsa hut at 600 m; Pältsa N slopes of N part 850 m (Sm: U); Pältsavagge (FRIES 1913 p. 115); Måskokaise SE slope 900 m (Sm: U); SW of Måskojaure.

**Luzula spicata** (L.) DC.

Low-alpine to middle-alpine belt (600—1200 m). Indifferent to lime. — Gåbnetjåkko (WAHLENBERG's diary 4.7.1800); on the esker 1 km NW of the Pältsa hut in *Empetrion*; Pältsa (CPL: U); S Peak SE slope 850 m; Middle Peak 1200 m (R: S); Low Peak NE slope (NORDHAGEN 1939 p. 694); Low Peak NE slope 1050 m; Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure.

**Tofieldia pusilla** (MICHX) PERS.

Subalpine to middle-alpine belt (550—1080 m). Calcicole, mainly occurring on solifluxion terraces with little snow-protection in winter. — In a fen in the upper birch-forest; SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak W slope 1080 m in *Tetragono-Dryadetum*; lower Pältsavagge (RK p. 321); Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7.

**Chamorchis alpina** (L.) L. C. RICH.

Low-alpine belt to 1000 m. On solifluxion terraces with little snow-protection in winter, calcicole. — Nirjivare W slope (Sm: U); Pältsa 1000 m (A & T: U); S Peak SE slope 800 and 900 m (Sm: U; R: S); Middle Peak S slope on solifluxion terrace in *Nardino-Dryadetum* at 875 m; Pältsa: two localities on the NE slopes (JALAS 1949 p. 94).

**Leucorchis albida** (L.) E. MEY.

Low-alpine belt; calcicole. — S Peak SE slope 850—950 m (Ht: U; Sm: U; R: S; cf. JALAS 1949 p. 94).

**Coeloglossum viride** (L.) HARTM.

Low-alpine belt to 800 m. — Kummajärvi (FRIES & MÅRTENSON 1910 p. 62); S Peak SE slope 800 m (Ht: U; Sm: U); Pältsa NE slope (JALAS 1949 p. 94).

**Corallorrhiza trifida** CHÂT.

S Peak SE slope in very moist meadow 700 m (Sm: U).

**Populus tremula** L.

Subalpine belt. — In birch-forest a little above the waterfall in Nirjijokk near the Pältsa hut (Sm: U).

**Salix reticulata** L.

Low-alpine and middle-alpine belts (550—1180 m). Calcicole, indifferent to snow-protection in winter. — Fen in upper birch-forest 550 m; Nirjivare (WAHLENBERG 1812 p. 262); SW of Nirjijaure; Pältsa (CPL: U); S Peak SE slope 850 m; Low Peak N slope 950 m and NE slope 1100 m in *Tomenthypno-Dryadetum*; Low-Peak E slope 1080 m in *Nardino-Dryadetum* and *Tetragono-Dryadetum*; Low-Peak W slope 1180 m; High Peak E slope 1060 m; Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 800 m; Veigematto E slope 750 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 72); Tjårrokaise (TENGWALL & ALM 1920 p. 237).

**Salix herbacea** L.

Subalpine to high-alpine belt (550—1450 m). Indifferent to snow-protection in winter, and more or less indifferent to lime, though on calcareous soil largely replaced by *S. polaris*. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Empetrion, Myrtillion* and *Deschampsio-Anthoxanthion*; Nirjivare NE slope (Sm: U); Pältsa (CPL: U); Low Peak W slope 1180 m in *Nardino-Dryadetum*; Low Peak summit 1290 m; High Peak E slope 1385 m; Pältsavagge (FRIES 1913 p. 73); lower Pältsavagge (RK p. 321); Måskokaise on the ridge between cirque 3 and 4 at 930—1450 m; Måskokaise SE slope 1425 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope 1360 m.

**Salix herbacea** × **lanata**

Pältsa (CPL: U, det. S. J. ENANDER).

**Salix herbacea** × **polaris**

Pältsa (FRIES & MÅRTENSON 1910 p. 71); Pältsa W slope (FRIES 1913 p. 92).

**Salix polaris** WG

Low-alpine to high-alpine belt (750—1250 m). Calcicole, indifferent to snow-protection in winter. — SW of Nirjijaure; Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); Low Peak N slope 950 m in *Tomenthypno-Dryadetum*; Low Peak W slope 1180 m in *Nardino-Dryadetum* and *Tetragono-Dryadetum*; High Peak NE slope 1100 and 1250 m; lower Pältsavagge (RK p. 321); upper Pältsavagge 900 m; Måskokaise towards the innermost part of Pältsavagge (Sm: U); Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 800 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 72); Veigematto E slope 750 m on dolomitic limestone; Tjårrokaise (TENGWALL & ALM 1920 p. 237); Paras S slope 1170 m.

**Salix myrsinites** L.

Subalpine and low-alpine belts, calcicole. — Fen in the upper birch-forest; SW of Nirjijaure; Pältsavagge (FRIES & MÅRTENSON 1910 p. 71); Pältsa, Måskokaise (TENGWALL & ALM 1920 p. 237); Veigematto E slope 750 m on dolomitic limestone.

**Salix glauca** L. ssp. **eu-glauca** HYL.

Subalpine and low-alpine belts. Indifferent to lime, appears to need snow-protection in winter. — Gåbnetjåkko N slope in the subalpine belt (FRIES 1913 p. 126); upper birch-forest E of the Pältsa hut at 550 m; on the esker 1 km NW of the hut at 600 m; SW of Nirjijaure; Pältsa S end 800 m (Sm: U); S Peak SE slope 850 m; SW of Måskojaure.

**Salix phylicifolia** L. ssp. **Weigeliana** (WIMM.) HERIB. N.

Subalpine belt, ascending a little in the lower part of the low-alpine belt. — Gåbnetjåkko N slope in the subalpine belt (FRIES 1913 p. 126); upper birch-forest above the waterfall in Nirjijokk 600 m (Sm: U); on the esker 1 km NW of the Pältsa hut; SW of Måskojaure 600 m.

**Salix arbuscula** L.; SM.

Pältsa (LAESTADIUS 1860; TENGWALL & ALM 1920 p. 237).

**Salix hastata** L.

S Peak SE slope 850 m.

**Salix hastata** × **herbacea**

Pältsa (CPL: U, cf. LAESTADIUS 1860).

**Salix lanata** L. ssp. **eu-lanata** HYL.

Low-alpine and middle-alpine belts to 1170 m. — SW of Nirjijaure; S Peak SE slope 850 m; Low Peak NE slope 1050 m; Måskokaise on the ridge between

cirque 3 and 4 at 930 m; SW of Måskojaure 600 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 71); Tjårrokaise (TENGWALL & ALM 1920 p. 237); Paras S slope 1170 m.

**Salix lapponum** L.

Gåbnetjåkko N slope in the subalpine belt (FRIES 1913 p. 126).

**Betula tortuosa** LED.

Forest-forming in the valley of Nirjijokk—Kummaeno up to a few 100 m from the Pältsa hut. An isolated patch of birch-forest also occurs on the W slope of Tuipal towards Lassivare. Spalier-shaped *Betula tortuosa* - shrubs are not uncommon in *Myrtillion* communities on the esker. One small shrub was further observed on the S slope of the S Peak at 840 m, and one seedling 6 cm tall on the S side of Paras at 1170 m.

**Betula callosa** NOTÖ × **tortuosa** LED.

Upper birch-forest on several places as solitary specimens (Sm: U; det. B. LINDQUIST).

**Betula (callosa × tortuosa) × nana** L.

Upper birch-forest, shrub about 1 m tall (Sm: U; det. B. LINDQUIST).

**Betula nana** L.

Subalpine and low-alpine belts to 930 m. Indifferent to lime and snow-protection in winter. — Upper birch-forest; on the esker 1 km NW of the Pältsa hut in *Empetrion, Myrtillion* and meadow willow-scrub; SW of Nirjijaure; Lassivare (RK p. 320); Middle Peak S slope in *Nardino-Dryadetum* 875 m; lower Pältsavagge (RK p. 318); upper Pältsavagge 900 m; Måskokaise on the ridge between cirque 3 and 4 at 930 m; SW of Måskojaure.

**Rumex acetosa** L. ssp. **lapponicus** HIIT.

Low-alpine belt to 930 m. Requires moderate to good snow-protection in winter. — On the esker 1 km NW of the Pältsa hut in *Myrtillion* and *Deschampsio-Anthoxanthion*; Nirjivare E slope (Sm: U); SW of Nirjijaure; lower Pältsavagge (RK p. 320); Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 750 m; SW of Måskojaure; Paras S slope 915 m.

**Rumex acetosella** L., coll.

The present author does not find it possible to distinguish in herbarium specimens between this species and *R. tenuifolius* (WALLR.) LÖVE; cf. HYLANDER 1945 a p. 133. — Low-alpine belt, introduced. — S Peak S end at an old camp site near Nirjijokk (Sm: U); at the Pältsa hut (H: U).

**Oxyria digyna** (L.) HILL

Low- and middle-alpine belts (600—1200 m). Indifferent to lime; appears to need good snow-protection in winter and irrigation in summer. — SW of

Nirjijaure; Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); lower Pältsavagge (RK p. 320); upper Pältsavagge (RK p. 319); Måskokaise on the ridge between cirque 3 and 4 at 930 and 1200 m; Måskokaise below cirque 7 at 800 and 1000 m; SW of Måskojaure 600 m; Paras S slope 1170 m.

**Polygonum viviparum** L.

Subalpine to middle-alpine belt (550—1180 m). Appears to be indifferent to lime and to snow-protection in winter. — Fen in the upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Myrtillion*; Lassivare (RK p. 320); SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak N slope 950 m in *Tomenthypno-Dryadetum*; Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); Low Peak W slope 1080 and 1180 m in *Nardino-Dryadetum*; lower and upper Pältsavagge (RK p. 320, 321); Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 1000 m; SW of Måskojaure; Paras S slope 1175 m.

**Stellaria nemorum** L. ssp. **montana** (PIERRAT) MURB.

Upper part of the birch-forest in willow shrubs at 500 m (Sm: U).

**Stellaria media** (L.) VILL.

At the Pältsa hut; introduced (H: U).

**Stellaria graminea** L.

In the birch-forest below the Pältsa hut c. 500 m (Sm: U).

**Stellaria calycantha** (LED.) Bong.

Subalpine and low-alpine belts (550—800 m). — In the upper birch-forest close to the waterfall in Nirjijokk 550 m (Sm: U); on the esker 1 km NW of the Pältsa hut in *Myrtillion*; Pältsavagge 800 m (Sm: U).

**Stellaria crassipes** HULTÉN (cp. HULTÉN 1943)

Middle-alpine belt, on moist, schistaceous, solifluxion ground (cf. NORDHAGEN 1939 p. 693). — Low Peak NE slope 1050—1150 m (RN: U; Sm: U); col between S Peak and Middle Peak at 1200 m (Sm & J: U); Middle Peak E slope 1200 m (Sm: U).

**Cerastium cerastoides** (L.) BRITTON

Lower Pältsavagge (RK p. 320); Måskokaise below cirque 5 on solifluxion terrace 870 m (H: U).

**Cerastium edmondstonii** (WATS.) MURB. & OSTF.

Low-alpine to high-alpine belt (870—1300 m). Indifferent to snow-protection in winter. — SW of Nirjijaure; S Peak N slope 1300 m (Sm: U); Middle Peak E slope 1000 m; Middle Peak NW slope 1200 m (Sm: U); Low Peak NE slope 1070 m in *Tomenthypno-Dryadetum*; Low Peak W slope 1180 m

in *Nardino-Dryadetum*; Pältsa NE slope 1200—1300 m (Sm: U); Pältsa N slopes of N part (Sm: U); Pältsavagge (FRIES & MÅRTENSON 1910 p. 62); High Peak NE slope 1250 m; Måskokaise below cirque 5 on solifluxion terrace 870 m; Måskokaise SE valley 1200 m (Sm: U).

**Cerastium edmondstonii** f. **glabrum** (TH. FR. JR.) HYL.

Måskokaise SE valley 1000 m (Sm: U).

**Cerastium alpinum** L.

Low-alpine to high-alpine belt (600—1350 m). Seems to be more or less indifferent to snow-protection in winter. — On the esker 1 km NW of the Pältsa hut; SW of Nirjijaure; S Peak SE slope 850 m; Pältsa NE slopes 1350 m (Sm: U); Low Peak NE slope 950 and 1050 m (H: U, cf. NORDHAGEN 1939 p. 694); Low Peak W slope 1100 m in *Tomenthypno-Dryadetum*; lower and upper Pältsavagge (RK pp. 320, 321); Måskokaise on the ridge between cirque 3 and 4 at 930 and 1330 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Tjårrokaise (TENGWALL & ALM 1920 p. 235); Paras S slope 1200 m.

**Cerastium alpinum** var. **lanatum** (LAM.) HEGETSCHW.

Middle Peak S slope 875 m, wind-exposed scree; Low Peak near the summit 1290 m (H: U); Måskokaise (TENGWALL & ALM 1920 p. 235).

**Cerastium alpinum** var. **glabrum** RETZ.

Pältsa (CPL: U, cf. FRIES & MÅRTENSON 1910 p. 61); Pältsa S part at Pältsajokk (Sm: U); Måskokaise (TENGWALL & ALM 1920 p. 235); Måskokaise E slope 950 m (Sm: U); SW of Måskojaure 600 m.

**Cerastium alpinum** × **edmondstonii.**

Pältsa S end at Pältsajokk (Sm: U); Pältsa NE slopes 1300 and 1350 m (Sm: U).

**Cerastium fontanum** BAUMG. ssp. **scandicum** GARTNER

Subalpine to lower low-alpine belt. — Upper birch-forest; on the esker 1 km NW of the Pältsa hut in meadow willow-scrub; at the edge of a fen SSE of Lassivare (Sm: U).

**Sagina caespitosa** (J. VAHL) LGE

Middle-alpine and high-alpine belts (1050—1300 m), on moist, N-exposed slopes. Calcicole. — S Peak N slope 1300 m (Sm: U); Low Peak NE slope on irrigated schistaceous soil 1050—1150 m (RN: U, cf. NORDHAGEN 1939 p. 694); Pältsa N slopes of N part 1200 m (Sm: U); Måskokaise SE valley at 1100 m (Sm: U).

**Sagina intermedia** FENZL

Low-alpine to high-alpine belt (750—1300 m). — Tjuosmir, Gapovare (FRIES & MÅRTENSON 1910 p. 71); Pältsa NE slopes on long snow-covered,

sandy shore of rivulet 1300 m (Sm: U); Måskokaise SE valley 1100 m (Sm: U); Måskokaise below cirque 7 at 750 m.

**Sagina saginoides** (L.) KARST.

Subalpine to middle-alpine belt (550—1200 m). — Upper birch-forest; Pältsavagge (FRIES & MÅRTENSON 1910 p. 71); Pältsa, Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 237); S Pältsa 1200 m (R: S); Måskokaise SE valley at 900 m (Sm: U).

**Minuartia rubella** (WG) HIERN

Mainly in the middle-alpine belt (950—1200 à 1300 m); calcicole. — Pältsa S slope 1200 m (A & T: U); S Peak W slope 1100 m (Sm: U); Pältsa E slope 1000 m (Sm: U); Pältsa NE slope 1200 à 1300 m (Sm: U); Middle Peak E slope 1100 m (Sm: U); col between Middle Peak and Low Peak (Sm: U); Low Peak NE slope 1100 m (RN: U, cf. NORDHAGEN 1939 p. 694); col between High Peak and Low Peak at 1150 m (H: U); Måskokaise SE valley 950 m (Sm: U); Tjårrokaise (TENGWALL & ALM 1920 p. 234).

**Minuartia stricta** (SW.) HIERN

Low-alpine and middle-alpine belts (750—1200 m). Calcicole. — SW of Nirjijaure; S Pältsa 900 m (R: S); S Peak W side 1100 m (Sm: U); col between S Peak and Middle Peak at 1000 m (Sm: U); Middle Peak S slope 850 m; col between Middle Peak and Low Peak (Sm: U); Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); Pältsa NE slopes 1200 m (Sm: U); Måskokaise on the ridge between cirque 3 and 4 at 930 m.

**Minuartia biflora** (L.) SCH. & TH.

Low-alpine to high-alpine belt (600—1300 m). — Gåbnetjåkko N slope (Ht: U); SW of Nirjijaure; S Peak W slope 1100—1200 m (Sm: U); Middle Peak SE slope 850 m; Middle Peak S side 1250 m (Sm: U); Low Peak NE slope 1050—1100 m in *Dryadion*; Pältsa NE slope 1300 m on sandy shore of rivulet (Sm: U); Pältsavagge (FRIES 1913 p. 115); High Peak E slope 1060 m in *Dryadion*; Måskokaise on the ridge between cirque 3 and 4 at 930 m and 1300 m; Måskokaise SE valley (Sm: U); SW of Måskojaure 600 m; Paras S slope 1170 m.

**Viscaria alpina** (L.) G. DON

Low-alpine belt (600—850 m). Appears to be more or less indifferent to snow-protection in winter and lime content of the soil, but sensitive to competition. — Gåbnetjåkko (f. fl. alb., J: U); on the esker 1 km NW of the Pältsa hut in *Empetrion* and *Myrtillion*; SW of Nirjijaure; Nirjivare S slope (Sm: U); S Peak SE slope 850 m; lower and upper Pältsavagge (RK p. 320—321); SW of Måskojaure 600 m.

**Silene acaulis** JACQ.

Low-alpine to high-alpine belt (800—1380 m). Needs no snow-protection in winter, but seems to require some lime in the soil. — SW of Nirjijaure;

S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak N slope 950 and 1070 m in *Tomenthypno-Dryadetum* etc. (H; cf. NORDHAGEN 1939 p. 694); Low Peak W slope 1080—1290 m in *Tetragono-Dryadetum*; lower and upper Pältsavagge (RK pp. 320—321); High Peak NE slope 1050 m and 1250 m; Måskokaise on the ridge between cirque 3 and 4 at 930 and 1050 m; Måskokaise below cirque 7 at 800 and 1000 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 73); Veigematto E slope; Tjårrokaise (TENGWALL & ALM 1920 p. 238); Paras S slope 1380 m.

**Melandrium rubrum** (WEIG.) GARCKE

Subalpine and low-alpine belts (550—900 m), in meadows. — Upper birch-forest at 550 m; S Peak E slope 900 m (Sm: U); Måskokaise W of cirque 7 at 760 m.

**Melandrium apetalum** (L.) FENZL

Low-alpine and middle-alpine belts (780—1030 m), in meadows etc. on irrigated soil with moderate snow-cover in winter. — Nirjivare (Sm: U); S Peak SE slope 850 m; Pältsa SE slope 850 m (Sm: U); Pältsa E slope (Sm: U); Low Peak N slope 1030 m; Low Peak NE slope (NORDHAGEN 1939 p. 694); Low Peak NW slope towards Nirjijaure (RK p. 322); Måskokaise on the ridge between cirque 3 and 4 at 930 m; Måskokaise below cirque 7 at 780 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 74).

**Thalictrum alpinum** L.

Subalpine to middle-alpine belt (550—1180 m). Indifferent to snow-protection in winter. — Fen in the upper birch-forest; on the esker 1 km NW of the Pältsa hut in meadow willow-scrub; SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak NE slope 1070 m in *Dryadion*; Low Peak W slope 1080 and 1180 m in *Nardino-Dryadetum*; lower Pältsavagge (RK p. 320); High Peak E slope 1050 m; Måskokaise below cirque 4 at 930 m; Måskokaise below cirque 7 at 900 m.

**Thalictrum alpinum** f. **pallidum** NORM.

Pältsa (JALAS 1949); High Peak E slope 1050 m.

**Caltha palustris** L.

Subalpine and low-alpine belts (550—900 m), along streams and lakes. — Upper birch-forest 550 m; lower Pältsavagge (RK p. 321); Pältsavagge 900 m (Sm: U); SE of Måskojaure 600 m.

**Trollius europaeus** L.

Subalpine and low-alpine belts (550—915 m); in high-grown meadows with good snow-protection in winter and irrigation in summer. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut; SW of Nirjijaure; S Peak SE slope 850 m; lower and upper Pältsavagge (RK p. 321); Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Veigematto E slope 750 m; Paras S slope 915 m.

**Ranunculus confervoides** (Fr.) Fr.

Nirjijaure 756 m (R: S).

**Ranunculus glacialis** L.

Low-alpine to high-alpine belt (930—1500 m), predominantly on irrigated soil melting out late. One of the most important species of the high-alpine belt. — Kummajärvi, Veigematto, Tjuosmir (Fries & Mårtenson 1910 p. 70); Low Peak 1180 m in *Nardino-Dryadetum*; Low Peak NE slope 1030—1290 m (cf. Nordhagen 1939 p. 694); Pältsavagge (Fries 1913 p. 118); High Peak NE slope 1285 m; Måskokaise below cirque 4 at 930 m; Måskokaise SE slope 1300—1500 m; Måskokaise below cirque 7 at 900 m; Tjårrokaise (Tengwall & Alm 1920 p. 237); Paras summit 1415 m.

**Ranunculus hyperboreus** Rottb.

In a fen SSE of Lassivare at 700 m (Sm: U); lower Pältsavagge (RK p. 320).

**Ranunculus pygmaeus** Wg

Low-alpine to high-alpine belt (to 1340 m), on irrigated soil melting out late. — Nirjivare (Sm: U); Pältsavagge (Fries 1913 p. 118); High Peak NE slope 1250 m; Måskokaise towards Pältsavagge (Sm: U); Måskokaise on the ridge between cirque 3 and 4 at 1300 and 1340 m; Paras S slope 1070 m.

**Ranunculus nivalis** L.

Low-alpine and middle-alpine belts (600—1250 m), on similar localities as the preceding. — SW of Nirjijaure; S Peak SE slope 850 m; Pältsavagge 1000 m (Sm: U); lower and upper Pältsavagge (RK p. 320—321); High Peak NE slope 1250 m; Måskokaise on the ridge between cirque 3 and 4 at 1050 m; Måskokaise SE slope 1000 m (Sm: U); Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Paras S slope 1170 m.

**Ranunculus nivalis** × **pygmaeus**

Måskokaise SE slope 1000 m (Sm: U).

**Ranunculus auricomus** L.

Pältsa NE slope (Jalas 1949 p. 94).

**Ranunculus acris** L. ssp. **boraeanus** (Jord.) R. & F.; Hyl.

Subalpine and low-alpine belts (550—1000 m); seems to require good snow-protection in winter and some irrigation in summer. — Upper birch-forest; SW of Nirjijaure; S Peak SE slope 850 m; Pältsa NE slopes 1000 m (Sm: U); lower and upper Pältsavagge (RK p. 320—321); Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope.

**Ranunculus acris** ssp. **boraeanus** var. **glabriusculus** (Rupr.)

Pältsa N slope 900 m (Sm: U); Måskokaise E slope 900 m (Sm: U).

**Ranunculus repens** L. var. **fistulosus** ROSEND.

In the birch forest below the Pältsa hut at 500 m (Sm: U).

**Papaver laestadianum** NORDH. (cf. NORDHAGEN 1931)

Mainly in the middle-alpine belt (900—1300 m) on moist ground sloping north (cf. LAESTADIUS 1860). Calcicole. Occurs all over the N slopes of Pältsa from S Peak to High Peak. — S Pältsa (R: S); S Peak NE slope (JALAS 1949 p. 95); Middle Peak (Sm: U); Low Peak NE slope on irrigated schistaceous soil (NORDHAGEN 1939 p. 694); Low Peak W slope 1200 m and N slope 1050 m; High Peak E slope 1150 m; High Peak N slope 900 m (Sm: U); Pältsa NE slope 1300 m (Sm: U).

**Draba norvegica** GUNN.

S Peak W side 1100—1200 m (Sm: U); S part of the col between Middle Peak and Low Peak (Sm: U); High Peak N slope 950 m.

**Draba hirta** L.; O. E. SCHULZ

Low-alpine to high-alpine belt (900—1300 m), calcicole. — S Peak SE slope 850 m; S Peak W side 1100—1200 m (Sm: U); col between S Peak and Middle Peak at 1300 m (Sm: U); col between Middle Peak and Low Peak (Sm: U); Pältsa E side 900 m (Sm: U); Pältsa on the slope towards Måskokaise at 1000 m (Sm: U); Måskokaise towards Pältsavagge (Sm: U).

**Draba lactea** ADAMS

Low-alpine and middle-alpine belts (900—1300 m), calcicole. — S Peak W slope 1100—1200 m (Sm: U); S Peak NE slope (Ö); col between S Peak and Middle Peak at 1300 m (Sm: U); Pältsa E side 900 m (Sm: U); Pältsa NE slopes 1200 m (Sm: U); Low Peak NE slope 1050 m (H: U; cf. NORDHAGEN 1939 p. 694); N Pältsa 1100 m (R: S); Måskokaise on the ridge between cirque 3 and 4 at 1050 m.

**Draba lactea** × **nivalis**

Pältsa NE part (JALAS 1949 p. 95).

**Draba lactea** × **norvegica**

Pältsa (TENGWALL & ALM 1920 p. 236).

**Draba fladnizensis** WULF.

Low-alpine to high-alpine belt (800—1300 m); calcicole, mainly occurring in *Dryadion*. Many specimens are almost entirely glabrous. — S Peak E slope 1300 m (Sm: U, cf. JALAS 1949 p. 95); Pältsa E slope in *Dryadion* at 950 and 1000 m (Sm: U); Pältsa NE slopes 800 and 1200 m (Sm: U); N Pältsa 1250 m (R: S); col between Low Peak and High Peak at 1050 m (H: U); Måskokaise towards inner part of Pältsavagge at 1000 m (Sm: U); Måskokaise SE valley at 1000 and 1100 m (Sm: U); Tjårrokaise 1200 m in *Dryadion* (TENGWALL & ALM 1920 p. 235, A & T: U).

**Draba fladnizensis × lactea**

Pältsa 1200 m (A & T: U, cf. TENGWALL & ALM 1920 p. 235, det. E. EKM.).

**Draba fladnizensis × nivalis**

Pältsa (CPL: U; T & A: U); Pältsa E side 900 m (Sm: U); Pältsa NE slope (JALAS 1949 p. 95); N Pältsa 1250 m (R: S); Tjårrokaise 1200 m in *Dryadion* (TENGWALL & ALM 1920 p. 235, A & T: U).

**Draba nivalis** LILJEBL.

Low-alpine and middle-alpine belts (950—1300 m), calcicole, on ground with little or no snow-protection in winter, mainly in *Dryadion*. — S Peak E side 1300 m (Sm: U); S Peak W side (Sm: U); Pältsa E side in *Dryadion* at 950 and 1000 m (Sm: U); Low Peak NW slope 1050 m in *Dryadion*; N Pältsa 1250 m (R: S); Tjårrokaise 1200 m in *Dryadion* (TENGWALL & ALM 1920, A & T: U); Paras S slope 1180 m.

**Draba alpina** L.

Mainly in the middle-alpine belt (900—1250 m), in snow-beds on calcareous soil. — Pältsa 1250 m (T & A: U); S Peak S slope (Ö); Pältsa E side 1200 m (Sm: U); Pältsa NE slope on long snow-covered schistaceous ground at 950 and 1100 m (Sm: U); col between Middle Peak and Low Peak (Sm: U); Low Peak NE slope (NORDHAGEN 1939 p. 694); Low Peak NW slope 1050 m; N Pältsa 900 m (R: S).

**Draba crassifolia** GRAH.

Middle-alpine belt (1000—1100 m), in late snow-beds on soil rich in lime. — Low Peak NE slope (?) (NORDHAGEN 1939 p. 694); easternmost part of Måskokaise in a small valley at 1000—1100 m (J: U; Sm: U).

**Cardamine pratensis** L., coll.

Low-alpine and middle-alpine belts (800—1080 m). — At the stream W of Nirjijaure 800 m (Sm: U); Low Peak W slope in small, dried-out pool at 1080 m, not flowering; Pältsa NE side along a small rill 900—1000 m (Sm: U); lower Pältsavagge (RK p. 321); Måskokaise (TENGWALL & ALM 1920 p. 235); SE of Måskojaure.

**Cardamine bellidifolia** L.

Low-alpine to high-alpine belt (to 1450 m). Seems to need some irrigation. — Nirjivare (Sm: U); Low Peak NE slope 1100 m in *Tomenthypno-Dryadetum* (H; cf. NORDHAGEN 1939 p. 694); Pältsavagge (FRIES 1913 p. 118); High Peak E slope 1265 m; Måskokaise on the ridge between cirque 3 and 4 at 1250—1450 m; Måskokaise SE slope 1100 m (Sm: U) and 1440 m; Tjårrokaise (TENGWALL & ALM 1920 p. 235).

**Arabis alpina** L.

Subalpine to high-alpine belt (550—1340 m). On irrigated soil along small rills etc. — Upper birch-forest; SW of Nirjijaure; S Peak SE slope (Ht);

upper Pältsavagge (RK p. 321); High Peak E slope 1050 m; Måskokaise on the ridge between cirque 3 and 4 at 1300 and 1340 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Tjårrokaise (TENGWALL & ALM 1920 p. 235).

**Braya linearis** ROUY

Middle Peak on the S slope towards Pältsavagge, only 1 specimen seen (A. NYGREN, Aug. 1949).

**Sedum rosea** (L.) SCOP.

Low-alpine and middle-alpine belts (600—1180 m). Appears to be indifferent to lime and to snow-protection in winter but seems to need some irrigation. — SW of Nirjijaure; S Peak SE slope 850 m; Low Peak 1180 m in *Nardino-Dryadetum*; lower Pältsavagge (RK p. 320); High Peak E slope 1060 m; Måskokaise below cirque 5 at 970 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Veigematto E slope 750 m; Paras S slope 1170 m.

**Parnassia palustris** L.

Subalpine and low-alpine belts (550—900 m) in irrigated meadows with good snow-protection in winter. — Upper birch-forest at 550 m; Gåbnetjåkko (FRIES 1913 p. 126); S Peak E slope 900 m (Sm: U); lower and upper Pältsavagge (RK p. 321); Måskokaise below cirque 7 at 800 m.

**Saxifraga oppositifolia** L.

Low-alpine to high-alpine belt (750—1300 m). Calcicole, needs no snow-protection in winter. — SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope 875 m in *Nardino-Dryadetum*; Low Peak W slope 1080—1250 m in *Nardino-Dryadetum* and *Tetragono-Dryadetum*; Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); lower and upper Pältsavagge (RK p. 321); High Peak E slope 1050 m in *Dryadion*; High Peak NE slope 1250 m; Måskokaise on the ridge between cirque 3 and 4 at 1050 and 1300 m; Måskokaise SE slope 1000 m (Sm: U); Måskokaise below cirque 7 at 800 m; Veigematto E slope 750 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 72); Tjårrokaise (TENGWALL & ALM 1920 p. 237); Paras S slope 1175 m.

**Saxifraga stellaris** L.

Low-alpine belt, in irrigated snow-beds and along rills. Not common. — Lower and upper Pältsavagge (RK p. 320—321); SW of Måskojaure 600 m.

**Saxifraga foliolosa** R. BR.

Low-alpine and middle-alpine belts (900—1100 m), on irrigated ground along rills etc. — SW of Nirjijaure; Pältsa N slopes of N part at 900 and 1000 m (Sm: U); Low Peak NE slope 1100 m (H; cf. NORDHAGEN 1939 p. 694); Pältsavagge 900 m (Sm & J: U); upper Pältsavagge (RK p. 321); Måskokaise E slope 950 m (Sm: U).

**Saxifraga nivalis** L.

Subalpine to high-alpine belt (550—1340 m). — Upper birch-forest on S-exposed steep rock at 550 m; SW of Nirjijaure; S Peak 1300 m (Sm: U); Middle Peak S slope 850 m; Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); Pältsa E side 1000 m (Sm: U); Pältsa NE slopes 1100—1200 m (Sm: U); upper Pältsavagge (RK p. 321); High Peak E slope 1050 m in *Dryadion*; Måskokaise on the ridge between cirque 3 and 4 at 1050 and 1340 m; Måskokaise below cirque 5 at 930 m; Måskokaise E slope (Sm & J: U); Måskokaise below cirque 7; Tjuosmir (FRIES & MÅRTENSON 1910 p. 72); Tjårrokaise (TENGWALL & ALM 1920 p. 237); Paras S slope 1180 m.

**Saxifraga tenuis** (WG) H. SM.

Low-alpine to high-alpine belt (to 1400 m); on moist ground with more or less open vegetation. — SW of Nirjijaure; col between S Peak and Middle Peak at 1300 m (Sm: U); Middle Peak S slope 1400 m (Sm: U); Low Peak NE slope 1050—1100 m; Pältsa NE slopes 1100 m (Sm: U); Pältsavagge (Sm: U); Måskokaise E slope towards Pältsavagge at 1000 m (Sm: U); Tjårrokaise (TENGWALL & ALM 1920 p. 237).

**Saxifraga aizoides** L.

Low-alpine and middle-alpine belts (800—1100 m); on irrigated ground, preferably with some snow-protection in winter, calcicole. — SW of Nirjijaure; S Peak SE slope 850 m; Low Peak NE slope 1100 m in *Dryadion* (H; cf. NORDHAGEN 1939 p. 694); Low Peak W slope 1080 m in *Tetragono-Dryadetum*; lower and upper Pältsavagge (RK pp. 320, 321); Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; Tjårrokaise (TENGWALL & ALM 1920 p. 237).

**Saxifraga cernua** L.

Subalpine to high-alpine belt (550—1300 m). Occurs mainly on irrigated soil with open vegetation. — Upper birch-forest E of the Pältsa hut 550 m; S Peak SE slope (Ht); Low Peak NE slope 1050—1150 m (NORDHAGEN 1939 p. 694); lower and upper Pältsavagge (RK p. 321); High Peak E slope 1060 m; Måskokaise on the ridge between cirque 3 and 4 at 1300 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Veigematto E slope 750 m; Tjuosmir (FRIES & MÅRTENSON 1910 p. 72); Tjårrokaise (TENGWALL & ALM 1920 p. 237); Paras S slope 1175 m.

**Saxifraga rivularis** L.

Pältsavagge (FRIES & MÅRTENSON 1910 p. 72); lower Pältsavagge (RK p. 321); Pältsa, Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 237); Måskokaise (CPL: U; J: U).

**Saxifraga groenlandica** L.

Subalpine to high-alpine belt (550—1330 m). Indifferent to snow-protection in winter. — Upper birch-forest E of the Pältsa hut on S-exposed rock at 550 m; Gåbnetjåkko (J: U); SW of Nirjijaure; Low Peak NE slope 1050—

1150 m (NORDHAGEN 1939 p. 694); summit of Low Peak 1290 m; High Peak E slope 1050 m; Måskokaise towards Pältsavagge (Sm: U); Måskokaise on the ridge between cirque 3 and 4 at 1300 and 1330 m; Tjårrokaise (TENGWALL & ALM 1920 p. 237); Paras S slope 1170 m.

**Filipendula ulmaria** (L.) MAXIM.

Subalpine belt. — Upper birch-forest near the waterfall in Nirjijokk, 550 m (Sm: U).

**Rubus chamaemorus** L.

Low-alpine belt, not common. — On the esker 1 km NW of the Pältsa hut in *Betula nana* scrub (cf. p. 71); at the SW shore of Nirjijaure 760 m; at the small lake in Pältsavagge (Sm: U); SW of Måskojaure 600 m.

**Rubus arcticus** L.

Subalpine and low-alpine belt (500—900 m). — In a precipice in the upper part of the birch-forest along Nirjijokk 500 m (Sm: U); Veigematto E slope 900 m.

**Rubus arcticus × saxatilis**

In the upper part of the birch-forest along Nirjijokk 500 m (Sm: U).

**Rubus saxatilis** L.

Subalpine and lower part of low-alpine belt, on sunny slopes. — Upper birch-forest 550 m; Pältsa S end at Pältsajokk (Sm: U); S Peak SE slope 850 m; in a ravine E of Gapovare at 700—800 m (Sm: U); at Råsto elv SW of Måskojaure 580 m.

**Potentilla palustris** (L.) SCOP.

Subalpine and lower part of low-alpine belt, in fens. — Upper birch-forest below the waterfall in Nirjijokk 550 m (Sm: U); Gåbnetjåkko (FRIES 1913 p. 126); SW of Måskojaure 600 m.

**Potentilla nivea** L.; HULT. (cf. HULTÉN 1945)

Low-alpine and middle-alpine belts (850—1200 m), on wind-exposed places with little or no snow-protection in winter. Calcicole. — S Peak SE slope 850 m; S Peak E slope 1200 m (Sm: U); Pältsa S slope 950 m (Sm: U); S Peak W side 1100 m (Sm: U); Middle Peak S slope 875 m in *Nardino-Dryadetum* (H: U); Low Peak W slope in *Nardino-Dryadetum*; High Peak E slope in *Dryadion* 1060 m; Måskokaise below cirque 5 at 930 m; Måskokaise E slope 1100 m (Sm: U); Tjårrokaise (TENGWALL & ALM 1920 p. 237). — The closely related *Potentilla Chamissonis* HULT. has not been found in this district (cf. HULTÉN op. cit.).

**Potentilla crantzii** (CR.) G. BECK

Subalpine to middle-alpine belt (550—1200 m). Indifferent to snow-protection in winter. Occurs in different types of *Dryadion* and in irrigated meadows.

— Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in meadow willow-scrub; SW of Nirjijaure; S Peak SE slope 850 m; S Peak W slope 1100—1200 m (Sm: U); Middle Peak 1200 m (Sm: U); Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak W slope 1080 m in *Nardino-Dryadetum* and *Tetragono-Dryadetum*; Pältsavagge (Fries 1913 p. 115); upper Pältsavagge 900 m; High Peak E slope 1050 m; Måskokaise on the ridge between cirque 3 and 4 at 1050 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Tjårrokaise (Tengwall & Alm 1920 p. 237); Paras S slope 1175 m.

**Sibbaldia procumbens** L.

Low-alpine to high-alpine belt (600—1330 m). On places with good snow-protection in winter; not favoured by lime. — On the esker 1 km NW of the Pältsa hut in *Myrtillion* and *Deschampsio-Anthoxanthion*; SW of Nirjijaure; S Peak SE slope 850 m; lower Pältsavagge (RK p. 320); Måskokaise on the ridge between cirque 3 and 4 at 980 and 1330 m; SW of Måskojaure 600 m; Paras S slope 1150 m.

**Alchemilla alpina** L.

Low-alpine belt. Occurs mainly in the W part of the district, hardly reaching E of the Norwegian border. — Pältsa (Wahlenberg 1812 p. 51); Måskokaise S slope 1.5 km NE of the E part of Måskojaure (and further westwards); Tjårrokaise (Tengwall & Alm 1920 p. 234; A & T: U).

**Alchemilla borealis** Sam. in sched.

Upper birch-forest 500 m (Sm: U); S Peak S side 850 m (Sm: U); Pältsa SE slope 800 m (Sm: U). Cf. Jalas 1949.

**Alchemilla murbeckiana** Bus.

Upper birch-forest 550 m (Sm: U; H: U); S Peak E side 950 m (Sm: U); Pältsa E slope 750 m (Sm: U).

**Alchemilla wichurae** Bus.

Pältsa, Måskokaise (Tengwall & Alm 1920 p. 234); S Peak S slope 900 m (Sm: U).

**Sorbus aucuparia** L.

In the ravine E of Gapovare c. 700—800 m (Sm: U).

**Dryas octopetala** L.

Low-alpine to high-alpine belt (750—1300 m). Calcicole, on places with no or moderate snow cover in winter and no or moderate irrigation in summer. — Gåbnetjåkko, Tjuosmir (Fries & Mårtenson 1910 p. 63); Nirjivare (Wahlenberg diary 4.7.1800); SW of Nirjijaure; S Peak SE slope 850 m; S Peak W slope 1100—1200 m (Sm: U); Middle Peak S slope 875 m; Low Peak NE and W slopes 950—1290 m; lower and upper Pältsavagge (RK p. 321); High Peak NE slope 1250 m; Måskokaise on the ridge between cirque

3 and 4 at 1050 and 1300 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 and 1000 m; Veigematto E slope 750 m; Tjårrokaise (TENGWALL & ALM 1920 p. 236); Paras S slope 1175 m.

**Astragalus alpinus** L.

Subalpine to middle-alpine belt (550—1180 m). Calcicole, indifferent to snow-protection in winter. — Upper birch-forest 550 m; on the esker close to the Pältsa hut (Ö); Tuipal W slope towards Lassivare 700 m (Sm: U); SW of Nirjijaure; Pältsa S end at Pältsajokk (Sm: U); S Peak E slope 900 m (Sm: U); S Peak SE slope 850 m in *Nardino-Dryadetum* (f. fl. alb., Sm: U); Low Peak NE slope (NORDHAGEN 1939 p. 694); Low Peak N, NE and W slopes 950—1180 m in *Nardino-Dryadetum, Tetragono-Dryadetum* and *Tomenthypno-Dryadetum*; lower and upper Pältsavagge (RK p. 320, 321); Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 and 850 m; SW of Måskojaure; Veigematto E slope 750 m.

**Astragalus frigidus** (L.) A. GRAY

Low-alpine belt (750—1000 m). Calcicole, on irrigated soil. — Pältsa SE slope 700 m (Sm: U); S Peak W slope 1000 m (Sm: U); S Peak SE slope 850 m; Måskokaise below cirque 7 at 750 m; Tjårrokaise (TENGWALL & ALM 1920 p. 237).

**Oxytropis lapponica** (WG) GAUD.

Low-alpine and middle-alpine belts (850—1100 m). Calcicole, on wind-swept ridges without snow-protection in winter, esp. in *Nardino-Dryadetum*. — S Peak SE slope 850 m; Pältsa S slope 950 m (Sm: U); Middle Peak S slope 850 m in *Nardino-Dryadetum*; Pältsa E side 850 m (Sm: U); Low Peak NE slope 1100 m; Måskokaise below cirque 7 at 850 m; Tjårrokaise (TENGWALL & ALM 1920 p. 236).

**Geranium silvaticum** L.

Subalpine and lower part of low-alpine belt (550—900 m). In meadows with good snow-protection in winter and some irrigation in summer. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in meadow willow-scrub; S Peak S slope 900 m (Sm: U); lower and upper Pältsavagge (RK p. 321); Måskokaise below cirque 7 at 760 m; SW of Måskojaure.

**Viola epipsila** LED.

Pältsa, in fens on the slope near Nirjijokk (Sm: U); in a fen at the stream W of Nirjijaure (Sm: U).

**Viola biflora** L.

Subalpine to middle-alpine belt (550—1170 m). Seems to require some snow-protection in winter and some irrigation in summer. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut; S Peak SE slope 850 m; SW of Nirjijaure; Pältsavagge (FRIES 1913 p. 115); lower Pältsavagge (RK

p. 321); Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Veigematto E slope 750 m; Paras S slope 1170 m.

**Epilobium palustre** L.

Fen in the upper birch-forest 550 m; in a fen E of Lassivare 700 m (Sm: U).

**Epilobium davuricum** Fisch.

Pältsavagge, Nirjijaure, Lassivare (Fries & Mårtenson 1910 p. 63); in a fen E of Lassivare (Sm: U).

**Epilobium anagallidifolium** Lam.

Pältsa NE slopes 800 m (Sm: U); Måskokaise, Tjårrokaise (Tengwall & Alm 1920 p. 236).

**Epilobium lactiflorum** Hausskn.

Pältsa (Tengwall & Alm 1920 p. 236; T & A: U); Pältsa 950 m (Sm: U); Nirjijokk (Jalas 1949 p. 95).

**Epilobium hornemanni** Rchb.

Upper birch-forest below the Pältsa hut 500 m (Sm: U); Nirjivare (Sm: U); lower Pältsavagge (RK p. 320).

**Chamaenerion angustifolium** (L.) Scop.

Subalpine and lower part of low-alpine belt (550—700 m). Seems to require good snow-protection in winter. — Upper birch-forest in S-exposed slope 550 m; on the esker 1 km NW of the Pältsa hut; Pältsa S slope towards Pältsajokk 700 m (Sm: U); SW of Måskojaure.

**Hippuris vulgaris** L.

Nirjijaure 756 m (Sm: U).

**Cornus suecica** L.

SW of Måskojaure 600 m; 5 km E of Gapovare at 600 m (Sm: U).

**Angelica archangelica** L. ssp. **norvegica** (Rupr.) Nordh.

Low-alpine belt, on irrigated soil with good snow-protection in winter. — Lower Pältsavagge (RK p. 320); Pältsa, Måskokaise (Tengwall & Alm 1920 p. 235); SW of Måskojaure 600 m.

**Pyrola minor** L.

Low-alpine belt (600—900 m). — On the esker 1 km NW of the Pältsa hut in *Myrtillion, Deschampsio-Anthoxanthion* and meadow willow-scrub; S Peak S slope 900 m (Sm: U); S Peak SE slope 850 m; Middle Peak E slope (Ö); Måskokaise E slope 750 m (Sm: U); SW of Måskojaure.

**Pyrola rotundifolia** L. v. **chloranthoides** Norrl. **(P. norvegica** Knaben)

Low-alpine belt (750—900 m). — Tuipal SE of Lassivare 750 m (Sm: U); Pältsa S side 900 m (Sm: U); S Peak N slope 750 m (Sm: U); S-Pältsa 800 m (R: S); Pältsa E side 800 m (Sm: U); Pältsa N base at 850 m (Sm: U); Måskokaise E side 750 and 800 m (Sm: U).

**Rhododendron lapponicum** (L.) Wg

Low-alpine belt (600—900 m), on wind-exposed places with little or no snow-protection in winter and often some irrigation in summer; preferably on solifluxion ground. Calcicole. — On the esker 1 km NW of the Pältsa hut on solifluxion terrace in *Empetrion* (cf. p. 68); S Peak SE slope 850 m; Pältsa S end in *Nardino-Dryadetum* 800 m (Sm: U); Middle Peak S end in *Nardino-Dryadetum* at 875 m; Pältsavagge 900 m (Sm: U); High Peak N slope 900 m (Sm: U); Måskokaise, Tjårrokaise (Tengwall & Alm 1920 p. 237).

**Loiseleuria procumbens** (L.) Desv.

Mainly in the low-alpine belt (600—1055 m). Requires neither lime nor snow-protection in winter. One of the most important species of the *Empetrion* alliance. — On the esker 1 km NW of the Pältsa hut at 600 m in *Empetrion* and *Myrtillion*; S Peak SE slope (Ht); upper Pältsavagge 900 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope 1055 m.

**Phyllodoce coerulea** (L.) Bab.

Subalpine to high-alpine belt (550—1400 m). Needs some snow-protection in winter; uncommon on soil rich in lime. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Myrtillion*; SW of Nirjijaure; Lassivare N slope 750 m (Sm: U); Gåbnetjåkko E slope (Wahlenberg's diary 4.7.1800); S Peak SE slope 850 m; lower Pältsavagge (RK p. 318); upper Pältsavagge 900 m; Måskokaise on the ridge between cirque 3 and 4 at 1050 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Paras S slope 1400 m.

**Cassiope tetragona** (L.) D. Don

Low-alpine to high-alpine belt (750—1380 m). Requires some little snow-protection in winter. One of the most important species of the middle-alpine belt. — Nirjivare (Wahlenberg's diary 4.7.1800); SW of Nirjijaure; S Peak SE slope (Ht); Middle Peak S slope 875 m; Low Peak NE and W slopes 1080—1290 m; lower Pältsavagge 900 m; High Peak E slope 1265 m; Måskokaise on the ridge between cirque 3 and 4 at 1050 and 1310 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 and 1000 m; Veigematto E slope 750 m; Tjårrokaise (Tengwall & Alm 1920 p. 235); Paras S slope 1380 m.

**Cassiope hypnoides** (L.) D. Don

Low-alpine to high-alpine belt (600—1450 m). Seems to be indifferent to lime and to snow-protection. One of the most important species of late snow-beds, especially on solifluxion ground (cf. Gjaerevoll 1949 p. 58). — Gåbne-

tjåkko E slope (WAHLENBERG diary 4.7.1800); on the esker 1 km NW of the Pältsa hut at 600 m in *Deschampsio-Anthoxanthion*; SW of Nirjijaure; S Peak SE slope 850 m; Low Peak W slope 1080 m in *Nardino-Dryadetum* and *Tomenthypno-Dryadetum*; upper Pältsavagge 900 m; High Peak E slope 1240 m; Måskokaise E slope 900 m (Sm: U); Måskokaise on the ridge between cirque 3 and 4 at 1210—1450 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 and 1000 m; SW of Måskojaure 600 m; Paras S slope 1220 m.

**Andromeda polifolia** L.

Low-alpine belt, in mires. — SW of Nirjijaure; lower Pältsavagge (RK p. 321); SW of Måskojaure.

**Arctostaphylus alpina** (L.) SPRENG.

Low-alpine belt (600—1050 m). Indifferent to lime; requires no snow-protection in winter, thus being one of the most important dominants of *Empetrion* (cf. Tab. 5). — On the esker 1 km NW of the Pältsa hut in *Empetrion* at 600 m; SW of Nirjijaure; S Peak SE slope 850 m; Low Peak N slope 1050 m in *Tomenthypno-Dryadetum*; lower Pältsavagge (RK p. 318); Måskokaise on the ridge between cirque 3 and 4 at 1050 m; SW of Måskojaure.

**Vaccinium vitis-idaea** L.

Subalpine to high-alpine belt (550—1350 m). Indifferent to lime, requires no snow-protection in winter. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Empetrion, Myrtillion, Deschampsio-Anthoxanthion* and meadow willow-scrub; SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope 875 m; Low Peak W slope 1080 m in *Tetragono-Dryadetum*; Low Peak summit 1290 m; High Peak N slope 950 m (Sm: U); High Peak E slope 1050 m in *Dryadion*; Måskokaise on the ridge between cirque 3 and 4 1050—1350 m; Måskokaise below cirque 5 at 930 m; Måskokaise SE valley in *Dryadion* 1100 m (Sm: U); Måskokaise below cirque 7 at 800 and 1000 m; SW of Måskojaure 600 m; Paras S slope 1225 m.

**Vaccinium uliginosum** L.

Subalpine to lower part of middle-alpine belt (550—1080 m). Indifferent to lime, needs no snow-protection in winter. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Empetrion* and *Myrtillion*; SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak W slope 1080 m in *Tetragono-Dryadetum*; upper Pältsavagge 900 m; High Peak E slope in *Dryadion*; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Paras S slope 1010 m.

**Vaccinium myrtillus** L.

Subalpine and low-alpine belts (550—970 m). Needs good snow-protection in winter and good drainage in summer (cf. p. 71). Absent or very sparse on soil rich in lime, as on the N slope of Pältsa, where not a single patch

could be traced higher than 770 m (close to Nirjijaure). — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut; SW of Nirjijaure 770 m; S Peak SE slope 850 m; Måskokaise cirque 5 at 915 m, solitary stand close to the lake; Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Paras S slope 970 m.

**Empetrum hermaphroditum** HAGERUP

Subalpine to high-alpine belt (550—1410 m). Indifferent to lime and to snow-protection in winter; one of the most important dominants in *Empetrion* (cf. p. 68). — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Empetrion, Myrtillion* and *Deschampsio-Anthoxanthion* (cf. Fig. 12); SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope 875 m in *Nardino-Dryadetum*; Low Peak W slope 1080 m in *Tetragono-Dryadetum*; Low Peak summit 1290 m; upper Pältsavagge 900 m; Måskokaise on the ridge between cirque 3 and 4 at 1410 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 and 1000 m; SW of Måskojaure; Paras S slope 1045 m.

**Diapensia lapponica** L.

Low-alpine to middle-alpine belt (600—1300 m). Indifferent to lime. Occurs mainly on wind-exposed ridges without snow-protection in winter. — On the esker 1 km NW of the Pältsa hut at 600 m in *Empetrion*; SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak W slope 1080 m in *Nardino-Dryadetum*; lower Pältsavagge (RK p. 321); upper Pältsavagge 900 m; Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; Paras S slope 1300 m.

**Trientalis europaea** L.

Subalpine and lower part of low-alpine belt (550—850 m), on places with moderate snow-protection in winter, esp. in *Myrtillion*. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Myrtillion* and meadow willow-scrub; S Peak SE slope 850 m; Pältsa S end near Pältsajokk (Sm: U); SW of Måskojaure 600 m.

**Armeria scabra** PALL. ssp. **sibirica** (TURCZ.) HYL.

Low-alpine to middle-alpine belt (750—1100 m). Calcicole, usually only found on irrigated soil with moderate snow-protection in winter. — Between Gapojaure and Nirjivare in *Dryadion* 750 m (H. SMITH 20.7.1933, first record from Sweden); Pältsa N slopes of N part on windy ridge 1100 m (Sm: U); Pältsa N side towards Nirjijaure 950 m (Sm: U); Pältsa 1050 m (R: S); Low Peak NW and NE slopes at 1030 and 1070 m, resp.; Paras S slope 1000 m (Sm: U); Paras E slope (RN: U).

**Gentiana nivalis** L.

Subalpine and low-alpine belts (550—1000 m). Indifferent to lime, seems to prefer some snow-protection in winter. — Upper birch-forest 550 m; between Tuipal and Gapovare (JALAS 1949 p. 95); S Peak SE slope 850 m;

Middle Peak S slope 875 m; lower Pältsavagge (RK p. 321); Måskokaise SE slope 1000 m (Sm: U).

**Gentianella tenella** (ROTTB.) BÖRNER

Low-alpine to middle-alpine belt (850—1100 m). Calcicole, needs little or no snow-protection in winter. — Lassivare (FRIES & MÅRTENSON 1910 p. 65); Pältsa SE slope in *Dryadion* (Sm: U); col between Middle Peak and Low Peak (Sm: U); Pältsa NE slopes 900 m (Sm: U); Måskokaise SE valley 1100 m (Sm: U).

**Polemonium acutiflorum** WILLD.

Subalpine and low-alpine belts, in willow scrub. — At Nirjijokk between Pältsa and Lassivare (A & T: U); Lassivare in willow-scrub 700 m (Sm: U); Gåbnetjåkko (FRIES & MÅRTENSON 1910 p. 69, J: U); Veigematto, Tjuosmir, Kummajärvi, Måskokaise, Pältsajokk, Nirjijaure, Nirjivare, Maselvare, Gapovare, Gapojaure (FRIES & MÅRTENSON 1910 p. 69); Pältsa near Pältsajokk (Sm: U); Pältsa NE slopes 800 m (Sm: U); Tjårrokaise (TENGWALL & ALM 1920 p. 237).

**Myosotis silvatica** EHRH. ssp. **frigida** T. VEST.

Subalpine and low-alpine belts (550—900 m). On irrigated ground with good snow-protection in winter. — Upper birch-forest 550 m; S Peak SE slope 850 m; S Peak E slope 900 m (Sm: U); Måskokaise below cirque 7 at 750 m.

**Veronica fruticans** JACQ.

Low-alpine belt (700—950 m). In S-exposed slopes on soil more or less rich in lime. — S Peak S slope 850 m; Pältsa S slopes at 700 and 950 m (Sm: U); Middle Peak S slope 850 m.

**Veronica alpina** L.

Mainly in the low-alpine belt (600—1100 m), in meadows etc. with good snow-protection in winter. — On the esker 1 km NW of the Pältsa hut 600 m; SW of Nirjijaure; S Peak SE slope 850 m; lower and upper Pältsavagge (RK p. 321); Måskokaise below cirque 5 at 930 m; Måskokaise below cirque 7 at 750 m; SW of Måskojaure 600 m; Paras S slope 1100 m.

**Melampyrum pratense** L.

Upper birch-forest (Sm: U; H: U).

**Melampyrum silvaticum** L.

Upper birch-forest (Sm: U); Gåbnetjåkko (FRIES & MÅRTENSON 1910 p. 66).

**Euphrasia frigida** PUGSL.

Subalpine and low-alpine belts (550—875 m), in *Dryadion* and meadows. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut; between

the Pältsa hut and Lassivare (Sm: U); at Pältsajokk in moist meadow 750 m (Sm: U); Middle Peak S slope 875 m; Måskokaise below cirque 7 at 850 m; SW of Måskojaure.

**Euphrasia lapponica** Th. Fr. j:r.

Low-alpine belt, calcicole, needs no snow-protection in winter. — S Peak S slope 850 m in *Nardino-Dryadetum* (Sm: U); Pältsa 1000 m in *Dryadion* (A & T: U); Pältsavagge at Pältsajokk (F: U, cf. Fries & Mårtenson 1910 p. 64). Cf. also Fries 1921 Fig. 4: 2.

**Rhinanthus minor** L. ssp. **groenlandicus** (Chab.) Neum.

Upper birch-forest 500 m (Sm: U); Lassivare (Fries & Mårtenson 1910 p. 71).

**Bartsia alpina** L.

Subalpine to middle-alpine belt (550—1080 m). Calcicole, needs no snow-protection in winter. — Upper birch-forest; SW of Nirjijaure; S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; Low Peak W slope 1080 m in *Nardino-Dryadetum* and *Tetragono-Dryadetum*; lower and upper Pältsavagge (RK p. 321); High Peak N slope 950—1000 m (Sm: U); Måskokaise cirque 5 at 800 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope 1000 m (Sm: U).

**Pedicularis sceptrum-carolinum** L.

Kummajärvi, Pältsa (Fries & Mårtenson 1910 p. 72); SW of Måskojaure 600 m.

**Pedicularis lapponica** L.

Subalpine and low-alpine belts (550—930 m). Indifferent to lime; seems to prefer some snow-protection in winter. — Upper birch-forest; on the esker 1 km NW of the Pältsa hut in *Myrtillion* and meadow willow-scrub; SW of Nirjijaure; S Peak SE slope 850 m; Måskokaise cirque 5 at 930 m; Måskokaise cirque 7 at 800 m; SW of Måskojaure 600 m.

**Pedicularis hirsuta** L.

Low-alpine and middle-alpine belts (800—1170 m). Calcicole. — SW of Nirjijaure; Pältsa E slope 800 m (Sm: U); Low Peak NE slope 1050 m; Pältsavagge (Sm: U); High Peak E slope 1100 m; Måskokaise cirque 5 at 930 m; Måskokaise below cirque 7 at 900 m; Tjuosmir (Fries & Mårtenson 1910 p. 67); Tjårrokaise (Tengwall & Alm 1920 p. 237); Paras S slope 1170 m.

**Pedicularis flammea** L.

Måskokaise below the SE slope (Tengwall & Alm 1920 p. 236, A & T: U).

**Pinguicula vulgaris** L.

Low-alpine belt (600—875 m). Calcicole, indifferent to snow protection in winter, occurs mostly on solifluxion soil. — S Peak SE slope 850 m; Middle Peak S slope in *Nardino-Dryadetum* 875 m; SW of Måskojaure 600 m.

**Pinguicula alpina** L.

Low-alpine belt (600—850 m). — S Peak SE slope 850 m (Sm: U); SW of Nirjijaure; Pältsavagge 700 m (Sm: U); Måskokaise (TENGWALL & ALM 1920 p. 237); SW of Måskojaure 600 m.

**Linnaea borealis** L.

Subalpine and lower part of low-alpine belt. — Rocky slope in the upper birch-forest (Sm: U); Gapojaure (Sm: U); lower Pältsavagge (RK p. 320).

**Valeriana sambucifolia** MIKAN FIL.

Upper birch-forest (Sm: U).

**Campanula rotundifolia** L.

Pältsajokk (FRIES & MÅRTENSON 1910 p. 59); Pältsa, Måskokaise (TENGWALL & ALM 1920 p. 235).

**Campanula uniflora** L.

Low-alpine and middle-alpine belts (875—1180 m). Calcicole, needs no snow-protection in winter, occurring mainly in *Dryadion*. — Pältsa E slope in *Dryadion* 900 m (Sm: U); Middle Peak S slope 875 m in *Nardino-Dryadetum*; Low Peak W slope in *Nardino-Dryadetum* at 1080 and 1180 m; Pältsa NE slopes 1100 m (Sm: U); High Peak E slope 1060 m (H: U); Måskokaise, Tjårrokaise (TENGWALL & ALM 1920 p. 235).

**Solidago virgaurea** L.

Subalpine to low-alpine belt (550—850 m). Needs snow-protection in winter, and occurs mainly on soils poor in lime, often in *Myrtillion* and *Deschampsio-Anthoxanthion*. — Upper birch-forest; on the esker 1 km NW of the Pältsa hut in *Myrtillion, Deschampsio-Anthoxanthion* and meadow willow-scrub; S Peak SE slope 850 m; lower Pältsavagge (RK p. 320); SW of Måskojaure 600 m; Paras S slope.

**Erigeron acre** L. ssp. **politum** (FR.) HYL.

Kummajokk, Pältsa (TENGWALL & ALM 1920 p. 236).

**Erigeron boreale** (VIERH.) SIMM.

Pältsa, Måskokaise (TENGWALL & ALM 1920 p. 236; JALAS 1949 p. 96).

**Erigeron uniflorum** L.

Low-alpine to high-alpine belt (600—1330 m). — Lassivare (J: U); Pältsa S end at Pältsajokk (Sm: U); S Peak SE slope 850 m; S Peak W slope 1100—

1200 m (Sm: U); Middle Peak SE slope (Sm: U); col between Middle Peak and Low Peak (Sm: U); Pältsa NE slopes 900 m (Sm: U); lower and upper Pältsavagge (RK p. 320—321); High Peak E slope 1060 m; Måskokaise on the ridge between cirque 3 and 4 at 1330 m; Måskokaise SE valley 1100 m (Sm: U); Måskokaise below cirque 7 at 800 m; SW of Måskojaure 600 m; Tjårrokaise (TENGWALL & ALM 1920 p. 236); Paras S slope 1135 m.

**Erigeron unalaschkense** (DC.) VIERH.

Low-alpine to middle-alpine belt (900—1100 m). Calcicole. — S Peak W side (Sm: U); Pältsa S end at Pältsajokk (Sm: U); col between Middle Peak and Low Peak (Sm: U); Pältsa N slope of N part 900—1000 m (Sm: U); Måskokaise SE valley 1100 m (Sm: U); Tjårrokaise (TENGWALL & ALM 1920 p. 236).

**Antennaria dioeca** (L.) GAERTN.

Subalpine and low-alpine belts (550—850 m). Indifferent to lime, mainly occurring in grass heaths. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut in *Myrtillion, Deschampsio-Anthoxanthion,* and meadow willow-scrub; between the Pältsa hut and Lassivare 650 m (Sm: U); S Peak SE slope 850 m; Pältsa S end at Pältsajokk (Sm: U); SW of Måskojaure 600 m.

**Antennaria alpina** (L.) GAERTN. ♀

Low-alpine to high-alpine belt (600—1410 m). Indifferent to lime; needs no snow-protection in winter. — On the esker 1 km NW of the Pältsa hut at 600 m in *Empetrion* and *Myrtillion*; between the Pältsa hut and Lassivare 700 m (Sm: U); Pältsa S end at Pältsajokk (Sm: U); S Peak SE slope 850 m; col between S Peak and Middle Peak (Sm: U); Middle Peak S slope 1250 m (Sm: U); Middle Peak S slope 875 m; Måskokaise on the ridge between cirque 3 and 4 at 1050 m; Måskokaise cirque 5 at 930 m; Måskokaise SE valley at 900 and 1100 m (Sm: U); Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope 1410 m.

**Antennaria alpina** (L.) GAERTN. ♂

On the esker between the Pältsa hut and Lassivare 700 m (Sm: U); on sandy soil where the stream breaks through the esker E of Lassivare at 700 m (Sm: U); Pältsa S end (Sm: U).

**Antennaria porsildii** ELIS. EKM.

Middle-alpine and high-alpine belts (1000—1350 m). — S Peak E side (Ö); col between S Peak and Middle Peak (Sm: U); Middle Peak S slope 1350 m (Sm: U); Måskokaise E side in snow beds 1000 m (Sm: U); Måskokaise S end towards Pältsa 1000 m (Sm: U); Måskokaise SE valley 1100 m (Sm: U).

**Antennaria carpathica** (WG) BL. & FING.

Mainly in the middle-alpine belt (900—1300 m). Calcicole. — Nirjivare S slope (Sm: U); S Peak E slope 1100 m (Sm: U); col between S Peak and

Middle Peak at 1300 m (Sm: U); Pältsa NE slopes 1100 m (Sm: U); Pältsa on the slope towards Nirjijaure (A & T: U); Low Peak W slope 1080 m in *Tetragono-Dryadetum*; Pältsa N slope 950 m (Sm: U); Pältsavagge (F & M: U, cf. FRIES 1913 p. 115); Måskokaise on the ridge between cirque 3 and 4 at 1050 m; Måskokaise towards Pältsavagge (A & T: U); Måskokaise SE slope 900 m (Sm: U); Paras S slope 1000 m (Sm: U).

**Gnaphalium supinum** L.

Mainly in the low-alpine belt (600—1100 m). Needs good snow-protection in winter, commonest on soil poor in lime. — At Nirjijokk below the Pältsa hut (Ö); on the esker 1 km NW of the Pältsa hut in *Deschampsio-Anthoxanthion* at 600 m; Pältsavagge (FRIES 1913 p. 118); Måskojaure below cirque 5 at 930 m; SW of Måskojaure; Paras S slope 1100 m.

**Gnaphalium norvegicum** GUNN.

Low-alpine belt (600—915 m). In grass heaths and meadows with good snow-protection in winter. — At Nirjijokk below the Pältsa hut (Ö); on the esker 1 km NW of the Pältsa hut in *Myrtillion, Deschampsio-Anthoxanthion* and meadow willow-scrub; Pältsa S end at Pältsajokk (Sm: U); SW of Måskojaure; Tjårrokaise 800 m (Sm: U); Paras S slope 915 m.

**Achillea millefolium** L.

Low-alpine belt; introduced. — Pältsa S end on old camp site (TENGWALL & ALM 1920 p. 234; Sm: U); Pältsavagge (FRIES & MÅRTENSON 1910 p. 56).

**Petasites frigidus** (L.) FR.

Low-alpine belt, in mires. — SW of Nirjijaure; Pältsa NE slope 800 m (Sm: U); at the lake in Pältsavagge (Sm: U).

**Arnica alpina** (L.) OLIN

Low-alpine and middle-alpine belts (875—1100 m). Calcicole, on wind-exposed ridges without snow-protection in winter, mainly in *Nardino-Dryadetum*. — S Peak E slope 1100 m (Sm: U), SW part of the col between S Peak and Middle Peak in *Nardino-Dryadetum* at 875 m (Sm: U; H: U); Pältsavagge (A & T: U); High Peak N slope 950 m (Sm: U); Måskokaise on the ridge between cirque 3 and 4 at 1050 m in *Dryadion*.

**Saussurea alpina** (L.) DC.

Subalpine to middle-alpine belt (550—1180 m). Indifferent to snow-protection in winter. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut; SW of Nirjijaure; S Peak SE slope 850 m; Low Peak N slope 950 m in *Tomenthypno-Dryadetum*; Low Peak W slope 1080 and 1180 m in *Nardino-Dryadetum*; lower and upper Pältsavagge (RK p. 321); High Peak E slope 1060 m; Måskokaise cirque 5 at 930 m; Måskokaise below cirque 7 at 800 m; SW of Måskojaure; Paras S slope 1175 m.

**Cirsium heterophyllum** (L.) HILL

Subalpine and low-alpine belts (550—850 m), on irrigated ground with good snow-protection in winter. — Upper birch-forest; S Peak SE slope 850 m; lower Pältsavagge (RK p. 321).

**Leontodon autumnalis** L.

Pältsa S end (Sm: U); Pältsavagge (FRIES & MÅRTENSON 1910 p. 66; A & T: U); Måskokaise (A & T: U).

**Taraxacum officinale** WEB., coll.

Subalpine and low-alpine belts (550—1070 m). In meadows with good snow-protection in winter. — Upper birch-forest 550 m; on the esker 1 km NW of the Pältsa hut; SW of Nirjijaure; Pältsa SE slope (Sm: U); S Peak SE slope 850 m; lower and upper Pältsavagge (RK pp. 320, 321); Måskokaise cirque 5 at 930 m; Måskokaise below cirque 7; SW of Måskojaure; Paras S slope 1070 m.

**Hieracium alpinum** coll.

Mainly in the low-alpine belt (600—1070 m). — On the esker 1 km NW of the Pältsa hut in *Myrtillion* and *Deschampsio-Anthoxanthion* at 600 m; Lassivare (RK p. 320); S Peak N slope 850 m (Sm: U); S Peak SE slope 850 m; lower and upper Pältsavagge (RK pp. 320—321); SW of Måskojaure; Paras S slope 1070 m.

The microspecies of the genera *Taraxacum* and *Hieracium* have not been satisfactorily studied in the district.

Chapter 5.

# A contribution to our knowledge of the moss flora of the Pältsa area.

By O. MÅRTENSSON.

The region to which the following lists of species refer comprises, besides the actual Pältsa-Måskokaise massif,[1] terrain to the east of this down to about 1 km below the Nirjijokk waterfall. The waterfall is approximately on the tree-line. In this connection, the localities given by WEIMARCK (1939), located relative to Gåbnetjåkko or Kummajoki (here Nirjijokk) and labelled with the height 550 m, have been included. WAHLENBERG's reports from Nirjijaure (»Njäravaara»), a mountain which I did not visit and which I have therefore not included in the area, have only been mentioned in the text, like other data from WAHLENBERG's journey over this region, where he does give localities and where his notes can be interpreted. For taxonomic and nomenclatural reasons, I have considered it inadvisable to include his observations in the lists of localities. In any case, many of the names he used are now ambiguous because of the revision of species, etc.

I visited the following parts of the massif:

*Pältsa*. All the peaks were visited on several occasions, although not the steepest slopes towards Pältsavagge.

*Måskokaise*. High Peak with its sub-peak to the NE; the region above cirque 5 (at the lower end of Pältsavagge), and beyond that to South-East Peak. On this latter peak, besides the north, north-east and east slopes, the slope towards Måskojaure was also visited. The ground sloping down towards this lake is in Norway (Överbygd herred), as are some of the localities on the higher parts of the Måskokaise group.

[1] A general geological survey of the area is given in STEN RUDBERG's article. As regards the names of the various peaks, etc., the sketch map and list of names should be referred to (p. 199 ff.).

*Pältsavagge*. I roamed over this valley on several occasions.

The small area of birch forest was visited many times, particularly the northern slope towards the Nirjijokki waterfall and the southerly slopes about 1 km to the NE. On Gåbnetjåkko, it was mainly the steep north slope and the precipice that were investigated.

A glance at the map will show that the extent of the area visited was mainly determined by the position of the Pältsa hut. I had previously hoped to be able to examine an area extending from the eastern tree-line to the western, but the unusually unfavourable weather conditions of the summer of 1949 prevented me. For the same reason, I was unable to make a more thorough investigation of the west and northwest slopes of Måskokaise, which even in the middle of July were more suited to skiing than to botanical excursions.

## Liverworts.

There does not appear to have been any proper collection of liverworts from the Pältsa-Måskokaise area until WEIMARCK visited the region in 1929. W.'s finds, which are indicated in the following list by (W), were presumably made on the steep southern and eastern slopes of South Peak — where they are not otherwise specified. Of the species included in the work of W. previously mentioned, there are, according to the list of localities, 38 liverworts found in the area, either only there or elsewhere as well. There are, of course, some isolated specimens from earlier visits — for instance, C. P. LAESTADIUS's find of *Asterella Lindenbergiana* in 1859 — but, as far as I know, these are only isolated finds. It is obvious that a thorough examination of earlier collections of musci, for instance, that of MÖLLER, would probably yield many more or less trivial liverworts among the main specimens, but it is unlikely that such a procedure would produce anything worth while in this case, especially as the localities are almost invariably given simply as »Peldsa». The test-square analyses in FRIES's work (1913) give some localities where fairly common liverworts were found. The specimens were collected in 1909, and FRIES says they were determined by H. W. ARNELL. They have been included among the references in the list of species.

The catalogue of the region's liverworts was extended considerably by ARNELL,[2] who visited the area in 1939. During the four days he was

[2] To avoid misunderstanding, it should be noted that SIGFRID ARNELL (Lasarettsläkare, Med. Dr., * 1895) is denoted by S. ARN. in the list of authors, and in the

Fig. 16. Gåbnetjåkko from the E. In the background to the right Måskokaise, in the foreground Kummajokk. Photo S. Rudberg 1949.

there, A., who gave his whole attention to this group, found 78 species just on the north and north-west slopes of Middle Peak, Low Peak and High Peak, together with Nirjijaure. Most of these finds were published in a paper, »Bidrag till kännedomen om levermossfloran i Norrbotten och Torne lappmark» (S. ARNELL, 1941, p. 226—230). All the localities given by A. — either in his paper or as personal communications are indicated here with (A). His heights are only estimations; where mine are estimated, this is indicated by »*c*» before the figure, and the figure is used by itself where the height was measured.

Literary references to the above publications of ARNELL and WEIMARCK have been omitted, in order not to encumber the presentation. Usually, when ARNELL has provided the information, he has done so by letter, and I have regarded it as unnecessary to distinguish such information from that derived from his published list. A. has examined that list, and, where possible, has kindly supplemented it with more detailed information drawn from his own private collection.

text as ARNELL or A., while H. W. ARNELL (the father of A., Fil. dr., Lektor, † 1932) is denoted by ARN. as author, and in the text has his initials included.

Thus, before I visited the area, about 84 liverworts were known there. My task was therefore confined to collecting a few »missing» species and »widening» the list of species based on earlier finds. The species which are easily identifiable on the spot have been noted, but by far the greater part of the localities I give correspond to collected specimens.

The number of liverworts now known to occur within the area is 107, a remarkably high figure for such a limited area situated at such a height. This may be compared with the 101 species of the Sarek flora (H. W. ARNELL & C. JENSEN, 1910, p. 229) from a region of very large extent in all directions. However, the comparison should not be carried too far: since that list was drawn up, new species have been described, and others have been combined, so that a strict numerical comparison is only possible after examination of the material, which, in any case, was collected during the course of a single journey through the region. If we turn to a more recent publication, MEDELIUS's »Mossvegetationen i Storlien med omnejd» (1926, p. 70), we find 94 species, and the area in this case includes a »spruce region». Only 8 of the 107 species from the Pältsa-Måskokaise area were found restricted to subalpine regions; of these, only *Lophozia longidens,* which prefers decayed trunks or other decayed wood, seems to be strictly confined to the birch region. A comparison between the alpine and subalpine regions yields scarcely anything of value. A slight extension of the area to include some of WEIMARCK's localities would give another picture. Thus, *Radula complanata* is only known from the birch region within our area, but W. found it at a height of 700 m only some km farther north. Several such instances could be quoted — as well as examples to the contrary. I have therefore been content to give the approximate vertical extent of the different species, together with their frequency and habitat. However, in some cases there is no information available, apart from the fact that the species were collected on Pältsa. Species previously known in the area but not rediscovered on this occasion have been examined, where specimens were available. Species which ought to be omitted for some reason or other, or whose occurrence in the area is uncertain, have been put in brackets. The systematic arrangement and the nomenclature follow BUCH, EVANS and VERDOORN (1937, pp. 3—8).

For the completion of this list of species I am greatly indebted to Med. Dr. SIGFRID ARNELL, who carried out the main work of determination. He was unable to realise his original intention of visiting Pältsa again to complete his earlier investigation there because of lack of time. For this reason, I have been entrusted with the task of com-

piling and publishing this list of liverworts. Finally, I would like to thank Dr. HANS BUCH, Helsingfors, who, among other things, has contributed to the discussion of the large-cell forms in the *Lophozia ventricosa* group, through Dr. ARNELL.

## Ptilidiaceae.

**Anthelia julacea** (L.) DUM.

Details regarding this find are lacking.
High Peak (A).

**Anthelia Juratzkana** (LIMPR.) TREV.

Unlike the preceding species, *A. Juratzkana* is very common in the area. It usually occurs where the snow melts late or on the banks of streams, often together with other small liverworts such as *Marsupella apiculata, M. condensata, Nardia Breidleri* and *Pleuroclada albescens.*

»Peldsavagge» (TH. FRIES, 1913, p. 119); Middle Peak (A); High Peak (A); Gåbnetjåkko; the esker; S Peak; SE Peak; Pältsavagge; Måskojaure.

**Ptilidium ciliare** (L.) N.

*P. ciliare* is one of the most common liverworts of the area, particularly in the numerous small hollows in the dwarf birch heath which are due to frost action. It often grows on decayed trunks in the subalpine belt. The other localities in which it occurs vary a great deal, and it also figures in societies rich in species. It has been found at considerable heights, although not on the highest summits.

»Auf den westlichen Abhang von Peldsa» (TH. FRIES, 1913, p. 92); »Peldsa in the valley 700 m»[3] (W); »precipice by Kummajoki 550 m» (W); »Peldsa» (A); Gåbnetjåkko; the birch forest; Lassivare; S Peak; Middle Peak; Low Peak, up to 1300 m; Pältsavagge.

## Lepidoziaceae.

**Blepharostoma trichophyllum** (L.) DUM.

*B. trichophyllum* seems to be the most common liverwort of the area. As WEIMARCK points out, it seldom occurs by itself, but usually as a more or less minor constituent of moss societies. The only places in which I have observed it growing by itself are shaded holes or within the spray area of waterfalls. The species occurs even at high levels: ARNELL found it at a height of about 1500 m, and I measured the height of one of its localities on Middle Peak as 1330 m.

The fertile material gathered from the area has a spore size of 12—14 μ and an elater thickness of 8 μ. Material from southern Sweden and central Europe has a spore size of about 8 μ and an elater thickness of 8 μ. According to ARNELL, *Blepharostoma* from our mountains usually belong to the large-spored kind, which appears to differ from the small-spored in that the perianth

[3] The occurrence records quoted from Swedish texts have been translated into English by the present writer.

has shorter cilia at the mouth and cells 20—26 μ at the base, as compared with 14—20 μ in the main form. The large-spored form also seems more often to have three-lobed leaves, with the trigones non-convex. It is also found in northern Canada, and it often occurs with short cells in the leaf lobes, so that the var. *brevirete* BRYHN & KAAL. probably belongs to this type. It must be genetically different from the main form, and it is possible that it may prove to be entitled to the rank of species. It is at present impossible to give a certain determination of sterile material, since the distinguishing features of the gametophytes are not sufficiently definite.

Peldsa», several places (W); »precipice by Kummajoki *c* 2 km N of Gåbnetjåkko» (W); High Peak, *c* 1500 m (A); also collected or noted from all the places named in this species list.

## Calypogeiaceae.

**Calypogeia Meylanii** BUCH

The species is mentioned by ARNELL without further particulars.

»Peldsa, *c* 1000 m» (A).

**Calypogeia Müllerіana** (SCHIFFN.) K. M.

**Calypogeia Neesiana** (MASS. & CAR.) K. M.

These two species both occur in samples collected in fens at a low level. They grew in peat together with *Lophozia incisa* and *L. ventricosa*.

SE Peak, NE slope, 650 m.

**Calypogeia sphagnicola** (ARN. & PERSS.) K. M.

In a mixed sample whose main constituent is *Plagiochila asplenioides*, there is a *Calypolygeia* species which is assigned to *C. sphagnicola* by ARNELL, with the comment that it resembles the North American type. The species has also been collected by ARNELL at Tjårrokaise, a little to the NW of Pältsa.

Gåbnetjåkko, N steep.

## Cephaloziellaceae.

**Cephaloziella arctica** BRYHN & DOUIN

This species is in all probability much more common than the list of localities indicates. It is easily overlooked on account of its small size.

»The precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); »Middle Peak» (A); Nirjijokk, just above the waterfall.

**[Cephaloziella grimsulana** (JACK) K. M.**]**

This species is included in ARNELL's list, but it ought really to be omitted. The *Cephaloziella* genus has always been one of the problems of hepaticology to which most collectors of liverworts are resigned. One of the most confusing factors is the large number species (39 in Europe). DOUIN is the authority for at least 25 of these. Recently, however, K. MÜLLER (1947,

pp. 8—36) has subjected DOUIN's system, which is accepted in many floras and check lists, to a critical examination, and has proposed a considerable reduction of DOUIN's species. Moreover, ARNELL, who is also interested in this question, has informed me that the »correct» *C. grimsulana* has not been found in Sweden, and is quite different in appearance from the liverwort which has hitherto been called by this name. The tangle is not improved by the fact that MÜLLER's *C. grimsulana* is the same as DOUIN's *C. alpina,* which led JÖRGENSEN to make the species synonymous in his flora (1934, p. 193). It is as well to mention for the sake of completeness that the correct *C. grimsulana* has been found in Norway: ARNELL found it among the material which he and myself brought home from Vestlandet in the early summer of 1949.

## Epigonianthaceae.

**Arnellia fennica** (G.) LINDB.

This species is abundant in the locality mentioned, and prefers the turfs bound together with *Dryas* and *Salix reticulata* which hang from shelves in the precipice there. Some of it grew in brown-green mats unmixed with other species, but it also occurred among *Distichium capillaceum, Hypnum hamulosum, Mnium orthorrynchum, Myurella julacea, Odontoschisma Macounii* and *Scapania gymnostomophila.* The fact that I was able to find *A. fennica* again the following summer without difficulty shows that the species is not rare there. But I was unable to find it on any of the other peaks, such as Low Peak, for instance, where I searched for it in several places which appeared suitable.

S Peak, SE steep, 1000 m.

**Barbilophozia Hatcheri** (EVS.) LSKE.

The species occurs here and there at the lower heights, while higher up it occurs abundantly and frequently, for instance, on the ridge-top at Low Peak, where it forms loose dark green mats of vegetation between the boulders and stones.

Var. *grandiretis* BUCH is a large-celled Arctic form which, according to ARNELL (1947, p. 213), resembles in its habit *Orthocaulis Floerkei* or *O. atlanticus.* The shoots are usually broader and longer than in the main type, and the underleaves are only slightly developed, sometimes occurring only at the tip of the shoot. It is also sometimes difficult to discern the cilia at the base of the postical margin of the leaves.

»Peldsavagge» (TH. FRIES, 1913, p. 115); »the precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); High Peak, *c* 1400 m (var. *grandiretis* BUCH) (A); Gåbnetjåkko, N steep; the esker; Low Peak, 1300 m; High Peak, 1400 m; the plateau between the ravine to the E and cirque 5, *c* 1300 m; SE Peak, the slope towards Måskojaure, 1300 m.

**Barbilophozia lycopodioides** (WALLR.) LSKE.

*B. lycopodioides* is probably common at lower levels within the district. It is abundant in several places in the birch forest by the Nirjijokk waterfall.

The species is more or less calcicole, and where the soil is poorer, as well as at higher levels, it seems to be replaced by the preceding species.

»By Kummajoki 2 km N of Gåbnetjåkko, *c* 550 m» (W); »Peldsa, above Nirjijaure, *c* 800 m» (A); the Nirjijokk waterfall; Low Peak; SE Peak, above Måskojaure.

**Gymnocolea inflata** (HUDS.) DUM.

This species is common — at least, lower down. I myself noticed it particularly in dried-out pools on the north-western parts of Gåbnetjåkko, and in rock-pools along Nirjijokk. *Odontoschisma elongatum* often occurs together with it. ARNELL says that *G. inflata* is common on the mountains up to 1500 m, but it was not possible to verify this statement for our area.

»Peldsa» (A); Gåbnetjåkko; Nirjijokk; Pältsavagge.

**Isopaches bicrenatus** (SCHMID.) BUCH

I myself have not observed this species. The only information is the following.

»Precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); Middle Peak (A); High Peak, *c* 1400 m (A).

**Jungermania atrovirens** DUM.

ARNELL describes the species as fairly common round Nirjijaure and on High Peak up to a height of 1500 m.

Middle Peak (A); High Peak (A).

**Jungermania cordifolia** HOOK.

Very common in the birch forest and a little above the tree-line. It occurs on the flood ground along small streams, and often grows densely. It has not been observed above a height of 800 m.

Middle Peak, *c* 800 m (A); Gåbnetjåkko; the birch forest; — SE Peak, E slope; Pältsavagge.

**Jungermania pumila** WITH.

The species has been found only by ARNELL.

Middle Peak, »several places up to a height of 1400 m» (A).

**Jungermania pusilla** (C. J.) BUCH

*J. pusilla,* which is not uncommon in the area, was found mainly on soil laid bare by frost-heaving in the alpine region.

»Peldsa, up to 1400 m» (A); Middle Peak, slope towards South Peak, *c* 1350 m; SE peak, slope towards Måskojaure, 1300 m.

**Jungermania scalariformis** N.

Only one specimen of this species was found. It grew on alluvial sand just below the waterfall, together with a few shoots of a Pohlia species — probably *P. gracilis.*

Nirjijokk waterfall.

**Jungermania Schiffneri** (LOITL.) EVS.

According to ARNELL, the species is fairly common up to 1400 m.
Middle Peak; High Peak; upper end of Nirjijaure; (all A).

**Jungermania sphaerocarpa** HOOK.

This species is merely mentioned by WEIMARCK. It has presumably been overlooked, however.

»Peldsa, in the valley at 700 m; also on a rock shelf, 1000 m, c. col.» (W).

**Leiocolea arctica** S. ARN.

*L. arctica* is a new species, recently described by ARNELL (1950, pp. 374—8). In examining the material which O. EKSTAM collected on Novaya Zemlya, A. found a liverwort resembling *Leiocolea heterocolpos,* with red tips to the shoots, and with larger cells than the latter. A. has since found the same liverwort in his material from Pältsa and in several localities in the Abisko district of Torne Lappmark, which made it possible to study the species in culture. At the time when the new species was described, the liverwort had also been found in the Virihaure district of Lule Lappmark and in Nedalen in north-western Härjedalen. Further particulars about the new species may be obtained from ARNELL's paper. The only points we will mention here are those characteristics which may be of interest for the field bryologist.

In size, *L. arctica* may be compared with *L. Gilmanii,* with which it is often associated, as a matter of fact. In colour, *L. arctica* is green, though the leaf-lobes at the tips of the shoots are as a rule a more or less strong shade of red. The leaves are shortly decurrent, directed to the side and somewhat forwards and usually two-lobed (occasionally three-), the incision being 1/6—1/4 of the length of the leaf. The lobes are as a rule obtuse and equal in size, with the incisions at right-angles to the edge. The perianth is of a form unlike that of other *Leiocola* species, since it tapers rather gradually towards the mouth. The habitat in which the moss has been found is almost invariably a limestone snow-bed, between 400 and 1450 m. The species is not uncommon on Pältsa's Low Peak, where it grows on the terrace soil deposits, so well known for the many rare vascular plants growing there, in the company of a number of other mosses (*Blepharostoma trichophyllum, Distichium capillaceum, Ditrichum flexicaule, Hypnum Bambergeri, Leiocolea Gilmanii, Lophozia grandiretis, L. incisa, Nardia geoscyphus, Odontoschisma Macounii, Orthocaulis quadrilobus, Orthothecium rufescens, Pleuroclada albescens, Tomenthypnum nitens,* and others).

Middle Peak (A); High Peak, 1450 m (A); Low Peak, the slope towards Nirjijaure, several places, 1050—1100 m (c. col.)—1150 m.

**Leiocolea badensis** (G.) JÖRG.

Only one sample of this species was found. It was growing on the weathered slate, in a crevice, together with *Distichium capillaceum* and *Orthothecium intricatum. L. badensis* has recently been found in several places in the Swedish mountains.

High Peak's sub-peak, the S slope towards Pältsavagge, 1100 m.

**Leiocolea bantriensis** (HOOK.) JÖRG.

Like the preceding species, *L. bantriensis* seems to be rare in the district. On Low Peak it was found growing in a snow-bed together with *Drepanocladus uncinatus*.

»Peldsa, mountain slope, 750 m» (W); Low Peak, the slope towards Nirjijaure.

**Leiocolea Gilmanii** (AUST.) EVS. *L. Kaurini* (LIMPR.) BUCH

*L. Gilmanii* is fairly common on Pältsa up to a height of at least 1000 m. Like the other members of the genus, it is more or less calcicole, and its usual station is a hollow or crevice in the steep slopes, where it often grows with other shade-preferring species such as *Isopterygium pulchellum, Orthothecium intricatum, Peltolepis grandis* and *Sauteria alpina*.

»Peldsa, in a crevice filled with soil, 1000 m; precipice by Kummajoki, *c* 2 km N of Gåbnetjåkko, 550 m» (W); Middle Peak (A); High Peak, *c* 1400 m (A); S Peak, S slope, 900 m and 1000 m; Low Peak, 1100 m.

**Leiocolea heterocolpos** (THED.) BUCH

*L. heterocolpos* is the most common species of this genus, and is found on Pältsa up to at least 1000 m. In the alpine belt it seems to be confined to a calcareous substratum while in the subalpine belt it is also found growing on rotting wood.

»Peldsa, in the valley, 700 m; also on the mountain slope, 800 m» (W); »Peldsa, common» (A); Gåbnetjåkko, N slope; birch forest; S Peak, SE steep, 100 m; cirque 5.

**Leiocolea Mülleri** (N.) JÖRG.

This species is presumably rare, since there is only one find from the district.

Middle Peak (A).

**Leiocolea Schultzii** (N.) JÖRG.

This large hepatic, which is not uncommon in fens rich in species, has been found in only two places in the Pältsa district. The specimens come from low levels, and ARNELL gives his locality as a *Carex aquatilis* fen.

Middle Peak, »low down» (A); South Peak, at the foot of and to the SE.

**Lophozia alpestris** (SCHLEICH.) EVS.

*L. alpestris* is common in the district, and frequently occurs on the actual summits and ridge-tops. It has been found in fens, on percolation surfaces, in snow-beds, on alluvial sand, and in other similar places.

»Peldsa vagge» (TH. FRIES, 1913, p. 119); »precipice by Kummajoki, 550 m» (W); Middle Peak (A); High Peak (A); the Nirjijokk waterfall; S Peak; SE Peak; Pältsavagge.

**Lophozia excisa** (DICKS.) DUM.

There are only a few localities for this species. In the locality cirque 5 it was found growing together with *Distichium capillaceum, Mnium hymeno-*

*phylloides* and *Sauteria alpina*. According to ARNELL, the specimen from the slope towards Nirjijaure resembles var. *cylindracea* (DUM.) K. M.

Middle Peak, the N slope (A); do., the slope towards Nirjijaure, 1350 m; the col between South and Middle Peaks, towards Pältsavagge, *c* 1000 m; cirque 5, 920 m.

**Lophozia grandiretis** (LINDB.) SCHFFN.

Only one sample of this species was collected. It grew in a snow-bed on a soil terrace together with *Distichium capillaceum, Leiocolea arctica, Odontoschisma Macounii* and *Orthothecium rufescens*.

Low Peak, the slope towards Nirjijaure, 1150 m.

**Lophozia incisa** (SCHRAD.) DUM.

This species seems to be common in the lower regions of the district. It grew by the lake in cirque 5, in a snow-bed together with *L. alpestris, L. Wenzelii* and *Nardia geoscyphus*.

»Peldsa, in a crevice filled with soil, *c* 1000 m» (W); »Peldsa» (A); the birch forest; Low Peak, 1050 m; SE Peak, NE slope, 650 m; cirque 5, 920 m.

**Lophozia longidens** (LINDB.) MAC.

I came across this species a few times in the birch forest. It grew on prone, rotting trunks or other decayed wood, together with *Dicranum montanum, L. porphyroleuca, L. ventricosa, Ptilidium ciliare,* and other species. *L. longidens* belongs to the few hepatics which occur only in the subalpine belt in this region.

The birch forest.

**Lophozia porphyroleuca** (N.) SCHFFN.

*L. porphyroleuca* has only been found for certain in the subalpine belt. The specimen referred to was taken from a birch trunk rotting on the ground, and it includes, among other things, *Lophozia longidens*. ARNELL makes some reservations about his reference to the occurrence of the species on *Pältsa*.

The birch forest.

**Lophozia silvicola** BUCH

The *Lopozia ventricosa* group has recently been the subject of a thorough study, by both BUCH and ARNELL, the main point of interest being the large-celled forms which are occasionally found, and which seem to be not uncommon in the mountains. It is probably a question of a sort of polyploidy, but this has not yet been definitely decided. The two varieties — var. *grandiretis* of *L. silvicola* and var. *lapponica* BUCH & S. ARN. of *L. Wenzelii* — included in this list of species have not yet been published, but the descriptions will appear shortly.

High Peak, *c* 1400 m» (A); var. *grandiretis* BUCH et S. ARN. — the steep S slope about 1 km NE of the Nirjijokk waterfall.

The main species, of which we have only one specimen from the district, is said by ARNELL to occur »up to 1400 m».

**Lophozia ventricosa** (DICKS.) DUM.

This species is probably common in the subalpine and low-alpine belts of the district. It appears to extend to a considerable height in the high-alpine region. But the specimen from SE Peak is a large-celled form, and was found growing together with *Diplophyllum taxifolium* var. *macrostictum*.

»Precipice by Kummajoki *c* 2 km N of Gåbnetjåkko — —, 550 m» (W); »Peldsa» (A); the birch forest; SE Peak, 1450 m.

**Lophozia Wenzelii** (N.) ST.

Like *L. alpestris*, this species is especially common in the alpine region. It occurs most frequently on the peaks and ridge-tops.

Var. *lapponica* is a large-celled form, distinguished by ARNELL and BUCH. See also *L. silvicola*!

Middle Peak (A); do., 1440 m.; High Peak (A); do., 1517 m; the ridge-top NE of cirque 5, 1400 m; cirque 5, 920 m; Pältsavagge; var. *lapponica* BUCH et S. ARN.; Gåbnetjåkko, NW part; High Peak, 1400 m.

**Mylia anomala** (HOOK.) GRAY

This species was found only twice, in the lower alpine region. In both cases it occurred as a minor component of mixed tufts which were made up of *Dicranum elongatum, Orthocaulis Binsteadii, Polytrichum strictum, Sphagnum fuscum, Sphenolobus minutus*, and other species. *M. anomala* often occurs in bog tufts of mires, and it presumably does so here as well. The frequency of its occurrence appears to decrease quite rapidly in the lower alpine region.

Gåbnetjåkko, the NW part, 600 m; SE Peak, the NE slope, 650 m.

**Mylia Taylori** (HOOK.) GRAY

*M. Taylori* has only been found on a single occasion in the area. However, it grew in abundance in that one locality, the substrate being the cracked surface of solifluction soil on the terminal moraine at the mouth of the cirque valley. As it is not at all difficult to recognise the species in the field, we may assume that it is rare. It usually occurs as a reddish brown growth unmixed with other species, or occasionally, like *Mylia anomala*, as a constituent of bog tufts or among other mosses of poor fens. It is well to note that *M. anomala* may sometimes occur in a reddish brown form. The whitish yellow gemmae of *M. anomala*, which are often quite abundant, are a good field character.

The shore of the lake in cirque 5, 920 m.

**Nardia Breidleri** (LIMPR.) LINDB.

*N. Breidleri* occurs in the area from the tree-line up to 1400 m. It has been found in snow-beds where the snow belts late, mainly together with *Anthelia Juratzkana*, but also by itself in the form of small reddish brown patches.

»Peldsa, up to 1400 m» (A); the esker, c. fr.

**Nardia crassula** LORB.

This species, for which the description has not yet been published, is a diploid *N. geoscyphus* (K. MÜLLER, 1939, pp. 141, 142). It differs from the

latter species in that the cells are larger and the leaves two-lobed. It was found growing on a shelf in the precipitous slope, together with *Leiocolea Gilmanii*, *Myurella julacea* and *Timmia norvegica*, that is to say, in an environment which was clearly calciferous. The distribution of the species in Fennoscandia is still incompletely known, only a few localities having been reported.

S Peak, the SE steep, *c* 1000 m.

**Nardia geoscyphus** (DE NOT.) LINDB.

*N. geoscyphus* is described in ARNELL's list of species as »particularly common», and at the lower altitudes it seems to occur almost everywhere there is bare poor soil or sand. It is abundant on the banks of streams, in snow-beds where the snow melts late, along paths, and so on, and exhibits a variety of forms as far as colour and size are concerned.

»Peldsa» (A); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; Low Peak, 1050 m; NE slope, 700 m; cirque 5, 900 m.

**Nardia scalaris** (SCHRAD.) GRAY

This species is of general occurrence at the lower levels, and its habit resembles those of the preceding species. It appears to be absent in the belt of calcareous slate, but it recurs on the actual peaks, as, for instance, at almost 1450 m on Middle Peak, where it was found growing together with *Arctoa fulvella* and *Pogonatum capillare*.

»Peldsa, on the mountain slope; do., in the valley, 700 m; precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); »Peldsa, common» (A); S Peak, *c* 1400 m; Middle Peak, the peneplain, 1448 m.

**Orthocaulis atlanticus** (KAAL.) BUCH

This species has its main territory in the region of the Norwegian west coast up as far as the Finnmark province, but it has also been found in recent years as a high-alpine moss in the Swedish mountains.

»High Peak, 1400 m» (A).

**Orthocaulis Binsteadii** (KAAL.) BUCH

The only place that I found unmixed specimens of this species was on Lassivare; otherwise, it was always in mixed tufts of *Dicranum elongatum*, *Mylia anomala*, *Polytrichum strictum*, *Sphenolobus minutus*, and other species.

Gåbnetjåkko; Lassivare; SE peak, NE slope, 650 m.

**Orthocaulis Floerkei** (W. & M.) BUCH

ARNELL says the species is common »in the mountain localities visited». I myself have noticed its abundance in the dwarf-birch heaths along the esker.

»Peldsa» (A); the esker; SE Peak, above Måskojaure, 950 m.

**Orthocaulis Kunzeanus** (HÜB.) BUCH

*O. Kunzeanus* is common in the lower parts of the district. In the upper birch forest and the lower alpine region I saw it here and there in fens and

on the banks of streams. Its frequency seems to decrease rapidly after that, and there is no certain record of its occurrence at heights greater than 900 m. If the species were equally common at higher levels, it should at least have been found as a constituent of other samples.

»Peldsa, in the valley, 750 m» (W); »Peldsa» (A); Gåbnetjåkko; the birch forest; Lassivare; Nirjijaure; cirque 5, 900 m.

**Orthocaulis quadrilobus** (LINDB.) BUCH

This species is fairly common on Pältsa. It has been found in fens together with *Drepanocladus revolvens,* among others, and on ground more of a heath type among *Ditrichum flexicaule* and *Hypnum Bambergeri.* One of the localities on Low Peak was a snow-bed, where it grew together with *Leiocolea arctica.* ARNELL also includes in his list a form called *heterophylla,* found at a height of 1400 m.

»Peldsa, several places» (A); S Peak, S steep, 1000 m; Low Peak, 1120 m; SE Peak, NE slope, 700 m; cirque 5, 900 m.

**Plectocoea obovata** (N.) MITT.

The unspecified locality given by ARNELL seems to have been in the northwestern part of the district. ARNELL also found *P. obovata* on Tjårrokaise.

»Peldsa» (A).

**Saccobasis polita** (N.) BUCH

ARNELL describes this species as common, without further specification; I myself have collected only a few specimens at a low level. At the foot of South Peak it was found growing together with *Lophozia alpestris* and *Scapania irrigua* among *Sphagnum compactum.* I observed it as mass vegetation at the edge of a spring on the tree-line.

»Peldsa» (A); *c* 1 km N of the Nirjijokk waterfall; S Peak; Low Peak.

**Sphenolobus minutus** (CR.) ST.

*S. minutus* is very common in the region, and is one of the most usual constituents of *Dicrana* tufts, predominantly *D. elongatum* and *D. fuscescens.* It occurs even at considerable heights, although not at all so frequently as lower down.

»Peldsa, in the valley, 700 m» (W); »the precipice by Kummajoki, *c* 2 km N of Gåbnetjåkko, 550 m» (W); »Peldsa» (A); Gåbnetjåkko; the birch forest; S Peak; Middle Peak, up to 1448 m; Low Peak; the ridge-top NW of cirque 5, 1410 m.

**Temnoma setiforme** (EHRH.) HOWE

I found this in a few places in the boulder ground of the subalpine region. It is scarce in the lower alpine regions, but very common on the actual peaks and ridge-tops, either singly or in association, principally with *Gymnomitrium concinnatum* and *Rhacomitrium lanuginosum. T. setiforme* does not attain its upper limit in the district, as the peaks are altogether too low.

»Peldsa, on the mountain slope, *c* 900 m» (W); »Peldsa, common up to 1400 m» (A); Gåbnetjåkko, N steep; the steep S slope *c* 1 km NE of the Nirjijokk waterfall; S Peak; Middle Peak; Low Peak; High Peak; the ridge-top NW of the cirque valleys; SE Peak.

**Tritomaria quinquedentata** (HUDS.) BUCH

This species is very common in the district, up to a height of 1000 m at least. Station and habit vary considerably. Turgid fen forms are frequent. The variety *tenera,* on the other hand, seems to be rare.

»Peldsavagge» (TH. FRIES, 1913, p. 115); »Peldsa, in a fen in the valley, 700 m» (W); »precipice at Kummajoki, *c* 2 km N of Gåbnetjåkko, 550 m» (W); »Peldsa» (A); Gåbnetjåkko; the birch forest; S Peak, up to 1330 m; Low Peak (also var. *tenera* (ARN. et JENS.) H. WEIM.); High Peak, 1300 m; Pältsavagge.

**Tritomaria scitula** (TAYL.) JÖRG.

*T. scitula* is widely distributed in the district, and usually occurs sparsely among other hepatics, such as *Leiocolea* species, *Peltolepis grandis* and *Sauteria alpina.*

»Precipice by Kummajoki, *c* 2 km N of Gåbnetjåkko, 550 m» (W); Middle Peak, »several places up to a height of 1400 m» (A); Gåbnetjåkko, N steep; the steep S slope about 1 km NE of the Nirjijokk waterfall; Low Peak, 1120 and 1180 m; the sub-peak of High Peak, S slope towards Pältsavagge, 1100 m.

## Harpanthaceae.

**Harpanthus Flotowianus** N.

*H. Flotowianus* is common beside streams and springs in the birch forest and the lower alpine region along Nirjijokk and up to Nirjijaure. None of the specimens from the district seems to have originated from a height above 800 m.

»Peldsa» (A); the birch forest; Nirjijokk; Low Peak; Måskojaure.

**Lophocolea minor** N.

In the subalpine region the species was found growing between stones and boulders together with *Leiocolea heterocolpos.* The other two specimens were found in snow-beds; in one case, the moss grew by itself on a boulder; in the other case, together with *Asterella Ludwigii.*

The steep south slope about 1 km NE of the Nirjijokk waterfall; S Peak, SE and S slopes, 700 m.

## Plagiochilaceae.

**Plagiochila asplenioides** (L.) DUM.

The only place in which this species was at all common was at the foot of Gåbnetjåkko vertical face. On Low Peak it grew in crevices in the broken limestone ground together with *Ditrichum flexicaule, Hypnum revolutum* and *Rhacomitrium lanuginosum.* The variety *subarctica* is one of the many forms of this hepatic, and is distinguished in its habit mainly by the manner in which the shoot is markedly compressed from the sides.

Gåbnetjåkko, the N steep; S Peak, the S steep (var. *subarctica* JÖRG); Low Peak, the SW slope, 1140 m.

## Scapaniaceae.

**Diplophyllum albicans** (L.) DUM.

This species, which is reported by ARNELL as new to Torne Lappmark, is surprisingly frequent, and occurs at remarkably high levels. It would appear that the region in which ARNELL says it is common is limited to the lime-deficient slopes to the NW of High Peak and its sub-peak.

»Peldsa, common up to 1400 m» (A); S Peak, NW slope, *c* 1400 m; Middle Peak, the peneplain, 1448 m.

**Diplophyllum taxifolium** (WAHL.) DUM.

The main form is considerably rarer than the variety, and only represented by one specimen. This was found on the shore of Nirjijaure, growing on a boulder in a bog. Var. *macrostictum* is more common, and occurs very high up. It grew on Middle Peak between stones and boulders together with *Lophozia alpestris, L. Wenzelii* and *Temnoma setiforme.* WEIMARCK states that the variety is common in the area.

High Peak (A); Nirjijaure, the NW end, 770 m, var. *macrostictum* BUCH: »the precipice by Kummajoki, 550 m» (W); »Peldsa» (A); Gåbnetjåkko, the N steep; the birch forest; Middle Peak, the E steep, *c* 1400 m; SE Peak, 1450 m.

**Scapania calcicola** (ARN. & PERSS.) INGH.

According to ARNELL, the species grew with *Jungermania Schiffneri* and *Tritomaria scitula.*

Middle Peak, *c* 1400 m (A).

**Scapania curta** (MART.) DUM.

The species is probably common at the lower levels. It was found in various habitats, such as on alluvial sand, alongside paths, soil slopes, etc.

»The precipice about 2 km N of Gåbnetjåkko by Kummajoki» (W); »Peldsa, in the valley», (W); »Peldsa» (A); the Nirjijokk waterfall; S Peak, SE slope, 850 m; SE Peak.

**Scapania cuspiduligera** (N.) K. M.

ARNELL says that he find the species »in several places» in the district. But it does not seem to be common on Pältsa, as, with its reddish black clusters of gemmae, it is usually easy to recognise, and I could hardly have failed to notice it if it were common.

Middle Peak (A).

**Scapania gymnostomophila** KAAL.

This calcicole moss grew on South Peak both in a compact mat of *Ditrichum flexicaule* and together with *Arnellia fennica.* It was comparatively unmixed on High Peak, with some shoots of *Myurella julacea* growing amongst it.

»Peldsa, 1000 m» (W); S Peak, 900 and 1000 m; High Peak's sub-peak, the steep south slope towards Pältsavagge, 1100 m.

**Scapania hyperborea** JÖRG.

*S. hyperborea* is common in the lower alpine region. ARNELL reports that when he was looking for *S. tundrae*, he found *S. hyperborea* growing densely on the shores of Nirjijaure. The species has not been found higher than 800 m.

»Peldsa, in the valley, 700 m» (W); Nirjijaure (A); Nirjijokk.

**Scapania irrigua** (N.) DUM.

This species, together with the two varieties, occurs frequently in streams and fens in the birch forest and the lower alpine region. It has not been found at heights greater than 920 m.

»Peldsa, in the valley, 700 m (var. *rufescens* BUCH)» (W); »the precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); »Peldsa» (A); the birch forest; Nirjijokk, *c* 1 km above the tree-line (var. *rufescens* BUCH); S Peak (var. *rubescens* BUCH); Low Peak; cirque 5, 920 m.

**Scapania Kaurinii** RYAN.

According to ARNELL, the moss is common between 1200 and 1500 m. The species seems to extend over the whole Måskokaise chain, as it is also abundant on South-east Peak. But I was unable to find it on the peaks belonging to the actual Pältsa group. Its habit in this district is reminiscent of *S. spitzbergensis*. The associated species on South-east Peak were *Gymnomitrium concinnatum, Lophozia alpestris, Marsupella apiculata* and *Temnoma setiforme*.

*S. Kaurinii* is a distinctly high-alpine hepatic in Scandinavia. The lowest level at which the species is reported in this neighbourhood is 1000 m, a figure given by WEIMARCK for a specimen from Rapitsatja, a mountain about 10 km to the east of Pältsa. JÖRGENSEN, in his flora (1934, p. 221), gives a figure of 750 m for a locality in Sör-Tröndelag (Vangsfjell), and this seems to be the lowest level known. On the other hand, it also occurs at remarkably high levels. I collected it on the summit of Kuåtotjåkko in Torne Lappmark, at a height of about 2000 m.

High Peak and its sub-peak, 1200—1500 m (A); SE peak, 1450 m.

**Scapania lapponica** (ARN. & J.) ST.

The sample from the esker contains a little *S. lapponica* in association with *Cephalozia ambigua*. They grew on fine moist sand.

*S. lapponica* was described by H. W. ARNELL and C. JENSEN (1907, pp. 93 and 94) from material collected in 1902 on sand by Kåtokjokk in the Sarek region. The scantiness of the material inclined many hepaticologists to doubt the value of the species (e.g. BUCH, 1928, p. 101). Furthermore, floras usually give only single localities. Thus JÖRGENSEN (1934, p. 226) mentions only a Norwegian locality, where HAGEN collected it in 1902, while H. W. ARNELL, in his liverwort flora (1928, p. 139), mentions only one find from Abisko apart from the original one. It was not until recently that *S. lapponica* was rediscovered by ARNELL, who found it on Helagsfjället in north-west Härjedalen. A closer examination of the material from Torne Lappmark by him and BUCH has revealed the occurrence of the species in the Pältsa and Nuolja districts; (the locality given as »Nuolja, Kåppasjokk, on alluvial sand, *c* 800 m»

refers to *S. lapponica,* and not to *S. tundrae* which is adjacent in the list). It remains to be seen how rare this species really is. It is easily overlooked on account of its small size, and it appears to be too rare to be collected by chance. It will be seen from the above that its habitat is almost the same for the specimens hitherto collected. A further guide for the collector is the fact that in its habit the species often resembles a small *Marsupella,* as JÖRGENSEN also points out in his flora (loc. cit.). The position of the species is not yet definitely clear. ARNELL reports that he has succeeded in inducing culture specimens of *S. lapponica* to develop gemmae resembling those found in other species of the *Scapania* genus. But he has not found any perianths, so we should be prepared for possible surprises. The structure of the pedicel of the antheridium also agrees with that of other Scapania.

»Peldsa, above Nirjijaure» (A); the esker, just above the tree-line.

**Scapania lingulata** BUCH

*S. lingulata* has been found in only a few localities in Torne Lappmark, and there is only one specimen of it from the Pältsa district. The specimen includes, besides *S. lingulata, S. curta, Jungermania sphaerocarpa* and *Cephalozia bicuspidata.* It is very probable that the species is rare in the district, although, as ARNELL has kindly informed me, he has also found it on the Norwegian mountain Paras, just north-west of Pältsa.

»Peldsa, in the valley, 700 m» (W).

**Scapania mucronata** BUCH

Only the variety *praetervisa* BUCH has been found in the district. It grew on fine sand between boulders, together with *Leiocolea heterocolpos.*

The S steep *c* 1 km NE of the Nirjijokk waterfall (var. *praetervisa* BUCH).

**Scapania paludicola** LSKE & K. M.

Details about the single specimen are lacking. WEIMARCK, however, found the species in six places in all within this neighbourhood, though none of them was at a height greater than 750 m, so that there is reason to believe that the species occurs only seldom in the alpine region, here as in other parts of the mountain chain.

»Peldsa, in the valley, 700 m» (W).

**Scapania paludosa** K. M.

Like the preceding, this species seems to be rare in the district. It was found growing together with *Harpanthus Flotowianus.*

Nirjijaure's outflow stream, 750 m.

**Scapania scandica** (ARN. & B.) MACV.

No exact locality is given for the species, but it seems that the specimen originated in the lower levels of the Nirjijaure region. ARNELL informs me that he has also collected *S. scandica* in the birch region of the nearby Norwegian mountain Paras.

»Peldsa» (A).

**Scapania spitsbergensis** (LINDB.) K. M.

ARNELL says that the species is common on High Peak. I also found it to be frequent there — where the snow had melted away. It grew on soil and alluvial sand between boulders and stones, sometimes by itself, and sometimes together with *Grimmia incurva, Gymnomitrium concinnatum, Lophozia alpestris, L. Wenzelii, Rhacomitrium lanuginosum* and *Temnoma setiforme*. A. has also found individual plants with gemmae buds. The gemma is described as »brown, unicellular as in *Sc. nemorosa*». The spores are described as minutely papillose and 14—20 μ in size, and the oil droplets in the cell are said to vary between 5 and 10 in number, being of a clear faint brown colour.

*S. spitsbergensis* is a species which has been regarded as very rare. It was first collected in Scandinavia in 1902 by W. ARNELL and C. JENSEN (1907, p. 95) on Pellorepe in the Sarek mountains, and previous to that was only known from Spitsberg and a place in Siberia. During the last twenty years it has been found in several other localities in the Swedish mountains, particularly in Torne Lappmark, and has also been reported from Finland and Norway. However, little is yet known about the distribution of the species in Fennoskandia, despite the fact that it is easy to recognise on account of its large size and reddish colour.

»High Peak and its sub-peak, 1200—1500 m, c. fr.» (A); the plateau to the W of cirque 5, *c* 1400 m.

**Scapania subalpina** (N.) DUM.

*S. subalpina* is common at lower levels in the district, and I found it in several places, often growing thickly, by the small streams running into Nirjijokk in the birch forest and just above it.

»The precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); »Peldsa» (A); Gåbnetjåkko; the birch region; Nirjijokk, just above the tree-line.

**Scapania tundrae** (ARN.) BUCH

In his species list ARNELL gives this species as new for Sweden, and mentions Nuolja besides the localities given below. (The Kåppasjokk locality is therefore not included; A. changed his determination to *S. lapponica* on further examination). It seems that another specimen which I collected on the north-western part of Gåbnetjåkko is also *S. tundrae*.

Altogether too little is known about *S. tundrae* as yet for any opinion to be advanced on its distribution. JÖRGENSEN's flora gives only two localities, one on Galdhöpiggen and the other in Opdal in Sör-Tröndelag.

Middle Peak; Low Peak; Nirjijaure (all A).

**[Scapania uliginosa** (SW.) DUM.**]**

No specimens, notes, or other information are available to confirm the occurrence of this species in the district. But ARNELL has found it on the nearby mountains Tjårrokaise and Paras, so it is reasonable to suppose that is has only not been noticed here. But *S. uliginosa* is usually quite common in a region if it does occur there, which suggests that it is unlikely that it was overlooked. Moreover, the substratum seems to be too alkaline over the greater

part of the district, and the heights somewhat large, for this moss to grow in any abundance.

**Scapania undulata** (L.) DUM.

*S. undulata* has been found in the district only in the birch region, and up to a height of barely 750 m. It was usually growing on stones in the flood verges of streams. There are no collected specimens.

»Nirjijaure» (A); the birch region.

## Trigonanthaceae.

**Cephalozia ambigua** MASS.

**Cephalozia bicuspidata** (L.) DUM.

These two similar species are common in the district. The choice of name is in many cases arbitrary, and some authors of flora (e.g. H. W. ARNELL, 1928, p. 162; JÖRGENSEN, 1934, p. 264) consider *C. ambigua* to be merely a mountain form of *C. bicuspidata.* However, since LORBEER has shown that *C. ambigua* has 9 chromosomes and *C. bicuspidata* 18, we must regard them as separate species. But it is often doubtful to which species a form of intermediary habit should be assigned. All the finds were made at low levels.

*C. ambigua*: »Peldsa» (A); Gåbnetjåkko; Nirjijokk, on and just above the treeline; Måskojaure.

*C. bicuspidata*: »Peldsavagge» (TH. FRIES, 1913, pp. 74 and 119); »the precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); »Peldsa, in the valley, 700 m» (W); Nirjijokk, above the waterfall.

**Cephalozia leucantha** SPR.

»Kummajoki, *c* 2 km N of Gåbnetjåkko» (W); »Peldsa» (A); Gåbnetjåkko; Nirjijokk, above the waterfall.

**Cephalozia media** LINDB.

»Peldsa, in the valley» (W); »the precipice by Kummajoki *c* 2 km N of Gåbnetjåkko» (W); »Peldsa» (A); the birch forest; Nirjijokk, above the waterfall; SE Peak, E slope; cirque 5, 920 m.

**Cephalozia pleniceps** (AUST.) LINDB.

ARNELL designates these three species as »common» in his species list. This appears to apply to the subalpine and lower alpine regions in this district. I myself paid no great attention to the *Cephalozia* genus, merely taking a few specimens from the parts of the area which had not previously been investigated.

»Peldsa» (A); the birch forest.

**Cladopodiella Fransisci** (HOOK.) BUCH

The species was found in a snow-bed, where it was growing together with *Lophozia alpestris* and *L. Wenzelii.*

It seems likely that *C. Fransisci,* like many other small hepatics, is often

overlooked. ARNELL gives it in his list as new for Torne Lappmark, and mentions three localities, one of which is Nuolja — among our best known mountains from the bryological point of view. He also states that the species is »fairly common on bare soil and in snow-beds».

The moraine below cirque 5, 900 m.

**Hygrobiella laxifolia** (HOOK.) SPR.

This species was found by a small stream flowing into Nirjijokk from the south-west, growing together with *Hygrohypnum alpestre* and *Jungermania cordifolia.*

»Peldsa, by Nirjijaure» (A); Nirjijokk, on the tree-line.

**Odontoschisma elongatum** (LINDB.) EVS.

This species appears to be common at lower levels within the district. I came across it several times in dried-up pools on the north-west part of Gåbnetjåkko, and saw it here and there in rock pools along Nirjijokk. It was often together with *Gymnocolea inflata.*

»Peldsa» (A); Gåbnetjåkko; Nirjijokk.

**Odontoschisma Macounii** (AUST.) UNDERW.

*O. Macounii* is common on Pältsa. On South Peak it was abundant, occurring together with *Arnellia fennica* in many places, and it was widely distributed and common on the soil terraces of Low Peak, where some of its companion species were *Hypnum Bambergeri, Leiocolea arctica, Lophozia grandiretis* and *Orthothecium chryseum.*

»Peldsa, several places» (A); S Peak, SE steep, *c* 1000 m; Low Peak, the slope towards Nirjijaure, 1000—1150 m.

**Pleuroclada albescens** (HOOK.) SPR.

*P. albescens* is very common in the district, from the tree-line high up into the alpine region. It was found on alluvial sand, percolation surfaces, in snow-beds where the snow melted late, and other similar localities. Most of the material seems to belong to the mountain form, var. *islandica* (N.) SPR.

»Peldsavagge» (TH. FRIES, 1913, p. 74); »Peldsa, snow-bed in the valley, 750 m» (W); High Peak (A); Gåbnetjåkko; Nirjijokk's waterfall; Lassivare; S Peak; Middle Peak; SE Peak; Pältsavagge.

## Marsupellaceae.

**Gymnomitrium concinnatum** (LIGHTF.) CDA.

This species is common, its frequency increasing with height. It is thus very common on the actual summits and ridge-tops, where it grows together with *Andreaea* species, *Grimmia incurva, Marsupella apiculata, Pogonatum capillare, Temnoma setiforme,* and other high-alpine types. Fructiferous or otherwise fertile individuals were rare.

»Peldsa, snow-beds in the valley, 750 m, c. col.» (W); »Peldsa» (A); Gåbnetjåkko; Middle Peak; High Peak, 1518 m; SE Peak; Pältsavagge.

**Gymnomitrium corallioides** N.

*G. corallioides* is common in the district, especially on wind-exposed knolls at lower levels — it is, for instance, abundant along the esker. Its usual companions are *G. concinnatum* and *Prasanthus suecicus*. The species seems to be fairly independent with respect to the substratum, and also occurs at very considerable heights.

»Peldsa, 1200 m» (W); »Peldsa» (A); Gåbnetjåkko; the esker; S Peak; Middle Peak, 1448 m; SE Peak, 1450 m; Pältsavagge.

**Gymnomitrium varians** (LINDB.) SCHFFN.

The species was found in two places. In the locality last mentioned it was growing together with *G. concinnatum, Pogonatum capillare* and a *Pohlia* species which could not be identified.

The sub-peak of High Peak (A); the plateau between the ravine to the north-east and cirque 5, *c* 1300 m.

**Marsupella apiculata** SCHFFN.

*M. apiculata* is common from about 1000 m upwards. The most usual companion species in samples taken from the actual peaks is *Gymnomitrium concinnatum*.

»Peldsa» (A); S Peak, 1400 m; Middle Peak, the peneplain, 1448 m; High Peak, 1400 m and 1517 m; SE Peak, 1400 m; Pältsavagge, 920 m.

**Marsupella Boeckii** (AUST.) LINDB.

ARNELL is the only one to have seen this species, which is easily overlooked.

»High Peak, 1400—1500 m» (A).

**Marsupella condensata** (AONGSTR.) KAAL.

This species is common, and has been found in snow-beds where the snow melts late and in places where water percolates, from a height of 800—900 m upwards.

»Peldsa» (A); Middle Peak, the peneplain, 1448 m; High Peak; the plateau between the ravine to the NE and cirque 5; SE Peak; Pältsavagge.

**Marsupella emarginata** (EHRH.) DUM.

This moss is conspicuously rare in the district, and has not been found on Pältsa itself. In other areas, where the rock types are more acid, it is usually prominent. The specimen which was collected came from a percolation surface, and includes some shoots of *Drepanocladus uncinatus* and *Hylocomium splendens*.

Gåbnetjåkko, the N steep, ♂.

**Prasanthus suecicus** (G.) LINDB.

I observed *P. suecicus* in abundance in several places along the esker, and it probably occurs in many other wind-exposed localities within the area.

regardless of height. *Gymnomitrium coralloides* seems to be its almost invariable companion. Fructiferous specimens are also common.

»Peldsa» (A); the esker, c. fr.; S Peak; Low Peak; the ridge-top W of cirque 5, 1400 m, c. fr.

## Radulaceae.

**Radula complanata** (L.) DUM.

This species grew in a thick mass on a large overhanging boulder, with some *Leskeella nervosa* among it. The specimen had some empty capsules. *R. complanata* appears to be rare in these regions, as only single stray finds have been made. WEIMARCK found it on Gapovare, just north of Pältsa.

The south steep *c* 1 km NE of the Nirjijokk waterfall, c. fr.

## Haplolaenaceae.

**Blasia pusilla** L.

*B. pusilla* is very widespread along the sandy shores of Nirjijokk, both below and a good deal above the tree-line. It decreases in frequency higher up, although ARNELL has found it at about 1400 m, a remarkable height for this latitude. The species' usual companions were badly developed specimens of *Calliergon sarmentosum, Philonotis tomentella* and *Pohlia gracilis.*

»Peldsa, by the stream in the valley, 700 m» (W); Middle Peak, *c* 1400 m (A); Nirjijokk.

**Pellia Neesiana** (G.) LIMPR.

*P. Neesiana* is very common at the lower levels within the district, and is seldom lacking on the edges of streams and snow-beds. There is no information about the occurrence of the species at higher levels. I myself have not noted it from a height greater than 870 m, though this height is merely a routine item in my notes, as I did not pay particular attention to the species. Only sterile specimens have been found.

»Peldsa» (A); the birch forest; Nirjijokk; S Peak; Middle Peak; Low Peak; SE Peak; Nirjijaure; Pältsavagge; Måskojaure.

## Dilaenaceae.

**Moerckia Blyttii** (MOERCK) BROCKM.

This species was found in abundance only in Pältsavagge, where it often occurs in the many snow-beds where the snow melts late. It was collected with fruits only once.

The moraine below cirque 5, 900 m, c. fr.; Pältsavagge, *c* 800 m; SE Peak, above Måskojaure, 950 m.

## Aneuraceae.

**Riccardia pinguis** (L.) GRAY

This species appears to be common in fens up to about 1000 m. There is no information about the frequency of the species, and I myself just noted it or collected it from a few localities where the heights were of particular interest, in view of the fact that JÖRGENSEN (1934, p. 40) gives its vertical distribution as »from sea level to at least 1100 m in southern Norway and 600 m in the north».

High Peak (A); S Peak, *c* 1000 m; Low Peak, 1015 m.

## Marchantiaceae.

**Marchantia polymorpha** L. var. **alpestris** N.

This mountain form is common at lower levels, and grows particularly abundantly and luxuriantly in the marshy willow scrub by Nirjijokk. It often occurs in the lower alpine region in the snow-beds rich in species, together with *Asterella Lindenbergiana* and *Preissia quadrata,* among others. It has not been found at any considerable height, and I myself have not noted any reliable height value greater than 900 m. Fertile specimens are rare.

»Peldsa» (A); Gåbnetjåkko; the birch forest; S Peak, c. fr.; Low Peak, c. fr.; SE Peak; Pältsavagge.

**Preissia quadrata** (SCOP.) N.

*P. quadrata* is common up to about 1000 m. It has been found in snow-beds, in crevices, and on shelves in steep slopes, and it often grows together with other *Marchantiaceae,* such as *Asterella Lindenbergiana, Peltolepis grandis* and *Sauteria alpina.* Both male and female inflorescences have been found.

»Peldsa» (W, A); Gåbnetjåkko, the N steep, c. fr.; the Nirjijokk waterfall, c. fr.; Lassivare; S Peak, c. fr.; Middle Peak; Low Peak, c. fr., up to 1100 m; SE Peak, c. fr.; Pältsavagge; cirque 5.

## Operculatae.

**Asterella Lindenbergiana** (CDA) LINDB.

Pältsa is the classic Swedish locality for this species, which was collected there as early as 1859 by C. P. LAESTADIUS, a find to which a specimen with spores in the Uppsala herbarium bears witness. The species is no rarity on Pältsa, and perhaps occurs most abundantly on the slopes of Low Peak towards Nirjijaure. It was found there as particularly fine specimens, abundantly fructiferous, at the foot of the soil terraces which there often form the edges of snow-beds.

*A. Lindenbergiana* is a hepatic whose rarity has certainly been exaggerated. In spite of its size it is often overlooked, as the forms which are found in some sunny dried-out snow-beds are often markedly red-brown in colour and easily confused in the non-fructiferous state with *Preissia quadrata,* which is very common in such a habitat. But in the fructiferous state, or in the

brilliant light green form which occurs at the foot of steeps or in rock holes, it is easy to recognise. Some species which are often found in the company of *A. Lindenbergiana* are *Brachythecium glaciale, Marchantia polymorpha* and *Pellia Neesiana.*

»Peltsanafjell» c. fr. (C. P. LAESTADIUS, 1859); »Peldsa» (M); S Peak, SE slope, c. fr.; do., NE slope, 1040 m; Low Peak, the slope towards Nirjijaure, c. fr.; SE Peak, NE slope, 700 m; the moraine below cirque 5, 900 m; Pältsavagge, below Middle Peak, 850 m.

**Asterella Ludwigii** (SCHW.) LINDB.

The specimen of this species which I found came from a snow-bed at the foot of S Peak, where it grew together with *Lophocolea minor.* Strangely enough, I did not find it on the actual steep slopes, where *Marchantiaceae* were abundant in the summer of 1948.

»Peldsa, in the valley, 750 m, c. fr.»; do., »in a soil-filled crevice in a snow-bed, *c* 1000 m» (W); S Peak, SE slope, *c* 800 m, c. fr.

**Mannia pilosa** (HORNEM.) FRYE & CLARK

There is only a scanty specimen of this species from my first visit to Pältsa. It was growing in crevices filled with fine gravel. I was unable to find it again the next summer.

S Peak, SE slope, *c* 1000 m, c. fr.

## Astroporae.

**Clevea hyalina** (SOMM.) LINDB.

This hepatic was growing in small holes and crevices in the weathered slate on the steep slopes in both localities. Occasional shoots of *Distichium capillaceum, Mnium orthorrhynchum* and *Orthothecium intricatum* also occur in the specimens. The species was scanty in both cases. But it might be expected to be considerably less rare on Pältsa in more favourable summers.

S Peak, the SE steep, *c* 1000 m, c. fr.; the sub-peak of High Peak, the S slope towards Pältsavagge, 1050 m, c. fr.

**Peltolepis grandis** (LINDB.) LINDB.

This species is presumably common on Pältsa. It prefers crevices and holes in steep slopes, but it also grows in snow-beds, and is markedly calcicole. *Preissia quadrata* and *Sauteria alpina* are almost invariable companion species. The latter species and *P. grandis* were very abundant on Pältsa during the summer of 1948 up to a height of about 1100 m — in the list of localities I have been content to mention only localities in which I have collected specimens — while only traces of them were visible the following summer, which was unusually late. The specimens are usually fructiferous.

»Peldsa, in the valley, 750 m» (W); »Peldsa» (A); Gåbnetjåkko, the N steep, c. fr.; S Peak, c. fr.; Pältsavagge, c. fr.; cirque, c. fr.

**Sauteria alpina** (N.) N.

This species resembles the preceding one in habit. It is probably more common, although this may be a mistaken impression, since it is much easier to

see the whitish green thalli of *S. alpina* than those of *Peltolepis grandis*, which are as a rule entirely green. *S. alpina* has been found in the district up to a height of 1200 m. It is usually fructiferous.

»Peldsa, in a snow-bed in the valley, 750 m; do., on a landslide slope, 750 m; do., in a soil-filled crevice, *c* 800 m, c. fr.; do., in a crevice with perennial snow, *c* 1000 m» (W); »Peldsa» (A); Gåbnetjåkko, the N steep, c. fr.; the Nirjijokk waterfall, c. fr.; S Peak; Middle Peak, c. fr.; Low Peak, 1100 m, c. fr.; SE Peak, the S slope, 1200 m; Pältsavagge, c. fr.; cirque 5.

## Musc .

Hj. Möller may be regarded as the first to visit Pältsa for mainly bryological reasons. There are, of course, earlier finds or information from Wahlenberg, C. P. Laestadius and Th. Fries, but they provide only a very incomplete picture of the moss flora of the area. An account of Möller's visit has already been given in the summary of the botanical investigations of the district. An examination of M.'s finds — I have consulted not only the reports to be found in »Lövmossornas utbredning i Sverige» (1913—1936) but also the collection of the Swedish Museum in Stockholm — shows that he collected primarily species belonging to the genera which he was going to treat in his monograph. He collected the greater part of the species which are now known for the district for the *Mnium* and *Cinclidium* genera, but I have not been able to find that he collected a single *Brachythecium* species. M. may have determined the material which was of interest for his monograp and left the rest somewhere, where it may still be lying. However, this is hardly probable since many other species which were not included in the monograph are in the Museum's herbarium.

Möller's localities have been denoted in the species list by (M). Where this letter is followed by a reference, the latter refers to M.'s work mentioned above. His information has only been checked in those cases where I have not refound the species.

After Möller's visit, it was not until 1929 that the moss flora of the area was again the subject of a collector's interest. As previously mentioned, Weimarck collected many mosses there that summer. The localities taken from his book, »Bryologiska strövtåg i nordligaste Sverige», have been denoted by (W), without any reference. Here also, I have checked species which I did not succeed in finding within the district, apart from those belonging to the *Bryum* genus. According to

W., these were determined by Dr. HERMAN PERSSON, one of the experts on that genus.

Pältsa was visited in 1939 by S. ARNELL, who concentrated his attention on the liverworts. He did, however, collect some few musci as well. An account of A.'s contributions to our knowledge of the liverworts of the area is given in the introduction to the species list for that group.

TH. FRIES's name sometimes appears in the species lists. It is mainly in connection with localities taken from the test square analyses in his doctor's thesis (1913). It is difficult to say how much of his material is still in existence: I have come across only a few specimens in the Uppsala herbarium. All the species in question have been found in the district subsequently.

Prior to my visit to the district, the number of musci known there was about 100. I did not succeed in finding 12 of these, 6 of which were *Bryum* species. The number of species now known is 209,[1] a figure somewhat in excess of that given by KOTILAINEN (1924) and ROIVAINEN (1934, pp. 37—43) for the Kilpisjärvi district. Another figure for comparison is that of 260 species given by ARNELL and JENSEN (1910, p. 229) for the Sarek district. MEDELIUS (1927, p. 71) gives exactly the same figure for the Storlien district. For south-western Jämtland and the neighbouring parts of Härjedalen, the number given is 243, (HERM. PERSSON, 1915, p. 64). A direct comparison should not be taken too far, especially as the species divisions vary a good deal from one author to the next. Moreover, the districts involved are quite different in size and with regard to the lower height limit. The number of species occurring in the Pältsa district must therefore be regarded as high. The subalpine part of the district is small in area, and not very representative in other respects. It is not worth while therefore to attempt to divide up the species according to occurrence in the alpine or subalpine belts. It is only necessary to mention that the vertical surfaces on the north steep of Gåbnetjåkko, where so many good specimens were found, lie on the tree-line. If this steep were either a little higher up or a little lower down, so that it became either definitely alpine or definitely subalpine, it is hardly likely that the combination of species present there would change to any great extent.

I have probably set wider limits than previous authors in distinguish-

[1] 'Species' here includes those cases where the main form was lacking, the species being represented only by sub-species or varieties, the name(s) of which are given in the heading.

ing the species. Varieties have as a rule been included in the lists of localities only when someone other than myself has communicated them. I have preferred, where possible, to indicate the extent of the variation in the text. It is obvious that species must be subject to considerable variation in the mountains, where habitat and microclimate, for instance, change so much from place to place. This may usually be observed quite clearly in the field, and one is therefore somewhat sceptical about the plurality of varieties described — frequently with just a few words — for perhaps a single collected specimen. It cannot be denied that the variation is certain cases is of genetic origin, but a distinction between different ecotypes should clearly be based on a thorough study of the plants concerned, preferably with cultivation tests, where it is possible to do so. Naturally, in a paper of this sort it is not possible to go into all the questions of systematic interest which crop up. Consequently, it is necessary in many cases to follow convention rather than inner conviction.

The species which are given in square brackets are such as have been reported for the district, but for which the determination has later been changed on re-examining the specimens. Other species marked in this way are those for which the report of their occurrence in this area is probably mistaken, and where no confirmatory specimen could be found in the herbaria. In both these cases the species are of course ones which I did not succeed in finding.

The heights given for my finds are estimated if they are preceded by »*c*». Otherwise, they were measured with a »Thommen» altimeter. Since most localities were visited on several occasions, and moreover two instruments of this type were used, which were checked against each other, the figures given should be reliable.

The families of musci are arranged according to BROTHERUS (1924—25). The nomenclature on the whole follows STEERE (1947), although I have not accepted his large *Grimmia* genus. The same applies to some subdivisions which I find unnecessary for Scandinavian conditions. Where the authority given in one way or another (with BR. EUR., BR. & SCH., or B.S.C.) is BRYOLOGIA EUROPAEA (1836—55), the information has been checked, as there proves to be hardly any author who is consistent in this respect. BR. EUR. means here, therefore, that the species is given in that work with a »Nob.». According to the title page, these species were defined by BRUCH, SCHIMPER and GÜMBEL in collaboration. Other species whose names come from the same work, but for which a special authority is given there, have been assigned the

abbreviations given by WEIMARCK (1937, pp. I—XVI). The abbreviation BR. & SCH. has been retained (for BRUCH & SCHIMPER), but it is advisable to point out that some authors, for reasons unknown to me, use this abbreviation to mean BR. EUR.

The material on which this list of musci is based is to be found in three museums. MÖLLER's collection is at the Swedish Museum in Stockholm, WEIMARCK's in the Lund Museum, and WAHLENBERG's and my own in Uppsala.

I would like to express my warmest thanks to Dr. HERMAN PERSSON, of the Swedish Museum in Stockholm, for check determinations and valuable discussions. I am also indebted to Dr. HUGO SJÖRS for help with some *Sphagna*.

## Sphagnaceae.

Our knowledge of the *Sphagnum* flora of the area is imcomplete, and the time I devoted to this genus was insignificant, my collecting being confined to an attempt to bring the number of species as near as possible to completeness. It seems that no one collected *Sphagna* in the Pältsa district prior to WEIMARCK.

**Sphagnum centrale** C. JENS.

This moss grew in the streamside willow verge together with *Orthocaulis Kunzeanus* and *Polytrichum commune*, among others, and appears to be rare in the district. This is the only find I made of any species belonging to the *Palustria* group. As this group is so seldom represented at such heights that I always collect practically any of its species, it is extremely unlikely that I should have overlooked such a moss as *S. magellanicum* BRID., for instance, if it had been observable.

The Lassivare stream.

**Sphagnum compactum** DC.

It seems that this species is not common either, in the parts of the district I wandered over.

The foot of S Peak towards the S.

**Sphagnum fuscum** (SCHIMP.) KLINGGR.

This moss forms characteristic brown cushions in mires in the birch region. It does not appear to be common in the higher parts of the area investigated.

»Peldsa, 750 m» (W); the birch forest; — the Lassivare stream.

**Sphagnum Girgensohnii** RUSS.

The species is probably common in a part of the swampy willow verge of Nirjijokk.

The birch forest; the sub-peak of High Peak, *c* 1200 m.

**Sphagnum Lindbergii** SCHIMP.

The only places where I saw this species in any abundance were on the outskirts of the district, in the neighbourhood of Måskojaure and Kummajärvi.

SE Peak, the E slope.

**Sphagnum rubellum** WILS.

Dr. H. SJÖRS assigned a specimen to this species with reservations.

The Lassivare stream.

**Sphagnum squarrosum** PERS.

The moss was found in the marshy willow verge, and I have no notes or recollection that I saw it growing elsewhere in the district. The species is in all probability rare at these heights.

The Lassivare stream.

**Sphagnum teres** (SCHIMP.) ÅNGSTR.

*S. teres* is one of the more common species of the genus in the district. WEIMARCK collected it from several places in Pältsavagge. The moss is found here and there in fens more or less rich in species. I observed a large form in the swampy osier beds along the Nirjijokk, growing together with *Helodium Blandowii* and *Paludella squarrosa*. More or less stunted forms are common, often as tufts with liverwort constituents such as *Cephalozia* species, *Orthocaulis Kunzeanus, Tritomaria quinquedentata.*

»Peldsa, in the valley, 700 m» (W); Nirjijokk; Nirjijaure.

**Sphagnum Warnstorfianum** DU RIETZ *S. Warnstorfii* RUSS.

This sphagnum is the most common species of the genus in the district. Its typical red growth may be seen everywhere in fens rich in species on the slopes of Pältsa. I have also observed it in the subalpine fens on several occasions.

»Peldsa, 650 m; do., 700 m» (W); the birch region; S Peak; Low Peak.

## Andreaeaceae.

**Andreaea Blyttii** SCHIMP.

*A. Blyttii* is probably not at all rare at higher altitudes. It was found growing in large red-brown to black carpets on percolation streaks filled with fine alluvial sand, together with small species belonging to the *A. rupestris* group, *Gymnomitrium concinnatum, Marsupella apiculata,* and other small liverworts. The moss was abundant in both localities, but without fruit.

High Peak, 1350 m (S. ARNELL, 1939)—1500 m; the plateau between the ravine to the NW and cirque 5, 1300—1400 m.

**Andreaea Hartmanii** THED.

A specimen in the Riksmuseum, Stockholm, has been classified in this species, which in my opinion should not really be given a higher rank than that of subspec. *obovata* of the following species.

»Peldsa Middle Peak, ca 1400 m», 1939 (H. SMITH & S. ARNELL).

**Andreaea rupestris** HEDW.

The main form is the most common of the *A. rupestris* group, and the most widely distributed, without regard to height. As regards the many subspecies, the greater part of them were collected from high-alpine localities, where they often grew thickly. *A. rupestris* exhibits little variation in the lowlands, but in its true territory it provides a great abundance of sub-species and forms. On high mountain plateaus I have often found slightly sloping sand-filled percolation streaks quite overgrown with *Andreaea* species, which — apart from *A. Blyttii* — almost provide test charts of the abundance of forms found in the *A. rupestris* group. The subspecies *obovata* (THED.) C. JENS. occurs in the more moist localities, its main characteristic being the broad, blunt leaves. This form was found on most of the peaks. If the neighbourhood is examined closely, it is usually found that there is a whole series of intermediate forms — as far as habit is concerned — between this and the ordinary *A. rupestris,* which may usually be seen growing on some nearby boulder. Another subspecies which I sometimes collected is subspec. *sparsifolia* (ZETT.) C. JENS., which is distinguished by its sparse leaves, of which the uppermost are secund. It was not infrequently found in the company of *Grimmia incurva,* that is, in more or less shady localities, and it gives the impression of being a shade-loving form. I mention these external characteristics to give some idea of how far it is possible to proceed with this group in the field. Later, under the microscope, the ambiguities increase rather than decrease. The variation in the shape of the leaves on a single stem is often remarkable in itself. The cell form and papillosity are also seen to be greatly varied. In consequence, insurmountable difficulties are often encountered — the more so as the floras are often brief and emphasize different characteristics. I have collected material in the district which includes most of the subspecies dealt with in the ordinary floras — with the exception of subspes. *papillosa* (LINDB.) C. JENS. In view of what I have said above, I have refrained form any attempt to arrange the specimens in the appropriate subspecies. A critical examinations of the group is badly needed.

Earlier collections: »Peldsa, 1000 m, c. fr.» (W). — subspec. *obovata* (THED.) C. JENS. »Peldsa» (M); Middle Peak, 1939 (S. ARNELL & H. SMITH).

## Fissidentaceae.

**Fissidens osmundoides** HEDW.

This moss is probably quite common. It is usually found on moist soil slopes together with such species as *Campylium stellatum, Distichium capillaceum, Ditrichum flexicaule* and *Oncophorus virens.* The alpine forms are often stunted, and it is hardly possible to find them without definitely looking for them. It occurred in several places at the south-eastern foot of South Peak at a height of about 800 m, but I did not find it higher up on the steep slopes, despite the fact that I was often there. It has not been found with fruit in the district.

Gåbnetjåkko, the N steep; the Nirjijokk waterfall; the S steep about 1 km N of of the falls; S Peak; the slope of Low Peak towards Nirjijaure.

## Ditrichaceae.

**Ditrichum cylindricum** (HEDW.) GROUT.

Only a single sparse sample of this species was obtained, found growing on bare soil together with *Anisothecium Grevillianum, Ceratodon purpureus* and *Distichium capillaceum*. The specimen, which was collected on the 26th July 1948, has both unripe and old, empty capsules.

S Peak, the E slope, *c* 800 m, c. fr.

**Ditrichum flexicaule** (SCHWAEGR.) HAMPE

*D. flexicaule* is common in the district, being most abundant on Pältsa. On the terraces of limestone slabs on the south slope of South Peak, at a height of about 900 m, it occurs in large carpets with only a little of contaminating species — e.g. *Scapania gymnostomophila* and *Orthocaulis quadrilobus*. It is also abundant on Low Peak. It grows together with a whole range of calcioles, and in this respect it almost vies with *Distichium capillaceum*. Among these companion species, *Hypnum Bambergeri* and *Orthothecium chryseum* deserve mention. *D. flexicaule* is very variable. The large, long-leafed form, var. *longifolia* ZETT. was found on the north steep of Gåbnetjåkko. The greatest height mentioned in my notes is 1100 m, but it is probably possible to find it considerably higher if it is sought with an eye to its upper height limit. It appears to be seldom fructiferous in the district. At least, I found no specimen with capsules, but WEIMARCK says that he found the moss in this state.

»Peldsa» (M); »Peldsa, on a precipice at *c* 1000 m, c. fr.; Gåbnetjåkko, the N steep; the Nirjijokk waterfall; Lassivare; S Peak, up to *c* 1000 m, c. fr.; Low Peak, up to 1080 m; the sub-peak of High Peak, 1100 m; SE Peak; Pältsavagge.

**Saelania glaucescens** (HEDW.) BROTH.

*S. glaucescens* is uncommon, and it was usually found among *Distichium capillaceum*. I found it with fruit only on South Peak, where it occurred in a few places up to a height of 1000 m.

WAHLENBERG's notes, however, mention that on Nirjivare »*Swarzia capillacea* and *Trichostomum glaucescens* were abundant in every hole». There is a fructiferous specimen from that mountain (»Njäravaara») in the Uppsala herbarium, but the label does not give the date or the collector — the handwriting is WAHLENBERG's, however.

The Nirjijokk waterfall; S Peak, the S and E steeps; Pältsavagge.

**Distichium capillaceum** (HEDW.) BR. EUR.

*D. capillaceum* is probably the most common of the acrocarpous mosses. It is most common on shelves, in holes and clefts in the steep slopes, but it also occurs in snow-beds or other places which are not too dry. It is unnecessary to name all the species which grow in association with it: it is sufficient to mention that *D. capillaceum* and *Blepharostoma* are the most usual contaminations in samples of other species collected in the district. It often has capsules, and I collected it with fruit at a height of almost 1300 m, although it is certainly possible to find single non-fructiferous shoots at even greater heights.

As mentioned in connection with the preceding species, WAHLENBERG mentions *D. capillaceum* from a short visit to Nirjivare.

»Peldsa» (M); »Peldsa, 1000 m, c. fr.» (W); Gåbnetjåkko, c. fr.; the birch region; Lassivare; S Peak, c. fr.; Middle Peak, 1320 m, c. fr.; Low Peak, 1140 m, c. fr.; the sub-peak of High Peak, c. fr.; SE Peak, c. fr.; Pältsavagge, c. fr.

**Distichium inclinatum** (HEDW.) BR. EUR.

This species was found in only three places. On South Peak it was growing in a crevice in a steep slate surface, on Low Peak between limestone boulders, and on South-east Peak at the edge of a snow-bed, together with *Asterella Lindenbergiana* and *Drepanocladus uncinatus*. It is almost certain that *D. inclinatum* is often overlooked in the mountains, as it is hardly possible to notice it when it does not have well-developed capsules. Where these are lacking or unripe, it is easy to believe that the moss is some mountain form of the almost ubiquitous *D. capillaceum*.

S Peak, the S steep, *c* 1000 m, c. fr.; Low Peak, 1050 m, c. fr.; SE Peak, the NE slope, 700 m, c. fr.

**Ceratodon purpureus** (HEDW.) BRID.

*C. purpureus* is distributed over the entire district. Around the Pältsa hut and along the esker it is common together with such mosses as *Dicranella cerviculata, Leptobryum pyriforme* and *Pohlia nutans*. Often, especially at higher altitudes, it shows itself to be cuprophile or nitrophile, and almost always occurs on the sites of old fires and not infrequently together with *Tetraplodon mnioides* and *T. pallidus,* where these grow on dry exposed places, as, for instance, on »bird rocks». *C. purpureus* decreases rapidly in frequency in the higher alpine region, and I did not find it higher than at 1300 m, and then on a »bird rock». The spores, however, seem to be distributed everywhere. Specimens with capsules were found in almost all localities, even where the main part of the tufts in a particular locality lacked fruit.

*C. purpureus* is mentioned in WAHLENBERG's notes as growing on an old hut site at the confluence of Lakonakoskijoki and the Kummaeno, that is, just east of the area of this investigation.

»Lassivare, *c* 700 m» (M): »the precipice by Kummajoki, 550 m, c. fr.» (W); Gåbnetjåkko; the Pältsa hut; the esker, several places; S Peak; Middle Peak; Low Peak, 1300 m; Måskojaure; all c. fr.

## Seligeriaceae.

**Blindia acuta** (HEDW.) BR. EUR.

*B. acuta* is fairly common and occurs up to 1000 m. It grows mainly on percolation surfaces and at the edges of streams. The alpine forms are usually stunted. The highest altitude at which I saw the species was on the sub-peak of High Peak, at a height of about 1100 m. I found it with fruit only once, and the capsules in that specimen, collected the 2nd August 1948, were unripe.

»Peldsa, 1000 m» (W); Gåbnetjåkko, the N steep; S Peak; Middle Peak; Low Peak, c. fr.; the sub-peak of High Peak; Pältsavagge.

**Blindia caespiticia** (SCHWAEGR.) C. MÜLL.

In the first locality, the moss grew in shaded crevices in the slightly weathered slate of the steep slope. The other locality was a larger vertical slate surface with percolating water. It was abundant in both places. The specimens had many capsules from the preceding year, while those for that year were unopened and partly green when collected, on the 18th July 1949.

*B. caespiticia* is rare, because of the special requirements it has with regard to habitat. It prefers shady vertical surfaces over which water percolates, where it grows in tufts in the small clefts filled with silt or direct on the rocks of calcareous shale or limestone. Sometimes it forms long borders on the vertical rock face. It grows usually in small tufts, remarkably free from other species. The usual foreign species found are specimens of *Blindia acuta*, *Distichium capillaceum* and *Hymenostylium recurvirostrum* ill-suited to the habitat. Most of the subalpine finds in Sweden are from canyon formations, which are probably over-represented because of JÄDERHOLM's excursions in the Torne Träsk region. *B. caespiticia* is equally well-suited to alpine localities, however. I have collected it in several such places, even as high as 1330 m (Gardetjåkko in Torne Lappmark).

S Peak, the SE steep, *c* 1000 m, c. fr., and the NE steep, 1170 m, c. fr.

**Seligeria brevifolia** (LINDB.) LINDB.

Low Peak, the slope towards Nirjijaure, 1140 m, c. fr.; the sub-peak of High Peak, the S steep, 1050 m, c. fr.

**Seligeria Doniana** (SM.) C. MÜLL.

These two species occur in very similar localities, and were found on Low Peak growing together in abundance. The substratum there was limestone or calcareous mica shale. The localities were very shaded. As both species often grow vertically downwards, the easiest way to collect them is usually to break loose with a knife a little of the slate from the roof of a hole or the underside of an overhanging block.

*S. Doniana* is the more common of the two, and I have found that it is the most common species of this genus in the mountains. The peculiar station it adopts, together with its small size which makes it easy to overlook, make it far from common, however. *S. brevifolia*, on the other hand, must be regarded as a definite rarity, with the localities reported here the most northerly in Scandinavia. The localities previously given as most northerly were in the Nordland province of Norway (JENSEN, 1939, p. 324).

S Peak, the E steep, *c* 900 m, c. fr.; the col between S and Middle Peaks towards Pältsavagge, *c* 1000 m, c. fr.; Low Peak, the slope towards Nirjijaure, 1130 m, c. fr.

## Dicranaceae.

**Trematodon brevicollis** HORNSCH.

This species is new to this country, and was found growing on fine slate detritus together with a depauperated *Bryum* species and *Plagiobryum Zierii*. The capsules on the specimen, which was collected on the 30th July 1948,

are yellowish green, and all the lids are unopened. *T. brevicollis* is one of the rarer and, in its occurrence, more unpredictable mosses of the Scandinavian mountain chain, HAGEN (1915, p. 179) writes, »In one of his travel journals, MOLENDO describes this species (with an expression taken from E. FRIES) as a 'nomad', because it never remains long in one place, and this is undeniably the case in Norway as well; . . .», and he goes on to report how he endeavoured in vain to find it again in a couple of known localities in Dovre. I suffered the same fate as HAGEN, when, in the summer of 1949, a year after the original find, I returned to the same patch on South Peak to look for more material.

According to JENSEN's flora (1939, p. 318), *T. brevicollis* has been found in the following Norwegian localities: Opland province, Våge (KAURIN); Sör-Tröndelag province, Opdal, a few places (C. & R. HARTMAN, KAURIN); Troms province, Rubben in Bardo parish (H. W. ARNELL); Venetvaara in Nordreijsen (JÖRGENSEN). It has also been found in Enontekis Lappmark in Finland (SAHLBERG). According to the same source, it is also known from the Alps, Central Europe and Greenland.

S Peak, the S steep, by the long snow-drift, *c* 1050 m, c. fr.

**Anisothecium Grevillianum** (BR. EUR.) LINDB.

Only a scanty sample of this species was obtained. It was found on bare soil together with *Ceratodon purpureus, Ditrichum cylindricum* and *Distichium capillaceum*. The specimen, which was collected on the 26th July 1948, has both greenish brown, unripe capsules and some old empty ones.

S Peak, the E slope, *c* 800 m, c. fr.

**Anisothecium squarrosum** (STARKE) LINDB.

The only place in which this species was found in even fair abundance was in the fen among the osiers just north-east of the Nirjijokk waterfall. In the lower alpine region I saw it only a few times growing by streams and springs together with such water-loving mosses as *Bryum pseudotriquetum, Calliergon sarmentosum* and *Philonotis tomentella*.

The Nirjijokk waterfall; S Peak, the E slope; SE Peak, the E slope, 660 m.

**Dicranella cerviculata** (HEDW.) SCHIMP.

The species occurs along foot paths and in other places where the fine sand is laid bare, from the birch forest to a little above the tree-line. It was very abundant on the north-western part of Gåbnetjåkko, on large peat surfaces which had been bared by frost-heaving. The numerous capsules still (the 3rd August 1948) had lid and calyptsa intact.

Gåbnetjåkko, *c* 600 m, c. fr.; the Pältsa hut, c. fr.

**Dicranella subulata** (HEDW.) SCHIMP.

Occurred on fine sand at the edge of a stream. The species was growing together with *Pohlia gracilis* and bore unripe capsules.

The Lassivare stream, c. fr.

**Paraleucobryum enerve** (THED.) LOESKE

*P. enerve* is distinctly alpine in the district, and the lowest height at which I found it was 800 m. It does not seem to occur on Pältsa until the calcareous slate ends and the amphibolite begins. It not infrequently grows in abundance on ground where there are snow-beds. The tufts are usually dense, and often contain shoots of one or another of *Barbilophozia Hatcheri. Drepanocladus uncinatus, Lophozia Wenzelii, Polytrichum alpinum* and *Temnoma setiforme.* I also found it in Pältsavagge in carpets of *Polytrichum hyperboreum.* As expected, I did not find it with fruit.

S Peak, the E slope; Low Peak, 1220 m; the ridge-top north-west of cirque 5 and the plateaus W and E of cirque 5, 1140—1400 m; Pältsavagge, 800 m.

**Paraleucobryum longifolium** (HEDW.) LOESKE

The sample was a fairly dense tuft, about 4 cm high, growing on a single boulder at the edge of Nirjijokk. The leaves are long, straight, and markedly dentate. The specimen appears to belong to var. *strictiforme* (C. JENS.) BROTH.

Nirjijokk, just above the tree-line.

**Amphidium lapponicum** (HEDW.) SCHIMP.

*A. lapponicum* seems to occur in abundance only on vertical surfaces on the north steep of Gåbnetjåkko. Elsewhere it occurs up to a height of 1100 m. It is commonly fertile.

»Peldsa, 1000 m, c. fr.»; »the precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); Gåbnetjåkko, the N steep, c. fr.; the Nirjijokk waterfall, c. fr.; Lassivare, c. fr.; S Peak, *c* 1000 m, c. fr.; Low Peak, 1100 m, c. fr.

**Amphidium Mougeotii** (BR. & SCH.) SCHIMP.

*A. Mougeotii* occurs only sparsely at lower altitudes in the district. It was, however, abundant on rocks in the spray zone of the Nirjijokk waterfall.

Gåbnetjåkko, the N slope; the Nirjijokk waterfall.

**Cynodontium strumiferum** (HEDW.) DNot.

This species was found at only two places in the district. In the subalpine region it grew on a large stone in boulder terrain, together with *Dicranum fuscescens.* The alpine locality was of the same type.

The S steep about 1 km NE of the Nirjijokk waterfall, c. fr.; Pältsavagge, c. fr.

**Cynodontium tenellum** (BR. EUR.) LIMPR.

Unlike the preceding species, *C. tenellum* is fairly common. It is quite abundant, for instance, on the subalpine steeps. It occurs on the heath above the Nirjijokk waterfall on a boulder together with *Dicranum fuscescens* and *Grimmia ovalis.* It also occur in *Dryas* heath on the limestone ground at the foot of South Peak in crevices together with species which demand rather more of their surroundings, such as *Distichium capillaceum, Isopterygium pulchellum* and *Myurella julacea.* Sometimes it occurred at surprisingly high altitudes, and I collected it on South Peak only a few metres from the summit cairn. It was usually fructiferous.

Gåbnetjåkko, the N slope, c. fr.; the Nirjijokk waterfall, c. fr.; the N steep above the Lassivare stream, c. fr.; South Peak, up to 1430 m, c. fr.; Pältsavagge, the entrance, c. fr.

**Dichodontium pellucidum** (HEDW.) SCHIMP.

This moss was usually found in alluvial sand at the edges of streams, and the species there forms fine dense carpets of a beautiful green, frequently free from foreign species. It can also be very small and sparse, and in this condition it most resembles a small *Barbula*. The usual companion species are *Bryum pseudotriquetum, Campylium stellatum, Oncophorus* species, *Philonotis tomentella* and *Pohlia* species. It grew in a different kind of habitat on the slope from Low Peak down towards the upper end of Nirjijaure, where it was found in a snow-bed together with *Asterella Lindenbergiana,* among others. According to ARNELL and JENSEN (op. cit., p. 18), the species extends a little into the birch region. Of the localities given, the only one in the birch region is that by the Nirjijokk waterfall, although the highest recorded probably does not exceed 900 m. No fructiferous specimens were found.

The Nirjijokk waterfall; Gåbnetjåkko, the NW end; Nirjijaure's outlet stream, 750 m; Low Peak, above the upper end of Nirjijaure.

**Dicranoweisia crispula** (HEDW.) LINDB.

*D. crispula* seems to be among the most common and most variable of the acrocarpous mosses of the district. It occurs in all kinds of habitats, from stones exposed to the sun to snow-beds where the snow melts late, and at all altitudes. It is small on slate, while in snow-beds it is large and often has the leaves secund. It is the almost invariable occurring smooth, straight capsule which facilitates identification in the field, and prevents this moss from being confused with *Kiaeria* and *Cynodontium* species.

The esker; Lassivare; S Peak; Middle Peak; Low Peak; High Peak and its subpeak; SE Peak; Pältsavagge; Måskojaure; all c. fr.

**Oncophorus virens** (HEDW.) BRID.

»Peldsa», c. fr. (M); Gåbnetjåkko, the N steep, c. fr.; the Nirjijokk waterfall, c. fr.; S Peak, c. fr.; Low Peak, c. fr.; SE Peak, c. fr.

**Oncophorus Wahlenbergii** BRID.

The *Oncophorus* genus is abundantly represented in the district. But in the field it is often difficult to decide which of the two species is the more common. This applies particularly to specimens from the higher altitudes. I have therefore included in the list of localities only those places for which there are collected specimens. Both species were found in fens, on the edges of streams, on percolation surfaces, and other similar localities. The fruit is common.

»Peldsa», c. fr. (M); Gåbnetjåkko, c. fr.; Middle Peak, the slope towards S Peak, 1320 m, c. fr.; the slope from Low Peak down towards Nirjijaure, c. fr.; the moraine below cirque 5, 900 m, c. fr.

**Arctoa fulvella** (DICKS.) BR. EUR.

*A. fulvella* is one of our most definitely high-alpine mosses, and it is no rarity on the peaks and ridge-tops of the district. It often occurs with capsules,

and it is then easy to recognise by the characteristic red peristome. It often occurs without capsules as well, in smaller, looser and more crinkled tufts between stones and boulders, but it is often difficult to identify these forms in the field. It grew thickly on the north-west slope of High Peak, where it covered the percolation surfaces filled with alluvial sand. The tufts in such places were long and dense, slightly contaminated with other species, mainly *Gymnomitrium concinnatum* and *Pohlia commutata*. The length of the seta also varies considerably. I did not find *A. fulvella* in the area at a height lower than 1300 m.

S Peak, 1350—1430 m, c. fr.; Middle Peak, the edge of the peneplain, 1440 m, c. fr.; High Peak, 1300—1400 m, c. fr.; SE Peak, 1450 m, c. fr.

**Kiaeria Blyttii** (Br. eur.) Broth. *Dicranum Blyttii* Br. eur.

A couple of specimens from Pältsavagge, their smooth capsules having bright red teeth, probably belong to this species, which is very similar to *K. Starkei*. Single shoots or small tufts of these two species occur between boulders on the higher mountain plateaus. Since they are almost always without fruit, I was not able to decide which of the two was the more common — as far as it is possible to distinguish between them.

Pältsavagge, c. fr.

**Kiaeria glacialis** (Berggr.) Hag. *Dicranum glaciale* Berggr.

This moss occurs in abundance mainly among the extensive snow-beds within Pältsavagge. I found it there in several places, often in large carpets on irregular solifluction terrain together with *Conostomum boreale, Polytrichum alpinum,* and other snow-bed mosses. It had there an abundance of capsules. It was also abundant on High Peak, together with *Pohlia commutata*. In spite of the high altitude, these specimens were fine large ones.

High Peak, 1500 m, c. fr.; cirque 5, c. fr.; Pältsavagge, 900 m, c. fr.

**Kiaeria Starkei** (Web. & Mohr) Hag. *Dicranum Starkei* Web. & Mohr

*D. Starkei* occurs in abundance, particularly in the many snow-beds in Pältsavagge, together with, among others, *Polytrichum alpinum* and *P. norvegicum*. The greatest altitude at which I found it with fruit was 1320 m. Otherwise, fructiferous specimens are not uncommon.

Nirjijokk, on the tree-line; S Peak; the ridge-top NW of cirque 5, 1320 m, c. fr.; SE Peak, c. fr.; Pältsavagge, c. fr.

**Dicranum angustum** Lindb.

This species was found mainly in some fens *c* 1 km north-east of the Nirjijokk waterfall, among *Aulacomnium palustre, Helodium Blandowii* and *Sphagnum Warnstorfianum*. I did not see it with fruit. Weimarck reports that he found it on Gapovare.

The birch region; Nirjijokk, *c* 2 km above the falls.

**Dicranum Bergeri** Bland.

*D. Bergeri* has been found only in the lower parts of the region, and it is not so common there as might have been expected. It prefers fens poor in

species, where it forms large tufts with such liverworts as *Orthocaulis Kunzeanus* and *Mylia anomala* as lesser constituents. I did not see it with fruit. A specimen collected by MÖLLER is said to have been obtained at a height of 600 m. I myself did not find it so high up that I thought of taking a measurement. My finds agree with those of MÖLLER as regards height.

»Auf dem westlichen Abhang von Peldsa» (TH. FRIES, 1913, p. 92); »Peldsa» (M); the birch region; Lassivare; S Peak.

**Dicranum elongatum** SCHLEICH.

*D. elongatum* is common in the district. It was abundant on some of the small moist soil steeps along Nirjijokk, in the form of hard dense tufts, in which the only foreign species were usually a few shoots of *Orthocaulis Binsteadii* or *Sphenolobus minutus*. It was absent or rare in the more calcareous parts of the district, recurring again at higher levels. It seldom bore fruit.

»Peldsa» (M); »Peldsa, on the mountain slope» (W); Gåbnetjåkko; Nirjijokk, c. fr.; S Peak, c. fr.; Low Peak, c. fr.; SE Peak, *c* 1400 m; Pältsavagge.

**Dicranum fuscescens** TURN.

This species is very common in the district, and, especially at higher altitudes, occurs in many forms. The subalpine localities are boulders, rotting trunks on the ground, etc. It usually occurs in heaths in the alpine regions, but I also came across it in snow-beds. It grows together with a number of other species. One of the most usual companion species is *Sphenolobus minutus*. I saw it fructiferous only in the lower parts of the district.

Of the many forms, subspec. *congestum* BRID. deserves mention. It was found on the higher alpine heaths. However, I have not considered it necessary to direct any special attention to it.

»Auf dem westlichen Abhang von Peldsa» (TH. FRIES, 1913, p. 92); »Peldsavagge» (TH. FRIES, 1913, p. 115); »Peldsa, in the valley, 700 m» (W); Gåbnetjåkko; the birch region, c. fr.; the esker; S Peak; Middle Peak; Low Peak, 1300 m; SE Peak; Pältsavagge.

**Dicranum majus** TURN.

It is difficult to say how common *D. majus* is in the district, since it almost always occurs in more or less orthophylliose forms, which, because of their similarity to *D. scoparium* forms, cannot easily be identified in the field. The forms of *D. majus* found in fens are usually these. The specimens found at higher altitudes are even more difficult to determine. The second of the two rows of eurocystes which *D. majus* has are often discernible in the cross-section of the leaf only as a single cell. Moreover, both species are almost always barren, so that the character »several setae together», which distinguishes *D. majus*, is quite inapplicable. Yet another difficulty arises from the fact that the appearance of the cell network in *D. scoparium* varies considerably, approaching in var. *integrifolium* LINDB. that of *D. majus*. It is remarkable how these two species, which are easy to distinguish on lower ground, become so problematic for field bryology in the mountains.

Gåbnetjåkko; the birch region; S Peak, 1350 m; Pältsavagge.

**Dicranum montanum** HEDW.

I found this species only in the subalpine region, where it was quite common on fallen decaying trunks and birch stumps, on which it grew together with *Lophozia longidens, L. ventricosa, Ptilidium ciliare* and *Pohlia nutans*. Specimens with capsules were rare.

»Peldsa, 600 m» (M); the birch region, c. fr.

**Dicranum Muehlenbeckii** BR. EUR.

This species grew in several places in abundant crinkly brown tufts in a *Leucorchis albidus* meadow on the terraces at the foot of South Peak, that being the only locality. A specimen assigned by WEIMARCK to this species was found to be a *D. fuscescens* form.

S Peak, the SE slope, 770 m.

**Dicranum scoparium** HEDW.

*D. scoparium* is common in the district. It is particularly versatile in its habit, the serration of the tip of the leaf and the back of the nerve, and so on. Var. *integrifolium* LINDB. was also found, but it appears to have been just a non-serrate extreme form. In the birch forest, *D. scoparium* usually grew on stones and boulders. Higher up it was usually a constituent of heaths, both rich and poor in species. The fruit is apparently very rare, and was not found in the district.

Gåbnetjåkko; the birch region; S Peak; Middle Peak; Low Peak; High Peak, 1300 m; SE Peak; Pältsavagge.

**Dicranum undulatum** TURN.

I found a tuft of this moss in the birch forest on the esker slope down towards Nirjijokk, where it grew with *Barbilophozia lycopodioides, Pleurozium Schreberi, Hylocomium splendens, Polytrichum commune* and *Ptilidium ciliare*. It is the first time I have encountered this moss in the mountain birch forest, though it is trivial in lower regions. It is certain that the species is rare in the mountains, since not even MEDELIUS (1926) has it in his detailed species list for the Storlien district. Neither is it included in ARNELL and JENSEN's work on the Sarek area. (Since MEDELIUS's list also covers the pine region, I mentioned it first; the chronological order is, of course, the other way about). A third detailed description of a mountain flora in which the species is not mentioned is HERM. PERSSON's »Bladmossfloran i sydvästra Jämtland and angränsande delar af Härjedalen» (1915).

The birch forest, *c* 1 km below the Nirjijokk waterfall.

## Encalyptaceae.

**Encalypta affinis** HEDW. FIL.

This species occurs in abundance on the steep slopes of South Peak. It grows there in considerable quantities in the *Dryas-Salix reticulata* clumps which hang from shelves in the slate precipices. *Distichium capillaceum*,

*Ditrichum flexicaule, Encalypta alpina, Mnium orthorrhynchum, Plagiopus Oederi* and *Saelania glaucescens* are common companions. The localities on Low Peak were of the same type. The plants bore an abundance of capsules.

»Peldsa, on the soil slope to the east, *c* 800 m» (W); S Peak, the E steep, *c* 800—1000 m, c. fr.; Low Peak, the SW slope, 1140 m, c. fr.

**Encalypta alpina** SM.

The only places in which this species was at all frequent were the south and east slopes of South Peak. It resembles the preceding species in its habit, and also bore an abundance of capsules.

»Peldsa, on the soil slope, 800 m, c. fr.» (W); the Nirjijokk waterfall; S Peak; Low Peak, 1100 m, c. fr.; the sub-peak of High Peak, 1100 m, c. fr.

**Encalypta brevicolla** BRUCH

This species was growing sparsely in small clefts in a vertical surface, together with *Cynodontium tenellum* and *Schistidium apocarpum.*

Gåbnetjåkko, the N steep, c. fr.

**Encalypta rhabdocarpa** SCHWAEGR.

*E. rhabdocarpa* was the most common and widely-distributed of the four species of this genus which I found in the district. It also had the greatest vertical range and the greatest variation in habitat. It usually grew on the looser kind of slate, and sometimes all that was required was a single slightly weathered lump of slate in an otherwise poor locality. It prefers drier localities than the other species, and I found it on the esker in places where it was exposed to strong winds. It probably occurs most abundantly on the south steep of South Peak, where it was found growing on the slate detritus together with *Barbula recurvirostris, Desmatodon latifolius, Stegonia latifolia* and *Tortula norvegia* up to a height of 1200 m. It varies considerably, even within the same collected sample. Thus the tip of the leaf may be more or less drawn out to a hyaline point, the striations on the capsule more or less clearly marked, and the peristome either lacking or developed to varying degrees. It was usually fructiferous.

It is in all probability our *E. rhabdocarpa* that WAHLENBERG refers to when he says that »Forsström showed me *Encalypta vulgaris* from the large field east of the pointed mountain peak Peltsanen».

»Peldsa, *c* 900 m» (W); »the precipice by Kummajoki, 550 m, c. fr.» (W); Gåbnetjåkko, the N steep; the S steep *c* 1 km NE of the Nirjijokk waterfall; the esker, by Lassivare; S Peak, up to 1200 m; Middle Peak; Low Peak; the sub-peak of High Peak; Pältsavagge; all specimens c. fr.

## Pottiaceae.

**Anoectangium aestivum** (HEDW.) MITT. *A. compactum* SCHWAEGR.

This species was found in only one place, the north steep of Gåbnetjåkko. It was particularly abundant there in shaded parts of the vertical rock face, on which it either formed fine green cushions or grew mixed in tufts of

*Barbula botelligera* and other species. I did not find any capsule-bearing specimens.

Gåbnetjåkko, the N steep.

**Hymenostylium recurvirostrum** (HEDW.) DIX. *H. curvirostre* LINDB.

*Eucladium recurvirostre* (HEDW.) C. JENS.

*H. recurvirostrum* is rather rare in the district. The locality on S Peak was quite large and the occurrence abundant, the usual habitat being shaded slate surfaces. In Pältsavagge it grew in small clefts in the crystalline limestone. It was everywhere in the form of dense tufts, almost free from other species. One of the specimens contained a few shoots of *Orthothecium intricatum, Blepharostoma trichophyllum* and *Distichium capillaceum*. All specimens were without capsules.

Gåbnetjåkko, the N steep; S Peak, the E steep, *c* 1000 m; Pältsavagge, below Middle Peak, 800 m.

**Tortella fragilis** (DRUMM.) LIMPR.

This species is rather rare. I found it a couple of times on South Peak. The only place where it was abundant was on perpendicular surfaces on the north steep of Gåbnetjåkko. Specimens from that locality which were collected on the 3rd August 1948 had still green capsules.

Gåbnetjåkko, the N steep, c. fr.; S Peak, 1000 m.

**Tortella tortuosa** (HEDW.) LIMPR.

*T. tortuosa* is fairly common in the district, and very abundant in some of the localities given below. It varies considerably, and in some exposed places I have seen forms which were very similar to the preceding species. Otherwise, the species is entirely typical, even up to 1100 m. The fruit, which is rare, was not found.

The Nirjijokk waterfall; Lassivare: S Peak; Low Peak, 1080 m; the sub-peak of High Peak; SE Peak; Pältsavagge.

**Barbula botelligera** MÖNK. *B. rubella* MITT. var. *brevifolia* LINDB. & ARN. *Didymodon botelliger* (MÖNKEM.) HAG.

Fine rusty red tufts of this species were found on moist perpendicular surfaces at the foot of the north precipice of Gåbnetjåkko. It also grew among *Anoectangium aestivum, Bryum pallescens, Distichium capillaceum, Ditrichum flexicaule, Encalypta rhabdocarpa* and *Myurella julacea*. The species, which was formerly regarded as a variety of *B. recurvirostris,* differs from this species mainly in that it propagates vegetatively. This is achieved by means of multicellular wine-red gemmae which form on the root-hairs. These are bottle-shaped, as the specific name indicates. There are fine examples of them on collected specimens. Other distinguishing characteristics are more relative. The respective localities preferred by *B. botelligera* and *B. recurvirostris* are rather different. The former occurs in small crevices on shaded, perpendicular surfaces, while the latter often grows in the mountains on fine, weathered slate and soil in the crevices of rocky ground or snow-

beds. This species is almost always found with fruit, whereas *B. botelligera* never has either fruit or gynaecium.

*Barbula botelligera* has been found in only a few localities in Scandinavia. In Sweden it has earlier only been reported from the Sarek mountains in Lule Lappmark and the Abiskojokk canyon in Torne Lappmark.

Gåbnetjåkko, the N steep.

**Barbula recurvirostris** (HEDW.) DIX. *B. rubella* MITT. *Didymodon rubellus* BR. EUR.

*B. recurvirostris* is fairly uncommon in the district, the only place in it which it may be said to be at all common being the south slope of South Peak. It was usually found as a sparse companion species to such other mosses as *Distichium capillaceum, Encalypta rhabdocarpa, Mnium orthorrhynchum* and *Myurella julacea*. It is often quite stunted on weathered soil in snow-beds. Only one specimen, from South Peak, may be described as large and free from foreign species. The fruit appears to be almost always present.

S Peak, the S slope, c. fr.; Low Peak, 1150 m, c. fr.; the col between S and Middle Peaks, towards Pältsavagge, c. fr.; the moraine below cirque 5, 900 m, c. fr.; SE Peak, by the ravine to the NE.

**Stegonia latifolia** (SCHWAEGR.) VENT.

Both the main form and var. *pilifera* (BRID.) BROTH. were abundant at the upper part of the long snow-drift on the south steep of South Peak. The loose slate there had been weathered to fine powder and grit, giving a substratum on which grew other acrocarpous mosses, e.g., *Desmatodon latifolius, Encalypta rhabdocarpa* and *Tortula norvegica*. There were plenty of capsule-bearing individuals. Some of the capsules on the specimens which were collected on the 11th August 1949 had lost their lids.

Mixed in amongst the main species was the var. *pilifera*, whos value is disputable.

S Peak, the S steep, 1100 m, c. fr.; the sub-peak of High Peak, the S steep, 1100 m, c. fr.; var. *pilifera* (BRID.) BROTH.: S Peak, the S steep, 1100 m, c. fr.

**Desmatodon latifolius** (HEDW.) BRID.

This species is rather uncommon in the district, the only place in which it was at all common being on S Peak, where it was widely distributed on soil and fine grit from weathered schists. The species usually found in association with it, regardless of the elevation, was *Encalypta rhabdocarpa*. *D. latifolius* varies considerably in size and the length of the hair-point. It was always found with capsules. Some of the lids were still intact on a specimen collected on the sub-peak of High Peak, at a height of 1100 m, on the 23rd July 1949.

»Peldsa» (W.); Gåbnetjåkko, the NE steep, c. fr.; the S steep c 1 km NE of the Nirjijokk waterfall; S Peak, up to 1100 m, c. fr.; the sub-peak of High Peak, 900—1000 m, c. fr.

**Tortula norvegica** (WEB. FIL.) WG.

The Nirjijokk waterfall; the S steep c 1 km NE of the Nirjijokk waterfall; S Peak, 850 m, c. fr., up to 1100 m.

**Tortula ruralis** (HEDW.) SM.

Taken together, these two very similar species are very common in the district. I have been content to list only the localities for which specimens are available. The distinguishing characteristics are relative, and specimens are often encountered which are difficult to place, particularly in the field. *T. norvegica* is a mountain species which is not difficult to determine in its typical form, and which must be accepted as a species. Furthermore, all specimens I have found in the alpine region were clearly *T. norvegica*. But I have not found anything which indicates an ecological difference between the two species. Nor does there seem to be any difference with regard to their altitude limits. It is obvious that a special investigation of these circumstances can give a more definite answer to the question of their relative status than any brief mountain notes. Only *T. norvegica* has been found with fruit in the district.

S Peak, the S and E steeps; the sub-peak of High Peak, the S steep towards Pältsavagge, 1120 m.

## Grimmiaceae.

**Grimmia elatior** BRUCH var. **alpigena** (ZETT.) MÖLL.

I did not find either the main form or the variety in the district. Specimens confirming MÖLLER's find are to be found in the Uppsala museum. I cannot offer any opinion as to what value ought to be assigned to the variety. Like the main form, it appears to be rather rare in the alpine region.

»Peldsa, by Nirjijokk» (M, 1933, p. 112).

**Grimmia elongata** KAULF.

The single locality consisted of more or less vertical percolation surfaces. The species was abundant there, growing in brown cushions with some *G. torquata* as an occasional constituent. Other specimens, a field examination of which suggested that it belonged to this species, appears on closer examination to be an extreme form of *G. ovalis*. It is impossible, however, to give a positive opinion.

Gåbnetjåkko, the N steep.

**[Grimmia funalis** (SCHWAEGR.) SCHIMP.**]**

MÖLLER says that he found this moss on Pältsa. But a specimen in the collection of the Swedish Museum, described as from »the edge of the river near Peldsa, growing on a stone», belongs to *G. ovalis*. The same applies to two other specimens collected by MÖLLER from places farther down the valley (»Kummajoki» and »Naimakka»). I myself looked for the species in vain, though it is quite common in the lower alpine region in other parts of the mountain chain. KOTILAINEN (1924, p. 18) found the moss in the Kilpisjärvi district, where it was not at all common, however, to judge from the list of localities.

**Grimmia incurva** SCHWAEGR.

This species was found on all peaks ascended, and it is probably to be found throughout the alpine border terrain. I found it on the slope of South-east Peak towards Måskojaure, on a fairly small isolated patch covered with boulders at a height of about 900 m. It recurred higher up there on the steeps, and abundantly in several places around the summit cairn.

*G. incurva* is certainly one of our most overlooked mountain mosses. Thus in JENSEN's flora (p. 256) there is not a single locality given for Torne Lappmark, although the species probably occurs on several of the higher mountains in the district (Some years ago, I observed that it was not uncommon on some of the peaks along Allesvagge). The reason why *G. incurva* is so often overlooked is undoubtedly its habit of growth. ARNELL and JENSEN point out in their Sarek flora (p. 191) that the moss grows »fast asusschliesslich auf den unteren Seite der Steine». They also mention two forms — one entirely green and shade-preferring with long, curled leaves standing out from the stem, and the other dark, almost black, with shorter and less curled, appressed leaves, growing in more open places. A glance at the material on which this distinction is based indicates that the latter form is more common. Actually, the shade-preferring form is the more common in the Pältsa area. Though it prefers the shaded parts of large boulders, it may also occur on fist-sized stones lying in loose heaps. If the stones from a hole dug in such ground are examined, there are almost always one or two individual specimens of *G. incurva* on them, and sometimes even small loose tufts.

The moss is easy to recognise in this form, as the hyaline hair-point and crinkled appearance can scarcely leave any doubt. The only species with which it might be confused are *Arctoa fulvella, Dicranoweisia crispula* and *Kiaeria* species, when growing sparsely. *G. incurva* is quite distinct from *Rhacomitrium* species and other *Grimmia* species by its habit. But the so-called *brevifolia* forms can cause considerable difficulties in identification. It is often possible to trace the whole series of forms in the field.

*G. incurva* also appears to be quite common in the southern part of the mountain chain. On a journey through the Anaris mountains (on the border of Jämtland and Härjedalen) in July 1949, I was able to collect the moss as often as the map gave me opportunity to name a new locality.

I found no specimens with capsules in the Pältsa district, and I have the impression from other parts of the mountain chain that the moss is not usually fructiferous.

S Peak, 1410 m; Middle Peak, 1448 m; Low Peak, 1300 m; High Peak, 1517 m; the ridge-top W of cirque 5, 1240 m; SE Peak, the S slope, 930—1452 m.

**Grimmia ovalis** (HEDW.) LINDB.

*G. ovalis* is the most common species of this genus in the district. It was abundant on the numerous boulders by Nirjijokk just above the tree-line. Fine specimens were found on the amphibolite steeps of South Peak, at a height of about 1100 m. It usually grows in open exposed places, although I also found it on percolation surfaces at higher altitudes. There is considerable variation with regard to size and the length of the hair-point, but the fruit which almost invariably occurs facilitates identification.

»Peldsa» (M, 1933, p. 43); »Peldsa, 1000 m» (W); Nirjijokk, c. fr.; S Peak, c. fr.; Middle Peak, *c* 1300 m, c. fr.; the ridge-top NW of cirque 5, 1350 m, c. fr.

**Grimmia torquata** HORNSCH.

*G. torquata* has a marked preference for vertical rock surfaces. I have scarcely seen it so abundant as on the north steep of Gåbnetjåkko, where the precipice provides good vertical surfaces. It grows there in fine greenish brown tufts, usually free from foreign species. Where such species were found, they were usually *Amphidium lapponicum, A. Mougeotii* and *Anoectangium aestivum*. The localities I give are at a height of about 600 m. I saw it on South Peak at a height of about 1200 m, that is to say, roughly where the amphibolite replaces the schists. As regards the substratum, I have not found the moss growing on limestone or schists which are calcareous to any degree, even where the localities were quite suitable in other respects. As expected, no fructiferous specimens were found.

»Peldsa, 1000 m» (W); Gåbnetjåkko, the N steep; the steep slopes just N of the Nirjijokk waterfall; Lassivare, the steep towards the stream.

**Hydrogrimmia mollis** (BR. EUR.) LOESKE

*H. mollis* grew in abundance in a small dried-out stream-bed. The specimen collected contains a little *Dicranoweisia crispula*. I had expected to find this moss more frequently, as it is quite abundant on nearby Paras. It was also without fruit here.

»Peldsa» (W, C. JENSEN, 1939, p. 262); Pältsavagge, below cirque 5, *c* 900 m.

**Schistidium alpicola** (HEDW.) LIMPR.

Unlike the following species, this one has quite a wide vertical range, and was often found growing on percolation surfaces. The forms found in such localities belong to var. *latifolium* (ZETT.) LIMPR. Both the main form and the variety were often fructiferous.

»Lassivare» (M, 1931, p. 47); »Peldsa, 1200 m» (var. *latifolium*, M, 1931, p. 49); »Peldsa, by the stream in the valley, 700 m, c. fr.; do. 750 m» (W); Gåbnetjåkko, the N steep, c. fr.; S Peak, c. fr.; SE Peak, the S steep, 1030 m, c. fr.

**Schistidium Agassizii** SULL. & LESQ *S. angustum* HAG.

This moss appears to be common at lower levels in the district. It grows exclusively in the flood verges of streams and small rivers, and is almost invariably fructiferous.

Both this and the preceding *Schistidium* species appear to be common. Every time I waded over Nirjijokk or Pältsajokk I noticed how abundant they were on stones and boulders in the flood zone. *S. Agassizii* is probably the most common at lower altitudes. The long, drawn-out shape of the leaf appears to be sufficient to identify the species in the field. S. *alpicola* var. *latifolium* was found only on percolation surfaces, and at greater altitudes than the main form and *S. Agassizii*.

Nirjijokk, c. fr.; Pältsajokk, c. fr.; Nirjijaure, c. fr.; Måskojaure, c. fr.

**Schistidium apocarpum** (HEDW.) BR. & SCH.

*S. apocarpum* is common in the district, especially perhaps on the steep slopes of South Peak. As usual, it varies considerably. I noted var. *gracile*

(SCHLEICH.) BR. EUR. on Low Peak and by the Nirjijokk waterfall, and on Gåbnetjåkko I collected a form with an unusually long hair-point, which somewhat resembled *Grimmia ovalis* in its habit. Percolation surfaces provided further forms with short hair-points and broad, obtuse leaves. The moss almost always had capsules when found.

»Peldsa, in a soil-filled crevice, *c* 1000 m, c. fr.» (W); Gåbnetjåkko, the N steep, c. fr.; S Peak, c. fr.; Middle Peak; Low Peak, 1150 m, c. fr.; the ridge-top NW of cirque 5, 1300 m, c. fr.; SE Peak, c. fr.; Pältsavagge, c. fr.

**Rhacomitrium canescens** (HEDW.) BRID.

The main form was found in only two places. The specimen I collected is an unbranched turgid high alpine form. Var. *ericoides* (BRID.) BR. EUR. does not seem to be common, either. The only place in which I found it in any abundance was on alluvial sand by Nirjijokk, just above the tree-line. I did not find either the main form or the variety with fruit.

»Peldsa» (M, 1931, p. 139); the ridge-top NW of cirque 5, 1370 m. Var. *ericoides* (BRID.) BR. EUR.: Nirjijokk; the esker; SE Peak.

**Rhacomitrium fasciculare** (HEDW.) BRID.

This species is common on boulders along Nirjijokk. It is widespread elsewhere, and quite normal specimens were found at a height of almost 1500 m. Var. *rivulare* (ZETT.) MÖLL., which is probably best regarded as a large, turgid, and broad-leaved aquatic form of the main species, grew in abundance in Pältsavagge in the small streams from the melting snow. Neither the main form nor the subsidiary one were found with fruit.

Nirjijokk, by Low Peak; High Peak, 1500 m; the plateau NW of the ravine towards the NE; Pältsavagge; Måskojaure.

**Rhacomitrium lanuginosum** (HEDW.) BRID.

*R. lanuginosum* is very common in the district, being most frequent on the actual peaks and ridge-tops, where it grew in broad tufts between the boulders, with *Temnoma setiforme* its chief companion. At lower altitudes it is also common on heaths and wind-exposed hillocks. It appears to have no particular preferred substratum. Although the species is so common, I did not find it with fruit.

»Auf dem westlichen Abhang von Peldsa» (TH. FRIES, 1913, p. 92); Gåbnetjåkko; the birch region; the esker; Lassivare; S Peak; Middle Peak; Low Peak; High Peak; SE Peak; Pältsavagge.

**Rhacomitrium microcarpum** (HEDW.) BRID.

The species is common in the lower parts of the district, usually growing on boulders covered with soil, or in similar localities. At higher altitudes it grows mostly on alluvial sand or soil covering flat stones in snow-beds and stream-beds, and quite often it forms large dense carpets. These forms have branches of the same height, and may be assigned to var. *fastigiatum* (LOESKE) C. JENS. The moss was fructiferous only at the lower levels.

Gåbnetjåkko, c. fr.; the birch region; S Peak; Middle Peak; Low Peak, c. fr.; the ridge-top NW of cirque 5, 1370 m; Pältsavagge, c. fr.

**[Rhacomitrium sudeticum** (FUNCK.) BR. EUR. *R. heterostichum* (HEDW.) BRID. subspec. *sudeticum* (FUNCK.) DIX.]

WEIMARCK includes this species in his list, with the locality given as »Peldsa, *c* 900 m, c. fr.». But the specimen in the Lund herbarium, which I have examined, belongs to *Grimmia ovalis*. This therefore lays some doubt on the occurrence of *R. sudeticum* in the district. I myself collected what I thought might be this moss, but it turned out not to be.

## Funariaceae.

**Funaria hygrometrica** HEDW.

The only place in which *F. hygrometrica* was found was on some old refuse heaps near the Pältsa hut. It was growing there in the summer of 1948 together with *Ceratodon purpureus, Leptobryum pyriforme, Tetraplodon mnioides* and *Pohlia nutans*. I was unable to find it again the following summer.

WAHLENBERG mentions *F. hygrometrica* in his notes. He found the moss together with *Ceratodon purpureus* on the site of an old Lapp hut where they stayed one night by the junction of Lakonokoskijoki and Kummaeno. A specimen in the Uppsala herbarium confirms his notes.

The Pältsa hut, c. fr.

## Splachnaceae.

**Tayloria Froelichiana** (HEDW.) MITT.

This species was always found on slate detritus, and the places where it grew were uncovered late by the thaw. It was infrequent, but all the specimens found were fertile. *T. Froelichiana* is more or less a rock moss in the Pältsa district, but elsewhere it is not at all unusual to find it in snow-beds. The more important companion species were *Blepharostoma trichophyllum, Encalypta rhabdocarpa, Mnium orthorrhynchum* and *Orthothecium chryseum*.

S Peak, the E steep, *c* 1000 m, c. fr.; Low Peak, the N steep, 1110 m, c. fr.; Pältsavagge, by the fall in the stream from cirque 5, *c* 800 m, c. fr.

**Tayloria lingulata** (DICKS.) LINDB.

*T. lingulata* is widespread in the lower parts of the region. It was found in shallow fens, on the edges of streams and snow-beds, together with such species as *Drepanocladus revolvens, Oncophorus virens* and *Philonotis tomentella*. I did not find it at levels higher than 930 m. The fruit is not uncommon. The capsules were unripe on specimens collected at the end of July and beginning of August 1948, at heights of 760 and 930 m respectively.

S Peak; Low Peak; the outlet stream from Nirjijaure, c. fr.; SE Peak, the NE slope; Pältsavagge; cirque 5, 930 m, c. fr.

**Tetraplodon mnioides** (HEDW.) BR. & SCH.

*T. mnioides* is rather infrequent in the district, and the only place where I found it in abundance was on ground soaked by seepage from the latrine

at the Pältsa hut. The preferred substratum seems in general to be the droppings of reindeer or birds. On the slope of Low Peak towards Nirjijaure, where I found it in a couple of places, it grew on the old bait of a wolf-trap. The other locality there was at 1150 m, the highest for the district.

»Peldsa» c. fr. (C. G. ALM 1919); »Peldsa, by Nirjijokk, 580 m, c. fr.» (var. *cavifolius* (SCHIMP.) MÖLL., M); »Peldsa, on reindeer droppings in the valley, 750 m» (W); Gåbnetjåkko; the Pältsa hut; Lassivare; the col between S and Middle Peaks, towards Pältsavagge, 850 m; Low Peak, 1150 m; SE Peak; all c. fr.

**Tetraplodon pallidus** HAG.

*T. pallidus* is common in the district, and practically always grows on reindeer droppings. Otherwise, the localities vary a great deal, from shallow fens to the higher, wind-exposed peaks and knolls to which the reindeer often go to avoid the mosquitoes. Most of the tufts are dense, but sometimes other mosses from the surroundings find their way into them. The only »genuine» foreign species, however, are *Ceratodon purpureus* and *Splachnum ovatum*. In other districts I have seen *T. mnioides* in the tufts.

*T. pallidus* is entirely alpine in this district, and occurs at considerably altitudes. The highest locality was on the peneplain of Middle Peak (1450 m).

*T. pallidus* was described as a species by HAGEN in 1893, but during the last 40 years it has usually been treated in the literature of the subject as a variety of *T. mnioides,* under the name var. *paradoxus* (R. BR.) C. JENS. The main reason for this is a change of opinion on the part of HAGEN (1910, pp. 17—19), given in his »Forarbejder till en norsk lövmossflora», where he relegates *T. pallidus* to the rank of variety. The sporophyte characters given in the specific description were not sufficiently constant, in HAGEN's opinion, to warrant the rank of species. But from the point of view of field bryology, it is more or less obvious that *T. pallidus* should be reckoned as a species, as it is considerably different from *T. mnioides* even in its habit. They are also different in their distribution. Unlike *T. mnioides, T. pallidus* HAG. and *T. paradoxus* (R. BR.) HAG. are not found in Central Europe (see, e.g. STEERE, 1947, pp. 416—417). The nomenclature here is not altogether clear. STEERE mentions *T. mnioides* var. *paradoxus* (R. BR.) N. COMB., and evidently means by this the arctic form, which is usually called *T. paradoxus* HAG., one of whose characteristics is that it is cleistocarpous. Actually, the authority should be given as (R. BR.) HAG. (HAGEN, 1900, p. 332). LYDIA SAVICZ (1924, p. 13) distinguishes this *T. paradoxus* from *T. pallidus* HAG., and calls the latter var. *pallidus* (HAG.) LYD. SAVICZ of *T. mnioides*. According to LYDIA SAVICZ, this strange occurrence of a cleistocarpous species in the *Tetraplodon* genus, the common occurrence of this species together with *T. mnioides* and *Voitia hyperborea* GREV. et ARN., and some unifying characters, may be due to hybridity of the species. There are several specimens of *T. paradoxus* in the Swedish Museum in Stockholm brought back from Novaya Zemlya by EKSTRAND in 1901. But *T. pallidus,* on the other hand, has not been found in arctic regions, being confined to Fennoscandia. Thus the three species may be briefly differentiated as follows:

| | |
|---|---|
| *T. mnioides* HEDW. | circumboreal species |
| *T. paradoxus* (R. BR.) HAG. | cleistocarpous arctic species |
| *T. pallidus* HAG. | Fennoscandian species |

Of course I have no experience of *T. paradoxus* and cannot contribute to the clarification of its status, but must confine myself to the consideration of the relative values of *T. pallidus* and *T. mnioides*.

I have noticed a clear difference in the frequency of the two forms in the Swedish mountain districts I have visited, and the following are some examples of their alpine occurrence. I would first like to point out that it is advisable to be rather cautions in judging the distribution of the *Splachanaceae* in general, as their frequency varies considerably from one summer to the next, because of a lemming year, for instance, or a change in the reindeer's grazing ground. In the Nedal district, on the border of Jämtland and Härjedalen, I observed in July 1948 that *T. mnioides* was common, whereas I found only a few isolated specimens of *T. pallidus*. Both species were about equally frequent round the large, spring-fed lakes which run into the Lule River in western Lule Lappmark, which accords with what ARNELL and JENSEN reported from the Sarek district (op. cit., p. 164). In one of my specimens from that district, both species are growing together in the same tufts. *T. mnioides* appears to be fairly rare in Allesvagge in the central region of Torne Lappmark, while *T. pallidus* is common — that is to say, the relative frequency is more or less the same as in the Pältsa district. All the districts mentioned are grazing grounds for considerable numbers of reindeer. I did not find *T. pallidus* anywhere in the subalpine region, though *T. mnioides* was quite common in the birch region. The frequency of the alpine occurrence of *T. mnioides* seems to decrease the farther north one comes, whereas the opposite seems to apply to *T. pallidus*. The distribution of the two species is quite different if the density is taken into account. The fact that *T. pallidus* is not merely a mountain form adapted to particular localities is shown, for one thing, by the fairly frequent occurrence of it together with *T. mnioides*.

S Peak, up to 1370 m; Middle Peak, up to 1450 m; Low Peak, up to 1300 m; SE Peak; Nirjijaure; Pältsavagge; all c. fr.

**Haplodon Wormskjoldii** (HORNEM.) R. BR.

The sample of this species, which was collected on August 1st, had empty capsules on shrunken setae, and grew in a fen on decaying animal matter which could not be identified.

A fen at the south foot of S Peak, c. fr.

**Splachnum ovatum** HEDW.

**Splachnum vasculosum** HEDW.

These two species are common in the district, providing as it does sustenance for a large number of reindeer. They usually grow on reindeer droppings in fens. *S. ovatum* sometimes grows on more heath-like ground, together with *Tetraplodon pallidus*. *S. vasculosum,* which appears to be somewhat less usual than *S. ovatum,* attains a height of at least 1150 m on the north slope of Low Peak. I did not find the other species so high up.

WAHLENBERG's notes mention that FORSSTRÖM collected a *Splachnum* species just east of Pältsa, but the name of the species is so illegible that I cannot say which of the two species it was.

*S. ovatum*: Nirjijokk; S Peak; Low Peak; Nirjijaure; all c. fr.
*S. vasculosum*: Gåbnetjåkko; Lassivare; S Peak; Low Peak, 1150 m; SE Peak; cirque 5; Pältsavagge; all c. fr.

## Georgiaceae.

**Tetraphis pellucida** HEDW.

Specimens with gemmae were found here and there on turf-covered birch roots, where the forest-covered south slope merges into the mire. I did not see the moss with fruit.

The swampy birch forest 1 km N of the Nirjijokk waterfall.

## Bryaceae.

**Mniobryum albicans** (WG.) LIMPR. *Webera albicans* (WG.) SCHIMP.

This species is abundant in springs and along streams in both the subalpine and lower alpine regions. It often grows in large bright green patches or together with other swamp mosses such as *Anisothecium squarrosum, Bryum Duvalii, Harpanthus Flotowianus, Philonotis tomentella,* etc. It was therefore the large variety, var. *glacialis* SCHIMP., that I mainly noticed. Only one fertile specimen was collected.

Nirjijokk; Middle Peak; Low Peak; Nirjijaure, c. fr.; Pältsavagge.

**Pohlia commutata** LINDB. *Webera commutata* SCHIMP.

*P. commutata* is certainly more common in the district than the list of localities indicates. Most moss specimens gathered from snow-beds contain tufts or shoots which probably belong to this species, but which are insufficiently developed to be determined with certainty. Even in the places where it grew in masses, the specimens were poor because of the late thaw. I did not see it with fruit.

»Peldsavagge» (TH. FRIES, 1913, p. 74); Low Peak; High Peak; the ridge-top NW of cirque 5, 1420 m.

**Pohlia cruda** (HEDW.) LINDB. *Webera cruda* (HEDW.) BRUCH

*P. cruda* is common in the lower parts of the district. I grows there on the drier, though preferably shaded rock faces, together with such species as *Bartramia ithyphylla, Cynodontium tenellum,* or *Distichium capillaceum.* The fruit is common. The moss is probably almost as common at higher altitudes, but it seldom bears capsules there. The opalescent shoots occur here and there between boulders and in holes in cliffs up as high as 1350 m.

»The precipice by Kummajoki, 550 m, c. fr.» (W); Gåbnetjåkko, the N steep, c. fr.; the birch region, c. fr.; Lassivare; Middle Peak, up to 1350 m; Low Peak, c. fr.

**Pohlia gracilis** (SCHLEICH) LINDB. *Webera gracilis* (SCHLEICH) DNOT.

This species was found in abundance on the sand at the edge of Nirjijokk, from the birch forest up to Nirjijaure. I also found it in snow-beds together with *Conostomum boreale, Oligotrichum hercynicum* and *Pleuroclada albescens.* Only a few specimens bore gemmae.

Gåbnetjåkko, c. fr.; Nirjijokk, c. fr.; Pältsavagge, c. fr.

**Pohlia nutans** LINDB. *Webera nutans* HEDW.

*Pohlia nutans* is common in the lower parts of the district. In the birch forest it occurs mainly on fallen dead trunks, together with *Dicranum montanum* and *Lophozia ventricosa.* On the esker it occurs along the edges of paths, on the sites of old fires, and in similar places. It is infrequent at higher altitudes, although it has been found at considerable heights. It grew at 1340 m on South-east Peak, together with *Cynodontium tenellum,* and I collected it by the summit cairn on South Peak.

Gåbnetjåkko, c. fr.; the birch region, c. fr.; the esker, c. fr.; Lassivare, c. fr.; S Peak, 1430 m, c. fr.; SE Peak, 1340 m, c. fr.

**Pohlia polymorpha** HOPPE & HORNSCH. *Webera polymorpha* (HOPPE & HORNSCH.) SCHIMP.

This species, which is very similar to *P. longicolla,* was found on a cliff-shelf. Dr. HERM. PERSSON has examined the specimen, and says that it is nearest to var. *acuminata* (HOPPE & HORNSCH.) C. JENS.

Gåbnetjåkko, the N steep, c. fr.

**Plagiobryum demissum** (HOPPE & HORNSCH.) LINDB.

This species was found growing on soil on a shelf in a slate cliff, together with *Bryum arcticum, Myurella julacea* and some dwarf individuals of *Polytrichum alpinum* and *Timmia norvegica.* The specimens, which were collected on the 26th July 1948, bear capsules, some of which are light brown and some yellowish green. None of the lids were open.

*P. demissum* appears to be one of the rarer mountain mosses. The classical Swedish locality is Tjidtjakk, where S. O. LINDBERG collected it in 1856. It has also been found in Sweden at Abisko, and I found it on the mountain Stipuok in west Lule Lappmark, in two places. It is rare even in Norway and Finland. It should be added that the moss is dioicous, and is almost invariably collected only when it bears capsules. The markedly curved neck of the capsule is an extreme characteristic. JENSEN's moss flora (op. cit., p. 150) gives the substratum as »soil poor in lime between rocks and in rock clefts in the mountains»; but, to judge from the other vegetation, the localities in which I found the species were highly calcareous.

S Peak, the E steep, *c* 1050 m, c. fr.

**Plagiobryum Zierii** (HEDW.) LINDB.

*P. Zierii* is infrequent in the district. It occurred on blocks of slate in the spray zone of the Nirjijokk waterfall, among *Ditrichum flexicaule,* which is its most usual companion. *Distichium capillaceum* and *Trematodon brevicollis* are two other species which I have found in its company. Almost uncontaminated specimens of it occurred on the sub-peak of High Peak. The substratum is detritus or grit covering surfaces or filling crevices in the slate steeps. The greatest height at which the species was found was 1250 m. The altitude limit here is presumably determined, as it is for so many other species, by the lack of suitable rock at the higher altitudes. No fructiferous specimens were found.

The Nirjijokk waterfall; S Peak, the S steep, 1050 m, the NE steep, 1250 m; High Peak's sub-peak, the S steep, 1100 and 1150 m.

**Leptobryum pyriforme** (HEDW.) SCHIMP.

This species abounds on the sites of old fires along the pathway near the Pältsa hut. *Ceratodon purpureus, Funaria hygrometrica* and *Pohlia nutans* grew in its company.

The Pältsa hut, c. fr.

**Bryum archangelicum** BR. EUR.

»Peldsa, on the mountain slope, 900 m, c. fr.» (W).

**Bryum arcticum** (R. BR.) BR. EUR.

The species grew on slate grit in *Dryas* heath, together with *Blepharostoma trichophyllum* and *Tritomaria scitula.*

Low Peak, the SW slope, 1100 m, c. fr.

**Bryum cirratum** HOPPE & HORNSCH.

I collected some specimens which probably belong to this species, but they are so poor that I think it better to mention the find only in passing.

»Peldsa, on a soil slope in the valley, 750 m, c. fr.» (W).

**Bryum Duvalii** VOIT IN STURM.

*B. Duvalii* is common in the lower parts of the district along the Nirjijokk valley, from the birch forest up towards the entrance to Pältsavagge. It is very widespread, and I have never seen larger clumps elsewhere. As a rule, the young shoots — which are a fine red colour, much more so than the older parts of the plant — form small red patches of colour in the green carpet of moss on the edges of streams and springs. *Blasia pusilla, Harpanthus Flotowianus, Pellia Neesiana, Scapania subalpina, S. uliginosa, Mniobryum albicans* and *Pohlia gracilis* are some of the species associated with it. It is not only by their red colour that the young leaves differ from the older ones, but also in that they are obtuse, which might lead to some confusion with *B. obtusifolium.*

The birch forest; Nirjijokk.

**Bryum elegans** NEES.

According to WEIMARCK, this species occurred together with *Bryum pallens.*

»Peldsa, on a soil slope in the valley, 750 m, c. fr.» (W).

**Bryum obtusifolium** LINDB.

I made some comments about this arctic species on a previous occasion (1949, pp. 460—467). I discussed the localities it prefers, but without saying anything about the possibility of it being calcicole. I am now in a position to add that the localities in which I found it in the Pältsa district are definitely calcareous; it is not always easy to decide such a matter, as there are seldom

any good indications as to the nature of the substratum in those localities where the moss is finest. As expected, I did not find fertile specimens.

Low Peak, the slope towards Nirjijaure; the ravine to the NE, the NW slope, 1100 m; below cirque 5, 900 m.

**Bryum inclinatum** (Sw.) Br. and Sch.

Weimarck states that the species grew together with *Bryum pendulum*. It seems that some of my specimens which are much depauperated belong to this *B. inclinatum*.

»The precipice 2 km N of Gåbnetjåkko, c. fr.» (W).

**Bryum pallens** Brid.

I did not succeed in finding this species with fruit. In several places, including some on Low Peak, I saw and even collected red sterile specimens of a Bryum species which was presumably this one. According to Weimarck, the species grew on a soil slope together with *B. cirratum* and *B. elegans*.

»Peldsa, on a soil slope in the valley, 750 m, c. fr.» (W).

**Bryum pallescens** Schleich.

*B. pallescens* was abundant in both of the localities given. It grew on vertical faces on the north steep of Gåbnetjåkko, one of its companions being *Barbula botelligera*.

Gåbnetjåkko, the N steep, c. fr.; the S steep *c* 1 km NE of the Nirjijokk waterfall, c. fr.

**Bryum pendulum** (Hornsch.) Schimp.

According to Weimarck, the moss grew together with *Bryum inclinatum*.

»The precipice *c* 2 km N of Gåbnetjåkko, c. fr.» (W).

**Bryum pseudotriquetrum** (Hedw.) Schwaegr.

*B. pseudotriquetrum* is common in the region. The main form seems to occur mostly in fens at a low level. The edges of streams and patches of silt provide more or less turgid forms, with shorter or longer nerves, the edges of the leaves recurved to varying extents, and so on; these forms belong to the many subspecies and varieties of this species. My field notes include only the main form.

»Peldsa, by the stream in the valley, 750 m» (W); »Peldsa, on a mountain slope, c. fr.» (subspec. *turgens* (Hag.) C. Jens.) (W); the birch region, c. fr.; Lassivare; S Peak; Middle Peak; SE Peak.

**Bryum rutilans** Brid.

The collected specimens, which are sterile, grew on a shelf in the shale cliff together with *Distichium capillaceum, Ditrichum flexicaule, Encalypta rhabdocarpa, Myurella julacea* and *Orthothecium intricatum*. Tufts of *B. rutilans* have a characteristic appearance, as I have previously pointed out, and they may therefore be identified even when there are no capsules. The determination was carried out by Dr. Herm. Persson.

S Peak, the S slope, 850 m.

**Bryum purpurascens** (R. Br.) Br. eur.

A depauperated specimen of this species was collected from alluvial sand by the river. The species is probably common in such localities, as I often came across shoots which seemed to belong it, judging from their appearance and manner of growing.

Nirjijokk, just above the waterfall, c. fr.

## Mniaceae.

**[Mnium affine** Bland.]

Möller (1926, p. 95) reports that he collected *M. cuspidatum* (L. ex. p.) Neck. on Pältsa. His classification, however, is no longer entirely satisfactory. When that of Tuomikoski (1936) is used, our mountain forms of *M. affine* seem best classified as *M. rugicum*. Dr. Herman Persson has informed me that the specimen in the collection at the Swedish Riksmuseum belongs to *M. rugicum*, so it is unlikely that *M. affine* has been found in the district.

**Mnium Blyttii** Br. eur.

This species is quite common on Pältsa up to about 1100 m. The lowest altitude at which I collected it was 880 m, on the south slope of South Peak, where it grew under an overhanging slate boulder. There were many fine large specimens of it on Low Peak, where it grew in the open on the terraces of solifluction soil and the upper edges of snow-beds. But in other places, where the conditions are much less favourable for it, it is frequently stunted, and sometimes hardly 1 cm tall. I did not find it in the subalpine region; nor with fruit, although the male flowers were not uncommon. The more noteworthy mosses found in its company were *Asterella Lindenbergiana, Distichium capillaceum, Ditrichum flexicaule, Drepanocladus uncinatus, Hypnum Bambergeri, Isopterygium pulchellum, Mnium orthorrhynchum, Preissia quadrata* and *Pohlia cruda*.

»Peldsa» (M., 1926, p. 47); S Peak, 880 m; Middle Peak; Low Peak; the sub-peak of High Peak; cirque 5, 900 m; Pältsavagge.

**Mnium cinclidioides** (Blytt) Hüb.

This moss was found in abundance in the birch forest mire just NE of the Nirjijokk waterfall, and in the willow scrub which occurs here and there on the north-west slope of Gåbnetjåkko and a little above the Nirjijokk waterfall. It grew together with other mire mosses, *Helodium Blandowii, Paludella squarrosa, Sphagnum teres*. I did not see it on Pältsa itself.

»Peldsa» (M); Gåbnetjåkko, 650 m; the Nirjijokk waterfall.

**Mnium hymenophylloides** Hüb.

It is very frequent in the subalpine region. It is infrequent in the alpine region, however, usually being a minor constituent among other mosses. It is not uncommon on the south-east slope of South Peak, in moist crevices and

holes at a height of 800—900 m. MÖLLER, who collected the moss on Pältsa, presumably in just this place, gives the height as 1000 m. I have estimated this to be the height for localities in the col between South Peak and Middle Peak, on the Pältsavagge side, and have measured the same height for a find on South-east Peak. *M. hymenophylloides* always grows in shady places in this district, and often together with *Blepharostoma trichophyllum, Distichium capillaceum, Isopterygium pulchellum, Leiocolea Gilmanii, Mnium orthorrhynchum, Orthothecium intricatum* and *O. rufescens.*

»Peldsa» (M, 1926, p. 137); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; the S steep *c* 1 km NE of the waterfall; Lassivare; S Peak, 1000 m; Pältsavagge.

**Mnium hymenophyllum** BR. EUR.

This fine moss is quite common in the district. At its best, it grows in dense tufts more than 10 cm high such as I found at the feet of the many northerly-exposed vertical surfaces of shale or limestone on the peaks belonging to Pältsa. It also occurs in most other parts of the district, up to a height of almost 1100 m, together with such species as *Brachythecium salebrosum* subspec. *turgidum, Bryum pseudotriquetrum, Hypnum Bambergeri, Orthothecium chryseum* and *Tomenthypnum nitens.* It occurred even higher up, and I found it at 1330 m on the slope of Middle Peak towards Low Peak. Individual plants with the characteristic shoots bearing the male flowers were not uncommon.

»Peldsa» (M, 1926, p. 177); »Peldsa, on the mountain slope» (W); »the precipice by Kummajoki, 550 m» (W); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; Lassivare; S Peak; Middle Peak ♂; Low Peak ♂; the sub-peak of High Peak; SE Peak; Pältsavagge.

**[Mnium marginatum** (DICKS.) P. B. *M. serratum* SCHRAD.**]**

WEIMARCK reports that he found this species on Pältsa. The only collected specimen I have been able to trace, however, is from Tantavaara, a locality not given in WEIMARCK's list. I would prefer not to accept the specimen as *M. marginatum,* as the cell network is not collenchymatous. It is therefore questionable whether the species does occur in the district. I myself have collected material belonging to this group of the genus, and it is unlikely that I would overlook *M. marginatum.* In spite of the considerable variation in the shape and serration of the leaf, I have always found that the areolation is fairly constant, which leads me to suppose that the specimen in question must be a form of *M. orthorrhynchum.* Where I have found flowers, these have always been male, so there seems to be no question of the synoicous *M. marginatum.*

**Mnium medium** BR. & SCH.

The three specimens of this moss which were collected differ considerably from the normal form of the species, in the less marked dentation of the leaves and in the cell network, which is arranged more in longitudinal rows and is less collenchymatous. If the long decurrence of the leaves is disregarded, it is easy to confuse *M. medium* with *M. rugicum,* which is very similar in its habit. *M. Seligeri* might also come to mind. However, the synoicous inflore-

scence shows quite clearly that the specimens in question belong to a local form of *M. medium*.

It is usual to classify *M. medium* as calcifuge (cf. JENSEN, 1939, p. 74). This is not true for the localities in the Pältsa district where this moss was growing in the ravine in a Poa meadow, associated with *Philonotis tomentella*. On Low Peak, it was also found growing together with *P. tomentella*, as well as *Aulacomnium palustre, A. turgidum* and *Tomenthypnum nitens*. The finds are also interesting in view of the altitude, since, according to MÖLLER (op. cit. pp. 76—77), it has been found only in the subalpine regions of our mountains. HAGEN (1901, p. 237) gives only two localities for this species in »Musci Norvegiae borealis», one of them in Skjerstad (Nordland province) and the other in Kistrand (Finnmark province). The former was in the birch forest, while there is nothing about the altitude of the latter, which is given as the northern limit (70° 15′ N). Since *M. medium* is often confused with species belonging to the *M. affine* group and thus overlooked, it would be well to bear it in mind on bryological excursions to the mountains.

One of the specimens from Low Peak, collected on the 2nd August 1948, has many empty capsules.

Low Peak, the slope towards the upper end of Nirjijaure, ♂ and c. fr.; the ravine to the NE, the SE slope, *c* 1000 m, ♀.

**Mnium orthorrhynchum** BRID.

*M. orthorrhychum* is fairly common in the district, from the birch region up to 1100 m. It usually grows in shady clefts and holes in steep slopes and among flat boulders, though it does not seem to require much lime. The shape of the leaves and the serration appears to vary a great deal, even on the same individual, but the cell network and the shape of the cells appears to be constant. The size and thickness of the growth vary from single shoots with few leaves to the thick, compact tufts free from foreign species which occasionally fill small crevices. *M. orthorrhynchum* has been found in the district together with many other species, from trivial ones like *Blepharostoma trichophyllum* and *Distichium capillaceum* to rarities such as *Arnellia fennica*. The greatest height at which I have a collected specimen is 1200 m. I did not find fructiferous specimens, though male flowers were found a few times.

»Peldsa» (M, 1926, p. 20); Gåbnetjåkko, the N steep; the S steep *c* 1 km NE of the Nirjijokk waterfall; S Peak; Middle Peak; Low Peak, up to 1150 m; SE Peak, 1300 m; Pältsavagge.

**Mnium pseudopunctatum** BR. EUR.

*M. pseudopunctatum* is common in fens and by streams from the birch region up to the entrance to Pältsavagge and up to Nirjijaure. It grows there together with *Aulacomnium palustre, Cinclidium stygium, Drepanocladus revolvens, Meesia triquetra, Paludella squarrosa, Philonotis tomentella* and *Tomenthypnum nitens*. It seems to decrease rapidly in frequency as the height increases, and I have not noted it for a height greater than 920 m. I found it with capsules only on two occasions.

»Peldsa» (M, 1926, p. 157); »the precipice by Kummajoki, 550 m» (W); Gåbnetjåkko, the N steep; NE of the Nirjijokk waterfall, c. fr.; S Peak, c. fr.; Low Peak; SE Peak; cirque 5, 920 m; Nirjijaure.

**Mnium rugicum** LAUR.

In this district, *M. rugicum* occurs mostly in fens rich in species, together with such companions as *Aulacomnium turgidum, Campylium stellatum, Philonotis tomentella* and *Tomenthypnum nitens.* I found it in the shady birch forest by the Nirjijokk waterfall, growing together with *Dicranum scoparium* and *Hylocomium splendens.* The specimens collected vary considerably in the shape and serration of the leaves, but even more so in size. Stunted plants sometimes occur at higher altitudes, and I found on Low Peak specimens of it which were hardly a couple of centimetres high, growing under an overhanging slate boulder together with *Blepharostoma trichophyllum, Distichium capillaceum, Hylocomium splendens, Mnium orthorrhynchum* and *Timmia norvegica.* The altitude of this locality was 1120 m, the highest in the district. It has not been found with fruit. The form which is distinguished by broad, non-serrate leaves was collected in the district by MÖLLER (1926, p. 104) and listed under the name *M. cuspidatum* (L. ex. p.) NECK. var. *integrifolium* LINDB. M's *M. affine* (which see) was actually *M. rugicum.*

»Peldsa» (M, 1926, pp. 95 and 104); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; S Peak; Low Peak, up to 1120 m; the ravine to the NE; Måskojaure.

**Mnium spinosum** (VOIT) SCHWAEGR.

This species was found growing sparsely on letter in the birch forest, together with *Barbilophozia lycopodioides.* It really belongs to the coniferous forest of Norrland, but it is sometimes encountered far up in the mountain birch region.

The Nirjijokk waterfall ♂; the S steep *c* 1 km NE of the waterfall.

**Cinclidium arcticum** (BR. EUR.) SCHIMP.

*C. arcticum* is not at all uncommon in the district. In particular, it was abundant on the irrigated terraces of solifluction soil on the slope of Low Peak towards Nirjijaure. It occurred in the shallow fens there, which are well supplied with percolation water, growing together with several other species, including *Catoscopium nigritum, Orthothecium chryseum* and *Philonotis tomentella.* The altitude range was from about 800 m to about 1100 m. I did not find any fertile specimens.

»Peldsa» ♂ and ♀, 1000 m (M, 1926, p. 173); Low Peak, the slope towards Nirjijaure, ♂; the moraine below cirque 5, 900 m; SE Peak, the slope towards Måskojaure, 1000 m.

**Cinclidium stygium** SW.

*C. stygium* is the only one of the species of this genus which may be said to be common in the district. It is abundant in fens rich in species, from the birch region up to 1000 m, though with decreasing frequency for the last 200 m. It is most abundant on the lower parts of the N slopes of Pältsa. The fruit is common.

»Peldsa» (M, 1926, p. 164) Gåbnetjåkko, c. fr.; the Nirjijokk waterfall, c. fr.; c 1 km NE of the waterfall, c. fr.; S Peak; Middle Peak; Low Peak; SE Peak, up to 1000 m; Nirjijaure; Pältsavagge, c. fr.

**Cinclidium subrotundum** LINDB.

There are only two specimens of this species from the district; they were both found in fens which were poor in species compared with the usual fens of the district, the bottom layer consisting of *Calliergon sarmentosum* and *Drepanocladus exannulatus*. *C. subrotundum* is one of the species which have their outposts in the lower alpine region.

The birch forest mire just N of the Nirjijokk waterfall, c. fr.; the Lassivare stream.

## Aulacomniaceae.

**Aulacomnium palustre** (HEDW.) SCHWAEGR.

*A. palustre* is very common in the birch region, and is also very abundant in the willow scrub growing beside Nirjijokk as far up as Nirjijaure, or beside Pältsajokk up into Pältsavagge. It occurs sparsely on the mountain slopes, and I did not find it higher up than 1000 m. Only the plants from the birch region bore fruit or gemmae. *A. palustre* occurs both in fens rich in species and those poor in species. I did not find var. *imbricatum*, which MÖLLER collected on Pältsa as well as the main form.

The birch region, c. fr.; Middle Peak; Low Peak; Pältsavagge; SE Peak, the S slope, up to 1000 m; var. *imbricatum* BR. EUR. »Peldsa» (M, 1936, p. 89).

**Aulacomnium turgidum** (WG) SCHWAEGR.

*A. turgidum* is common in the alpine region up to about 1100 m. It has not been found in subalpine localities. The lower localities reported seem to be of a secondary nature. On the N steep of Gåbnetjåkko it grew on small shelves in the rock face, and it flourished on flat rocks covered with sand by Nirjijokk. The habitat varies considerably, from fens to more heathy ground. Species often found in its company are *A. palustre*, *Cinclidium stygium*, *Drepanocladus revolvens*, *Hylocomium splendens* and *Tomenthypnum nitens*. The highest altitude at which I found the species was 1300 m. As expected, the moss was always sterile.

»Peldsa» (T. C. E. FRIES, 1909, according to M, 1936, p. 94, cf. FRIES, 1913, p. 92); »Peldsa, in the valley, 700 m» (W); »do., on the landslide slope, 1200 m» (W); »the precipice by Kummajoki, 550 m» (W); Gåbnetjåkko, the N steep; Nirjijokk, just above the tree-line; S Peak; Middle Peak; Low Peak; High Peak, 1300 m; Pältsavagge; SE Peak.

## Meeseaceae

**Paludella squarrosa** (HEDW.) BRID.

*P. squarrosa* is very common in the lower parts of the district, and I have noted it for most fens which I examined. It does not appear to be so particular so far as habitat is concerned, but it never occurs at higher altitudes. I did not see it at a height greater than 900 m. The fruit is not uncommon.

»Peldsa, in the valley, 700 m» (W); the birch region, c. fr.; S Peak, c. fr.; Middle Peak, c. fr.; Low Peak; Pältsavagge, c. fr.; SE Peak, c. fr.; Måskojaure.

**Meesia uliginosa** HEDW.

*M. uliginosa* is common in the district, growing in moist calcareous localities such as fens, on cliff-shelves, in small crevices, on vertical rock surfaces, and so on. Iits size is very variable. As a rule, the fen forms are 5 to 6 cm high, including the sporophyte. A few times, when I was looking for *Tayloria Froelichiana* on moist slate rocks, I came across the particularly stunted form var. *minor* (BRID.) HAG. But the intermediate stages between this and the main form seem to give such a continuous range that I did not consider it worthwhile to list it separately. I did not find *M. uliginosa* above 1120 m, though this figure is very probably too low to be taken as the altitude limit, particularly as I have found the species at considerably higher altitudes elsewhere. The fruit seems to be common. WAHLENBERG mentions this species in a note on a rest they took on Nirjivare: »A *Meesia* was growing there, perhaps *uliginosa*, though it was very short . . .».

»Peldsa» (both the main form and var. *angustifolium* (BRID.) HAG.) (M, 1936, pp. 62 and 63); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; the S steep *c* 1 km NE of the waterfall; S Peak; Low Peak, 1120 m; the sub-peak of High Peak, 1100 m, c. fr.; SE Peak; Nirjijaure; Pältsavagge; all c. fr.

**Meesia triquetra** (HOOK. & TAYL.) ÅNGSTR.

*M. triquetra* is not uncommon in the district, but the only places in which I found it in large unmixed clumps were in the birch forest and the numerous fens by Nirjijaure. It is destinctly a fen moss, and it usually grows loosely; though, on the slope of Nirjijaure towards Nirjijaure, I found it growing in more or less compact tufts. I noted the following mosses from a shallow fen of the irrigated type on this mountain slope: *Aulacomnium palustre, Brachythecium salebrosum* subspec. *turgidum, Bryum pseudotriquetrum, Catoscopium nigritum, Cinclidium stygium, Drepanocladus revolvens, Hylocomium splendens, Meesia triquetra, M. uliginosa, Orthothecium chryseum, Paludella squarrosa, Sphagnum Warnstorfianum, Tomenthypnum nitens* and *Tritomaria quinquedentata* var. *turgida. M. triquetra* is most frequent up to 900 m. I did find it here and there on Low Peak, however, up to a height of 1000 m. I found it only at a lower level at the fact of South Peak, the peak to which MÖLLER's figure of 1000 m seems to refer (1936, p. 70). I did not find it with capsules.

»Peldsa» (M, 1936, p. 70); *c* ½ km NE of the Nirjijokk waterfall; S Peak; Middle Peak; Low Peak, up to 1000 m; SE Peak, the NE slope.

## Catoscopiaceae.

**Catoscopium nigritum** (HEDW.) BRID.

This species is common in the district. It occurs as a fen moss in the lower regions, whereas higher up it is found mostly on shelves in steep irrigated slopes, where it forms dense tufts as much as 10 cm high, usually free from foreign species. It was abundant on the slope of Low Peak towards Nirjijaure,

on the irrigated terrace of solifluction soil, together with species such as *Cinclidium arcticum, C. stygium, Drepanocladus revolvens* and *Tomenthypnum nitens*. It reached there an altitude of 1140 m, the highest I noted for the district. Fructiferous specimens are rare.

Gåbnetjåkko, c. fr.; S Peak; Middle Peak; Low Peak; the sub-peak of High Peak; SE Peak; Pältsavagge, c. fr.

## Bartramiaceae.

**Plagiopus Oederi** (GUNN.) LIMPR.

The species was abundant wherever I encountered it. I found it in several places on the steep east and south faces of South Peak where it grew in dense tufts matted together with rhizoids, hanging over shelves in the steep surface. The tufts were unusually free from other species, but there were some shoots of *Distichium capillaceum, Myurella julacea* and *Orthothecium chryseum*. The shaded forms, however, grew in lose cushions, in which foreign species were more common. I did not find *P. Oederi* at any considerable altitude, 1120 m being the highest. The species was almost always fertile, and even where plants occurred without capsules, capsule-bearing specimens could be found nearby. I have not noted the variety, nor do I remember having seen it, though it is possible that I disregarded it, since I am dubious about its value.

»Peldsa» (both the main form and var. *alpina* (SCHWAEGR.) MÖLL.) (M, 1925, pp. 118 & 119); »Peldsa, on the precipice, 1000 m, c. fr.» (the main form and var. *alpina*) (W); Gåbnetjåkko, the N steep, c. fr.; the S steep *c* 1 km N of the Nirjijokk waterfall, c. fr.; S Peak, c. fr.; Low Peak, 1120 m, c. fr.; the sub-peak of High Peak, 1100 m, c. fr.; Pältsavagge, c. fr.

**Bartramia ithyphylla** BRID.

*B. ithyphylla* is common, and distributed over the greater part of the district. It prefers poor soil, growing in rock crevices between boulders and in the cracks of irregular solifluction ground, etc. The moss never grows thickly, and sometimes there are only a few shoots. It was usually fructiferous. It appears to be just as common in the birch region as in the alpine, where it occurred at considerable altitudes — I found it a couple of times at 1300 m.

»The precipice *c* 2 km N of Gåbnetjåkko by Kummajoki, 550 m, c. fr.» (W); Gåbnetjåkko; the birch region, c. fr.; Lassivare; S Peak; Low Peak, c. fr.; Pältsavagge, c. fr.; the ridge-top W of cirque 5, 1310 m, c. fr.; SE Peak, the S slope, up to 1300 m, c. fr.

**Bartramia pomiformis** HEDW. var. **crispa** (WEB. & MOHR) BR. EUR.

This variety was found growing in a few cushions on the vertical surface at the foot of Gåbnetjåkko's north face. The specimen collected has a couple of empty capsules. The variety is usually considered to be more common than the main form, but it is rare in Torne Lappmark. It was first reported for the area in 1942 (UGGLA, p. 392). It does not occur in KOTILAINEN's list (1924) for the nearby Kilpisjärvi district.

Gåbnetjåkko, the N steep, c. fr.

**Conostomum boreale** Sw. — *C. tetragonum* (Dicks.) Lindb.

This species is common in the district. The lowest place at which I found it was on the edge of Nirjijokk just above the tree-line. It becomes increasingly common at higher altitudes, and is particularly abundant in the snow-beds in the inner part of Pältsavagge. I also found it on all the peaks I ascended. The finest specimens occur in snow-beds where the snow melts late, and where *Anthelia nivalis, Marsupella apiculata, Moerchia Blyttii, Pleuroclada albescens, Polytrichum norvegicum* and *Pohlia commutata* also grow; in such localities its dense growth make yellowish or bluish green tufts in the surrounding brownish-green moss carpet. Higher up it grows together with *Andreaea Blyttii, A. rupestris* forms, *Gymnomitrium concinnatum* and *Temnoma setiforme*. I found it on several occasions with capsules.

»Peldsa» (M, 1925, p. 124); »Peldsa, in a snow-bed in the valley, 750 m; do., on a precipice, 1100 m» (W); Gåbnetjåkko; Nirjijokk, above the waterfall, c. fr.; Lassivare; S Peak; Middle Peak, 1440 m; Low Peak, c. fr.; High Peak; Pältsavagge; SE Peak.

**Philonotis caespitosa** Wils.

Möller lists this species. I obtained no specimen myself. Weimarck mentions a locality on Gapovare.

»Peldsa» (M, 1925, p. 25).

**Philonotis seriata** (Mitt.) Lindb.

This species grows thickly by some streams and springs in the birch forest just north-east of the waterfall in the flood zone, together with *Calliergon sarmentosum* and *Cratoneurum commutatum*. The other locality was of the same type, and was at a height of 700 m.

»The precipice by Kummajoki, 550 m» (W); NE of the Nirjijokk waterfall, ♂; SE Peak, the NE slope.

**Philonotis tomentella** Mol.

*P. tomentella* is common in the district, occurring in fens, by the sides of streams and on irrigated shelves in precipitous slopes. Usual companions are *Bryum pseudotriquetrum, Brachythecium salebrosum* subspec. *turgidum, Campylium stellatum, Cinclidium stygium, Mnium pseudopunctatum, Oncophorus virens* and *Tomenthypnum nitens*. It very rarely grows above 1000 m. Fruit and flowers are rare.

»Peldsa» (the main form and var. *borealis* (Hag.) Loeske) (M, 1935, pp. 38 & 41); Gåbnetjåkko; the Nirjijokk waterfall, c. fr.; Lassivare, ♂; S Peak; Low Peak, c. fr.; SE Peak; Pältsavagge.

## Timmiaceae.

**Timmia austriaca** Hedw.

*T. austriaca* occurs sparsely all over the district, up to a height of about 1200 m. I saw it here and there on the banks of streams in the birch forest just north of the Nirjijokk waterfall. In the alpine region it grew on shelves in the shady precipitous places, on solifluction slopes, and so on. When it

grows in the open, the locality is as a rule quite moist, with species such as *Aulacomnium turgidum, Ditrichum flexicaule, Hylocomium splendens* and *Tritomaria quinquedentata* var. *turgida* richly represented. The forms from the higher altitudes are stunted, sometimes hardly 1 cm high, the leaves are shorter and lie closer to the stem, but they are never difficult to recognise. though their small size does make them difficult to find. I have not found plants with capsules, neither in this district nor elsewhere in the mountains.

»Peldsa» (M, 1923, p. 11); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; S Peak; Low Peak, 1180 m; the sub-peak of High Peak, 1120 m; Pältsavagge.

**Timmia bavarica** HESSL.

I found this species growing sparsely on mould in a hole under a large slate boulder about 1 km north-east of the Nirjijokk waterfall. The specimen collected includes some shoots of *Pohlia cruda.*

The birch forest *c* 1 km NE of the Nirjijokk waterfall.

**Timmia norvegica** ZETT.

*T. norvegica* is not rare in the district. It grows in shaded places — under overhanging boulders of slate or limestone or in holes and crevices in north slopes, for instance. I did not find any large unmixed clumps; it usually grows in a moss carpet whose more common components are *Distichium capillaceum, Ditrichum flexicaule, Hypnum Bambergeri, Mnium hymenophyllum, Orthothecium chryseum* and *Tomenthypnum nitens.* I found it on the south slope of South-east Peak at 1200 m, the highest altitude for the district.

The Nirjijokk waterfall; S Peak, the E steep; Middle Peak, the N slope; the col between S and Middle Peaks on the Pältsavagge side; Low Peak, the NW part, 1120 m; the moraine below cirque 5; SE Peak, the slope towards Måskojaure, 1200 m.

## Orthotricaceae.

**Ulota curvifolia** (WG) BRID.

According to a specimen in the Uppsala museum this species has been found in the area investigated — probably at the lower altitudes. The specimen is a *nigrescens* form and has unripe fruits.

»Peltsana-fjell», c. fr. (C. P. LAESTADIUS, 1859).

**Orthotrichum alpestre** HORNSCH.

This species was found growing sparsely in a few places. It grew together with *Encalypta rhabdocarpa* on slate boulders in the birch forest.

The S steep *c* 1 km NE of the Nirjijokk waterfall, c. fr.

**Orthotrichum Blyttii** SCHIMP.

*O. Blyttii* was growing in thriving tufts in a deep crevice under the nest of a bird of prey on the north face of Gåbnetjåkko. A specimen collected from a limestone boulder serving as a 'bird rock' on Low Peak, where the habitat was not at all favourable, seems also to belong to this species. This locality

was at 1120 m. *O. Blyttii* is most probably nitrophile. I had previously found it in a similar place in Lule Lappmark.

Gåbnetjåkko, the N steep, c. fr.

## Fontinalaceae.

**Fontinalis antipyretica** HEDW.

This species was found in only two places. The locality was in each case a slowly-running brook just above the tree-line. The moss was abundant in both places. It has also been found in abundance just south of the outlet stream from Kummajärvi.

Gåbnetjåkko, the NW part, *c* 600 m; *c* 1/2 km NW of the Nirjijokk waterfall.

**Dichelyma falcatum** (HEDW.) MYR.

This moss was growing sparsely in a small pool on the north-western part of Gåbnetjåkko as usual on the water-line. It is one of the species which must be regarded as rare in the alpine region. As far as MÖLLER's report is concerned, I can only say that the estimated height given was probably exaggerated.

»Peldsa, *c* 800 m» (M); Gåbnetjåkko, 630 m, c. fr.

## Climaciaceae.

**Climacium dendroides** (HEDW.) WEB. & MOHR

The species is common in the subalpine part of the district, where it is found on the turf beside streams, and among shady willow and birch scrub. It was rare on Pältsa itself; I found it only a few times on South Peak. It was very stunted there, and the stem usually did not extend above the surrounding moss covering, which consisted of such species as *Drepanocladus uncinatus, Hylocomium splendens* and *Mnium orthorrhynchum*. The highest altitude at which I saw it was about 1000 m, the same figure as is given for MÖLLER's specimen.

Gåbnetjåkko; the birch region; South Peak, *c* 1000 m (M); the E slope, *c* 1000 m; Pältsavagge, below S Peak, 810 m, Måskojaure.

## Hedwigiaceae.

**Hedwigia ciliata** (HEDW.) BR. EUR.

*H. ciliata* is rare in the district, as it is in general in the mountains. It grew on a large boulder of the archean rock at the edge of Nirjijokk, together with *Dicranum fuscescens, Grimmia ovalis* and *Polytrichum piliferum*.

»Peldsa» (W); Nirjijokk, just above the tree-line, c. fr.

## Neckeraceae.

**Neckera oligocarpa** BRUCH

I found this species in only two places, at the foot of Gåbnetjåkko's N face. The locality in each case was deep clefts in the vertical surface. One of the

specimens includes some shoots of *Isopterygium pulchellum* and *Mnium orthorrhynchum*.

Gåbnetjåkko, the N steep.

## Theliaceae.

**Myurella julacea** (HEDW.) BR. EUR.

*M. julacea* is common on Pältsa. It usually occurs among other mosses, and I did not find it unmixed with other species. It occurs in many moist shaded places on the steeps of South Peak, where it grows together with a number of calcicole rock mosses. The leaves are sometimes quite distant, more or less as in *Myurella tenerrima*. I have found shoots in mixed specimens where the leaves in the lower part are markedly distant, whereas those in the upper part have the normal appearance. It is therefore often difficult in the field to decide whether or not mixed shoots belong to *Myurella tenerrima*. Other variations are that the tip of the leaf is often drawn out to some extent, and the leaf more concave and papillose. I found *M. julacea* at a height of 1100 m. But, if one especially looks for the species, it is probably to be found even higher up.

»Peldsa» (M, 1917, p. 72); »Peldsa, 900 m» (W); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; the S steep *c* 1 km NE of the waterfall; South Peak, 1000 m (W); Middle Peak; Low Peak; the sub-peak of High Peak, 1100 m; Pältsavagge.

**Myurella tenerrima** (BRID.) LINDB. *Myurella apiculata* BR. EUR.

*M. tenerrima* is uncommon in the district. It should be remembered, however, that forms of *M. julacea* occur which may be confused with *M. tenerrima* in the field, which makes the search for the latter more difficult. Otherwise, when growing in an unmixed state, *M. tenerrima* is easy to identify. I have such an unmixed specimen from the subalpine part of the district. The moss grew there on flat shaded stones over which the water from a calciferous percolated. There are a few shoots of *Mnium hymenophylloides* in the specimen, but no other foreign species. It was collected on the August, 6th 1948, and bears an abundance of capsules at the stage when they are just losing their lids. It is difficult to say how far up the mountain slopes *M. tenerrima* extends. WEIMARCK gives a figure of 1000 m. I myself noted it at 1130 m. Although the localities I have listed for this species are such as correspond to collected specimens, I think it permissible to mention this height, since I regard it as the probable altitude limit.

»Peldsa» (M, 1917, p. 65); »Peldsa, 1000 m» (W); the S steep *c* 1 km NE of the Nirjijokk waterfall, c. fr.; S Peak, 1000 m, 880 m.

## Leskeaceae.

**Leskeella nervosa** (SCHWAEGR.) LOESKE

Gåbnetjåkko, the N steep; the S steep *c* 1 km NE of the Nirjijokk waterfall; Low Peak; the S slope, 1100 m.

**Leskeella tectorum** (A. Br.) Hag.

*L. nervosa* is fairly rare, while *L. tectorum* seems to be quite widely distributed. Both species vary considerably, and it is therefore only possible to distinguish the normal forms in the field. Both species prefer sunny rocks and boulders of limestone or slate. *L. tectorum* was also collected from a 'bird rock'. No fructiferous specimens of either species were found.

The S slope *c* 1 km NE of the Nirjijokk waterfall; S Peak, the S steep, *c* 1000 m; Middle Peak, the SW slope, 850 m.

**Lescuraea mutabilis** (Brid.) Lindb. var. **saxicola** (Br. eur.) Hag.

*L. mutabilis* var. *saxicola* is the most common representative of the subfamily *Pseudoleskeeae*. It usually grows on stones and boulders. I saw it together with *Brachythecium reflexum* and *Bartramia ithyphylla* in the subalpine region. The specimens collected in the alpine region contain some *Dicranoweisia crispula* and *Leskeella tectorum*. It was not found with fruit.

Gåbnetjåkko, the N steep; the S steep *c* 1 km NE of the Nirjijokk waterfall; S Peak, up to 1000 m; the col between S and Middle Peaks, on the Pältsavagge side; cirque 5, 920 m; Måskojaure.

**Pseudoleskea decipiens** (Limp.) Kindb.

Jensen's moss flora states that this species, which resembles *Lescuraea mutabilis* var. *saxicola* in its habit, has been found on Pältsa, and the report is confirmed by a specimen in the Lund herbarium. Dr. Herman Persson did the determination. I myself have some specimens which ought perhaps to be assigned to *P. decipiens,* but it is difficult to get a clear picture of this species, since the comparison material in the herbaria is particularly heterogeneous and the descriptions in the flora altogether too brief. The cells of the forms assigned to *P. decipiens* are too long and the leaves of these specimens too slightly hooked and taper too gradually to be convincing.

»Peldsa» (W, acc. to C. Jensen, 1939, p. 412).

**Pseudoleskea incurvata** (Hedw.) Dix.

S Peak, the SE slope.

**Pseudoleskea radiosa** (Mitt.) Kindb.

To judge from sample specimens collected, *P. radicosa* is the more common of these two species. It was usually found as a rather coarse form, on boulders or earth in snow-beds. In a snow-bed on South-east Peak where the snow melted quite late, it grew together with *Asterella Lindenbergiana*. It was growing on crystalline limestone in Pältsavagge. The *P. incurvata* specimen came from flat boulders in a snow-bed. It is not always easy to distinguish the two species. The papillosity is usually given as the principal distinctive characteristic, but it is almost certainly subject to quite a wide variation. A comparable case is provided by the Lescuraea, It is therefore desirable that greater systematical value should be assigned to the cell form.

»Peldsa, 1200 m, c. fr.» (W); several places on the S and E slopes, 700—800 m, c. fr.; Pältsavagge, below Middle Peak, 650 m; SE Peak, the E slope, 700 m.

## Thuidiaceae.

**Heterocladium papillosum** LINDB.

Quite an abundant sample of this species, which is markedly concentrated in the north-east of Scandinavia, was collected in a deep crevice at the foot of Gåbnetjåkko's north face, where it grew as a thin cover to the shaded vertical surface. KOTILAINEN found this moss in the nearby Kipisjärvi area (1924, p. 29).

Gåbnetjåkko, the N steep.

**Thuidium abietinum** (BRID.) BR. EUR. *Abietinella abietina* (BRID.) C. MÜLL.

*T. abietinum* is not at all infrequent on Pältsa. It is most abundant among the juniper scrub which grows here and there on the small steep slopes between the terraces at the foot of South Peak. It extends from there up to a height of about 1200 m. I found it at 1150 m on the north-east face of that peak. It was quite frequent on the ridge of Low Peak in a *Dryas - Carex nardina* heath. *T. abietinum* is most usually found, though, on soil or boulders covered with soil on steep southern slopes, together with such species as *Brachythecium salebrosum* subspec. *turgidum, Hypnum revolutum, Rhytidium rugosum, Tortula norvegica* and *T. ruralis*. I did not find it in the birch region. Nor did I find it with fruit.

»Peldsa, *c* 800 m» (M, 1913, p. 41); »Peldsa, *c* 900 m» (W); S Peak, up to 1200 m; Low Peak, 1080 m; the sub-peak of High Peak, 1120 m.

**Helodium Blandowii** (WEB. & MOHR) WARNST.

This species occurred in abundance in the willow scrub which covers the banks of the stream running into Nirjijokk, within the region extending from the north-western part of Gåbnetjåkko some kilometres up this river. I also found it in the birch forest, in dense carpets covering flat stones over which the water from a calciferous spring percolated. In the willow scrub, its usual companions are *Mnium cinclidioides* and *Sphagnum Warnstorfianum*. Other more exacting species found with it are *Cinclidium stygium, Mnium pseudopunctatum* and *Philonotis tomentella*. There were fructiferous individuals in both localities. *H. Blandowii* is one of the species which is seldom found above the birch region.

The birch region, c. fr.; Gåbnetjåkko, 630 m, c. fr.

## Amblystegiaceae.

**Cratoneurum commutatum** (HEDW.) ROTH var. **falcatum** (BRID.) C. JENS.

All the localities were tributaries of Nirjijokk which gave a good supply of nutrients. The moss was abundant there, both as thick unmixed growth and together with *Calliergon sarmentosum* and *C. decipiens*. Some of the forms were very coarse, and had both straight and falcate leaves. I did not find any fructiferous specimens.

The birch region; Lassivare; SE Peak, the NE slope, 700 m.

**Cratoneurum decipiens** (DNOT) LOESKE

*C. decipiens* was about as common as the preceding species, but I did not see it growing unmixed with other species. It occurred in streams together with *C. commutatum,* and by springs, where its chief companion was *Philonotis tomentella.* The principal variation is in the regularity of the branching. The fruit seems to be rare.

*C* 1 km NE of the Nirjijokk waterfall; at the foot of and to the E of S Peak; SE Peak, the slope towards Måskojaure, 690 m.

**Campylium Halleri** (HEDW.) LINDB.

I found this characteristic moss in only one place, though it was abundant there. It was growing tightly pressed against a vertical limestone surface.

In the mountains, *C. Halleri* is known chiefly as a subalpine species. But it does also occur in the alpine region, and not infrequently at considerable altitude. Thus I collected it at 1330 m on Gardetjåkko in Torne Lappmark. The forms which are found at the higher altitudes grow in thin carpets clinging to the rock, but they are easy to recognise. The usual substratum is limestone, dolomite, or calcareous slate. Plants with capsules appear to be rare, and I did not find them either on Pältsa or elsewhere.

S Peak, the NE steeps, 1100 m.

**Campylium stellatum** (HEDW.) J. LANGE & C. JENS.

*C. stellatum* is common in moist places on precipitous slopes and in fens. It grew by the Nirjijokk waterfall, on the north slope in the spray zone. I saw it growing on the slope of Low Peak towards Nirjijaure, together with *Aulacomnium turgidum, Orthothecium chryseum, Philonotis tomentella* and *Tomenthypnum nitens.* The variation is considerable, particularly in the case of some rock forms which have shorter and more appressed leaves. Some small forms which grow in snow-beds should also be mentioned. The species is not found at the higher altitudes, the highest altitude I noted being 1080 m. I did not find it with fruit.

The Nirjijokk waterfall; S Peak; Middle Peak; Low Peak, up to 1080 m; Pältsavagge; cirque 5; Måskojaure.

**Amblystegiella Sprucei** (BRUCH) LOESKE

*A. Sprucei* is scarce in the district, and, despite the fact that I was on the watch for it, I did not find it growing by itself, but only obtained it as a minor constituent of other samples. It occurred by the Nirjijokk waterfall in a tuft of *Amphidium lapponicum.* The specimen from Middle Peak in which it was found consisted mainly of *Orthothecium chryseum.* I have found it growing by itself, however, at the foot of the Norwegian mountain Paras, just to the north of this district. It has not been found with fruit in the district.

»The precipice *c* 2 km N of Gåbnetjåkko, by Kummajoki, 550 m» (W); Middle Peak (S. ARNELL & H. SMITH, 1939); the Nirjijokk waterfall; S Peak, the NE slope, 1100 m; Pältsavagge, by the waterfall on the stream from cirque 5.

**Drepanocladus badius** (HN) ROTH

*D. badius* is widespread in the district, without being common. I saw it at the lower altitudes on the edge of *Scorpidium* fens (Gåbnetjåkko) and on

irrigated flat stones by the side of Nirjijokk. I found it in several places on Low Peak, up to a height of almost 1000 m. Some stunted and hardly determinable specimens collected on High Peak are from 1300 m.

Gåbnetjåkko, 630 m; Nirjijokk, just above the tree-line; *c* 1 km NE of the Nirjijokk waterfall; Low Peak, up to 1130 m; High Peak, 1300 m.

**Drepanocladus exannulatus** (Br. eur.) Warnst.

Most of the material of this species gathered by me belongs to the much-discussed *purpurascens* form, which is of course common in the mountains. Some authors consider it to be a good species (e.g. Herm. Persson, 1943, pp. 20—21), while others (e.g. Tuomikoski, 1949, p. 38) are more cautious. I therefore decided to leave this form (or species) as *D. exannulatus* until its status has been definitely fixed. Another form, *Rotae* (DeNot.) Moenk., is listed by Weimarck as from »Peldsa, in a pool».

»Peldsa» (M); »Peldsa, on a landslide slope» (W); Gåbnetjåkko, c. fr.; the birch region, c. fr.; the Lassivare stream, c. fr.; SE Peak, the NE slope; Nirjijaure.

**Drepanocladus revolvens** (Sw.) Warnst.

*D. revolvens* and its subspecies *intermedius* (Lindb.) Grout are common in the district. I have not tried to distinguish between the main form and the subspecies in my notes, especially as forms intermediate with regard to habit are frequent, leaving the sexual division as the only determinative character.

In this district, *D. revolvens* grows in the main in fens rich in species, but it is also found on moist shelves in steep slopes, or similar localities. In the latter case, the forms should be assigned to subspec. *intermedius*, to judge by the habit. I made no direct measurements of altitude for this species, but it is certain that it is not uncommon at 1000 m, at least.

»Auf dem westlichen Abhang von Peldsa» (Th. Fries, 1913, p. 92); »Peldsa, 900 m» (M); »Peldsa, on a soil slope» (W); Gåbnetjåkko; the birch region; Lassivare (M); S Peak, c. fr.; Low Peak; the sub-peak of High Peak; SE Peak; Måskojaure, c. fr.; subspec. *intermedius* (Lindb.) Grout.: »Peldsa, 900 m» (M).

**Drepanocladus tundrae** (Arn.) Loeske

This species, whose position was clarified by Tuomikoski, was particularly abundant in the fen on the south-west side of Nirjijaure, sometimes growing in patches. It was usually free from other species there. *Calliergon sarmentosum* was the most common of the occasional foreign species. Capsule-bearing specimens were rather rare.

SE Peak, the NE slope, 750 m; Nirjijaure, by the outlet stream, 750 m, c. fr.; Low Peak, the slope towards Nirjijaure, 820 m.

**Drepanocladus uncinatus** (Hedw.) Warnst.

*D. uncinatus* is the most common and widespread of the Musci in the district, and it appears in the most diverse localities, from the finest *Dryas* heaths to the most meager streams from the melting snow. It is very variable. There are great patches of a large, coarse, and almost unbranched form in the streams of water from the melting snow and on ground where water per-

colates on the north slopes of Måskokaise, while plants on the rock debris below South Peak form thin matted carpets. It also occurs at high altitudes, and I found it together with *Paraleucobryum enerve* and *Polytrichum alpinum* at a height of 1400 m. I do not recollect that I saw it with fruit.

»Peldsa» (C. P. LAESTADIUS, 1859); »Peldsavagge» (TH. FRIES, 1913, p. 115); »Peldsa» (M); »Peldsa, 1000 m; the precipice by Kummajoki, 550 m» (W); Gåbnetjåkko; the birch region; Lassivare; S Peak; Middle Peak; Low Peak; the sub-peak of High Peak; SE Peak; Pältsavagge; Måskojaure.

**Hygrohypnum alpestre** (HEDW.) LOESKE. *H. rivulare* BROTH.

This species was very abundant in places at the foot of the north face of Gåbnetjåkko. I also found dense carpets of it on flat stones by Nirjijokk, and smaller tufts on stones by the sides of the many small tributaries. Like the other species, it prefers to grow in the flood zone. It often bears an abundance of fruit.

Gåbnetjåkko, the N steep, c. fr.; Nirjijokk, c. fr.; Low Peak, 1040 m.

**Hygrohypnum cochlearifolium** (VENT.) BROTH.

I myself did not see this species in the district.

Middle Peak, *c* 1000 m (S. ARNELL & H. SMITH, 1939).

**Hygrohypnum dilatatum** (WILS.) LOESKE

I found *H. dilatatum* a few times in the birch region. It also occurs far up in Pältsavagge, where one of the places at which I collected it was in cirque 5, at a height of 900 m. It appears to be seldom fructiferous.

»Peldsa, by the stream in the valley, 750 m» (W); Gåbnetjåkko; Nirjijokk; Pältsavagge, 900 m; Nirjijaure.

**Hygrohypnum ochraceum** (TURN.) LOESKE

*H. ochraceum* is very abundant in the small streams near the Nirjijokk waterfall, mainly coarser forms growing there. Its frequency seems to decline rapidly higher up. I did collect it at 800 m, but the specimen was very stunted. However, it is difficult to give a satisfactory estimate of the extent of a species which has so many forms. The moss has not been found with fruit in the district.

The birch region; Nirjijokk; Middle Peak, 800 m.

**Hygrohypnum polare** (LINDB.) BROTH.

*H. polare* is particularly common in the district. Large carpets of it occurred on the sand-covered flat stones by Nirjijokk. These plants were large, and the leaves slightly falcate. The species also occurs in abundance along the many small streams from the melting snow at 1100 m, in many forms, so that in several cases it was only the long, thick nerve which made identification possible. Two companion species were *Orthothecium chryseum* and *Philonotis tomentella*. The sporophyte was not found.

»Lassivare, *c* 700 m» (M); Nirjijokk, *c* 200 m above the waterfall, 600 m; Middle Peak, the E slope, 1160 m; Low Peak, the slope towards Nirjijaure, up to 1100 m.

**Calliergon giganteum** (SCHIMP.) KINDB.

This species seemed to be rare, as I did not succeed in finding it, despite a direct search. WEIMARK's specimen is in the Lund herbarium.

»The precipice *c* 2 km N of Gåbnetjåkko» (W).

**Calliergon sarmentosum** (WG.) KINDB.

*C. sarmentosum* is one of the most common and most variable species in the district. It was found in fens, pools, on percolation surfaces, on stones, in small streams, and so on. Patches of it often occurred, especially in Pältsavagge and by Nirjijaure. There is scarcely one character of this moss which is constant — except the need for water and perhaps the small point at the tip of the leaf. I found it growing together with *Cratoneurum* species on limestone slabs in streams, as mass vegetation in association with *Calliergon trifarium*. It was equally common on soil either rich or poor in nutrients. I saw the sporophyte only once. MÖLLER collected the species »just below the peak».

»Peldsa» (M); Gåbnetjåkko; the birch region; Nirjijokk; Lassivare; S Peak, c. fr.; Middle Peak; Low Peak; Pältsavagge; SE Peak; Måskojaure.

**Calliergon stramineum** (BRID.) KINDB.

*C. stramineum* is common at lower levels in the district. But the typical straw-coloured, easily-recognisable fen form is rare. The more or less green, creeping forms seem to be most common, especially on the sand at the edge of Nirjijokk. Other types, coarser, green, and resembling *C. cordifolium*, were also collected during the search for this species. The moss has not been found with fruit.

»Below the precipice by Kummajoki, *c* 2 km of Gåbnetjåkko, 55 m» (W); »Peldsa, *c* 1000 m» (M); Gåbnetjåkko; the birch region; Lassivare; Pältsavagge, 870 m.

**Calliergon trifarium** (WEB. & MOHR) KINDB.

This species seems to be fairly rare. It was growing by Nirjijokk as a sparse component of a *Scorpidium* carpet which covered a slab of stone at the side of the river. Most of the finds were from *Scorpidium* fens. One of the localities at the entrance to Pältsavagge was exceptional, however; there the moss was quite abundant in patches of *Calliergon sarmentosum*. The locality by Nirjijaure seemed to be the highest. As expected, the moss was not found with fruit.

Nirjijokk, *c* 200 m above the waterfall; at the foot of and SE of S Peak; at the upper end of Nirjijaure, 760 m; Pältsavagge.

**Calliergon turgescens** (TH. JENS.) KINDB.

The only places in which *Calliergon* was found were close to running water: at the sides of streams, on schist slabs or other ground over which water percolated. The forms I found were short, and often grew in dense tufts, or even carpets, frequently free from foreign species. Where such foreign species did occur, they were usually *Bryum pseudotriquetrum, Ditrichum flexicaule* and *Drepanocladus revolvens*. In their habit, these forms are somewhat remiscent of *Hygrohypnum* species. I did not find any specimens with capsules.

The slope of Low Peak towards Nirjijaure, 1030 and 1100 m; Pältsavagge, the col between S and Middle Peaks, *c* 1000 m; the col between Low Peak and the sub-peak of High Peak, 1000 m.

**Scorpidium scorpioides** (HEDW.) LIMPR.

*S. scorpioides* is frequent in several of the fens in the region between Gåbnetjåkko and the entrance to Pältsavagge, at a height of 600—800 m. It is also common in the fens by Nirjijaure. It often grows in dense carpets, apparently free from foreign species, in still water in streams or on irrigated stones; the only immixed species is *Calliergon trifarium*. In other places it is found together with such exacting mosses as *Cinclidium stygium, Drepanocladus revolvens, D. badius, Mnium pseudopunctatum*. The height given for one of the specimens collected by MÖLLER in the district is *c* 900 m. I myself did not find the moss so high up. Fructiferous specimens have not been found in the district.

»Peldsa» (M); Gåbnetjåkko; Nirjijokk; S Peak; Nirjijaure; Pältsavagge.

## Brachytheciaceae

**Tomenthypnum nitens** (SCHREB.) LOESKE

*T. nitens* is common in the district up to about 1100 m. At the lower altitudes it occurs as a bright golden-yellow, silky moss, growing in fens together with such species as *Aulacomnium palustre, Helodium Blandowii, Mnium pseudopunctatum, Orthocaulis Kunzeanus* and *Sphagnum Warnstorfianum*. But higher up, it seems to prefer moist *Dryas*-covered rock shelves and solifluction terraces, where it often forms large brown carpets. Its main companions there are *Aulacomnium turgidum, Cinclidium arcticum, Ditrichum flexicaule, Hypnum Bambergeri* and *Orthothecium chryseum*. The forms found at the higher altitudes are often less branched, stiffer, and with leaves shorter than in the normal form. Since the nerve is often difficult to see on the very plicate leaf, one must be very careful in a field examination not to confuse these forms with *Orthothecium chryseum* — a common associate. I did not find the moss with fruit.

»Peldsa» (M); »Peldsa, in a fen in the valley, 700 m» (W); *c* 1 km NE of the Nirjijokk waterfall; Lassivare; S Peak; Middle Peak; Low Peak; the sub-peak of High Peak; Nirjijaure; SE Peak; Pältsavagge.

**Brachythecium collinum** (SCHLEICH.) BR. EUR.

In spite of a careful search, I did not succeed in finding good specimens of this tiny, rare species. I found some small *Brachythecium* shoots probably belonging to this species among *Stegonia latifolia* on South Peak. The more noteworthy immixed species in WEIMARCK's specimen are *Asterella Ludwigii* and *Bartramia ithyphylla*.

»Peldsa, on the soil slope» (W); S Peak.

**Brachythecium glaciale** BR. EUR.

*B. glaciale* is fairly common in the district. It was found only in snow-beds where the snow melts late and the flood verges of streams from melting snow

in the more calcareous terrain. It usually grows by itself, and not infrequently in patches, but I did sometimes see it growing sparsely, together with *Asterella Lindenbergiana, Distichium capillaceum, Preissia quadrata,* or *Pseudoleskea incurvata. B. glaciale* varies considerably. The main characters affected are the branching and the convexity and imbrication of the leaf. I brought back a specimen from Middle Peak in which the leaves are closely imbricate and markedly convex, so that the habit of the moss, which is not much branched, resembles that of *Myurella julacea.* The nerve is also unusually thick, and the cells considerably shorter than in the normal individual, as a rule 3—5 times longer than broad. The species not infrequently bears fruit.

S Peak; Middle Peak, c. fr.; Low Peak, up to 1140 m, c. fr.; the ravine towards the NE; cirque 5; Pältsavagge, c. fr.

**[Brachythecium glareosum** (BRUCH) BR. EUR.]

NORDHAGEN (1939, p. 694) gives this species (though without specifying the authority) in a table for a test square in a *Stellaria longipes* locality on Low Peak's slope towards Nirjijaure. It seems likely that this is a case of confusion with *B. salebrosum* subspec. *turgidum.* This latter species is common there, whereas, so far as I know, *B. glareosum* has not been found in the alpine region.

**Brachythecium latifolium** (LINDB.) PHILIB.

This species was found in only one place, despite the fact that I loked for it in several parts of the district. It grew together with *Drepanocladus uncinatus,* and the specimen has some old setae.

Low Peak, above the upper end of Nirjijaure, *c* 800 m.

**Brachythecium reflexum** (BRID.) BR. EUR.

*B. reflexum* is common in the subalpine part of the district, growing as small thick carpets on soil slopes, boulders, and roots of willow, birch and juniper. It is widespread in the alpine region, usually growing at the base of the stem or on the roots of juniper or willow. I found it on the rock debris at the foot of South Peak's southern face as abundant, fructiferous specimens growing thickly on boulders. It usually grows in the drier localities, but I did find it a couple of times on ground which is best described as a snow-bed. I have no specimen from an altitude higher than 900 m. It is not infrequently fructiferous.

»Below the precipice by Kummajoki *c* 2 km N of Gåbnetjåkko, 550 m» (W); Gåbnetjåkko, the N steep; the birch region; the esker; S Peak, c. fr.; cirque 5, 900 m; Måskojaure.

**Brachythecium rivulare** BR. EUR.

*B. rivulare* was found only in the subalpine region on the fine alluvial sand by the sides of the streams which run from the north-west down into Nirjijokk below the waterfall.

NE of the Nirjijokk waterfall.

**Brachythecium salebrosum** (HOFFM.) BR. EUR. subspec. **turgidum** HN.

*B. salebrosum* is probably the most common and widespread species of this genus in the district. Only subspec. *turgidum* seems to occur. In the subalpine region I found it on slate boulders in the spray zone of the Nirjijokk waterfall, and beside some streams just north of the waterfall. In the alpine region I came across it in a variety of places, in the more shallow fens, at the edges of streams, in snow-beds, and on cliff-shelves. The moss is clearly calcicole — at the higher altitudes, anyway — and occurs in surroundings rich in species. There are a great variety of forms, which have been thoroughly discussed by ARNELL and JENSEN (1910, p. 210), who consider that »var. *turgidum* darf daher höchstens als eine Varietät des *Hypnum plumulosum* [1] und nicht als eine selbständige art aufgefasst werden». I entirely agree with this opinion, though I have listed the form under its usual name as a matter of formality.

*B. salebrosum* subspec. *turgidum* has been found in the district at altitudes up to almost 1000 m. It appears to be very rarely fertile, and has not been found in this state in this area.

Gåbnetjåkko, the N steep; the birch region; S Peak; Middle Peak; Low Peak; the sub-peak of High Peak; SE Peak; Pältsavagge.

**Brachythecium Starkei** (BRID.) BR. EUR.

This species grew here and there among stones and boulders in the birch forest on the south slope about 1 km north-east of the Nirjijokk waterfall. It is one of the rare species in the mountains. The specimen is without fruit.

The S steep *c* 1 km NE of the Nirjijokk waterfall.

**Brachythecium trachypodium** (FUNCK) BR. EUR.

It grew sparsely in the two places where I found it, which were both shady localities on weathered detritus. The growth was brownish green and free from other species. The capsules were still green and undeveloped on the 8th August 1949.

*B. trachypodium* is one of the rarer species of this genus. It is very similar in appearance to *B. velutinum,* but distinctly alpine. The locality on South Peak is the lowest of all those where I have found the moss in Lule and Torne Lappmarks. It does also occur in the subalpine region in the well-known locality in the Abiskojokk canyon, for instance.

S Peak, the S steep, 1160 m, c. fr.; Middle Peak, the steep slope towards S Peak, *c* 1350 m.

**[Eurhynchium pulchellum** (HEDW.) JENNINGS, var. **diversifolium** (SCHLEICH) MOL. & LOR.]

WEIMARCK lists this species with »Peldsa» as the locality. But the specimen in the Lund herbarium which I have examined should be assigned to *Brachythecium collinum,* which makes it doubtful whether the above variety does occur in the district. Moreover, it seems to be quite rare in the alpine region.

[1] *B. salebrosum* according to the nomenclature used here.

I myself have collected it only one occasion in the lower alpine region, so I have little experience of it.

## Entodontaceae.

**Pterygynadrum filiforme** HEDW. var. **decipiens** (WEB. & MOHR.) LIMPR.

*P. filiforme* var. *decipiens* is rare in the district. A small specimen, resembling the main form, was collected from a vertical amphibolite surface on South Peak, where it was growing together with *Grimmia ovalis*. The moss was also found on an exposed limestone knoll in Pältsavagge, together with *Rhytidium rugosum*. All the collected specimens were without fruit.

It is probably this variety that WAHLENBERG refers to when he mentions that he found »*Pterogonium gracile*» in the region to the east of Pältsa, probably on the overhanging cliffs level with the Nirjijokk waterfall. A specimen in the Uppsala museum has on the label »The Enontekis mountains, 3rd July 1800», the date given being FORSSTRÖM's date for the journey past Pältsa (W. gives the 4th July).

»Peldsa» (M, 1917, p. 92); Gåbnetjåkko, the N steep; the S steep *c* 1 km NE of the Nirjijokk waterfall; S Peak, 1080 m; Pältsavagge, below Middle Peak.

**Entodon orthocarpus** (LA PYL.) LINDB.

The moss was found as a large thick carpet mostly free from foreign species. *Hylocomium splendens* and *Rhytidiadelphus triquetrus* grew among it at the edges of the carpet, both of them growing luxuriantly in the neighbourhood. The locality was fairly dry on the 3rd August 1948, but at the same time the following year very moist from spray and seepage from the perpendicular surfaces of Gåbnetjåkko's north face — due to the heavy snowfall of the winter 1948—49.

The extension of *E. orthocarpous* in the mountain chain is not yet completely known. There appear to be at present five known localities on the Swedish side. The species is probably overlooked because of its similarity to some other pleurocarpous mosses — in the mountains, *Pleurozium Schreberi*. If a moss resembling the latter is found in the company of *Rhytidiadelphus triquetrus, Thuidium abietinum* or some other moss which indicates good ground, it is well to bear *E. orthocarpus* in mind. The Scandinavian distribution of the moss has been dealt with by KRUSENSTJERNA (1945, p. 176), and a map accompanies his text.

Gåbnetjåkko, the N steep.

**Orthothecium chryseum** (SCHWAEGR.) BR. EUR.

*O. chryseum* is the most common species of this genus, and is frequent over the greater part of the district. It varies in colour, but more so in size. An abundance of giant specimens grow on the percolation surfaces at the foot of Gåbnetjåkko's north face, whereas some specimens from Low Peak are no more than some centimetres high. *O. chryseum* usually grows in considerably more open localities than the other two species. It is common alongside the small streams from the melting snow and on the solifluction terraces of

Low Peak. The species most frequently met with in its company are *Bryum pseudotriquetrum, Campylium stellatum, Ditrichum flexicaule, Drepanocladus revolvens, Hypnum Bambergeri, Mnium Blyttii, M. hymenophyllum* and *Tomenthypnum nitens*. The moss was not found with fruit in the district.

»Peldsa, on a mountain slope» (W); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; S Peak, 1100 m; Middle Peak; Low Peak; 1140 m; the sub-peak of High Peak, 1150 m; Pältsavagge; cirque 5.

**Orthothecium intricatum** (Hn.) Br. eur.

The main localities for *O. intricatum* in the district are holes and shady rock crevices in steep slopes of limestone or slate. It is nearly always found in the company of such species as *Blepharostoma trichophyllum, Isopterygium pulchellum, Leiocolea Gilmani* and *Mnium hymenophylloides*. The shape of the leaf and the colour vary considerably, and on several occasions I came across forms in which these characters were like those of *O. strictum*, I found the species in the subalpine region, growing thickly on flat stones irrigated by water from a calciferous spring. The species is widespread on the peaks of Pältsa, but hardly common. The greatest height at which I noted it was 1140 m. I did not find it with fruit.

Gåbnetjåkko, the N steep; the S steep *c* 1 km NE of the Nirjijokk waterfall; S Peak; Low Peak, 1140 m; the sub-peak of High Peak.

**Orthothecium rufescens** (Dicks.) Br. eur.

*O. rufescens* is the rarest of the three species of this genus that I found in the district, although it does occur in abundance where it is found, e.g., on the north slope of Low Peak. It grows in shady holes and clefts in the slate cliffs. Where there is spray or seepage water it may also grow in the open. Usual companions are *Blepharostoma trichophyllum, Distichium capillaceum, Isopterygium pulchellum, Leiocolea Gilmanii, L. heterocolpos* and *Orthothecium intricatum*. As expected, I did not see it with fruit.

Gåbnetjåkko, the N steep; S Peak; Low Peak; the sub-peak of High Peak, 1150 m; Pältsavagge.

**Pleurozium Schreberi** (Will.) Mill. *Hylocomium Schreberi* (Brid.) Mill.

*P. Schreberi* is very common in the birch forest. It also occurs in the dwarf birch scrub on the esker and on Lassivare. I even found it on the poor irregular solifluction soil at the entrance to Pältsavagge, where not many species grow. But I did not succeed in finding it on Pältsa itself. It grows together with other trivial mosses such as *Dicranum fuscescens, D. scoparium, Drepanocladus uncinatus, Ptilidium ciliare, Polytrichum juniperinum* and *Tritomaria quinquedentata*. It is difficult to say how widespread *P. Schreberi* is in the higher alpine region. I had previously been inclined to the opinion that it does not occur there, but I have since found some shoots of it a few cm long in a tuft of *Barbilophozia Hatcheri* at a height of 1400 m. My earlier experience agreed with the observations made by Arnell and Jensen (1910, p. 215), who state that *P. Schreberi* decreases rapidly in frequency in the lower alpine region. The find on High Peak was therefore a surprise. It is difficult to say whether it was just an isolated occurrence or not. It is evidently not

common at higher altitudes, however; for if it were I should at least have found it among other species I collected. I did not find it with fruit.

Gåbnetjåkko, the birch region; the esker; Lassivare; the entrance to Pältsavagge; High Peak, 1400 m.

## Plagiotheciaceae.

**Plagiothecium denticulatum** (HEDW.) BR. EUR.

*P. denticulatum* is relatively common in the lower parts of the district, where it forms small bright yellowish green carpets in clefts and hollows in the poorer and drier localities on steep slopes. It appears again in a dark green form at considerably higher altitudes, presumably avoiding the region where the substratum is calcareous. I cannot say how common it is, since I did not pay direct attention to it, but the higher find is probably an isolated instance, as I could hardly have failed to notice it if it were at all common. *Pohlia cruda* seems to be its constant companion, regardless of altitude. I did not find fructiferous specimens.

»The precipice by Kummajoki, 550 m, c. fr.» (W); Gåbnetjåkko, the N steep; the steep slope N of the Nirjijokk waterfall; Middle Peak, the N face of the peneplain, *c* 1400 m.

**Plagiothecium Roeseanum** (HAMPE) BR. EUR.

This species is often considered as a variety of *P. silvaticum* (BRID.) BR. EUR. I came across it only a few times in the small pass up towards the Pältsa hut. The specimens were without fruit, and grew together with *Pohlia cruda*.

The steep slopes by the Nirjijokk waterfall.

## Hypnaceae.

**Hypnum arcuatum** LINDB. *Breidleria arcuata* (HEDW.) LOESKE

*H. arcuatum* was found in several localities up to a height of almost 900 m, and may be described as more or less a fen moss. The forms found are almost invariably a shade of reddish brown, and the shoots are often markedly flattened. It grew in abundance among the boulders by the lake in cirque 5, together with *Brachythecium salebrosum* subspec. *turgidum, Calliergon sarmentosum* and *Drepanocladus uncinatus*. Species growing amongst it in the locality on South Peak were *Ditrichum flexicaule, Polytrichum alpinum, Timmia norvegica* and *Tritomaria quinquedentata*. I did not find the moss with fruit.

Gåbnetjåkko, the N steep; the Nirjijokk waterfall; S Peak, the E slope; Low Peak, the N slope; cirque 5, 930 m.

**Hypnum Bambergeri** SCHIMP. *Stereodon Bambergeri* LINDB.

*H. Bambergeri* is common on Pältsa itself. It is particularly abundant in the *Dryas* heaths which cover the north slopes. It appears to avoid places which are too exposed, as well as those which are too moist. It sometimes occurs as coherent carpets, but it usually grows together with *Campylium stellatum, Distichium capillaceum, Ditrichum flexicaule, Myurella julacea* and *Orthothe-*

*cium chryseum* — in the col between South and Middle Peaks, for instance. As expected, I did not find the moss with fruit.

»Peldsa» (W); South Peak; the col between South and Middle Peaks, on the Pältsavagge side; the moraine below cirque 5; SE Peak.

**Hypnum callichroum** Brid.

I found this species in only one place, on a soil-covered boulder watered by spray at the foot of Gåbnetjåkko's N face. The specimen is a divergent form with a thick branched nerve and few auricular cells.

Gåbnetjåkko, the N steep.

**Hypnum fastigiatum** Brid.

Stangely enough, I did not find *H. fastigiatum* elsewhere than in the one locality at a considerable height. It grows in abundance on limestone outcrops on the western part of the peak mentioned, in places where *Carex nardina* is also abundant. I did not find the sporophyte, which is common elsewhere.

Low Peak, 1180 m.

**Hypnum hamulosum** Br. eur., *Stereodon hamulosus* Lindb.

The species grew on South Peak on turf hanging on the slate cliff, and immixed with it were *Annellia fennica, Blepharostoma trichophyllum, Distichium capillaceum* and *Ditrichum flexicaule*. On Low Peak it grew on a boulder of crystalline limestone. I did not find it with fruit.

S Peak, the SE steep, *c* 1000 m; Low Peak, 1150 m.

**Hypnum revolutum** (Mitt.) Lindb.

*H. revolutum* was abundant in all the localities, on boulders of slate or limestone and soil slopes. It was probably most common and widespread on the south slope of South Peak. It was growing there together with *Hypnum Vaucheri, Leskeella tectorum, Schistidium apocarpum* and *Tortula norvegica*. I collected it on Low Peak on the limestone crags at a height of 1150 m. As expected, I did not find it with fruit.

S Peak, the S and E steeps; Low Peak, 1150 m; SE Peak; the moraine below cirque 6; 1000 m; Pältsavagge.

**Hypnum Vaucheri** Lesq., *H. cupressiforme* Hedw. var. *Vaucheri* (Lesq.) C. Jens., *Stereodon Vaucheri* Lindb.

Like Steere (1947, p. 472), I have allowed this moss the rank of species, perhaps mainly because I did not find in the area anything which I could assign to *H. cupressiforme*. It is consistent in its habitat, occurring mainly on boulders of slate or limestone exposed to the sun, together with *Hypnum revolutum, Leskeella* and *Pseudoleskea* species. Only on South Peak does it seem to be more widespread. It has not been found with fruit.

Gåbnetjåkko, the N steep; the S steep *c* 1 km NE of the Nirjijokk waterfall; S Peak, the E and S steeps, up to 1200 m; Pältsavagge.

**Isopterygium pulchellum** (DICKS.) BROTH.

The species was found mainly in holes and crevices together with *Blepharostoma trichophyllum, Leiocolea Gilmani, Mnium Blyttii, M. hymenophylloides* and *Orthothecium intricatum.* It is fairly common in the lower parts of the region up to 1000 m. The highest altitude at which I found it was 1350 m, on the north-west face of Middle Peak. It often bore fruit.

Gåbnetjåkko, the N steep, c. fr.; the S steep *c* 1 km NE of the Nirjijokk waterfall; S Peak; Middle Peak, 1350 m; Low Peak, 1050 m, c. fr.; the sub-peak of High Peak; SE Peak, 1200 m; Pältsavagge.

## Rhytidiaceae.

**Ptychodium plicatum** (SCHLEICH.) SCHIMP.

The species grew sparsely on soil covering slate boulders in the spray zone of the Nirjijokk waterfall, together with *Brachythecium salebrosum* subspec. *turgidum, Ditrichum flexicaule, Hylocomium splendens* and *Rhytidiadelphus triquetrus.* In the other locality, it grew as a dense carpet on a small boulder of crystalline limestone. The specimens are without fruit.

The Nirjijokk waterfall; the sub-peak of High Peak, the steep facing Pältsavagge, *c* 1000 m.

**Rhytidium rugosum** (HEDW.) KINDB.

This fine large moss is common in the district up to 1200 m. It flourished in the spray zone on the north slope by the Nirjijokk waterfall. On South Peak's steep south and east slopes, which are covered with *Dryas* heath, it was common on shelves, growing together with *Aulacomnium turgidum, Ditrichum flexicaule, Hylocomium splendens,* and other species. It not infrequently grows in places very much exposed to the wind (the esker, the Low Peak ridge), together with *Dicranum fuscescens* forms, *Gymnomitrium coralloides, Prasanthus suecicus* and *Rhacomitrium lanuginosum.* The habitat thus varies considerably. As expected, the species was not found with fruit.

»Mount Peldsana» (C. P. LAESTADIUS, 1859); »Peldsa» (M); »Peldsa, 900 m» (W); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; the esker, by Lassivare; S Peak; Middle Peak; Low Peak; the sub-peak of High Peak; SE Peak; Pältsavagge; Måskojaure.

**Rhytidiadelphus triquetrus** (HEDW.) WARNST. *Hylocomium triquetrum* (HEDW.) BR. EUR.

The only localities in which I found this species in any abundance were subalpine. It grew in broad carpets in the spray zone on the north slope by the Nirjijokk waterfall. There were also thriving specimens growing rather sparsely on a percolation slope at the foot of Gåbnetjåkko's north face, companion species being *Entodon orthocarpus* and *Hylocomium splendens.* The alpine locality in which I found the species was a hole under a large slate boulder. There was some *Hylocomium splendens* and *Mnium orthorrhynchum* growing among it there. I did not find *R. triquetrus* as high up as 1000 m. The moss is not found with fruit.

»Peldsa, *c* 1000 m» (W); Gåbnetjåkko, the N steep; the Nirjijokk waterfall; S Peak, the E steep, 950 m; Pältsavagge, below Middle Peak, 860 m.

## Hylocomiaceae.

**Hylocomium pyrenaicum** (SPRUCE) LINDB.

This species is abundant in the places where it is found. It occurs in the *Trollius* meadows at the foot of South Peak, together with such mosses as *Barbilophozia lycopodioides, Brachythecium salebrosum* subspec. *turgidum, Drepanocladus uncinatus* and *Tritomaria quinquedentata* var. *turgida*. It occurs on the south slope of Low Peak up to 1000 m, and I did not find it at a higher altitude elsewhere in the district. As might be expected, these plants are somewhat smaller and grow closer to the rock. I did not see fructiferous specimens.

The Nirjijokk waterfall; Lassivare; S Peak, the E slope up to 950 m; Low Peak, above Pältsavagge, 1000 m; SE Peak, on the Måskojaure side.

**Hylocomium splendens** (HEDW.) BR. EUR.

Unlike the preceding species, *H. splendens* is very common, even in the higher parts of the district. There are unlimited quantities of it on the *Dryas* covered slopes of Pältsa. The only places from which it is definitely absent are poor, very dry ground, places exposed to strong winds, and fens. As it belongs to moss societies rich in species, it is impossible to list all the mosses which are seen in its company. Even if some of the more common were taken, the picture would still be incomplete. The alpine forms of *H. splendens* seldom have the characteristic shoot formations of lowland forms. They are also less branched, and, of course, considerably smaller. Although the species is so common, I did not see fertile specimens.

»Auf dem westlichen Abhange von Peldsa» (TH. FRIES, 1913, p. 92); »Peldsa, the landslide slope, *c* 1200 m» (W); Gåbnetjåkko; the birch region; S Peak, *c* 1200 m; Middle Peak, up to 1330 m; Low Peak; High Peak, 1400 m; SE Peak.

## Diphysciaceae.

**Diphyscium foliosum** (HEDW.) MOHR. *D. sessile* LINDB.

The specimen collected by WEIMARCK presumably comes from South Peak, and is in the Lund museum. I myself did not find the moss in the district.

»Peldsa, 900 m» (W).

## Polytrichaceae.

**Psilopilum laevigatum** (WG.) LINDB.

It is a time-consuming task to endeavour to search out this arctic species. As it is dioicous, it is rarely that one sees the characteristic hooked capsules which immediately reveal it. The difficulty is increased by the fact that it often grows together with *Oligotrichum hercynium,* which, being also dioicous, almost invariably lacks fruit. It is not difficult to distinguish one from the other when they are fully developed; but in snow-beds where the snow melts fairly late, *O. hercynicum* is often stunted so that it resembles *P. laevigatum*. It might be expected that in such northerly latitudes *P. laevigatum* would be

found at lower altitudes — for instance, by Nirjijokk, to take a locality analogous to the well-known one in Karesuando. However, I did not find it so low in this district, though a sparse specimen collected from a snow-bed on the north-east slope of South Peak, at 670 m, contains some shoots which appear to be *P. laevigatum*.

*P. laevigatum* is mainly a snow-bed moss in our mountains, and grows together with such mosses as *Kiaeria* species, *Oligotrichum hercynicum, Pleuroclada albescens, Polytrichum alpinum, P. norvegicum* and *Pohlia commutata*. For reasons easy to understand, our knowledge of the distribution of this species in the mountain chain is incomplete.

SE Peak, the NE slope, by the ravine to the NE, c 1000 m.

**Oligotrichum hercynicum** (HEDW.) LAM. & DC.

*O. hercynicum* is very widespread in the district. It grew in great abundance beside the path to the Pältsa hut — a not quite natural locality which was also occupied by *Dicranella subulata, Polytrichum piliferum* and *Pohlia nutans*. There were many specimens with flowers and fruits just on the tree-line. It is less frequent in the alpine region, but it does occur here and there. It is primarily a snow-bed moss there, and grows together with *Conostomum boreale, Kiaeria* species, *Pleuroclada albescens, Polytrichum alpinum, P. norvegicum, Pohlia commutata,* and others. It is often quite stunted, and I did not find it with fruit elsewhere than in the locality just mentioned. Its frequency decreases at higher altitudes, the highest altitude I measured for it being 1300 m, though I did not pay special attention to it. I am inclined to believe that it attains considerably higher altitudes, even in these latitudes. The species is absent from the more calcareous ground in the district.

Gåbnetjåkko; NE of the Nirjijokk waterfall, c. fr.; the esker; Lassivare; Low Peak, 1300 m; SE Peak, the NE slope; Pältsavagge; Måskojaure.

**Pogonatum capillare** (MICHX.) BRID.

*P. capillare* is not common until one reaches the actual peaks and high plateaus, where it is one of the characteristic species. I did not find it with fruit.

The esker; S Peak; Middle Peak; Low Peak; High Peak; the ridge-top north-west of the cirque valleys; SE Peak.

**Pogonatum urnigerum** (HEDW.) PB.

*P. urnigerum* is widespread in the lower parts of the district. It is impossible to know for certain in the field whether a specimen belongs to this or the preceding species, as *P. capillare* does occasionally occur at lower altitudes. (MÖLLER states that he found it in Kummavuopio, 25 km farther up the valley (1919, p. 58), and I myself found it near the Pältsa hut). On the other hand, *P. urnigerum* sometimes occurs at considerable altitudes. I collected a specimen from the south face of South-east Peak which must be assigned to this species. To judge by the sampling specimens I collected, it appears that not until the altitude exceeds 1200—1300 m is it possible to state definitely that a specimen belongs to *P. capillare*. It should be added that the decisive character — the shape of the edge cells — requires a good leaf cross-section,

and that even with this there is often considerable variation in the appearance of these cells).

The S steep *c* 1 km NE of the Nirjijokk waterfall; S Peak, the E steep, 900 m; SE Peak, the S steep, 1200 m; Pältsavagge; the moraine below cirque 5, 900 m.

**Polytrichum alpinum** HEDW.

*P. alpinum* is the most common of the species of this genus in the district. It is not worth-while to endeavour to describe its different habitats. It is sufficient to point out that they vary from *Dryas* heaths very rich in species to the poorest snow-beds. It varies a great deal. On the heaths it is usually large, with the leaves clearly dentate, while in the snow-beds it is stunted, the leaves indistinctly dentate or not at all, and its habit like that of *P. norvegicum*. *P. alpinum* has been found at almost all altitudes up to about 1400 m. But at these heights it is usually a question of single shoots or small tufts growing among such species as *Kiaeria glacialis* or *Paraleucobryum enerve*. The moss is common with fruit.

»Peldsa, on a mountain slope, 800 m» (W); Gåbnetjåkko, c. fr.; Lassivare, c. fr.; S Peak; Middle Peak, 1350 m, c. fr.; Low Peak; High Peak, *c* 1400 m; SE Peak; Pältsavagge.

**Polytrichum commune** HEDW.

*P. commune* is especially common in birch forest mires and along Nirjijokk and its tributaries, where it grows tall and coarse. In higher and more open localities, it is smaller and the leaves shorter. I collected it in Pältsavagge at 820 m, and I have no record that I saw it higher up. The fruit appears to be rare, and it was only in the birch forest that I found specimens with capsules.

Nirjijokk, c. fr.; S Peak; Lassivare; Nirjijaure; Pältsavagge, under S Peak, 820 m.

**Polytrichum gracile** SM. var. **anomalum** (MILDE) HAG.

*P. gracile* var. *anomalum* is rare in the district. I succeeded in finding it after a long search between boulders in a snow-bed where the snow melted late — that summer, at least, after the heavy snow of the winter 1948—49. It was growing together with *Orthocaulis Kunzeanus*. The specimen has old setae.

Gåbnetjåkko, the N steep.

**Polytrichum hyperboreum** R. BR.

*P. hyperboreum* is no rarity in the district. It belongs to the wind-exposed poor dwarf-birch scrub, and large dense clumps of it often occur on the parts of Lassivare which are poor in lime and up towards Nirjijaure. I found it at 1300 m on Low Peak. But I did not find on the high plateaus, that is, above 1400 m, presumably because there is too much moisture. Otherwise, *P. hyperboreum* is a species which does not shun the higher altitudes. In this district, however, it is most common between 700 and 900 m. The moss species found in its company indicate a poor substratum. Thus, *Barbilophozia Hatcheri, Dicranum scoparium, Paraleucobryum enerve* and *Ptilidium ciliare* occur immixed in the specimen from Pältsavagge. It would be possible to extend this list to make the evidence even more convincing. *P. hyperboreum* is often found with flowers or fruit. The capsules on specimens which were

collected on the 27th July 1949 in Pältsavagge were undeveloped and still had the calyptrae quite intact.

Gåbnetjåkko, c. fr.; Lassivare; Low Peak, 1020 and 1300 m; Nirjijaure, c. fr.; Pältsavagge, below S Peak, c. fr.; by the stream from SE Peak to the E, c. fr.

**Polytrichum juniperum** HEDW.

*P. juniperum* is especially common on the numerous heaths on the sandy parts of the esker. The forms I saw usually had somewhat extended hair-points, and were nearest var. *alpinum* SCHIMP. *P. juniperum* was often found with fruit.

Gåbnetjåkko, c. fr.; the birch region, c. fr.; the esker, c. fr.; Lassivare; Middle Peak; Low Peak, c. fr.; SE Peak, c. fr.; Måskojaure.

**Polytrichum norvegicum** HEDW., *P. sexangulare* FLÖRKE

*P. norvegicum* was most abundant in the large snow-beds in Pältsavagge. It also occurs higher up, up to the highest ridge-tops, where it is found here and there between boulders and stones. The finest specimens occur in snow-beds where the snow melts late, where it often grows in masses together with *Anthelia Juratzkana, Kiaeria Starkei, Conostomum boreale, Moerchia Blyttii, Pleuroclada albescens,* and other snow-bed mosses. It seldom bears capsules.

SE Peak, the south slope, 950 m, the NE slope, 650 m; the plateu W of cirque 5, 1430 m, c. fr.; cirque 5, 920 m; Pältsavagge, 800 m, c. fr.

**Polytrichum piliferum** HEDW.

*P. piliferum* is widespread, and is usually found in the drier sandy places. Thus it is found in several places along the esker and on boulders by Nirjijokk. It is less frequent in the higher alpine region, though it does sometimes occur there. I found it on one ridge-top at 1420 m. These more elevated localities are sometimes of snow-bed type, and in such places the moss is very stunted and usually quite red-brown, except for the long hyaline hair-points. *P. piliferum* grows exclusively on poor ground, often on small soil slopes or irregular solifluction ground together with *Bartramia ithyphylla* or some other moss. It was also found in the dwarf birch scrub together with *P. hyperboreum*. The fruit seems to be rare, and I only saw it a couple of times.

»Peldsa, in a snow-bed in the valley, 750 m, c. fr.» (W); Gåbnetjåkko, c. fr.; the esker; S Peak; Low Peak, 1300 m; the sub-peak of High Peak, c. fr.; the ridge-top W of cirque 5, 1420 m; SE Peak.

**Polytrichum strictum** TURN.

This species occurs in abundance in fens at the lower altitudes, together with *Aulacomnium palustre* and *Sphagnum* species, among others. I also found heath forms with strongly developed root-down. I have not included noted localities, as it was later found that several of these latter forms were better assigned to *P. juniperum*, on account of the appearance of the marginal cells of the lamellae (as given by MÖLLER, 1921, Table 3). The length of the hair-point, like that of the leaf, varies considerably. Fructiferous specimens were usually found at the lower altitudes.

»Peldsa» (var. *alpestris* (HOPPE) RABH.) (M, 1921, p. 96); »Peldsa, in the valley, 700 m» (W); Gåbnetjåkko; the birch region, c. fr.; Lassivare; Low Peak.

# Some remarks on the geographical names.

By O. MÅRTENSSON.

In the districts where Finnish and Lappish meet, and where they are both spoken, there is usually a great deal of confusion about geographical names. Such is the case in this area, to an even greater extent perhaps, since some Lappish names also occur in their Norwegian spellings. In the simpler cases it is probable that almost anyone could pick out the synonyms — for instance, that Pältsanen, Pältsama, etc. refer to Pältsa. But it is not likely that anyone unfamiliar with the languages would venture to say that Pältsavagge and the Finnish form Pältsamavanka are equivalent. It is easy enough to place localities where they are given according to the General Staff Map (here abbreviated to GSM), but some tourist maps now give other names, and there are also a number of »private» names which have originated in the district. Most of these alternatives are Finnish forms of Lappish names. In order to facilitate location of particular places I have drawn up a list of the different names and spellings I have come across in descriptions of the flora, maps, the report of the Renbeteskommission (1909), and so on. With the generous assistance of Dr. ISRAEL RUONG, the Archives of Place Names at Uppsala (here abbreviated to APN) have also been consulted. The information derived from them has been recorded by Professor B. COLLINDER.

*Gåbnetjåkko* (GSM); *Gåbmevare* also occurs on tourist maps; according to APN, the mountain is called *Kåbmetjåkko* (Ghost Peak). *Kummajärvi* (GSM); also *Gåbmejaure* on tourist maps; according to accepted usage, and in conformity with APN, it should be spelt *Kåbmejaure*. Likewise, according to APN, the stream running down to Kummaeno should be called *Kåbmejåkko* (*Kåbmejokk*); but several people who have used GSM have consistently called the stream *Kummajoki* after the Finnish name of the lake, whereupon the other branch from *Nirjijaure* has been called *Nirjijokk,* since no other name was available. According to APN, the name *Pältjanjåkko* (*Pältjanjokk*) should also apply to the section below the junction referred to above. APN calls the stream form the N meeting Kummaeno roughly opposite Pausavare (GSM), which has no name on GSM, *Lakkonjoasjåkko* (*L-jokk*), and the mountain *Pausavarre* (Lip Mountain). Also, according to APN, the stream from the

NW meeting Nirjijokk about 1 km below the waterfall should be called *Pållusjåkko* (*P-jokk*), and that from the N meeting Nirjijokk just E of Lassivare (GSM) *Tjärbmakjåkko* (*T-jokk*); it is usually called *Lassivare-bäcken*. *Pollus* and *Polluksenkoski* seem to be synonyms for localities near the Nirjijokk falls; otherwise (APN) *Pållus* denotes terrain on the snow line.

*Lassivare* (GSM) also appears as *Lassivaara*; according to APN, *Lassavarre* (the flat block mountain).

*Nirjivare* (GSM); *Nirjijaure* (GSM); *Nirjijokk* (GSM); *Njärrejokk* occurs on tourist maps. According to APN, the appropriate names are *Njärrevarre, Njärrejaure, Njärrejåkko* (*Njärrejokk*). The names given on GSM are presumably derived from a Finnish form of the first part of the word, which denotes a place in a river where the water runs in such a way that its motion can be observed. Forms yet more Finnish are *Nirjijoki* and *Nirjivaara*. The valley of the Nirjijokk is sometimes called *Nirjivagge*.

*Gapovare* (GSM); the Renbeteskommission's reports have *Gapåive, Gapoaive,* and *Kappåive* as synonyms. APN gives the spelling *Kappåive*.

*Maselvare* (GSM); according to APN, the name of this small mountain should be *Kaggavarre*.

*Peldsa* (GSM); a number of different designations and spellings occur for this mountain, such as *Peltsa, Peltsama, Peltsana* and *Peltsanen*. *Peltsanentunturi* (*tunturi*: Finnish for treeless mountain terrain) is not unusual, particularly in older accounts of the district. According to APN, the mountain should be called *Pältjan*. The spelling most used in tourist maps and more recent literature is *Pältsa,* both for the mountain itself and for compound names such as *Pältsajokk* (according to APN, *Pältjanjåkko*) and *Pältsavagge*. The latter name refers to the large valley in the Pältsa-Måskokaise massif. In the reports of the Renbeteskommission, the name *Pältsajokk* is applied only to the branch of the river above the junction with Nirjijokk. Below this junction, the name *Kummajoki* is used, and still lower *Kummaeno*.

*Moskon tuoddar* (GSM); the most common name for this part of the massif is the Finnish form *Moskana,* other Finnish names being *Moskanen* and *Moskanentunturi*. The Norwegian province map gives *Mosko Varre,* and the map in WAHLENBERG's Flora Lapponica (1812) *Måskonkaise* — although *Moskonvaara* is used in the text (p. XXIV). According to APN, the mountain should be called *Måskokaise,* a name which also occurs on tourist maps. *Tuottar* (=Finnish *tunturi*) signifies treeless mountain terrain, and is less adequate than *kaise,* which means a high mountain. The first part of Måskokaise is very common in Lappish names, and denotes something which only has one opening. It is therefore possible that the name originally applied to the whole of the horse-shoe shaped mountain massif (including Pältsa).

*Moskojavvre* (province map); this Norwegian lake sometimes occurs with the Swedish spelling, *Måskojaure*.

Some ambiguities have also arisen in specifying localities within the actual massif. Older information in this respect is quite summary, and usually only gives the mountain, so that it is only by trying to follow the route of the botanist in question that we can guess where the

specimen was collected or the note made. Some of the peaks more commonly visited and more fruitful from the botanical point of view have now received names of their own. The south-easterly peak of Pältsa is almost invariably called *South Peak* (*Sydtoppen*), though not quite correctly. The same applies to the next peak, *Middle Peak* (*Mellantoppen*) (1448.0). Various names have been used for the ridge between this peak and the lowest point of the chain, running parallel to Nirjijaure, and the fog which often lies there has contributed considerably to the confusion. A minor peak projecting from this ridge is usually called *Limestone Peak* (*Kalktoppen*). I have called the whole of this section *Low Peak* (*Lilltoppen*), as Pältsa is then divided into three definite sections, and the name Mellantoppen is then appropriate. The highest point of the chain (1517.8 m) is the summit of a peak which is sometimes called *West Peak* (*Västtoppen* — sometimes even *Nordvästtoppen*), and which is thus included in Pältsa. However, it is really part of Måskokaise, and it has now been given the unambiguous name *High Peak* (Stortoppen). Of Måskokaise's other peaks, only that farthest to the SE (1452.7) has received a special name, that is, *South-East Peak* (*Sydosttoppen*). The rather ravine-like valley to the NE of the northern part of Sydosttoppen is usually designated »the ravine to the NE», or something of the sort.

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