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The Vegetation at the Margin of the Receding Glacier Skaftafellsjökull, Southeastern Iceland

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Introduction

In the summer of 1962 (July 16—August 10) investigations were carried out in the Skaftafell area in southeastern Iceland by a group of biologists from Lund University, Sweden. The aim was to study the biological and climatical conditions at the margin of an inland-ice of the present times. The leader of the group was professor Carl H. Lindroth (entomologist), who has earlier worked in Iceland (Lindroth 1931). The present author took part as a botanist with the main object of describing and characterizing the vegetation around the climatological measuring stations. Twelve such stations were selected and investigated thoroughly especially with regard to vegetation and fauna. The results of the climatological investigations will be published by Lindroth in a coming paper (1965) which will contain also the general features of vegetation and flora of the area.

The aim of the present paper is twofold. Firstly, it will describe the distribution and immigration of the vegetation on the ground laid bare at the margin of the receding glacier. Secondly, it will describe the vegetation and to some extent the soil conditions at the measuring stations in order to support the discussion of the biota and the lococlimate in the mentioned work by Lindroth. Therefore, also measuring stations situated outside the special area will be described.

The laboratory work has been carried out by Mrs. Mimmi Varga, who has also drawn the diagrams. The head of the institute, Laborator Nils Malmer, has critically read the manuscript.

The Skaftafell area

Skaftafell is situated in southeastern Iceland, south of and in immediate connection with the large glacier Vatnajökull. The northwestern, northern and eastern sides of the area are surrounded by ice and the rest by "sandur" (figure 1). Sandurs are large "sand" areas almost entirely free from vegetation. They are periodically inundated by glacier water. The Skaftafell area has a vertical stretch from c. 100 to c. 1,385 m above sea level. The slopes to the south and the west (c. 100—200 m above sea level) are occupied by birch forest (the height of the trees 3—6 m) which in the lower part forms a marked border towards the sandur. In the upper part the forest gradually turns into birch scrubs and then into heaths and meadows.

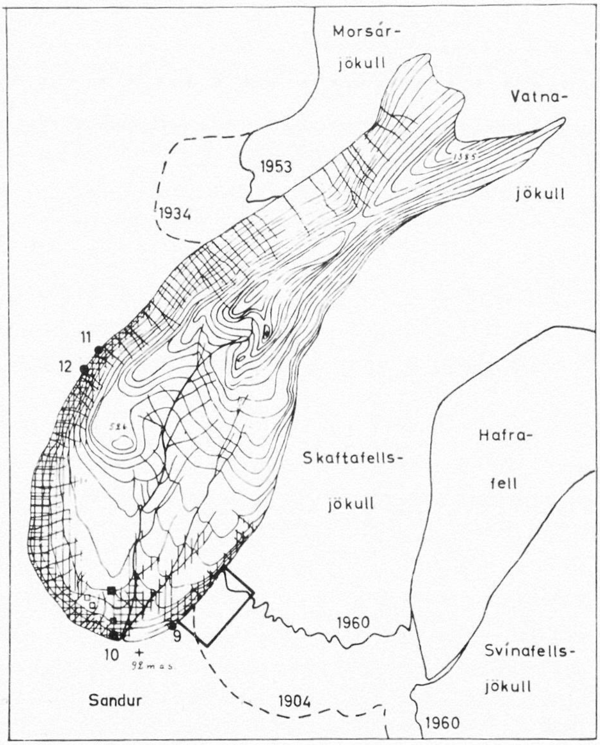

Fig. 1. Map (scale 1 : 50,000) showing Skaftafell with surrounding glacier (jökull) and "sandur" areas. The investigated area marked with a rectangle. — From Lindroth (1965) with small changes.

Due to a positive temperature anomaly (the proximity to the Gulf Stream) Iceland has a better temperature climate than could be expected from its northern situation. Due to changes in the climate the Icelandic glaciers have receded during the last 30 years. For a more extensive treatment of the nature conditions of the Skaftafell area the reader is referred to Lindroth (1965).

In 1960 the Skaftafell area was visited by a group of Danish botanists and zoologists. Both they and the present author have to some degree happened to investigate similar botanical subjects. However, we have agreed on publishing different parts of the material. — A popular description of the Skaftafell area is given by Larsen and Kjøller (1962), two of the participants of the Danish group. For further information on earlier botanical investigations in the area see Lindroth (1965).

The special area

The special area (figures 1 and 2) is situated on moraine ground laid bare at the recession of the glacier Skaftafellsjökull. The situation of the ice margin in 1904, 1954, 1960 and 1962 is marked on the map, figure 2.

Data are taken from the following sources. The situation of the glacier margin of 1904 is taken from the Danish General Staff map of 1904 (sheet 87 Öraefajökull SV). The ice margin of 1954 is drawn from aerial photos taken by Á. Bödvarsson, Sept. 15, 1954 (cf. Thorarinsson 1956 p. 7) and that of 1960 from American aerial photos taken in August 1960. In 1962 the glacier front was approximately marked on the map sketch during the field work in August. The contour lines on figure 2 are drawn from the map of 1950 from the U.S. Army Map Service (sheet 6019 III) based on aerial photos taken in August 1945.

During the period of 1934—62 the glacier has receded about 1100 m (figure 3). The recession in different years during the mentioned period is shown in figure 3. It is seen that the recession has not been entirely uniform. In some cases stagnations have occurred. In the field as well as on the aerial photos (1954, 1960) 4 well delimited moraine ridges can be easily distinguished. Due to their situation parallel to the ice margin marked on the map there are reasons to believe that they are terminal moraines. Because the author does not know the exact position of the lines along which the measurements of the recession of the ice (figure 3) were performed, it is difficult to date the moraines with certainty. However, it seems likely that the western slope of

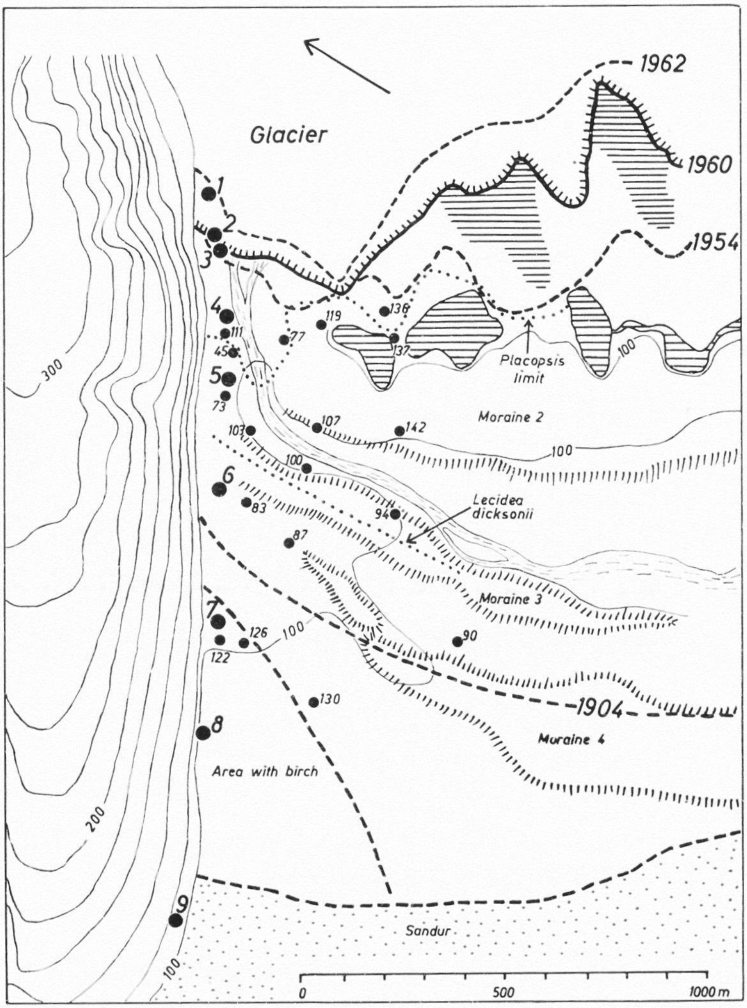

Fig. 2. Map sketch of the investigated moraine area. The measuring stations marked with large dots. Small dots mark other investigated stands. Moraine 1 is situated just above the row of small lakes.

moraine 2 was formed at about 1938—1939. Moraine 3 (*Lecidea dicksonii*) possibly corresponds to the ice margin of 1934.

Between the moraine ridges there are dried-up river-beds of earlier ice-rivers which have drained the glacier water from the northwestern margin of the glacier. The ice-river between the moraines 2 and 3 had a strong water flow as late as in 1960 (according to the aerial photo

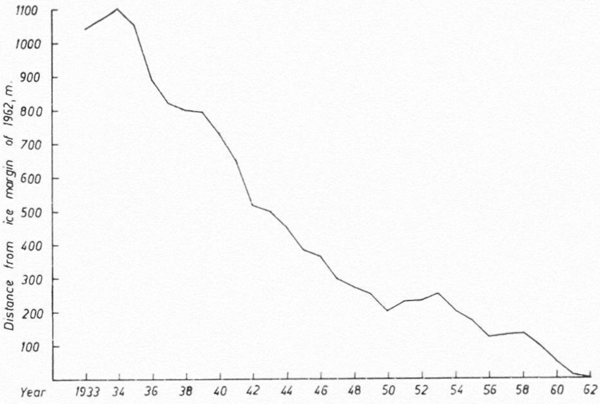

Fig. 3. The retreat of Skaftafellsjökull (the northern part) during 30 years (1932—62). — Figures from Thorarinsson (1956) and later reports in Jökull (Eythorsson). — On a large scale the curve corresponds to conditions farthest to the right in figure 2.

of 1960 and a statement of the farmer at one of the farms at Skaftafell. In 1961 there was probably a small water flow but in 1962 the river-bed was almost totally dried-up. All melt-water had instead taken its course southeast of the present investigation area. The course in 1960 of the mentioned ice-river is marked in figure 2.

I have not studied the petrographical and mineralogical composition of the moraine material. Some physical and chemical properties of the fine fractions are discussed below.

Broadly speaking the above-mentioned stations 1—7 were placed in a straight line at right angles to the ice margin. Their positions in relation to each other and to the ice margin are seen in figure 2. The distance between the stations 1 and 7 is about 1 km. The different stations have about the same distance from an almost vertical precipice, about 40 m in height. The exact positions of the stations in relation to each other and to the precipice are given by Lindroth (1965). Station 8 is situated closer to the precipice. There are different reasons for believing that it is not comparable to the other stations. Stations 9—12 are situated within the birch forest; nos. 9—10 on south-exposed and nos. 11—12 on north- or northwest-exposed slopes (figure 1).

The situations of the stations were determined mainly from a microclimatological point of view. They were placed where the substratum was tolerably uniform. Because measurements of soil temperatures should be performed a comparably fine material (sand, gravel) was desirable. Further, the terrain ought to be plane or only insignificantly broken because topographical variations may affect the microclimate

Fig. 4. The glacier front and moraine 1 (the latter not marked on the map, figure 2). On the upper left side the front of Svinafellsjökull and to the right the row of small lakes (figure 2).

considerably. Objections may be raised that the stations are situated at too short a distance from the cliff. They may therefore be favoured microclimatically compared with corresponding localities farther out on the morain field. This will be discussed by Lindroth (op.c.). The ground at stations 5 and 6 has probably been eroded by wind. The vegetation at these points has not been closed to the same degree as in surrounding areas. In these cases the vegetation has therefore been described not only just at the stations proper but also in non-eroded areas not far from them.

By comparing the vegetation at the different stations it is possible to get an idea about the development of the vegetation from the first pioneer stages to later stages with a closed vegetation. However, already

Fig. 5. The investigated moraine area. On the lower left moraine 1. Then follow: Two of the small lakes; moraine 2; river-bed (ice river marked in figure 2); moraine 3 and moraine 4. Because the photo was taken after a heavy rain, occasional surface water is seen in several places, e.g., in the river-bed usually dry and further on the "sandur" in the background.

at the first view it was seen that the vegetation varied considerably when comparing different stands at the same distance from the ice margin. This differentiation of the vegetation seems to depend mostly on differences in the texture of the mineral earth. There are difficulties for a closed vegetation to be developed on a moraine where boulders and large stones predominate. However, one could also find areas with no or insignificant vegetation in places rich in fine earth which have probably been strongly influenced by wind erosion. The best development seems to occur on morain rich in small stones as well as in fine earth. From the above it is seen that it is not sure that the vegetation analyses from the measuring stations are quite representative. In order to get a more representative material more stands were analyzed further out on the moraine field (figure 2).

Phytosociological methodology

Due to the short stay in the area a thorough and time-consuming methodology was out of the question. It was found expedient to use the method most common in Sweden, viz., small square analysis with estimation of the degree of cover using the Hult—Sernander—Du Rietz scale (cf. Persson 1961 p. 23). At every sampling point 3 squares with a square size of 1 m² were analyzed. The analysis was completed with a description of the stand. Also species found outside the squares were recorded. A greater number of squares per stand was considered too time-consuming.

In table 1 small square analyses from the vegetation at stations 4—7 are given. To publish the analyses also from the other stands would require too

Table 1. The vegetation at stations 3—7

Station no.	3	4						5			6			7		
Arctostaphylos uva-ursi	.	.	.	.	.	.	.		+			+			+	
Betula pubescens	.	.	.	.	.	.	.		+		.	1	.	.	2	2
Dryas octopetala	.	.	.	.	.	.	.	.	.	.		+			+	
Empetrum sp.	.	.	.	.	.	.	.	.	.	.	.	1	1	3	1	1
Salix herbacea	.	.	.	.	.	.	.	.	.	.		+		1	1	1
— *lanata*	.	.	.	.	.	.	.	.	.	.	.	1	.		+	
— *phylicifolia*	.	.	.	.	.	.	.	.	.	.		+		.	.	.
Vaccinium uliginosum	.	.	.	.	.	.	.	.	.	.		+			+	
Alchemilla alpina	.	.	.	.	.	.	.		+		1	1	1	1	1	1
Arenaria norvegica	+	.	.	.	.	.	.	.	.	1		+		.	.	.
Botrychium lunaria	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
Cardaminopsis petraea	.			+				1	.	1	.	.	1	1	.	1
Cerastium alpinum	+	.	1	.	.	1	.	1	1	.		+			+	
— *fontanum*[1] coll.	+	.	1	.	.	1	.	1	1	1	1	.	.	.	.	1
Coeloglossum viride	.	.	.	.	.	.	.	.	.	.	.	.	.		+	
Corallorhiza trifida	.	.	.	.	.	.	.	.	.	.	.	.	.		+	
Epilobium collinum	.	.	.	.	.	.	.	.	.	.		+		.	.	.
Erigeron boreale	.	.	.	.	.	.	.		+			+			+	
Galium normani ssp. *isl.*	.	.	.	.	.	.	.	.	.	.	1	1	1	1	1	1
— *verum*	.	.	.	.	.	.	.	.	.	.	1	.	1	.	1	.
Gentiana nivalis	.	.	.	.	.	.	.	.	.	.	.	.	.		+	
Gentianella aurea	.	.	.	.	.	.	.	.	.	.	.	.	.		+	
Hieracium sp.	.	.	.	.	.	.	.	.	.	.		+			+	
Lycopodium selago	.	.	.	.	.	.	.	.	.	.		+		.	.	.
Minuartia rubella	.			+					+			+		1	.	.
Oxyria digyna	.	.	.	1	.	.	.		+			+		.	.	.
Parnassia palustris	.	.	.	.	.	.	.	.	.	.	.	.	.		+	
Pinguicula vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.		+	
Polygonum viviparum	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Rhinanthus minor[2]	.	.	.	.	.	.	.	.	.	.		+		.	.	1
Saxifraga aizoides	.			+				.	.	.	.	.	.	.	.	.
— *caespitosa*	.	1	1	1	.	.	.	1	1	1		+		1	1	.
— *hypnoides*	.	.	.	.	1	.	.	.	1	1		+		.	.	.
— *nivalis*	.			+				.	.	.	.	.	.	.	.	.
— *oppositifolia*	.	1	.	1	.	.	.	.	1	1	1	1	.	.	1	.

[1] According to Jalas (1963). [2] Including *R. groenlandicus*.

Table 1. Continued.

Station no.	3	4						5			6			7		
Sedum acre	.	+						.	.	.	.	.	1	.	.	.
— *annuum*	.	.	.	.	.	.	.	1	.	1	.	1	.	.	.	.
— *rosea*	.	.	.	.	.	.	.	+			.	.	.	.	.	.
Silene acaulis	.	+						.	.	.	1	.	.	1	1	.
— *maritima*	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Thymus drucei	.	.	.	.	.	.	.	+			1	1	1	1	1	1
Veronica fruticans	.	.	.	.	.	.	.	+			.	.	.	.	.	.
Viscaria alpina	.	+						.	.	.	.	.	.	.	.	.
Agrostis canina	.	1	1	.	.	1	.	.	.	.	.	.	.	1	1	1
— *stolonifera*	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.
— sp.	+	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.
Festuca rubra	+	1	1	.	.	.	.	1	1	.	.	.	.	1	1	1
— *vivipara*	.	.	.	.	1	.	.	1	.	1	1	1	1	1	1	1
Juncus trifidus	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1
Kobresia myosuroides	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.
Luzula multiflora	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
— *spicata*	.	.	.	.	.	.	.	.	.	.	1	1	1	1	1	.
Poa alpina	.	+						.	1	1	.	.	.	.	.	.
— *glauca*	.	1	1	1	1	1	1	.	.	1	1	.	1	.	.	.
— sp.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trisetum spicatum	.	.	.	.	.	1	.	+			.	.	.	.	.	.
Barbula icmadophila	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
— *recurvirostris*	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Brachythecium albicans	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
— *rivulare*	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Bryum cf. *caespiticium*	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
— *pseudotriquetrum*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylium sp.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Ceratodon purpureus	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Climacium dendroides	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Ditrichum flexicaule	.	1	.	.	.	.	.	1	1	.	.	.	.	.	.	.
Drepanocladus uncinatus	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
Funaria hygrometrica	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hylocomium splendens	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Hypnum revolutum	.	1	1	.	.	1	1	.	.	.	.	.	.	.	.	.
Pogonatum urnigerum	.	.	.	.	.	.	.	.	.	.	1	1	1	1	.	1
Pohlia albicans	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
— *drummondii* f. *rothii*	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
— sp.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichum juniperinum	.	+						.	.	.	.	.	.	.	1	.
— *piliferum*	.	+						.	1	.	.	.	.	.	.	.
Rhacomitrium canescens	.	1	1	1	1	.	1	5	5	5	4	4	5	3	4	5
— *lanuginosum*	.	.	.	1	.	.	.	1	.	.	3	1	1	5	5	2
Rhytidiadelphus squarrosus	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schistidium sp.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Cladonia sp.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.
Peltigera sp.	.	.	.	.	.	.	.	.	1	1	1	.	1	1	1	.
Placopsis gelida (on stones)	.	.	.	.	.	.	.	+			+			+		
Rhizocarpon (on stones)	.	.	.	.	.	.	.	+			+			+		
Stereocaulon	.	.	.	.	.	.	.	2	1	1	1	2	2	.	1	.
Stones and bare soil	+	5	5	5	5	5	5	3	3	3	4	5	4	.	.	.

Fig. 6. Station 3. The glacier in the background.

much space and it would be difficult to survey the material. Instead, a survey table is given (table 2). In this table the different vegetation stages are treated separately. For each stage has been calculated the small quadrate frequency (or small square frequency) of the species, i.e., the number of squares in which a species occurs calculated in per cent of the total number of squares (Du Rietz 1957 p. 30). A comprehensive expression for the degree of cover in the squares where a species occurs (characteristic degree of cover) is calculated (cf. Persson op.c. p. 23) and given in the table in those cases when the degree of cover exceeds 1. For example, the expression 100^4 indicates that a species has the frequency 100 and the degree of cover 4. In tables 1 and 2 species occurring outside analyzed squares are marked with +. For a more extensive description of the phytosociological methods see Persson (op.c. pp. 21—25).

The nomenclature of the vascular plants follows Hylander (1955). The names of the mosses follow Nyholm (1954—1965). Mrs. Nyholm has kindly determined or confirmed the determinations of several mosses.

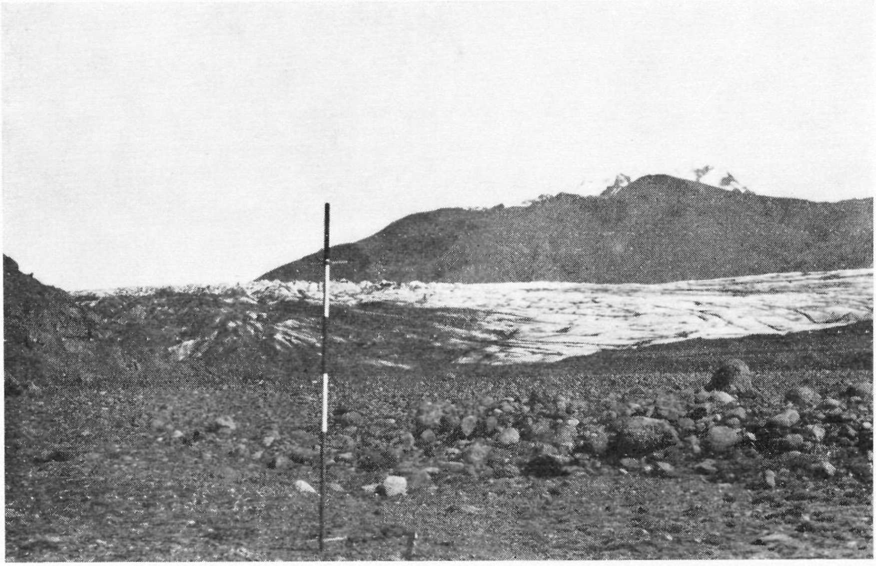

Fig. 7. Station 5. Most of the ground covered by *Rhacomitrium canescens* (table 1: 5). A small open area is seen just around the measuring point. — Photo C. H. Lindroth.

The stations

Station 1. During the field work (1962) this station was situated close to the ice margin separated from it only by a stream of melt-water. The small ridge on which the station was situated seemed to be a small remainder of the glacier consisting of ice covered by a thin layer of moraine. The station was entirely free from vegetation.

Station 2. This station seemed to be situated on moraine without ice. In 1960 (Aug. 23, aerial photo) it was completely covered with ice. Thus, in 1962 it can have been uncovered for only one and a half vegetation periods. Probably it was free from ice as late as in the summer of 1962. Vegetation was lacking with the exception of a plot a small distance from the station where some old individuals of a *Brachythecium* species were bedded in fine earth. They had probably fallen down from the precipice situated not far from the station.

Station 3. In 1960 this station (figure 6) was situated at or immediately outside the ice margin of 1960. At the time of investigation it had probably been uncovered for the second (or perhaps third) summer. Here the first pioneer vegetation is seen. A few metres from the station within an area of c. 30 m^2, broadly speaking, 1 or 2 individuals of each of the species listed in table 1: 3 were found.

Station 4. The analyzed stand (5×20 m^2) had a very sparse vegetation according to table 1: 4.

Fig. 8. Station 7. Mainly a closed bottom layer of *Rhacomitrium canescens* and *R. lanuginosum*. Small individuals of *Betula pubescens*.

Station 5. The station was surrounded by an open area [1] with very few individuals of *Cardaminopsis petraea, Cerastium alpinum, Saxifraga caespitosa, S. oppositifolia, Sedum acre, S. annuum, Festuca vivipara* and *Poa glauca*. Outside the station there was a stand (c. 300 m^2) of rather closed *Rhacomitrium* vegetation with dominating *R. canescens* (table 1: 5; figure 7).

Station 6. Around the station the ground was almost completely open [1] (4×12 m^2) and with a rather fine substrate (mainly sand) between blocks and large stones. There was a sparse vegetation of *Cardaminopsis petraea, Cerastium alpinum, Galium normani* ssp. *islandicum, Rumex tenuifolius, Saxifraga oppositifolia, Sedum acre, S. annuum, Silene maritima, Thymus drucei, Veronica fruticans, Agrostis* sp., *Festuca rubra, F. vivipara, Luzula spicata* and *Poa glauca*. — Outside the station the fine soil was covered by a comparatively closed *Rhacomitrium* vegetation (table 1: 6). The vegetation cover was interrupted by boulders and large stones.

Station 7. A closed *Rhacomitrium* heath with creeping birches and rather much *Empetrum* (table 1: 7; figure 8).

Station 8. The station was situated only c. 10 m from the precipice. The

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[1] The vegetation not included in table 1.

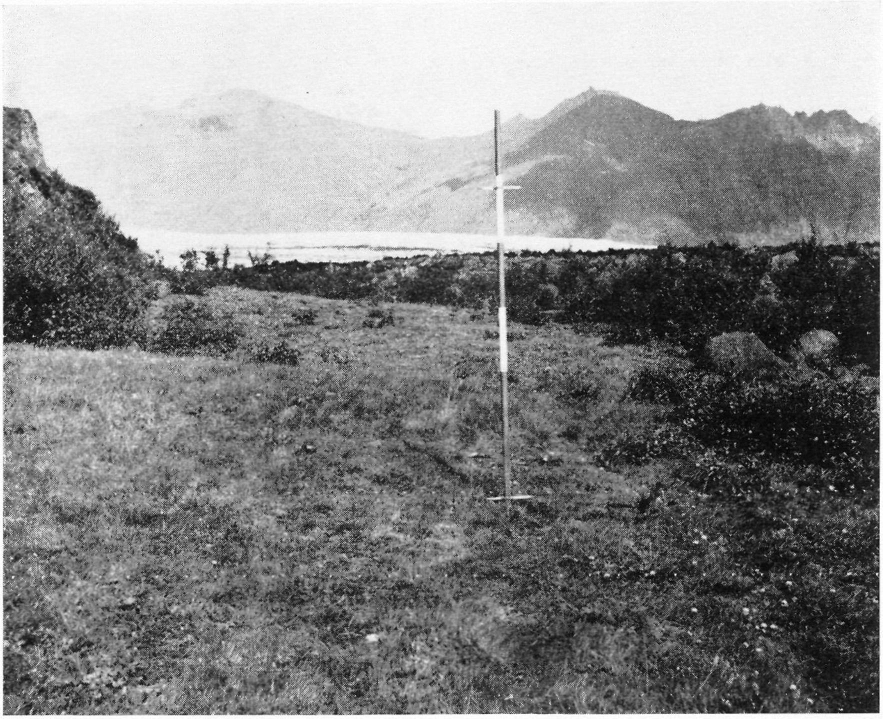

Fig. 9. Station 8. Closed meadow vegetation with dominating *Trifolium repens* and *Anthoxanthum odoratum*. Part of the precipice to the left. — The station is situated within the area with low-grown birches marked "Area with birch" on the map.

vegetation which can be classified as a low-grown dry meadow vegetation was entirely closed with *Trifolium repens* and *Anthoxanthum odoratum* as dominants in the field layer (figure 9). This station deviates very much from the other stations on the moraine area concerning the vegetation as well as the situation close to the precipice.

Station 9. Situation, see figure 1. Opening in a low-grown birch forest (birches $^1/_2$—2 m high) on a S-exposed slope. Meadow vegetation with dominating *Trifolium repens* and a prominent intermixture of *Galium verum* and *Anthoxanthum odoratum*. *Geranium silvaticum* occurred only in connection with *Betula* and *Salix*.

Species list: *Salix phylicifolia, Campanula rotundifolia, Cerastium fontanum* coll., *Epilobium collinum, Equisetum arvense, E. pratense, E. variegatum, Erigeron boreale, Galium normani* ssp. *islandicum, G. verum, Geranium silvaticum, Leontodon autumnalis, Linum catharticum, Myosotis arvensis, Parnassia palustris, Platanthera hyperborea, Polygonum viviparum, Prunella vulgaris, Rubus saxatilis, Thymus drucei, Trifolium repens, Viola* cf. *palustris, Agrostis tenuis, Anthoxanthum odoratum, Carex capillaris, Festuca rubra,*

Fig. 10. Station 12. Birch forest mainly with grasses dominating in the field layer.

Kobresia myosuroides, Luzula multiflora, Drepanocladus uncinatus, Hylocomium splendens, Pleurozium schreberi, Rhytidiadelphus squarrosus, R. triquetrus, Rhytidium rugosum, Thuidium philibertii and *Peltigera* sp.

Station 11. Situated in the northwestern part of the Skaftafell area. Small open part of the birch forest close to the "sandur". The height of the birches c. 3—4 m. Very sparse field layer without dominating species. Swelling bottom layer with co-dominance of *Hylocomium splendens, Rhytidiadelphus squarrosus* and *R. triquetrus.*

Species list: *Salix lanata, Alchemilla alpina, Cerastium fontanum* coll., *Equisetum arvense, E. variegatum, Galium normani* ssp. *islandicum, Galium verum, Listera cordata, Parnassia palustris, Polygonum viviparum, Rhinanthus minor, Selaginella selaginoides, Silene acaulis, Thalictrum alpinum, Thymus drucei, Agrostis canina, Deschampsia flexuosa, Festuca rubra, F. vivipara, Juncus trifidus, Kobresia myosuroides, Luzula multiflora, Poa glauca, Climacium dendroides, Drepanocladus uncinatus, Hylocomium splendens, Polytrichum juniperinum, Rhacomitrium canescens, Rhytidiadelphus squarrosus, R. triquetrus, Timmia austriaca* and *Peltigera* sp.

Station 12. Birch forest. Small glade with meadow vegetation (figure 10).

The height of the birches 3—4 m. Low-grown *Salix phylicifolia* was prominent in spots. Field layer very sparse, mainly grasses. Swelling bottom layer with *Hylocomium splendens, Rhytidiadelphus squarrosus* and *R. triquetrus.*

Species list: *Salix lanata, S. phylicifolia, Vaccinium uliginosum, Cerastium fontanum* coll., *Equisetum arvense, E. variegatum, Erigeron boreale, Galium normani* ssp. *islandicum, G. verum, Parnassia palustris, Polygonum viviparum, Potentilla crantzii, Rhinanthus minor, Agrostis canina, Anthoxanthum odoratum, Festuca rubra, F. vivipara, Juncus trifidus, Kobresia myosuroides, Luzula multiflora, Poa pratensis, Climacium dendroides, Drepanocladus uncinatus, Rhytidiadelphus squarrosus, R. triquetrus* and *Peltigera* sp.

For further information about stations 9—12 the reader is referred to coming works by Lindroth (op.c.) and the Danish botanists. The latter ones have received the vegetation analyses of the present author for publishing together with their own material from birch forests. — Station 10 has been excluded in the present paper because no soil sample was collected there.

Stages in the development of the vegetation

On a large scale there is a continuous change in the vegetation from the glacier front out over the moraine area. Close to the ice margin there is no visible vegetation but not far away the first mosses and vascular plants appear. Then the species composition and the number of species and individuals change more or less successively with increasing distance from the glacier. A fairly closed plant cover is however not met with before station 6.

A rather successive development of the vegetation is to be expected at least within that part of the area that has been laid bare during the period 1934—50. Broadly speaking, the recession of the glacier has taken place with about the same rate during that time (figure 3). Further, from a chemical point of view the moraine is probably rather uniform. However, there is a variation in soil moisture within the area. As mentioned before the more or less wet depressions are not considered in the present paper.

The analyses are too few in number to give a detailed picture of the variation and development of the vegetation within the area. However, it is obvious that the different groups of analyzed stands represent different stages in the development of the vegetation from the first pioneer stages to an entirely closed and comparatively stable vegetation.

Stage I. The first stage is characterized by the pioneer vegetation colonizing the bare ground the first years after it has been free from ice.

Table 2. Survey of the stages in the development of the vegetation

Stage no.	I	II	III	IV	V
Free from ice (years, approx.)	2—3	4—9	> 12	> 30	> 60
Number of stands and squares	1: 0	3: 18	10: 33	4: 12	4: 12
A. *Bryum pseudotriquetrum*	+	—	—	—	—
Funaria hygrometrica	+	—	—	—	—
Pohlia albicans	+	—	—	—	—
B. *Arenaria norvegica*	+	11	58	+	—
Minuartia stricta	—	6	21	—	—
Oxyria digyna	—	22	12	8	—
Poa alpina	—	17	18	8	—
Rumex tenuifolius	—	6	9	8	—
Saxifraga hypnoides	—	6	9	+	—
— *nivalis*	—	+	21	17	—
Sedum acre	—	+	12	42	—
— *annuum*	—	22	27	8	—
Silene maritima	—	11	3	+	—
Barbula icmadophila	—	28	51	25	—
— *recurvirostris*					
Ditrichum flexicaule	—	6	18	8	—
Hypnum revolutum	—	67	24	8	—
C. *Cardaminopsis petraea*	—	17	48	67	42
Cerastium alpinum	+	11	45	25	25
— *fontanum* coll.	+	39	42	50	25
Galium normani ssp. *island.*	—	6	27	92	100
Minuartia rubella	—	+	9	8	8
Saxifraga caespitosa	—	50	61	+	17
— *oppositifolia*	—	22	64	50	75
Silene acaulis	—	+	6	17	50
Thymus drucei	—	6	30	67	92
Agrostis canina	—	17	6	—	33
— *stolonifera*	—	44	39	67	50
Festuca rubra	+	33	24	8	75
— *vivipara*	—	17	73	100	67
Luzula spicata	—	6	12	92	92
Poa glauca	—	94	94	83	25
Trisetum spicatum	—	22	12	+	25
Drepanocladus uncinatus	—	17	9	8	8
Pogonatum urnigerum	—	11	33	92	92
Polytrichum juniperinum	—	6	—	8	25
Rhacomitrium canescens	—	89^{2}	100^{4}	100^{5}	100^{5}
— *lanuginosum*	—	6	48	75	100^{4}
Peltigera	—	17	24	50	50
Stereocaulon	—	11	94	100	58
D. *Betula pubescens*	—	—	+	8	33^{2}
Dryas octopetala	—	—	+	+	+
Empetrum sp.	—	—	15	25	58^{2}
Salix herbacea	—	—	3	+	50
— *lanata*	—	(6)	12	25	+
— *phylicifolia*	—	—	+	+	+
Vaccinium uliginosum	—	—	3	+	+
Alchemilla alpina	—	—	18	75	92
Galium verum	—	—	9	42	25
Polygonum viviparum	—	—	15	17	25

Table 2. Continued.

Stage no.	I	II	III	IV	V
Free from ice (years, approx.)	2—3	4—9	> 12	> 30	> 60
Number of stands and squares	1: 0	3: 18	10: 33	4: 12	4: 12
Cladonia spp.	—	—	3	25	67
Placopsis gelida (on stones)	—	—	++	++	++
Rhizocarpon spp. (on stones)	—	—	++	++	++
E. *Juncus trifidus*	—	—	—	+	67
Botrychium lunaria	—	—	—	—	42
Campanula rotundifolia	—	—	—	—	25
Stones and bare soil	100^{5}	100^{5}	100^{4}	100^{3}	42^{1}
Mean of vasc. plants per sq. m.	—	4.8	9.0	11.0	12.7
Total number of vasc. plants	(7)	33	56	48	38
Mean of mosses per sq. m.	—	2.8	3.1	3.7	3.4

In addition:

Vascular plants. *Armeria maritima* III (+), IV (8); *Chamaenerion latifolium* III (+); *Coeloglossum viride* V (17); *Corallorhiza trifida* V (+); *Cystopteris fragilis* III (+); *Draba incana* III (+); *Draba* sp. II (6); *Epilobium collinum* IV (+); *Epilobium* sp. II (+), III (+); *Erigeron boreale* III (+), IV (+), V (8); *Gentianella aurea* V (+); *Gentiana nivalis* V (+); *Hieracium* sp. III (+), IV (+), V (+); *Leontodon autumnalis* III (6), IV (17); *Lycopodium selago* IV (+); *Parnassia palustris* II (+), III (6), V (+); *Pinguicula vulgaris* V (+); *Potentilla crantzii* III (3); *Rhinanthus minor* IV (8), V (8); *Rumex acetosa* III (+); *Saxifraga aizoides* II (+), III (9); *Saxifraga cotyledon* (small sterile ind.) III (+); *Sedum rosea* III (+); *Stellaria media* II (+); *Thalictrum alpinum* III (+); *Tofieldia pusilla* IV (+); *Veronica fruticans* III (6), IV (+); *Viscaria alpina* II (+), IV (8); *Agrostis* sp. IV (25); *Deschampsia alpina* III (3); *Juncus balticus* IV (+); *Kobresia myosuroides* IV (8), V (17); *Luzula multiflora* III (+), IV (8), V (8); *Phleum commutatum* III (+); *Poa* sp. (viviparous) III (3).

Mosses. *Aulacomnium palustre* II (+); *Bartramia ithyphylla* IV (17); *Brachythecium albicans* II (17); *Brachythecium rivulare* II (6); *Brachythecium* sp. III (3); *Bryum* cf. *caespiticium* IV (8); *Bryum* cf. *inclinatum* III (3); *Bryum* sp. II (+); *Calliergonella cuspidata* II (6), III (3); *Campylium* sp. II (6); *Ceratodon purpureus* IV (8); *Climacium dendroides* II (6); *Homalothecium sericeum* III (3); *Hylocomium splendens* IV (8); *Philonotis* sp. II (+); *Pohlia drummondii* f. *rothii* IV (8); *Pohlia* sp. II (+); *Polytrichum alpinum* V (8); *Polytrichum piliferum* III (6), V (8); *Rhytidiadelphus squarrosus* II (6); *Rhytidium rugosum* III (3); *Schistidium* sp. II (6), III (3); *Timmia* sp. III (3).

Lichens. *Cetraria crispa* V (8); *Cornicularia aculeata* V (8); *Thamnolia vermicularis* V (8).

In the vegetation at station 3 (table 1: 3) the following vascular plants were noted: *Arenaria norvegica, Cerastium alpinum, C. fontanum* coll., *Festuca rubra* and undetermined individuals of *Agrostis* and *Poa*. The occurring mosses *Bryum pseudotriquetrum, Funaria hygrometrica* and *Pohlia albicans* are found only in stage 1 (table 2: 1).

With the exception of *Arenaria norvegica* the first vascular plants belong to group C (table 2) containing species which are found, usually abundantly, in all stages in the development of the vegetation of the moraine ground. *Arenaria norvegica* and among the mosses *Funaria hygrometrica* are species that colonize open ground but disappear again when the vegetation begins to be closed. In Scandinavia *Arenaria norvegica* occurs mainly in talus slopes with more or less open soil. Within the investigation area it belongs foremost to stages II and III.

A still younger vegetation was noticed in the vicinity of station 4 in the upper part of the above-mentioned (p. 326) river-bed where the water was strongly flowing in 1960 and which was almost dried-up in 1961. Very small individuals of *Cerastium* (probably *C. alpinum*) and a grass (probably *Poa*) were noted. Very small undeveloped specimens of mosses were seen on fine earth usually south and southwest of and close to large boulders. *Plagiobryum zierii* and *Pohlia* sp. were collected.

Stage II is represented by station 4 together with the stands 111 and 77. From a further stand, no. 136, there is only a species list.

The number of species (33 vascular plants and c. 20 mosses) is rather high compared with the preceding stage but the vegetation is still very sparse. On an average there are 4.8 vascular plants per square metre (table 2: II). Among the most prominent species are, e.g., *Cerastium fontanum* coll., *Agrostis stolonifera, Festuca rubra, Poa glauca, Oxyria digyna, Agrostis canina, Cardaminopsis petraea, Festuca vivipara, Trisetum spicatum, Saxifraga caespitosa* and *S. oppositifolia*. These and practically all other species of importance in the investigated area are very common species in Iceland.

Of some interest is the occurrence of *Stellaria media* (cf. *Arenaria norvegica* and *Funaria hygrometrica* in stage I).

The vegetation in stage II is further characterized by the absence of crustaceous stone lichens. However, lichens of the genera *Peltigera* and *Stereocaulon* begin to occur (very small specimens in stand 77). Ligneous plants are not found with the exception of one very small individual of *Salix lanata*.

Among the mosses *Rhacomitrium canescens* and *Hypnum revolutum* are the most prominent ones. *Rhacomitrium canescens* is the only species that reaches a degree of cover > 1 (2—4 in stand 77).

Stage III is represented by station 5 together with stands 45, 119, 137, 142, 107, 73, 94, 100 and 103.

A most prominent feature of the vegetation in this stage is the occurrence of crustaceous lichens on blocks and big stones. The first appearance of such lichens takes place so abruptly that it is possible to draw a very sharply defined limit. In the field, by means of the very characteristic lichen *Placopsis gelida,* the author was able to determine this limit to within 5—10 m. On the map (figure 2) the limit is marked "*Placopsis* limit". At the same time the first individuals of *Rhizocarpon norvegicum* Räs.[1] are met with. From this limit the crustaceous lichens increase rapidly in the number of species and individuals as well as in the size of the individuals. However, the "lichenometrical" method of determining the age of the moraines has not been used.

The situation of the *Placopsis* limit corresponds to the situation of the glacier margin somewhat earlier than in 1954. There is reason to believe that the period of stagnation in 1950—53 may have caused this "vegetation limit" in the lichen vegetation. If this is true, the ground along the *Placopsis* limit was free from ice at about 1948 or 1949 (figure 3), i.e., c. 13—14 years ago (1962).

The herbs and the graminaceous plants are much the same as in stage II but they are usually somewhat more common. A few new ones are added (group D). Ligneous plants such as *Betula pubescens, Dryas octopetala, Empetrum, Salix herbacea, S. lanata, S. phylicifolia* and *Vaccinium uliginosum* begin to occur, but they are rare and the individuals are very small. In this stage also the first *Cladonias* are found.

The vascular plants grow very sparsely. No one of them reaches a degree of cover higher than 1. The moss layer is comparatively well developed. *Rhacomitrium canescens* is the only dominating species. In most stands (except 119, 137 and 142) *Rhacomitrium* forms comparatively closed mats which are however interrupted by stones and small open sand spots.

In the field it was at first expected that station 5 together with the stands 73, 103, 100 and 94 could be treated separately from the other stands, that these groups of stands had different vegetation and that

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[1] New to Iceland. Determined by Hans Runemark (cf. Runemark 1956 a pp. 61—63 and 1956 b pp. 19—20).

they corresponded to different stages in the formation of bare soil at the recession of the glacier. However, there are no obvious features in the vegetation indicating that the first-mentioned stands have had more time to be developed than the other stands. It seems very probable that at least the stands 100 and 103 were covered by flowing melt-water for at least some years after the ice had left this area because they are situated on plane terraces which may have been formed by water-action.

Stage IV is represented by station 6 together with stands 83, 87 and 90. This stage of vegetation is not distinctly separated from the preceding stage. There are, however, some differences. At first the occurrence of *Lecidea dicksonii,* a crustaceous lichen, on stones and boulders should be mentioned.

The first appearance of this lichen is marked on the map (figure 2). It follows the third terminal moraine rather well. This limit is not as easy to follow in the field as the "*Placopsis* limit". The very small lichen individuals near the limit are difficult to notice. The author, who is not a lichenologist, is not absolutely sure that this lichen does not occur also in the preceding stage. The ground along this limit has been free from ice for at least 25 years.

There is a tendency that species in group C (table 2) become more common in this stage, e.g., *Galium normani, Luzula spicata, Thymus drucei, Pogonatum urnigerum, Rhacomitrium canescens, R. lanuginosum* and *Peltigera.* Also *Cladonia* spp. (group D) can be mentioned. On the other hand, other species become more rare, which is the case of most species in group B. Especially interesting are *Arenaria norvegica* and *Minuartia stricta.* The former is found only once and the latter seems to be entirely lacking in this stage.

In this and the preceding stage only mosses form closed vegetation. The vascular plants grow always very sparsely. No one of them covers more than 5 per cent of the sample squares.

Rhacomitrium canescens is still the dominating bottom layer species. *R. lanuginosum* is somewhat more prominent than in the preceding stage but only occasionally does it occur with the degree of cover 2 or 3.

Stage V. The vegetation at station 7 and the stands 122, 126 and 130 representing stage V, differs distinctly from the vegetation in stage IV. Species in group B are lacking. Certain ligneous plants, *Betula pubescens* and *Empetrum,* can be prominent in spots (table 1: 7; figure 8). Species in group E are added. The comparatively rich occurrence of *Juncus trifidus* is important.

The moss cover is almost entirely closed (figure 8). Only big stones stick up through the moss layer. *Rhacomitrium canescens* is here not always the most prominent species. *R. lanuginosum* can co-dominate in spots.

Comparing the stages II—V, the number of vascular plants per square metre increases from 4.8 in stage II to 12.7 in stage V. However, the total number of vascular plants is highest in stage III and decreases in stages IV and V (table 2). Regarding the mosses there is a similar tendency. Stages II and III have the greatest total number of species (c. 15—20) which then successively decreases in stages IV and V. Stage V has about half the number of species compared with stages II and III.

Soil conditions

Methods

Sixteen soil samples were collected mainly at the measuring stations, 2—5 cm below the surface of the mineral soil. In some cases samples from different soil layers at the same site were taken (see table 3). The soil samples were air-dried in the field and sent to Lund for mechanical and chemical analyses. The mechanical analysis was important because a knowledge of the mechanical composition of the soil is essential for the interpretation of the soil temperature conditions (cf. Lindroth 1965). Also some chemical analyses were performed in order to obtain a measure of the rapidity of the leaching of the soil.

The author is aware of the fact that the small number of soil analyses (table 3) cannot yield a satisfactory knowledge of the soil conditions on the moraine area and in the investigated forest sites. However, concerning certain chemical properties of the soil, there is an obvious trend and regularity in the material which increase the possibility of drawing some conclusions from it.

After particles larger than 2 mm (gravel, stone) had been separated from the original samples on a 2 mm sieve, analyses were performed on the fine earth.

Mechanical analysis was performed as combined sedimentation and pipette analysis according to Tamm (1934).

Loss on ignition was determined by ashing in a muffle furnace at 550°C.

pH was determined electrometrically with glass electrode in water extracts after sedimentation for 12 hours. The volume relation between soil and the mixture of soil and water was 1 : 2. In a smaller number of samples pH was determined in extracts of soil treated with 0.2-N KCl instead of water.

Extractable cations were extracted with normal acetic acid (abbrev. Ac in table 3) and normal ammonium acetate (abbrev. Am). The sum of extractable metal ions and hydrogen ions respectively was determined by the change in pH according to the method originally proposed by Brown (1943). Extractable metal cations in per cent of the exchange capacity (the sum of metal cations and hydrogen ions) is termed percentage of neutralization (Sjörs 1961). See further Persson 1962 pp. 64—65 and literature cited there.

The acetic acid and ammonium acetate extracts were filtered and evaporated to dryness. After treatment with HNO_3+HClO_4 (4 : 1) in order to destroy organic matter the residues were dissolved in HCl and diluted to 50 ml. From these solutions suitable amounts were taken for the determination of the different metal cations.

Sodium and potassium were determined with a Kipp & Zonen flame photometer (type H 45 with gasol-air flame). See Malmer 1960 p. 88 and 1962 p. 187.

Calcium was determined by versenate titration.

The soil samples are numbered in accordance with the numbers of the measuring stations. Samples Nos. 5 a, 6 a and 7 a are from the undisturbed surface layer below *Rhacomitrium* carpets. Nos. 5 b and 6 b are taken from the open soil in close connection with the measuring points. No. 7 b is from the subjacent layer 5—10 cm below the surface layer rich in humus. Samples 5 b, 6 b and 7 b are in some diagrams treated in a separate group with a low content of humus. — As for forest soils a-samples are from the surface layer and b-samples from the subjacent layer.

Mechanical analysis and loss on ignition

The mechanical analysis shows that on an average the particle-size composition of the original soil does not vary very much between the different stations on the moraine area. Together the fractions stones and gravel make up on an average 65 per cent of the original soil with the exception of station 6 where the main part (65 per cent) consists of fine earth. At this station parts of the ground were uncovered, probably eroded by wind (cf. p. 334). Regarding station 7 and stand 130 only the surface layers deviate. They consist almost entirely of fine earth, mainly fine sand. This is due to a secondary effect. Fine sand carried by the wind is caught by the *Rhacomitrium* layer which sometimes seems to be almost entirely impregnated with sand. The moss shoots successively grow up over the sand, while the lower parts of the mosses are decomposed into humus which gives the surface layer a darker colour. Below the sandy surface layer which is about 5 (—10) cm thick

Table 3. Soil analyses

Values calculated per 100 g dry soil

Sample no. (=station no.)	Loss on ign. %	pH (H_2O)	pH (KCl)	Neutr. %	Exch. cap. me	Na^+ Am/Ac me	K^+ Am/Ac me	Ca^{2+} Am/Ac me	Fine earth (< 2 mm) composition in per cent			Stones and gravel, per cent of total mineral soil
									Sand 2—0.2 mm	Fine sand 0.2—0.02 mm	Silt+clay < 0.02 mm	
Moraine area												
1. Bare soil	1.4	8.2	7.3	100	23	0.56/0.68	0.35/0.15	16.2/18.2	76	20	4	69
2. Bare soil	1.9	8.3	7.2	100	23	0.51/0.59	0.20/0.12	15.4/19.5	92	4	4	56
4. Bare soil	1.9	7.6	—	100	20	0.68/0.73	0.44/0.15	15.9/16.0	58	37	5	75
5 a. *Rhacomitrium*	1.8	6.9	—	98	18	0.64/0.54	0.50/0.11	11.7/ 7.3	—	—	—	62
5 b. Bare soil	1.4	6.9	—	100	16	0.50/0.81	0.42/0.22	10.8/11.3	65	33	2	59
6 a. *Rhacomitrium*	3.6	6.3	5.0	87	19	0.90/0.89	0.90/0.23	10.8/ 8.4	—	—	—	36
6 b. Bare soil	2.2	6.9	5.6	92	17	0.46/0.79	0.38/0.26	12.4/10.0	82	15	3	34
7 a. *Rhacomitrium*	3.9	6.1	—	80	20	0.87/0.97	0.94/0.23	7.3/ 6.8	—	—	—	0
7 b. Subjac. layer .	1.6	6.5	5.2	90	15	0.59/0.80	0.44/0.16	7.9/ 6.2	53	43	4	70
130. *Rhacomitrium* .	5.0	6.2	—	88	20	0.86/1.06	0.84/0.27	10.3/ 9.3	28	71	1	1
Forest sites												
9 a. Surface layer	10.5	6.0	5.2	—	—	0.68/2.8	0.34/0.32	10.0/12.6	—	—	—	2
9 b. Subjac. layer .	6.1	6.3	—	78	23	0.42/0.47	0.13/0.04	6.7/ 6.8	18	72	10	0
11 a. Surface layer	11.3	6.1	4.8	—	—	1.83/2.7	0.96/1.24	20 /19.5	—	—	—	6
11 b. Subjac. layer .	5.1	6.4	5.1	85	32	1.20/1.16	0.91/0.29	19.8/12.1	—	—	—	32
12 a. Surface layer	10.7	6.1	4.7	—	—	2.2 /2.2	1.63/0.88	21 /20	—	—	—	1
12 b. Subjac. layer .	6.0	6.4	5.2	85	34	1.17/1.13	1.27/0.42	20 /14.6	27	62	11	1

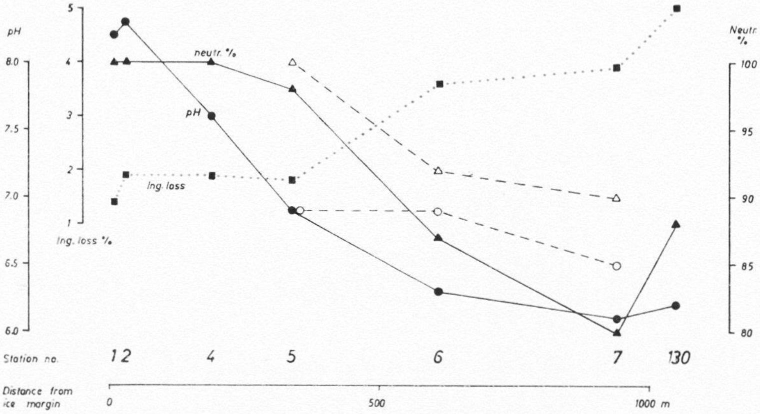

Fig. 11. pH, percentage of neutralization and loss on ignition in soil samples from different stations. Filled symbols denote a-samples (see the text) and unfilled ones mark b-samples.

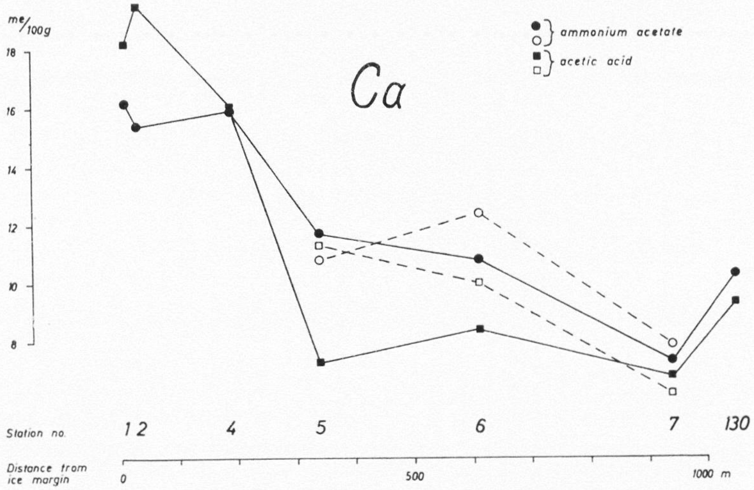

Fig. 12. Extractable calcium. Filled symbols denote a-samples (see the text) and unfilled ones mark b-samples.

the soil remains unchanged. These conditions must be considered when interpreting the chemical analyses below.

In soil samples from the moraine area the sand fraction predominates whereas the fine sand is the main fraction in samples from the forest area. The latter seem to be loessial soils. However, Jóhannesson (1960

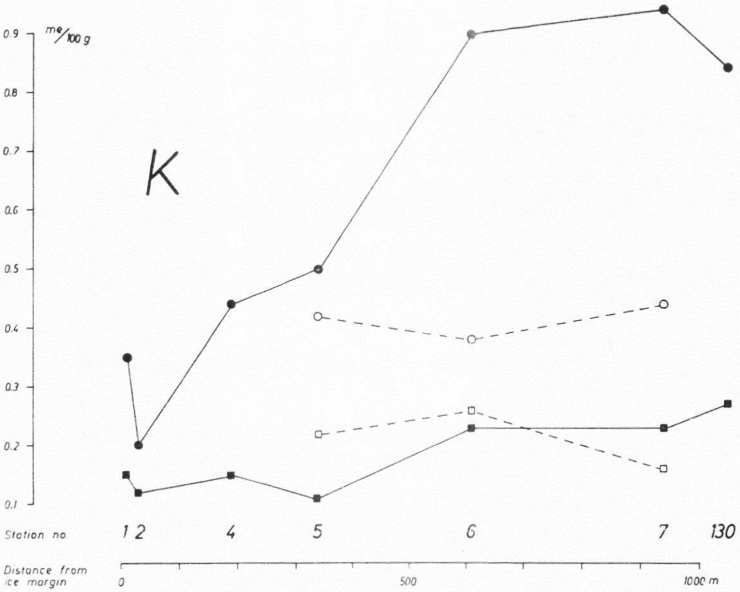

Fig. 13. Extractable potassium. Symbols and explanations, see figure 12.

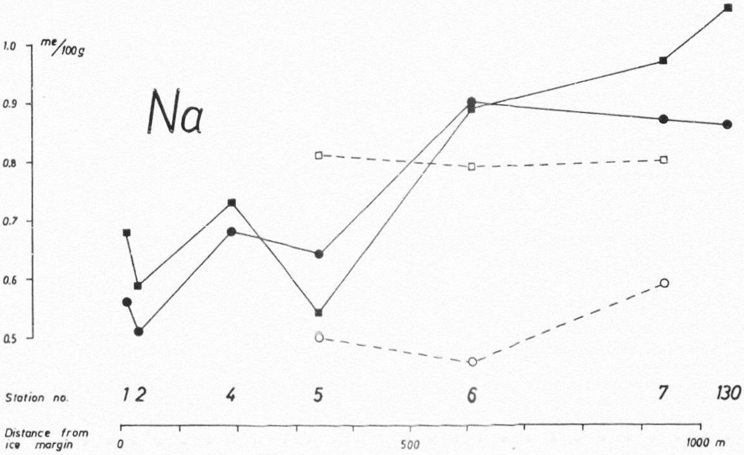

Fig. 14. Extractable sodium. Symbols and explanations, see figure 12.

pp. 57 and 102—103) gives a much higher content of silt (and clay) for such soils.

A striking feature of the fine soil is the almost total absence of the clay fraction and the occurrence of a very small amount of silt. According to Jóhannesson (op.c. p. 57), great problems are met with in per-forming mechanical analyses of Icelandic loessial soils because of the amorphous nature of the finest fractions. There are reasons to believe that in Iceland "there does not exist any well defined clay fraction in the soils, and the quantity of material found in the clay range by sedimentation depends to some degree on the mechanical pretreatment of the samples". The dispersion of the soils often presents difficulties.

Even if loss on ignition is not a very good measure of organic matter the values may serve as relative measures (table 3; figure 11). It is seen that the content of organic matter is very small (loss on ignition c. 2 per cent) in the original moraine soil. Only in the surface layer at stations 6 and 7 and in stand 130 where a closed moss layer has had time to be developed are higher values (4—5 per cent) found.

The samples from forests have considerably higher values in the surface layer, c. 11 per cent, while the figures from the subjacent loessial sand were about 5—6 per cent. Because samples are taken only c. 10—15 cm below the surface, nothing can be stated about the conditions below the root-zone. According to Jóhannesson (op.c. p. 56) the organic matter content of Icelandic soils is generally rather high even in rather deep layers of the soil profiles.

Acid-base status

At first considering the moraine area, there is an obvious decrease in pH of the undisturbed surface layer from station 1 to station 7 (table 3; figure 11). As high values as 8.2 and 8.3 were measured in moraine soil just freed from ice. As there is no increase in organic matter at stations 4 and 5 the decrease in pH may mainly be explained by the action of the leaching water. The further decrease in pH at stations 6 and 7 seems to be due also to a higher content of humus substances. In the subjacent layer at station 7 there is a smaller decrease.

At the forest stations (nos. 9, 11 and 12) the pH values 6.0, 6.1 and 6.1 were measured. Jóhannesson measured pH 6.6 in a forest site (1960, p. 103, no. 65 B) with similar vegetation.

The decrease in percentage of neutralization on a large scale runs parallel to the decrease in pH (figure 11). The soil at the stations near the ice margin is entirely neutralized. Not before station 6, where the humus content increases, is there an obvious decrease in neutralization. This decrease is less marked in samples 6 b and 7 b which are less rich in humus.

The exchange capacity is remarkably high in soils from the moraine area. In samples from deep glacial drifts in the English Lake District (ignition loss c. 2 per cent, pH 6—6.5) Gorham (1953 p. 130) gives values only half as large. According to Jóhannesson (op.c. p. 59) the exchange capacity of the mineral fraction of Icelandic soils cannot be referred only to the smallest particles. Because the particles of pumic and rhyolitic ash are porous they have a large surface. If such particles make up a part of a relatively coarse-grained soil the exchange capacity will be higher than expected. — In samples 5 a, 6 a and 7 a the exchange capacity is higher than in samples 5 b, 6 b and 7 b with a low humus content.

Metal cations

The amount of extractable calcium (table 3; figure 12) in the undisturbed surface layer decreases from the ice margin to station 7 (including stand 130). The Ca-curve has about the same course as the curves of pH and percentage of neutralization. — Values from forest sites are higher than those from moraine areas covered with vegetation and of the same size as those given by Jóhannesson (1960 pp. 102—103) from Icelandic silt loam.

For some reason the potassium values in ammonium acetate are much higher (2—4 times) than those in acetic acid (figure 13). This is especially the case in samples from stations 6, 7 and stand 130 (soil comparatively rich in humus from stands with a closed vegetation cover). The increase in potassium (also in ammonium acetate) does not agree with results given by Stork (1963). — In the forest sites the potassium values are higher in the surface layer rich in humus than in the subjacent layer. The values are of the same size as those given by Jóhannesson (l.c.).

If the surface layer in undisturbed soil is considered, the amount of sodium (figure 14) is highest at stations 6, 7 and stand 130 (rich in humus). AmAc- and HAc-values agree rather well. However, there is no such increase if samples 6 b and 7 b are considered. Besides, in the last-mentioned samples there is an obvious difference between AmAc- and HAc-values. This is quite the opposite to conditions with the potassium values discussed above. — Concerning forest sites sodium behaves in much the same manner as potassium.

Discussion

Very soon, probably the year after the ground is freed from ice, the first plants begin to colonize the area. It is most probable that the first species appear in a more or less occasional mixture. However, during the development towards a plant community the plants will occur more and more regularly.

Perhaps there may be a long range dispersal of diaspores to the area freed from ice. It is likely, however, that the main part of the diaspores is brought to the bare ground partly from the vegetation on the moraine areas already colonized, partly from the vegetation above and in the large precipice. In the latter case diaspores from plants of a great number of different plant communities have possibilities of being effectively dispersed over the moraine plane. There is reason to believe that this diaspore supply from one direction may have the effect that certain species, e.g., those with heavy diaspores, are more common in the vicinity of the precipice than farther out on the moraine area. In the author's material there are no obvious features in the vegetation that with certainty can be referred to such differences in the supply of diaspores. It is quite evident, however, that the ground out to about 10—20 m from the precipice has a vegetation that deviates from the other parts of the moraine plane. This may be due partly to a position microclimatically more suitable but above all to other soil conditions, weathering material from the precipice and a richer water supply. On the other hand, certain differences can be pointed out between the author's material and that collected by the Danish botanists further out on the moraine area. They have investigated the vegetation mainly on the moraine ridges but to some degree also in the low parts between them. The moraine ridges are better marked in the outer parts of the area. On the ridges the plants are usually more sparse-growing. The mosses do not form such closed covers as in the author's material. However, stands 119, 137 and 142 have a sparse bottom layer.

Naturally, the diaspores of many species cannot develop due to an unsuitable habitat. However, because the competition from other species is unimportant or lacking, several species may have a chance to develop at least occasionally.

It would have been of great interest to follow the development between stages I and II in detail. Lack of time and conditions difficult to interpret at moraine 1 have made this impossible. The further development of the vegetation is seen from table 2 and descriptions on pp. 340—343.

Disregarding species of group A, it is obvious that the main part of the pioneers form part of the vegetation as far as to stage V. Plants of group B make an exception. It seems likely that some of them, e.g., *Arenaria norvegica, Minuartia stricta* and *Sedum annuum* are eliminated above all due to an increasing competition in a more and more closed plant cover (cf. above). According to the Danish botanists (personal communication) *Arenaria norvegica* is rather common also on moraines 3 and 4 but in a vegetation which was not closed. — In other cases changes in the soil conditions (see below) or a combination of increased competition and changed soil conditions may be the cause of the disappearance of species in group B.

This as well as earlier investigations show that new species are added in the vegetation with increasing time after the ground was free from ice. Only to a lesser extent does this depend on conditions of dispersal of the diaspores. Climatical changes with increasing distance from the glacier front may perhaps in certain cases be of importance. Usually the successive changes in soil conditions seem to be the main cause.

From the present material it is seen that ligneous plants do not occur or occur only occasionally in the earliest stages (< 10 years). The Danish botanists have observed scattered small specimens on moraine 1. However, ligneous plants are not common in any stage with the exception of *Betula pubescens, Empetrum* and *Salix herbacea* which increase obviously in stage V (probably more than 60 years). In the Kebnekajse mountain area, northern Sweden (the alpine region), *Salix* species appeared in the following order at the margin of a retreating glacier: *Salix* sp. (6 years), *S. herbacea* (c. 10 years), *S. polaris* (13 years), *S. glauca* (21 years, but with occasional occurrences earlier) and *S. lanata* (30 years) according to Stork (1963). At the Rotmoos Gletscher, Austria (1,950 m above sea level) Palmer and Miller (1961 p. 78) report *Salix herbacea* as a pioneer already the first year after the recession of the ice front. According to Faegri (1933 p. 111) a specimen of *Salix phylicifolia* had colonized the ground 3 years after the retreat. Lüdi (1958) reports colonization of scattered ligneous plants 3—4 years after deglaciation (Aletschgletscher, Switzerland).

Regarding graminaceous plants and herbs the Danish botanists noted *Juncus trifidus* (group E) on moraine 2. Faegri (op.c. p. 113) gives 7 years for this species and Stork (op.c.) > 15 years. *Polygonum viviparum* (group D) is reported not before moraine 3 (c. 30 years) by the Danish botanists. According to Stork (op.c.) it begins after 30 years (with sporadical occurrences earlier). Palmer and Miller (op.c. p. 79) reports 16 years.

Stork (op.c.) treats the colonization of bryophytes extensively and gives for the appearance of *Rhacomitrium canescens* (group C) 12 years after the recession of the glacier and for *R. lanuginosum* 200 years.

As previously mentioned, crustaceous lichens appear very suddenly (the "*Placopsis* limit") in the present investigation area. Their first appearance may be dated to about 13 years. However, it is likely that they might have appeared some years earlier. This cannot be cleared up because the ice margin was probably situated close to this limit for about 5 years. However, it may be stated that identifiable crustaceous lichens do not occur earlier than 8—9 years after deglaciation. Stork (op.c.) mentions 5—10 years for *Lecidea* sp. on stones and the same time for *Stereocaulon* on soil. Palmer and Miller dated the first appearance of lichens to 13 years after the recession of the glacier. According to Faegri (op.c. p. 141) the boulders at the glacier Jostedalsbre were free from vegetation 0—20 years after deglaciation and the "stage of crustaceous lichens" could be dated to about 20—40 years.

Several other authors have treated the immigration of plants and plant communities at receding glaciers, e.g., Cooper (1931), Crocker and Major (1955) and Crocker and Dickson (1957).

The results of the present investigation of the soil conditions agree rather well with those of similar investigations of earlier authors (e.g. Crocker and Dickson 1957 and Stork 1963) concerning changes in pH and content of organic matter. Stork (op.c.) reports a decrease in pH from 8.1 to 6.1 during 30 years in an area with a basic material. The amount of organic matter increased during the same time from 0 to about 2 per cent.

The changes in acid-base status and humus content from station 1 to station 7 certainly run parallel to changes of other properties of the soil, e.g., those that are dependent on the development of micro-organisms. It seems probable that species with mycorrhiza, e.g., *Betula pubescens, Empetrum* and *Vaccinium uliginosum* cannot reach a good development before a later stage in the succession. "Acidophilous" plants are met with mainly in stage V (*Salix herbacea, Juncus trifidus*).

Only vegetation on "dry" moraine has been considered. Species obviously indicating moist soil conditions are very rare in the vegetation tables. Those that occur play a very unimportant rôle and are poorly developed. Real indicators of moisture occur in group A (table 2), viz., *Bryum pseudotriquetrum* and *Pohlia albicans*. In stand 136 (stage II) *Aulacomnium palustre, Calliergonella cuspidata* and *Philonotis* sp. were noted. In the same stage poor individuals of *Saxifraga aizoides* occurred. It is evident that such species are found only during the time next to the deglaciation. The moraine is easily drained and becomes dry very soon, especially since the melt-water streams are deeply cut down taking almost all water directly from the glacier. In the old river-beds mentioned above there is in some places a deviating vegetation with the character of a "moist meadow vegetation".

Lindroth (1965) discusses the influence of the climate upon the vegetation at the measuring stations. He states that a number of species which from a Scandinavian point of view are "southern species" (e.g. *Sedum annuum, S. acre* and *Galium verum*) occur very near the ice margin. There is, however, no increase of such species with increasing distance from the glacier. — The occurrence of southern species indicates that the temperature climate might not be too unfavourable. In the present material it is difficult to point out any features in the differentiation of the vegetation on the moraine area which with certainty can have been caused by climatical conditions.

The vegetation within the special area often gives an impression of "poorness". The plants look low-grown and dwarfed. Here it cannot be decided whether this is due mainly to climatical or edaphical conditions. The amount of available nitrogen and phosphorus have not been determined. According to Jóhannesson (1960 p. 57) there is a marked deficiency of nitrogen and phosphorus also in old loessial soils in natural conditions (cf. also op.c. pp. 131—134).

The investigated area is grazed by cows and sheep. The grazing is not especially intense. It seems likely, however, that the growth of *Betula* and *Salix* is considerably impeded.

Stage V is developed outside the glacier front of 1904. The ground has been bare for at least 60 years, probably for about a century (see Thorarinsson 1956 p. 4). However, it is not certain that the vegetation in front of the stationary ice margin had developed very much before the glacier began to recede. — The vegetation of stage V is rather similar to *Grimmia* (*Rhacomitrium*) heath vegetation occurring at higher levels (see e.g. Steindórsson 1945 pp. 450—56). However, stage V is a transitional stage in the development towards a vegetation with a shrub or tree layer (figures 8 and 9). It seems likely that a "heath birch forest" will form the final stage in the development of the vegetation, at least in sheltered positions in the vicinity of the precipice.

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Anopodium, a New Genus of Coprophilous Pyrenomycetes with Apically Pedicellate Spores

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Introduction

In 1953 C. Moreau described an odd fimicolous Pyrenomycete, *Pleurage dagobertii* C. Moreau, characterized by having the primary appendage of the spore — or pedicel [1] as I prefer to call it — directed upwards in the ascus. In all other *Pleurage* species as well as in all other members of the *Sordariaceae* with pedicellate spores, the pedicel is always basally placed, except in the genus *Zygopleurage* (p. 362). Moreau did not attach much importance to the remarkable spore arrangement in *P. dagobertii,* apart from regarding it as a specific character. He observed that in several *Pleurage* species one or more spores in an ascus could occasionally be reversed (ibid. p. 194), and he apparently considered that the step from such a phenomenon to a reversal of all spores in all asci was not great.

A few years ago I found in Sweden two species of coprophilous Pyrenomycetes with spores resembling those of *P. dagobertii.* These finds gave me an opportunity of becoming better acquainted with the unique spore morphology. My investigations have now convinced me that this spore type, as well as the whole spore ontogeny, is so alien to that of *Pleurage* (or *Podospora*) that *P. dagobertii* cannot belong to this genus. My two new species and *P. dagobertii* constitute herewith the new genus *Anopodium,* although the latter species is for special reasons not formally included (p. 360).

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[1] 'Pedicel' is used here for any cellular, hyaline appendage without consideration to its origin or position on the spore.

Anopodium Lundq. n.gen.

Derivation: Greek: *ano-*, above, turned upwards; *podium* from *pous*, foot, referring to the apical pedicel of the spore.

Gender: neuter.

Type species: *Anopodium ampullaceum* Lundq.

Saprophyticae, fimicolae. Perithecia sine stromate, glabra vel pilosa, membranacea. Paraphyses filiformes. Asci unitunicati, annulo apicali non incrassato, iodo non caerulescente. Sporae initio hyalinae, unicellulares, parte basali globosa, parte superiore cylindracea, demum bicellulares: cellula inferior brunnea, incrassata, ellipsoidea vel irregulariter ellipsoidea, cellula superior (=pedicellus) hyalina, cylindracea vel claviformis; porus germinalis solitarius, basalis.

Saprophytic, fimicolous. **Perithecia** non-stromatic, glabrous or hairy, membranaceous, light-coloured, except for the dark neck. **Paraphyses** filiform. **Asci** unitunicate, with an apical invagination and a hardly visible apical ring not coloured blue by iodine. **Spores** at first hyaline, one-celled, consisting of a spherical body with an apical cylindrical part, then two-celled: the lower cell swelling to an ellipsoid or inaequilateral form, brown, the upper cell (=pedicel) cylindrical or claviform, remaining hyaline; germ pore single, basal.

Key to the species

Perithecia hairy .... *A. ampullaceum*
Perithecia glabrous
  Spores 28—32 μ long, pedicel 12—15 μ long .... *A. epile*
  Spores 30—36 μ long, pedicel about 24 μ long (measurement of the pedicel based on one large spore, see p. 360) .... *Pleurage dagobertii*

Anopodium ampullaceum Lundq. n.sp.

Derivation: Latin: *ampulla*, small bottle, referring to the inflated tips of the perithecial hairs.

Perithecia 410—530×335—430 μ, sparsa, semiimmersa, pyriformia, sursum pilis rigidis, brunneis, septatis, 40—120×4 μ obtecta, cellula apicali 6 μ lata, incrassata, ampullacea, hyalina; peridium membranaceum, pellucidum, flavescens, cellulis angulatis 5—18 μ diam. Asci 200—240×25—32 μ, 8-spori, claviformes. Sporae initio ± uniseriatae, demum biseriatae, bicellulares: cellula inferior ellipsoidea, paullo inaequilateralis, 27—32×16—19 μ, pedicellus ± cylindraceus, 15—18×2,5—3 μ; porus germinalis circ. 2,5 μ diam.; sporae gelatino carentes.

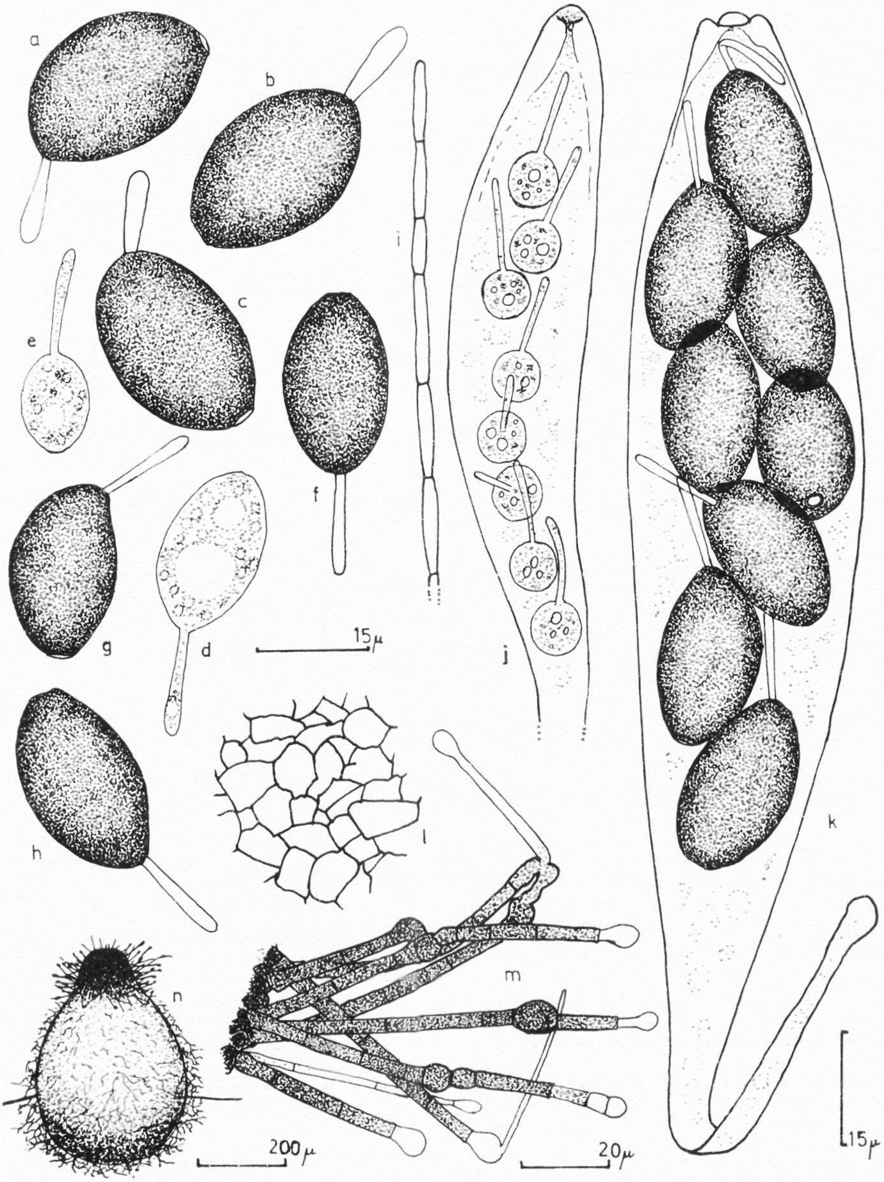

Fig. 1. *a—d. Anopodium epile. e—n. A. ampullaceum. a—c, f—h.* Ripe spores seen from different angles. *a, c, g, h.* Spores in "lateral" view. *b, f.* Spores in "front" view. *e, d.* Immature spores. *i.* Paraphysis. *j.* Ascus with immature spores. *k.* Ascus with mature spores. *l.* Part of the peridium in horizontal view. *m.* Rigid hairs from the neck of the perithecium. *n.* Perithecium.

Perithecia 410—500×335—430 μ, scattered, semi-immersed, pyriform to globose with a short neck, light-coloured, covered below with brown or hyaline, ramified, anastomosing hyphae, and above with rigid, light brown, septate, occasionally anastomosing hairs, 40—120×4 μ, with 6 μ-broad, hyaline, swollen tips, sometimes also with intercalary brown swellings; peridium membranaceous, transparent, yellowish (except in the dark neck), composed of angular, thin-walled cells, 5—18 μ in diam. **Paraphyses** 4—5 μ broad. **Asci** 200—240×25—32 μ, 8-spored, claviform, tapering above to a narrowly rounded apex, and below to a moderately long stipe. **Spores** at first ± uniseriate, hyaline, one-celled, then biseriate, two-celled: the lower cell ranging through olivaceous to dark brown, swelling, ellipsoid, slightly inaequilateral, 27—32×16—19 μ, with a rounded apex and a truncate base; the pedicel 15—18×2.5—3 μ, remaining ± cylindrical and hyaline, in "lateral" view somewhat excentrically attached and pointing askew; germ pore circ. 2.5—2.8 μ in diam.; no gelatinous equipment.

Sweden: Västergötland: Brandstorp parish, 3 km W. of Brandstorp in pine forest. Developed on fresh hare dung (*Lepus timidus*) after two weeks in moist chamber in Uppsala together with *Podospora appendiculata, Sporormia leporina,* and *S. splendens.* 5.VI.1960, Lundqvist 2371 d, **typus** (UPS).

A. ampullaceum is a highly characteristic species owing to the inflated tips of the perithecial hairs, a property which among coprophilous Pyrenomycetes is hitherto known only in *Podospora inflatula* Cain.

Isotypes will be distributed to IMI (Kew), PC (Paris), and TRTC (Toronto).

Anopodium epile Lundq. n.sp.

Derivation: Latin: *e-,* without; *pilus,* hair, referring to the glabrous perithecia.

Perithecium 530×385 μ, pyriforme, glabrum; peridium membranaceum, pellucidum, flavescens. Asci 170—230×30—40 μ, 8-spori, claviformes. Sporae biseriatae, brunneae, 28—32×16—21 μ (pars basalis); pedicellus claviformis, 12—15×3—3,8 μ; sporae gelatino carentes.

Ab *Anopodio ampullaceo* distat: peritheciis glabris, sporis crassioribus, pedicello claviformi, breviore, et a *Pleurage dagobertii*: perithecii minoribus, ascis brevioribus, sporis minoribus, pedicello breviore, angustiore.

This species differs from *A. ampullaceum* by its glabrous perithecia, broader asci, and broader spores with a shorter, broader, distinctly claviform pedicel. The very young, hyaline spores are distichously arranged, contrary to the latter species, where they lie more or less in one series. This last distinction may, however, vanish when more material is studied. *A. epile* is distinguished from *Pleurage dagobertii* by its smaller perithecia, shorter asci, and smaller spores with a smaller pedicel.

Sweden: Lappland: Torne Lappmark: 30 km W.N.W. of Abisko near the Norwegian border on the N. slope of Mt. Liutatjårro. Developed on lemming dung (*Lemmus lemmus*) after three weeks in moist chamber in Uppsala together with i.a. *Coniochaeta philocoproides, Podospora tetraspora,* and *Sporormia bipartis*. 22.IX.1960, leg. G. Sandberg, **typus** (UPS).

This collection consists of a single specimen only, so the measurements of the perithecium do not give any variation in perithecium size. The measurements given for ascus and spore size might also be too low.

Pleurage dagobertii C. Moreau

Encycl. Mycol. 25: 245, 317, fig. 31 f, 39 d, e, 59, 1953. (Without a Latin diagnosis.)

Perithecia 600—800×400—600 μ, pyriform, glabrous, yellowish brown with a short, dark neck. **Paraphyses** ? **Asci** 250—300×30—45 μ, 8-spored, claviform with an apical invagination and a stipe of medium length. **Spores** distichous, at first hyaline, one-celled, consisting of a globose body and an apical, cylindrical part, then two-celled: the lower cell swelling, brown, ellipsoid, 30—36×16—21 μ, the pedicel c. 24×5 μ or smaller (see p. 360), hyaline, claviform; germ pore single, basal; no gelatinous equipment.

France: Oise: Montmorency Forest, on rabbit dung. Leg. C. Moreau. Type non-existing.

Several of the characters of *P. dagobertii* are not described in Moreau's incomplete diagnosis but are scattered in the text of his large work. The description above is based on the original diagnosis, although enlarged and changed to fit the formula of the other two specific descriptions given here. I have not seen any material of *P. dagobertii,* and therefore have not been able to work out the description in all details.

At the base of the perithecial neck of *P. dagobertii* there are said to be black tubercles (arranged in rows) of similar kind to those of *P. decipiens* (Wint. ex Fuck.) O.K. (ibid. p. 153, 155). This is somewhat contradicted by Moreau's fig. 31 f, showing a portion of the peridium in question. It has black, thick cell walls that seem to protrude slightly from the peridium surface, but has no real tubercles as in *P. decipiens*. In *A. ampullaceum* and *A. epile* the peridium cells are thick-walled just below the neck, and in the neck the whole peridium is black and opaque. In this respect all three species apparently agree.

Paraphyses probably exist, although they are not mentioned. The asci are called long-stipitate, having a stipe of about one third of the ascus length (sporidial part 160—200 μ, ibid. p. 167). It is perhaps a matter of taste, but in comparison, for instance, with many *Podospora* species the ascus stipes in *P. dagobertii* cannot be designated as long.

Nowhere is it stated that the spores of *P. dagobertii* are inaequilateral. In Moreau's drawing of the spores (fig. 59) they are ellipsoid, but if there is an asymmetry it could have been overlooked. The very young spores are biseriate as in *A. epile*. The mature spores seem to vary greatly in size. The extreme variation 28—41×14—23 μ (ibid. p. 206) should be compared with the "normal" variation 30—36×16—21 μ. I do not know whether the very large or very small spores are to be considered as normal in size. No information is given on the size of the pedicel, but in fig. 59 f a spore is depicted, and from the scale one can calculate the spore head to be 39×21 μ, and the pedicel 23.6×5.3 μ. This large spore, of course, may not be representative.

It has already been pointed out that *P. dagobertii* is not validly published, and that no type material exists (C. Moreau in litt.). I have tried to get as much as possible out of the original descriptions and figures, and, of the various morphological characters discussed here, the size of the perithecia, asci, and spores, including the pedicel, are the most useful as specific characters. My conclusion is that *P. dagobertii* and *A. epile* certainly are not conspecific, although it cannot yet be completely proved. I think it is wise to postpone the validation of *P. dagobertii*. If more material is found and further studies prove this species to be identical with *A. epile,* then *epile* would be the correct name. If, on the other hand, my interpretation of *P. dagobertii* and *A. epile* as two distinct species turns out to be right, the epithet *dagobertii* could be validated and a neotype selected.

On the spore morphology

A new generic classification of the coprophilous, ascohymenial Pyrenomycetes will soon be needed. It is not within the scope of the present paper even to sketch such a classification, but I want to draw attention to a few morphological details which have been rather neglected as generic characters in the *Sordariaceae*: the ontogeny of the spores, the number of germ pores, the place of the germ pores (i.e. the orientation of the spores), the apical apparatus of the ascus, and the lack or occurrence of paraphyses. Only in recent years has some attention been paid to the significance of these characters in the family, especially by Cain, C. Moreau, and Fernier. Even more important is certainly the distinction between germ slits and germ pores. *Coniochaeta* is the only genus in the *Sordariaceae* having spores with a germ slit, and for that reason, i.a., it ought to be excluded from the *Sordariaceae* and perhaps form a family of its own. It is remarkable that, as late as the 1920's, fimicolous *Coniochaeta* species were considered to be members of *Sordaria*.

As regards the morphology of the hyaline spores, this was recognized and accurately described long ago in several species of the present genus *Bombardia* s.lat. (spores vermiform, filled with uniseriate globules, and tipped with gelatinous caudae). The explanation is undoubtedly that the hyaline spores are here physiologically mature and very conspicuous, and that the ultimate, pigmented stage in the spore development is rather rare and in some species never found. Most earlier mycologists, however, never cared to describe the unripe spores, except sometimes noticing that they were hyaline or olivaceous, and it was not until Chenentais (1919) made an important study of *Lasiosordaria* (incl. *Bombardia*), *Podospora,* and *Lasiosphaeria,* that the various shapes of the hyaline spores were given a taxonomic value as generic or subgeneric characters. Chenantais regarded the vermiform, or cylindrical, hyaline *Lasiospaeria* spore as an ancestor of the spore types in *Lasiosordaria, Podospora,* and many other genera. His idea has not gained general acknowledgement, and some authors consider the evolution to have taken the opposite direction, i.e. the *Lasiosphaeria* spore thus in reality being an advanced type, becoming mature in a persisting, juvenile state. Several of Chenantais's conclusions are undoubtedly antiquated today, but in certain respects I agree with him. A detailed discussion of these intricate problems cannot be included here (see also p. 363).

In the large genus *Podospora* (*Pleurage*), as it is circumscribed today, there are many different kinds of unripe spores. Spores without pedicel are ellipsoid or fusiform in their hyaline state. Pedicellate spores, on the other hand, may first be cylindrical, then claviform. The cylindrical stage may be lacking or well developed, even long and vermiform as in *P. decipiens* and *P. pleiospora.* The claviform spores have usually a rounded apex, but in species of the *P. curvula* group the apex is conical, and the whole spore is in fact more or less fusiform with its broadest part above the middle. In some species the hyaline spores are dumbbell shaped. Other characters of importance in the spore ontogeny of *Podospora* are colour (olivaceous, yellow), plasma granulations (small or big globules), and how soon a septum develops between the spore head and the pedicel.

Several species will certainly be segregated from *Podospora* into other genera, some of which are not yet described, and it is my firm conviction that spore ontogeny and ascocarp development, as well as the other characters mentioned in the beginning of this chapter must then be taken into consideration. This development has already started. Fernier established 1954 the new genus *Pleurosordaria* (unfortunately not validly published) based on *Podospora brassicae* (Klotzsch ex Berk. in Hook.) Wint. in Rabh., a species having non-pedicellate spores with two gelatinous caudae and two germ pores. The strange *Podospora zygospora* (Speg.) Niessl, the spores of which have an extremely long, intercalary "pedicel", was by Boedijn 1962 placed in the new genus *Zygopleurage*. Some more examples could also be given.

The establishment of *Anopodium* is a link in this new taxonomic arrangement. The genus is characterized especially by two spore qualities: the peculiar "lollipop" shape of the immature spores, and the apical pedicel. Both characters are unique and not encountered previously in the *Sordariaceae*. All three species also lack gelatinous equipment on the spores, but it is very doubtful whether this is a generic character. In *Sordaria arctica* Cain, for instance, the spores lack a gelatinous sheath, and yet it is a true *Sordaria*. The spores of *Podospora unicaudata* (C. & M. Moreau ex G. Smith) Cain lack gelatinous caudae, and nevertheless it seems to be a real *Podospora*. The absence or occurrence of such gelatinous equipment is thus often a phenomenon on the species level only, and this may also be the case in *Anopodium*. In an analogous way the claviform shape of the asci in *Anopodium* is perhaps not typical of the genus.

A character worth observing is that the pedicel is separated from the spore head by a septum just previous to the pigmenting of the spore wall. When the spore head is olivaceous the pedicel is still full of plasma, but in quite mature spores the plasma of the pedicel has more or less disappeared.

Relationships

Concerning the spore orientation in Anopodium I have avoided designating the spores as 'reversed', as did Moreau when he described *Pleurage dagobertii,* because such a formulation indicates a taxonomic or rather phylogenetic point of view that I do not maintain. If *Anopodium* really has evolved from *Podospora,* one could of course say that the *Anopodium* spore is nothing but a reversed *Podospora* spore. If all spores in all asci in some *Podospora* species would turn around, and this phenomenon could be genetically fixed, then the first step would have been taken towards the *Anopodium* spore type.

However, I find no support for such an interpretation of the origin of *Anopodium.* One could in fact for the same reason vindicate the opposite theory, viz. that *Podospora* has evolved from *Anopodium.* According to both interpretations *Anopodium* and *Podospora* are very closely related genera, and in the *Anopodium* spore the pedicel thus must be homologous to the pedicel of the *Podospora* spore.

As a principle I can accept the spore reversal theory, and I have even used it to explain the special spore orientation found in *Fimetariella* (Lundqvist 1964). There is, however, a third and in my opinion a more probable explanation of the apical position of the pedicel in the Anopodium spores, viz. that this genus and *Podospora* have evolved independently of each other but from the same ancestor. I mention again Chenantais's idea that the origin of i.a. *Podospora* should be sought in *Lasiosphaeria* ("Les *Lasiosphaeria* marquent le premier stade des Sordariées." Ibid. p. 80), or, more cautiously expressed: in a taxon close to *Lasiosphaeria* and with a similar kind of spores, i.e. long, cylindrical or vermiform, hyaline and originally non-septate. Thus, in *Podospora* and *Bombardia* s.lat. the upper part of the spore has become swollen and pigmented at maturity. In *Zygopleurage* the hyaline, young spore is very long and vermiform, and at maturity both apex and base swell and turn brown, these terminal cells linked by the undifferentiated "pedicel". I think *Zygopleurage* too has evolved from a taxon in the vicinity of *Lasiosphaeria.*

With these two spore types in mind — one with a basal pedicel, the other with an intercalary "pedicel" — it is quite natural, phylogenetically speaking, to accept that the basal part of such a cylindrical, hyaline spore can also become inflated and pigmented at maturity, i.e. an apical pedicel has evolved as in *Anopodium.* As a consequence of this theory the pedicel of the *Anopodium* spore is not homologous to the pedicel of the *Podospora* spore, but to the brown spore head.

Summary

The new, Pyrenomycete genus *Anopodium* Lundq. n.gen. (fam. *Sordariaceae*) is described, containing three fimicolous species: *A. ampullaceum* Lundq. n.sp. (type species), *A. epile* Lundq. n.sp., and *Pleurage dagobertii* C. Moreau. The first has been found on blue hare dung (*Lepus timidus*) from Brandstorp in Västergötland, Sweden, the second on lemming dung (*Lemmus lemmus*) from Mt. Liutatjårro in Torne Lappmark, Swedish Lapland, and the third on rabbit dung from Montmorency Forest in Oise, France. *P. dagobertii* has not been validly published, nor does any type material exist. The present author has therefore found it best to postpone the validation of the epithet until the species has been refound and a neotype selected. A key to all three species is given.

Anopodium deviates from all other members of the *Sordariaceae* by two spore characters: the pedicel of the spore has an apical position, and the very immature spore is composed of a spherical body with an apical, cylindrical part, i.e. the future pedicel or primary appendage. In all three species the spores lack gelatinous equipment, but this is perhaps not a generic character. Other typical features in the genus are the occurrence of paraphyses, and asci with an apical invagination and a non-thickened apical ring.

The spore morphology is discussed, and special importance is given to the spore ontogeny, which is seen in relation to the phylogeny of the genus. Comparisons are made with *Podospora* and *Zygopleurage,* and it is the author's opinion that these three genera have evolved independently of each other from a taxon closely related to *Lasiosphaeria* or directly from this genus in a wide sense. The original spore type is thus hyaline, cylindrical or vermiform, nonseptate. According to this interpretation the *Anopodium* spore is not to be regarded as a reversed *Podospora* spore.

Acknowledgements

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Two New Species of Scrophularia from East Afghanistan

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Abstract

Scrophularia elegantissima Rech. fil. et Wendelbo (sect. *Tomiophyllum*) from the province of Ghazni and *S. landroveri* Wendelbo (sect. *Scrophularia*) from the province of Parvan are described.

During a stay in Vienna in February 1964 the author did some preparatory work on the family *Scrophulariaceae* for K. H. Rechinger's "Flora iranica" (comprising Afghanistan and Persia). When the material of the 1962 expeditions of Rechinger and of Hedge and Wendelbo was worked through, the two new species of *Scrophularia* described below came to light. The material of this family previously known from Afghanistan was treated by Rechinger in Symbolae afghanicae IV. (1958.)

I am much indebted to Dr. Rechinger for so kindly granting me all facilities during my work in Vienna.

Scrophularia elegantissima Rech. f. et Wendelbo sp. nov. (fig. 1).

Sect. *Tomiophyllum* Benth., subsect. *Lucidae* Stiefelh.

Perennis stricte erecta ramosissima subglabra. *Caulis* ad 75 cm altus, basis ad 5 mm diam., a basi fere ramosus, ramis ascendentibus strictis tenuibus. *Folia* longa petiolo incluso usque ad 40 mm, usque ad 5 mm lata, linearia vel lineari—elliptica, apice acuta usque acuminata et mucronulata, sessilia vel sensim in petiolum brevem latiusculum attenuata, margine integra vel regulariter sed remote denticulata. *Inflorescentia* principalis $^1/_2$—$^2/_5$ caulis occupans, e dichasiis lateralibus dispersis composita; dichasia e ramulis mono- rarius dichasialibus 1—4(—6) floris glandulis minutis capitatis obsitis composita; rami inferiores in inflorescentiam angustam paucifloram exeuntes. *Bracteae*

Fig. 1. *Scrophularia elegantissima* Rech. fil. et Wendelbo, sp. nov. a. Habit, $\times {}^{3}/_{7}$; b. Leaves, nat. s. c. Calyx compressed, from below, ×3. d. Corolla dissected, ×3. e. Ovary with style, ×3. — Miranda Bødtker del.

usque ad 10 mm longae, lineares vel lineari-subulatae, acutae. *Pedunculi* dichasiorum usque ad 15 mm longi, sensim decrescentes, ramulis monochasialibus usque ad 25 mm longis. *Bracteolae* usque ad 4 mm longae, lineari-subulatae. *Pedicelli* usque ad 1 mm longi, minute capitato-glandulosi. *Calyx* c. 3.5 mm longus, cylindrico-campanulatus, fere usque ad basin in lobos late ovatos, late hyaline-marginatos, acuminatos apice recurvos divisus. *Corolla* c. 5.5 mm longa, cylindrico-urceolata, pallide flava, labio superiore projecto, bilobo; labium inferius c. 1.5 mm longum, ligulatum, crenulatum, lobi laterales c. 1.2 mm longi, c. 2 mm lati, oblique transverse ovati, crenulati, lobi superiores c. 2.2 mm lati, suborbiculati, crenulati. *Stamina* 4; antherae c. 1 mm longae; filamenta 3.5 mm longa, minute glandulosa. *Staminodium* 2.5 mm longum, parte adnata 1.5 mm longa, parte libera triangulato-obovata, crenulata. *Stylus* c. 3.5 mm longus, filiformis. *Ovarium* late obovoideum, in stylum attenuatum. *Capsula* et semina non visa. Floret mense Junio—Julio.

Afghanistan. Ghazni: Loman (Lomar) inter Qurabagh et Sang-i-Masha, ca. 33°15′N, 67°30′E, 2400 m, 30.VI.1962 (Rechinger 17424 Holotypus W, isot. BG); NW Ghazni c. 33°50′N, 68°20′E, c. 2300 m, 3.VII.1962 (Rechinger 17810 W); distr. Jaghuri in jugo Kotal-e Ketschru NW Sang-i Másha, c. 33°20′N, 67°00′E, substr. granit, 2880 m, 2.VII.1962 (Rechinger 17534 W).

S. elegantissima apparently occupies a somewhat isolated position among the species of sect. *Tomiophyllum* subsect. *Lucidae*. It belongs to the group of perennial species with the staminode dilated towards the apex. Following Stiefelhagen's key (1910) one will arrive somewhere near *S. frigida* Boiss. *S. elegantissima* is distinguished from the other species of the group by the tall stem with alternate or subopposite narrow, denticulate leaves, and especially by the acuminate, broadly hyaline-margined calyx lobes with recurved tips as well as the yellow colour of the corolla.

Scrophularia landroveri Wendelbo, sp. nov. (fig. 2).

Sect. *Scrophularia*.

Perennis, tota planta canescenti-viridis, pubescens et glandulosa. *Radix* ignota, collo ad 1 cm lato, elongato, squamis vel residuis squamarum c. 5 mm longis comoso. *Caules* 1—2, 8—25 cm alti, stricte erecti, prope basin foliosi, minute pubescentes. *Folia* opposita, prope basin aggregata; lamina 1.5—4.5 cm longa, 0.8—2.2 cm lata, anguste elliptica usque obovata, obtusa usque subacuta, margine integra usque aliquantum undulata, nervis primariis paribus 4—5 distinctis, subtus dense patule pubescentia, pilis c. 0.3 mm longis applanatis, saepe globula minutissima terminatis; petiolus circiter dimidiam laminam aequans, anguste alatus. *Inflorescentia* ineunte anthesis subcapitata demum elongata subracemosa, usque 14 cm longa, 1—1.5 cm lata, glandulosa; flores solitarii vel in dichasia triflora disposita, rarius 2. *Bracteae* et bracteolae pedunculos et pedicellos aequantes vel iis breviores, subulatae. *Pedunculi* 1—3 mm longi. *Pedicelli* usque ad 6 mm longi. *Calyx* c. 3.5 mm longus, fere

Fig. 2. *Scrophularia landroveri* Wendelbo, sp. nov. a, b. Habit, ×2/3. c. Flower, ×5. d. Calyx compressed, from below, ×5. e. Corolla dissected, ×5. f. Ovary with style, ×5. — Miranda Bødtker del.

usque ad basin in lobos 5 divisus; lobi ligulati, anguste hyaline marginati, extus glandulosi, intus glabri. *Corolla* 4.5 mm longa, inflata, subglobosa, viridis, hyaline marginata, 5-loba; lobus inferior c. 1 mm longus, ligulatus, apice reflexus; lobi laterales c. 1.5 mm lati. *Stamina* 4, exserta; antherae c. 1.3 mm longae; filamenta c. 5.5 mm longa, glabra. *Staminodium* nullum. *Ovarium* late ovoideum, acuminatum, glandulosum. *Stylus* c. 5 mm longus, longe exsertus, tenuis, glaber; stigma subcapitatum. *Capsula* non visa, juvenilis ut videtur acuminata, calyce alignante increscente cincta. *Semina* non visa. Floret mense Maio.

Afghanistan. Parvan: east side of Shibar pass near summit, 2600 m, 20 May 1962 (Hedge et Wendelbo W. 3326, holotype BG, isotype E).

Scrophularia landroveri is named in honour of our trusty Landrover that suffered so much in the cause of Botany during our collecting in Afghanistan. Cars of this type have made the collecting in the vast — often more or less roadless — areas of the Iranian highlands much easier, and thus have helped to promote the knowledge of the flora of the region.

The new species is inconspicuous due to the greyish green colours of all its parts — a colour it shares with the Landrover. The leaves are thickish with rather indistinct nerves, but held against strong light they show a reduced anastomosing nervation. This indicates the section *Scrophularia* (in most works called sect. *Anastomosantes* Stiefelh.) although *S. landroveri* must be a rather aberrant member. The species coming closest to it may be *S. koeiei* Rech. fil. (1958: 101, fig. 38) from NW. Afghanistan, and *S. nikitinii* Gorschkova (1954: 333) from Badhys in Turcomenia. *S. landroveri* shares with both these species the very narrow inflorescence, the glandular, inflated—urceolate, greenish corolla and the absence of the staminode. From both species it differs by being smaller, and by the entire, densely pubescent subbasal leaves. From *S. koeiei* it also differs in the exserted anthers.

In addition to the two localities known for *S. koeiei* (Rechinger 1958: 103) there may now be added a third one: 30 km west of Maymana (Hedge and Wendelbo 3634). All three localities are in the NW. Afghanistan.

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The Genus Euchlora Eckl. & Zeyh. as Distinguished from Lotononis Eckl. & Zeyh.

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Abstract

The monotypic genus known as *Euchlora* Eckl. & Zeyh. is critically examined, nomenclaturally clarified, and an account of its distribution and previous treatment is given. Special attention has been paid to the morphology of the leaves, which are generally simple but in some aberrant samples lobed or partly differentiated towards the trifoliolate condition. In one particular collection certain leaves were found to be not only trifoliolate and petiolate but also supplied with stipules, whereas most leaves are of the common simple type; various transitional types were also found. The leaves and other parts, e.g., the pods, of *Euchlora* are discussed in relation to those in certain species of *Lotononis,* and the conclusion is that *Euchlora* should be incorporated in the latter genus. The name of the single species will be *Lotononis serpens* (E. Mey.) comb. nov.

Historical Notes and Synonymy

The species known in recent literature as *Euchlora hirsuta* first appeared under *Ononis* (as *O. hirsuta*) in Thunberg 1800, p. 129. It was described later in Thunberg's "Flora Capensis" (1823, p. 585) in the following words.

> "*Herba* tota hirsutissima villo subferrugineo. *Caulis* herbaceus, articulatus, ramosus. *Rami* alterni, filiformes, angulati, flexuoso-erecti, rarius ramulosi, palmares *ramulis* brevibus. *Folia* alternia, sessilia, integra, imbricato-patentia, unguicularia. *Flores* racemosi, brevissime pedunculati. *Racemus* terminalis, ovatus, cernuus, pollicaris."

The specimens cited were collected "in Bockland" and "prope Cap juxta Leeuwestaart". One of the specimens in Uppsala (the lectotype) bears the latter locality statement. The entire leaf margins did not seem an important difference from the European *Ononis* species to Thunberg, because he included in this genus also other species with entire leaf margins. Some of these species are now treated in *Aspalathus,* e.g., *Ononis capillaris* (=*A. bracteata*), *O. fasciculata* (=*A. fasciculata*), *O. lagopus* (=*A. heterophylla*), and *O. spicata* (=*A. sericea*). A feature apparently not studied by Thunberg in the species mentioned was the staminal tube, which is closed in *Ononis* proper, but has a split on the adaxial side in *Aspalathus* and the plant known as *Euchlora.*

In 1832 Meyer described the species here concerned as *Crotalaria serpens* from an Ecklon plant collected on the sand flats near "Salzrivier" not far from Cape Town. Meyer incorrectly cited *Ononis villosa* Thunb. (? instead of *O. hirsuta* Thunb.) as a synonym of the species.

In the beginning of 1836 the species was described by Ecklon and Zeyher (p. 171) in a new genus, *Euchlora.* The name of the species, *E. serpens,* is to be regarded as a new combination of Meyer's *Crotalaria serpens* under *Euchlora.* In the generic diagnosis the "bifid" appearance of the calyx was especially pointed out, which was hardly justified. The absence of bracteoles was observed ("bractea 1 setacea pedicelli basi", l.c.). Meyer's *Crotalaria serpens* as well as Thunberg's *Ononis hirsuta* were cited as synonyms.

Later in 1836 Meyer described the same species in another genus, *Microtropis.* The material used by him was collected by Drège. The legume was described as turgid and the branches were said to resemble those of *Corydalis fabacea* in having small scale-like leaves on the basal parts. The single species was called *M. hirsuta* and, as *Ononis hirsuta* Thunb. was cited as a synonym, the name should be regarded as a new combination of the latter specific name with the new genus.

Thus the legitimate combination of *Euchlora,* the oldest generic name, with the oldest specific name (*Ononis*) *hirsuta* remained to be made. This was done as late as in 1917 (by Druce). Already Walpers (1839, p. 505) observed that *Euchlora serpens* and *Microtropis hirsuta* were conspecific.

In 1843 Bentham (p. 470) remarked that *Euchlora* had "the calyx and foliage of *Rafnia,* the habit, the hairs, corolla and pod of *Lotononis*".

In "Flora Capensis" II (1862) and "The genera of South African plants" (1868) Harvey gave rather complete descriptions of the species.

However, the thick and woody underground caudex was still unknown, but the narrow glabrous basal parts of the branches were described.

The genus was described by Phillips in 1926 (p. 320) where it was also included in a key to the genera. The second edition of the same work (Phillips 1951) suffers from some mistakes in the key. In order to arrive at *Euchlora* (spelled "*Eurochloa*") the following features should be observed (l.c., p. 384): "staminal-tube not split to the base", "petals adnate to the staminal tube", and "keel without pockets". It is evident from the description in this paper that the first two features are incorrect and the last one at least doubtful.

In Hutchinson 1946, pp. 71 and 74 (figure), the thick woody underground caudex was mentioned for the first time in literature. "Here" (between Salt River and Kalabas Kraal) "we also gathered a remarkable Papilionaceous plant with prostrate stems arising from a huge woody tuber — *Euchlora hirsuta* (Thunb.) Druce".

The present study was incited by the observation that the leaves are not always simple, as had been thought previously. The writer happened to see a collection where the leaves are differentiated towards a trifoliolate condition. The rich fruit material in one collection (Barker no. 9476) also indicated a close connection with certain species of *Lotononis*.

The **synonymy on the generic level** of the species, which for reasons given below should be included in *Lotononis,* may be expressed as follows.

Ononis L. pro parte in Thunberg 1800, p. 129, and 1823, p. 585.

Crotalaria L. pro parte in Meyer 1832, p. 153.

Euchlora Eckl. & Zeyh. in Ecklon & Zeyher 1836, p. 171, Bentham 1843, p. 470, Harvey in Harvey & Sonder 1862, p. 38, Bentham & Hooker 1862—67, p. 475, Harvey 1868, p. 73, Taubert 1894, p. 220, Phillips 1926, p. 320, Adamson & Salter 1950, p. 465, Phillips 1951, p. 404, and Dahlgren 1963, p. 268.

Microtropis E. Mey. in Meyer 1836, p. 65.

Lotononis Eckl. & Zeyh. pro parte — at present.

The **synonymy on the specific level** is as follows.

Ononis hirsuta Thunb.; Thunberg 1800, p. 129, and 1823, p. 585; Ecklon & Zeyher 1836, p. 171 (as a synonym of *Euchlora serpens*); Meyer 1836, p. 65 (as a synonym of *Microtropis hirsuta*); Walpers 1839, p. 505 (as a synonym of *Euchlora serpens*). — *Microtropis hirsuta* (Thunb.) E. Mey.; Meyer 1836, p. 65. — "*Microtropis hirsuta* E. Mey." in Walpers 1839, p. 505, and Bentham 1843, p. 470 (as a synonym of *Euchlora serpens*). — *Euchlora hirsuta* (Thunb.) Druce: Druce 1917, p. 622; Hutchinson 1946, pp. 71, 74; Adamson & Salter

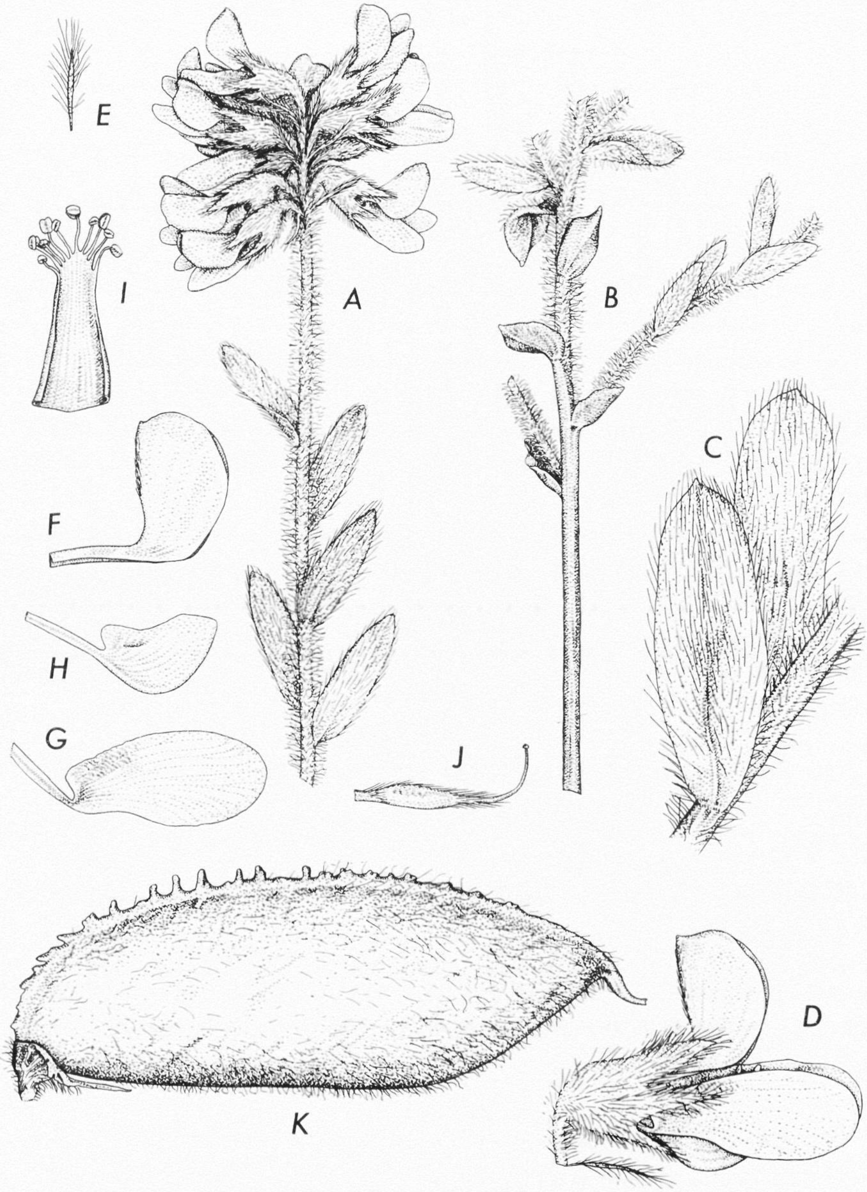

Fig. 1. *Lotononis serpens*; *A*—*B* and *D*—*J*: Winkler no. 119 from the Darling area; *C*: Schlechter no. 10912 from "Onder Bokkeveld"; *K*: Barker no. 9476 from the Clanwilliam Division. — *A*: Branch end with inflorescence. — *B*: Part of branch in the transitional region near the ground level. — *C*: Leaves. — *D*: Flower. — *E*: Bract. — *F*: Vexillum, side view. — *G*: Ala petal. — *H*: Carina petal. — *I*: Staminal sheath. — *J*: Pistil. — *K*: Pod. (*A*—*B* ×2; *C*—*K* ×4.)

1950, p. 465. — Orig. spec.: "Pone Leeuwestaart in Cap. b. spei, Thunberg" (UPS-THUNB, lectotype).

Crotalaria serpens E. Mey.; Meyer 1832, p. 153; Ecklon & Zeyher 1836, p. 171 (as a synonym of *Euchlora serpens*). — *Euchlora serpens* (E. Mey.) Eckl. & Zeyh.; Ecklon & Zeyher 1836, p. 171. — "*Euchlora serpens* Eckl. & Zeyh." in Walpers 1839, p. 505, Bentham 1843, p. 470, Harvey in Harvey & Sonder 1862, p. 39, Bolus & Wolley-Dod 1903, p. 251, Schlechter in Zahlbruckner 1905, p. 15, Phillips 1951, p. 404. — *Lotononis serpens* (E. Mey.) R. Dahlgr. comb. nov. (see below). — Orig. coll.: "Sandige Stellen unweit Salzrivier. Aug. 20—24." Ecklon (S, lectotype).

"*Rafnia axillaris*" auct. non Thunb.: Willdenow 1802, p. 951 (cf. Walpers 1839, p. 505).

"*Ononis villosa*" auct. non Thunb. in Meyer 1832, p. 153 (as a synonym of *Crotalaria serpens*). The name was probably a misprint for "*Ononis hirsuta* Thunb."

The oldest specific epithet of the species is "*hirsuta*" (Thunberg 1800), but when included in *Lotononis* this cannot be used as there has already been described a species named *Lotononis hirsuta* Schinz.

Instead the following **new combination** is proposed:

Lotononis serpens (E. Mey.) R. Dahlgr. comb. nov.

Basionym: *Crotalaria serpens* E. Mey. in Meyer 1832, p. 153. — The type is the Ecklon collection from near Salt River mentioned above.

Description

A low subherbaceous plant with an up to > 1 cm. thick underground caudex. Subterranean parts of the branches pale yellow—brown, glabrous, c. 1(—2) mm. thick and up to > 25 cm. long, horizontal, sparingly branched, with often transversely splitting outer layers ("articulate").

Subterranean leaves sparsely distributed, squamose, entire, usually triangular-ovate, semiamplexicaul, obtuse(—acute), up to c. 7 mm. long, partly hyaline or at least with ± hyaline margins, indistinctly veined except for a distinct midvein.

Underground branches continuing into ascending, up to c. 10—20 cm. high, often rather densely branched, sparsely or densely woolly *supraterranean branch systems*. Lowest *leaves* above the ground, especially on the main branches, simple, exstipulate, ovate or triangular-ovate, relatively short, obtuse(—acute), green (or brownish), sometimes partly hyaline, glabrous or almost glabrous. Other leaves usually exstipulate, usually simple, entire, varying from narrowly elliptic, oblong, or lanceolate to narrowly ovate or obovate, and from <2.5×c. 0.7 to >24× 7 mm. in size, obtuse or acute, woolly or long-sericeous (seldom almost villous) below, especially on the midvein, sparsely long-pubescent or almost glabrous above. Leaves on part of the branches occasionally trilobate (palmate) or with a distinct terminal leaflet and a lateral lobe on each side from the broad basal part; some leaves in one case even stipulate (one or two stipules), petiolate, and trifoliolate (see below).

Branches ending as subglobose—elongate, usually 6—20(—30)-florous *racemes*. Internode below the inflorescence usually 1.2—3.5(—4.5) cm. long, rather peduncle-like.

Flowers medium-sized. *Bract* simple, linear—subfiliform, usually 2—4 mm. long and <0.4 mm. broad, sometimes broadest near the apex, acuminate, weak and flexible, with long hairs on the tuberculate-undulate surface especially on the lower side and margins. *Pedicel* usually 1.0—2.2 mm. long, densely woolly. *Bracteoles* usually lacking, very seldom present on the lowest flower in a long raceme and then linear or subfiliform.

Calyx campanulate, c. 5—5.5 mm. long from base to lobe apices, villous or woolly-sericeous. Lobes usually (1.5—)1.8—3.0 mm. long, but upper two lobes separated by a sinus 2 mm. deep or less. Lowest lobe rather narrow, usually c. 0.6—0.8 mm. broad (at the base). Upper two lobes c. 1.4—1.8 mm. broad at the level of the upper sinus.

Petals almost glabrous, pale or light yellow or usually with some violet or mauve shades on the basal half of the vexillum and ala blades and sometimes on the carina. *Vexillum* blade broadly obovate, (3.8—) 4.6—6.0×5.0—7.0(—7.9) mm. large, with obtuse base, emarginate apex, and marginal parts on each side of the apex incurved. Midrib slightly sericeous on the back side. Claw (2.3—)2.7—3.7 mm. long, linear, rather straight, directed at right angles to the blade. *Ala* blades obliquely and usually narrowly (sometimes rather broadly) obovate, (5.6—) 6.0—7.5(—7.9)×2.5—3.8(—4.8) mm. large, glabrous, with rounded apex, and with some rows of rather irregular obliquely transverse folds on the upper basal parts. Lower margins usually slightly concave near the base. Claws 2.0—3.2 mm. long, free from the staminal sheath. *Carina* blades lunate, obtuse, usually 3.5—4.5(—4.7)×2.1—3.0 mm. large, glabrous, with a prominent basal upper ear and usually with (seldom without) a shallow basal bulge. Upper margins slightly convex on the apical and slightly concave on the basal half. Claws 2.1—3.0 mm. long, free from the staminal sheath.

Filaments forming an almost straight sheath split above to the very base on either side of the median adaxial stamen. The distal parts of the filaments, c. $^1/_4$—$^1/_5$ of the length (for the upper filaments more), free from each other and curved upwards. *Anthers* unequal, the longer ones about twice the length of the shorter.

Pistil with short thick stipe and lanceolate, 4—12-ovulate ovary long-sericeous on the base, otherwise glabrous. Stigma almost regular, capitate.

Pod (limited material seen) rather inflated, oblong-oblanceolate, about 20—21×8—9.5 mm. large (when seen from the side), yellowish-brown, striated or rather smooth, sparsely long-woolly, and with rigid, short, obtuse, tooth-like processes on the adaxial margin (fig. 1 K). *Seeds* reniform, slightly compressed, c. 6—6.5×5 mm. large, and (in the single collection studied) dark brown with black linear pattern.

Distribution and Collections

The distribution is western and ranges from the Cape Peninsula to Little Namaqualand. Of the marginal collections (see the list below) one record from "near Worcester" must be regarded as dubious as to the locality. For another sample, Bolus no. 6557, the record "Klipfontein" (in the northern part of Little Namaqualand, i.e., further north than any other record) must be regarded as slightly dubious, although not improbable. The leaves in this particular form are of extraordinary interest because of their rich differentiation.

A couple of collections deviating from the commoner forms in having lobate or subtrifoliolate leaves (see below) derive from the Calvinia Division. They are symbolized by open rings on the map.

The substrate is in several cases stated to be sand, but the information on habitat is poor in the herbarium material. In a couple of cases the species has been recorded from cultivated or formerly cultivated ground.

The vegetation in which the species takes part is the more arid types of the Cape fynbos or macchia but also apparently transitional types between the fynbos and the Karroo or succulent Karroo vegetation (cf. Acocks 1953). The presence of a thick woody caudex suggests that the narrower subherbaceous branches develop rapidly only under favourable conditions, notably after rains. Most flowering specimens derive from August—September, but some from July or October, and in one case, June.

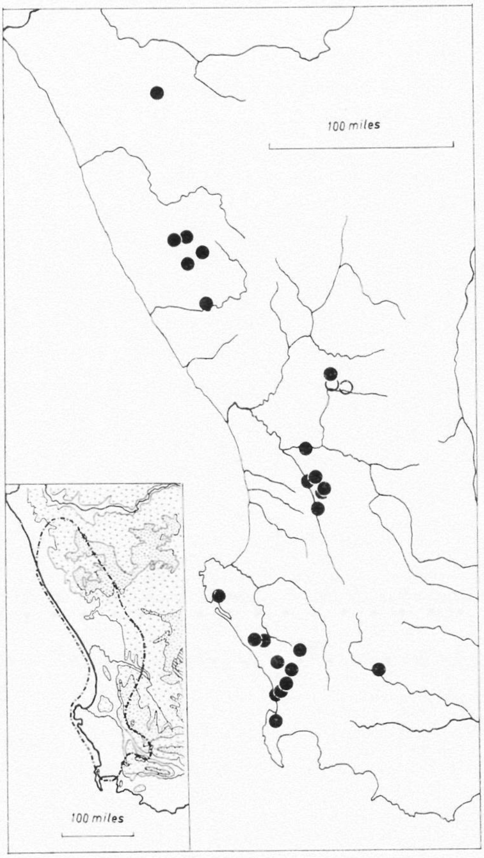

Fig. 2. Approximate distribution of *Lotononis serpens* (formerly *Euchlora*). The two open rings represent forms with trilobate leaves and leaves with a distinct terminal leaflet and two lateral lobes.

Collections

Forms with exclusively simple leaves (one exception).

Cape Town Div.: Pone Leeuwestaart. Thunberg (UPS).

Wynberg Div.: In arenosis humidis, Campground prope Rondebosch. 1892, Schlechter no. 1532 (BOL).

Bellville Div.: Sandy places nr. "Salzrivier". 1820—24, Ecklon ("*Crotalaria serpens mihi,* E. M.") (S). — Between Salt River and Kalabas Kraal, 11 miles from Cape Town towards Saldanha Bay. 1928, Hutchinson no. 163 (BM, BOL, K, PRE). — Melkbosch Rd. 1942, Compton no. 13438 (NBG). — Between "Paardeneiland", "Blauwberg", and "Tygerberg". Sandy flats below 500 ft. alt. Drège ("*Microtropis hirsuta* a") (K, S). — In arenosis planitiei capensis prope "Zoutrivier" . . . Ecklon & Zeyher no. 1246 p.p. (K, LD, PRE, S, SAM).

Malmesbury Div.: Kalabas Kraal. 1936, Garabedian, SAM no. 52215 (SAM). — Malmesbury. 1941, Bond no. 1045 (NBG). — Malmesbury rd.

15 miles out. 1938, Penfold (NBG). — NE. slopes of the S. prolongation of Dassenberg. 1933, Pillans no. 6857 (BOL). — In arenosis prope Darling; 100 ft. 1894, Schlechter no. 5343 (BM, BOL, K, S). — Darling Flora Reserve. 1956, Winkler no. 119 (NBG). — In "Zwartland". Ecklon & Zeyher no. 1246 p.p. (K, LD, PRE, S, SAM).

Hopefield Div.: Ad "Saldanhabay". Ecklon & Zeyher no. 1246 p.p. (K, LD, PRE, S, SAM).

Worcester Div.: Nr. Worcester (dubious statement). 1926, Leipoldt no. 4488 (BOL).

Clanwilliam Div.: Between Citrusdal and Clanwilliam, Nat. Rd. 1961, Barker no. 9476 (NBG). — Clanwilliam. 1895, Leipoldt no. 228 (SAM). — In lapidosis graminosis montium supra Wupperthal; 1,800 ped. 1897—99, Mac Owan nos. 1170 (BM) and 3368 (K, SAM). — In monte Koudeberg, Cederbergen, prope Wupperthal. 1897, H. Bolus no. 8968 (BOL). — Nr. Pakhuis. 1933, Leipoldt no. 20762 (BOL).

?Vanrhynsdorp Div.: Onderbokkeveld, Papelfontein; 2,200 ft. (?=Papekuilsfontein, c. 26 miles SE. of Vanrhynsdorp). 1897, Schlechter no. 10912 (BM, K, LD, PRE, S).

Calvinia Div.: 4 miles from Nieuwoudtville on the Loeriesfontein rd. 1930, Lavis, BOL no. 19637 (BOL).

Little Namaqualand Div.: "Namaland". Scully no. 4195 (PRE). — Between Garies and Bitterfontein. 1941, Leipoldt no. 3747 (BOL). — Brakdam. 1951, Johnson no. 195 (NBG). — Groot Vlei nr. Kamieskroon. 1937, Compton no. 6822 (NBG); 1945, Barker no. 3718 (NBG); 1945, Lewis no. 1317 (SAM); 1954, Barker no. 8404 (NBG). — Kamieskroon. 1941, Esterhuysen no. 5707 (BOL); 1942, Barker no. 1388 (NBG). — Old corn-field, Witsand, Khamiesberg. 1911, Pearson, P. Sladen Mem. Exp. no. 6565 (BOL, K). — In agris olim cultis prope Klipfontein; 3,100 ped. H. Bolus no. 6557, Herb. Norm. Austr. Afr. no. 438 (BM, BOL, K, SAM; on the leaves of this form: see below).

Forms with also lobate and digitate leaves on the younger branches.

Calvinia Div.: Between Nieuwoudtville and Oorlogs Kloof. 1941, Leipoldt no. 3746 (BOL). — 26 miles W. of Calvinia. 1953, Theron no. 1323 (BM, K, LD, PRE).

Morphological Observations

The Leaves in Lotononis serpens

These are exclusively simple, entire, sessile, and exstipulate in all forms except in three of the studied collections. The common appearance is seen in figure 1 A, B, and C. The leaves on the subterranean parts and on the parts in or close above the ground surface are relatively short, broad, and glabrous and have a semi-amplexicaul base and often hyaline margins, whereas most leaves on the parts above the ground are lanceolate or narrowly oblong-elliptic and clothed with 3-celled hairs,

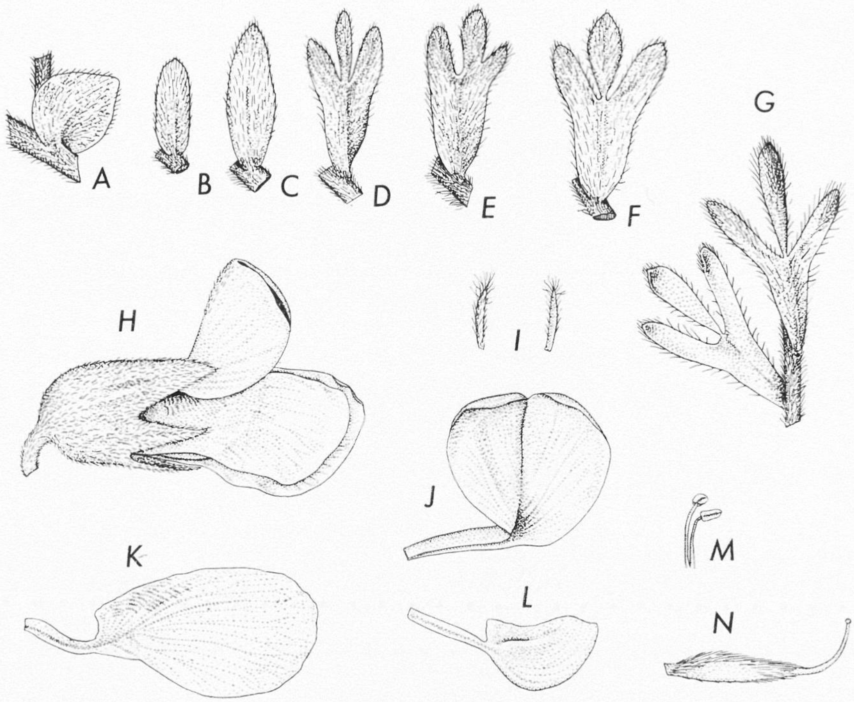

Fig. 3. *Lotononis serpens*; Theron no. 1323 from the Calvinia Division. — *A*: A basal leaf of the parts of a branch above the ground surface. — *B—G*: Some of the successive leaves on a lateral branchlet. — *H*: Flower. — *I*: Bract, lower and upper sides. — *J*: Vexillum. — *K*: Ala petal. — *L*: Carina petal. — *M*: Anthers. — *N*: Pistil. (All ×4.)

the apical cell of which is elongated into one long "arm" only. The stomata are considerably more numerous on the lower than on the upper side (cf. Cohn 1901, p. 544). The veins are not supplied with sclerenchyma strands (l.c.).

In two collections (Theron no. 1323, Leipoldt no. 3746) from the Calvinia Division the leaves on part of the branches deviate from the common type just described in being trilobate or in having a separate terminal leaflet and two elongate lobes, one on each side of the terminal leaflet. The lobes merge into the basal part of the leaf, which is not very different from the basal half in the common simple leaf type. This is seen in figures 3—4. The veins of the lateral elongate lobes emerge at the base of the terminal leaflet when this is distinct, not at the base of the leaf (cf. figs. 3 F, G, and 4 H, K). In the trilobate leaves

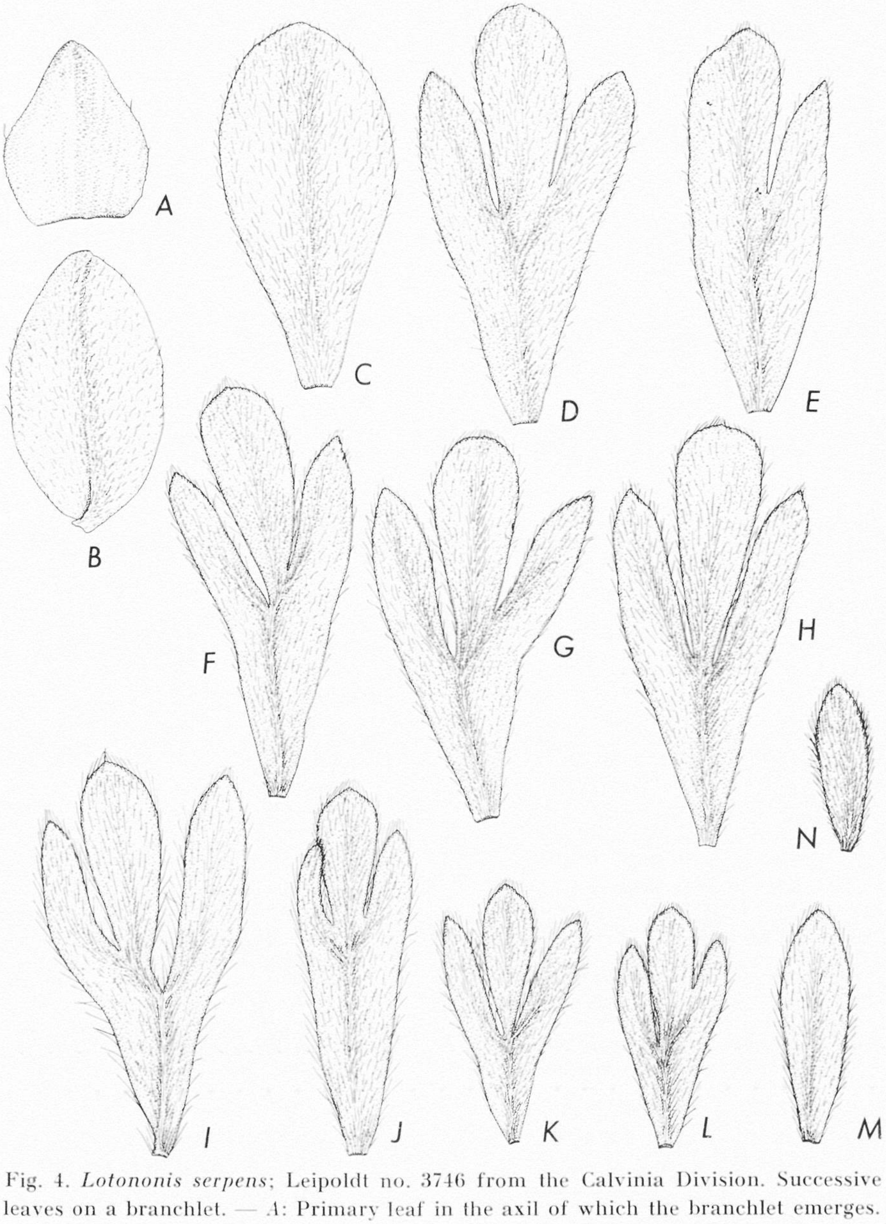

Fig. 4. *Lotononis serpens*; Leipoldt no. 3746 from the Calvinia Division. Successive leaves on a branchlet. — *A*: Primary leaf in the axil of which the branchlet emerges. — *B* The first, *C* the 4th, *D* the 5th, *E* the 6th, *F* the 8th, *G* the 9th, *H* the 10th, *I* the 13th, *J* the 19th, *K* the 22nd, *L* the 23rd, *M* the 24th, and *N* the 29th leaves from below. The 7th leaf resembled the 6th, the 12th, 15th, 16th, 17th, 20th, and 21st leaves resembled the 10th, the 11th and 18th leaves resembled the 13th, and the 25th, 26th, 27th, 28th, 30th, and all the following leaves were entire and like the 24th and 29th leaves. (All ×4.)

the veins sometimes branch off from the midvein at different levels (fig. 4 D, F, I). Stipules have not been found in these plants. The leaves vary gradually from the base to the tip of the branch. The lowest are simple, generally short and broad, and often subglabrous if the branch emerges near the ground. The following leaves are also simple but elongate and pubescent. Further types are bi- or usually trilobate, and these merge gradually into types where the terminal leaflet is clearly distinct (i.e., has a narrow base). The variation usually continues reversely towards the branch apex with lobate and finally entire elongate leaves. However, the variation is not altogether regular, which is seen in the figures.

Several of the successive leaves in one of the two collections are seen in figure 4, and a few leaves of a branch in the other collection are seen in figure 3 B—G. Besides the richer differentiation of the leaves in the two collections the pubescence — also on stem, pedicel, and calyx — is shorter, villous—short-woolly or sericeous, than in the common forms, where it is rather long woolly—sericeous. Otherwise no differences from the forms with exclusively simple leaves can be pointed out, and the variation, e.g., in floral parts falls entirely within the variation range of these forms. A distinction of the two collections as a separate subspecific taxon might be possible but has not been attempted here. One of the two collections (Leipoldt no. 3746) has considerably larger growth and leaves than the other, but this may very well be just a modification.

In another collection, Bolus no. 6557, recorded from “Klipfontein”, Little Namaqualand (if accurate, the northernmost locality of the species), the condition is as follows. Most leaves, and on some branch systems in the collection all the leaves, are simple and of exactly the same shape as in the common forms of the species. The pubescence is also long as in these. However, the variation in leaf shape on some of the branches is extraordinarily rich. The lowest leaves are simple. Some of the following ones may be parted on both or either side(s). The form of some leaves further up (fig. 5 E, F) is the same as in the Calvinia Division forms mentioned above. Some leaves may be even more differentiated, having three separate leaflets, in which case there is also a narrow distinct petiole. Another interesting feature is that one or two stipules are generally developed in these leaves (fig. 5 G, H, I, N, O), but stipules may also occur on leaves which are in other respects less differentiated (fig. 5 C, P). On the whole the differentiation of the leaves is much more irregular in this collection than

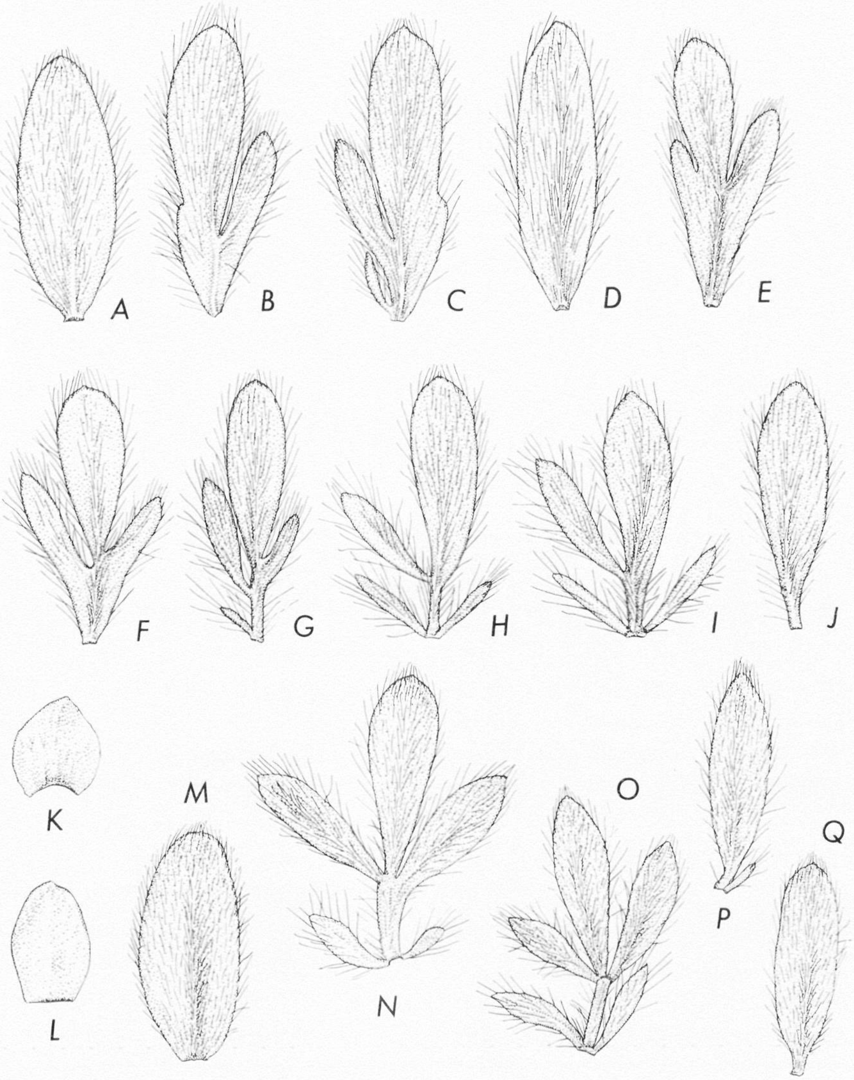

Fig. 5. *Lotononis serpens*; H. Bolus no. 6557 recorded from "Klipfontein", Little Namaqualand. — *A—J*: Leaflets from a lateral branchlet in the following order (lines and letters representing the successive leaves, the letters referring to the figures): —, —, —, *A*, —, —, *B*, —, —, *C*, *D*, —, *E*, *F*, *G*, *H*, *I*, *J*, —, —, etc. — *K—Q*: Some leaves from a young branchlet bearing an inflorescence (bud stage); *K*: The leaf in the axil of which the branchlet is situated; *L* the first leaf of the branchlet, *M* the 4th, *N* the approximate 10th, *O* the approximate 14th, *P* the approximate 20th, and *Q* the approximate 22nd (or the 2nd last) leaf of the branchlet. (All ×4.)

in the Calvinia Division forms described above, where the variation pattern appears more "stabilized".

The presence of stipulate, petiolate, and trifoliolate leaves in this species gives a new basis for a comparison with other species of *Lotononis* and contributes materially in overbridging the morphological gap hitherto imagined. We may look upon the "simple-leaved" condition as the effect of an inhibition of or rather a change in the differentiation. According to this view a regression may have occurred in isolated forms, viz., those last described. Another possibility is that these forms represent original types in relation to those with simple leaves. That the simple-leaved condition in this case is the original one does not seem probable judging from the condition in the subtribe *Crotalariinae* as a whole.

Morphological Comparison with Other Lotononis Species

The considerable underground caudex, apparently partly of stem but mainly of root character, found in *L. serpens* has its counterpart in other *Lotononis* species, e.g., *L. prostrata* (L.) Benth. and *L. corymbosa* (E. Mey.) Benth. The dominance or exclusive occurrence of simple leaves and the horizontal underground branch bases bearing simple, short, and glabrous leaves are still characters that distinguish *L. serpens* from the other species, but considering the sporadic occurrence of trifoliolate or partly trifoliolate-differentiated leaves the difference can be regarded as less significant.

The leaves in *Lotononis* otherwise vary considerably, but the commonest type is the trifoliolate with a canaliculate petiole and one or two stipules (cf. figs. 6 A and 7 B, C, E). The solitary (unilateral) stipules characteristic of many species represent an unsymmetrical condition, a morphological "crux" which deserves a special study. Extraordinary is the condition in *L. lupinifolia* (Boiss.) Benth. where the leaflets are 3—5 and also the stipules, present on only one side of the leaf base, vary from one to two or even three (fig. 7 A, B). However, this species is apparently not closely allied to *L. serpens*. The leaflets in some species are reduced to one only.

The flowers may be solitary or assembled in racemes or head-like clusters, and the bracts vary considerably in size and form, *L. serpens* falling entirely within the variation pattern of the genus. The upper calyx lobes in *L. serpens* are broader than the lower and the upper two ones are separated from each other by a shallower sinus (i.e., appearing partly "united") than the lower. A common condition in *Lotononis* is that the four upper lobes are more closely connected and separated by rather deep sinuses from the lowest lobe, but there are

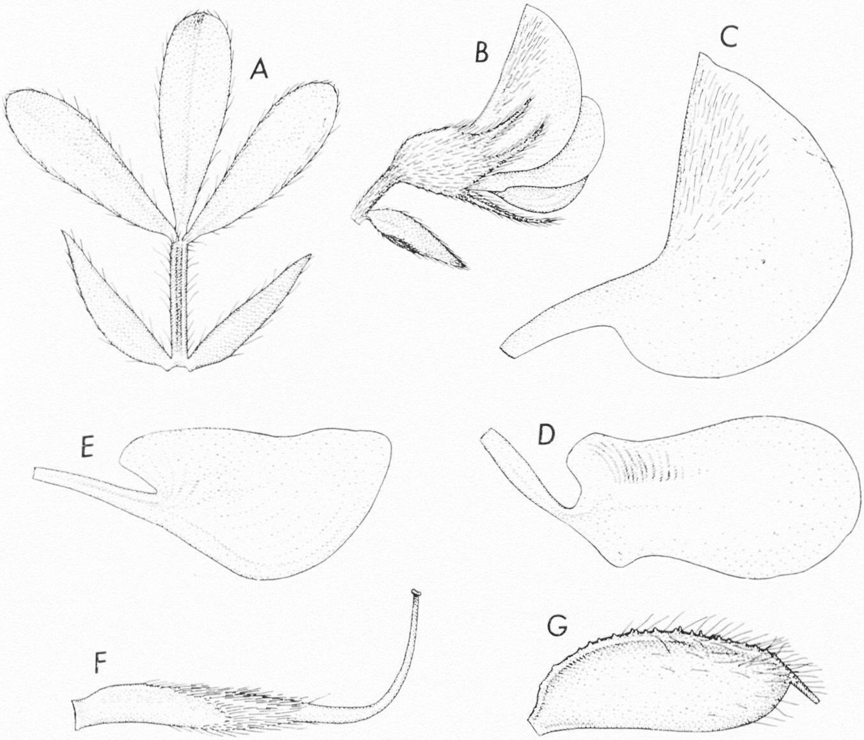

Fig. 6. *Lotononis peduncularis* (E. Mey.) Benth.: Sidey no. 2151, Cape Peninsula (*A—F*) and *L. involucrata* (L. fil.) Benth.: 1938, Wall, French Hoek Pass. (*G*). — *A*: Leaf. — *B*: Flower. — *C*: Vexillum. — *D*: Ala petal. — *E*: Carina petal. — *F*: Pistil. — *G*: Pod. (*B* ×2; *A*, *C—G* ×4.)

also species with a condition similar to that in *L. serpens,* and others where the lobes are separated by subequally deep sinuses. In petal colour and form there are no obvious differences between *L. serpens* and certain other species in the genus, although the claws are relatively long and the carina blades small in relation to the large ala blades. The stamens and pistil do not exhibit any differences, and the pod in *L. serpens* (fig. 1 K) is of a kind most typical of certain series of species in *Lotononis,* especially in the inflated form and the toothed adaxial amrgins. In figures 6 G and 7 D and F examples are given of pods in some species, showing the great similarity.

The "one-armed" hair type found in *L. serpens* occurs in the other *Lotononis* species mentioned in this article, *L. lupinifolia* excepted, and

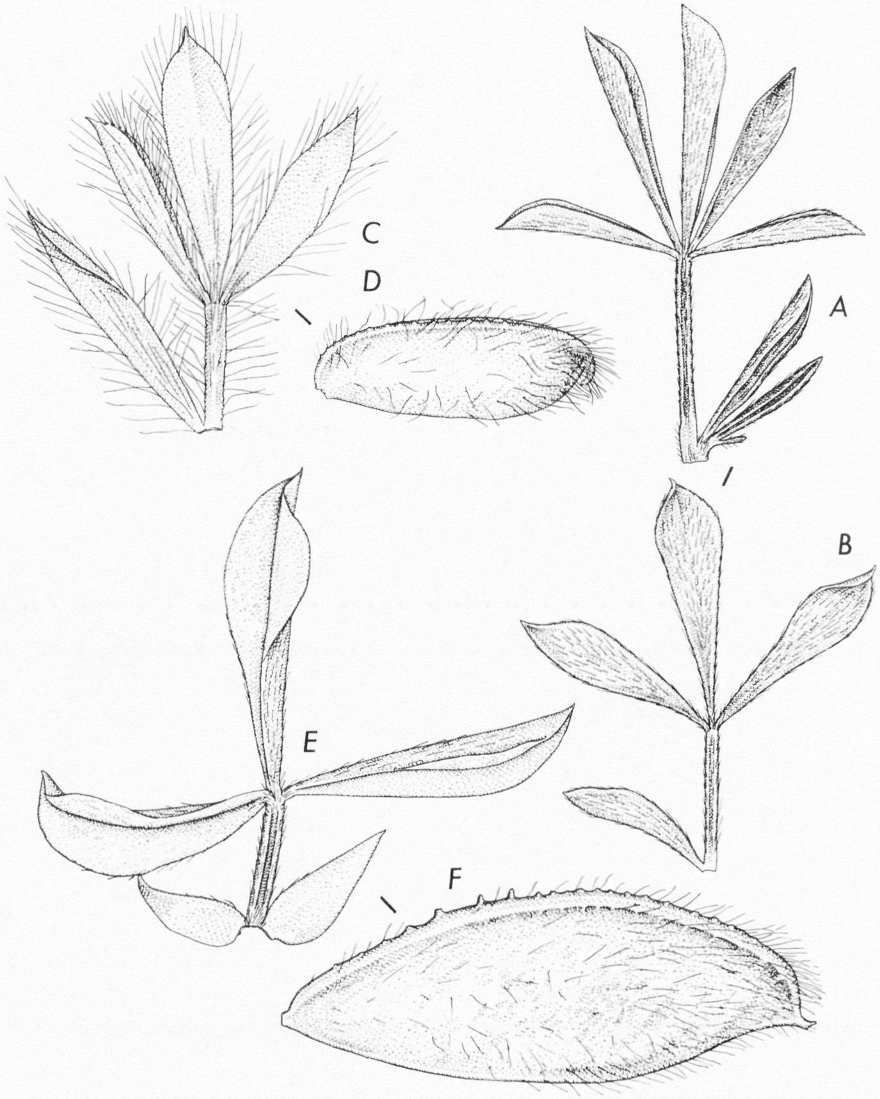

Fig. 7. *Lotononis lupinifolia* (Boiss.) Benth.: 1906, Faure, Oran (*A—B*); *L. tenella* Eckl. & Zeyh.: Ecklon & Zeyher no. 1282 (*C—D*); *L. azurea* (Eckl. & Zeyh.) Benth.: Fries, Norlindh, & Weimarck no. 65 (*E—F*). — *A, B, C, E*: Leaves. — *D, F*: Pods. (All ×4.)

there does not seem to be any other anatomical difference of importance. Cohn remarked (1901, p. 544) that the stomata are more numerous on the lower than on the upper side of the leaves in *L. serpens,* and about equally densely distributed on both sides in the leaves of the species treated which he referred to *Lotononis,* but this possible difference may be of little significance.

The conclusion of this comparison is that it is still technically quite possible to uphold *Euchlora* as separate from *Lotononis* through the presence of simple leaves (the possible difference in stoma density may also be added), but all other circumstances seem to favour an incorporation of *Euchlora* in *Lotononis,* and due consequence of this has been taken.

Addition

After this article had been written I was fortunate to study a collection of *Lotononis serpens* from the Calvinia Division made by Mr. B. Nordenstam (no. 745) in 1962. The plant grew at "Oorlogskloof, on stony ridges north of the river, in clayey very granulated soil (rich in worms)". Although collected in the same region as those with lobate-subtrifoliolate leaves, this form has exclusively simple elongate leaves and rather long pubescence as the common forms of the species.

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Festuca arenaria Osb. — A Misinterpreted Species

By EBBE KJELLQVIST

(Meddelande från Lunds Botaniska Museum, Nr 192)

In "Utkast til Flora Hallandica" 1788 p. 8 the following description of *F. arenaria* was given by Osbeck: "Culmo infracto, foliis canaliculatis, spicis villosis. cfr. dumetorum". He further gave a very important information when writing: "Uti flygsanden", which means that the species grows in drift sand.

A more complete description based on examination of a large material collected in the field and kept in cultivation in the Botanical Garden of Lund, will be as follows:

Perennial herb with extensively creeping rhizomes. Shoots 1—3 dm long. Leaf-sheaths 4—8 cm long, tubular, glabrous, purplish. Blades up to 3 dm long, with a hard acute apex, about 1 mm in diameter, usually tightly inrolled, 5—9-ribbed, hairy. Culms 2—5 dm high, erect, usually with 2 nodes towards the base, ribbed near the panicle, smooth. Panicle 7—12(—18) cm long, erect—inclined, contracted and rather dense, with scabrous axis and branches, greyish-green. Spikelets 20—40 per panicle, 10—15 mm long, usually 5—8-flowered, with pilose rachilla. Glumes unequal, narrowly lanceolate, keeled, acute, scabrous on the keel and margins near the tip, sometimes sparsely pilose; lower 3—5 mm long, usually 1-nerved; upper 4—7 mm long, 3-nerved. Lemmas 6—8 mm long, lanceolate, terminating in a scabrous up to 3 mm long awn, usually covered with slender hairs, finely 5-nerved. Paleas shorter than the lemmas, deeply bidentate and with ciliated keels. Anthers about 3 mm long, yellow. Grains 3—4 mm long, brown-red.

Osbeck did not designate any type specimen, but in Herbarium Osbeckii at Riksmuseum, Stockholm, a well preserved specimen of *F. arenaria* Osb. with the handwriting of Osbeck on the sheet has been selected as lectotype. Fig. 1 shows the type specimen.

Fig. 1. Drawing of type specimen of *Festuca arenaria* Osb. ×$^1/_3$.

Cytology

About 300 plants representing 47 collections (p. 394—395) have been cytologically investigated and all of them have the same chromosome number, 2n=56 (fig. 3).

The chromosome numbers have been obtained from root tips, that were fixed in the Svalöv modification of Navashin-Karpeschenko fixative, embedded in paraffin, sectioned, and stained with crystal violet, and crystal violet with anilin. The last mentioned stain gave the best result.

Fig. 2. *a* spikelet, *b* glumes, *c* lemma, *d* anther of type specimen of *Festuca arenaria* Osb. ×7.

Flovik (1938, 1940) and Sokolovskaja & Strelkova (1960) reported 2n=42 for *F. rubra* L. var. *arenaria* Osb. but as their material originated from Spitzbergen and Kolguev, areas where *F. arenaria* Osb. is missing, the reports can not be considered relevant for *F. arenaria* Osb. Most likely they have dealt with *F. rubra* L. ssp. *Richardsonii* (Hook.) Hult. instead, as this is the only native taxon of the *F. rubra*-group in these areas. Due to certain similarities between *F. arenaria* Osb. and *F. rubra* L. ssp. *Richardsonii* (Hook.) Hult. — they have both hairy lemmas — *F. arenaria* Osb. has often been recorded from the Arctic ever since Lange (1880) reported it from Greenland. Porsild gives (1957) in his excellent Flora a distribution map on p. 167 of *F. rubra* L. var. *arenaria* Osb., but what was concerned was actually ssp. *Richardsonii*.

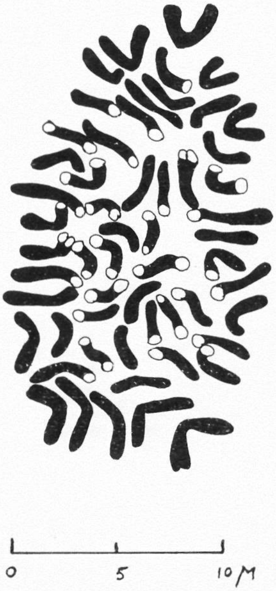

Fig. 3. The chromosome set of *Festuca arenaria* Osb. $2n=56$. Plant nr. EE12—5.

Nakajima (1930) reported $2n=42$ for "*F. arenaria* L." on material from Tokyo. What taxon it may have been is difficult to say. It is, however, quite obvious, that it was not *F. arenaria* Osb. as this species does not occur in Asia. Another confusing thing is that Linnaeus and not Osbeck is given as auctor. Linnaeus never described a *F. arenaria.*

Gregor (1954) reports $2n=56$ for *F. juncifolia* St.-Amans.

Ecology and distribution

F. arenaria Osb. is a typical sand dune species and grows together with *Elymus arenarius* and *Ammophila arenaria.* It is a valuable binder and consolidator of drifting sand. It is always best developed in the mobile dunes and is usually missing in the fixed ones.

The distribution is mainly restricted to the coasts of western Europe from north Spain to south Norway including the British Isles. It does not reach Portugal or the Mediterranean but is quite common around the Baltic and Gulf of Finland. It also occurs inland in lacustrine sand at the Lakes Chudskoe and Ladozhskoe. In Flora of the U.S.S.R. 1934 it was recorded from Lake Onezhskoe, a record that has not yet been veryfied by me as any material from there has not been seen. Tzvelev (1964) does not record it from Onezhskoe.

Taxonomy

Festuca arenaria has got a number of synonyms. The ones most used in modern literature are:

F. villosa Schweigg. 1819, in K. Hagen, Chlor. Boruss. p. 34.
F. juncifolia St.-Amans 1821, Fl. Agenaise p. 40.
F. sabulicola Duf. 1825, in Ann. Sc. Nat. sér. 1, 5, p. 85.
F. dumetorum auct. non L.

Tzvelev (1964) declares that *F. arenaria* Osb. 1805 is a homonym of *F. arenaria* Lam. 1791 and the correct name should be *F. villosa* Schweigg. 1819. But as *F. arenaria* Osb. is described in 1788 (p. 389) and not in 1805, which is usually stated, this statement is without validity. The correct name is *F. arenaria* Osb. 1788.

Howarth (1923) and Hubbard (1954) regarded *F. arenaria* Osb. as a variety of *F. rubra* and kept *F. juncifolia* St.-Amans as a separate species. In Flora of the British Isles 1962 the same treatment is found.

Howarth (1923) made a comparison between *F. rubra, arenaria* and *F. juncifolia* as follows:

F. rubra, arenaria	*F. juncifolia*
1. As many intravaginal as extravaginal branches	1. Branches mostly or all extravaginal
2. Laminae, blunt apex	2. Laminae, sharp point
,, keeled in transverse section	,, complicate (suborbicular)
,, 5—7 nerves	,, 7—11 nerves
,, 3—5-costate	,, 5—pluri-costate
,, scler. distinct	,, scler. continuous
3. Sterile glumes unequal	3. Sterile glumes subequal
4. Fertile glumes broader about or above the middle, aristate	4. Fertile glumes broader in the lower half, mucronate or shortly aristate

A rapid glance at this schedule seems to reveal quite good differences. On p. 329 when talking about reduction in size of "*F. rubra, arenaria*" Howarth says that specimens from Lapland, Spitzbergen and Novaya Zemlya are smaller than the British ones. This statement reveals that he included *F. rubra* ssp. *Richardsonii* (Hook.) Hult. in his concept of *F. arenaria*. By doing so one might very well come to the conclusion that *F. arenaria* is separate from *F. juncifolia*. That Howarth had troubles when dealing with British material is evident. On p. 321—322 he writes: "The characters of the glumes, etc. often leaves one undecided, but the unfailing test is to be found in the transverse section of the radical leaf". As said before (Kjellqvist 1961) the amount of sclerenchyma is very variable and very much influenced by the environment. Anatomical studies of material from all collections, both before and after cultivation, also have completely verified this statement. There is no anatomical difference in the material and there is no morphological discontinuity. *F. juncifolia* St.-Amans is a synonym to *F. arenaria* Osb. This opinion is held by Wilde-Duyfjes (1964) too, but here *F. arenaria* is treated as a synonym to *F. juncifolia*. The name *arenaria* is antedated by *juncifolia* only on the subspecies level. There are, however, strong reasons to treat *F. arenaria* as a species, both from morphological and cytological points of view. It is morphologically clearly distinct from *Festuca rubra* and through cross experiments between the two taxa it is quite clear that a sterility barrier also exists. As *F. rubra* has 2n=42, hybrid plants will get 2n=49. A number of such plants have been the result of performed crossings. As these hybrids are sterile there is no hesitation about the specific rank of *F. arenaria* Osb. In nature no hybrids have been observed, but quite often one can find *F. rubra* with hairy lemmas. Often such plants have wrongly been looked upon as hybrids.

A complete presentation of performed investigations on spontaneous *F. rubra* s.lat. in Scandinavia will be published in Opera Botanica.

Locality list of cytologically investigated material of F. arenaria, all with 2n=56.

Coll. nr.	Nr. of plants	Country	Province	Locality
E002	4	S	Scania	Löderup, the beach
E003	4	S	,,	,, Hagestad
E004	5	S	,,	,, Kåseberga
E006	6	S	,,	Vitaby, Vitemölla, the beach
E008	6	S	,,	,, ,, 300 m inland from the beach
E149	4	S	,,	Veberöd, 4 km E. the church
E153	6	S	,,	Ö. Nöbbelöv, 500 m N. Gislövshammar
E010	6	S	Halland	Ölmevalla, the beach
E013	6	S	,,	Harplinge, Haverdalsstrand
E016	6	S	,,	Söndrum, Frösakull
E203	6	S	,,	Mellbystrand
E120	5	S	Gotland	Fårö, 400 m S. the light
E150	11	DK	Jutland	Nyminde, Nyminde gab
E157	4	DK	,,	,, 7 km S. Hvidesand
E158	7	DK	,,	Vedersö, Vedersö klint
E161	11	DK	,,	Lild, Skarreklit

Coll. nr.	Nr. of plants	Country	Province	Locality
E162	4	DK	Jutland	Ingstrup, Kettrup, 3 km S. Lökken
E163	6	DK	,,	Raabjerg, Skivern, N. Tvärsted
E165a	3	DK	,,	Skagen, Nordstrand
E165b	6	DK	,,	,, Grenen
E166	6	DK	,,	Hulsig, 2 km NNV. stn
E167	8	DK	,,	Raabjerg, Aalbeck's harbour
E168	12	DK	,,	Strandby, 200 m N. harbour
E169	6	DK	,,	Hirtshals, 5 km SV. harbour
E197	8	DK	,,	Römö, beach
E198	6	DK	,,	,, 1 dune, landside
E199	2	DK	,,	,, 1 ,, seaside
E200	16	DK	,,	Oksby, Blaavands Huk
E201	11	DK	,,	Henne, Hennestrand
E170	3	N	Vag	Austad, 10 km NO. Lindesnes
EE8	6	E	Santander	San Vicente
EE9	5	F	Les Landes	Labenne
EE10	5	F	Medoc	Lacanau-Ocean
EE11	6	F	,,	Soulac
EE12	6	F	Vendee	Les Sables
EE13	6	F	Bretagne	Pornichet
EE14	6	F	,,	Larmor Plage
EE15	6	F	,,	Mesperleuc Plage
EE17	6	F	Normandie	Deauville
EE18	6	F	Artois	Fort Mahon Plage
EE19	6	F	,,	Loon Plage
EE20	6	F	,,	Zuydcoote
EE21	6	B	—	Ostende, 5 km S. the town
EE22	6	NL	—	Zandvoort
EE104	6	GB	Fife	Tentsmuir
EE105	3	D.D.R.	Zingst	Prerow
EE106	7	D.D.R.	,,	West-Darss

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Taxonomic Revision of the Pyrola rotundifolia Complex in Fennoscandia

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Introduction

When carrying out the taxonomic evaluation of the complex of the species *Pyrola rotundifolia* L. in Central Europe I met with taxonomic problems of the North-European populations the study of which I consider as essential for solving the infraspecific variability of the whole complex. A systematic analysis with a phytogeographical outline of this polymorphous species was thoroughly carried out by Andres (1912, 1914 a, b). It was a survey embracing the complete area which, for its considerable extent could not be directed to a detailed comparative population study. In the present paper I concentrated on clearing the values of species included in the past in the species *P. rotundifolia,* or separated from it into independent taxonomical categories, in the area of the Boreal and Sub-arctic Europe. The Central-European variability was being partly solved in another paper (cf. Křísa 1964). In the present paper I am introducing the results received by quantitative analysis of morphological features, and by means of this comparative feature-complex of distinguishing phenomena has resulted in the following survey.

General part

The occurrence of the nominatic population of *P. rotundifolia* with an increasing latitude decreases considerably, and in the Sub-arctic zone itself this populations grows very rarely, or is missing altogether. It is replaced by populations morphologically utterly different with somewhat different area-genetic relations. In the Nearctic the section *Rotun-*

difolieae, subsect. *Rotundifoliae* (syn.: sect. *Eu-Thelaia* (Alef.) Andr., subsect. *Alefeldiana* Andr. 1914: 65) is represented by several species. In the Sub-arctic and Arctic zones of Canada and Alaska a nominatic shortstyled population of the species *P. grandiflora* Rad., is present which covers the whole area of the Arctic Eurasia, with the exception of Fennoscandia. Here, it does not grow, not even in the Sub-alpine Birch Woodland belt around the Arctic Circle. Chorologically, this species appears as an Arctic geoelement limited only to the region of the Arctis. In the Sub-arctic area of Alaska and Canada there is a species *P. asarifolia* Michx., which is distributed right to the forest Boreal zone of South Canada and the Alpine belt of the Rocky Mountains. In the Nearctic this species represents a Sub-arctic geoelement appearing as two morphologically distinguishable populations and geographically partially vicariating. The species *P. asarifolia* has been investigated at another place. In the Sub-arctic and Boreal zone of the Pacific region of Alaska, Canada and in the north-western extremities of the United States there is *P. bracteata* Hook., the identity of which will have to be ascertained with regard to populations of East Asia. Further related species of this section in North America: *P. americana* (Sweet) Fern. and *P. elata* Nutt. have their chief point of distribution in the Boreal and Sub-boreal zone of the Pacific area. It is probable that the developmental centre of this section in North America was in the region of the Rocky Mountains (cf. Andres 1914 b: 249).

In the Palearctic area the florogenesis of the section is much more complicated. It requires a great quantity of comparative materials and a detailed study of the morphological features by means of quantitative analysis. It is particularly the Central-Asiatic high-montane region of the Far East, representing the key positions for solving the area-genesis of the whole family. In the first stage of investigations the work was concentrated on North-European populations, especially on their taxonomic evaluation. Lately, owing to Scandinavian authors, these questions have been gaining greater publicity.

When following the geographical frequency of the nominatic of the species *P. rotundifolia* s.str. in Fennoscandia, especially its regional distribution, this species appears, according to the character of its distribution as a post-glacial migrant, typical for lowland southern and central regions of Fennoscandia. In Europe it is a typical element of Nemoral vegetative zone with a wide amplitude to the north of the Boreal zone as well as to the south into the Steppe zone. In Fennoscandia it grows mostly in Boreal zone communities, namely in coni-

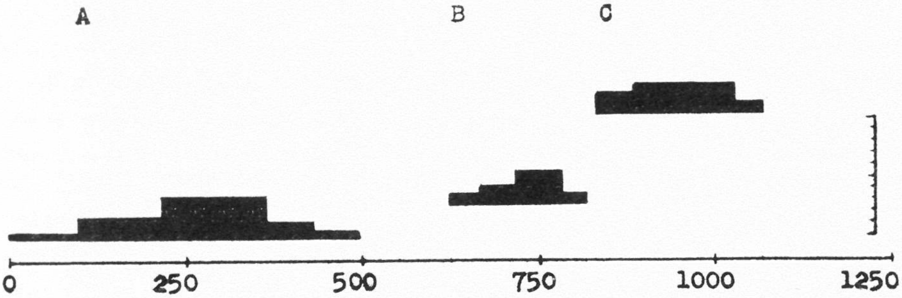

Fig. 1. Vertical distribution in Fennoscandia. A. *P. rotundifolia* s.str. B. *P. intermedia.* Without localities in extreme northern regions. C. *P. grandiflora,* ssp. *norvegica.* The vertical scale indicates number of collections.

ferous forests with *Pinus silvestris* and *Picea alba* from the sea cost to an approximate altitude of 500 m. above the sea level (see Fig. 1). In the whole South of Fennoscandia it forms a part of the Boreonemoral zone. It covers exclusively the space eastwards and southwards of the Scandes. On the western Norwegian coast it is very sparce. Regarding the Sub-arctic and Boreo-montane zone of the Scandinavian massif, the population is ecologically and temporaly distinctly limited. Its absence in the vast area from approx. 67° north latitude to the north, is typical not only for Fennoscandia but also for the whole Palearctic florographical region.

In the area of the NW Europe there is a maritime population of the species *P. rotundifolia* designated as subsp. *maritima* (Ken.) Warb. Its occurrence in Scandinavia along the south coast of Sweden and Norway was investigated in detail by Nilsson (1963). In the maritime region of the NW Europe, intermediary forms approaching the nominatic occur, so that the evaluation of the subspecific level is suitable. The area of this subspecies is limited only to the Atlantic region of Europe and to the British Isles. The data originating from the Canadian and New Foundland coasts (cf. Fernald 1904, Hultén 1958), are wrong. Fernald's collections concern the species *Pyrola asarifolia* Michx. When revising the Scandinavian herbarium materials I found sheets from the western coast of Norway from the region of Tronfield (coll. Källström 1891, LD). It is a new locality from the coastal area of Fennoscandia and it proves that the plant may be expected also in other places along the western coast.

In the Swedish-Norwegian border massif there is the species *Pyrola grandiflora* Rad., subsp. *norvegica* (Knab.) Löve et Löve. From the point of view of the biotic zonation of the North-European vegetation grades (Sjörs 1963) it is distributed in the Alpine belt of the Scandes (optimum altitude 800—1100 m. above sea level) and in the Swedish Lapland it reaches the Sub-alpine Birch Woodland belt. Thus, it is missing in the woodland-tundra zone in the provinces of the extreme North. The data on its occurrence from the provinces Tröms, Finnmark and from the polar regions of Finland refer to the species *Pyrola intermedia* Schl., whose taxonomy I am describing below. The Scandinavian montane population was distinguished already by Blytt 1874: 850 and introduced as the species *P. rotundifolia* L. β *pumila* Horn. Apart from the wrong interpretation of name, Blytt correctly presumed that the population was closely related to the species *P. grandiflora*. Knaben (1943) describes this population as *P. norvegica* Knab., and takes it for endemic for the alpine region of Scandinavia. She stresses the chromosomal relations, especially the differences in the size of chromosomes (cf. Hagerup 1928, 1941; Knaben 1950). I assume that cytological examinations are significant for a taxonomical survey only when proved on vast quantities of material from the whole area. Thus, to a certain extent differences of regional populations are interpolated. By investigating the herbarium materials from the Circumpolar area of the Holarctic it becomes evident that the species *P. grandiflora* forms a number of regional populations, sometimes with not very clearly distinguishable morphological features. Thus, it greatly inclines to form intermediate forms, especially in the Arctic zone of the European part of the USSR, and also, in the West Greenland and North Canada. The disjunct small area in Scandinavia cannot be considered as stenoendemic since there are graduated intermediary types between this population and the nominatic in the Palearctic as well as Nearctic. The present taxonomical evaluation of the species *P. grandiflora* (cf. Löve et Löve 1961) represents, in a suitable way, the problem of the species. *P. grandiflora* s. lato represents in the Arctic undoubtedly a species which originated in the course of the lower Pleistocene period with a gradual limitation of its area at suitable intervals between the individual glacial periods (cf. Knaben 1961). There is a serious question concerning the migration of the species into montane parts of Scandinavia and its relationships to the Western and Eastern Arctic flora which may explain the area-genesis of some species of the genus *Pyrola*. Areschoug (1869) believes that the Arctic flora of Scandinavia could originate in North Siberia. On the other hand, other authors (cf. Blytt 1882; Sernander 1896) presume that the Norwegian montane elements are relics of the flora of the interglacial periods of Scandinavia with a Greenland-American origin. Nordhagen (1936, 1963) taking up a theory of glacial refugia, stresses that the migration to the inland of Scandinavia could occur only after the deglaciation of Norway. According to the sorting of the Scandinavian montane flora carried out by Fries (1913), *P. grandiflora*, subsp. *norvegica* represents a bicentrical group delimitated approximately in two centres of a mountain range. The southern centre is spread from Jotunheimen to the environs Mt. Dovre. The northern centre is spread approximately from Saltdal in the province of Nordland as far as the region of Jukkasjärvi in the province of Torne Lappmark. This centre protrudes to the south in the border area right to the region of Tärna and Vilhelmina. A similar example of bicentrical distribution in the Scandinavian montane flora is *Saxifraga hieraciifolia, Stellaria crassipes, Papaver radicatum* s.l. and other plants (cf. Nordhagen 1931).

A new species for Fennoscandia from the relationship of the complex *P. rotundifolia* is represented by the species *Pyrola intermedia* Schleicher, this being typical for the Boreo-montane and Sub-arctic zone of Fennoscandia. The total area of this species is restricted only to the Palearctic florographical region where it represents an Artic-alpine element with a comprehensive distribution in the Boreo-sub-arctic Eurasia and with several disjunct little areas in Central Europe. In the Central-European area it appears as a high-montane species in the whole Alps and sparcely, at highest altitudes of the Carpathians (see Fig. 2), mainly on limestone or dolomite foundations. In Fennoscandia, it occurs continuously from Jotunheimen throughout the whole frontier massif, the optimum altitude being approximately 600—800 m. above the sea level, and extending on into the Sub-arctic Woodland-tundra zone, without interruption over Kola, through the Sub-arctic region of the European part of the USSR, Northern Ural, as far as Western Siberia. In the area between the provinces of Jämtland and Lycksele Lappmark it vicariates vertically with the nominatic of the species *P. rotundifolia,* and in the area behind the Arctic Circle it replaces it entirely. The species *P. intermedia* represents a distinct morphological population typified geographically as well as eco-coenologically.

It is to be stressed that the majority of authors considered this population in the central Fennoscandia as the species *P. rotundifolia* s.str. and in the polar regions either as *P. grandiflora* Rad. and *P. norvegica* Knab., or took it for hybrids of the species *P. minor*×*norvegica* and *P. minor*×*rotundifolia* (cf. Andres 1909, Dahl 1934: 374, Knaben

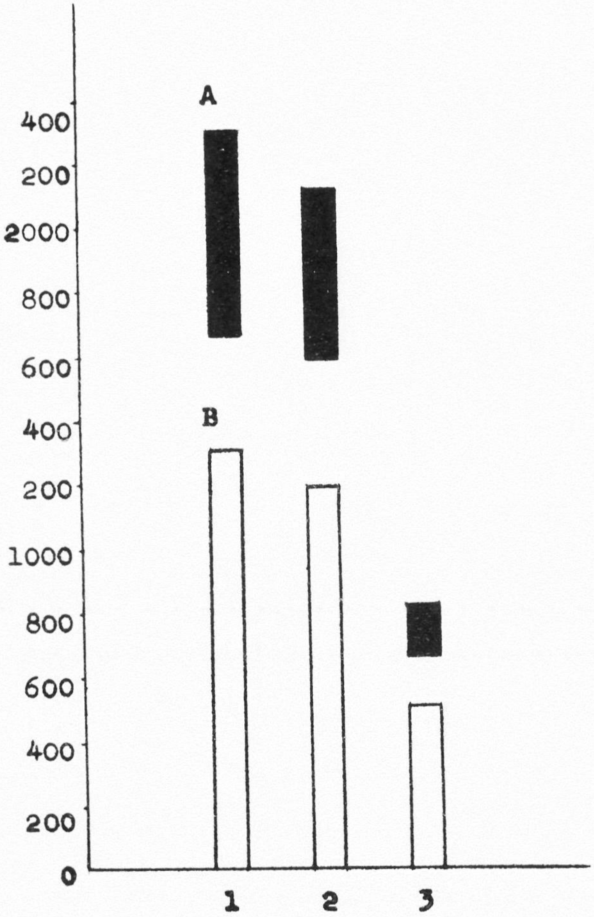

Fig. 2. Vertical delimitation of the species in Europe: A. *P. intermedia.* B. *P. rotundifolia* s.str., 1) Alps, 2) Carpathians, 3) Fennoscandia. Without localities in extreme northern regions.

1943, map No. 1360 in Hultén 1950). Regarding the continuous continental area in the Sub-arctic Eurasia (the eastermost localities have, up to now, been checked only as far as the area of the lower Ob regions), the species *P. intermedia* in the flora of Fennoscandia represents the east-arctic element. A continuous infiltration into montane parts of Scandinavia from the East may also be expected with the species *P. grandiflora,* subsp. *norvegica,* although the migration by the way of a continental bridge from Greenland cannot be excluded. By means of quantitative analysis of morphological features of the species *P. intermedia* (the size and shape of the calyx lobes, the size of style, bracts, and the type of inflorescence, the shape and size of leaves) an absolute identity has been ascertained between the Central-European and North-European populations. The analysis of the holotype (sub No. 568 *P. rotundifolia* L. in Linnean Society London) indicated that three plants of the original sheet represent juvenile specimens of the species *P. rotundifolia* L. s.str., namely a typical nominatic population (lanceolate calyx lobes 2.9—3.3 mm. long, the style 8 mm. long) growing abundantly in southern and central lowland parts of Sweden.

Methods

The statistical evaluation of the morphological features was carried out on herbarium materials and individual results were tabulated or plotted in diagrams. The quantitative analysis of the feature complex has helped to estimate the distinguishing features for individual species and the range of their variability (the length of calyx lobes, the size of anthers, the size of the style).

The spot maps of the distribution in Fennoscandia were made only from herbarium sheets. The designations and abbreviations of Scandinavian provinces were taken over from the periodical List of Botanical Garden Lund, 1963, and for the Finnish area from a printed leaflet I had received by courtesy of Dr. T. Ulvinen from the Department of Botany, University of Oulu.

Special part

Key to the species treated:

1 a Plants of sturdy growth (10)20—30(40) cm. high, with large, long-petioled leaves; the inflorescence consisting of rich, two-sided, long racemes; flowers smaller with a distinctly curved style .... *P. rotundifolia* s.l. 4

1 b Plants of medium growth (8)12—22(26) cm. high with roundish-oval to elliptical leaves, in the upper third distinctly narrower; inflorescence thin, shorter racemes, flowers large with curved style 2

2 a Bracts widely oval lanceolate, as a rule longer than flower stems; calyx lobes widely lanceolate right from the base, and of the same width all along, but in the last third abruptly obtusely ended, (2.5)2.7—3.1(3.3) mm. long, in the centre of their length 1.5—1.8 mm. wide, anthers (2.0)2.2—2.3(2.5) mm. long; the style is curved, but slightly thickened at the tip, (7.0)7.5—8.5(9.0) mm. wide .... *P. intermedia*

2 b Bracts ovally to longish lanceolate, as a rule along the flower stems; calyx lobes oval er elliptic, most often pinkish to purple red; anthers (1.7)1.9—2.0(2.2) mm. long; style curved, thickened at the tip (3.5)4.5—5.5(7.0) mm. long
P. grandiflora s.l. 3

3 a Calyx lobes (2.6)2.8—3.2(3.4) mm. long; style (3.5)4.0—5.0(5.5) mm. long ssp. *grandiflora*

3 b Calyx lobes (1.8)2.0—2.4(2.6) mm. long; style (5.0)5.5—6.5(7.0) mm. long ssp. *norvegica*

4 a Calyx lobes lanceolate, growing narrow from the base into long, narrow lobes (3.3)3.5—3.9(4.1) mm. long, in the centre of their length hardly 1 mm. wide; anthers (2.3)2.5—2.6(2.8) mm. long; style (8.5)9.0—9.5(10) mm. long ssp. *rotundifolia*

4 b Calyx lobes widely lanceolate to oval-shaped, often narrowed at the base, (2.2) 2.4—2.8(3.0) mm. long; anthers (1.9)2.1—2.2(2.4) mm. long; style (6.5)7.0—7.5(8.0) mm. long .... ssp. *maritima*

In the following part I am introducing the analysis of a new species for Fennoscandia and a survey of the further remaining species.

Pyrola intermedia Schl.

Schleicher Catalogus plant. in Helvetia .... 3: 23, 1815.
Syn.: *P. rotundifolia* L. var. *arenaria* Koch, Synopsis Fl. German. et Helvet., ed. 1: 478, 1837, p.p.
Thelaia intermedia Alefeld, Linnaea 12: 65, 1856.
P. rotundifolia L. subsp. *intermedia* (Schl.) Dost., Květena ČSR, 1115, 1950.
P. rotundifolia L. var. *chloranthoides* Norrl. in sched.
P. rotundifolia L. var. *brachysepalus* Arrhenius in sched.
P. rotundifolia L. auct. fl. scandinav.

Description: Plant (8)12—22(26) cm. high with a creeping, indistinctly branched rhizome; four-angled stem, in the upper part slightly winged, bare, with a radical leaf-rosette and with a few embracing, widely oval scales; the leaves are evergreen, with petioles of a medium length (2)4—6(8) cm. long, rounded-oval to elliptical, in their upper thirds distinctly narrowed, pointed, approximately 2.5×3.5 cm. wide, leathery rigid, with the main vein protruding and dentate serrate margins; the flowers in a thin two-sided raceme, 5—10 cm. long, the raceme being multiflowered, containing mostly 8—12 flowers; bracts oval, lanceolate, longer than flower stems, often of a reddish to purple colour; the flowers are widely campanulate, white or pink, calyx lobes widely lanceolate from the bases, evenly wide all along, in the upper third abruptly obtusely ended, (2.5)2.7—3.1(3.3) mm. long in the centre of the length, 1.5—1.8 mm. wide, always pinkish and serrate at the margin; the petals widely oval—egg-shaped, usually 2 to 2 1/2 times longer than calyx lobes; the stamina around the ovary inclined, anthers (2.0) 2.2—2.3(2.5) mm. long with filaments remarkably widened in their lower parts; style curved, thin and slightly thickened at its end, dis-

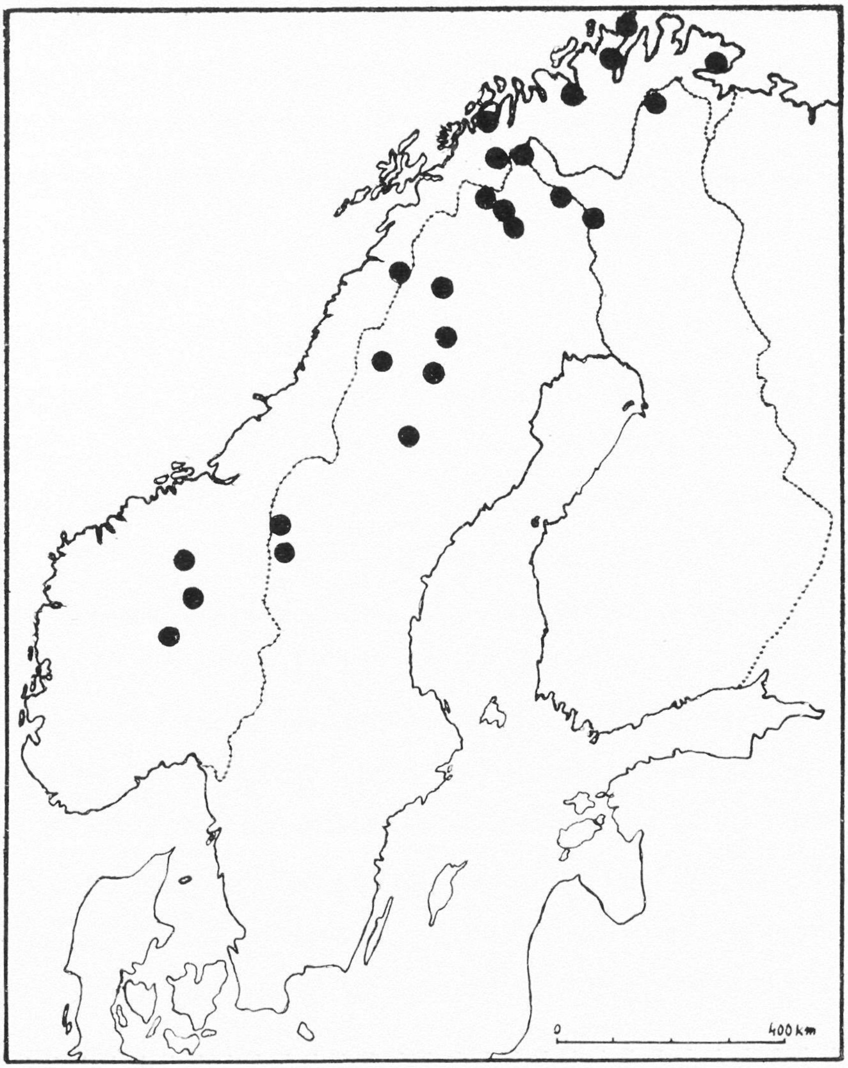

Fig. 3. Distribution of the species *P. intermedia* in Fennoscandia.

tinctly protruding from the flower, (7.0)7.5—8.5(9.0) mm. long, stigma always narrower than the end of the style; capsule round, as a rule 3.5 to 4.5 mm. long with remarkably outstanding valves.

Distribution in Fennoscandia: Sweden: Hrj; Jmt; ÅsL; LyL; PL; LL; TL. Norway: Op; Nrd; Tr; Fmk. Finland: KemL; EnL; InL. The species grows in the Boreal zone in the wider sense of the word, namely, from

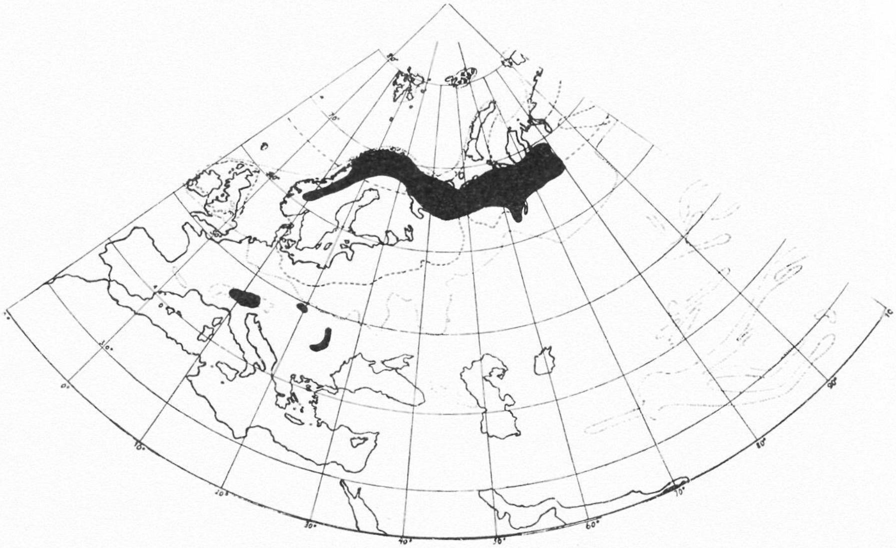

Fig. 4. Total area of the species *P. intermedia*.

the Boreo-sub-montane zone over the Sub-alpine Birch Woodland zone, right into the tundra zone of the extreme north. It mostly occurs in birch woods or on the heaths on limestone gravel, or sandy soils (see Fig. 3).

Total area: in Central Europe it grows only in the Alps (in most of limestone areas of the whole massif) and in the Carpathians (Belanské Tatry, Pop Ivan, Bucegi, Fagarasului, Retezatului). In Northern Europe it grows approximately from the north latitude of 61° farther to the north in montane regions of Fennoscandia over the Kola peninsula, along Petchora river, to the North Ural. In Asia it occurs at present, judging from the records, only along the lower river Ob in Western Siberia. It is probable that the continuous area extends eastwards to the Soviet Sub-arctic Asia (see Fig. 4).

Variability and relationships: The distinguishing features of this species are predominantly in the floral organs: the shape and length of calyx lobes, the length of anthers, and the length and curving of the style. By a quantitative analysis of these features their relative constancy and a certain constant amplitude in the range of the fluctuation variability is indicated. The enclosed (see Fig. 5, 6, 8) indicate the values of the above features for the species *P. intermedia* in comparison with species with which this species used to be united. The statistical measurements were carried out exclusively on Scandinavian plants, and the results were compared with the values for Central European speci-

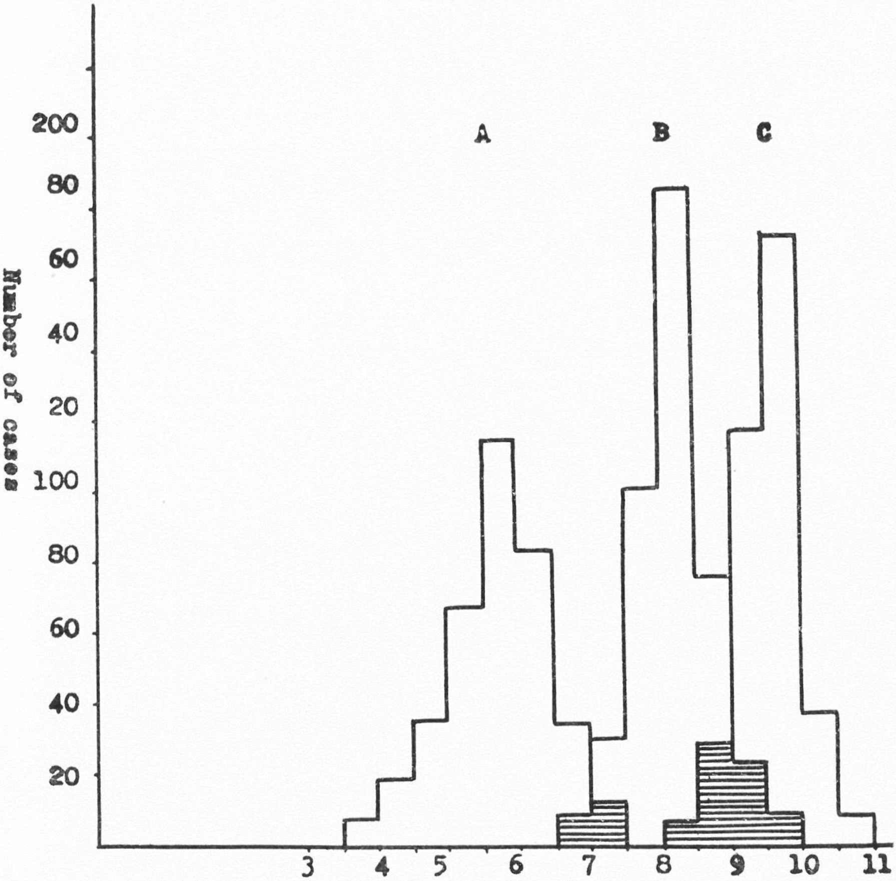

Fig. 5. Size of style in mm.: A. *P. grandiflora*, ssp. *norvegica*, B. *P. intermedia*, C. *P. rotundifolia* s.str.

mens. In the Central European area the summary values of the feature-complex indicate similar constant deviations between the species *P. intermedia* and *P. rotundifolia* s.str. On the ground of the taxonomical evaluation, the species *P. intermedia* approaches mostly the species *P. incarnata* Fish. ex DC. This species grows from Western Siberia onwards right to the Far East, mostly in the Boreal zone of coniferous, especially pine forests. The frequency of this species in that vast area has not yet been known, although it is evident that its optimum distribution in Asia has a more southern trend than the area of the species *P. intermedia*.

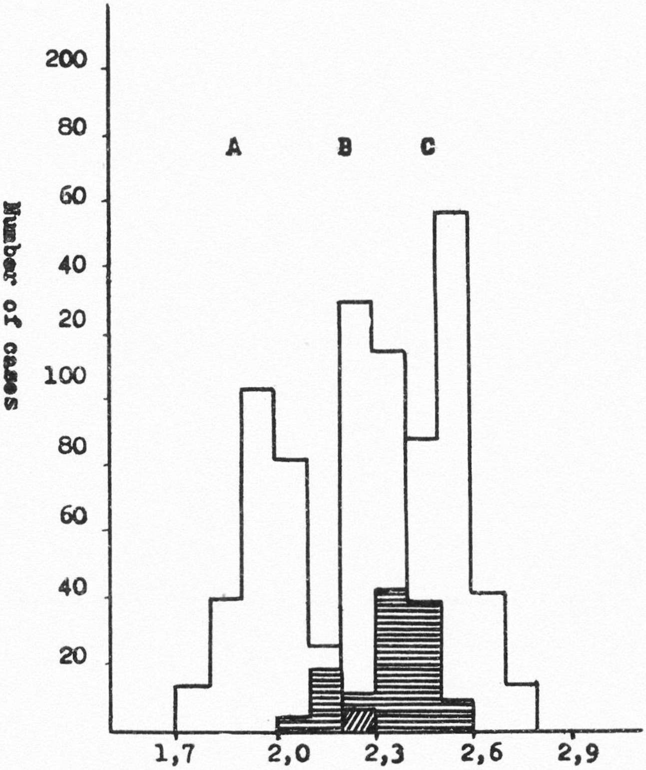

Fig. 6. Size of anthers in mm.: A. *P. grandiflora,* ssp. *norvegica,* B. *P. intermedia,* C. *P. rotundifolia* s.str.

Pyrola grandiflora Rad., subsp. *norvegica* (Knab.) Löve et Löve 1961 grows in the area of Fennoscandia only in the massif of the Swedish-Norwegian frontier region. The small area of this population is evidently concentrated in two centres. In Sweden it is distributed in the following provinces: ÅsL; LyL; TL. With a certain probability, it will certainly be found in the remaining provinces of the Swedish Lapland. In Norway it grows only in the province of Opland, the other data apply to the previous species (see Fig. 7). Subsp. *grandiflora* grows at the nearest in the Arctic and Sub-arctic zone of the European part of the USSR where its morphological features remarkably approach the Scandinavian population, it is probable that by investigating more material from that area the occurrence of that subspecies will also be confirmed in that part of the USSR (see above in the General part).

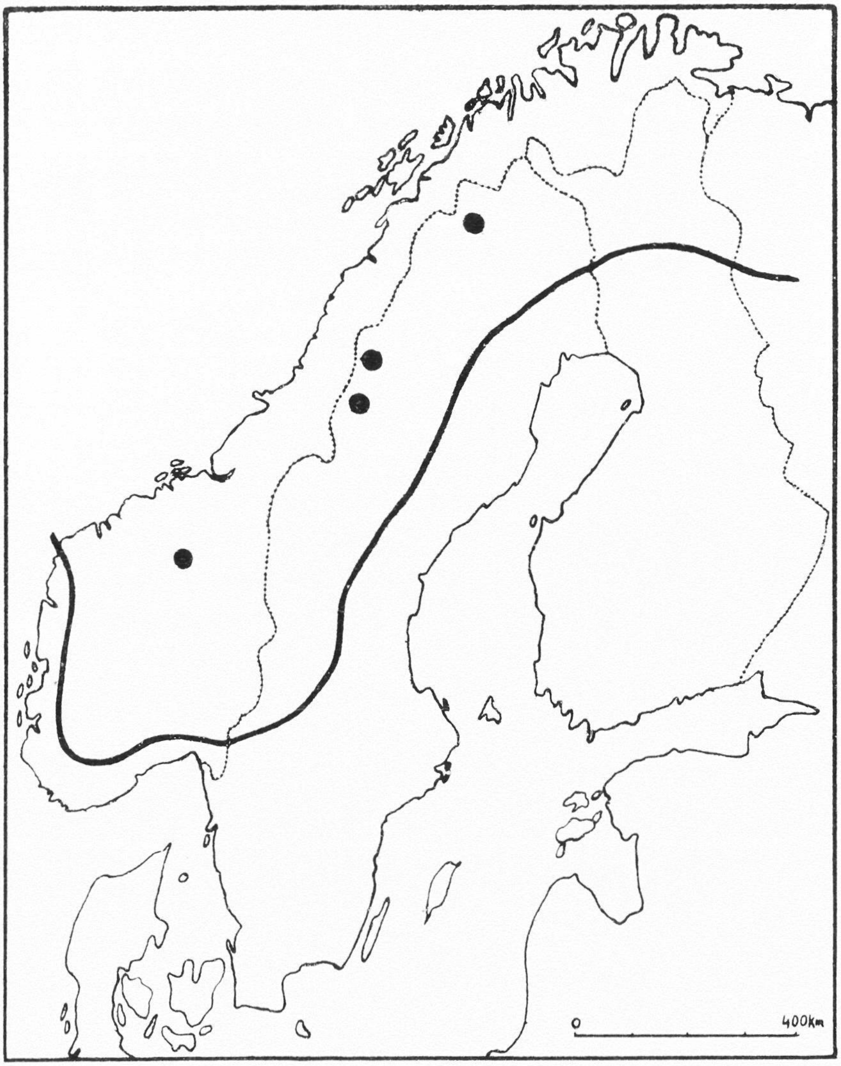

Fig. 7. Distribution of the species *P. grandiflora*, ssp. *norvegica* in Fennoscandia. The bold line designates the distribution of the nominatic population of the species *P. rotundifolia*.

Hybrids

The following hybrids were described in the nature which belong to the above-mentioned species. Knaben (1943) states from the montane region of the Scandinavian massif the hybrids *P. minor*×*norvegica*.

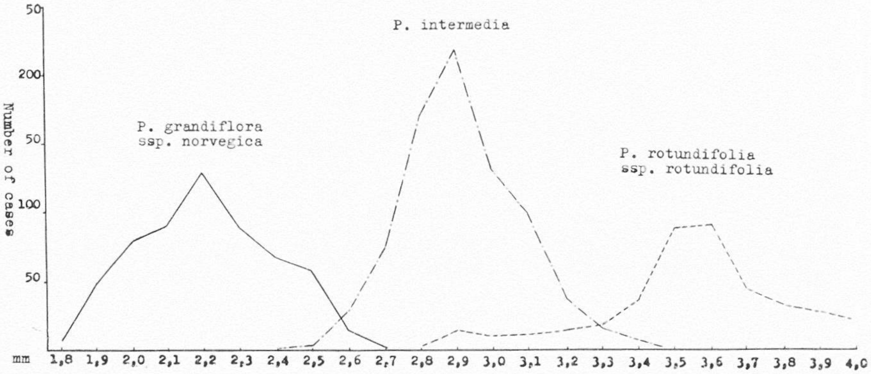

Fig. 8. Size of calyx lobes of species growing in the area of Fennoscandia.

They are hybridogenous specimens between the species *P. minor* and *P. grandiflora,* ssp. *norvegica.* Knaben confirms the existence of hybrids by a cytological analysis of the idiogram (2n—46), and, especially, she stresses the differences in the sizes of chromosomes. Regarding a similar frequency of the species *P. minor* in the Sub-arctic and Boreal zones of the Holarctic the occurrence of this hybrid is absolutely real. The hybridogenous population between the nominatic of the species *P. grandiflora* with the species *P. minor* from the area of Greenland (cf. Böcher 1961), and from the region of the NE Canada (according to herbarium sheets) confirm a possibility of hybridisation between the species *P. minor* and *P. grandiflora,* ssp. *norvegica* in Fennoscandia. By investigating the vast Scandinavian herbarium materials I ascertained a conspicuous sterile hybrid *P. minor*×*intermedia.* According to the analysis of the feature-complex (the length of calyx lobes, length and curvature of the style, the size of anthers, size of leaves, the imperfectly developed pollen) hybrids represent intermediary-featured specimens between both species (see table). The occurrence of the hybrid is comparatively low although both parental species grow in Fennoscandia in the same biotope complementing each other in localities. The herbarium sheets come from province of Torne Lappm.: par. Karesuando, Peldsa, cca 850 m s.m. and Moskana, approxim. 750 m s.m. 1948, Smith, (UPS). A relatively sparce occurrence of the hybrid may be explained on the ground of slightly different phehophases of the both species and the pollination processes being often specific for the

Tab. 1. Length of calyx lobes.

mm	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	S
P. grandiflora ssp. norvegica	6	49	79	89	128	86	68	59	13	2	—	—	—	—	—	—	—	—	—	—	—	—	—	579
P. intermedia	—	—	—	—	—	—	1	4	29	75	166	219	131	98	35	19	7	1	—	—	—	—	—	785
P. rotundifolia ssp. rotundifolia	—	—	—	—	—	—	—	—	—	—	4	18	12	13	18	20	34	87	88	42	31	27	22	416

mm	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	S
P. minor	8	31	106	122	35	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	307
P. minor×intermedia	—	—	—	—	—	—	—	—	4	36	67	33	10	5	—	—	—	—	—	—	—	155
P. intermedia	—	—	—	—	—	—	—	—	—	—	—	—	1	4	29	75	166	219	131	98	35	758

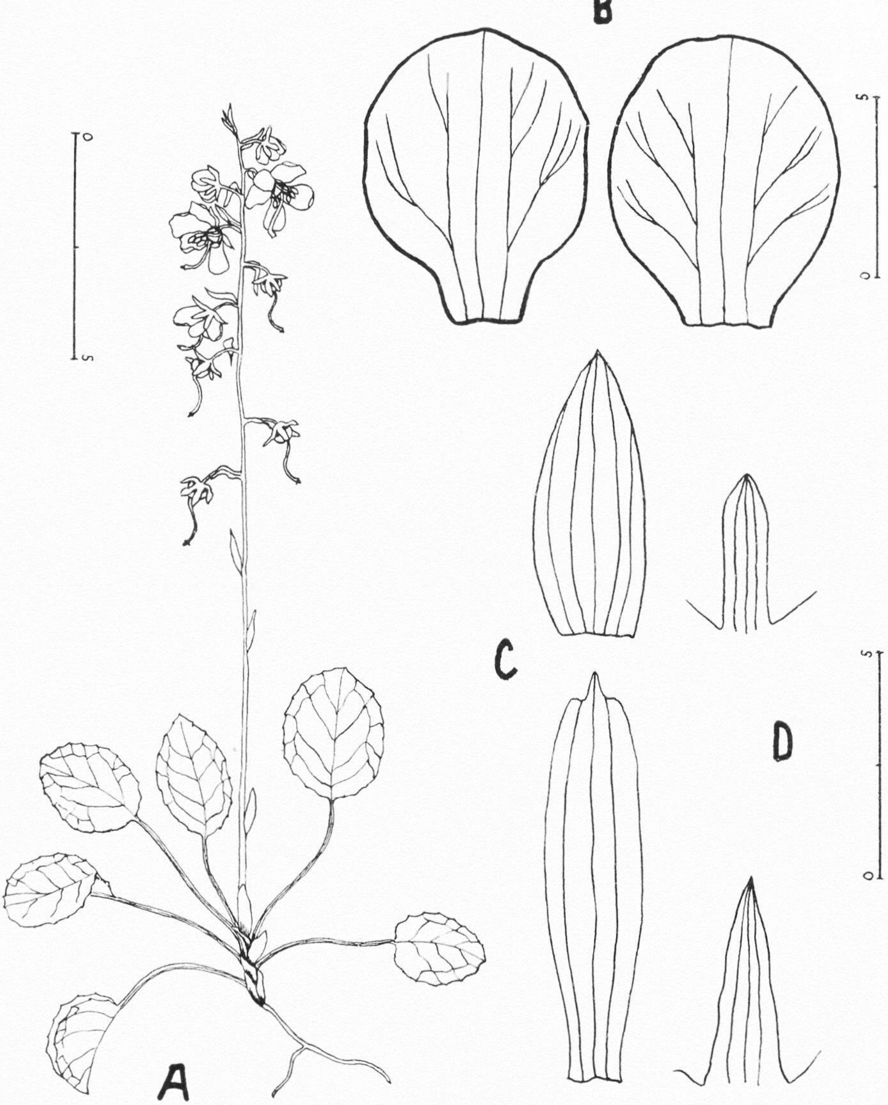

Fig. 9. *P. intermedia.* A. Specimen from TL, Jukkasjärvi (Sylvén). B. Petals of the same specimen. C. Bract and calyx lobe of the species *P. intermedia.* D. Bract and calyx lobe of *P. rotundifolia* s.str. from Östergötland, Krigsbergs (Segerström). Scale for the specimen in cm., for the bract, petals and calyx lobes in mm.

Fig. 10. *P. grandiflora,* ssp. *norvegica.* A. Specimen from ÅsL, Vilhelmina (Rune). B. Petals. C. Bract. D. Calyx lobe. Scale for the specimen in cm., for the petals, bract and calyx lobe in mm.

individual species of the genus *Pyrola*. On one hand, it is the allogamy and the phenomena supporting it; proterandry, proterogyny, autosterility, on the other hand the autogamy of allogamies differently combined. These phenomena, which, for a number of species of the genus *Pyrola* have not yet been solved, can explain questions concerning the population variability. They either provoke or check the gene exchange within a certain population, determining thus the type of the genotype changes in the population.

These problems affect also the species *P. media* Sw. This species is being considered as an amphidiploid hybrid created by alloploidisation between the species *P. minor* and *P. rotundifolia* (Hagerup 1941; Knaben 1943). The feature measurements of intermediary types between the latter species are often being identified with the species *P. media*. The summary values of the morphological features in intermediate specimens do not, however, conform with the variability range of the features of *P. media*. In the continuous European area the species *P. media* represents a homogeneous population and also, in the neighbouring regions of the Western Siberia, Asia Minor and Near Asia. At the same time one of the presumed initial species, *P. rotundifolia*, represents in the same part of the area several morphologically distinct populations originating undoubtedly as a property of a geographical population variability. This fact would certainly affect the homogeneity of the populations of the species *P. media*. Likewise, the criteria of alloploidity contradict the last results in the floral morphology of the genus *Pyrola* (cf. Těrechin 1962). It indicates that both species (*P. media* and *P. rotundifolia*) incline to autogamy, of two different mechanisms of this autogamy. I believe that the species *P. media* represents an autoploid population in which occurred a somatic duplication of chromosomes (2n—92). Of the original great number of lines on the comparatively vast area, that population of plants has survived which has been the best adopted to the locality. The developmental tendency of this species could have some connection with related species of the Central Asiatic and East Asiatic areas (cf. Andres 1913: 447).

Revised Herbarium material

P. intermedia Schl.

Sweden: Härjedalen: Funäsdalen, Ljusnedalens björklider omkring Röllekbäcken 1907, Dahlstedt, (S); Jämtland: Storlien, reg. alp., 1895, Ahlfvengren, (LD); Åsele Lappmark: Vilhelmina s:n, Kittelfjälls by, ängsartat kärr i V. delen av byn, 550 m, 1946, Rune, (S); Lycksele Lappm.: Tärna, Stora Umevatten, 550 m, 1963, Asplund, (S); Sorsele s:n, Vuomatjåkko (S om Tjulträsk), reg. alp., ca 800 m, 1948, Rune, (S); Tärna socken, Mieskatjåkko 1938, Asplund, (LD); Tärna s:n, Gräskevardo, 650 m, 1932, Lillieroth, (LD); Pite Lappm.: Arjeplog s:n; Avatjåkko vid Merkenes 1948, Wistrand, (S); Lule Lappm.: Kvikkjokk, granurskog N om Saggat 1946, Selander, (S); Kvikkjokk, Tarra, 510 m, 1923, Möller, (S, LD); Kvikkjokks kapellförs. 1943, Selander o. Dahlbeck, (S); Torne Lappm.: in reg. lacus Torneträsk, Paddos 1927, Samuelsson et Zander, (S); Jukkasjärvi s:n, Björkliden, ca 420 m, 1903, Sylvén, (LD), 1928, Alm, (LD), 1946, Lundevall, (LD, OULU), 1959, Evers, (LD, OULU): Jukkasjärvi s:n, Abisko, ca 400 m, 1921, Alm, (C), 1925, Alm, (S), 1926, Holmberg, (LD), 1928, Levan, (LD), 1943, Nannfeldt, (UPS); Jukkasjärvi s:n, Vassijaure, 1942, Lundh, (LD), 1948, Asplund, (S); Karesuando, S-Peldsa, ca 800 m, 1947, Liro et Roivainen, (S); vid mynningen av Jebrenjåkk, 1913, Sylvén, (LD), 1957, Snogerup, (LD); Nuoljatunndus tok, 1929, Holmberg, (LD); Jukkasjärvi s:n, Rautojöki 1946, Nyholm, (LD); Jukkasjärvi s:n, Ostovare, reg. subalp., 1925, Alm, (S), 1945, Runemark, (LD); Jukkasjärvi s:n, Låktatjåkko, reg. subalp., 1943, Nannfeldt, (UPS).

Norway: Opland: Dovre, Kongsvold 1865, Falck, (LD), 1866, Blytt, (C), 1875, Kindberg, (C), 1885, Tedin, (LD), 1885, Nyman, (S), 1891, Krok, (S), 1927, Nilsson et Degelius, (S); Valders 1893, Söderlund, (S); Gudbrandsdalen, 900 m, 1898, Trägårdh, (LD); Nordland: Sulitelma 1914, Gorton, (LD); Fylke, Junkerdalen 1953, Pedersen, (C); Målselv h:d, Kirkenes 1948, Norrman, (LD); Troms: Ruostafjæld 1907, Taylor, (C); Tromsöysund herred, Tromsöy, ca 95 m, 1958, Norrman, (LD, UPS); Finnmark: Alte, Kåfjord 1962, Ulvinen, (OULU); Vadsö, Salttijärvi 1929, Seppänen, (OULU); Kistrand, Porsanger Kolvik 1951, Lindquist et Selander, (S); Magerö, Duken 1935, Asplund, (S).

Finland: Kemin Lappi: Muonio 1922, Montell, (LD, C, W); prope pag. Ulimuonis 1922, Montell, (LD); Enontekiön Lappi: Kilpisjärvi 1911, Jokela, 1913, Sandström, (OULU); ad montis Saana in lacus Kilpisjärvi 1932, Montell, (LD, BP), 1959, Jokela, (OULU); Inarin Lappi: Utsjoki, Tuomasvaara 1956, Kause, (OULU); Laanila 1962, Ulvinen, (OULU), have not been marked.

P. grandiflora Rad., subsp.norvegica (Knab.) Löve et Löve

Sweden: Åsele Lappm.: Vilhelmina s:n, V. Vardofjäll, reg. alp. ca 950 m, 1946, Rune, (S); Vilhelmina s:n, Remdalen, 1069 m, 1945, Rune, (S); Lycksele Lappm.: Sorsele s:n, Döre Altsvatten i *Dryashed* 1948, Rune, (S); Tärna s:n Västansjö, ca 700 m, 1948, Rune, (S); Tärna s:n, Gränssjö, reg. alp., ca 1000 m, 1946, Rune, (S); Torne Lappm.: Jukkasjärvi s:n, Abisko 1945, Weimarck, (LD); Jukkasjärvi s:n, Björkliden 1945, Weimarck, (LD); ovan Riksgränsens station 1945, Weimarck, (LD); Jukkasjärvi s:n, Vassitjakko 1945, Weimarck, (LD); Jukkasjärvi s:n, Torneträskområdet Rakkaslako 1948, Asplund, (S); Västra, Njulja 1946, Sjögren, (LD, S); Jukkasjärvi s:n, Kopparåsen, 800 m, 1943, Norlindh o. Wall, (LD), 1944, E. Nymann, (LD), 1945, Lönnqvist, (S), 1946, Sjögren, (LD), 1945, Weimarck, (LD, S).

Norway: Opland: Sör Tröndelag, Kongsvold, 950 m, 1955, Evers, (LD).

Acknowledgements

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Smärre uppsatser och meddelanden

Cerinthe minor L. som adventivväxt i Västergötland

I denna tidskrift för år 1959 (s. 121—133) publicerade undertecknad resultaten av en undersökning rörande växter som år 1958 anträffats införda med manganmalm till Vargöns bruk i Västergötland (Västra Tunhem sn). Malmen härstammade från Turkiet (Marmarasjöns nordsida). Antalet inkomna arter var betydligt: åtminstone 94 av de sammanlagt 119 på manganmalmhögarna noterade (5 voro tidigare okända för Sveriges adventivflora). (Betr. *Polygonum kitaibelianum* se Hylander 1964 s. 233.)

Man frågar sig, hur det sedan gått med alla dessa växter. Har en del lyckats överleva och eventuellt sprida sig? Följande kan meddelas. I aug. 1959 besöktes malmhögarna av herr Eric Kihlberg (Vänersborg); enligt meddelande i brev av den 23/11 1964 kunde han blott notera några få av de tidigare sedda växterna (förutom *Chaenorrhinum minus* som är vanlig inom brukets område: *Anagallis arvensis, Chenopodium opulifolium, Ch. vulvaria, Polygonum kitaibelianum, Setaria viridis, Trigonella monspeliaca*), men två nya påträffades (*Cichorium intybus, Sideritis montana*). Densamme har sedan flera gånger undersökt lokalen, dock utan att finna något av intresse. För ytterligare studier av förhållandena företogs från Botaniska trädgården i Göteborg den 28 aug. 1964, alltså sex år efter den stora invasionen, en bilexkursion till Vargön ledd av fil. lic. Carl-Axel Jansson och med fil. dr Carl Blom samt undertecknad som deltagare.

Resultatet var nedslående. Icke en enda av de talrika införda växterna återfanns. Större delen av malmhögarna borttogs visserligen redan under året 1960, men man tycker att åtminstone någon art borde ha kunnat rädda sig till närmaste omgivningen. (Flera arter hade 1958 mogna frön, se nämnda uppsats s. 123.) Detta stämmer emellertid väl överens med det kända förhållandet, att införda växter ha mycket svårt att hävda sig i konkurrensen med den inhemska floran.

Exkursionen blev dock icke helt utan positiva resultat. En av de vid bruket anställda förde oss till en mer avläget liggande, tidigare ej undersökt hög av »mullformig» manganmalm, vid en plats benämnd »Mjölkberget» i skogen N om järnvägen Vänersborg—Vargön. Denna malm härstammar från södra Ryssland, närmare bestämt Tschiaturi (=Chiaturi), en plats uppe i bergen i SV Kaukasien (innanför hamnstaden Poti), i Georgien. Högen har legat här sedan 1951, alltså i 13 år, men har icke varit helt orörd. (Dessa uppgifter välvilligt meddelade av inköpschefen Bertil Hansson.) Floran å densamma var fattig, men efter en stund fann jag en växt, som jag från södra Europa igenkände såsom tillhörande släktet *Cerinthe* (fam. *Boraginaceae*). Vid närmare undersökning visade den sig vara *C. minor* L., en mångformig art, och enligt dr Bloms bestämning dennas var. *hispida* Turrill. (Varieteten utmärks av »pedicellis hispidis», alltså styvhåriga och icke glatta blomskaft, se närmare Turrill 1924 s. 355, 1930 t. 3133.) Den förekom riklig inom ett begränsat område av den branta sluttningen av manganhögen. Blomningen var rik liksom fruktsättningen (på insamlade exemplar har jag iakttagit talrika mogna frukter). Växtens höjd kunde nå 4 dm eller något mer. De underjordiska delarna äro kraftigt utvecklade (växten är perenn). Uppenbarligen har arten levt här flera år, kanske större delen av tiden efter högens tillkomst. Beläggexemplar insamlades liksom också exemplar för plantering.

C. minor är, så vitt jag kunnat finna, den enda art av släktet som anträffats adventiv hos oss (i odling förekomma även andra arter, ehuru sällan, se t.ex. Svensson 1893 s. 463, Lundström 1914 s. 81, Holzhausen 1943 s. 109). Ett enda tidigare fynd är mig bekant: Göteborg, Kvarnen Tre Lejon (1954 Carl Blom; jfr Blom 1961 s. 115); också här föreligger var. *hispida* som framgår av beläggexemplaret i Göteborgs-herbariet. Arten har som spontan en tämligen vid utbredning, omfattande Mellaneuropa (här dock delvis ruderat), Sydösteuropa och Främre Asien t.o.m. Persien. Varieteten *hispida* synes vara inskränkt till de östra delarna av området (se Turrill ll.cc.).

På samma hög och i närheten av *C. minor* förekom — sparsammare — *Cardaria* (*Lepidium*) *draba*. Utanför högen anträffade dr Blom *Rapistrum rugosum* (sparsam). Även dessa växter ha uppenbarligen inkommit med malmen. F.ö. växte här bl.a. mycket *Senecio viscosus* och *Chaenorrhinum minus*, mer sparsamt *Erigeron canadensis*. *Epilobium rubescens* ingick även i vegetationen liksom trädgårdsflyktingen *Solidago canadensis* m.m. (I andra delar av bruksområdet samlades av oss exemplar av följande sparsamt förekommande växter: *Cichorium intybus, Herniaria glabra, Potentilla intermedia, Stachys annua.*)

Göteborg i nov. 1964.

GUNNAR DEGELIUS

Citerad litteratur

BLOM, CARL 1961: Bidrag till kännedomen om Sveriges adventiv- och ruderatflora V. — Acta Horti Gotob. 24. Göteborg.

DEGELIUS, GUNNAR 1959: Plants from Turkey Introduced with Manganese Ore into a Place in Västergötland (Sweden). — Bot. Not. 112. Lund.

HOLZHAUSEN, AXEL 1943: Odlade växter skildrade familjevis. IV. — Stockholm.

HYLANDER, NILS 1964: Om några adventiva Polygonum-arter av gruppen Avicularia. — Bot. Not. 117. Lund.

LUNDSTRÖM, ERIK 1914: Beobachtungen und Studien bei den in den Jahren 1912—13 ausgeführten Pflanzenbestimmungen im botanischen Garten Bergielund. — Acta Horti Berg. 5: 3. Stockholm.

SVENSSON, P. 1893: Flora över Sveriges kulturväxter. — Stockholm.

TURRILL, W. B. 1924: On the Flora of the Gallipoli Peninsula. — R. Bot. Gardens, Kew: Bull. Miscell. Inform. 1924: 9. London.

— 1930: i Hooker's Icones Plantarum; etc. 32. — London.

Ny fyndort för Botrychium matricariifolium (Retz.) A.Br. på Jylland

Till de tidigare kända lokalerna på Jylland för ovannämnda sällsynta art (se Wiinstedt 1953 s. 377) kan läggas en ny, nämligen Hansted Sg. (i Thisted Amt): Hansted, i gamla dyner Ö om Molen (24 juni 1961, G.D.).

Arten anträffades där under en exkursion som jag företog tillsammans med min numera avlidne vän fil. lic. Arne Hässler (Lund). Förekomsten var som vanligt mycket sparsam. De få exemplaren uppträdde i en mossmatta med *Thymus serpyllum* samt sparsamma exemplar av *Armeria maritima, Carex arenaria* och *Festuca rubra.* På stranden ej långt därifrån växte *Senecio integrifolius* (ett 10-tal exemplar i icke täckande vegetation av *Lotus corniculatus*; den är tidigare känd från trakten, se Pedersen 1961 s. 286). *Calystegia* (*Convolvulus*) *soldanella,* som vi egentligen voro på jakt efter, kunde ej påträffas (den är uppgiven från området, se Hansen 1963 s. 147 och där anförd litteratur samt s. 174).

Göteborg i nov. 1964.

GUNNAR DEGELIUS

Citerad litteratur

HANSEN, ALFRED 1963: Convolvulaceernes etc. udbredelse i Danmark. — Danm. Topogr.-Bot. Unders. 30. Bot. Tidsskr. 59. Köbenhavn (tr. i Odense).

PEDERSEN, ANFRED 1961: Kurvblomsternes udbredelse i Danmark (ekskl. Hieracium og Taraxacum). — Ibidem 28. Bot. Tidsskr. 57.

WIINSTEDT, K. 1953: Pteridofyternes Udbredelse i Danmark. — Ibidem 18. Bot. Tidsskr. 49.

Landskronatraktens adventiv- och ruderatflora II

Anteckningar om Landskronatraktens flora VI

Följande förteckning innehåller några äldre, opublicerade uppgifter jämte arter och former, som noterats under de tvenne sist förflutna årens exkursioner. Nomenklaturen följer konsekvent Nils Hylanders »Förteckning över Nordens Växter», Lund 1955.

I. Floran på jordar som bemängts med avfall från burfåglar och duvor

I ett nu raserat koloniträdgårdsområde i Borstahusen har en av lotterna använts till uppfödning av burfåglar och duvor. Kring denna anläggning och närliggande jordar, som gödslats med avfall därifrån, spirade under somrarna 1963—64 en rik växtlighet, delvis bestående av för våra trakter m.el.m. främmande arter, av vilka kan nämnas följande:

Amaranthus Palmeri S. Wats. Två sent utvecklade plantor 1963 (det. Carl Blom).

Atriplex patula L. En jättestor, meterhög, rikt grenig och mycket sent blommande planta av sannolik utländsk proveniens (1963).

Brassica napus L. och *B. nigra* (L.) Koch. Några ex. 1963—64.

Cannabis sativa L. 2 ex. 1963.

Chenopodium förekom talrikt och i flera olika typer, en del så sent utvecklade att de aldrig hann blomma, andra relativt tidiga.

C. album L. v. *glomerulosum* (Rchb.) Peterm. Flera ex. 1963 (det. Carl Blom).

C. opulifolium Schrad. Några ganska tidigt utvecklade plantor 1963.

C. pratericola Rydb. Som föregående art.

C. suecicum J. Murr. Flera ex. 1963—64 (det. Carl Blom).

Datura stramonium L. 1 ex. 1963.

Digitaria sanguinalis (L.) Scop. Fåtalig 1963.

Echinochloa crus-galli (L.) PB. 1 ex. 1964.

Guizotia abyssinica (L. fil.) Cass. v. *sativa* (DC.) Oliver o. Hiern. 2 ex. 1963.

Helianthus annuus L. och *H. debilis* Nutt. Fåtaliga 1963.

Hirschfeldia incana (L.) Lagr.-Foss. v. *geniculata* (Desf.) Thell. f. *trichocarpa* Thell. 1 frodig planta 1963 (det. Carl Blom).

Lactuca sativa L. Flera ex. 1963.

Lolium multiflorum Lam. ssp. *Gaudini* (Parl.) Sch. o. K. 2 ex. 1963.

Malva cretica L. Några väl utvecklade och rikt blommande plantor 1963—64 (det. Carl Blom).

M. parviflora L. Som föregående 1963—64.

Medicago lupulina L. En förmodligen utländsk, långgrenig, spenslig typ, av Carl Blom identifierad med v. *prostata* Rob. Keller.

Panicum capillare L. 1 ex. 1963.

— *miliaceum* L. Talrik 1963.

Phalaris canariensis L. Fåtalig 1963.

Setaria italica (L.) PB. Talrik 1963.

— *viridis* (L.) PB. v. *major* (Gaud.) Posp. Några ex. 1963.

Zea mays L. Fåtalig 1963.

Av kulturväxter kan för övrigt nämnas: *Avena sativa* L., *Hodeum distichum* L. och *Triticum aestivum* L.

II. Diverse adventiver

Acer pseudoplatanus L. Uppträder som fullt naturaliserad i Landskronatrakten, ofta talrikt och i olika åldrar.

Avena fatua L. Åkrarna på gränsen till Borstahusen vid Strandvägen i Landskrona har nu tagits i bruk för bebyggelse. De hyste förut rika bestånd av flyghavre. På de förliden sommar ännu obebyggda delarna växte flera delvis individrika kolonier av denna växt i följande tre typer: 1) med som mogna bruna yttre blomfjäll m.el.m. tätt klädda i långa, relativt glesa, ljust bruna hår och vid basen försedda med likaledes ljusbruna långa tofshår, 2) yttre blomfjäll glatta, vid mognaden gråsvarta och vid basen försedda med vitaktiga, utpräglat korta tofshår = v. *glabrata* Peterm., 3) blomfjäll glatta vid mognaden ljust gula med långa glänsande vita tofshår. En egendomlighet med dessa typer var, att de inte uppträdde i blandade bestånd utan i strängt skilda och enhetliga grupper innehållande enbart en av typerna, ett fenomen, som kanske kan finna sin förklaring däri, att havre är självbefruktare.

Brassica juncea (L.) Zern. Har under senare år använts av Hilleshögs betförädlingsinstitut som skydd och avskärmning för avståndsisolerat förädlingsmaterial på olika håll inom staden och närmaste omgivningar. Växten uppträder därefter ibland på vägkanter, vändtegar eller i efterföljande grödor och har antecknats från Landskrona, Örja, Säby och Härslövs socknar.

Bromus commutatus Schrad. Säby, åkergräns nära stationen, talrik 1964.

Calendula arvensis L. Har i flera år uppträtt som ogräs i rabatter och försöksland på Weibullsholm, särskilt talrikt 1963.

Carex riparia Curt.×*rostrata* Stokes. Omnämnes i en publikation om Örjas flora (Nilsson 1952) som inplanterad i ett järnvägsdike vid Weibullsholm. Som följd av dikets successiva uttorkning har hybriden försvagats och är nu helt försvunnen därifrån. Lokalen bör alltså strykas ur Weimarcks flora (1963), i vilken den är upptagen.

Chrysanthemum. Som prydnadsväxter odlade arter påträffas årligen på Landskronas avfallsplatser, ditförda med trädgårdsavfall och ofta i talrika exemplar:

C. coronarium L., *C. lacustre* Brot., *C. leucanthemum* L. (tidigt blommande, storblommigare trädgårdsformer), *C. multicolor* Hyl., *C. viscidohirtum* (Scott) Thell. och *C. parthenium* L., en art, som även uppträder förvildad i trädgårdar och häckar lite varstans — ofta i m.el.m. utpräglat gulbladiga typer.

C. macrophyllum W. o. K. Säby, förvildad i dike utanför gård i byn.

C. vulgare L. v. *crispum* (L.) Bernh. Tillsammans med svagare krusiga mellanformer som kulturflykting på järnvägsvall vid Weibullsholm.

Conium maculatum L. Landskrona i vassarna norr om Nordkap, ett individrikt bestånd.

Cotula squalida Hook. fil. Hildesborgs herrgård. Planterad i fogarna på en terrass och därifrån utvandrad i mängd till parkens intilliggande gräsmattor. I England är denna nyzeeländska växt känd som förvildad under liknande förhållanden enligt uppgifter hos McClintock (1960).

Crocus speciosus M.B. Förvildad på gräsmark utanför Strandvägen 180 (Landskrona).

Eryngium planum L. Landskrona Citadell, kvarstående från tidigare odling.

Filago germanica L. I Lundåkrabuktens innersta del, några 100 m söder om Nygård och ett par 100 m öster om landsvägen, finnes en ännu öppen, ca 2 har stor glänta i tallskogen. Området användes nu som betesmark, men brukades ännu för ca 15 år sedan som åker. År 1952 genomströvade förf. denna då ganska nyss övergivna åkermark och fann då ett ganska individrikt bestånd av den i våra dagars Skåne vikande och nu i det närmaste helt försvunna örten *Filago germanica*. Av åkerogräsen funnos då åtskilliga kvar om än många av dem förekommo sparsamt. I allt noterades minst ett dussin annuella sådana ogräs, arter, som efterhand har blivit allt sällsyntare och nu praktiskt taget helt är borta. Området är alltså numera slutet i en från omgivande sandmarker invandrad vegetation med för sådana jordar typiska arter.

Filago germanica har sedan 1952, då ca 100 ex. inräknades, varierat starkt i antal olika år emellan. Redan 1953 var den sparsam, 1954 söktes den förgäves, medan den år 1956 kulminerade med minst 500 ex., av vilka dock ett stort antal voro verkliga dvärgar med 2 cm som minimimått och ett mycket litet blomhuvud i toppen på den trådsmala stjälken. Redan året därpå (1957) var den sällsynt, och sedan dess har den uppträtt endast i enstaka eller få ex., de år den har eftersökts. 1961 fann dir. Helge Rickman, Malmö, 2 ex. och 1963 sågs likaledes ett par plantor.

Orsaken till växtens tillbakagång i vårt land hänger säkerligen intimt samman med jordbrukets ändrade bruksformer, lönsamhet och rationalisering, vilket bl.a. har haft till följd, att bruket att träda åkrarna har försvunnit, och att svagare, mindre eller ej alls lönsamma jordar lämnas att växa igen i skog eller brukas som betesmark.

Geranium pratense L. Säby, järnvägsdike nära stationen.

Gypsophila paniculata L. Säby stationsområde (självsådd).

Holcus mollis L. Säby stationsområde 1964, ett större bestånd.

Inula britannica L. Säby sn, Brohusen, i gränsområde till ett nyligen övergivet trädgårdsland, ett livskraftigt bestånd — ca 100 blommande stjälkar spridda på 10—15 m^2. Arten har förgäves eftersökts på intilliggande kulturäng. Troligen har växten inkommit med någon prydnadsväxt eller planterats som sådan. Adventiva förekomster har förut konstaterats i vårt land, så t.ex. i Hörby och Laholm (Nilsson 1952).

Juglans regia L. Härslövs sn, Hildesborg, i ett björkkärr vid Öresund, ca 400 m norr om gränsen till Säby sn, ett ca 3 m högt ex.

Laburnum alpinum (Mill.) Bercht. Säby stationsområde 1964 (fröplantor).

Lactuca serriola L. Säbyholms sockerbruk, talrik på fabrikstomt; Vadensjö sn, åkergräns i södra delen (1 ex. 1964); Härslövs sn, Hildesborg, vägkant (flera ex.).

Lathyrus latifolius L. Landskrona, Exersisfältet, 1 ex. 1964, antagligen spridd från närliggande trädgårdar.

Nicotiana×*Sanderae* Sander. Landskrona, byggnadstomt vid Karlslund — flera ex. tillsammans med *Petunia axillaris* (Lam.) ssp. *hybrida* (Villm.) Hyl.

Ornithopus perpusillus L. I Håstenlöv, någon km nordost om Norrvidinge kyrka (Norrvidinge sn) och öster om järnvägen, ligger på en höjdsträckning trenne ättehögar, vilka under pågående inventering av floran på västskånska ättehögar besöktes i aug. 1954. På en av högarna, belägen strax intill en gård, som av ägaren betecknades som Håstenlöv nr 9 (21 på Allmänna kartverkets blad över Teckomatorp), fanns några ex. av den i Skånes flora sällsynta örten. En närmare undersökning av omgivande sandiga betesmarker visade, att växten där förekom ganska rikligt. Vegetationen innehöll de för lätta sandjordar vanliga, i följande förteckning upptagna arterna (korsen (+) efter namnen avser att gradera arternas olika frekvens — + = enstaka plantor, ++ = sparsam förekomst, +++ = ymnig och vitt spridd; tecknet – före namnen att arten endast är antecknad från ättehögen).

Agrostis canina L. ssp. *montana* Hartm. +++
— *tenuis* Sibth. +++
– *Anemone pulsatilla* L. +
– *Arrhenatherum pratense* (L.) Samp. +
Artemisia campestris L. +
– *Calluna vulgaris* (L.) Hull. ++
Cerastium arvense L. +++
– *Deschampsia flexuosa* (L.) Trin. +
– *Festuca ovina* L. ssp. *vulgaris* (Koch) Sch. o. K. +++
— *trachyphylla* (Hack.) Kraj. ++

Filago minima (Sm.) Pers. +
Helichrysum arenarium (L.) Moench ++
Hernaria glabra L. +++
Hypochoeris radicata L. +
– *Galium verum* L. ssp. *euverum* Hyl. +
Jasione montana L. +
– *Luzula campestris* (L.) DC. ++
Ornithopus perpusillus L. ++
– *Pimpinella saxifraga* L. +
– *Potentilla argentea* L. +
– — *erecta* (L.) Räusch. +
Rumex acetosella L. +++
Scleranthus annuus L. (sannolikt S. polycarpos). +
— *perennis* L. +++
Sedum acre L. +
– *Sieglingia decumbens* (L.) Bernh. ++
– *Succisa pratensis* Moench +
Teesdalia nudicaulis (L.) R. Br. +
– *Thymus serpyllum* L. ssp. *angustifolius* (Pers.) Vollm. +++
– *Viola canina* L. ++

Förmodligen har *Ornithopus* inkommit till denna lokal med utsådd *Festuca trachyphylla,* och möjligen har *Hypochoeris radicata* spritts på samma sätt. Huruvida den fortfarande finnes kvar är ovisst. Vid förf. senaste besök på platsen (1959) var den fåtalig och liksom övrig vegetation mycket hårt nerbetad.

Picris hieracioides L. Örja sn, banvall nära Marieberg, talrik (bortglömd i Örjafloran, Nilsson 1952).

Potentilla recta L. v. *sulphurea* (Lam.) Lapeyr. Landskrona, citadellvallarna.

Rosa villosa L. v. *pomifera* (Herrm.) Desv. Nya lokaler utöver förut kända: Säby sn, dike vid järnvägen Säby—Säbyholm, 1 buske; gränsvall mellan Säby skola och Säby by, flera äldre buskar; Landskrona, busksnår vid vägen strax intill Erikstorp, 1 ex.

Rubus armeniacus Focke. Säby sn, märgelgrav nära skolan; Härslövs sn, Hildesborg, björkkärr nära Öresund. En större buske på vardera stället.

Salix myrsinifolia Salisb. En från traktens sparsamt vildväxande typer väl skild, vacker, ännu under förvintern grön, förmodligen ursprungligen planterad form (♂) växer vid Wallabäcken strax invid Öresund vid Landskrona stads gräns mot Säby sn. Exakt samma form återfinnes även längre norrut vid Öresundskusten (det. Carl Blom).

Sedum telephium L. ssp. *maximum* (L.) R. o. C. En svagt rödanlupen med rödaktiga ståndare försedd form växer på stengärdesgård norr om Nordkap, Landskrona, tillsammans med några andra planterade Sedum-arter. Nämnda form visar tendens att sprida sig på lokalen.

S. telephium L. ssp. *purpurascens* (Koch) F. Aresch. Härslövs sn, vägkant väster om Smörhålan, talrik.

Trisetum flavescens (L.) PB. Vadensjö sn, kulturäng öster om kyrkan; Landskrona, citadellvallarna, talrik.

Thalictrum minus L. v. *Kochii* (Fr.) Neum. Landskrona, ett individrikt bestånd på och vid gärdesgård norr om Nordkap (förvildad).

ARVID NILSSON

Litteratur

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Epilobium adenocaulon, E. adenocaulon × obscurum och E. rubescens i Matteröds socken

Inventering av Matteröds socken för Skånes Flora påbörjades 1964 och avses avslutas 1965. Arter med intressant utbredning eller frekvens noteras från varje påträffad växtplats. Hit hör från Nordamerika inkomna dunörter. Beträffande dessa arter är resultaten av årets inventeringsarbete så anmärkningsvärda, att särskild redovisning ansetts påkallad.

Epilobium adenocaulon är allmän i Matteröds socken. Se fig. 1. Kärr, diken och bäckar är vanligaste växtplatser. Mera tillfälliga lokaler utgör en gles granplantering på sluttning, skogsvägar och blomsterrabatter. Till storlek och bladform påminner denna art om *E. montanum,* men avviker genom fler, smärre och betydligt mörkare blommor med hopstående märken. Lättast känns *E. adenocaulon* igen på de frodiga, fasta, tätbladiga basala rosetterna.

E. adenocaulon×*obscurum* är funnen i ett videkärr 100 m ONO hus beläget 3400 m V Matteröds kyrka. Beståndet täcker ett par kvadratmeter. Denna

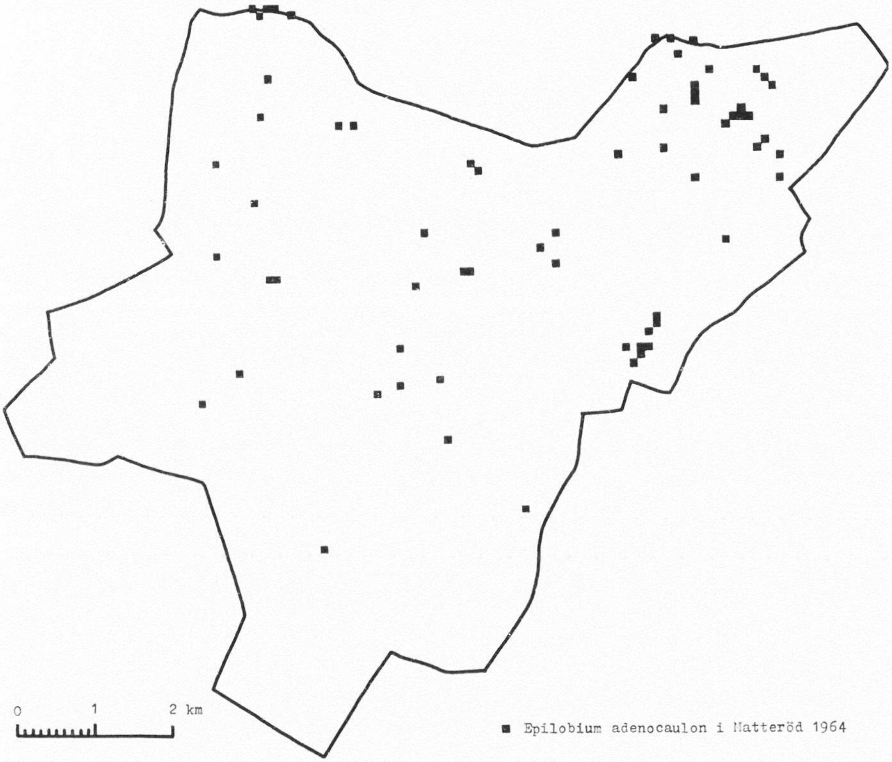

Fig. 1. *Epilobium adenocaulon* har 1964 visat sig vara allmän i Matteröd, en av landskapets centralt belägna socknar.

hybrid är meterhög, blommar ännu i september och har dålig frösättning. Båda föräldraarterna, som finns på platsen, överträffas i såväl längd som blomstorlek, medan hybriden i övrigt representerar en tydlig mellanform. En del kronblad är fläckiga i föräldraarternas två skilda färger.

E. rubescens är naturaliserad på en lokal i Matteröds socken, nämligen mellan bäck och kraftledning 550 m ONO Måleböke. De ca 1,2 m höga exemplaren, som förekommer inom en yta av ett fåtal kvadratmeter, liknar till växtsätt och bladform *E. adenocaulon,* men har mera upprätta grenar och smärre basala rosetter. De blott 4—6 mm långa kronbladen hos *E. rubescens* är vita, varigenom arten avviker från släktets övriga representanter i Skåne.

Skånes Flora 1963 upptar tre nordamerikanska dunörter. Av dem anges *E. glandulosum* från en lokal, *E. adenocaulon* från fem lokaler och *E. rubescens* från en tillfällig adventivlokal. Någon hybrid med dem upptas inte.

Åtminstone beträffande *E. adenocaulon* finns det sålunda skäl att anta att en snabb spridning för närvarande äger rum, varför i Skåne verksamma fältbotanister uppmanas eftersöka nordamerikanska dunörter, även på lokaler där sådana för inte längesen saknades.

Lund, Botaniska museet.

ALF OREDSSON

Citerad litteratur

WEIMARCK, HENNING. 1963. Skånes flora. Malmö.

Sedum anglicum Huds. på Christiansö

I Botaniska Notiser 1964 (s. 222—224) omtalar lektor Vilhelm Gillner de inplanteringar av *Sedum anglicum* till Christiansö, hittills obekanta i litteraturen, som gjordes på 1920-talet, kanske tidigare, av den svenske marinmålaren Oscar Hullgren. Materialet medförde han från Cornwall och Bretagne. Gillner betvivlar därför att de av mig (i Botaniska Notiser 1963, s. 105—106) funna lokalerna på Christiansö för arten ifråga, skulle vara »spontana» och härröra från artens spridning genom sjöfåglar från Sveriges eller Norges västkust eller från England, vilken förklaring jag ansåg mest plausibel. »Med all sannolikhet har *Sedum anglicum* helt människan att tacka för sin förekomst på Christiansö», skriver Gillner.

Frågan är emellertid om *Sedum anglicum*'s historia på ön är uttömd genom Hullgrens inplantering. Den möjligheten föreligger att arten funnits spontant vildväxande där långt innan inplanteringen skett. Vi skulle därmed ha ett parallellfall till *Sedum album* L., som otvivelaktigt förekommer dels som spontan, dels av människan inplanterad på ön.

På tal om *Sedum*-floran på Christiansö skulle jag vilja fästa uppmärksamheten på *S. telephium* L., som här uppträder i en form med svagt svavelgula blommor. Denna form synes vara specifik för ön.

Lund, december 1964.

GÖTE TURESSON

Summary

In Botaniska Notiser 1963 I reported on the presence of *Sedum anglicum* on Christiansö, probably spread, according to my opinion, by sea birds to the island from the main districts in Sweden or Norway, or from England. In a subsequent paper (Botaniska Notiser 1964) Dr. Gillner reports on the introduction of the species from Cornwall and Brittany by the Swedish artist Oscar Hullgren already about fourty years ago. He thinks that the appearance of the species on the island is due to man and not to a spontaneous spread.

However, the possibility remains that the species grew wild on the island long before its introduction by man, just as in the case of *Sedum album* L., which here undoubtedly grows spontaneously together with material of the species introduced by man.

Botaniska Notiser 1964 · Vol. 117 · Fasc. 4 · Lund

In Memoriam

Adolf Hugo Magnusson

1/3 1885—14/7 1964

Adolf Hugo Magnusson var född i Gottröra i Uppland, där fadern var folkskollärare. Efter studentexamen i Uppsala år 1904 och en kort tids naturvetenskapliga universitetsstudier sökte han in på seminariet i Uppsala och avlade folkskollärarexamen år 1906. Ett par års lärartjänst på Lidingö och i Onsala i Halland följdes av anställning vid Göteborgs folkskolor år 1908. Han kompletterade sin utbildning med en fil. mag.-examen i moderna språk, geografi och pedagogik år 1914. År 1918 blev han lärare vid seminariets övningsskola, en tjänst som han uppehöll tills han år 1948 avgick med pension.

Även om Hugo Magnussons lärargärning säkerligen bedrevs med skicklighet och nit, överskuggas den dock helt av hans hängivna och sällsynt produktiva livsverk inom botaniken och speciellt inom lavforskningen. Redan på 1920-talet hörde han till eliten av samtidens lavsystematiker, och vid sin bortgång var han den internationella lavforskningens grand old man.

Hans intresse för lavar väcktes i Uppsala. Den skola av lavforskare, som under 1800-talets senare decennier samlats kring Th. M. Fries, hade upplösts kring sekelskiftet. Professorn i växtbiologi Rutger Sernander, som visserligen var mera ekolog än systematiker, förde emellertid lavtraditionen vidare. Impulserna från Uppsala kom på längre sikt att spela en betydande roll för Magnussons utveckling till lichenolog. Under ferierna återvände han gärna till Uppsalamuseets rika samlingar, där han, liksom på Riksmuseet i Stockholm och senare även i Lund, var en ofta sedd gästforskare.

På västkusten, särskilt på klipporna nära stranden, fann han en art- och individrik lavflora, som i många stycken var föga känd. Hans exkursioner utsträcktes snart till hela Bohuslän samt angränsande delar av Västergötland och Halland. I yngre år ägnade han även ett visst intresse åt fanerogamer, och han publicerade notiser om nya lokaler för några arter. Särskilt intressant är hans fynd av hjorttungan vid Onsala. (Se B. Palm, *Scolopendrium vulgare* Sm. i Halland, Sv. Bot. Tidskr. 2 s. 151, 1908.)

Hans första mera betydande arbete om lavar (»Material till västkustens lavflora» 1919) visar en vid överblick över lichenologien och en mogen syn på en rad systematiska problem. Åtskilliga arter anges som nya för västkusten eller för hela Sverige. Han refererar ibland till de få svenska lichenologerna under 1910-talet, främst G. O. Malme och G. E. Du Rietz, kontakter som säkerligen var stimulerande för alla parter. Men i stort sett var Magnusson autodidakt, och hans insats utgör en bred och självständig fåra på det lichenologiska fältet.

På 1920-talet vidgades hans horisont betydligt, dels genom exkursioner i den svenska fjällvärlden, dels genom utlandsresor. Redan 1919 tillbringade han en sommar i Abisko. År 1921 återvände han dit, och 1924 var han i Lycksele Lappmark. Lappmarkerna, som lichenologiskt var föga kända, visade sig hysa en rik lavflora. I serien »New or Interesting Swedish Lichens» (i Botaniska Notiser fr.o.m. 1923) beskrev han flera för vetenskapen eller för landet nya arter, i början särskilt från Torne Träsk-området. Denna serie kom sedan att lämna många viktiga bidrag till kännedomen om de svenska lavarnas systematik och utbredning i skilda delar av landet. Sammanfattande arbeten om lappländska lavar, väsentligen grundade på insamlingar från 1920-talet men kompletterade med material samlat av andra lichenologer, utkom emellertid först flera decennier senare (Lycksele Lappmark, 1946, Torne Lappmark, 1952). Särskilt boken om Torne Lappmark, som innehåller bestämningsnycklar till en rad stora och kritiska skorplavsläkten, är ett värdefullt arbete, av stor betydelse även för lavforskare inom andra delar av Arktis.

I Lycksele Lappmark väcktes hans intresse för *Stereocaulon*, ett släkte av större lavar, som förut ansågs relativt väl känt. Magnusson visade emellertid (»Studies on Boreal Stereocaula», 1926) efter en noggrann utredning om morfologi och variation, att det innehåller en rad förut obeaktade systematiska enheter. 5 nya arter urskildes, mest på nordskandinaviskt material, vartill kom ett stort antal varieteter och former. De senare, som väl oftast är av ståndortsfaktorer orsakade modifikationer, beskrevs utförligt.

På 1920-talet gjorde Magnusson flera studieresor till Europas större lavherbarier, bl.a. Helsingfors, Paris, London, Berlin, München, Wien, Budapest och Genève. Han knöt även personliga kontakter med samtidens ledande lichenologer såsom Vainio (Helsingfors, Åbo), Lynge (Oslo), Zahlbruckner (Wien), Annie Lorrain Smith (London) samt ej minst Frey (Bern) och Erichsen (Hamburg), båda i vardagslag lärare som han själv men med lavforskning som full fritidssysselsättning. Studierna i herbarierna omväxlade med exkursioner, särskilt i Alperna.

Magnusson blev med tiden en mycket allsidig lavsystematiker. Ingen grupp i systemet var egentligen honom främmande, men hans intresse riktades snart på de stora skorplavsläktena *Acarospora, Lecidea* och *Lecanora*. År 1924 publicerade han en monografi över de skandinaviska arterna av *Acarospora*. Han urskilde 35 arter, varav 11 nybeskrivna. Till jämförelse må nämnas att Th. M. Fries (Lichenographia Scandinavica, 1871) erkände 11 arter. Nytillkommet material (jämte ett med åren allt snävare artbegrepp) gjorde att han år 1950 räknade ej mindre än 47 arter *Acarospora* från Skandinavien. *Acarospora*-studierna växte till en världsmonografi över släktet, som kom ut år 1929. Det är ett imponerande arbete på 400 sidor och unikt genom att den fortfarande är den enda existerande monografien över ett större släkte av skorplavar. 199 arter, varav 92 n.sp. eller för första gången upphöjda till artnivå, beskrevs med utförliga data om anatomi, variation och utbredning. Beskrivningar och nomenklatur grundades i regel på studier av typexemplar, vilket ofta betydde ett mödosamt detektivarbete. *Acarospora*-monografien följdes av en rad arbeten grundade på nytillkommet material och av två sammanfattande supplement (1933 och 1956). I det sistnämnda räknade han med inalles 306 arter *Acarospora* från hela världen, varav 210 med H. Magn. som auktorsnamn.

Lecidea, som i varje fall i Europa är det artrikaste lavsläktet, blev tidigt föremål för Magnussons speciella intresse. »*Lecidea rivulosa*-gruppen», d.v.s. *L. cyathoides* och ett antal besläktade arter, varav flera visade sig vara vanliga på klippor nära havet i Bohuslän och norra Halland, ägnades en systematisk utredning år 1924, vilken 1935 följdes av en utförligare kartering av denna växtgeografiskt intressanta grupp. Senare behandlade han andra sektioner av *Lecidea,* bl.a. de arktiska — högalpina *armeniaca*- och *elata*-grupperna (1931) och den på sten mycket vanliga *goniophila*-gruppen (1945). År 1952 sammanfattade han sin uppfattning av *Lecidea*-arterna i Skandinavien och Finland i två examinationsschemata, som upptog ej mindre än 360 arter.

Även till kännedomen om släktet *Lecanora* lämnade han viktiga bidrag. *L. subfusca*-gruppen (främst de skandinaviska arterna) ägnade han en mera summarisk revision år 1932. Gruppen har senare behandlats av en rad andra lichenologer (Lamb, Clauzade, Poelt och Motyka) med ganska skiftande artuppfattning. Sista ordet om denna kritiska artgrupp torde ännu ej vara sagt. Magnussons mest betydande arbete inom *Lecanora* (från år 1939) faller inom sektionen *Aspicilia,* främst arterna kring *L. cinerea, caesiocinerea, aquatica* och *laevata*. Det upptar 115 arter, varav 55 nybeskrivna eller upphöjda till artnivå, och närmar sig en monografi över dessa grupper, i varje fall för norra halvklotets vidkommande. Till *Aspicilia*-systematiken återkom han i flera senare sammanhang med beskrivning av åtskilliga nya arter.

Senare behandlade han även delar av de stora skorplavsläktena *Caloplaca* (främst *ferruginea*-gruppen, 1944), *Rinodina* (speciellt europeiska och sibiriska arter på bark och jord, 1947, senare även amerikanska arter) och *Buellia* (särskilt sydamerikanska arter, 1955).

Decenniet före sista världskriget betecknade höjdpunkten i Magnussons lichenologiska produktion. Han utgav världsmonografier över släktena *Ionaspis*, 1933, 17 arter) och *Maronea* (1934, 13 arter). Hans bearbetning av familjerna *Acarosporaceae* och *Thelocarpaceae* i andra upplagan av Rabenhorst's Kryptogamenflora von Deutschland, Österreich und der Schweiz (1935) är klar och koncis i motsats till flera bidrag av andra författare i detta mångskiftande verk. Enligt planen skulle Magnusson även behandlat *Lecideaceae*, men av kriget orsakade förhållanden avbröt verkets fortsättning.

För nordiska botanister i allmänhet torde Magnusson vara mest känd genom sin »Flora över Skandinaviens busk- och bladlavar» (1929), ett mönstergillt arbete, tyvärr sedan länge utgånget ur bokhandeln, och »Förteckning över Skandinaviens växter. 4. Lavar (1936, tillägg 1937, stencilerat supplement 1950). Lavförteckningen, som 1936 upptog 1.733 arter från Sverige, Norge och Danmark (1950 var antalet ökat till 2.052), ingår i Lunds Botaniska Förenings bekanta serie av »poängförteckningar».

I detta sammanhang bör även nämnas hans exsickatverk »Lichenes selecti Scandinavi exsiccati», varav under åren 1929—1952 utkom inalles 17 fasciklar med 425 nr. Denna samling, som bl.a. innehåller material av åtskilliga nya arter beskrivna av Magnusson, finns i de flesta större lavherbarier. Även till exsickat utgivna av andra lichenologer [Malme, Sandstede, Zahlbruckner (Lichenes rariores och Kryptogamae exsiccatae Vindobonenses)] bidrog han med material.

Från mitten av 1930-talet började Magnusson att i stigande omfattning bearbeta lavsamlingar från utomeuropeiska områden. Början gjordes med en samling hemförd av finländaren M. Brenner från A. E. Nordenskiölds expedition till Jenisejområdet år 1876. Bestämningsarbetet avslutades i stort sett, och 14 nya arter beskrevs år 1936, men det utkom aldrig något sammanfattande arbete (frånsett *Rinodina*, 1947) över denna stora samling (c:a 8.000 nr.), som befinner sig på Riksmuseet i Stockholm

Om asiatiska lavar handlar också Magnussons till formatet största verk, »Lichens from Central Asia» (1940, supplement 1944). Det behandlar de lavar som åren 1927—1935 samlades i Mongoliet och angränsande länder av Sven Hedins expeditioner, främst av B. Bohlin och D. Hummel. Området var lichenologiskt nästan okänt, vilket förklarar det höga antalet nya arter. Av inalles 216 behandlade arter var 192 nybeskrivna.

Krigsåren medförde betydande svårigheter för Magnussons arbete främst genom att det blev omöjligt att låna material från utländska herbarier. Vid slutet av 1930-talet hade han fått en stor samling lavar från Hawaii, hemförd av C. Skottsberg åren 1922, 1926 och 1938. Ett arbete om stictacéer publicerades i Göteborgsfestskriften för Skottsberg år 1940. Materialet kompletterades med åtskilligt Hawaiimaterial, mer eller mindre obestämt, från de svenska herbarierna. Under arbetets gång fick Magnusson också övertaga ett stort manuskript över Hawaiilavar, som A. Zahlbruckner efterlämnat. Materialet var huvudsakligen samlat av Abbé Faurie år 1909. Dechiffreringen av det handskrivna manuskriptet var mödosam, men så småningom inkorporerades det i Magnussons arbete, och resultatet blev ett stort verk i 3 delar, »Hawaiian Lichens» (1943—1945). 487 arter behandlades, varav 204 från Skottsbergs samlingar. 110 arter var nybeskrivna, 60 av Magnusson och 50 av Zahlbruckner. Magnusson framhöll själv i företalet att arbetet led av vissa brister. Zahlbruckners material i Wienherbariet hade han ej sett, och i allmänhet var beskrivningarna grundade mera på data ur litteraturen än på granskning av typmaterial. Efter kriget tillkom ytterligare material från Hawaii, bl.a. en ny samling av Skottsberg (från 1948) och en stor samling av Faurie, som legat obestämd i Parisherbariet. Det gamla och nya materialet sammanfattades i »A Catalogue of the Hawaiian Lichens», 1954) med examinationsschemata till de större släktena. Sammanlagt 678 arter uppgavs från Hawaiiöarna, varav Magnusson nybeskrivit inalles 82. 268 arter (38 %) angavs som endemiska.

Hawaiiarbetet var det sista större verk, som Magnusson fullbordade. Under arbetet med lavar från Hawaii och andra exotiska områden inriktades hans intresse på *Ramalina,* och under sitt sista decennium var han sysselsatt med att skriva en monografi över detta stora släkte. Han lånade ett stort material från alla ledande herbarier och beskrev i manuskript åtminstone ett hundratal nya arter. Hans efterlämnade manuskript till en *Ramalina*-monografi torde emellertid ej föreligga i så avslutat skick att det kan publiceras. Arbetet med *Ramalina* förde honom ut på nya resor, bl.a. till herbarierna i Genève, Wien och Verona år 1956. År 1958 begav han sig — 73-årig — på en tre månaders resa till U.S.A., där han genomgick materialet av *Ramalina* i de större herbarierna och sammanträffade med en rad amerikanska lichenologer.

Mot slutet av 1940-talet började hans hälsa visa tecken på försämring. En trombos i ena benet besvärade honom tidvis. Under sin krafts dagar hade han ett enastående minne och en sällsynt vid överblick över lavsystematiken och dess litterära hjälpmedel, men vid mitten av 50-talet började dessa för en systematiker så väsentligare kvaliteter att svika honom. Hans familj och hans kolleger minns med vemod, hur han de sista åren förgäves kämpade för att fullborda sitt stora *Ramalina*-verk.

Under närmare ett halvsekel stod Magnusson i livlig kontakt, brevledes eller genom personliga besök, med de flesta samtida lavforskare. Hans villa vid Fyradalersgatan 26 i Göteborg (nära Botaniska Trädgården) var en välkänd adress för lichenologer över hela världen. Många av dem såg han som gäster i sitt hem. Hans herbarium var säkerligen den största enskilda lavsamling som någonsin existerat (c:a 70.000 nr.), och hans bibliotek var synnerligen välförsett. Han föreslog gärna en exkursion, ofta till de närbelägna Änggårdsbergen eller till de lavrika klipporna på någon skärgårdsö. Där var han i sitt esse, och det var en upplevelse att följa honom på dessa lichenologiska jaktmarker, som han behärskade suveränt. Hans kolleger fann snart att bakom den till synes barska fasaden doldes en stor välvilja och en redobogenhet att bistå med råd och dåd, så snart han märkte ett verkligt intresse för lavar. Han ställde stora krav, både på sig själv och på andra, och han kunde emellanåt yttra sig rätt kritiskt om forskare som han, i regel på goda grunder, ansåg ytliga och slarviga. Att den svenska lavforskningen efter ett par decenniers stagnation upplevt en viss renässans är i betydande mån Hugo Magnussons förtjänst.

Hans insatser blev tidigt uppmärksammade av fackbotanister och akademier, och under årens lopp belönades han med en rad utmärkelser. Vetenskapssocieteten i Uppsala tilldelade honom år 1923 sitt Linnépris för hans skandinaviska *Acarospora*-monografi. År 1932 blev han hedersdoktor vid Uppsala universitet. År 1956 blev han invald i Göteborgs Vetenskaps- och Vitterhetssamhälle. Han blev även korresponderande ledamot av Bayerische Botanische Gesellschaft och hedersledamot av American Bryological Society.

Magnusson blev snart en förgrundsgestalt bland Göteborgs botanister. Åren 1935 och 1938 vikarierade han som prefekt för Göteborgs Botaniska Trädgård. Han var en av stiftarna av Göteborgs Botaniska Förening, och under trettio år var han dess sekreterare. Han blev slutligen föreningens hedersledamot.

Det är omöjligt att nu överblicka och värdera Magnussons betydelse som lavforskare, men det är uppenbart att han bör jämföras med lichenologiens stora namn: Acharius, E. Fries, Th. M. Fries, Massalongo, Nylander, Tuckerman, Müller Argoviensis, Vainio och Zahlbruckner. I motsats till dem var han ingen systembyggare eller nydanare inom gruppsystematiken, utan hans huvudinsats låg i det minutiösa beskrivandet av arter eller subspecifika enheter. I fråga om antalet beskrivna nya taxa överträffas han av få, möjligen Acharius och Nylander. Antalet lavarter, som nybeskrivits av »H. Magn.» torde uppgå till c:a 900.

Hans artbegrepp var i början tämligen vitt och gav rum åt en betydande subspecifik variation. På 1930-talet reagerade han kraftigt mot en del samtida »artmakare», främst Gyelnik och Räsänen, i arbetet »Gedanken über Flechtensystematik und ihre Methoden». Så småningom blev emellertid hans arter allt snävare avgränsade, ofta på anatomiska karaktärer såsom sporstorlek, hymeniets höjd etc. eller med hjälp av kemiska reaktioner, och under senare år var arten nästan den enda systematiska enhet han arbetade med. Hans bästa insatser faller inom de grupper som han kände genom egna iakttagelser i naturen, t.ex. *Stereocaulon* och skorplavar på västkustklipporna, under det att hans beskrivningar av exotiska arter ibland grundades på ett ganska knappt material. »Omvärdering», i regel föranledd av tillgång till rikare material är ju alla systematikers lott. Det bör också framhållas att lichenologiens artbegrepp är svårare att objektivt fastlägga än inom många andra växtgrupper. Man kan erinra om hur »lavsystematikens fader» Acharius på 1820- och 30-talen blev beskylld för onödigt artmakeri av Wallroth, Meyer och E. Fries. Liknande kritik drabbar även en del av Magnussons arbeten. Särskilt W. A. Weber (»Environmental Modification and the Taxonomy of Crustose Lichens», Svensk Bot. Tidskr. 56, s. 293, 1962) har, stödd på ett stort material från arida områden i U.S.A., framhållit att de ekologiska faktorerna ofta ger upphov till en betydande modifikativ variation, ej minst inom *Acarospora*. Kritiken kan ha visst fog, men hur framtidens artbegrepp än kommer att gestalta sig, står det likväl klart att Magnussons noggranna och utförliga beskrivningar av typexemplaren har ett bestående värde.

Sällan har det botaniska fältet sett en flitigare och hängivnare arbetare än Hugo Magnusson. Hans arbetsförmåga var nästan otrolig. Ofta tog han ett par timmars arbetspass vid mikroskop eller skrivmaskin före klockan åtta på morgonen, då hans skoldag började. Hemkommen från en full arbetsdag i katedern var han utan dröjsmål åter bland de kära lavarna, och hans arbetslampa brann till långt in på kvällens sena timmar. Att hans mödor gav synliga resultat framgår av nedanstående förteckning över hans utgivna skrifter, som upptar 136 arbeten.

Magnussons lavherbarium och bibliotek har förvärvats av Institutionen för Systematisk Botanik i Uppsala, som härmed befäst sin ställning som ett lichenologiskt centrum av första ordningen. Dessa samlingar är ett *monumentum aere perennius,* en skattkammare för framtida forskning och ett vittnesbörd om en livsgärning inom lavforskningen, som har mycket få motstycken.

OVE ALMBORN

Bibliografi över A. H. Magnussons utgivna skrifter

AfB=Arkiv för Botanik. Uppsala.
AHG=Acta Horti Gothoburgensis. — Meddelanden från Göteborgs Botaniska Trädgård. Göteborg.
BN=Botaniska Notiser. Lund.
GVH=Göteborgs Kungliga Vetenskaps- och Vitterhetssamhälles Handlingar. Göteborg.
SBT=Svensk Botanisk Tidskrift. Stockholm/Uppsala.
VAH=Kungliga Svenska Vetenskapsakademiens Handlingar. Stockholm.

Parmelia tubulosa (Hagen) Bitter funnen fertil i Uppland. SBT 4, s. (47). 1910.
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Starkare förkortningar. — Shorter abbreviations

AAS: Acta Agriculturae Scandinavica, Stockholm.
AfB: Arkiv för Botanik, Stockholm.
AHG: Agri Hortique Genetica, Landskrona.
BN: Botaniska Notiser, Lund.
ECR: Experimental Cell Research, New York (tr. i Uppsala).
GP: Grana Palynologica, Stockholm.
Her.: Hereditas, Lund.
NiL: Natur i Lappland, Uppsala.
PP: Physiologia Plantarum, Köbenhavn (tr. i Lund).
RPBR: Recent plant breeding research, Svalöf 1946—1961, Uppsala.
SBT: Svensk Botanisk Tidskrift, Stockholm.
SFS: Studia Forestalia Suecica, Stockholm.

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Arne H. Holmqvist

Litteratur

Flora Europaea Vol. 1. Lycopodiaceae—Platanaceae. — Cambridge University Press 1964. — Pris 84 shilling.

Flora Europaea är efterlängtad. De europeiska floraförfattarna har hittills ägnat sig åt exotiska områden, där med mindre ansträngning mera sensationella resultat kunnat vinnas, eller också har de arbetat med enskilda länder eller delar av Europa, där det för en eller ett fåtal personer varit lättare att överblicka materialet. När därför den första volymen av den första europeiska floran nu presenteras, är det med stor spänning man griper sig an med att ta del av innehållet.

Tanken att ge ut en flora över Europa är inte ny. Redan på 1940-talet påbörjade W. Rothmaler ett sådant arbete. Bl.a. Murbeck utarbetade ett manuskript om *Verbascum* till Rothmalers flora. Projektet kunde emellertid den gången på grund av de oroliga tiderna ej genomföras. På den internationella kongressen i Paris 1954 diskuterade man frågan om en europeisk flora. Intresset visade sig vara stort. I början av 1956 hölls ett första kommittésammanträde i Leicester.

De ledande i verksamheten är alla engelsmän. Därmed har vunnits, att de lätt kan sammanträffa för överläggning. Organisationen kan fungera.

I redaktionskommittén (the Editorial Committee) är T. G. Tutin, Leicester, ordf., V. H. Heywood, Liverpool, sekr. Övriga medlemmar är N. A. Burges, Liverpool, D. H. Valentine, Durham, S. M. Walters, Cambridge och D. A. Webb, Dublin. Förutom dessa sex ingår A. R. Clapham, Sheffield, R. D. Meikle, Kew, och A. Melderis, London, i en organisationskommitté. Vidare har ett 30-tal rådgivare från olika europeiska länder varit verksamma. Ett 50-tal specialister har bidragit med bearbetning av olika familjer, släkten och artgrupper. Av nordiska botanister har T. W. Böcher, N. Hylander, J. Jalas och R. Nordhagen på olika sätt medverkat.

Från engelska fonder har stora anslag beviljats, med vilkas hjälp man 1957 kunde upprätta ett sekretariat och avlöna heltidsanställda assistenter. Tack vare denna organisation har goda och snabba resultat kunnat erhållas, och priset kunnat sättas lågt.

Den föreliggande volymen omfattar kärlkryptogamer, gymnospermer och av angiospermerna *Amentiferae, Polygonaceae, Caryophyllaceae, Ranunculaceae, Cruciferae, Crassulaceae* samt en rad småfamiljer besläktade med dessa större grupper. Av större släkten märks *Salix* med 70, *Rumex* med 50, *Arenaria* med 51, *Minuartia* med 57, *Cerastium* med 51, *Silene* (inkl. *Melandrium*) med 166, *Dianthus* med 121, *Ranunculus* med 131, *Alyssum* med 64, *Sedum* med 57 och *Saxifraga* med 123 arter.

Vissa nybeskrivningar av taxa och ändringar i nomenklatur publiceras i en särskild serie »Notulae Systematicae» i Feddes Repertorium. Ändringar av de vetenskapliga (»latinska») namnen är nästan alltid ovälkomna. Detta gäller särskilt för vanliga eller sedan gammalt allmänt kända arter.

Vid en preliminär genomläsning har rec. observerat en del nomenklaturändringar, som här återges.

Lycopodium selago: *Huperzia selago* (L.) Bernh. ex Schrank & Mart. 1829
— *inundatum*: *Lepidotis inundata* (L.) C. Börner 1912
— *complanatum*: *Diphasium complanatum* (L.) Rothm. 1944
— *tristachyum*: *Diphasium tristachyum* (Pursh) Rothm. 1944
Isoëtes echinospora: *I. setacea* Lam. 1789
Athyrium alpestre: *A. distentifolium* Tausch ex Opiz 1820
Pseudotsuga Douglasii: *P. Menziesii* (Mirbel) Franco 1950
Larix leptolepis: *L. Kaempferi* (Lamb.) Carrière 1856
Betula verrucosa: *B. pendula* Roth 1788
Ulmus carpinifolia Gled. 1773: *U. minor* Mill. 1768
Polygonum convolvulus: *Bilderdykia convolvulus* (L.) Dumort. 1827
— *dumetorum*: *Bildardykia dumetorum* (L.) Dumort. 1827
Cerastium glutinosum: *C. pumilum* Curt. 1777 ssp. *pallens* (F. W. Schultz) Schinz & Thell. 1907
— *atrovirens* (*tetrandrum*): *C. diffusum* Pers. 1805 ssp. *diffusum*
— *subtetrandrum*: *C. diffusum* ssp. *subtetrandrum* (Lange) P. D. Sell & Whitehead 1964
Spergula vernalis: *S. Morisonii* Boreau in Duchartre 1847
Spergularia marginata: *S. media* (L.) C. Presl 1826
Tunica saxifraga: *Petrorhagia saxifraga* (L.) Link 1831
Kohlrauschia prolifera: *Petrorhaghia prolifera* (L.) Ball & Heyw. 1964
Delphinium consolida: *Consolida regalis* S. F. Gray 1821 ssp. *regalis*
Anemone hepatica: *Hepatica nobilis* Mill. 1768
Corydalis cava: *C. bulbosa* (L.) DC. 1815
Turritis glabra: *Arabis glabra* (L.) Bernh. 1800
Sedum rupestre: *S. reflexum* L. 1762

Rec. kan endast framföra den förhoppningen att nomenklaturen snart måtte stabiliseras. Benämningarna är ju vanligtvis ej problem av botaniskt slag utan endast ett nödvändigt vetenskapligt hjälpmedel. Namnändringar åstadkommer i allmänhet förargelse och bidrar föga till att stärka den botaniska systematiken.

Man kan beträffande kritiska artgrupper strida om värderingen av de olika taxa, om ett taxon bör uppskattas till art, underart eller något annat. I många fall torde det vara omöjligt att enas. Barriärerna mellan olika systematiska enheter kan ju vara av olika slag och mer eller mindre övertygande. Det viktiga är kunskapen om barriärernas natur. Sedan är värderingen av enheterna en omdömesfråga.

Den linnéanska arten *Polypodium vulgare* har i Flora Europaea uppdelats i 3 skilda arter: *P. australe* med 2n 74, *P. vulgare* med 2n 148 och *P. interjectum* med 2n 222. Här har de grundliga cytotaxonomiska undersökningar, som genomförts av Manton och hennes skola, varit vägledande. En uppdelning av *P. vulgare* i de 3 ovannämnda taxa bör kunna allmänt accepteras.

Går vi däremot till släktet *Cerastium,* där de annuella arterna bearbetats av Sell och Whitehead, de perenna av Jalas, blir man inte fullt så tillfredsställd. *C. semidecandrum* har uppdelats i 2 underarter *semidecandrum* och *macilentum,* den senare av Möschl uppskattad till en självständig art men i själva verket skild från *C. semidecandrum* s.str. blott genom avsaknad av behåring. Kala former av arter, som normalt är håriga, är ingenting ovanligt, och borde ej ens namngivas i en så översiktlig flora som denna. *C. pumilum* har uppdelats i 3 underarter *pumilum, pallens* och *litigiosum.* Ssp. *pallens* är vad vi hittills i Norden uppfattat som *C. glutinosum. C. pumilum* s.lat. uppges ha 2n 90—100. *C. glutinosum* har kromosomtalet 2n 72(70—72), vilket inte angivits i floran. Då de nämnda två enheterna är morfologiskt skilda och har olika kromosomtal, borde de värderas som arter, ej endast som underarter. Slutligen har Runemark i Bot. Not. 1961 beskrivit *C. coronense* (nom. illeg.), i Flora Europaea anförd som *C. runemarkii* men utan uppgift om kromosomtal. I Runemarks originalbeskrivning anges dock kromosomtalet till 2n 36.

Pteris arguta är hemmahörande på Madeira, Kanarieöarna och i n.v. Afrika, men upptages i Flora Europaea under namnet *P. serrulata,* beskriven av Forskål från Yemen. Här har dock Runemark i Bot. Not. 1962 gjort en utredning, vilken borde ha beaktats.

Släktet *Montia* har behandlats av Walters. *Claytonia,* enl. Örjan Nilsson rätteligen *Limnia* (med de amerikanska, i Europa införda arterna *perfoliata* och *sibirica*) har förenats med *Montia,* och de europeiska representanterna sammanslagits till *M. fontana* med 4 underarter, vilket förefaller rec., som sett Örjan Nilssons mångåriga odlingar av *Montia,* vara en mer än vanligt styvmoderlig behandling. Överhuvudtaget har underartsbegreppet enl. rec:s mening alltför ivrigt och flitigt använts.

Omnämnandet av hybrider har skett mycket ofullständigt och utan konsekvens. Ibland har hybriderna uppställts på ett sätt, som om det gällt arter, i andra fall har de nämnts i en diskussion, vilket förefaller bättre.

Tid och utrymme har inte tillåtit mer än en mycket flyktig granskning. Det har inte varit möjligt att bedöma annat än sådant material, som på senare år varit föremål för undersökningar i rec:s närmaste omgivning. Ofullkomligheter i detaljerna har framkommit, men den nu föreliggande Flora Europaea kommer att kraftigt stimulera till fortsatta undersökningar över den europeiska floran.

Henning Weimarck

Fægri, K. & Iversen, J.: *Textbook of Pollen Analysis.* 2nd ed. — Munksgaard. Copenhagen 1964. 228 s., 9 planscher. 34: 50 sv. kr.

Fægri-Iversens »Textbook» har utkommit i en ny, betydligt reviderad upplaga. Den första publicerades 1950. Med tanke på de pollenanalytiska framstegen under det sista decenniet har en moderniserad lärobok varit efterlängtad. I sexton kapitel behandlas olika avsnitt av kvartär pollenanalys och pollenmorfologi. Ett kapitel om prekvartär pollenanalys har tillkommit. Det är författat av prof. Waterbolk, Groningen. Boken avslutas med en bestämningsnyckel för nordvästeuropeiska pollentyper.

Den pollenmorfologiska terminologin följer det av danska pollenanalytiker sedan länge använda systemet (IVERSEN & TROELS-SMITH 1950). Det finns olika skolor i detta avseende. Vilket system som är bäst kan diskuteras, men det bör betonas, att för pollenanalytiker är de pollenmorfologiska termerna endast hjälpmedel vid pollenbeskrivningar (bl.a. i bestämningsnycklar). Systemet måste framför allt vara enkelt, och detta krav uppfyller det danska. Termerna är tydligt förklarade både i text och bild. Bestämningsnyckeln har väsentligt utökats, och här ligger säkerligen det största arbetet med den nya upplagan. Art- och släkturvalet är rikligt och väl avpassat för nordvästeuropeiska förhållanden. Nyckeln är uppdelad i sektioner och synnerligen överskådlig, varför den är lätt att använda. Huvudnyckeln kompletteras med specialnycklar för familjerna Cyperaceae (bl.a. skiljes en *Schoenoplectus*-typ från övriga cyperacéer), Gramineae (förutsätter användning av faskontrast), Caryophyllaceae och Plantaginaceae. Detta förfaringssätt är mycket lämpligt för att ej belasta huvudnyckeln. Ett pollenanalytiskt önskemål för framtiden är flera detaljerade specialnycklar för vissa familjer och släkten. Sannolikt skulle även Caryophyllaceae kunna behandlas mera ingående. Bestämningsnycklarna bör användas vid sidan av en referenssamling med recenta pollen och de illustrerade pollenfloror, som redan finns för Skandinavien.

I kapitlen om pollenanalytisk metodik finner man beskrivningar av bl.a. förbättrad borrteknik (ex. Livingstoneborret) och det nya inbäddningsmediet silikonolja. Nya storleksundersökningar av pollenkorn (recenta och från olika jordarter) efter olika kemisk behandling inbäddade i glycerin eller silikonolja ligger till grund för en tabell med omvandlingsfaktorer. Litteraturförteckningen har väsentligt utökats.

Läroboken är oumbärlig för pollenanalytiker, men av största värde även för de botanister, som söker upplysningar om hur pollendiagrammen i vegetationshistoriska arbeten bör tolkas.

BJÖRN E. BERGLUND

Notiser

Göteborgs Botaniska Trädgård. De sakkunniga för tillsättandet av prefektbefattningen vid Göteborgs Botaniska Trädgård, förenad med en forskningsprofessur vid Göteborgs universitet, har avgivit sina utlåtanden. Två av de sakkunniga, professorerna T. W. Böcher, Köpenhamn, och J. A. Nannfeldt, Uppsala, placerar docent Olov Hedberg, Uppsala, i första rummet till befattningen, en, professor Rudolf Florin, Stockholm, sätter docenten, t.f. professorn Tycho Norlindh främst, medan den fjärde sakkunnige, professor O. A. Höeg, Oslo, i främsta rummet placerar dr Per Wendelbo, Bergen.

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