

# Alpine und arktische Flora und Vegetation : a comparison of the alpine regions and vegetations of Eastern America, Norway and Switzerland

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Objektyp: **Article**

Zeitschrift: **Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich**

Band (Jahr): **3 (1925)**

PDF erstellt am: **20.06.2024**

Persistenter Link: <https://doi.org/10.5169/seals-306776>

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Je viens de traiter fort incomplètement d'un sujet sur lequel peu de choses ont été publiées. Je me propose, si les circonstances s'y prêtent, de poursuivre cette étude à Zermatt et ailleurs.

## XV.

## A comparison of the alpine regions and vegetations of Eastern America, Norway and Switzerland

By JOHN W. HARSHBERGER, Philadelphia

Eingegangen 12. Mai 1924<sup>1</sup>

### Topographic Comparisons

**E a s t e r n N o r t h A m e r i c a.** Eastern North America has relatively few alpine peaks, where a typical alpine flora may be found. The following comprise the mountains that rise sufficiently above the upper limit of trees to be well within the alpine region. Mt. Katahdin, Maine (1590 m. — 5215 feet); Mt. Washington, New Hampshire, (1932 m — 6300 feet) and the higher peaks of the Presidential Range; Mt. Mansfield, Vermont (1630 m. — 4363 feet), and Mt. Marcy, New York, (1630 m. — 5344 feet), with a few nearby peaks, such as Mt. Mc Intyre, (1560 m. — 5112 feet). As outlying districts with an arctic alpine flora may be mentioned western Newfoundland, Anticosti, Gaspé Peninsula and the northern Green Mountains, Vermont.

Mt. Katahdin in central Maine is a ridge several miles long instead of a dome. In parts, it is covered with red granite slabs which lie scattered promiscuously over the elevated plateau. There are a few boggy areas, but the uniformity of conditions of physiography and of habitats are reflected in a relatively meager alpine flora.

Mt. Washington has a bald and rugged summit around which storm clouds linger and upon which the blasts of storm winds

<sup>1</sup> Aus technischen Gründen hier eingefügt (die Red).

beat. The summit is piled with loose granite blocks and the sides of the mountain are seamed with a number of gorges such as Great Gulf (North), Huntington Ravine (East), Tuckerman Ravine (Southeast), Ammonoosuc Ravine, heading in the Lakes of the Clouds, is another cleft in the Mt. Washington massif. The topography is, therefore, varied and as a result there is a corresponding greater number of alpine plants. The alpine region of Mt. Mansfield in the Green Mountains, Vermont, is relatively restricted and, therefore, has a poor alpine flora. Mt. Marcy (Tahawus) in the Adirondack Mountains lacks loose boulders, for the rocks are planed smooth, making for an extremely bare summit with few situations favorable for alpine plants.

N o r w a y. Norway has four districts where snow mountains are found. The first is the plateau known as Hardangervidden with the alpine peaks around Finse on the Bergen Railroad. The second is along the north side of Sognefjord, while the third known as Jotunheimen is at the head of that fjord. The fourth is the Dovre plateau from which rise snowy peaks, such as Snehatta. The real Jotunheimen, which was crossed by the writer in August 1922, is a wilderness of grim peaks, forbidding bogs, glittering snow fields, rocky fjeld with many snow covered peaks such as Galdhøpig, Glittertind, Memuntinder, Fanaraaken, Gokkeraxlen, Troidsteinhöier, Skaagastolstind. Glittertind is probably the highest mountain in Norway (1512 m — 8240 feet). At an elevation of 4300 feet the first snowfields were encountered on August 9, 1922 and the trail across the Sognefjeld was often covered with larger and smaller snow patches, but wherever the snow had melted recently plants in flower were found in abundance. At the highest elevation reached on the trail (1494 m. — 4900 feet), a wide panorama was presented. Here is the Fanaraaken Range with living glaciers feeding large alpine lakes, the source of several important streams. Beyond lay Smörstabben with its glaciers névé and icy peaks. Glacial lakes, some of them covered with ice, nestle in the mountain basins. Yet the southern slopes were bright with flowers of alpine plants forced into growth by the warmth of the sun. The Dovrefjeld repeats the topography of the Sognefjeld with the exception that it is not dominated by as high peaks as is the latter, although

Snehatta (2438 m. — 8000 feet) and Rondane dominate the country. Thus across Norway from Hardangerfjord to Trondhjemfjord, the mountain ranges extend presenting the greatest variety of terrain elevated sufficiently above sea level to have alpine conditions. Here is presented an arctic-alpine flora of great richness as the habitats and exposures vary from station to station.

**S w i t z e r l a n d.** Physiographically Switzerland presents three well-defined regions, which show in general southwest and northeast trends. The first region comprises the Jura mountains, the second the Swiss plain extending from Lake Geneva to Lake Constance, and the third the alpine system of mountains. The alpine mountains proper are divided geologically into a northern limestone division with many prominent minor elevations and a southern division, the crystalline series. The crystalline series comprises the northern giants of the Bernese Oberland and the southern Pennine and Lepontine Alps comprising the entire mass of central and southern Switzerland. There are many lofty summits in the Alps. Mt. Blanc (4810 m. — 15 782 feet); Monte Rosa (4638 m. — 15 215 feet), Matterhorn (4505 m. — 14 780 feet), Jungfrau (4167 m. — 13 670 feet), are some of the highest peaks. There are large alpine meadows on the flanks of these mountains and numerous alpine lakes. The terrain of Switzerland is, therefore, of a most varied character and the arctic-alpine flora is consequently large and adapted to growth under the manifold conditions of soil and exposure.

**C o n c l u s i o n s f r o m T o p o g r a p h i c S u r v e y.** The preceding short survey of the physiographic conditions of the alpine regions of eastern North America, Norway and Switzerland shows that the eastern American alpine regions are limited in extent and widely disconnected in Gaspé, Maine, New Hampshire, Vermont and New York. The extensive plateaus, or fell fields connecting the various alpine peaks in Norway present almost continuous areas from north to south, where alpine plants can spread and grow. The same is true of the Swiss Alps, where from east to west through central Europe extend almost continuous chains of snow mountains with country between, which reaches above timber line.

### Comparison of tree limits

**E a s t e r n A m e r i c a.** The belt of forest trees extends up the southern slopes of Mt. Katahdin to approximately 1067 m. (3500 feet) and 914 m. (3000 feet) on the north slopes. The belt of dwarf trees (Krummholz, pucker-bush) extends to an elevation of 1219 m. (4000 feet). Trees of merchantable size extend upwards on Mt. Washington to 1219 m. to 1372 m. (4000 to 4500 feet). Here cone production ceases, the trees reproducing and extending by a process of layering. The puckerbush extends upwards on the slopes of Mt. Washington above the Alpine Garden (1876 m. — 5500 feet). Absolute tree line is not many hundred meters below the top of Mt. Washington. Descending from the summit of the mountain, the writer had to force his way through dwarf timber above the level of the Alpine Garden. In some places, he walked some distance on the tops of the prostrate trees. The alpine area on Mt. Mansfield, one of the Green Mountains in Vermont, is extremely circumscribed. Trees in upright form extend up to 1219 m. (4000 feet) and at the summit 1330 m. (4364 feet) there are gnarled trees growing in the rifts between the rocks. Dwarf timber is reached at 1503 m. (5000 feet) on Mt. Marcy (Tahawus) in the Adirondacks. At 1550 m. trees are only 3—6 decimeters (1—2 feet) high and disappear entirely at approximately 1600 m. (5248 feet) not far below the summit.

**S c a n d i n a v i a :** In Dalarne, Sweden, GUNNAR SAMUELSON<sup>1</sup> puts the limit of coniferous trees in the mountains of that country at 760 m. (2492 feet). The upper limit of the birch in Dalarne is between 800 m. and 955 m. (2624 feet to 3132 feet). VESTERGRENN places the tree limit in the Sarek mountains at 750 m. The upper limit of the coniferous forest in Torne Lappmark is placed by THORE C. E. FRIES<sup>2</sup> at between 360 m.—430 m. (1181 feet to 1410 feet). WILLE<sup>3</sup> in his «Flora of Norway and its Immigration» gives a table which is apropos.

<sup>1</sup> SAMUELSON, GUNNAR: Studien über die Vegetation der Hochgebirgsgegenden von Dalarne. Nova Acta Regiae Societatis Scientiarum Upsaliensis. Ser. IV, Vol. 4, No. 8, 1917.

<sup>2</sup> FRIES, THORE C. E. Botanische Untersuchungen im Nördlichsten Schweden, Uppsala, 1913.

<sup>3</sup> Annals of the Missouri Botanical Garden 2: 63, April 1915.

	Snow line. Ft.	Birch Limit. Ft.	Pine Limit. Ft.
Gausta in Telemarken (South of Norway),	—	3450	3024—3113
Vos (west of Norway)	3936	3359	1994
Snaehatta in the Dovre Mountains (Central Norway)	5375	3464	2880
Rödö in Helgeland (just within Arctic Circle)	3280	—	777
Alten in Finnmark (70° N. Lat.)	3516	1476	777—1023

Switzerland. SCHRÖTER in the second edition of his «Das Pflanzenleben der Alpen» (1923) gives (page 33) the mean altitude of the forest limit for the most important regions of Switzerland. In the southern high Alps it is 2060 m. (6757 feet); for the northern high Alps, 1800 m. (5904 feet); for the Voralps 1640 m. (5379 feet). The highest elevation recorded for the forest limit in Switzerland is in the Ortler Group 2159 m. (7053 feet). When one sees *Pinus cembra*, as above the Morteratsch Glacier, as full sized trees above the usual tree limit, one is led to believe that the tree limit reached much higher in former centuries than in the present one. In other words, the present tree limit in Switzerland has been caused by man's interference and is, therefore, an artificial one.

### Floral comparisons

A few comparative notes are given below of species, which have been collected in the botanical field work of the author, and the geographical distribution of which has appealed to him especially. They are presented in systematic sequence.

*Salix herbacea* LINN. occurs on Mt. Katahdin in Maine, on Mt. Washington in New Hampshire, on the Sognefjeld in Norway and on the Alps of Switzerland. On Mt. Washington I have found it in the Great Gulf and in the Alpine Garden in patches usually where the snow has lasted well into the summer. The plant on the Sognefjeld of Norway covers areas, an acre or more in extent always where the snow persists until midsummer. This prostrate willow grows in the Jura and in the Swiss Alps, as a snow patch plant, but according to my observations never in such pure growth over large areas as in Norway.

*Phleum alpinum* LINN. is found in eastern America, Norway, Sweden and Switzerland, but I have not seen it in large quantities anywhere in these countries.

*Oxyria digyna* HILL. grows in wet places at the head of the Great Gulf on Mt. Washington. It is not an abundant plant there. In the European Alps, it is not uncommon. It is widely spread and in considerable abundance on the Sognefjeld of Norway. There it becomes one of the most conspicuous plants of that elevated plateau.

*Polygonum viviparum* LINN. The alpine bistort, or serpent-grass, extends in America from Greenland and Labrador to Alaska, south to the summits of the mountains of New England (Mt. Washington), and in the Rocky Mountains to Colorado. It was noticed by me growing in the greatest abundance on the Sognefjeld in central Norway at 1214 m. to 1494 m., (4000 to 4900 feet) and was collected by me on Mt. Pilatus and on the Gornergrat in Switzerland. It is widely distributed in the Alps, Voralp and Jura. The wide geographic range of this small plant is one of the many interest points brought by a comparison of the alpine floras of the world.

*Silene acaulis* LINN. This plant on Mt. Washington occurs on the grassy areas just below the summit, but although not rare it is not a common plant. In the Sognefjeld, according to my observations, it has a scattered distribution. The abundance of the plant in the European Alps and the size of the cushions almost smothered with pink flowers was a revelation to the writer, while on the Third International Phytogeographic Excursion through the Swiss Alps in the summer of 1923.

*Sibbaldia procumbens* LINN. discovered by the older New England botanists on Mt. Washington several generations ago was lost to sight for many years until its existence on that mountain became mythical. A few years ago, however, a party of the New England Botanical Club rediscovered the plant on Mt. Washington, although it is there extremely rare. The plant occurs in considerable abundance on the Sognefjeld in Norway, where I have collected it. It occurs in the Swiss Alps, but I have no information as to its abundance there. It was collected by the writer on Alp Buffalora.

*Sedum roseum* (LINN.) SCOP. The red-root occurs in America in rocky places, Labrador and Arctic America to Maine, Vermont, Chittenango Falls, New York and on the red shale cliffs of the Delaware River in eastern Pennsylvania. On the Nockamixon Rocks in Pennsylvania it occupies the upper part of a rocky amphitheatre where there are probably not over a hundred plants. This plant is one of the most conspicuous and abundant plants on the Sognefjeld above 1219 m. (4000 feet), showing what continuity of surface conditions will do in the spread of a plant. It occurs also in Switzerland, but it is rare there.

*Diapensia lapponica* LINN. This alpine cushion plant grows in eastern America on Mt. Katahdin, Mt. Washington, Mt. Marcy. On these mountains it is not a rare plant, but can hardly be called an abundant one. It occurs in Norway and Sweden, but is absent from Switzerland.

*Loiseleuria procumbens* DESV. grows as an alpine, prostrate perennial on Mt. Washington. I collected it in Upper Boeverdalen, Norway where it grows in extended mats. It is a plant of the alpine regions of Switzerland. Here I collected it on Alp Buffalora at the Bernina Hospiz, among the loose rocks of the Cambrena Delta.

*Phyllodoce coerulea* LINN. This alpine plant also called *Bryanthus taxifolius* ASA GRAY is found on Mt. Katahdin and Mt. Washington. It grows in Upper Boeverdalen, Norway, where the writer gathered specimens in flower on August 10, 1922. It is absent from the Swiss Alps.

*Rhododendron lapponicum* WAHL. This species was first discovered by LINNAEUS in the high mountainous regions of Lapland. It forms a constituent of the alpine floras of Mt. Katahdin, Mt. Washington and Mt. Marcy (Tahawus), but is absent from the Alps of Switzerland.

*Veronica alpina* LINN. This small alpine plant with bright blue flowers is found on Mt. Washington in New Hampshire, in Norway and in Sweden. It occurs in the high Alps of Europe at elevations between 1000 m. to 3050 m. Here it usually grows in meadows and on loose rubble of talus slopes, or screes.



### Conclusion

The foregoing notes have been written as a contribution to the «Festschrift zum 70. Geburtstag von Prof. Dr. CARL SCHRÖTER, Zürich.» They represent the facts which have appealed to the writer in a comparative field study of alpine-arctic species in eastern North America, Norway and Switzerland. The paper is not a monograph, but merely the presentation of some comparative data which should appeal to American, as well, as to European alpinists and botanists, and lead them to sympathize with the scientific aims and investigations of each other and enable them to see the interdependence of all scientific botanical research, however widely separated the countries and floras which are chosen for investigation.

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## Zweiter Teil

# Ausseralpine Vegetation

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### I.

## Natürliche Wiesen in Russland

Von Prof. G. J. TANFILJEF, Odessa

Eingegangen 1. November 1924

Eine überaus hervorragende klimatische Eigentümlichkeit von Osteuropa bildet, neben dessen Kontinentalität, seine mächtige Schneedecke. Ganz besonders grosse Schneemengen sammeln sich mit Vorliebe im Windschutz der Flusstäler an und verschwinden im Norden oft erst im Mai mit der Befreiung der Flüsse von ihren Eisfesseln, die sie im hohen Norden 8½ bis 9 Monate, in Mittlrussland etwa 6 Monate, im Süden etwa 2½ bis 3 Monate tragen.

Der Schnee hat nun für die Vegetation eine überaus grosse Bedeutung, da er nicht nur den Boden, also auch die Pflanzen mit Wasser versorgt, sondern ihm auch einen Schutz gegen die strenge Winterkälte bietet, was schon WAHLENBERG in seiner