

DET KGL. NORSKE VIDENSKABERS SELSKAB
MUSEET

GUNNERIA

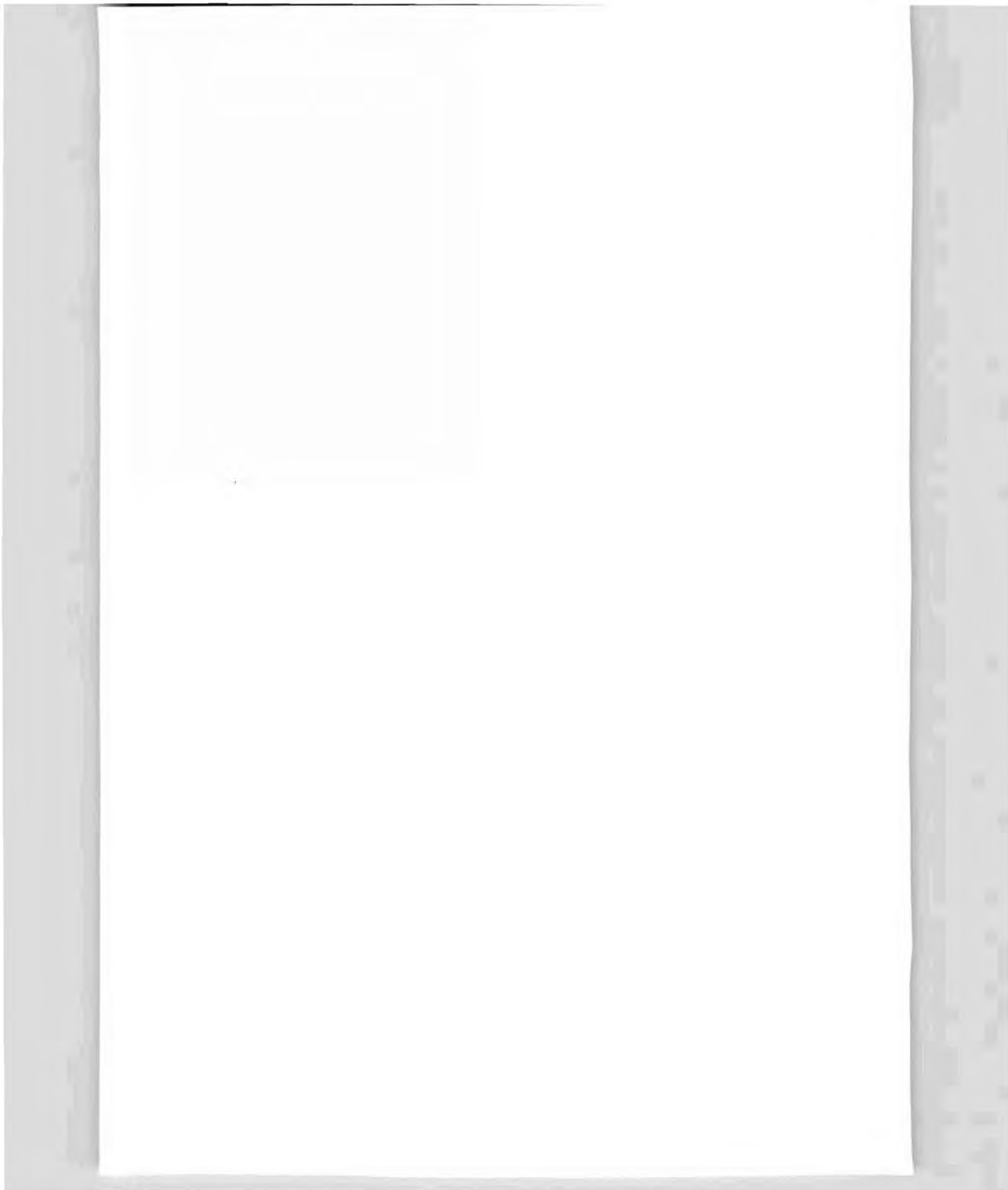
41



Arne A. Frisvoll

A TAXONOMIC REVISION OF
THE *RACOMITRIUM CANESCENS* GROUP
(BRYOPHYTA, GRIMMIALES)

TRONDHEIM 1983

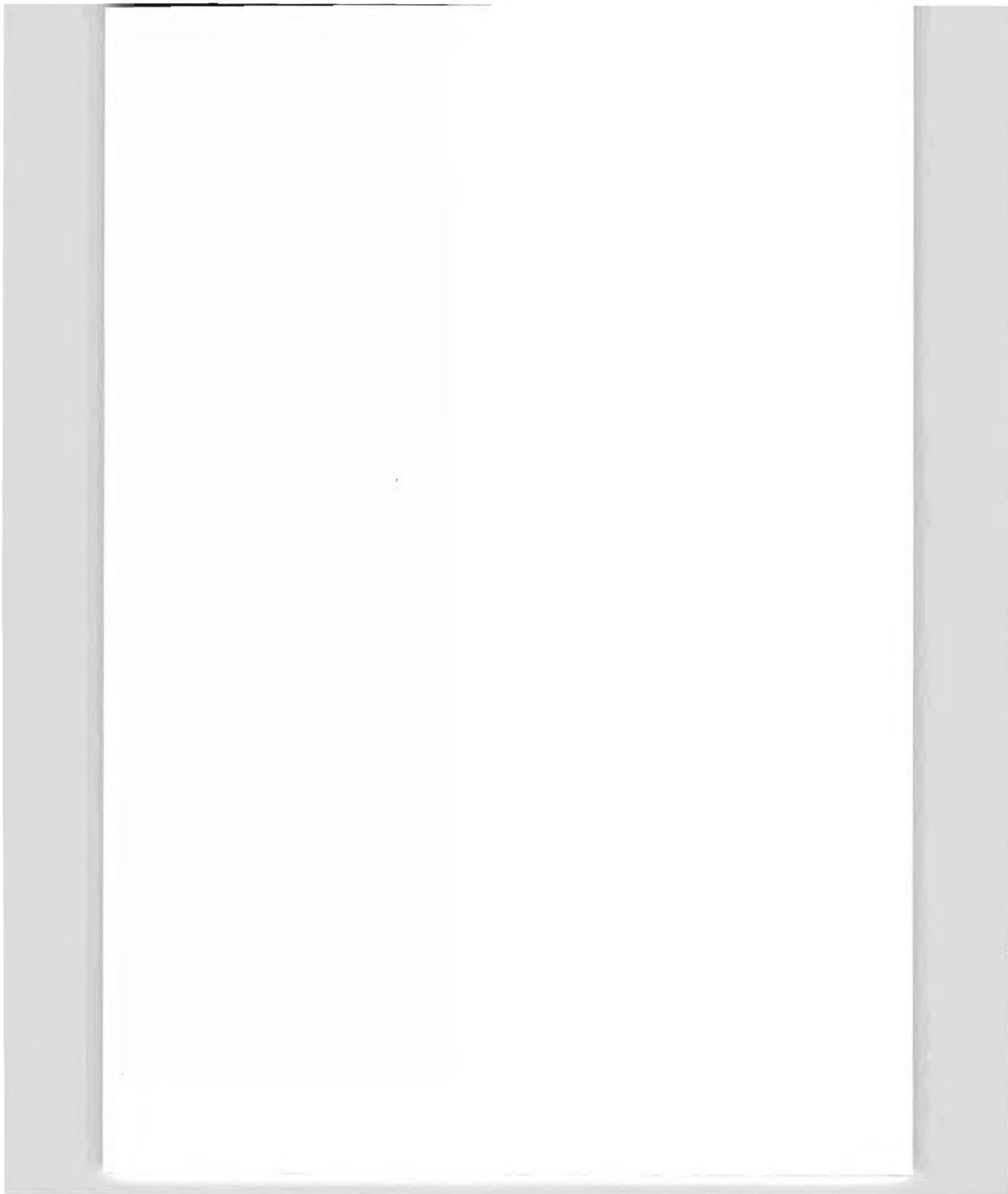


A TAXONOMIC REVISION OF THE *RACOMITRIUM*
CANESCENS GROUP (BRYOPHYTA, GRIMMIALES)

by

Arne A. Frisvoll

University of Trondheim
The Royal Norwegian Society of Sciences and Letters, The Museum

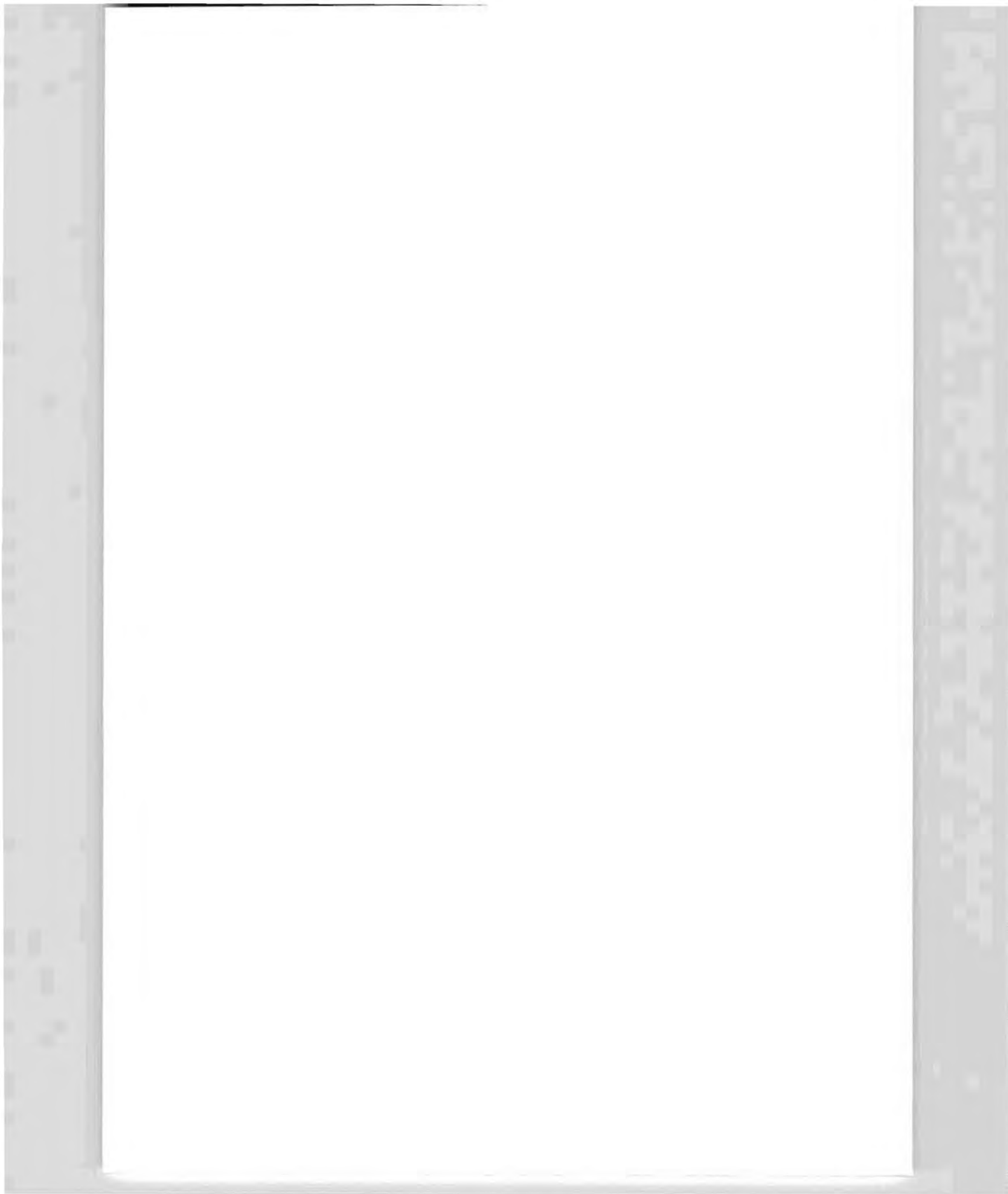


Aber erst eine monographische Bearbeitung dieser Pflanze [*Racomitrium canescens*], der ein sehr grosses Material und eine eingehende Beobachtung zugrunde gelegt werden müsste, kann eine befriedigende Gliederung ermöglichen.

Leopold Loeske in
Die Laubmoose Europas. I.
Grimmiaceae, p. 190. 1913.

The literature ... allots *R. ericoides* a total area roughly similar to that of *R. canescens*. The distribution of the two species in northern Europe certainly suggests that a closer examination of all the pertinent material would show marked differences in their total ranges, and that additional taxa should perhaps be separated in order to clear up the situation within the *R. canescens* group.

Kirsti Heinonen in
Ann. Bot. Fennici 8: 148.
1971.



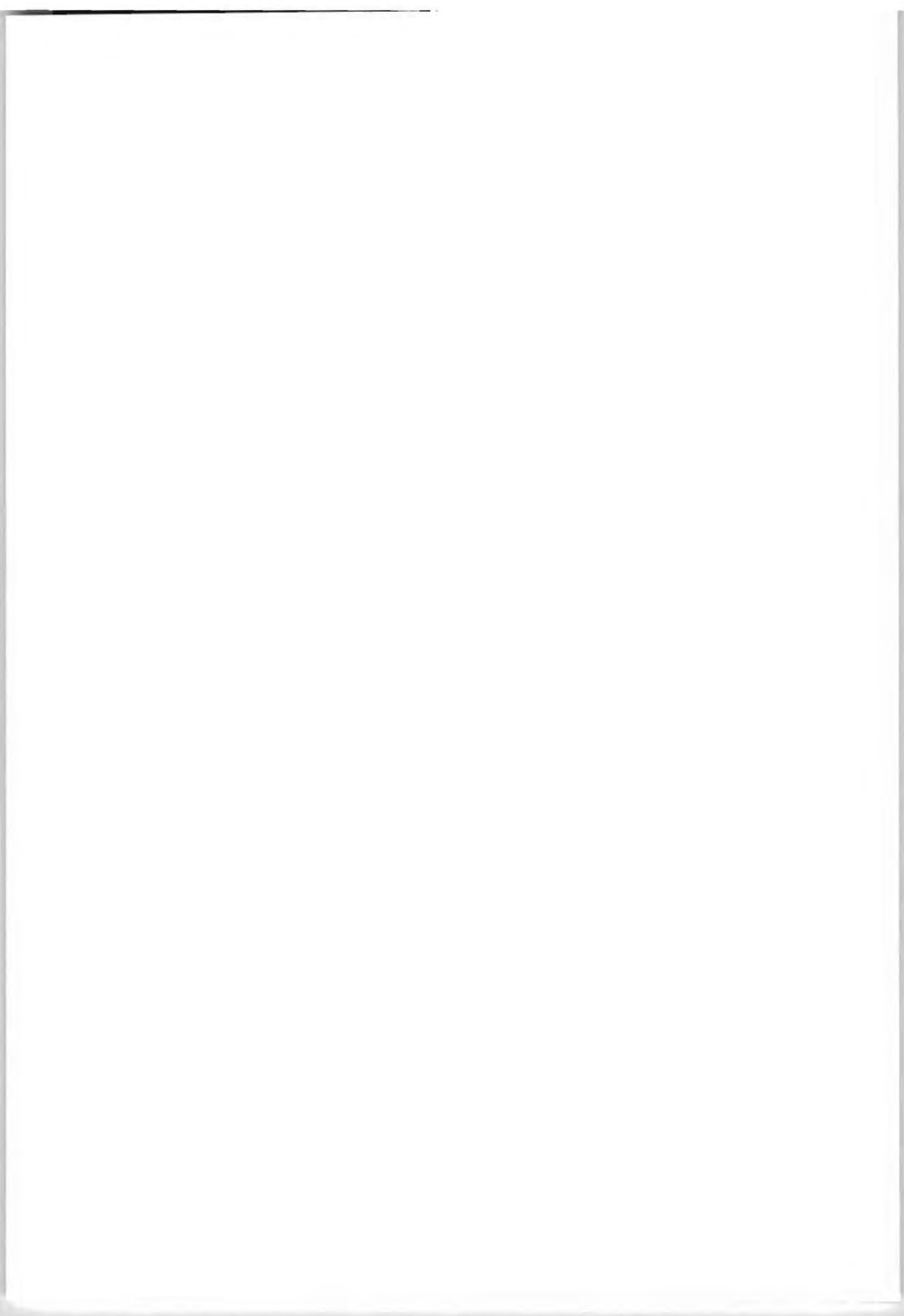
ABSTRACT

Frisvoll, Arne A. 1983. A taxonomic revision of the *Racomitrium canescens* group (Bryophyta, Grimmiales). *Gunneria* 41: 1-181.¹

From the study of mixed stands it is evident that many distinct genotypes occur in the *Racomitrium canescens* group. The numerous parallel environmental modifications presented by the genotypes have hitherto prevented a good understanding of the taxonomy of the group, and standard short designations describing these modifications are proposed. A number of stable leaf characteristics have been found, including the form and papillosity of the leaves, and the structure of costa, hairpoint and papillae. Within the genus, the taxa related to *R. canescens* constitute a natural group, which here is treated as a section; *Racomitrium* sect. *Racomitrium* is divided into two subsections: subsect. *Canescens* Frisvoll subsect. nov. with short branched costa and obtusely keeled leaves, and subsect. *Ericoides* Frisvoll subsect. nov. with long unbranched costa and more sharply keeled leaves. In this paper subsect. *Ericoides* includes six species: *R. ericoides* ((Web.) ex Brid.) Brid., *R. elongatum* (Ehrh.) ex Frisvoll spec. nov., *R. pygmaeum* Frisvoll spec. nov., *R. barbuloides* Card., *R. muticum* (Kindb. in Macoun) Frisvoll stat. nov., and *R. japonicum* Doz. et Molk.; and subsect. *Canescens* includes two species and one subspecies: *R. canescens* (Timm ex Hedw.) Brid. subsp. *canescens*, *R. canescens* subsp. *latifolium* (C. Jens. in J. Lange et C. Jens.) Frisvoll stat. nov., and *R. panschii* (C. Müll.) Kindb. Each taxon is described and illustrated, and the current known distribution is mapped. The status of all names previously proposed in the group is discussed. In Norway, *R. panschii* occurs in Svalbard, *R. ericoides* occurs in most districts, *R. canescens* subsp. *latifolium* is northern, *R. canescens* subsp. *canescens* is eastern and southern, and *R. elongatum* is western and southern.

Arne A. Frisvoll, University of Trondheim, The Royal Norwegian Society of Sciences and Letters, The Museum, N-7000 Trondheim, Norway.

¹ Botanical Series No. 13.



CONTENTS

I	INTRODUCTION	9
II	MATERIAL	10
III	PRE-HEDWIGIAN HISTORY	10
	A Names and descriptions	10
	B Illustrations	13
IV	MIXED STANDS	16
	a Definition and history	16
	b Mixed stands with three taxa	18
	c Mixed stands between two taxa	19
	d Summary	29
V	ENVIRONMENTAL MODIFICATIONS	30
VI	GENERAL ECOLOGY	38
VII	GENERAL DISTRIBUTION	39
VIII	TAXONOMIC CHARACTERS	42
	A Gametophyte	42
	B Sporophyte	50
IX	TAXONOMY	53
	A <i>Racomitrium</i> sect. <i>Racomitrium</i>	54
	B Key to subsections and species	55
	C Subsect. <i>Ericoides</i>	58
	1 <i>Racomitrium ericoides</i>	60
	2 <i>Racomitrium elongatum</i>	74
	3 <i>Racomitrium pygmaeum</i>	83
	4 <i>Racomitrium barbuloides</i>	89
	5 <i>Racomitrium muticum</i>	95
	6 <i>Racomitrium japonicum</i>	101
	D Subsect. <i>Canescens</i>	106
	7 <i>Racomitrium canescens</i>	106
	a <i>Racomitrium canescens</i> subsp. <i>canescens</i>	107
	b <i>Racomitrium canescens</i> subsp. <i>latifolium</i>	123
	8 <i>Racomitrium panschii</i>	128
X	TAXA EXCLUDED FROM THE GROUP	138
XI	AN ANNOTATED LIST OF THE BASIONYMS PROPOSED IN THE GROUP	138
XII	TAXA WITHOUT LOCATED TYPE MATERIAL	167

APPENDIX. THE <i>RACOMITRIUM CANESCENS</i> GROUP IN NORWAY ...	169
A The Mainland	169
B Svalbard	172
C Jan Mayen	172
REFERENCES	174

1. INTRODUCTION

Some taxa of the *Racomitrium canescens* group are common in most parts of the North Temperate and Arctic zones, and they are often referred to in botanical works from the area. Since 1801, the starting point of the nomenclature of mosses, eleven specific epithets have been proposed in the group, but *R. canescens* has usually been treated as a polymorphous species including in it the other taxa. With regard to Europe, Loeske (1913, 1930) monographed Grimmiales including the *R. canescens* group. In Loeske's (1930) account the author was not able to discover the basic differential characteristics between *R. canescens* s.l. and *R. ericoides* s.l.; in fact he obscured rather than elucidated the differences between them. It is likely that Loeske's monographs perpetuated the idea that *R. ericoides* is an unimportant variety, form or modification of *R. canescens*. The first step towards a better understanding of the group was taken by Heinonen (1971). In an excellent paper she declared that *R. ericoides* ought to be treated as a taxon distinct from *R. canescens* at the species level. This was a revolutionary discovery as *R. ericoides* had been included in *R. canescens* as a subordinate taxon or neglected for a long time (probably since it was treated as a species by De Notaris, 1869). After Heinonen (1971) presented her study, *R. ericoides* sensu Heinonen has sometimes been accepted as a species. Noguchi (1974) published a monograph of the genus *Racomitrium* in Japan. He recognized one species in the group, viz. *R. canescens* including the varieties *canescens*, *ericoides* and *epilosum*. According to the present study, *R. canescens* is uncommon in Japan, whereas two other species are common. Smith (1978), Steere (1978), and Crum and Anderson (1981) all refer to Heinonen's (1971) paper, but the first author treats *R. ericoides* as a variety, and the other authors treat it as a synonym of *R. canescens*. A strange view of *R. ericoides* was presented by Düll (1980: 296): "Obwohl taxonomisch gut von *R. canescens* geschieden, besser [sic] die Einstufung als Varietät." It is evident that the group is in need of a taxonomic revision.

In this paper the following designations are regarded as synonyms: *Racomitrium* sect. *Racomitrium* = the *R. canescens* group = *R. canescens* coll.; *Racomitrium* sect. *Racomitrium* subsect. *Canescens* = *R. canescens* s.l.; *Racomitrium* sect. *Racomitrium* subsect. *Ericoides* = *R. ericoides* s.l.; *Racomitrium canescens* = *R. canescens* subsp.

canescens plus *R. canescens* subsp. *latifolium*. The following abbreviations occur:

b = *R. barbuloides*; c = *R. canescens*; cc = *R. canescens* subsp. *canescens*; cl = *R. canescens* subsp. *latifolium*; el = *R. elongatum*; er = *R. ericoides*; j = *R. japonicum*; m = *R. muticum*; pa = *R. panschii*; py = *R. pygmaeum*.

II. MATERIAL

Material for the present study has been requested from the following herbaria; the herbaria which are marked with an asterisk have not replied: ALA, ALTA, B, BG, BM, BP, C, FI, G, GJO, GL, GOET, H, HAL, HBG, JE, KR, KRAM-B, L, LY, MAK, MSTR, NFLD, NICH, NY, O, OULU, OXF, PAV, PC, *PI, POZ, PRC, S, *TR, TRH, TROM, UBC, UPS, W, WTU, WU, and ZT. With regard to Svalbard specimens were also borrowed from Oosterveld and Heinemeijer's collections (Netherlands' Foundation for Arctic Biological Research, Zeist) and J.-P. Frahm's private herbarium in Duisburg. Literary records have been disregarded. I have tried to see type material of all but one of the taxa proposed in the group, and have located and examined types of all validly published specific names; and all of the commonly used varietal names have been identified (Tab. 3, p. 139). All but six subordinate taxa consider European material, and I assume that the European types which I have not seen refer to modifications of *R. canescens*, *R. elongatum* and *R. ericoides*. The six extra-European taxa are based on Japanese and North-American material; of these I have seen five. Comments on all names proposed in *Racomitrium* sect. *Racomitrium* are presented in a separate section.

III. PRE-HEDWIGIAN HISTORY

A. Names and descriptions

The continental and western European taxa of the *Racomitrium canescens* group have been present in the literature for a long

time. Dillenius (1741: 368, 371) described "The common hoary, Hypnum-like Bryum": *Bryum hypnoides, hirsutiae canescens, vulgare* (Loca: "Verum potuisset prope Londinum in Ericeto nigro, Wulwicensi & Hamstediensis videre. Vidi porro in saltu Enfieldensi, in Ericeto Dartfordiensi & copiose passim in Cambria.") and "The Heath-like alpine Bryum, with bearded Heads": *Bryum hypnoides, Ericae facie, capsulis barbatis, alpinum* ("In ... montis Widhva Cambris, ..."). His herbarium makes it clear that the former phrase-name refers, inter alia, to three taxa in the *R. canescens* group (see p. 111, and below), whereas the latter phrase-name refers to *R. ericoides* (see p. 67, and below). The fact that Dillenius in 1741 could present two synonyms to his *Bryum hypnoides, Ericae facie, capsulis barbatis, alpinum* and eleven synonyms to his *Bryum hypnoides, hirsutiae canescens, vulgare* is significant. The first two synonyms are found in Ray (1724: 478, *Bryum hypnoides capitulis plurimis erectis, non lanuginosum* and *Muscus trichodes montanus, capitulis erectis, foliis Ericae non hirsutis, cauliculis procumbentibus* - "On the moist Rocks of Widna. Dr. Richardson." [Snowdon, Wales]).

With regard to *Bryum hypnoides, hirsutiae canescens, vulgare* the first mentioned author of the synonyms are (almost in order of time as in Dillenius, 1741): Caspar Bauhin (1623: 361, *Muscus terrestris candidus ramosus* - [Switzerland ?]); James Petiver (1695: 13, *Muscus trichoides lanuginosus Alpinus* - "Our small hairy Mountain Goldilocks. I found this about Mid-summer, 1692, on some Rocks in Leicestershire." [England]); John Ray (1696: 31, *Muscus capillaris, lanugine canescens, pediculis tenuibus oblongis, capitulis in mucrones longos recta sursum exporrectis* - "Communicavit D. Vernon" [Cambridge, England]); Joseph Pitton de Tournefort (1698: 500, *Muscus capillaceus, densissimus, lanuginosus* - "Cette mousse est couchée sur les rochers de saint Germain & de Fontainebleau." [Paris, France]); Johann Scheuchzer (1703: 138, *Muscus capillaris ramosus apicibus candicantibus* - [The Alps, Switzerland]); do. (1723: 516, *Muscus capillaceus densissimus lanuginosus albo viridis apicibus niveis* - "... in saxo quodam Grindeliae Vallis, ..." [Grindelwald, Switzerland]); Henrich Bernhard Ruppius (1718: 342, *Muscus ericetorum, hirsutiae canescens, & ramosus* - "In ericetis, quercetisque passim." [Jena, E. Germany]); Johann Jacob Dillenius (1719: 224, *Bryum erectis capitulis trichodes, lanuginosum* - "Locis arenosis & in pascuis siccioribus abunde." [Giessen, W. Germany]); John Ray (1724: 97, *Muscus trichoides*

montanus Ericæ hirsuto folio, capitulis erectis acutis - "On Black-Heath and Dartford-Heath." [England]); Hermann Boerhaave (1720: 20, *Muscus terrestris tenuioribus foliis, cæspitosus, varius* - [Leiden, Netherlands]); and Sebastian Vaillant (1727: Tab. 26, Fig. 14., *Muscus foliis plurimis reflexis, ex uno puncto confertis* - [Paris, France]).

Most of these phrase-names probably refer to *Racomitrium canescens* coll., but may also in addition refer to various *Racomitrium* species with long hairpoints, especially of the *heterostichum* group; *R. lanuginosum* was usually named separately. When herbarium material is lacking it is often impossible to ascertain the identity of the phrase-name as employed by a special author (such material is not sought after), but sometimes the locality and description may indicate which taxon is considered.

Linnaeus (1745: 326) adopted Dillenius' (1741) phrase-names *Bryum hypnoides*, *hirsutie canescens*, *vulgare* and *Bryum hypnoides*, *Ericæ facie*, *capsulis barbatis*, *alpinum* as subordinate (β and ξ respectively) to his *Bryum capsulis erectis, caule erecto, ramis lateralibus brevibus fertilibus* [= *Racomitrium lanuginosum* fid. Möller 1931: 149]. But in the first edition of *Species Plantarum* (Linnaeus 1753: 1120) he only included *Bryum hypnoides* γ *Bryum hypnoides*, *Ericæ facie*, *capsulis barbatis*, *alpinum*. Later (Linnaeus 1755: 392) he also correspondingly listed *Bryum hypnoides* β *Bryum hypnoides*, *hirsutie canescens*, *vulgare*.

The nomenclatural history of *Racomitrium canescens* and *R. ericoides* (s.l.) between 1753 and 1801 was minutely recorded by Bridel (1826: 209f.). The names used in this period were mostly binomial combinations; with regard to *R. canescens*: *Bryum canescens*, *B. hypnoides*, *B. hypnoides* var., *Hypnum canescens* var. *pilosum*, and *Trichostomum canescens*; with regard to *Racomitrium ericoides* (s.l.): *Bryum ericoides*, *B. elongatum*, *B. hypnoides* var., *Hypnum canescens* var. *ericoides*, *Trichostomum ericoides*, *T. canescens* var., and *T. elongatum*. The meaning of these names must be checked against original material if we are to know which of the actual three continental and western European taxa were considered by a particular author. With regard to the different manners of dealing with the two taxa by post-Hedwigian authors, I refer to the Introduction in Heinonen (1971). As to valid nomenclature and typification see comments under *R. canescens* subsp. *canescens*, *R. elongatum* and *R. ericoides* in the taxonomical section.

B. Illustrations

Vaillant (1727: Tab. 26, Fig. 14) figured two plants of his *Muscus foliis plurimis reflexis, ex uno puncto confertis* (the moss was not described in the text); the figures refer to *Racomitrium ericoides* [s.l.] as indicated by Bridel (1798: 126), Röhling (1800: 258) and Lindberg (1863: 459). In my opinion it is a good illustration of *R. elongatum* (Fig. 1 A). This is the earliest illustration

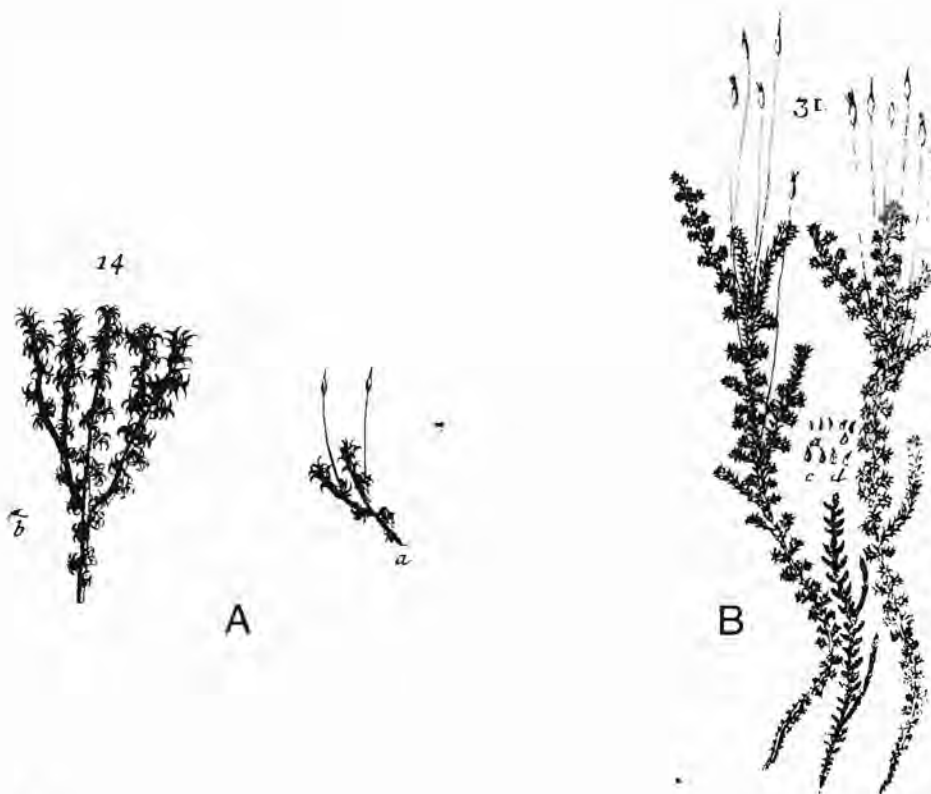


Fig. 1. A. Vaillant (1727) Tab. 26, Fig. 14. *Muscus foliis plurimis reflexis, ex uno puncto confertis*. a. Fertile plant. b. Leaf. B. Dillenius (1741) Tab. 47, Fig. 31. *Bryum hypnoides, Erica facie, capsulis barbatis, alpinum*. Left and right: moist plants; middle: dry plant. a-b. Branch leaves. c-d. Stem leaves. (cf. Fig. 24.) (1:1)

of any taxon in the *R. canescens* group; it is curious that it refers to a taxon which until now has been totally neglected or misunderstood.

Dillenius (1741: Tab. 47, Fig. 27 A-G) figured seven plants of his *Bryum hypnoides*, *hirsutiae canescens*, *vulgare*. With regard to the corresponding herbarium specimens (OXF-DILL, H-SOL) Fig. A, F-G represent *Racomitrium heterostichum*, Fig. B and E represent *R. elongatum* (excluding two out of seven herbarium plants which are *R. canescens* subsp. *canescens*), and Fig. C-D represent *R. ericoides*.

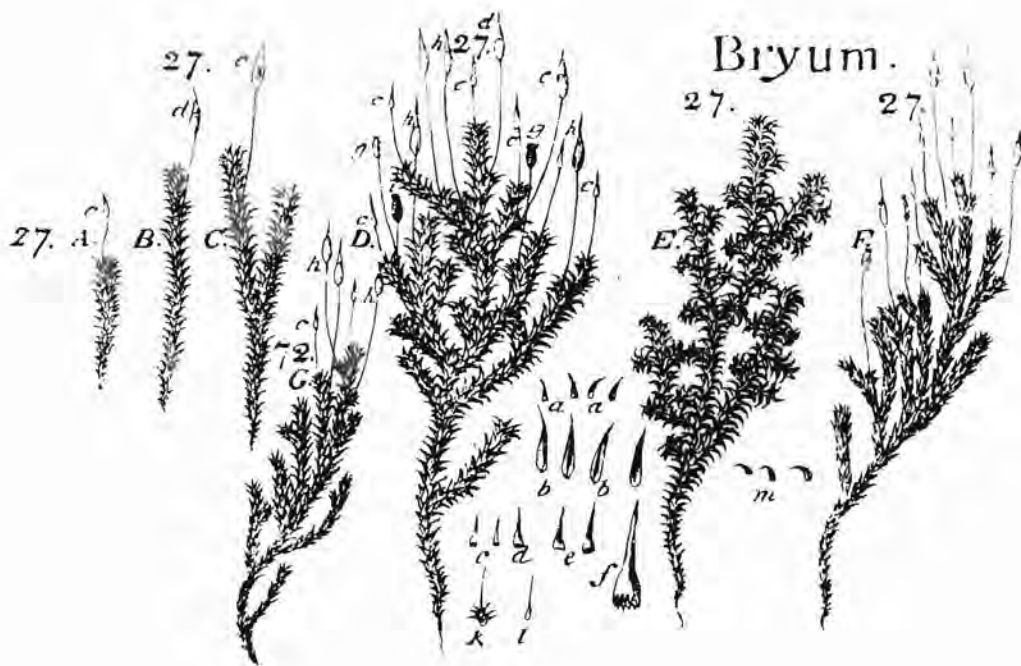


Fig. 2. Dillenius (1741) Tab. 47, Fig. 27 A-G (72, error of 27). A-D. *Bryum hypnoides*, *hirsutiae canescens*, *vulgare*. E. Var. *cum foliis magis reflexis*. F-G. Var. *strigosior*. a-b. Leaves (a. Life-size. b. Magnification). c-f. Calyptrae (c-e. Different stages of development. f. Magnification). g, i. Deoperculate capsule. h. Capsule including operculum. k. Perichaetium including seta. l. Swollen base of seta. m. Reflexed leaves in E. (cf. Fig. 38.) (x 1.4)



Fig. 3. Hedwig (1792) Tab. III. *Trichostomum canescens*. 1 a-b. Plants (a. Fertile. b. Sterile). 2. The plant in 1 a. c. Capsule including calyptra. d. Capsule without calyptra. 3. Stem leaf. 3 e. Do. from the stem apex. 4. Perigonia. 5. Antheridia. 6. Perichaetium. 7. Archegonia. 8. Deoperculate capsule. 9. Peristome tooth. 10. Spores. (1. Life-size. 2-10. Magnifications.) (x 0.5)

(Fig. 2, 38). The figure of *Bryum hypnoides*, *Erica facie, capsulis barbatis, alpinum* (Dillenius 1741: Tab. 47, Fig. 31) is an excellent drawing of one dry and two moist plants of *Racomitrium ericoides* (Fig. 1 B, 24).

Hedwig (1792: Tab. III) includes the most beautiful illustration ever presented of plants from the group (Fig. 3); it is made up of one large and two small plants which by implication belong to the type of *R. canescens* (see p. 116f.).

IV. MIXED STANDS

a. Definition and history

If two taxa are genetically different, then stems or shoots of the two taxa are able to grow intermingled in the field without the existence of intermediates. Then a mixed stand is present. In mixed herbarium specimens it should be evident that stems of the taxa also have been mixed in the field. Specimens composed of different cushions or stems of two (or more) taxa are not considered mixed stands; such collections are as common as true mixed stands. In the text a mixed stand is marked with an addition sign, e.g. *R. barbuloides* + *R. japonicum*.

As emphasized in several papers (e.g. Frisvoll 1978) I consider the study of mixed stands very useful in order to define the differences between related taxa. When closely related taxa grow together in several places it is an indication to the taxonomist that something more than unimportant forms or modifications are present. Often the best rank for such plants is the specific rank; and even in critical complexes it is the authors opinion that they should be given at least subspecific rank.

Loeske (1930: 226) was aware of the value of mixed stands in the *R. canescens* group: "Aber sowohl *vulgaris* [*R. canescens* subsp. *canescens*] wie *ericoides* [*R. ericoides*/*R. elongatum*] habe ich häufig in Massenwuchs auch ohne jeden Übergang beobachtet, und die jeweilige Ausbildung in Zusammenhang mit Standortbedingungen ist erst noch zu erweisen." But as Poelt and Wriessnegger (1973: 56) remarked: "Die vielen Modifikanten der beiden Arten haben aber Loeske

[1930: 226] offenbar dazu induziert, kurz vorher zu schreiben 'Übergänge (von *ericoides*) zu *vulgaris* sind in allen Graden zahllos bekannt'." Loeske considered var. *strictum* to be of greater taxonomic value than var. *ericoides*, and although he did not actually report on mixed stands between *R. canescens* var. *vulgaris* [= *R. canescens* subsp. *canescens*] and var. *strictum*, it may be justified to quote the following passage (Loeske 1930: 228): "Die Var. *strictum* selbst als blosse Gletschersand-Morphose des *Rh. canescens* aufzufassen, dazu konnte ich mich bisher nicht entschliessen, weil ich dort, wo ich sie beobachtete, wiederholt, aber vergeblich, nach Übergängen suchte, obwohl gewöhnliches *Rh. canescens* in der Nähe wuchs und die Standorte alle Möglichkeiten für Übergänge boten. Die var. *strictum* tritt so plötzlich und so scharf umgrenzt auf, soweit ich sie sah, dass die Möglichkeit einer fixierten Rasse gegeben ist." It is possible that var. *strictum* in the above passage at least in part refers to epilose *R. ericoides*, cf. the paper of Poelt and Wriessnegger (1973: 56): "Die haarlosen Formen, die gewöhnlich als var. *strictum* ... zusammengefasst werden ... liessen sich im allgemeinen gut an eine der beiden Arten anschliessen, einerseits an *R. ericoides*, ... andererseits an *R. canescens*, ..." I have never seen mixed stands of *R. mollissimum* (\equiv *R. canescens* var. *strictum*) and *R. canescens* (subsp. *canescens*), and regard the former as a modification of the latter (see p. 103 and 165).

With regard to taxa in *Racomitrium* sect. *Racomitrium* I have collected or located in herbarium specimens numerous mixed stands. Six taxa (*canescens* subsp. *canescens*, *canescens* subsp. *latifolium*, *elongatum*, *ericoides*, *muticum*, and *pygmaeum*) are recorded from Washington and British Columbia, western North America; five taxa (*barbuloides*, *canescens* subsp. *canescens*, *ericoides*, *japonicum*, *muticum*) from Japan; and four taxa from e.g. Greenland (*canescens* subsp. *latifolium*, *elongatum*, *ericoides*, *panschii*) and the Norwegian mainland (*canescens* subsp. *canescens*, *canescens* subsp. *latifolium*, *elongatum*, *ericoides*). However, I have never seen a mixed stand with four or more taxa. But *R. canescens* subsp. *canescens*, *R. canescens* subsp. *latifolium*, *R. elongatum*, and *R. ericoides* are in different areas mixed with three to five other taxa. And in areas where four or more taxa occur there is every possibility that mixed stands including as many taxa exist (Fig. 4).

b. Mixed stands with three taxa

Mixed stands including three taxa of the *R. canescens* group seem to be fairly common in some districts.

In Svalbard I have found that *R. canescens* subsp. *latifolium*, *R. ericoides*, and *R. panschii* commonly grow in the same areas and in mixed stands, and from the following localities I have obtained collections including all three taxa:

NORWAY, Svalbard. Longyearbdalen: In front of Longyearbreen, 24.VIII.1973. - Adventdalen: In the bottom of Foxdalen at the N side of Foxelva, 13.VII.1977 (Fig. 7 A). - Nordfjorden: Tschermakfjellet N, 17.VIII.1973. - Liefdefjorden: SE of Siktefjellet, 27.VIII.1974. - Barentsøya: Frankenhalsvøya SW, 2.VIII.1977 Hjelmstad (TRH, coll. by the author unless otherwise stated).

At the following Scandinavian localities I have made collections from mixed stands including *R. canescens* subsp. *latifolium*, *R. elongatum*, and *R. ericoides*:

NORWAY, Sør-Trøndelag. Agdenes: Verrafjorden, by the farm Fjorden, 25.VI.1980. - Åfjord: By Austdalsvatna, 18.VII.1981. - Midtre Gauldal: Soknedal N of Hasselbraut, 27.VII.1980; N of Øverli, 15.IX.1981; Bakken, 15.IX.1981; Osøy bridge, 25.VII.1981; Almås, 25.VII.1981. - Holtålen: Haltdal centre, 25.VII.1981. - Nord-Trøndelag. Stjørdal: Ca. 1 km E of Hell railway station, 18.VI.1980; Tømmerdalen, N of Trøin, 29.VII.1981. - Levanger: By road E-6 S of Fiborgtangen, 18.VI.1980. - Verdal: By Skjækerfossen, 2.X.1981; E of Julnes, 2.X.1981. - Namsos: Fjærbotn, Kalvik, 19.VII.1981 (Fig. 6 B). SWEDEN, Jämtland: By the railway ca. 1 km from the Swedish - Norwegian border at Storlien, 24.VII.1980 (TRH, coll. by the author).

From western North America I have seen mixed stands between *R. canescens* subsp. *canescens*, *R. elongatum* and *R. ericoides* from the following localities:

USA, Washington: King County, between Cottage Lake and Duvall, ab. 3 mi W of Duvall, Lawton 2370 (WTU, Fig. 5, 16 a, c; 18 d-f, 22-23). - CANADA, British Columbia: Naden Harbour, old whaling station, NW Graham I., Queen Charlotte I., 54°00'N, 132°35'W, Schofield 34381 (UBC).

From Norway and Sweden I have obtained mixed collections including *R. canescens* subsp. *canescens*, *R. canescens* subsp. *latifolium* and *R. ericoides* from the following localities:

NORWAY, Hedmark. Åmot: 6 km E of Osa bru towards Nordre Osen, 11.IX.1980; 1 km S of Deset, 12.IX.1980. - Rendalen: Ca. Holmslia by Stor-sjøen, 12.IX.1980. - Tynset: By Tunna bru, 12.IX.1980; 1 km N of Tørresvangen towards Kvikne, 12.IX.1980. - Sør-Trøndelag. Røros: Øvre Fjellheim, 29.VII.1981. - Tydal: SE of Storvollen, 29.VII.1981; Håen, 29.VII.1981 (Fig. 7 B). - Selbu: Hyttbakken, 29.VII.1981 (Fig. 16 b, h; 36-37). - Nord-Trøndelag. Lierne: Storbergvika, 20.VII.1981; Furu-tangvika by Tunnsjøen, 20.VII.1981. - Røyrvik: Sandtangen, 20.VII.1981 (Fig. 8). - SWEDEN, Jämtland: Near the Norwegian border at Ren-gen, 20.VII.1981 (TRH, coll. by the author).

c. Mixed stands between two taxa

Mixed stands between two taxa are more common, and in areas where two taxa occur it is easy to collect a great many mixed stands. In addition to the mixed stands between two taxa which can be deduced from the above collections with three taxa (viz. cc + cl, cc + el, cc + er, cl + el, cl + er, cl + pa, el + er, er + pa), I have also seen the constellation b + j, cl + j, er + j, and el + m (Fig. 4).

To my knowledge the geographical ranges of *R. barbuloides* and *R. japonicum* do not overlap with the ranges of *R. elongatum*, *R. panschii*, and *R. pygmaeum*. With regard to *R. muticum* I have only located mixed stands with *R. elongatum*, although several other taxa also grow in the area in question. The following constellations have not been located; the constellations marked with asterisks probably occur (cf. Fig. 4): b + c*, el, er*, m*, and pa; j + el, m*, and pa; m + c*, er*, and pa; py + b, c*, el*, er*, j, m*, and pa; and el + pa*.

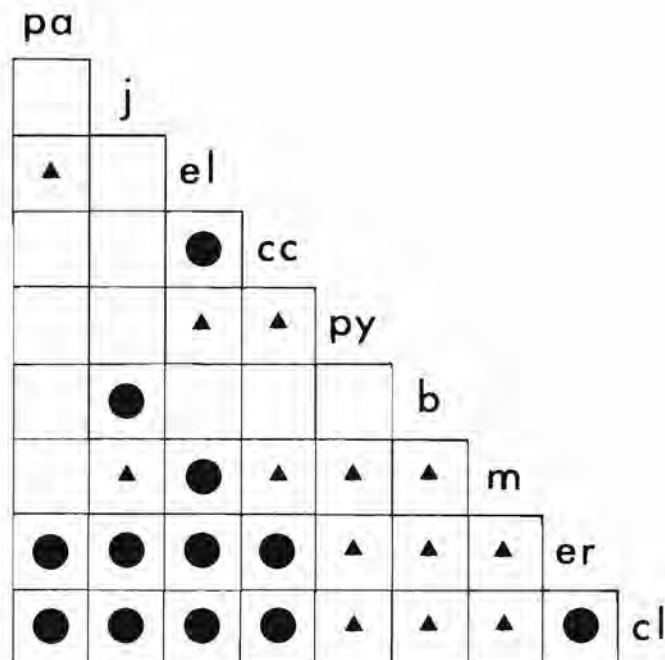


Fig. 4. The known (●) and hypothetical (▲) occurrence of mixed stands in the *Racomitrium canescens* group.

Below a number of mixed collections from different areas are listed; mixed collections from Norway including Svalbard are numerous and most of them have been omitted; these include the constellations cc + er, cl + el, cl + er, cl + pa, el + er, and er + pa.

Racomitrium barbuloides + *R. japonicum* (Fig. 9 A)

JAPAN, Honshu: Yamanashi pref., Mt. Fuji, Koponen 22048 (H); Tottori pref., Mt. Daisen, Koponen 21799 (H); Gifu pref., Mt. Ontake National Forest, Koponen 16462 (H); Aomori pref., Oirase, Noguchi 34222 (NICH); Simane pref., Gakuenzi, Noguchi 30112 (NICH); Prov. Rikutyu, Morioka, 31.III.1926 Toba (H); Sandan-kyo, Hiroshima pref., 20.XI.1976 Ando (H). - Shikoku: Ehime pref., Nii-gun, Suminocho, Tonaru, Noguchi 49505 (NICH, Fig. 9 A, 17 a-b, 30-31). - Mt. Tarzawa, 29.VIII.1910 Sakurai (H, O). - [Loc. in Japanese], Toyoma 1037 (MAK).

Racomitrium canescens subsp. *canescens* + *R. canescens* subsp. *latifolium* (Fig. 7 B, 8, 11)

NORWAY, Hedmark. Åmot: 11 km N of Deset, 12.IX.1980. - Rendalen: Ca. Rydningen by Storsjøen, 2.IX.1980; by Lomnessjøen, 12.IX.1980; 7 km S of Øvre Rendalen, 12.IX.1980; 2 km N of Øvre Rendalen, barn bridge, 12.IX.1980; 2 km E of Fonnås towards Unset, 12.IX.1980. - Trysil: By exit to Søndre Tøråsen, 11.IX.1980. - Engerdal: E og Engeren at Røa, by bridge over the river Røa, 11.IX.1980. - Sør-Trøndelag. Midtre Gauldal: Litlåsen, 15.IX.1981. - Røros: Vauldalen, by the Swedish border, 9.IX.1980; SW of Molunga bridge by Aursunden, 8.IX.1980; W of Øversjøen by the road between Brekken and Tydal, 1.VIII.1980 Flatberg. - Selbu: Heggset, 29.VII.1981; Hyttbakken, 29.VII.1981 (Fig. 36-37). - Nord-Trøndelag. Lierne: Linmyran, 20.VII.1981. - SWEDEN, Härjedalen: Near the Norwegian border at Vauldalen, 9.IX.1980 (TRH, coll. by the author unless otherwise stated).

Racomitrium canescens + *R. elongatum* (Fig. 5, 6 B)

Racomitrium canescens subsp. *canescens* and subsp. *latifolium* are not separated in this and the next list, as there are sometimes only a few stems of *R. canescens* and the material may be difficult to interpret.

USA, Washington: Two mi W of Highway 21 near Seabeck, Ireland 5627 (ALTA). - Alaska: NW shore of Queen Inlet near Carrol Glacier Terminus, 58°50'N, 136°31'W, Worley & Rawson 13173 (UBC); mile 200 Richardson Highway, near Paxson's Lodge, 63°31'N, 145°33'W, Webster 148 (ALTA); Juneau area, around the base of Mendenhall Glacier, 58°20'N, 134°20'W, Shaw 1986 (ALTA). - CANADA, British Columbia: Hope, Schofield 16702 (UBC); Yard Creek, E of Sicamous, ca. 50°55'N, 118°50'W, Schofield & Tan 60499 (UBC); Steward area, 6.3 mi SE of Hwy 37 Nass River crossing, ca. 56°00'N, 129°04'W, Vitt 18892 (ALTA); do., ca. 55°58'N, 129°03'W, Schofield 64952 (ALTA). - GERMANY. Rhön, s.a. Goldschmidt (JE). - Hercynia, zwischen Wiesenbecker Teich und dem Ravensberg, V. 1894 Quelle (JE). - Kr. Lauterbach, Grossenluder, Kalkhügel beim Kalkbergwerk, 26.VIII.1966 Hupke (JE). - FRANCE. Wale of Chamouni, IX. 1859 Boswell (OXF). - NORWAY. Many collections of *R. canescens* subsp. *latifolium* + *R. elongatum* (TRH).

Racomitrium canescens + *R. ericoides* (Fig. 5, 6 B, 7-8)

USA, Oregon: Multnomah Co., Elk rock, Scheldon 11885 (ALTA). - Washington: Snohomish Co., E of Goldbar, Lawton 3273 (WTU). - Alaska: Juneau area, W of Mendenhall Glacier, Vitt 12568, 12574 (ALTA); area of Mendenhall Visitor's Centre, Mendenhall Valley, Worley & Boas 11895 (H, UBC); 11924 (UBC); Herbert Glacier, Juneau, Armstrong 221 (H); NW shore of Queen Inlet near Carroll Glacier Terminus, 58°58'N, 136°31'W, Worley & Rawson 13173 (UBC); just S of the Riggs Glacier, Glacier Bay, 59°03'N, 136°10'W, Worley & Rawson 13092 (UBC); slopes and ridges of Red Mt., Muir Inlet Area, Glacier Bay, Worley 13320 (UBC); W shore of Reid Inlet, Glacier Bay, Worley & Rawson 12557 (UBC); Dollar Cove on mainland E of Russel Isl., Glacier Bay, Worley & Rainers 10703 (UBC); vic. of Nunatak Knob, E shore of Muir Inlet (S of McBridge Glacier) Glacier Bay, Worley 10428 (UBC); do., on top of North Plateau, 9.VIII.1974 Buttrick (UBC); mainland immediately above (NW) Sebree Cove and W of Caroline point, Glacier Bay, Worley et al. 10548 (UBC); Seward, 15 mi N along Seward - Anchorage Hwy, ca. 60°18'N, 148°54'W, Svihla 4115 (WTU); Copper Center, VII.1933 Thompson (WTU). - CANADA, British Columbia: Green River, ca. 25 mi E of Prince Rupert, Schofield 13835 (UBC); ca. 15 mi E of Hwy 37 crossing over Bear River at Stuart, ca. 20 mi W of Cranberry Jct. Rd. intersection, Schofield 65122 (UBC); near Burns bog, delta area, Schofield 35768 (UBC); Teresa Isl., Birch Mt., Atlin Lake, Buttrick 21 (UBC). - Yukon: Dezadeash Lake, E facing slope of Mtn. to W of Lake, opposite island on W end of lake, 60°26'N, 137°07'W, Vitt 12692 (ALTA). - GREENLAND. Nigerdleg, 62°04'N, 49°20'W, 22.VII.1966 Sørensen & Larsson (C); W of Qordlortq, 62°17'N, 49°25'W, 9.VII.1968 Øllgård (C); Søndre Strømfjord, Itivdlunguaq, 66-67°N, 24.VII.1946 Holmen (C). - ICELAND. Hof, 18.VII.1909 Hesselbo (C); head of Skagafjörður, 15.VII.1947 Holmen (C); Langakofi N of Valurjökul, 22.VII.1935 Davidsson (C). - ENGLAND. Westmoreland, III.1868 coll. ignot. (OXF). - Northern Ireland, in dune slack Dundrum Sandhells Co., Down, XI.1961 Caldwell (OXF). - GERMANY. Thuringia, Gehlbergen Muhle, IV.1912 Bornmüller (JE). - NORWAY, Jan Mayen: Blinddalen, 25.VIII.1972 Frisvoll; The Mainland and Svalbard: Numerous collections (TRH).

Racomitrium canescens subsp. *latifolium* + *R. japonicum*

JAPAN, Hokkaido: Soya distr., Rishiri Island, SE slope of Mt. Rishiri, Koponen 20451, 20486, 20488 p.p., 20489 (H).

Racomitrium canescens subsp. *latifolium* + *R. panschii* (Fig. 7 A)

USA, Alaska: Mt. McKinley National Park, on slope below Stony Hill Switchback, Hermann 21342 (H); Killik River Quad., Kurupa Lake, 68°22'N, 154°39'W, Murray 5912A (ALA). - CANADA, NWT: Ellesmere Island, Van Hauen Pass, ca. 81°07'N, 86°55'W, Brassard 2867 (NFLD). - GREENLAND. Kangerdluarssuk, 69°35'N, 50°25'W, Holmen & Mogensen 71-1292 (C); Inglefield Bay, 77°23'N, 68°W, 1.IX.1957 Frstrup (C). NORWAY, Svalbard: Many collections (TRH) including - Kongressfjellet S, 17.VIII.1973 (Fig. 16 d-e, 41-42).

Racomitrium elongatum + *R. ericoides* (Fig. 5-6)

CANADA, British Columbia: Below Neve Glacier, Garibaldi Park, 19.IX.1964 Krajina (UBC); Paul Ridge, Round Mt., Garibaldi Park, Schofield 14457 (UBC); Prince Rupert, 9.VIII.1926 MacFadden (ALTA); Perry Creek Falls trail, Schofield & Ireland 21755 (UBC); Stuart, sea level near Alaska boundary, ca. 55°58'N, 130°W, Schofield 65035 (ALTA). - USA, Alaska: Along road 8 mi S of Wrangell, Wrangell I., Worley 7758 (UBC); Falls Creek and Blunt Mt. (S of



Fig. 5. Mixed stand of *Racomitrium elongatum* (bottom), *R. ericoides* and *R. canescens* subsp. *canescens* (top). - USA: Washington, King County, Lawton 2370 (WTU). (Phot. P. Fredriksen.)

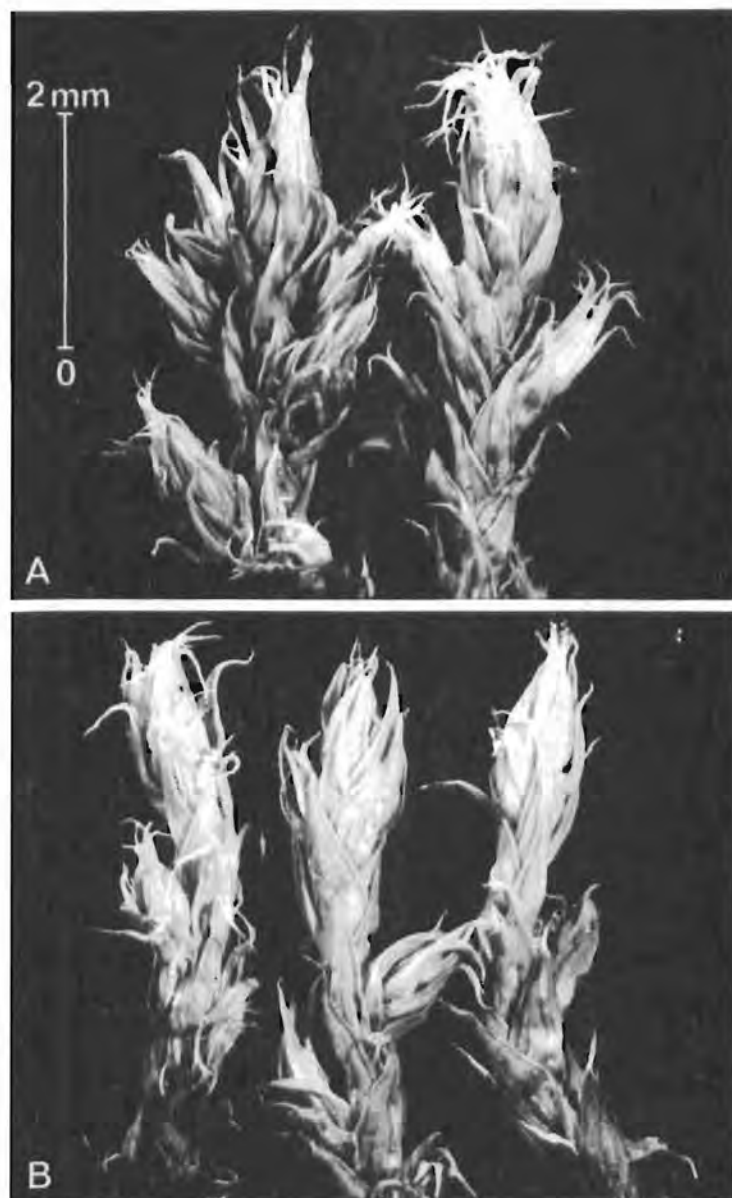


Fig. 6. A. Mixed stand of *Racomitrium ericoides* (left) and *R. elongatum*. - Norway: ST, Malvik, 29.VI.1980 Frisvoll (TRH). B. Mixed stand of *Racomitrium elongatum* (left), *R. ericoides* and *R. canescens* subsp. *latifolium* (right). - Norway: NT, Namsos, Fjørbotn, 19.VII.1981 Frisvoll (TRH). (Phot. P. Fredriksen.)



Fig. 7. A. Mixed stand of *Racomitrium ericoides* (left), *R. panschii* and *R. canescens* subsp. *latifolium* (right). - Norway: Svalbard, Foxdalen, 13.VII.1977 Frisvoll (TRH). B. Mixed stand of *Racomitrium canescens* subsp. *canescens* (left), *R. canescens* subsp. *latifolium* and *R. ericoides* (right). - Norway: ST, Tydal, Håen, 29.VII.1981 Frisvoll (TRH). (Phot. P. Fredriksen.)

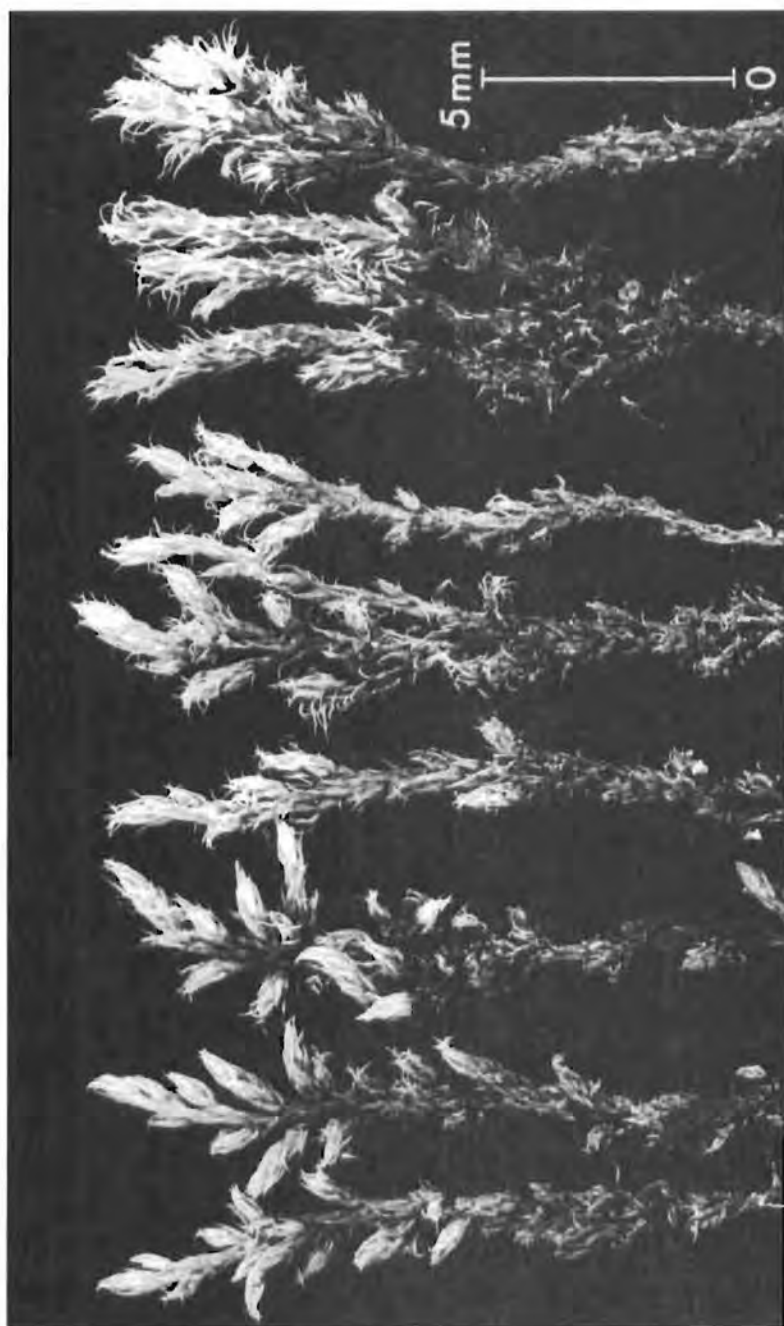


Fig. 8. Mixed stand of *Racomitrium ericoides* (bottom, three shoots), *R. canescens* subsp. *latifolium* and *R. canescens* subsp. *canescens* (top, three shoots). - Norway: NT, Røyrvik, Sandtangen, 20.VII.1981 Frisvoll (TRH). (Phot. P. Fredriksen.)

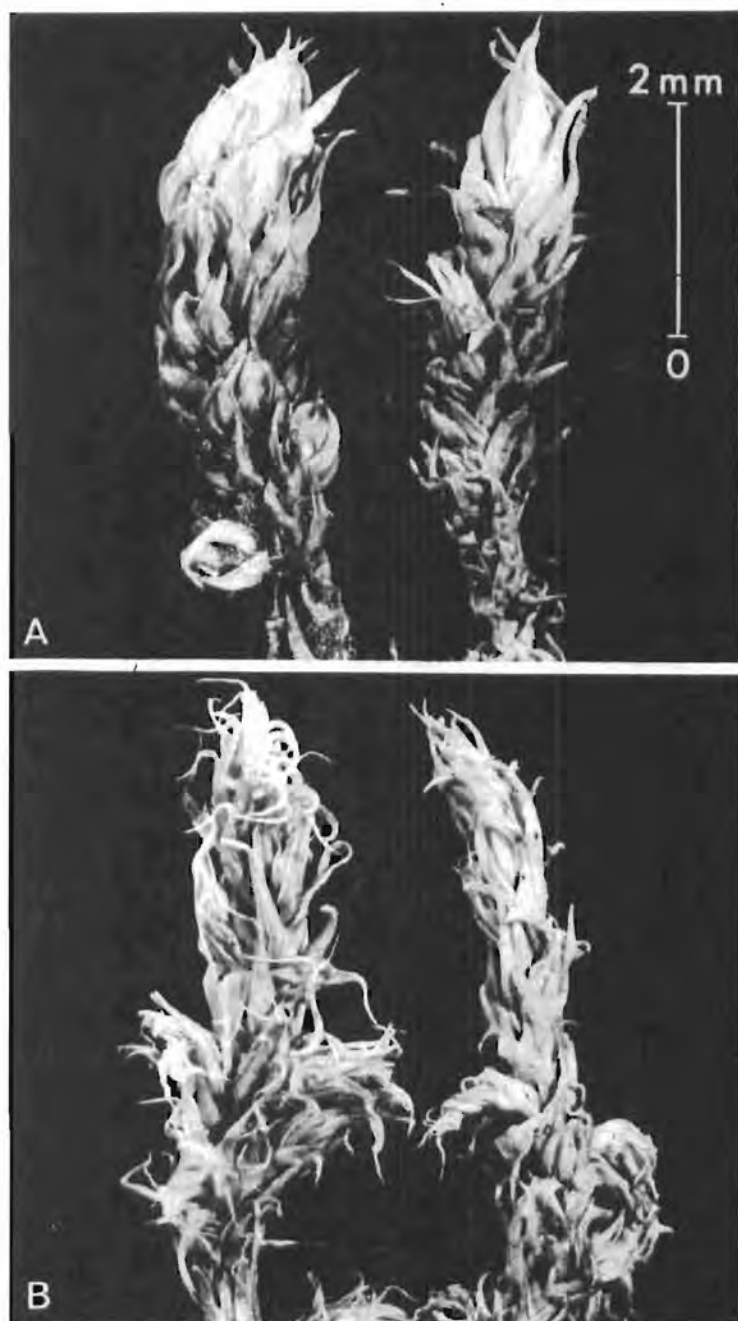


Fig. 9. A. Mixed stand of *Racomitrium japonicum* (left) and *R. barbuloides*. - Japan: Ehime pref., Noguchi 49505 (NICH). B. Mixed stand of *Racomitrium elongatum* (left) and *R. muticum*. - Canada: Moresby Isl., Schofield 32337 (UBC). (Phot. P. Fredriksen.)

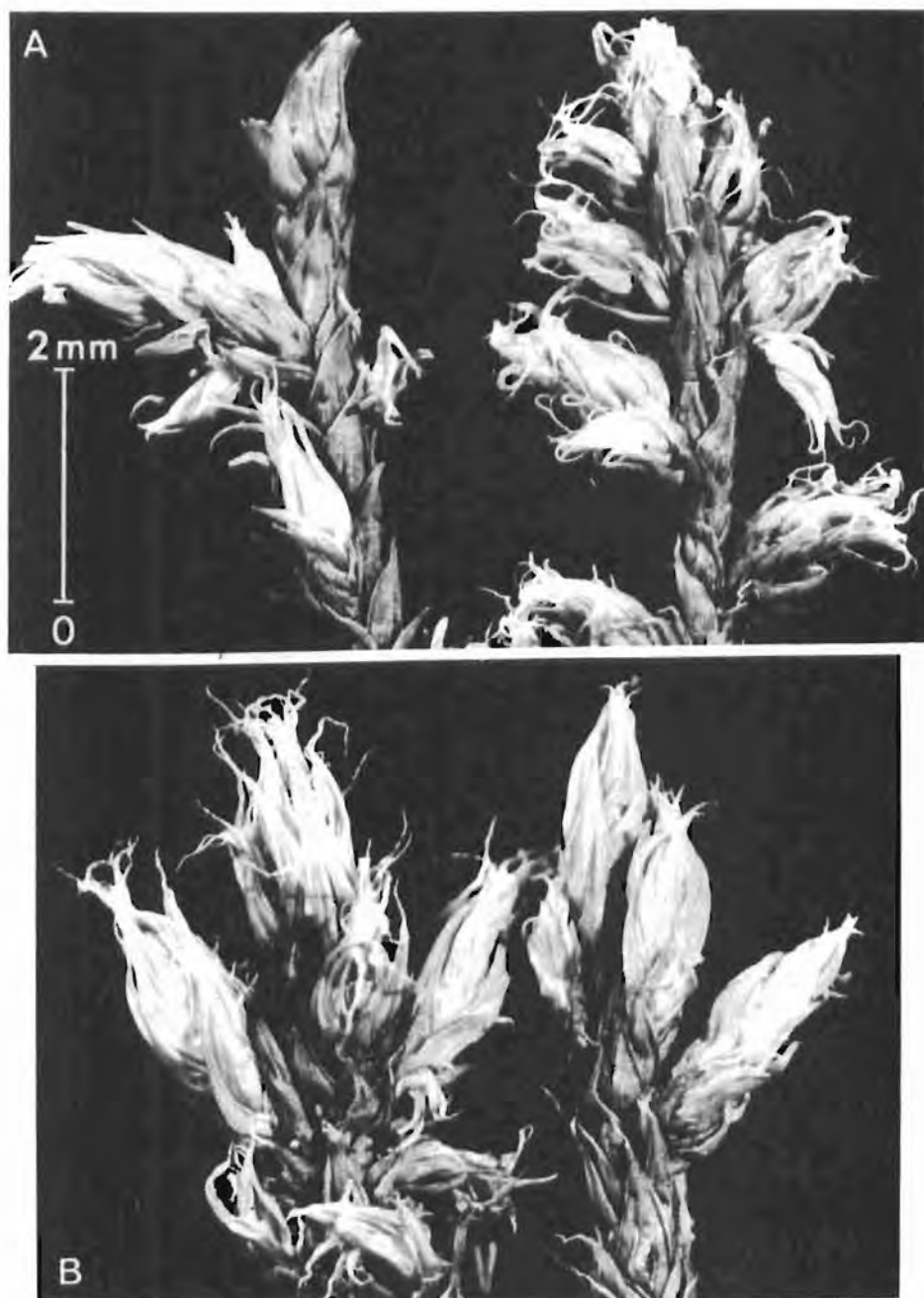


Fig. 10. A. Mixed stand of *Racomitrium elongatum* (right) and a plant related to it. - Canada: Vancouver Isl., Schofield 44007 (UBC). B. Mixed stand of two different plants of *Racomitrium ericoides*. - Norway: NT, Namsskogan, Skorovatn, 20.VII.1981 Frisvoll (TRH). (Phot. P. Fredriksen.)



Fig. 11. A. Mixed stand of two different plants of *Racomitrium canescens* subsp. *canescens* (left) and *R. canescens* subsp. *latifolium*. - Norway: He, Rendalen, 12.IX.1980 (TRH). B. Mixed stand of *Racomitrium canescens* subsp. *latifolium* (left) and a plant related to it. - Norway: Svalbard, between Svenskehuset and Hagahytta, 20.VIII.1973 Frisvoll (TRH). (Phot. P. Fredriksen.)

Crillon Inlet), Upper Lituya Bay, Glacier Bay National Monument, Worley & Streueller 13062 (UBC). - ICELAND. Isafjord, Dagverdardal, 25.VII.1938 Andersen (C); NW Sugandafjord, 7.VII.1912 Hesselbo (C). - FAEROES. Østerø, Slættaratindur, 7.VII.1973 Holmen, Lewinsky & Rasmussen (C). - GERMANY. Thüringer Wald, bei Gehlberg, 1952 Grolle (JE). - ENGLAND. Wales, Penmaenmawr & Aber, Canarvon, 16.VII.1907 W.R.J. (OXF); NE of Talysarn, 9.V.1980 Frisvoll (TRH); by Llyn Llydaw, 8.V.1980 Frisvoll (TRH). - NORWAY. Numerous collections (BG, O, TRH).

Racomitrium elongatum + *R. muticum* (Fig. 9 B)

CANADA, British Columbia: Vancouver Isl., Heather Mt. overlooking W end of Cowichan Lake, 48°57'N, 124°28'W, Halbert 3171 (UBC), Halbert & Price 3207 (UBC); Glacier National Park, Cougar Valley, summer 1978 Coll. unknown 28 (ALTA); mountain between peak of Moresby Mt. and Mosquito Mt., Moresby I., Queen Charlotte Is., Schofield 32337 (UBC, Fig. 9 B). - USA, Alaska: Along road about 8½ mi S of Wrangell, Wrangell I., Worley 7631 (O, UBC).

Racomitrium ericoides + *R. japonicum*

JAPAN, Hokkaido: Soya distr., Rishiri Island, SE slope of Mt. Rishiri, Koponen 20488 p.p. (H). - Honshu: Toyoma pref., Chubu Sangaku Nat. Park, Mt. Tateyama, Koponen 16139 (H).

d. Summary

The interpretation of the taxonomy of the *R. canescens* group would be much more difficult without the location of mixed stands. However, the study of mixed stands has revealed that there are still minor taxonomical problems within the group: From Greenland and Norway I have seen plentiful mixed material (Fig. 10 B) of two different plants which both are referred to *R. ericoides* in this paper (see p. 69). From Canada I have seen a mixed stand (Fig. 10 A) between *R. elongatum* and a plant related to it (see p. 79). In Svalbard I have collected mixed material (Fig. 11 B) of *R. canescens* subsp. *latifolium* and a plant closely related to that taxon (see p. 125). And in Norway I have collected mixed material (Fig. 11 A) between *R. canescens* subsp. *canescens* and a plant closely related to it and different from *R. canescens* subsp. *latifolium* with which it also is mixed (see p. 118). These plants have so far not been given formal taxonomic rank since only one collection of most of them exists. But the occurrence of mixed stands demonstrate that different genotypes are present; and if more collections are located, some of the above plants should be named. The plants are in no characteristic intermediate between any of the taxa accepted in this work, and the status of these taxa is independent of the existence of the aberrant plants.

The study of mixed stands has convinced me (1) that there are at least six species within *R. ericoides* s.l., and (2) at least

two species within *R. canescens* s.l., and (3) that *R. canescens* is composed of two taxa which are treated as subspecies in this study.

V. ENVIRONMENTAL MODIFICATIONS

The variation of the European *R. canescens* coll. has long been observed, and many attempts at description have been made. The introduction of new subordinate epithets indicated that the authors considered they had discovered new variations. Finally, most bryologists stopped recognizing subordinate taxa within *R. canescens*; only the epithets *epilosum*, *ericoides* and *strictum* were sometimes used.

It has long been claimed that the habitat influences the structure of the plants in the group. This assumption was often due to a collective treatment of *R. canescens*. With regard to their "*R. canescens* Brid." [*R. canescens*, *R. elongatum* and *R. ericoides*] the authors of *Bryologia Europaea* (Bruch et al. 1845) stated: "Die Localitätsverhältnisse haben einen grossen Einfluss auf das zahlreichere oder sparsamere Erscheinen der sterilen Seitenästchen". Although this is only partly correct, it was of importance that the conditions at the locality were considered taxonomically significant. They probably considered their var. *prolixum* to be a modification of their var. *ericoides* (see p. 158). Schimper (1860: 236) regarded var. *prolixum* and var. *ericoides* as modifications of *R. canescens*: "Var. β. et γ. [*prolixum* and *ericoides*] nil nisi formae typicae modificationes sunt e locorum natura enatae, ..."

Zetterstedt (1861: 130) stated that *R. canescens* [coll.] is very variable with regard to branching habit and the length of the hyaline point: "Variat caulibus subsimplicibus l. valde ramulosis, foliis longipilis, brevipilis l. prorsus muticis, ..." And he (implicitly) established the following system:

- [I : 1] fo. *simplicior cana* = fo. *simplicior longipila* (= *R. canescens* Brid.) [Exsicc. no. 37 (UPS) = *R. canescens* subsp. *canescens*].
- [2] fo. *simplicior brevipila*
- [II : 1] fo. *ramosior cana* = fo. (*ramosior*) *ericoides cana* = fo. *ericoides pilifera* (= *R. ericoides* Brid.) [Exsicc. no.

38 (UPS) = *R. elongatum*].

[2] fo. *ericoides brevipila*

[3] fo. *ericoides submutica* [Exsicc. no. 39a (UPS) = *R. ericoides* + fragment of *R. elongatum*], incl. fo. *ericoides submutica riparia laxiuscula* = fo. *ericoides submutica alpigena* [Exsicc. no. 39b (UPS) = *R. ericoides*].

[4] fo. *ericoides mutica* [Exsicc. no. 40a-b (UPS) = *R. ericoides*].

[III : 1] fo. *prolixa subsimplex riparia*

From the corresponding exsiccate specimens (Zetterstedt's *Grimmieæ* et *Andreae* Exsiccata no. 37-40) we can see that [I : 1] is *R. canescens* subsp. *canescens*, [II : 1] is *R. elongatum*, and [II : 3-4 (and probably also II : 2)] are *R. ericoides*. Zetterstedt's system is remarkably up-to-date, and it influenced the view of later bryologists. It is likely that the words *cana* = *longipila* = *pilifera*, *brevipila*, *submutica*, and *mutica* were considered names of environmental modifications by Zetterstedt. His *forma* designations cannot be regarded as binomial combination, because they are composed of more than one word. Most of Zetterstedt's *formae* were validated by Möller (1931); he interpreted e.g. Zetterstedt's *R. canescens* fo. *ericoides submutica* as *R. canescens* var. *ericoides* fo. *submutica* (see p. 147ff.).

Loeske (1913) established a similar system, but did not refer to Zetterstedt (1861). It is, however, unlikely that he then was unacquainted with Zetterstedt's famous work, which he later included in a list of "Spezielle und grössere Gebiete Europas umfassende Literatur" (Loeske 1930: 38). The following forms of var. *vulgaris* are included in Loeske's (1913: "Übersicht" p. 189) key, and in the text (p. 190) he stated that "Die in der 'Übersicht' für v. *vulgaris* angegebenen Formen *epilosa* [sic, misprint of *pilosa*!], *subepilosa* und *epilosa* lassen sich ... ebenso bei v. *ericoides* unterscheiden":

var. <i>vulgaris</i>	var. <i>ericoides</i>	var. <i>strictum</i>
fo. <i>pilosa</i>	fo. <i>eu-ericoides</i>	fo. <i>eustricta</i>
fo. <i>subepilosa</i>	fo. <i>pilosa</i>	fo. <i>tortuloides</i>
fo. <i>epilosa</i>	fo. <i>subepilosa</i>	
	fo. <i>epilosa</i>	
	fo. <i>prolixa</i>	

The following passages by Loeske (1913: IX, 14) indicate that he

considered the forms to be environmental modifications: "... Formen, deren Merkmale sich auf die Beschaffenheit der Lebensbedingungen zurückführen ..." "Bei allen mit hyalinen Spitzen vorkommenden Grimmiaceen kann man je eine *f. epilosa*, *subepilosa*, *brevipila* und *longipila* (ohne Autor) unterscheiden." Loeske (1930: 224ff.) retained *R. canescens* var. *vulgaris*, var. *ericoides* and var. *strictum*, and described the variation of these taxa, but omitted all the above *forma* names. He also made it clear that he used the term *forma* about environmental modifications (Loeske 1930: 12): "Wie bei den schon erwähnten 'Varietäten' mit langen, kurzen oder ohne Haarspitzen, so wende ich auch für alle übrigen Formen, die sich entweder augenfällig oder auf andere Weise als Standorts-Modifikationen erweisen, nur die Bezeichnung 'forma' an ..." "... der Modificationen, also meiner *formae*, ..."

When Möller (1931: 132ff.) treated *R. canescens* he referred to Zetterstedt (1861) and Loeske (1913); and he also gave a definition of his form names: "With regard to the length and occurrence of the points of the leaves of var. *canescens* one can distinguish between three forms, viz. *forma pilosa* Loeske [1913: 189] (*forma simplicior cana* Zett. [1861: 130]), in which all the leaves have fairly long hairpoints so that the form becomes light gray in colour; *forma subepilosa* Loeske which has some leaves with and some leaves without hairpoints and also *f. epilosa* Loeske, which has no hairpoints at all" (translated from Swedish). With regard to his var. *ericoides* Möller used Zetterstedt's (1861) designations. Möller's system is as follows:

[var. <i>canescens</i>]	var. <i>ericoides</i>	var. <i>strictum</i>
fo. <i>pilosa</i> Loeske	fo. <i>cana</i> Zett.	[fo. <i>strictum</i>]
fo. <i>subepilosa</i> Loeske	fo. <i>submutica</i> Zett.	fo. <i>pseudofasciculare</i> Möll.
fo. <i>epilosa</i> Loeske	fo. <i>mutica</i> Zett.	
	fo. <i>prolixa</i> (Br.Eur.) Warnst.	

With regard to the length of the hyaline point it is evident from field studies that the taxa in the section are modified in the same way: In dry sites the hairpoints are relatively long, whereas in neighbouring humid localities they may be poorly developed or absent. Thus we get parallel environmental modifications within several related taxa. I consider that the European *R. canescens*

coll., which the above authors treated as one polymorphous species, is made up of four taxa (three species and one subspecies). It was an impossible task for the previous authors to force these four taxa and their modifications into a simple scheme.

It is disputed whether the taxonomic rank *forma* (cf. I.C. B.N. Art. 4. 1, Stafleu et al. 1978) should have a genetical base or not. With regard to mosses a definite stand on this question was lately taken by Margadant (1972: 122): "Personally I use the rank 'forma' to indicate a modification, ..." In my mind it is unnecessary to make *forma* synonymous with modification. And it seems unwise to give environmental modifications formal taxonomic rank. The muscologists should follow the hepaticologists in employing short designations about environmental modifications which are worth recognition; such terms are without nomenclatural standing (see e.g. Schuster 1966: 331ff.). In the *R. canescens* group I propose the following terms with regard to the length of the hyaline point (Fig. 12-15):

- | | |
|----------------------------------|---|
| 1. mod. <i>longipilum</i> | Hairpoint very long, and embracing a greater portion of the upper part of the lamina. |
| 2. mod. <i>pilosum</i> | Hairpoint distinct but not embracing much of the lamina; this is the most common condition in many species. |
| 3. mod. <i>brevipilum</i> | Hairpoint present, short to very short. |
| 4. mod. <i>epilosum</i> | Hairpoint absent. |
| (2+)3+4. mod. <i>subepilosum</i> | Some leaves with and some leaves without hairpoint; points usually short to very short. |

Different taxa have different tendencies to develop long or short hairpoints: *Racomitrium canescens* subsp. *canescens* are often met with as mod. *longipilum* and very rarely as mod. *epilosum*, whereas *R. ericoides* is rarely seen as mod. *longipilum* and often as mod. *epilosum*. So far I have only seen mod. *epilosum* and *subepilosum* of *R. muticum*.

From the study of mixed stands it can be seen that the branching habit of the taxa is more genetically controlled than the length of the hyaline point. Nevertheless, all taxa are encountered as pinnately branched, irregularly branched and little branched plants. The following terms are useful in describing the branching habit of the plants:

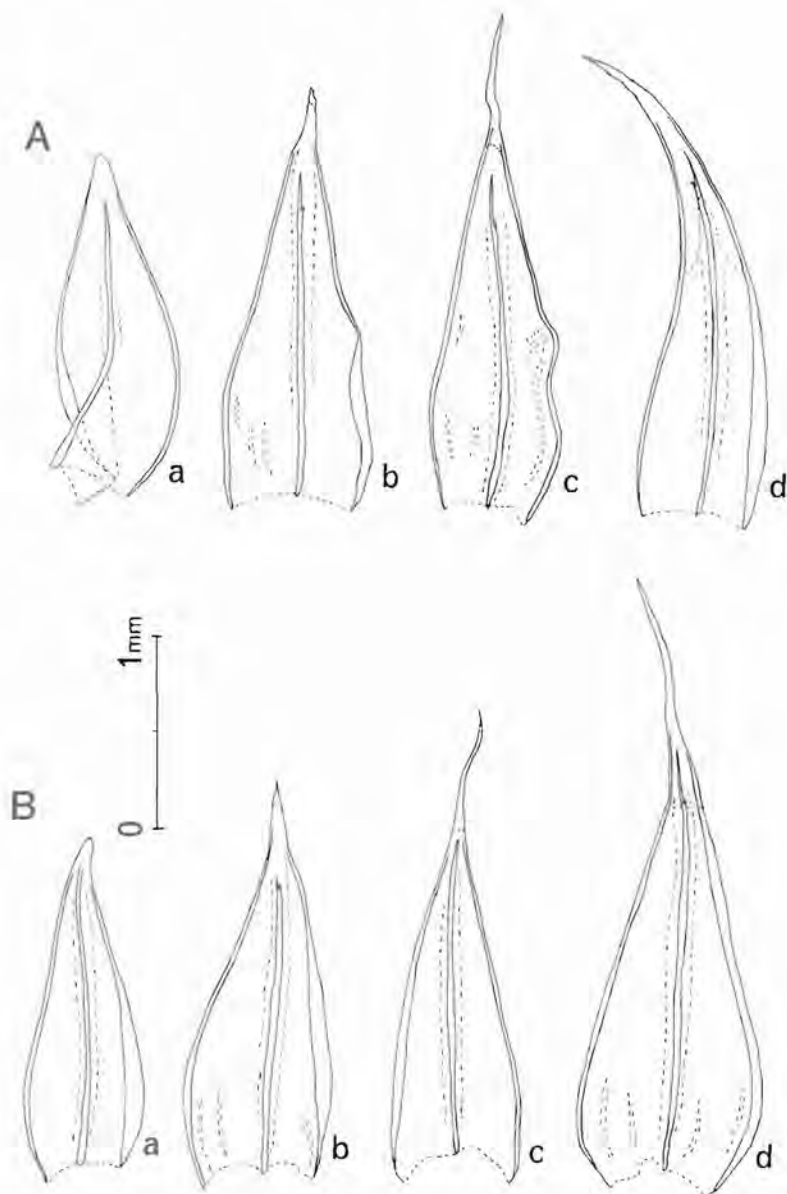


Fig. 12. Environmental modifications. A. *Racomitrium elongatum*. B. *R. ericoides*. a. mod. *epilosum*. b. mod. *brevipilum*. c. mod. *pilosum*. d. mod. *longipilum*. - A.a. *R. canescens* var. *subepilosum* Warnst.; holotype (JE). b. *R. canescens* var. *epilosum* H. Müll.; lectotype (JE). c. Turkey: Distr. Trapezunti, Handel-Mazzetti 877 (H). d. Canada: Vancouver Isl., Kujala 1931 (H). B.a. *R. canescens* fo. *muticum* Möll.; isolectotype (TRH). b. USA: Alaska, NE of Fairbanks, Hermann 21080 (H). c. Norway: Jan Mayen, 19.VII.1929 Lynge (O). d. NT, Namsskogan, Skorovatn, 20.VII.1981 Frisvoll (TRH).

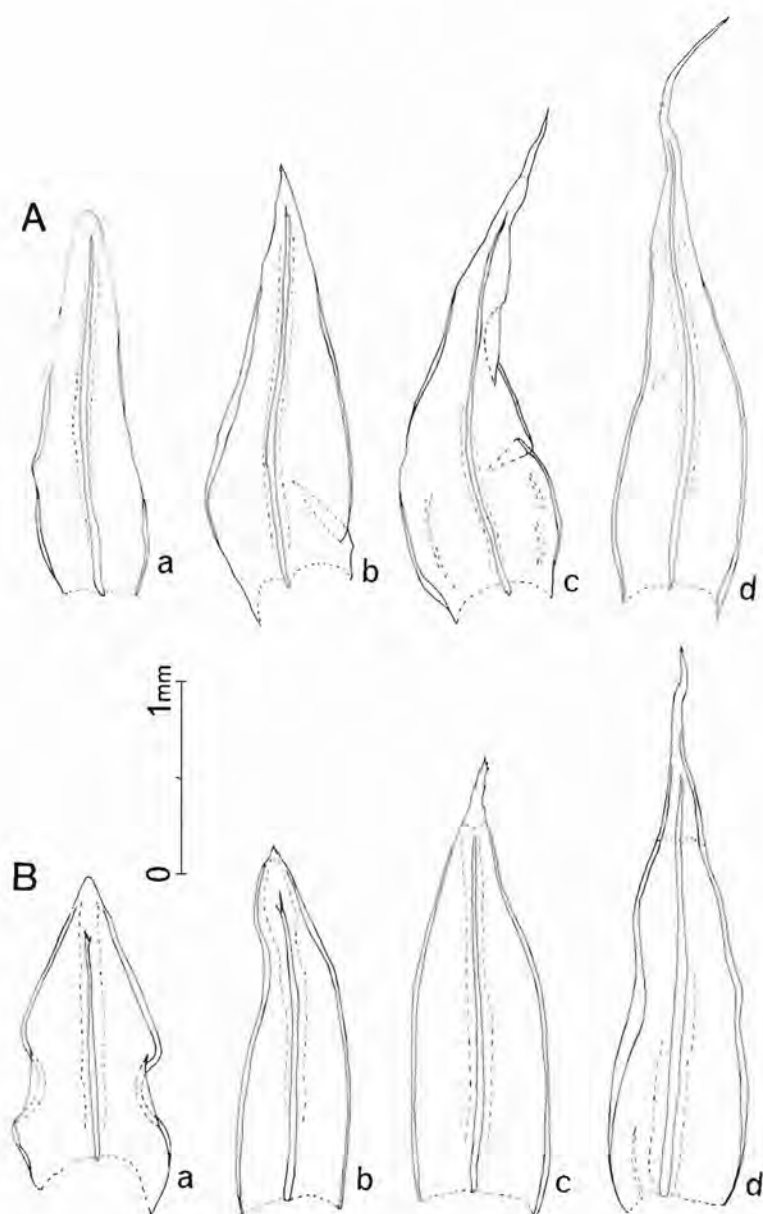


Fig. 13. Environmental modifications. A. *Racomitrium barbulooides*. B. *R. japonicum*. a. mod. *epilosum*. b. mod. *brevipilum*. c. mod. *pilosum*. d. mod. *longipilum*. - A.a. Japan: Mie pref., Nakajima 208 (NICH). b. Aomori pref., Noguchi 34222 (NICH). c. Prov. Iburi, Takaki 32476 (H). d. Hiroshima pref., 20.XI.1976 Ando (H). B.a. Isl. Rishiri, Iwatsuki 1829 (NICH). b. *R. barbulooides* var. *brevipilum*; holotype (BM). c. Japan: Oyabu, Tosa, 1.I.1907 Okamura (H). d. Kii, Nakusa, 4.IV.1905 Nakanishiki (H).

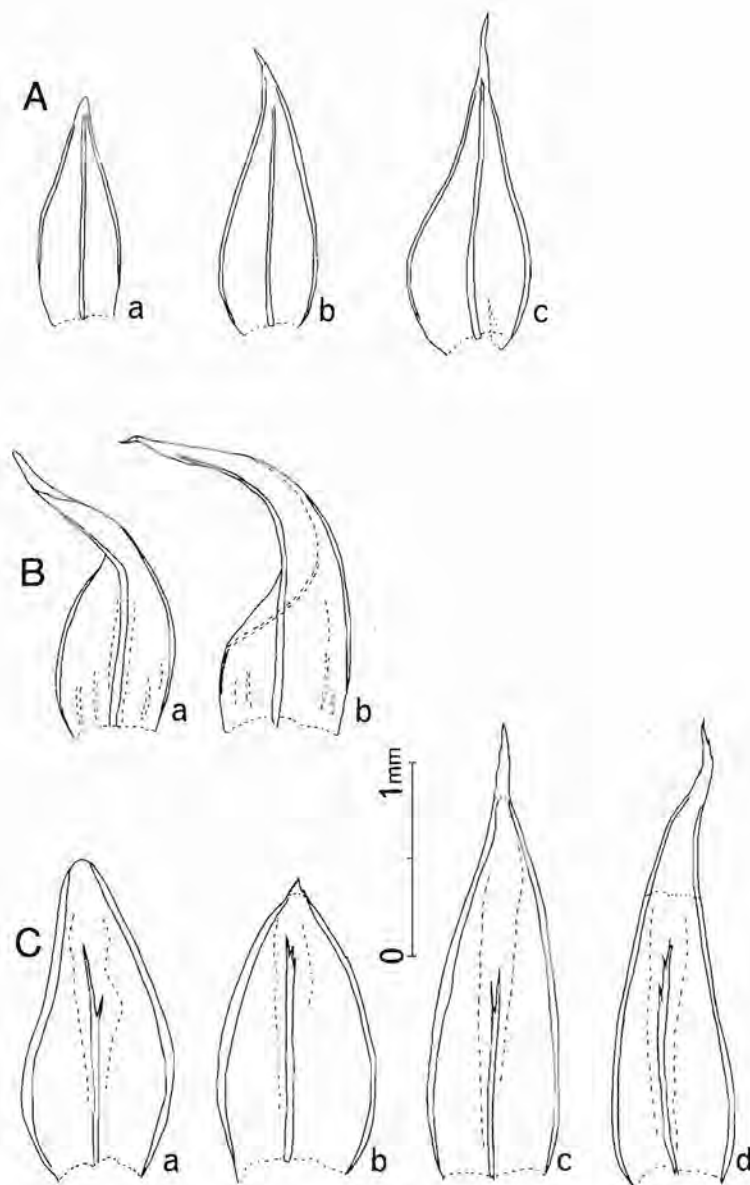


Fig. 14. Environmental modifications. A. *Racomitrium pygmaeum*. B. *R. muticum*. C. *R. panschii*. a. mod. *epilosum*. b. mod. *brevipilum*. c. mod. *pilosum*. d. mod. *longipilum*. - A.a. Canada: Kokanee Glacier Park, Tan & Ensing 77-799 (TRH). b. Kokanee Glacier Park, Tan & Ensing 77-1111 (UBC). c. Bugaboo Glacier Park, Tan & Ensing 77-1800 (UBC). B.a. USA: Washington, Mt. Rainier Natl. Park, Lawton 4860 (WTU). b. Washington, Snohomish Co., Lawton 4540 (WTU). C.a. Norway: Svalbard, 27.VIII.1974 Frisvoll (TRH). b. Canada: Nouveau-Quebec, Bournerias 704417 (H). c. USSR: Reg. Transbaikalskensis, 5.VII.1912 Zolotuchina (H). d. USA.: Alaska, Mt. McKinley Natl. Park, Hermann 21342 (H).

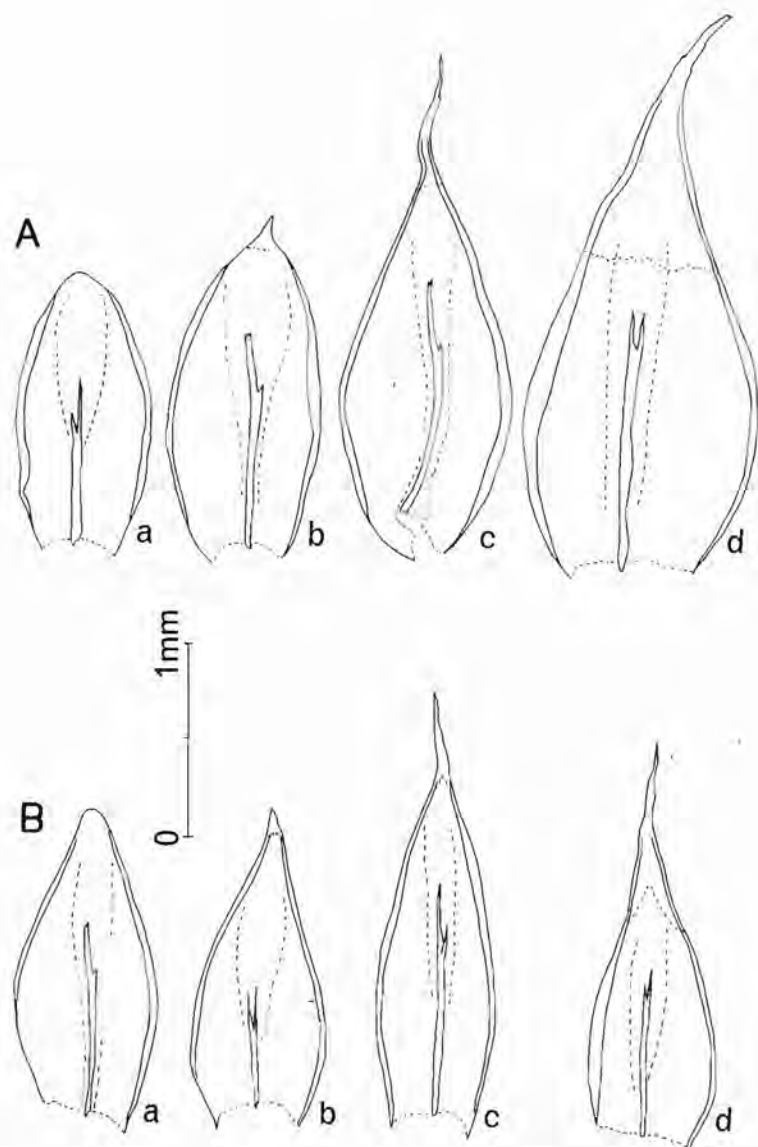


Fig. 15. Environmental modifications. A. *Racomitrium canescens* subsp. *canescens*. B. *R. canescens* subsp. *latifolium*. a. mod. *epilosum*. b. mod. *brevipilum*. c. mod. *pilosum*. d. mod. *longipilum*. - A.a. Norway: Bu, Ringerike, V.1889 Bryhn (O). b. *R. canescens* var. *glaciale* Amann; lectotype (ZT). c. Norway: He, Åmot, 11.IX.1980 Frisvoll (TRH). d. Italy: Vergosa pr. Comum, 8.III.1898 Artaria (TRH). B.a. Norway: ST, Oppdal, 23.VII.1878 Kiær (O). b. Op, Bøverdalen, 19.VIII.1887 Hagen (O). c. Greenland: Alangordlia, VIII. 1956 Holmen (H). d. USA: Alaska, near McCallum, Svihla 4093 (H).

- | | |
|----------------------------|---|
| 1. mod. <i>pinnatum</i> | Plants regularly and pinnately branched. |
| 2. mod. <i>subpinnatum</i> | Plants almost or somewhat pinnately branched. |
| 3. mod. <i>subsimplex</i> | Plants with fairly few irregularly arranged branchlets. |
| 4. mod. <i>simplex</i> | Plants almost or completely without branchlets. |

Racomitrium elongatum is e.g. often met with as mod. *pinnatum* and rarely as mod. *subsimplex*, whereas *R. canescens* are commonly seen as mod. *subsimplex-vel-simplex* and rarely as mod. *pinnatum*.

Unbranched and strongly pilose plants may be described as mod. *simplex-longipilum* whereas regularly branched plants with short hairpoints may be designated mod. *pinnatum-brevipilum*. As quoted above, the Swedish bryologist Zetterstedt (1861) seems to have used this system about 120 years ago; he called the former alternative fo. *simplicior cana* = fo. *simplicior longipila* and the latter alternative fo. *ericoides brevipila*.

Other characteristics which are influenced and modified by the habitat are e.g. the habit and colour of the plants, the cell structure of the leaves, and the occurrence of rhizoids. It is unnecessary to introduce special terms for these modifications.

VI. GENERAL ECOLOGY

The taxa in the *R. canescens* group are slow-growing mosses and weak competitors; they establish themselves on barren ground which, at least periodically, lacks water; e.g. on rocks and stones, and sandy habitats like river banks, roadsides, and naked mineral soil. Mostly they grow on noncalcareous substrate, but some taxa (notably *R. canescens* subsp. *canescens* and *R. elongatum*) are found on calcareous ground as well. Taxa with overlapping distribution areas often grow in mixed stands, but it is possible to find habitats where only one out of two taxa is able to grow.

The different distribution areas to some extent reflect the ecological requirements of each taxon. But historical factors must also be considered; otherwise it is impossible to explain the restricted distribution area of several taxa.

In this taxonomical paper I have not tried to establish in

detail the autecology of each of the taxa; but some comments are presented in the taxonomical section.

VII. GENERAL DISTRIBUTION

The taxa of the *R. canescens* group are only found in the northern hemisphere. *Racomitrium panschii* extends north as far as there is land (Greenland, 83°00'N). I have only seen a few specimens from areas south of 40°N, and all but one specimen is collected north of the Tropic of Cancer, 23.5°N; this specimen is *R. japonicum* (Vietnam, ca. 22°N). A general survey is given in Tab. 1. According to Heinonen (1971: 148) *R. canescens* has also been reported from Mongolia, India, Pakistan, Burma, Thailand, North Africa, the Canary Islands, and the Bermudas; I have seen no material from these areas. Mitten (1859, see also Paris 1905 and Gangulee 1972) reported *R. canescens* from Sri Lanka (Ceylon), ca. 7-8°N; this probably refers to *R. japonicum*, and if the information is correct this is the southernmost known locality of any taxon in the group. The specimen has not been traced (BM, NY).

Distribution maps are plotted for each of the nine taxa recognized in this paper (Fig. 25-26, 29, 32, 34-35, 39-40, 43). Some regions are poorly covered by (available) herbarium specimens; the most important of these regions is the USSR including Siberia. I have also seen few specimens from the North West Territories and the Hudson Bay region, Canada. Moreover, the taxa occurring in the Far East probably have a wider distribution than I can demonstrate. On the other hand I have seen the majority of the collections from Norway including Svalbard, and Greenland. And I have also seen many specimens from Japan, Central Europe and western North America. The unequal covering in different areas should be kept in mind when the distribution maps are scrutinized. A summary is given in Tab. 2.

With regard to *R. muticum*, *R. panschii* and *R. pygmaeum* the list of localities includes all specimens studied. Otherwise the lists include only a small selection of specimens to represent the known occurrence in all countries, states, areas, etc. In districts where a taxon is rare I have usually cited all specimens studied. Specimens cited as "Mixed stands" (p. 20ff.) are not repeated in the locality lists. The same is the case with type localities cited in

Tab. 1. The known latitude ranges of the taxa in the *Racomitrium canescens* group based on herbarium specimens.

	barbuloides	canescens canescens	canescens latifolium	elongatum	ericoides	japonicum	muticum	panschii	pygmaeum
80-83°40'N			x		x			x	
75-79°N			x		x			x	
70-74°N			x	x	x			x	
65-69°N		x	x	x	x			x	
60-64°N		x	x	x	x			x	
55-59°N		x	x	x	x		x	x	
50-54°N		x	x	x	x		x	x	x
45-49°N		x	x	x	x	x	x	x	x
40-44°N	x	x	x	x	x	x			
35-39°N	x	x	x	x	x	x	x		
30-34°N	x			x		x			
25-29°N	x		x			x			
20-24°N	x					x			

Tab. 2. The known occurrence of the taxa in the *Racomitrium canescens* group. The upper five lines correspond to the regions referred to in Index Muscorum (Wijk et al.).

	barbuloides	canescens canescens	canescens latifolium	elongatum	ericoides	japonicum	muticum	panschii	pygmaeum
Am. 1		x	x	x	x		x	x	x
Eur.		x	x	x	x			x	
As. 1		x	x		x	x		x	
As. 2	x		x		x	x			
Afr. 1				x	x				
N America W		x	x	x	x		x		x
N America N			x		x			x	
N America E		x	x	x	x			(x)	
Greenland			x	x	x			x	
Europe E, C, S, W.		x		x	x				
Europe N		x	x	x	x			x	
Africa NW (= Afr. 1)									
Siberia (= As. 1)									
Japan	x		x		x	x	x		
China, Sikkim, Vietnam	x		x			x			

the synonym lists.

Non-Scandinavian place names which are not mentioned in The Times Atlas of the World (1977) have usually not been identified. Where the spelling of the label and the Atlas is different, I have sometimes added the spelling of the Atlas in the list of localities.

VIII. TAXONOMIC CHARACTERS

In the past several differential characters have been used in distinguishing between taxa in *Racomitrium* sect. *Racomitrium*; characters such as the branching habit, the occurrence and length of hyaline hairpoints, the colour of the plants, the occurrence of rhizoids, etc. These characters are subject to great variation due to modifications by the habitat. When traditional distinguishing characteristics are not sufficient, it is essential to search for other more constant qualities. In the *R. canescens* group these are found in the structure of the leaves, viz. in their form and keeling, in the length and structure of the costa, in the structure - not length - of the hyaline point, and in the structure and occurrence of papillae in different parts of the leaf. When these stable leaf characters are applied to the *R. canescens* group there are very few, if any, plants that cannot be determined with certainty. This is surprising for a group of which the genotypes have been so much confused.

Below I comment on the characters taken into account in the present study. Before examining leaves, they should be reversed and flattened out; it may be important to examine a number of leaves from each plant or collection!

A. Gametophyte

The taxa have to be separated on the basis of characteristics in the gametophyte and especially in the leaves; this is the case with many taxa within Grimmeriales.

Robustness. Although this is an unimportant taxonomic character, *R. japonicum* (Fig. 9 A) is usually more robust and *R. pygmaeum* (Fig. 28) less robust than the other taxa in the group. *Racomitrium canescens*

subsp. *canescens* is usually more robust than *R. canescens* subsp. *latifolium* (Fig. 7 B, 8).

Branching habit. All taxa can be found unbranched, irregularly branched or as pinnately branched plants. *Racomitrium barbuloides*, *R. elongatum* and *R. ericoides* are often found as mod. *pinnatum*, while *R. panschii* often occurs as mod. *simplex*. The branching habit of the other taxa is variable. In *R. elongatum* the branchlets are mostly recurved. Heinonen (1971: 142) stated that "the difference in branching is usually so marked that the taxa [*R. canescens* and *R. ericoides* sensu Heinonen] can easily be determined on sight in the field". But several herbarium specimens of *R. canescens* mod. *pinnatum* were named *R. ericoides* by Heinonen.

Colour. The upper part of the plants is greenish, the lower part is brownish or blackish. Differences in colour between related taxa are best seen in mixed stands. The colour of the cushions varies with the length of the hyaline point. The colour of the plants often seems to be correlated with the height of the leaf papillae. *Racomitrium canescens* and *R. elongatum* are more greyish green than the other taxa, which are mostly olive-coloured. *Racomitrium muticum* is often olive-coloured with a rusty-red tinge. When growing in unfavourable habitats most taxa become yellowish, brownish or blackish.

Rhizoids. In *R. japonicum* the stems and leaf bases usually have abundant rhizoids, and many rhizoids are present in the few known collections of *R. pygmaeum*. Otherwise the occurrence of rhizoids depends on the substrate of a specimen. In sandy habitats the stems of all taxa may be strongly covered by a red-brown rhizoid felt. Erect plants have fewer rhizoids than prostrate ones.

Leaf orientation (Fig. 5-11, 28). When *dry* the leaves of *R. barbuloides* are usually strongly contorted and wrinkled, as are, to a lesser extent, the leaves of *R. japonicum* and *R. muticum*. In *R. panschii* the leaves are usually straight and not contorted, whereas the other taxa are variable and intermediate regarding this characteristic. The leaves of *R. japonicum* are often spirally twisted round the stem. When *moist* the leaves of *R. panschii* are erect-spreading; the leaves of *R. elongatum* and *R. japonicum* are recurved to reflexed, whereas the leaves of the other taxa are often erect-spreading to recurved.

Leaf shape (Fig. 12-15). The leaves of *R. barbuloides*, *R. japonicum* and *R. muticum* are usually approximately triangular or slightly ovate-lanceolate in outline, while those of *R. canescens* and *R. panschii* are ovate-lanceolate or sub-elliptical. The leaf shape of *R. elongatum*, *R. ericoides* and *R. pygmaeum* tends to be intermediate between these two groups, but their leaves are sub-triangular rather than ovate-lanceolate.

Leaf margin (Fig. 12-15). The only taxa with predominantly narrowly recurved margin are *R. barbuloides* and *R. muticum*, in which the margin is recurved to 1/2-3/4 the length of the leaf. In the other taxa the margin is usually broadly recurved towards the apex. Bistratose margin has been found in *R. barbuloides* (Fig. 30 h).

Leaf keeling. This character is found to be of great importance in the species group concerned. In *R. ericoides* s.l. the leaves are comparatively sharply keeled or channelled in upper part of the leaf; in *R. canescens* s.l. they are more obtusely keeled.

Leaf plication and undulation. The plication of the leaves varies to a great extent, and I have not found this characteristic to be very useful within the group. *Racomitrium ericoides* and *R. muticum* are often more plicate than the other taxa. In vigorous pilose specimens of *R. barbuloides* the upper lamina may be transversely undulate; this is never pronounced in any of the other taxa, but is sometimes seen in *R. japonicum*.

Costa (Fig. 12-15). In *R. ericoides* s.l. the costa is usually unbranched and reaches towards the apex (sometimes it is slightly branched or split at the top). In *R. canescens* s.l. the costa is usually branched and reaches to 1/2-3/4 the length of the leaves. This difference is correlated with the keeling of the leaves (q.v.). The costa is usually indistinct in the upper part, especially when branched; when studying the costa it is important to examine leaves which are flattened. It must be stressed that a number of leaves should be examined in order to ascertain the structure of the costa.

Lamina cells (Fig. 44-49). The cells in the basal part of the leaf are usually long, and in the upper part they are shorter. In *R. barbuloides* and *R. japonicum* the long basal cells contrast with the short and wide cells in the upper part of the leaf - the transitional zone

between the two cell types is short. In the other taxa the upper leaf cells tend to be elongated, but all taxa frequently produce phenotypes with very short cells above the elongated basal cells.

Papillosity of leaf except hyaline point. In all taxa most cells are papillose over the lumen on both sides of the leaf - exceptions being alar cells, extreme basal cells and parts of the costa and hairpoint. The papillae may be high or low, wide or narrow, and they are most conspicuous in the lower parts of the leaf. In some taxa the papillae in the basal and upper part of the leaf are different. The papillae are usually cylindrical or conical, but forked or irregular papillae occur in *R. canescens* (Fig. 36).

Alar and supra-alar cells (Fig. 16-17). The basal marginal leaf cells of the taxa are hyaline or yellowish, esinuose, epapillose, often decurrent, inflated and forming distinct auricles; the cells sometimes have thick transversal and thin longitudinal walls. The supra-alar cells may be short or long, sinuose or esinuose, and papillose or epapillose. The structure of the alar and supra-alar cells is an important taxonomic character within the *R. canescens* group; it has never been used taxonomically before.

Hairpoint, length (Fig. 12-15). The relative length of the hyaline point has led to the creation of many subordinate taxa in the past. In the present study this criterion is considered of no taxonomic value; every taxon except *R. muticum* is sometimes found with epilose leaves and sometimes with very long hairpoints (see p. 30ff.). In this paper the pilose modifications of the taxa are not considered more "typical" than the epilose expressions; it is the higher frequency of mod. pilosum in most species and in most areas that has led to this axiom. Most specimens belonging to the group can be named on the basis of characters taken from the epilose part of the leaves. But when present the structure of the point provides us with additional information of great value.

Hairpoint, orientation (Fig. 5-11, 28). The points of *R. barbuloides*, *R. canescens* subsp. *latifolium*, *R. ericoides*, and *R. pygmaeum* are often strongly flexuose; the points of *R. panschii* are usually slightly or not flexuose and directed towards the shoot apex; and the points of *R. canescens* subsp. *canescens* are usually falcate. The points of *R. japonicum* are stout and slightly or not flexuose, whereas

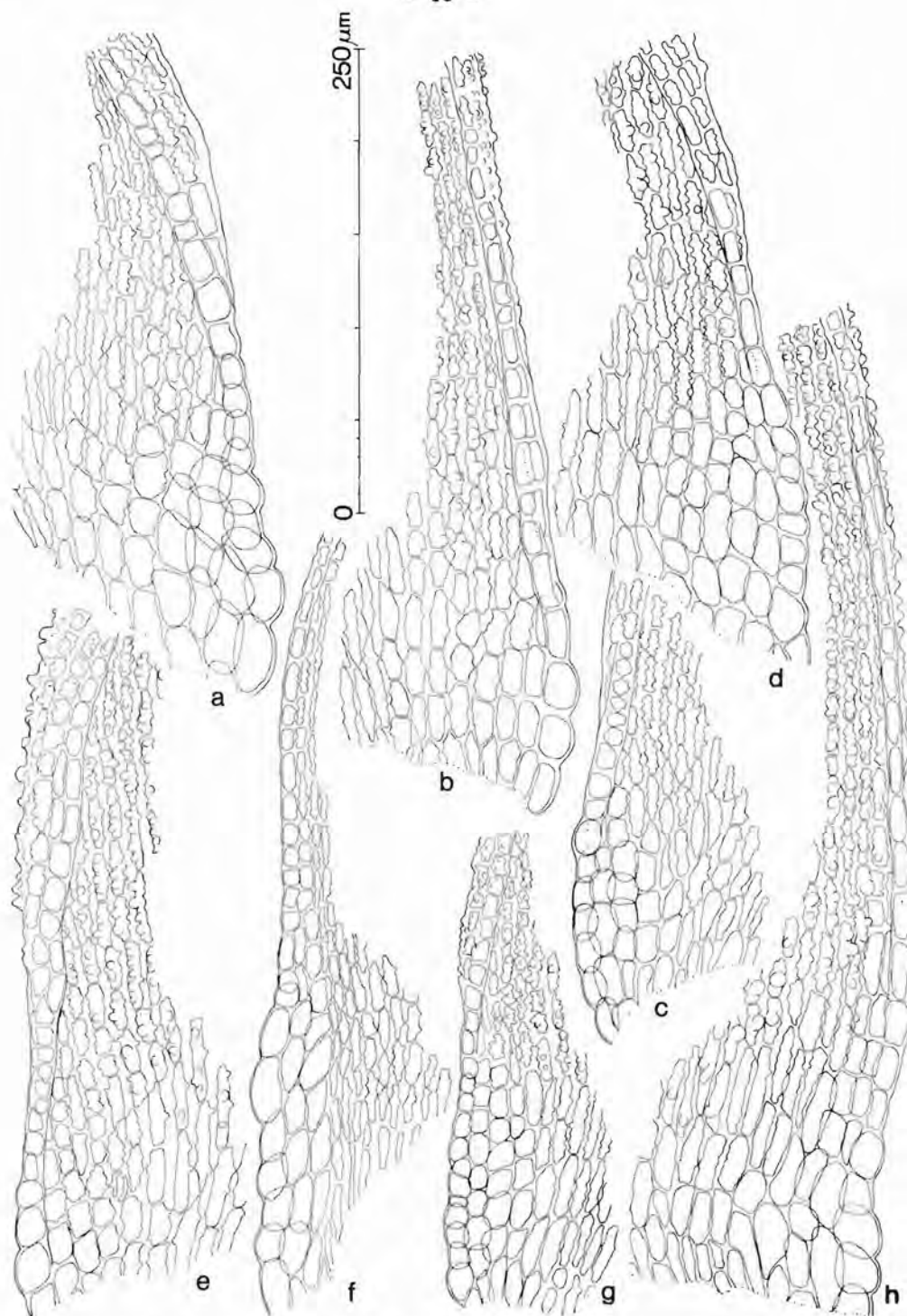


Fig. 16. Basal marginal leaf cells including alar and supra-alar cells. a. *Racomitrium ericoides*. b, e. *R. canescens* subsp. *latifolium*. c. *R. elongatum*. d. *R. panschii*. f. *R. muticum*. g. *R. pygmaeum*. h. *R. canescens* subsp. *canescens*. - a, c. Mixed stand, USA: Washington, King Co., Lawton 2370 (WTU). b, h. Mixed stand, Norway: ST, Selbu, 29.VII. 1981 Frisvoll (TRH). d-e. Mixed stand, Norway: Svalbard, Kongressfjellet S, 17.VIII.1973 Frisvoll (TRH). f. Lectotype (S). g. Holotype (UBC).

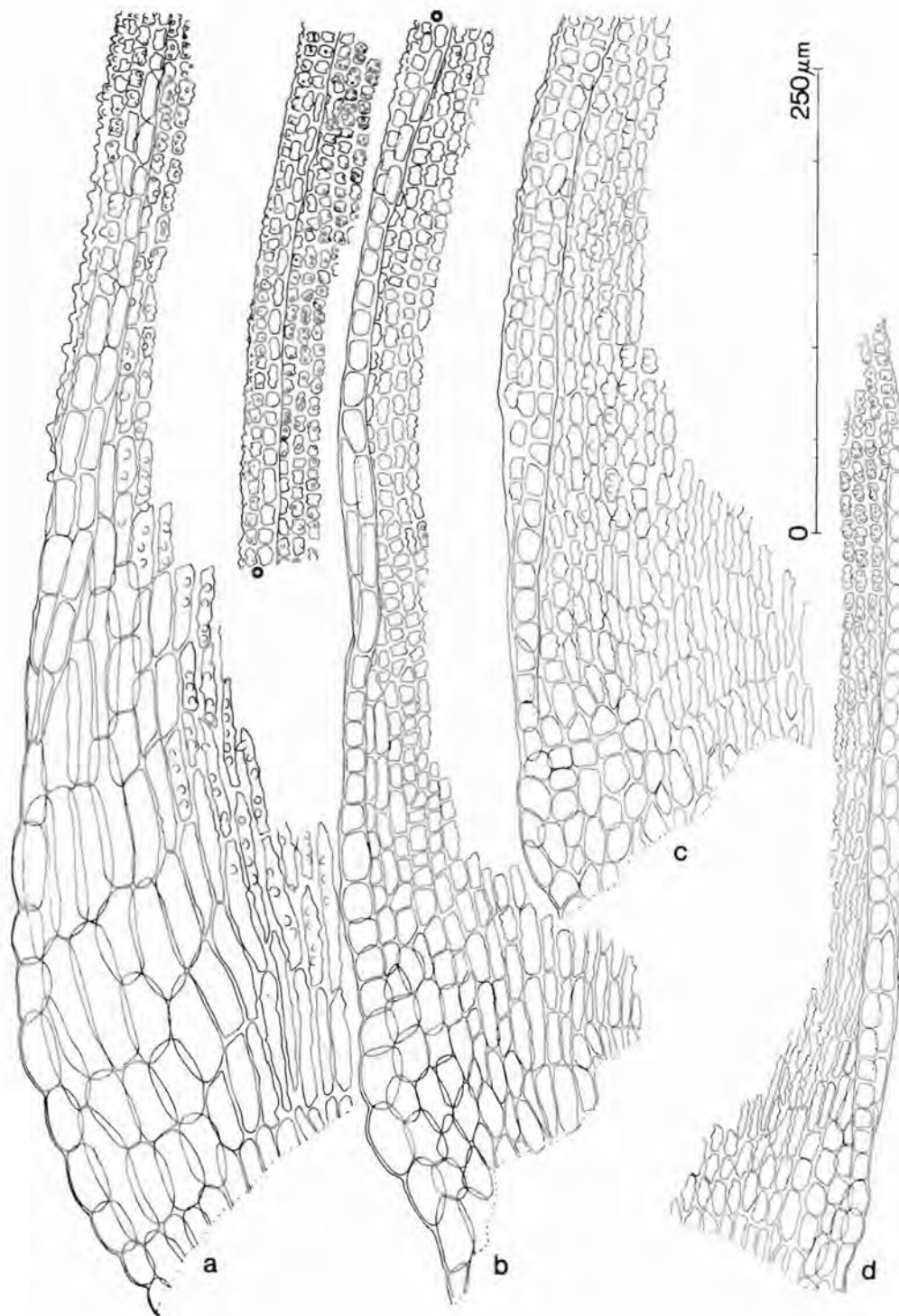


Fig. 17. Basal marginal leaf cells including alar and supra-alar cells. a. *Racomitrium japonicum*. b, d. *R. barbuloides*. c. *R. panschii*. - a-b. Mixed stand, Japan: Ehime pref., Noguchi 49505 (NICH). c. Lectotype (S). d. Lectotype (PC).

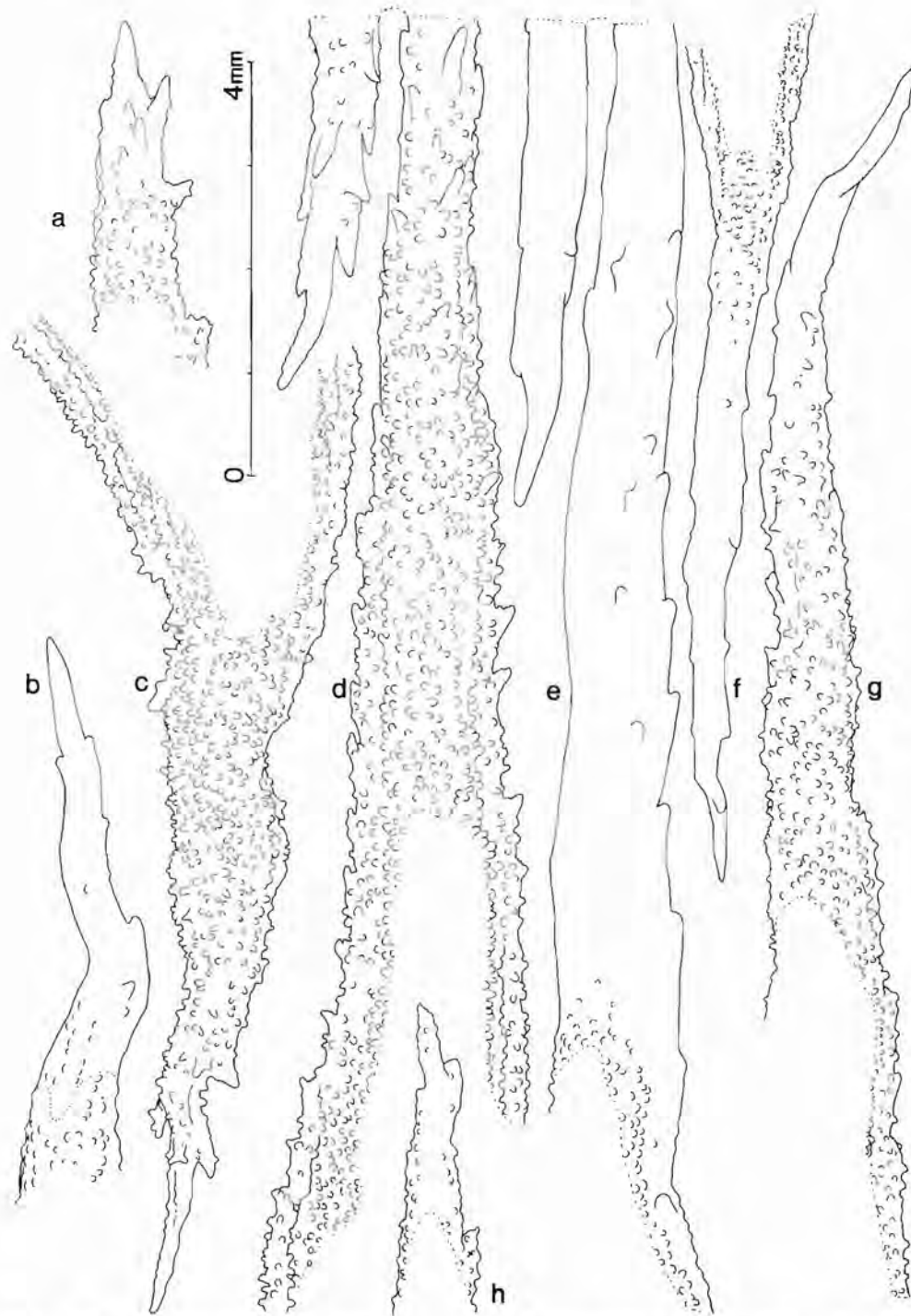


Fig. 18. Hyaline hairpoints. a, c-d. *Racomitrium elongatum*. b. *R. pygmaeum*. e-g. *R. ericoides* (e-f. Point slightly papillose. g. Point papillose). h. *R. muticum*. (Dotted line indicates the transitional zone between hyaline and chlorophyllous cells.) - a. USA: Michigan, Hermann 28732 (WTU). b. Holotype (UBC). c. USA: Idaho, 13.VII.1972 Steele (WTU). d-f. Mixed stand, USA: Washington, King Co., Lawton 2370 (WTU). g. USA: Alaska, Marco Lewis 720 (UBC). h. USA: Washington, Lawton 4540 (WTU).

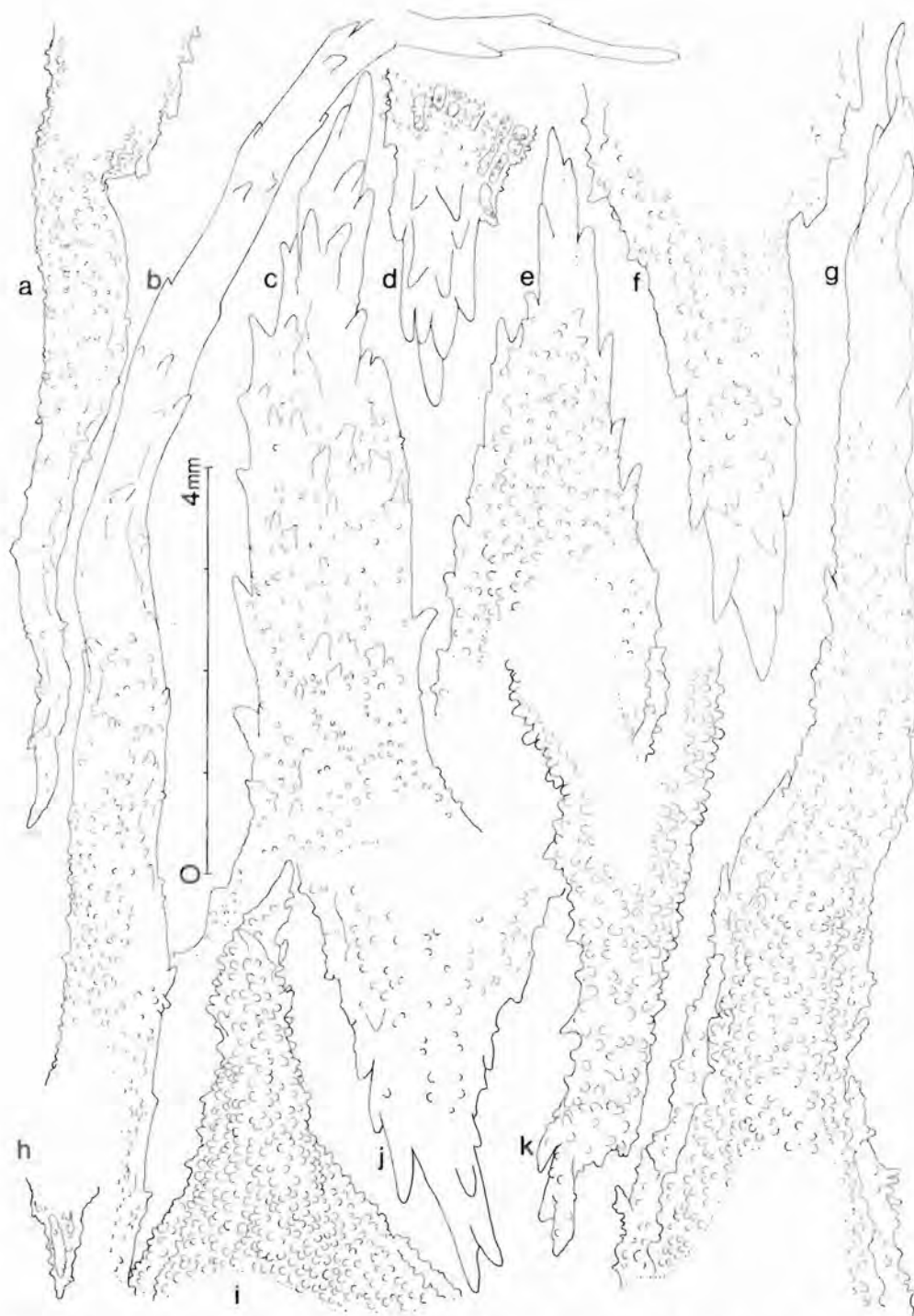


Fig. 19. Hyaline hairpoints. a-b, h. *Racomitrium barbuloides*. c-d. *R. japonicum*. e-g, j. *R. panschii*. i. *R. canescens* subsp. *canescens*. k. *R. canescens* subsp. *latifolium*. (Regarding dotted lines, see Fig. 18.) - a. Japan: Prov. Rikutyun, 3.VII.1925 Toba (H). b. Hiroshima pref., 20.IX.1976 Ando (H). c-d. Isotype (H). e-f. Lectotype (S). g. Norway: Svalbard, Kongressfjellet NW, 16.VIII.1973 Frisvoll (TRH). h. Isolectotype (H-BR). i. *R. tortuloides* Herz.; lectotype (JE). j. Norway: Svalbard, SE of Siktefjellet, 27.VIII.1974 Frisvoll (TRH). k. Holotype (C).

the points of *R. elongatum* are usually characteristically reflexed.

Hairpoint, structure and papillosity (Fig. 18-19). A specimen can usually be named on the basis of its hyaline points only. Then it is the structure of the point that is of interest. The points may vary from stout to capillaceous; they may be spinulose or not, and from strongly papillose to epapillose.

Bracts (Fig. 20). The inner perichaetial bracts are quite different from vegetative leaves, being ovate to ovate-oblong with cell walls thin and not or scarcely sinuose, and papillae confined to central (costal) parts or quite absent. Moreover, they are hyaline or yellowish; the costa is weak and the margin crenulate-dentate in the upper part. In mod. *pilosum-vel-longipilum* of *R. canescens*, *R. elongatum*, *R. ericoides* and *R. panschii* the innermost perichaetial bracts are broadly and roundedly acute and sometimes piliferous, whereas in the same modifications of *R. barbuloide*s and *R. japonicum* the apex is obtuse to subacute. In mod. *epilosum-vel-subepilosum* of all species the perichaetial bracts are always obtuse. The perigonal bracts are hollow and convolute, and for the most part reddish hyaline; the margin is recurved only in the chlorophyllous part, and the costa is long and unbranched.

B. Sporophyte

The species in the section are dioicous and are consequently often sterile. *Racomitrium pygmaeum* is never seen with sporophytes; *R. panschii* has been seen three times with very young sporophytes and old setae without capsules, and once with ripe and immature capsules; and *R. muticum* has been seen once with a few capsules (see lists of localities). *Racomitrium barbuloide*s and *R. elongatum* are less fertile than *R. canescens*, *R. ericoides* and *R. japonicum* which frequently are collected with sporophytes. There are few diagnostic features in the fertile structures of the taxa. Heinonen (1971) found no marked differences between the sporophytes of *R. canescens* and *R. ericoides* [incl. *R. elongatum*].

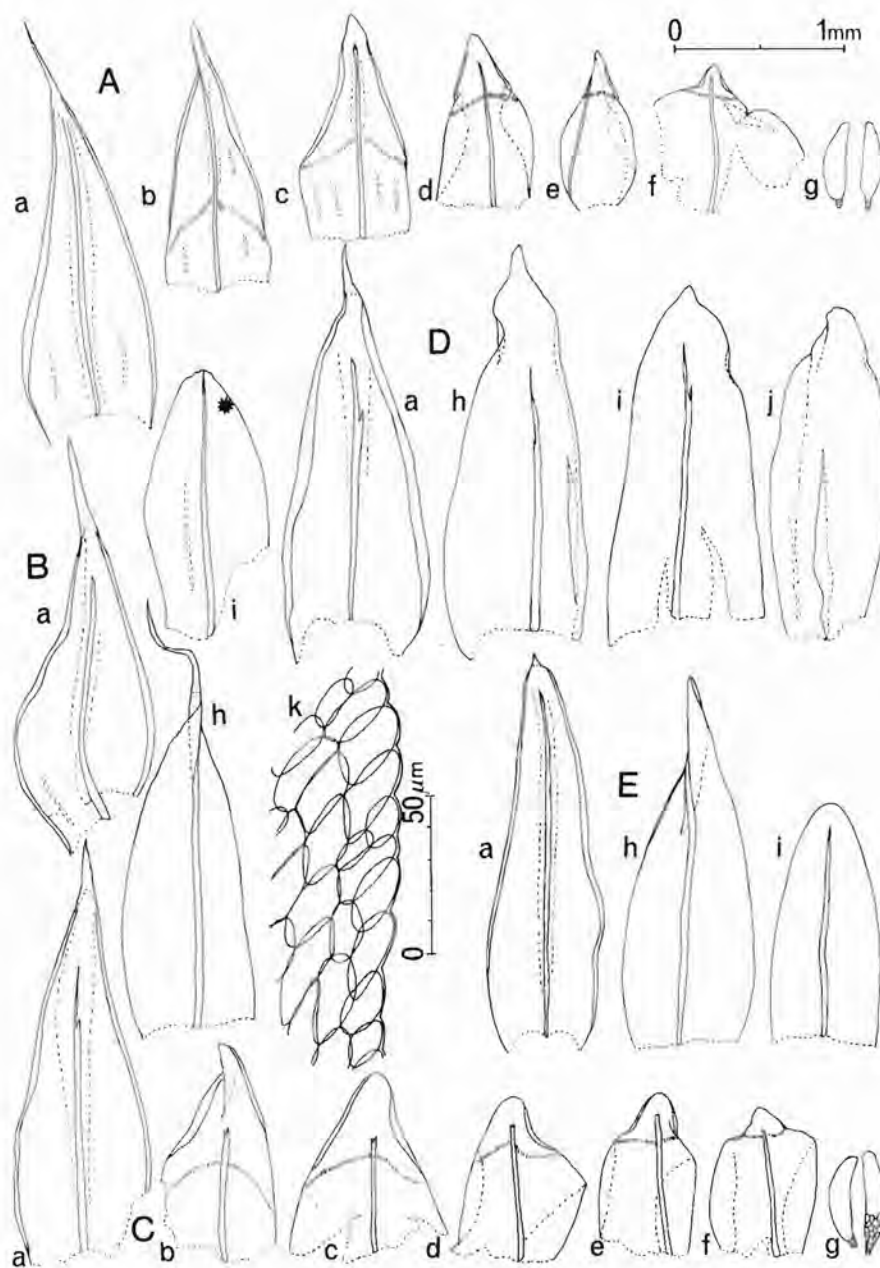


Fig. 20. Male and female bracts. A. *Racomitrium ericoides*. B. *R. elongatum*. C-D. *R. panschii*. E. *R. japonicum*. a. Vegetative leaf. b-f. The five innermost bracts in a perigonium; the cells below the dotted line are reddish-hyaline. g. Antheridia. h-j. Female bracts. k. Crenulate margin at the asterisk in leaf B i. - A. Norway: NT, Verdal, 2.IX.1981 Frisvoll (TRH). B. ST, Rissa, 18.VII.1981 Frisvoll (TRH). C. USSR: Reg. Transbaikalskaya, 5.VII.1912 Zolotuchina (H-BR). D. Amur distr., 22.VII.1911 Prochorov & Kuzeneva (H-BR). E. *R. iwasakii* Okam.; syntype (NICH).

Seta. In all taxa of the group the seta is smooth and twisted counter-clockwise in the upper part when dry; in the other *Racomitrium* taxa except *R. fasciculare* and *R. lanuginosum* the seta is twisted clockwise, and in all but *R. lanuginosum* the seta is smooth (Loeske 1913: 171). The seta is normally 1-2 cm long, erect and yellowish red to blackish red; it becomes darker with age and towards the base.

Capsule. The capsule is erect, ovate to oblong-cylindrical, and varies from yellowish brown to reddish-brown and blackish-brown. It is difficult to demonstrate differences in capsule shape between the taxa; in the same cushion of one taxon the capsules may be ovate, oblong and oblong-cylindrical.

Exothecial cells. At the capsule mouth there are some small, rounded and incrassate cells. In *R. barbuloides* and *R. canescens* there are 1-3 rows of small cells on average, whereas in *R. elongatum*, *R. ericoides*, and *R. japonicum* there are usually 4-6 rows of small cells; however, this difference is by no means constant. The cells of the capsule wall are elongated. At the poorly marked neck the cells are small and mostly rounded; here a few stomata are present in one or two indistinct rows.

Peristome. Usually the peristome teeth are almost as long as the urn. The height and possibly also the structure of the papillae of the teeth may be slightly dissimilar in some of the taxa. *Racomitrium barbuloides* seems to have coarser and lower papillae than the rest of the taxa, but owing to the scarcity of usable capsules of that taxon this is not established. As indicated by Noguchi (1974, as *R. canescens* var. *epilosum*) the peristome of *R. barbuloides* may also be shorter than that of *R. japonicum* (named *R. canescens* var. *canescens* by Noguchi, 1974).

Spores. The spores of *R. barbuloides* are about (10)13-(15.5) μm ; this is larger than in the other taxa, where spores are about 8-11 (13) μm . The spores in all taxa are finely granular on the surface.

IX. TAXONOMY

The genus *Racomitrium* Brid. is heterogeneous, and the *R. canescens* group has variously been grouped with other species or treated as a separate subdivision. Bryologia Europaea (Bruch et al. 1845) established *Racomitrium* [subgen.] II. *Racomitrium* including *R. canescens* coll. as well as *R. fasciculare*, *R. heterostichum*, *R. microcarpon*, and *R. lanuginosum*. The *Racomitrium* subgen. *Racomitrium* of Schimper (1860), *Rhacomitrium* [subgen.] B. *Eu-Rhacomitrium* of Dixon (1896), and *Rhacomitrium* subgen. *Eurhacomitrium* of Jones (1933) have the same delimitation. The *Grimmia* [subgen.] A. *Trichostomum* of Lindberg (1879) includes the same taxa plus [*Racomitrium*] *aquaticum* and [*R.*] *aciculare*. Kindberg (1898) treated the *R. canescens* group as a separate subdivision: *Racomitrium* [sect.] 2. *Canescentia*. Loeske (1913) grouped the European *Racomitrium* species into four, with *R. canescens* coll. plus *R. lanuginosum* in one of the groups. The *Racomitrium* subgen. *Canescentes* of Vilhelm (1925) comprises *R. canescens* coll. plus *R. lanuginosum* and *R. fasciculare*. The *Racomitrium* [subgroup] C. of Brotherus (1924, 1925) includes *R. austro-canescens*, *R. barbuloides*, *R. canescens* and *R. iwasakii*. Lawton (1971) treated *Rhacomitrium canescens* coll. in a category of its own. Noguchi (1974) included only *R. canescens* coll. in *Racomitrium* sect. *Racomitrium*. (The spelling of the above names is original.)

Racomitrium canescens coll. is a well defined, monophyletic group, and there is strong evidence that the group should be treated as a separate entity. "Ich halte *Rh. canescens* [coll.] für die abgeleitetste und jüngste Art der Gattung [*Racomitrium*], und ihre Beziehungen zu *Rh. lanuginosum* für sehr vage. Es ist allerdings auch keine andere Art ersichtlich, der sie näher stände, und in der Tat bildet *Rh. canescens* m. E. einen isolierten Typus." (Loeske 1930: 18). Probably the large genus *Racomitrium* Brid. ought to be divided into monophyletic genera as suggested for the correspondingly large and heterogeneous genera *Grimmia* Hedw. and *Mnium* Hedw. by Bremer (1981) and Koponen (1968) respectively. The *Racomitrium canescens* group would constitute a natural genus with no intermediate taxa between it and the other groups of *Racomitrium* s.l.; the name of this genus would be *Racomitrium* Brid., whose type species is *R. canescens*. However, such a classification should be established in connection with a generic revision of *Grimmiaceae*. (Valuable comments on the relationships between *Racomitrium* and the genera *Grimmia*, *Schistidium*,

Coscinodon and *Ptychomitrium* are given by Deguchi, 1978). Here I take the more conservative stand of Kindberg (1898) and Noguchi (1974), treating the *R. canescens* group as a section. As the taxa of the section can be grouped into two I have established two subsections.

The names and author citations in this paper are in accordance with the original publications and the present nomenclatural rules (Stafleu et al. 1978). Some combinations and author citations presented by Wijk et al. (1959-1969) are erroneous.

A. *Racomitrium* sect. *Racomitrium*

Plants mostly 2-5 cm, erect to prostrate, olive-coloured to greyish green or green. Stem simple to pinnately branched, rhizoids sparse or, more rarely, abundant.

Leaves imbricate, flexuose, contorted or spirally twisted around the stem when dry, erect-spreading to reflexed when moist, narrowly triangular to elliptical in shape, obtusely or narrowly keeled to channelled in upper part, not or strongly plicate, not or moderately undulate; margin broadly or narrowly recurved from the base to 3/4-1/1 the leaf length; costa stout or weak, flat in upper part, 1/2-1/1 the length of the leaf, forked, branched or simple; alar cells distinct, of thin-walled hyaline or yellowish, esinuose and epapillose, partly inflated cells; leaf cells sinuose, incrassate, narrowly elongate to rectangular in basal part of the leaf, shortly rectangular to quadrate in upper part; papillae mostly simple, cylindrical or conical, present over the lumen of most leaf cells except alar cells, extreme basal cells and parts of the costa and hyaline point, largest in lower and upper part of the leaf, smallest in central part of the leaf lamina and the margin, usually several papillae per cell; hyaline hairpoint from absent to very long, subulate or stout, not or strongly flexuose and ranging from strongly denticulate and spinulose to quite smooth, and from strongly papillose to epapillose.

Dioicous, male and female plants similar. Inner perichaetial bracts thin and pellucide, obtuse, acute or piliferous, often crenulate-dentate, cells thin-walled, little or not sinuose, and epapillose or with broad epapillose plane margin; costa weak and mostly unbranched. Seta 1-2 cm, reddish brown, darker towards the

base, in upper part twisted counter-clockwise when dry, smooth. Capsule 1-2 mm, mostly erect, indistinctly to distinctly ribbed when dry, ovate to oblong-cylindrical or elliptical, mouth narrow; annulus of two rows of large cells, separating; exothecial cells at mouth small and rounded, below rectangular, arranged in alternating yellowish and orange rows with elongate incrassate cells and shorter less incrassate cells respectively, corresponding to the longitudinal striation of the dry capsule, at base 1-2 rows of phaneropore stomata surrounded by small rounded cells; operculum with erect beak as long as or longer than the urn; peristome of 16 long and straight teeth, cleft into two equal filiform, papillose and nodose divisions joined at the base; preperistome present; calyptra mitriform, scabrous, fringed at base, yellowish brown with darker apex; spores 7-11 μ m, sometimes to 15 μ m, finely granular.

B. Key to subsections and species

- A. Leaves sharply keeled or channelled in upper part, ovate-lanceolate to triangular; costa in most leaves unbranched or sometimes split at the upper end, about 3/4-1/1 the length of the leaves (Fig. 12-13, 14 A-B); papillae tending to be comparatively small and inconspicuous in upper part of the leaf lamina (Fig. 22-23, 27, 30-31, 33)
..... I. subsect. *Ericoides* = *R. ericoides* s.l.
1. Basal leaf cells with papillae which do not contrast sharply with the papillae of the rest of the leaf; auricles not very conspicuous, of 3-7 cell rows; hairpoint when present subulate and not or slightly spinulose; plants not robust.
2. Margin in most leaves recurved towards apex (Fig. 12, 13 B, 14 A).
3. Plants large: main stem including dry leaves about 2-5(10) cm x 1 mm, leaves in piliferous specimens mostly 2-3 mm (Fig. 12 A-B); true costa indistinct,

situated in a leaf furrow which imitates a costa (Fig. 23 f-g); leaf cells with coarse to slight papillae, mostly not opaque, mostly not yellowish (except at base and on the costa); alar cells mostly large and inflated; hairpoint from almost epapillose to strongly papillose.

4. Marginal cells just above the alar cells (i.e. the supra-alar cells) usually elongate and always thin-walled and slightly sinuose to esinuose (Fig. 16 a); most hairpoints erect-flexuose when dry (Fig. 5-6), usually not distinctly decurrent down margin of lamina (Fig. 12 B), often faintly denticulate to edenticulate - rarely more strongly denticulate, in lower part papillose with indistinct to high papillae, in upper part sparsely papillose to quite epapillose (Fig. 18 e-g) 1. *R. ericoides*

4. Supra-alar cells mostly short and always thick-walled and strongly sinuose (Fig. 16 c); most hairpoints distinctly recurved and little flexuose when dry (Fig. 5-6), often strongly denticulate and decurrent down margin of lamina (Fig. 12 A), in lower part papillose with high distinct papillae, in upper part less papillose but rarely quite epapillose (Fig. 18 a, c-d) 2. *R. elongatum*

3. Plant small: main stem including dry leaves about 0.5-1.5 cm x 0.5-0.75 mm, leaves in piliferous specimens mostly 1.5-1.75 mm (Fig. 14 A); costa sharply

- delimited, not situated in a leaf furrow; leaf cells with comparatively coarse papillae, opaque, distinctly yellowish (Fig. 27); alar cells mostly small and little inflated (Fig. 16 g); hairpoint practically epapillose (Fig. 18 b) 3. *R. pygmaeum*
2. Margin in most leaves recurved to 1/2-3/4 the length of the leaves (Fig. 13 A, 14 B).
5. Leaf in basal 1/4 with cells long, very narrow and incrassate, and almost epapillose, contrasting sharply with the short and wide (rarely slightly elongate) cells of the rest of the leaf (Fig. 30, 46 C); auricles not sharply delimited, of 5-7 cell rows; three narrowing to one hyaline, esinuose and epapillose supra-alar cell row extends as a border to 1/5-1/2 the leaf length (Fig. 17 b, d); hairpoint when present often long and subulate, distinctly decurrent down margin of lamina, denticulate, and moderately papillose (Fig. 19 a-b, h) 4. *R. barbuloides*
5. Cells in basal and upper part of leaf less different (Fig. 33); auricles distinct and sharply delimited, of 3-5 cell rows; border of supra-alar cells indistinct or absent (Fig. 16 f); hairpoint almost always absent, and when present short to indistinct and with low papillae (Fig. 18 h) 5. *R. muticum*
1. Basal leaf cells with papillae which are much higher than broad and contrast sharply with

the comparatively small papillae of the rest of the leaf (Fig. 31, 46 A-B); auricles the largest in the section, of 6-8(10) rows of sharply delimited and partially inflated cells (Fig. 17 a); hairpoint when present stout and strongly spinulose (Fig. 19 c-d); plant the most robust in the section (Fig. 9 A) 6. *R. japonicum*

A. Leaves obtusely keeled in upper part, (sub-)elliptical to ovate-lanceolate; costa in most leaves distinctly branched, about 1/2-3/4 the length of the leaves (Fig. 14 C, 15); papillae tending to be comparatively large and conspicuous in upper part of the leaf lamina (Fig. 36-37, 41-42)
..... II. subsect. *Canescens* = *R. canescens* s.l.

1. Most leaves from ovate base fairly suddenly narrowed into apex; basal leaf cells with tall and broad papillae (Fig. 15, 36-37, 42); hairpoint when present often broad at base and subulate above, with or without teeth or spinulae, densely covered with high papillae towards apex; papillae at dorsal base of the point tall and broad and very conspicuous (Fig. 19 i, k) ... 7. *R. canescens*

1. Most leaves from ovate base gradually tapering towards apex; basal leaf cells less papillose (Fig. 14 C, 41); hairpoint when present often broad towards apex and usually spinulose and/or serrulate, with fairly high papillae in lower half, not or faintly papillose in upper part; papillae at dorsal base of the point narrower and more irregularly arranged (Fig. 19 e-g, j)
..... 8. *R. panschii*

C. Subsect. *Ericoides* Frisvoll subsect. nov.

Folia ovato-lanceolata vel triangulata, acute carinata vel canaliculata in partem superiorem; in foliorum maximam partem costa eramosa, foliorum longitudine inter 3/4 et 1/1 percurrens; papillae in partem superiorem laminarum foliorum maxima ex parte admodum parvae.

Type species: *Racomitrium ericoides* ((Web.) ex Brid.) Brid.

Loeske (1930: 193) considered *Racomitrium* to be most similar to the ancestors of Grimmiaceae subfam. Grimmioideae (but see Deguchi 1978: 152), and *R. lanuginosum* close to the "Urtypus" of the subfamily. In this context taxa with few or no branchlets are not as close to the ancestral form as taxa with a pinnate branching habit. It is probable that the genus *Racomitrium* was derived from an ancestor similar to Pottiaceous mosses (Noguchi 1974). I consider that the taxa in subsect. *Ericoides* are closer to the ancestral form of sect. *Racomitrium* than taxa in subsect. *Canescens* (Fig. 21). The

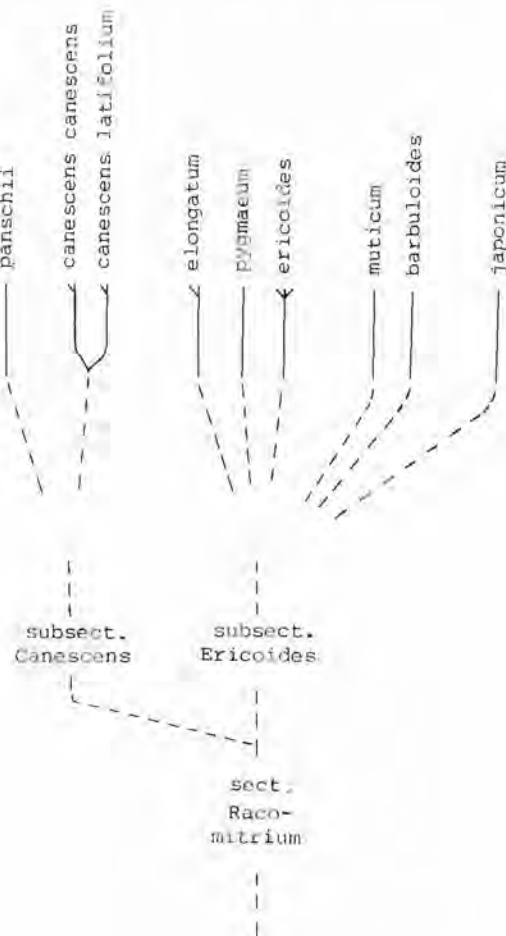


Fig. 21. Possible relationships between the taxa in the *Racomitrium canescens* group. Splitting at the top of a branch indicates that the taxon appears to be composed of more than one genotype; this assumption is based on the occurrence of mixed stands.

long unbranched costa (cf. Miller 1979), and probably also the more triangular and sharply keeled leaves are primitive features. It is also considered that taxa with low or little differentiated papillae are more primitive than taxa with high or heterogeneous papillae. When these criteria are applied to the *R. canescens* group, the most primitive taxon may be *R. ericoides*. This taxon is usually pinnately branched and has few or no advanced structures in leaves, cells and papillae. *Racomitrium elongatum* is close to *R. ericoides*, but is inter alia more strongly papillose. *Racomitrium pygmaeum* is smaller than the other taxa in the group, and within any group larger mosses are generally more primitive than smaller ones (Miller 1979). Many characteristics - including the strikingly different areolation of basal and upper part of the leaf and the undulation of the lamina - indicate that *R. barbuloides* is more derived than *R. ericoides*; moreover, the former taxon is often not pinnately branched. *Racomitrium muticum* possesses many independent, probably advanced characteristics. *Racomitrium japonicum* is distinct in the different structure of the papillae in basal and upper part of the leaf, and in having stout hyaline points; these structures are regarded as derived. Beyond that it is often met with as unbranched plants, more rarely it is pinnately branched.

1. *Racomitrium ericoides* ((Web.) ex Brid.) Brid -
Fig. 1 B, 5-8, 10 B, 12 B, 16 a, 18 e-g, 20 A, 22,
24-25, 38 a: C-D, 45 A-B, 47 C, 49 A, 50

Trichostomum ericoides (Web.) ex Brid., Journ. für Bot. (Schrader) 1800 1(2): 290. Apr. 1801 (γ. *Hypnum canescens*, [var.] *ericoides* Web., Spic. Fl. Gott. 82. 1778 nom. inval.). - *Bryum ericoides* ((Web.) ex Brid.) Dicks., Pl. Crypt. Brit. fasc. 4: 14. Oct. 1801. - *Racomitrium ericoides* ((Web.) ex Brid.) Brid., Mant. Musc. 78. 1819. - *Trichostomum canescens* Hedw. [var.] β *ericoides* ((Web.) ex Brid.) Hartm., Handb. Skand. Fl., Ed. 1: 400. 1820. - *Trichostomum canescens* Hedw. [var.] β **ericetorum* Hartm., Handb. Skand. Fl., Ed. 2: 321. 1832. nom. illeg. err. cit. pro *T. canescens* var. *ericoides*. - *Racomitrium canescens* (Hedw.) Brid. [var.] β. *ericoides* ((Web.) ex Brid.) Hampe, Flora 20: 281. 1837. - *Grimmia canescens* (Hedw.) C. Müll. [var.] β. *ericoides* ((Web.) ex Brid.) C. Müll., Syn. I: 807. 1849. - *Grimmia *ericoides* ((Web.) ex Brid.) Lindb.,

Musci Scand. 29. 1879 *hom. illeg. non* Pyl. in Brid., Bryol. Univ. 1: 768. 1826. - *Racomitrium canescens* (Hedw.) Brid. fo. *ericoides* ((Web.) ex Brid.) Chal., Grimm. tatr. 115. 1882. - *Racomitrium brevipes* Kindb. var. *ericoides* ((Web.) ex Brid.) Kindb. in Macoun, Bull. Torr. Bot. Cl. 17: 272. 1890. - *Racomitrium canescens* (Hedw.) Brid. fo. **eu-ericoides* Loeske, Laubm. Eur. I: 189. 1913 *nom. illeg.* - Type: Wales, "In cautibus udis montis Widhva Cambris, i.e. elatiori jugorum Snowdon parte observavit Rich. Richardson, ubi etiam ipse postea vidi, sed non copiose." (OXF-DILL; Herb. fol. 118, no. 31 = *Bryum hypnoides*, *Ericæ facie*, *capsulis barbatis*, *alpinum* Dill.; lectotype nov. - Fig. 24 and 45 A; Dillenius 1741: 372).

Racomitrium canescens (Hedw.) Brid. var. *epilosum* H. Müll., Westfalens Laubmoose, Fasc. 6 no. 333, Aug. 1865. - *Racomitrium canescens* (Hedw.) Brid. fo. *epilosum* (H. Müll.) Chal., Grimm. tatr. 115. 1882. - *Grimmia *ericoides* (Brid.) Lindb. var. *epilosa* (H. Müll.) C. Jens., Medd. Grønland 15: 425. 1898. - *Grimmia canescens* (Hedw.) C. Müll. var. *epilosa* (H. Müll.) C. Jens., Bot. Færøes Dan. Invest. 1: 165. 1901. - Type: [W. Germany] Bei Winterberg von mir gesammelt, Dr. H. Müller (JE, lectotype nov. - Fig. 49 A; MSTR, isoelectotype. - Westfalens Laubmoose, Fasc. 6. no. 333. Distributed Aug. 1865).

Racomitrium canescens (Hedw.) Brid. var. *brevifolium* Kindb., Forh. Vid.-Selsk. Christiania 1888(6): 20. 1888. - Type: [Norway, Sør-Trøndelag, Oppdal] Kongsvold, Høgsnydda 1300 m, 28. July 1887 Kindberg (S, holotype).

Racomitrium canescens (Hedw.) Brid. subsp. **R. subfasciculare* Kindb., Eur. N. Am. Bryin. 2: 236. 1898 ('1897'). - Type: Norvegia, Dovre, Kongsvold, 1000 m, July 1833 N.C. Kindberg (S, lectotype nov. - Fig. 47 C).

Racomitrium consocians Stirt., Ann. Scott. Nat. Hist. 1907 (63): 179. 1907. - Type: Scotland, Killin, Glen Lochy, 28. March 1903 D. Haggart (GL, holotype; BM, syntype - Fig. 45 B).

Racomitrium canescens (Hedw.) Brid. [var.] b) *epilosum* H. Müll. fo. *immersum* H. Wint., Hedwigia 49: 296. 1910 ('immersa'). - *Racomitrium canescens* (Hedw.) Brid. var. **vulgare* (Chal.) Loeske fo. *epilosum* (H. Müll.) Chal. subfo. § *immersum* (H. Wint.) Podp., Consp. 298. 1954. - Type: [Norwegen, Oppland] Valders, Skogstadt, am Ufer der Bägna zum Wasser umspült, Juli 1908 Winter (JE, holotype).

Racomitrium canescens (Hedw.) Brid. fo. *angustifolium* Vilh., Věstn. Král. Čěsk. Spol. Nauk Tr. 2, 1925(5): 17. 1925 ('angustifolia'). - Type: [Czechoslovakia] Tatrís, Malá Studená Dolina, rupes sub Pět

Ples, 1919 Vilhelm (PRC, holotype).

Racomitrium canescens (Hedw.) Brid. fo. *repens* Vilh., Věstn. Král. Česk. Spol. Nauk Tr. 2, 1925(5): 17. 1925. - Type: [Czechoslovakia] In Tatrís prope Zelené pleso sub Lomnický štít ad 1500 m, 1919 Vilhelm (PRC, holotype).

Racomitrium canescens (Hedw.) Brid. var. *ericoides* (Brid.) Hampe fo. *muticum* Zett. ex Möll., Rev. Bryol. n.s. 2(56): 83. 1929 ('mutica') (*R. canescens* fo. *ericoides mutica* Zett., Rev. Grimm. Scand. 131. 1861). - Type: [Suecia] In saxís montis Tystingsbergen paroeciæ Wiby, Nericiæ, Jul. 1855 J.E. Zetterstedt (UPS, lectotype nov.; TRH, isoelectotype. - Zetterstedt's Grimmeræ at Andreæ Exsiccata no. 40b; syntypes, do. no. 40a: In saxís juxta Nya Hvarfvet prope Götheborg, 23. Aug. 1858 J.E. Zetterstedt).

Racomitrium canescens (Hedw.) Brid. fo. *rivulare* Timm ex Loeske, Bibl. Bot. 101: 229. 1930 ('rivularis'). - *Racomitrium canescens* (Hedw.) Brid. var. **vulgare* (Chal.) Loeske fo. *epilosum* (H. Müll.) Chal. subfo. §§ *rivulare* (Timm ex Loeske) Podp., Consp. 298. 1954. Type: "... von Wahnschaff 1911 in der Aare bei Haudegg (Schweiz) gesammelt und mir durch Prof. Dr. R. Timm mitgeteilt." (Loeske l.c.; type not seen).

Racomitrium canescens (Hedw.) Brid. var. *ericoides* (Brid.) Hampe fo. *submuticum* Zett. ex Möll., Ark. Bot. 24A(2): 140. 1931 ('submutica') (*R. canescens* fo. *ericoides submutica* Zett., Rev. Grimm. Scand. 131. 1861) [excl. syn. *R. canescens* var. *ericoides* fo. *subepilosum* Warnst. 1899 = *R. elongatum*]. - Type: [Suecia] In locis sabulosis juxta urbem Venersborg, Vestrogothiæ, Apr. 1859 N.C. Kindberg (UPS, lectotype nov.; TRH, isoelectotype. - Zetterstedt's Grimmeræ et Andreæ Exsiccata no. 39a).

Racomitrium canescens (Hedw.) Brid. var. *strictum* Limpr. fo. *pseudofasciculare* Möll., Ark. Bot. 24A(2): 147. 1931. - Type: Suecia: Åsele Lappmark, Vilhelmina, Marsfjällen, Ropentjokk, 700 m, 9.VII.1926 Möller (S, lectotype nov., isoelectotype, syntypes).

Stem (1)3-5(12) cm, brownish except for the uppermost part (ca. 1-2 cm) which is olive-coloured, mostly pinnately or subpinnately branched, occasionally irregularly branched to unbranched; branchlets usually indistinctly or not recurved at their apex.

Leaves (Fig. 12 B, 22 a) to 3 mm including hairpoint but often shorter, mostly imbricate and slightly twisted when dry, erect-spreading to slightly recurved when moist, ovate-lanceolate to

sub-triangular, gradually tapering towards apex, sharply keeled in upper part, plicate; margin broadly recurved from base to apex; costa in most leaves unbranched, or sometimes shortly split in uppermost part, reaching towards apex, in lower part indistinct, situated in a leaf furrow which imitates a costa, the leaf furrow (65)75-100 μm wide (dorsal view); alar cells (Fig. 16 a) of 3-5 cell rows, marginal alar cells often rounded and inflated, large (often exceeding 20(-50) x 15 μm); marginal cells just above the alar cells mostly elongate and always thin-walled and little sinuose to esinuose, marginal cell row including alar cells with up to 10(-15) esinuose cells; basal laminal cells (Fig. 22 d) elongate (40-50 x 4.5-6 μm), longitudinal walls mostly not thicker than cell lumens, papillose with small to fairly large (\pm 4.5 μm broad) papillae except for the basal 1-4 cell rows which are epapillose, middle and upper cells (Fig. 22 b-c) shortly rectangular (10-20 x 6-10 μm), papillose with relatively low and narrow papillae; hairpoint (Fig. 18 e-g) erect-flexuose or sometimes slightly reflexed-flexuose, often relatively short and not infrequently missing, subulate, usually slightly denticulate, in xeromorphous plants longer and embracing parts of the upper lamina but usually not much decurrent down margin of lamina, always capillaceous and slightly papillose to quite epapillose in upper part, in lower part slightly to strongly papillose with low or sometimes high and narrow papillae.

Inner perichaetial bracts in piliferous specimens acute or piliferous; costa as in vegetative leaves but weaker. Spores 9-12 μm .

Nomenclature and typification

"*Trichostomum canescens* var. *ericoides* Hedw., Sp. Musc. 111. 1801" is usually cited as the basionym of *Racomitrium ericoides* (cf. Wijk et al. 1969). Hedwig himself did not even mention the taxon in the original manuscript; but Schwaegrichen (cf. Florschütz 1960: XV) added a parantheses in which he reminded that Hedwig previously had treated *Trichostomum ericoides* as a variety of *T. canescens*: "(Huc retulit, ut varietatem, trichostomum *ericoides* Hedwigius [1792] in manuscripti vetustiore parte, antequam Schraderi [1794] spicilegium divulgatum erat.)" In Hedwig (1792: 7) the Dillenian phrase-name *Bryum hypnoides*, *Ericæ facie*, *capsulis barbatis*, *alpinum* is conside-

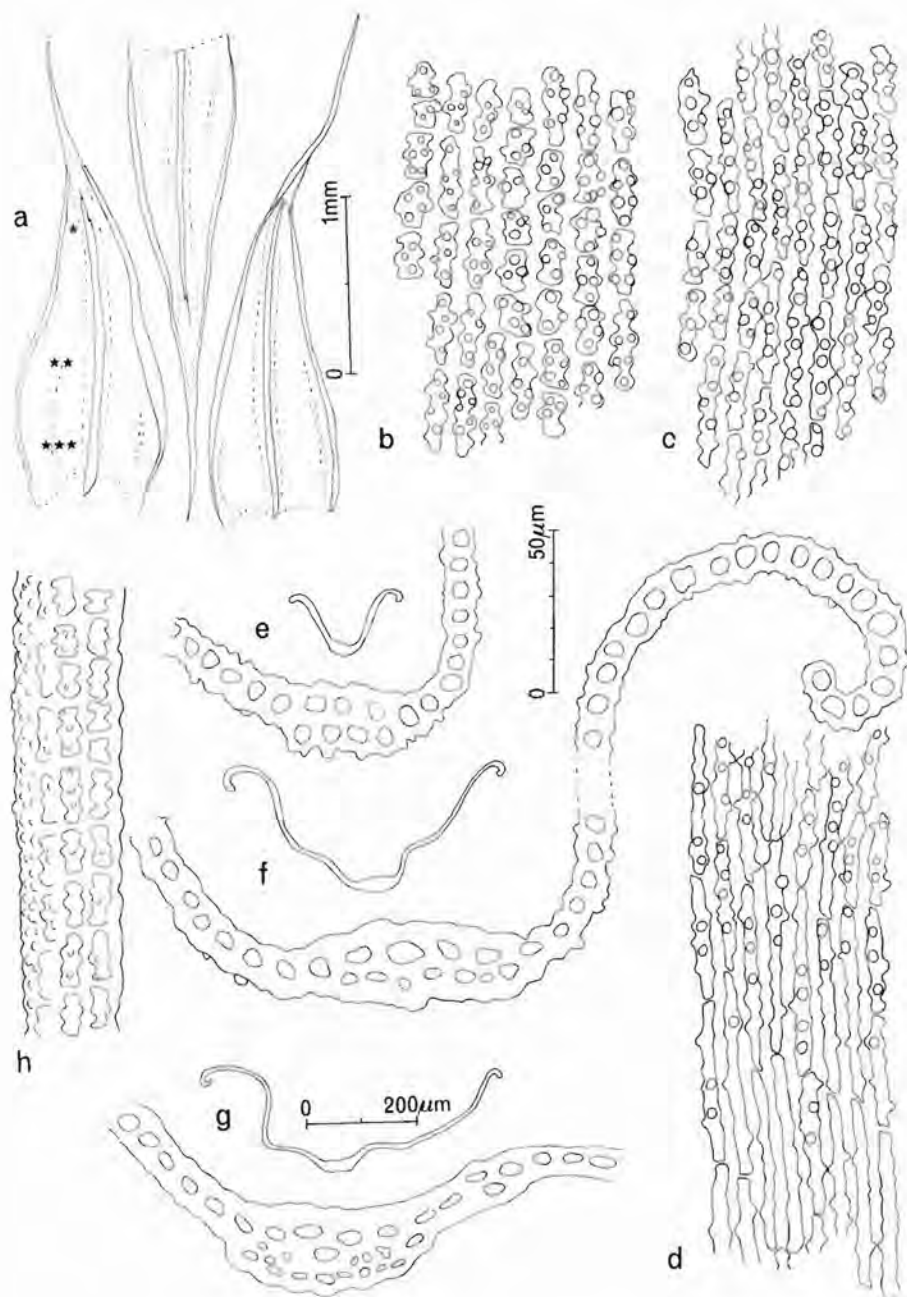


Fig. 22. *Racomitrium ericoides*. a. Leaves. b-d. Cells from the upper (*), lower middle (**), and central basal (***) part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. h. Marginal cells from the middle part of the leaf. - USA: Washington, King Co., between Cottage Lake and Duvall, ab. 3 miles W of Duvall, 21.VII.1954 Lawton 2370 (WTU). Mixed stand between *R. ericoides* and *R. elongatum*, cf. Fig. 5 and 23.

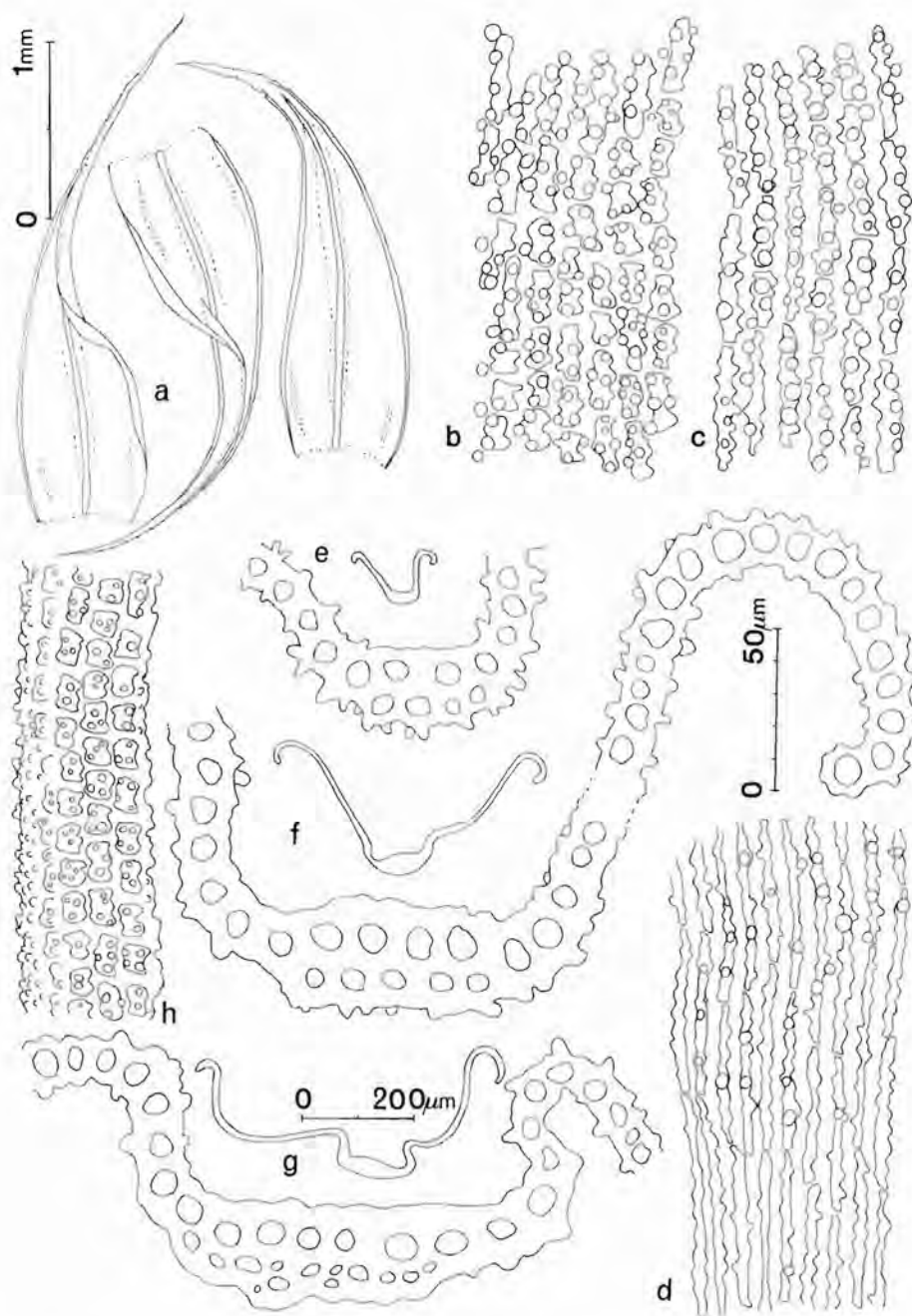


Fig. 23. *Racomitrium elongatum*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. h. Marginal cells from the middle part of the leaf. - Lawton 2370 (WTU), cf. Fig. 22.

red a variety of *Trichostomum canescens* without the introduction of any binomial varietal epithet: "At Dillenbergii Bryum Hypnoides, Ericae facie, ... mihi quidem potius hujus varietas esse videtur, ..." Under the present nomenclatural rules (Stafleu et al. 1978: Art. 33, 1) it is incorrect to regard *T. canescens* var. *ericoides* Hedw. as the basionym of *Racomitrium ericoides*, as this combination was not presented in *Species Muscorum*. Nor is it correct to list *Trichostomum ericoides* Hedw. as the basionym of the taxon (see e.g. Lawton 1971) as this combination was not included as the name of a species in that work.

Bridel (1798) described and discussed the status of *Trichostomum ericoides*, and later (Bridel 1801) he again commented on the status of the taxon; according to Sayre (1959) the works of Hedwig (1801) and Bridel (1801) were published simultaneously, viz. 19. April 1801.

With regard to *T. ericoides*, Bridel (1798) has numerous references to previous names and authors, and like most post-Dillenian authors he has a reference to Dillenius' (1741: 371, Tab. 47, Fig. 31) *Bryum hypnoides, Ericae facie, capsulis barbatis, alpinum* (see p. 11f.). Bridel (1798) also referred to Weber (1778: 82) who appears to have been the first to employ the epithet *ericoides* in a binomial combination; Weber listed *Hypnum canescens* (which according to most authors referred to *Racomitrium lanuginosum* in present day sense) with the subordinate taxon "γ. *Hypnum canescens, ericoides*. Varietas ..." referring to Tab. 47, Fig. 31 in Dillenius (1741). The epithet *ericoides* originates from Dillenius' polynomial, which in turn originates from older phrase-names; the oldest name including a reference to an *Erica*-like look of the actual species is *Muscus trichoides montanus, capitulis erectis, foliis Ericae non hirsutis, cauliculis procumbentibus* (Ray 1724: 478). The *Erica* of the phrase-name is the *Erica vulgaris* of Ray (1696, 1724) and Linné (1753), now called *Calluna vulgaris* (L.) Hult. The identity of the plants in Ray (1724) and Dillenius (1741) is unquestionable. Dillenius anonymously revised and enlarged Ray's *Synopsis* ed. III (Stafleu 1971, Stearn 1973), and he was responsible for the phrase-name and treatment of the taxon in Ray's posthumous work. Both Ray (1724) and Dillenius (1741) gave the same locality and referred to Dr. Rich. Richardson as the first observer of the moss. According to Lindberg (1883: 4) R. Richardson was one of those men who under the influence of John Ray started collecting cryptogams; he must have been at Snowdon

before the publication of Ray's Synopsis ed. III (1724). According to Richards (1979) Dillenius visited Wales in August 1726, and he spent three weeks in Gwynedd during which he climbed Snowdon; there he must have seen and collected *R. ericoides*, because after stating that R. Richardson observed the moss he (Dillenius 1741) noted that it still could be seen there "sed non copiose" (but not abundant).

When I found that the European *R. ericoides* was composed of two taxa, it was not evident which should be called *R. ericoides* s.str. without seeing the specimens in Bridel's and Dillenius' herbaria:

The eight collections named *Racomitrium* [not *Trichostomum*!] *ericoides* in Bridel's herbarium (B) are glued to three small herbarium sheets; of these, two specimens are *R. ericoides* sensu Dillenius, four specimens represent the other European *ericoides* taxon, viz. *R. elongatum*, one specimen is *R. fasciculare*, and one specimen is *R. lanuginosum*. Only one of these specimens was definitely collected before 1801 - the year the protologue of *Trichostomum ericoides* was published; it is labelled "var. *foliis apice viridibus*, Auvergne, Mont d'Or, June 1800." But this specimen was collected after 1798 when the detailed description referred to by Bridel (1801) was published; this particular specimen is *R. ericoides* sensu Dillenius. The second specimen of *R. ericoides* is also labelled var. *foliis apice viridibus*, whereas one specimen of *R. elongatum* is labelled var. *foliis apice canus* [!]. In addition to the locality mentioned above, one collection is labelled "Basses Alpes 1820 [leg.] Requier" and two collections "In Franconia [Central Germany] arenosis". Otherwise there is no information regarding localities, habitats or collectors. Bridel was, to a certain extent, able to distinguish between *R. canescens* and *R. ericoides* s.l., and no collection named *R. ericoides* turned out to be *R. canescens* (see also p. 115).

The plants in Dillenius' herbarium (OXF) named *Bryum hypnoides*, *Ericæ facie*, *capsulis barbatis*, *alpinum* represent the most northerly of the two European taxa in question (Fig. 24). The material is homogeneous, plentiful and representative of the taxon. As most authors - including Bridel (1798) - directly or indirectly refer back to Dillenius (1741), the specimen in Dillenius' herbarium corresponding to the figure (Tab. 47, Fig. 31) - Herb. fol. 118, no. 31 - is selected as the lectotype of *Trichostomum ericoides*. The locality is cited as follows: "On the moist rocks of Widna" (Dillenius in Ray



Fig. 24. *Bryum hypnoides, Ericæ facie, capsulis barbatis, alpinum* Dill. (OXF-DILL). Lectotype of *Racomitrium ericoides*. (cf. Fig. 1 B).

1724: 478), "In cautibus udis montis Widhva Cambris, i.e. elatiori jugorum Snowdon ..." (Dillenius 1741: 372) [Widna, Widhva = the Welsh name of Snowdon, nowadays spelt Yr Wyddfa; Cambris = Wales].

In May 1980 I visited Snowdonia National Park (Frisvoll 1980). I did not climb the summit of Snowdon, 1085 m a.s.l., but collected *R. ericoides* about 2 km E of the top, 430-450 m, where it was common along the nature trail by (the lake) Llyn Llydaw. There and elsewhere in the district *R. ericoides* is mixed with the other European taxon within *R. ericoides* s.l., viz. *R. elongatum*.

Taxonomical notes

1. Previously, *R. ericoides* has been considered very close to *R. canescens*. I consider this is incorrect and that the existence of *R. elongatum* has caused the confusion. For differences between *R. ericoides* and *R. barbuloides*/*R. elongatum*/*R. muticum*/*R. pygmaeum*, see the latter four species.

2. Within *R. ericoides* there seems to exist a number of regional races or ecotypes, with small but fairly constant distinc-

tions. The European plant - including the Dillenian type - is characterized by erect-flexuose point with small papillae in the lower part and is almost without papillae in the upper part; the papillae in the whole leaf are low. Plants which match the European material completely occur along the western coast of North America (Oregon, Washington, British Columbia, SE and SW Alaska). In specimens from the rest of North America and Siberia the hairpoint is more strongly papillose and sometimes reflexed-flexuose, and the leaf papillae are mostly higher. Many collections from these districts are less regularly pinnate. - It is remarkable how constant certain small regional differences can be (the Jan Mayen population of *R. ericoides* has e.g. slightly more papillose hairpoint than the Svalbard population), the evidence points to the fact that the above differences are genotypical. In Greenland some collections are similar to the European plant, whereas others are more strongly papillose and resemble the eastern and continental North American plants. I have seen comparatively few collections from eastern North America, and am uncertain about the occurrence and variation of *R. ericoides* in that area. From Greenland and Norway I have seen plentiful mixed collections of two different plants which are referred to *R. ericoides* in the present sense (Fig. 10 B). Thus the situation appears to be confusing. However, I have not been able to find clear-cut morphological differences between any of the above-mentioned genotypes, and until further investigations are carried out *R. ericoides* should include all these plants.

3. The complexity of *R. ericoides* in North America probably has a historical background. It is well known that glaciation has been limited in large parts of northern North America, especially in northern Alaska-Yukon, but also in northern British Columbia and southernmost Northwest Territories (Steere 1978). It is in these areas that the variability of *R. ericoides* is striking. During the glaciation the northern populations of *R. ericoides* were effectively isolated from the southern (coastal) populations. Steere (1978) writes about "relict arctic populations which have persisted in refugia for perhaps a million years ...". The Yukon populations of *R. ericoides* can mostly be known from herbarium specimens, and they are slightly different from some continental Alaskan populations which differ from the coastal populations. The northern populations are more similar to *R. elongatum* than are the southern populations. The

reasons for this are not easy to explain. *Racomitrium elongatum* is more southern than *R. ericoides* throughout the total distribution area of the taxa. In North America the northernmost known locality of *R. elongatum* is Glacier Bay, SE Alaska. If *R. elongatum* has influenced the structure of the continental North American *R. ericoides*, this must have taken place long ago.

4. The few known Japanese specimens have fairly papillose point, which, however, is capillaceous and erect-flexuose. The leaf cells are slightly papillose with small papillae, and the Japanese specimens are referred to the moderately papillose plant.

Ecology

Racomitrium ericoides is clearly less xerophilous than e.g. *R. elongatum* and *R. canescens*. It is sometimes found in humid sites where the other two taxa are absent. It may be the taxon of the group which occupies the most diverse types of habitats. Unlike *R. canescens* and *R. elongatum*, however, it does not seem to grow on limestone.

Distribution (Fig. 25)

Plants with moderately papillose leaves and hairpoints are found in the Azores; Central, West and North Europe including the Atlantic and Arctic islands; South Greenland; western parts of North America from Oregon to South Alaska including the Aleutian Islands; and Japan. This moderately papillose plant seems to be confined to humid, oceanic or high alpine areas. Plants with more papillose leaves and hairpoints are found in continental parts of North America and Siberia; the southern North American localities in Alaska, Yukon and British Columbia, are from the range of mountains close to the coast. Two important collections (Canada: Quebec; USSR: Kap Tsjeljuskin) with short points have been difficult to refer to either of these categories; they appear to belong to the less papillose plant. - Southernmost locality, Japan: Honshu, Chubu Nat. Park, ca. 36°36'N; northernmost locality, Norway: Svalbard, Nordkapp, ca. 80°30'N.

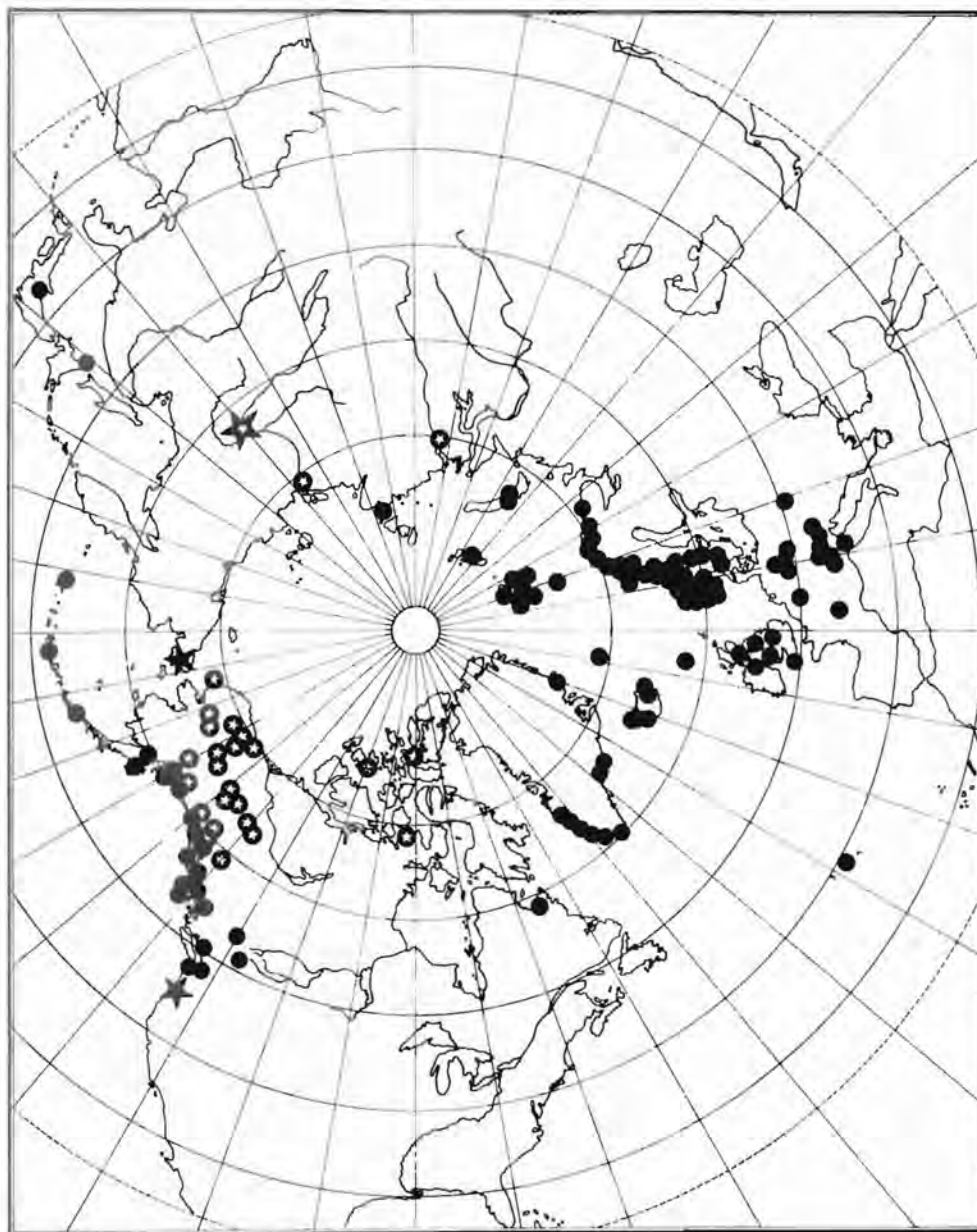


Fig. 25. Distribution of *Racomitrium ericoides* based on herbarium specimens. ●★ slightly papillose plant, ●★ strongly papillose plant, ●★ ordinary station, ★ locality inexact.

List of selected localities (see also "Mixed stands")

USA, Washington: Snohomish Co., S fork of the Stilliguamish River, between Verlot and Silverton, Lawton 3756 (WTU). - Alaska: Just E of Town of Craig, 55°28.5'N, 133°09'W, Worley & Hamilton 6716 (UBC); Petersburg, on the Panhandle, ca. 56°40'N, 133°00'W, Horton 1831 (ALTA); trail from rd. at Jamestown Bay (E of Sitka) to Mt. Verstovia, 57°3.6'N, 135°15.9'W, Worley & Thorpe 3329 (UBC); Yakutat Pier, Yakutat, 59°33'N, 139°45'W, Mathieson 49 (UBC); Cordova, 12.II.1974 Bishop (ALTA); Kenai Peninsula, along Glacier View Trail at Portage Glacier, below Byron Glacier, Vitt 18532 (ALTA); Newhalen, on Lake Iliamna, Summit Mt., Thomas 51-48 (WTU); Kodiak Island, Pillar Mt., 57°20'N, 153°40'W, 14.IV.1972 Bishop (ALTA); Aleutian Islands, Unalaska, Captains Harbour, 1.V.1932 Hultén (ALTA); Adak Island, Smith 3651 (WTU); Attu Isl., vicinity of Massacre Bay, Lookout Hill, Van Schaack 324 (UBC); 20 mi NE of Valdez, Thomson Pass, 60°10'N, 145°44'W, Svihla 4145 (WTU); at the terminus of the Kahiltna Glacier, 62°28'N, 151°15'W, 27.-28.VI.1956 Viereck (UBC); Alaska Range District, Upper Valley of the Swift Fork of the East Fork of the Kuskokwim River (= Tonzona R.), 62°40'N, 152°30'W, Vierek 5106 (ALTA); White Mts., the headwater of Sourdough Creek, Gjærevoll 1036 (TRH); Mt. McKinley Nat. Park, base of Mt. Eielson (Copper Mt.), 63°25'N, 150°25'W, 24.VII.1956 Weber & Viereck (WTU); Circle Quadrangle, vic. of Eagle Summit, 65°29'N, 145°25'W, Steere 72-796 (ALTA); Angayucham Mts., Mauneluk River, "Chasm Creek", 66°59'30"N, 156°09'W, Lewis 720 (UBC); Ambler River Region, 1.5 mi S of Bornite, 67°03'N, 156°54'W, Lewis 1689 (UBC); Cape Lisburn, N side, 68°52'N, 166°15'W, Steere & Crum 20523 (ALTA); Brooks Range, Peters Lake, 69°19'N, 145°03'W, 27.VII.1960 Steere, Holmen & Mårtensson (ALTA). - CANADA, British Columbia: Hudson Bay Mt. area above ski area, Smithers, Schofield 56581 (ALTA); Mt. Martier, E of Pemberton, Schofield 56820 (UBC); Kootenay area, creek which drains into the floodplain valley of Goldstream River, 51°35'N, 118°05'W, Tan & Scagel Jr. 79-590 (UBC); Canoe River Campground S of Tete Jaune Cache, Schofield 56092 (UBC); Takakia Lake, Moresby Island, Queen Charlotte Islands, Schofield 25194 (UBC); Cassiar Mtns., Atsutla Range, lake 11 mi E of Kedahda Lake, 59°15'N, 131°14'W, Vitt 19369 (ALTA); 12 mi W of British Columbia - Yukon border, Haines Hwy., 59°40'N, 136°40'W, Schofield 62210 (UBC). - Yukon: Carcross Area, 6.4 mi S of bridge over Bennett-Nares Lakes on Arctic Gold-Silver Mine Road, 60°07'N, 134°41'W, Vitt 15662 (ALTA); Kluane National Park, Goatherd Mtn., ca. 37 mi SSE of Haines Junction, Douglas 6992 (ALTA); Aishihik Lake Road, 17.0 mi N of Alaska Hwy., SE of Otter Falls, 61°03'N, 136°55'W, Vitt 12659 (ALTA); Hess Mtns., Keele Peak, 63°31'N, 130°23'W, Vitt 15942 (ALTA); Keno Hill, 63°57'N, 135°11'W, Vitt 16204 (ALTA); Mackenzie Mtns., Bonnet Plume Range, 5 mi NNE of Pingicula L., 64°45'N, 133°24'W, Horton 6537 (ALTA); at headwater of Ogilvie River on SE slope of Mt. Klotz, 65°22'N, 140°06'W, Vitt 7564 (ALTA). - North West Territories: Logan Mountains, along SE shore of lake close to Nahanni River, 62°34'N, 128°30'W, Vitt 23156 (ALTA); Mackenzie Mtns., Backbone Ranges, Grizzly Bear Lake, 62°41'N, 127°50'W, Vitt 23667 (ALTA); Keewatin Distr., 4 mi NW of the Hayes River, 67°36'N, 94°25'W, Gubbe, Maddison & Burr M991 (ALTA); Melville Isl., about 5 km E of Bridgeport Inlet, 75°08'N, 108°25'W, Maddison & Steen M 1723 (ALTA); North Kent, ca. 76°50'N, VI.1901 Simmons (O). - Quebec: Ungava, vic. of Helen Falls, George River, 58°09'N, 65°49-50'W, Brasseur 1331 (WTU); do., along E bank and floodplain of George River, 57°20-21'N, 65°18-20'W, Weber 1290 (NFLD). - GREENLAND. Julianehåb distr., N of Apugkup nua, 60°13'N, 44°13'W, Jacobsen 3006 (C); Nars-

sarssuaq, Tunugdliarfik Fjord, 61°10'N, 45°23'W, Steere 62-787(C); Tasiussaq avangnardleq, 61°47'N, 48°52'W, Damsholt 65-0489 (C); Fiskeneset distr., Sioralik, Alangordlia, 63°39'N, 50°42'W, Andersen & Feilberg 72-579 (C); Godthåb, 64°11'N, Holmen 3083 (C); N of the outflow from Taserssuaq into Ikamiut Kangerdluarsuat at Sukkertoppen, 65°47'N, 52°40'W, 8.VII.1958 Holmen (C); Angmagssalik distr., Sieraq, 65°56'N, 37°09'W, Lewinsky 70-1549 (C); Angmagssalik distr., Tugtlik, 66°20'N, 35°00'W, Lewinsky 41-443 (C); Wollastone Foreland, Mt. Zackenberg, 74°30'N, Holmen 524 (C). - ICELAND. Gullfoss, 15.VII.1948 Holmen (C); N of Hvitavatn, 4.VIII.1934 Grøntvedt (C); Muli v. Esja, 20.VII.1955 Grøntvedt (C); Eskifjardarheidi, 29.VI.1894 Jonsson (C); Kirkjubæ, 11.VI.1894 Jonsson (C). - FAEROES. Strømø, Kollfjardardalur, S of Leynavatn, NW slope of Lejnum Satan, Fagerstén & Haapasaari 549 (C); Syderø, Frodebø, 7.VIII.1867 Rostrup (C); Vaagø, Rensatindur, 29.V.1896 Jensen (C). - ENGLAND. Cornwall SW, Truro, 11.X. 1965 Paton (OXF); on Stanton Park Wall, Derbyshire, s.a. Herb. Bowman (OXF); Honister Pass, 9.X.1944 Warburg (OXF); Sheddin Clough, Todmorden, IV.1847 Wood (OXF); Ben Lawers, s.a. Braithwaite (OXF). - PORTUGAL. Azores, Pico, 9.V.1937 Persson (BM). - FRANCE. Auvergne, Mont d'Or, VI.1800 (B-BRIDEL). - BELGIUM. Orchimont, s.a. Gravet (O). - ITALY. Alpe di Darenzo, Domaso, Lae de Come, 15.VIII.1898 Artaria (BM, TRH); Aemilia, Pion delagotti, 9.VI.1926 Lunarch (TRH). - W. GERMANY. Westfalen, Tentoburgen Wald bei Bielefeld, 19.IX.1888 Holler (TRH). - E. GERMANY. Im Tale der Wilden Gera, VII.1910 Kramer (JE); bei Gehlberg, 5.IX.1902 Bornmüller (JE); Annaberg-Buchholz, 24.VII.1965 Manitz (JE); bei Oberhof, s.a. Krahmer (JE); Harz, Brocken, auf dem Gipfel, 28.V.1882 Janzen (JE). - SWITZERLAND. Pontresina, VII.1888 Winter (JE); Uri, Göschenen Reuss, 12.V.1900 Herzog (JE). - AUSTRIA. Tirol, Innervillgraten, 6.XII.1890 Garder (JE); Steiermark, Sulzbacher Alpen, 20.VII.1897 Glowacki (JE); Ferevall, am Ufer der Rosanna hinter St. Anton, VIII.1941 Herzog (JE). - POLAND. Tatra, s.a. Haussknecht (JE). - SWEDEN. Nerike, Viby, Tystingsbergen, 26.VI.1853 Zetterstedt (TRH), Västergötland, Göteborg, Landvetten, Kärnet, 4.IX.1925 Stenholm (TRH); Dalarne, Hemfjället, 22.VII.1909 Möller (TRH); Jämtland, in monte Vellista, 19.VII.1917 Öhrstedt (TRH); Lule L., reg. Sarjekensis, Sarvatjåkko, 1902 Jensen & Arnell (UPS); Torne L., Jokkmokks socken, Vaisa-området, Slappehaures avflöde, 9.VIII.1947 Mårtensson (UPS). - FINLAND. Li., Utsjoki, Kevo, Tsarsjoki, 13.VII. 1966 Heinonen (H). - USSR. Petsamo Lappmark, Yläluostari, vid Petsamojoki, 15.VIII.1927 Häyren (H); Lapponia Murmanica, Rinda, 18.VII. 1887 Brotherus (H); do., ad. fl. Harlofka, 25.VII.1887 Brotherus (H); Novaja Zemlja, Krestovoja Bay, VIII.1901 Palibin (BM, H); Terra Franz Josef, insula Scott Keltie, 25.VII.1930 Savicz (BM); Siberia, Kap Tscheljuskin, 1.IX.1901 Birula (H); Jenisei, Tolstoinos, 70°10'N, 2.IX.1876 Arnell (UPS); regio Jakutsk, in valle fl. Vatoma, 13.VII. 1912 Sokolow (H); in valle flum. Lena, Kumachsur, 70°30'N, 7.VIII. 1898 Nilsson-Ehle & Arnell (UPS); Terra Tschukt-schorum, Emmahafen, 13.-16.IX.1881 Krause (H). - JAPAN. Hokkaido: Soya distr., Rishiri Island, Mt. Rishiri, Koponen 20356, 20357 (H). - Honshu: Toyama pref., Chubu Sangaku Nat. Park, Mt. Tateyama, Midagahara, Koponen 16139 (H).

2. *Racomitrium elongatum* (Ehrh.) ex Frisvoll spec. nov. -

Fig. 1 A, 2 E, 5-6, 9 B, 10 A, 12 A, 16 c, 18 a, c-d; 20 B, 23, 26, 38 a: B, 38 b: 1, 3-6; 45 C, 49 C, 50

*Trichostomum *elongatum* Ehrh., *Plantae cryptogamae* Linneae no. 233. 1791 nom. inval. - *Bryum *elongatum* Hoffm., *Deutschl. Flora* 2: 41. 1796. nom. inval. (excl. syn. "Dill.[enius (1741) *Historia* *Musc.[orum]* tab. 47. fig. 31." = *Racomitrium ericoides*, q.v.).

*Grimmia *ericoides* (Brid.) Lindb. fo. *squarrosa* Lindb., *Krit. gr. moss. Dill. Hist. Musc.* 28. 1883. - Type: OXF-DILL; *Herb. fol.* 117, no. 27 E p.p. = *Bryum hypnoides*, *hirsutiae canescens*, *vulgare* var. *cum foliis magis reflexis* Dill.; lectotype nov. (Fig. 38 b: 1, 3-6; 49 C). H-SOL, syntype.

Racomitrium canescens (Hedw.) Brid. var. *c. intermedium* Vent. et Bott., *Atti Soc. Critt. Ital.* 3: 214. 1884. - Type [Italy] "Su tutte le alte montagne Toscana, Appennino, Emilia. Colli di Genova. Monti di Novara" (Venturi and Bottini l.c., type not seen).

Racomitrium canescens (Hedw.) Brid. var. *ericoides* (Brid.) Hampe fo. *subepilosum* Warnst., *Ver. Bot. Ver. Brandenburg* 41: 54. 1899 ('*subepilosa*'). - Type: [E. Germany] Sommerfeld (Lauritz) Klinge in alten Tongruben, Juli 1898 C. Warnstorf (JE, holotype).

Racomitrium canescens (Hedw.) Brid. var. *ericoides* (Brid.) Hampe fo. *canum* Zett. ex Möll., *Ark. Bot.* 24A(2): 140. 1931 ('*cana*') [excl. syn. *R. canescens* var. *longipilum* Warnst. 1904 = *R. canescens* subsp. *canescens*]. - Type: [Suecia] In locis sabulosis saxosis juxta Jella prope Upsaliam, 25. May 1855 J.E. Zetterstedt (UPS, lectotype nov.; TRH, isolectotype. - Zetterstedt's *Grimmieæ et Andreae Exsiccatae* no. 38).

Caulis 3-5 cm altus, pinnate ramosus. Folia acute carinata, ad apicem pilifera, costae usque ad apicibus foliorum ducentes; cellulae foliorum admodum forte papillosae; cellulae marginales supralares breves, crasse et fortiter sinuose tunicatae; pilus apicalis recurvatus, papillosus, denticulatus, per margines folii decurrens.

Holotype: Norway. Sør-Trøndelag: Skaun, Djupsjøåsen ca. 500 m SE of the cottage, sloping rock in front of a fen soak, 31.V. 1982 Frisvoll (TRH). Isotypes (ALTA, B, BG, C, CANM, G, H, JE, NY, O, S, TRH, UBC, WTU).

Stem (1)3-5(13) cm, greyish or brownish except for the upper-

most part (ca. 1-2 cm) which is greyish olive-coloured, pinnately or subpinnately branched, very rarely irregularly branched to unbranched; branchlets mostly distinctly recurved at their apex.

Leaves (Fig. 12 A, 23 a) to more than 3 mm including hairpoint but often shorter, mostly imbricate and not or indistinctly twisted when dry, recurved when moist, ovate-lanceolate to subtriangular, gradually tapering towards apex, sharply keeled in upper part, indistinctly plicate; margin broadly recurved from base to apex; costa in most leaves unbranched or shortly split in uppermost part, reaching towards apex, in lower part indistinct, situated in a leaf furrow which imitates a costa (Fig. 23 f-g), the leaf furrow mostly 75-100 μ m wide (dorsal view); alar cells (Fig. 16 c) of 3-5 cell rows, marginal alar cells often rounded and inflated, marginal cells just above the alar cells mostly short, and always thick-walled and strongly sinuose, marginal cell row including alar cells with 10 or less esinuose cells; basal laminal cells (Fig. 23 d) elongate (20-50 x 4-6 μ m), longitudinal walls mostly not thicker than cell lumens, papillose with large (to 6 μ m broad) papillae except for the basal 1-4 cell rows which are epapillose, middle and upper cells (Fig. 23 b-c) shortly rectangular to quadratic (6-15 x 5-8 μ m), distinctly papillose; hairpoint (Fig. 18 a, c-d) recurved to reflexed and not or scarcely flexuose, often long and very rarely almost or quite absent, subulate, usually strongly denticulate, mostly embracing parts of the upper lamina and distinctly decurrent down margin of lamina, sometimes stout but mostly capillaceous and slightly to distinctly papillose in upper part, in lower part strongly papillose with high, narrow papillae.

Inner perichaetial bracts in piliferous specimens usually piliferous; costa as in vegetative leaves but weaker. Spores 9-11 μ m.

Nomenclature

This species has until now been without a valid name at the species level. It was figured and named *Muscus foliis plurimis reflexis, ex uno puncto confertis* (Fig. 1 A) by Vaillant (1727: Tab. 26, Fig. 14). Later it was figured (Fig. 2 E) and named *Bryum hypnoides, hirsutiae canescens, vulgare* var. *cum foliis magis reflexis* (including a reference to Vaillant, 1727, and the above name) by

Dillenius (1741: 369; Tab. 47, Fig. 27 E). Lindberg (1883) renamed this Dillenian variety *Grimmia ericoides* (var. *ericoides*) fo. *squarrosa*.

In 1791 Ehrhart distributed a plant called *Trichostomum elongatum* as no. 233 of his exsiccate "Plantae cryptogamae Linneae" (with regard to Ehrhart and his exsiccatae, see e.g. Britton, 1922). Later Hoffmann (1796) described this plant as *Bryum elongatum*; Hoffmann's description runs as follows: "Caule elongato superne ramoso; ramulis alternis pinnatis, foliis confertis recurvis in apicem canum denticulatum brevem productis". Pinnate stems with alternating branchlets are very characteristic of the present species - more so than of *R. ericoides*, and the mention of recurved leaves with denticulate hyaline point hints at the present taxon and excludes *R. ericoides*; *R. canescens* has less regularly pinnate stems, and it is unlikely that *Bryum elongatum* Hoffm. refers to that taxon, which was described as *Bryum canescens* in the same book. According to Wijk et al. (1969) the pre-Hedwigian names *Trichostomum elongatum* and *Bryum elongatum* have never been validated.

In herb. Ehrhart (GOET) there are at least four specimens of the *R. canescens* group which were collected or studied by Ehrhart: (1) *Bryum Hypnoides* β , Hanoverae 1748 Ehrhart No. 7810 β [= 6 stems of *R. elongatum* + 3 stems of *R. ericoides*]; (2) do., *folia in hoc vix pilifera* [= 3 stems of *R. elongatum* + 3 stems of *R. ericoides*; the original labels were written by Ehrhart, and the collections may be duplicates]; (3) *Trichostomum canescens* Timm, ex herb. Ehrhart [= 6 stems of *R. elongatum*]; (4) *Trichostomum canescens* Timm, Osterode, ex herb. Ehrhart [= 3 stems of *R. canescens* subsp. *canescens*]. I have not been able to locate any specimen of no. 233 *Trichostomum elongatum* from Ehrhart's Plantae cryptogamae (BM, GOET, HAL, UPS), but it is probable that it was *Racomitrium elongatum* which was distributed as *Trichostomum elongatum* by Ehrhart and later described as *Bryum elongatum* by Hoffmann (1796). Original material may exist in some herbarium (probably MW or LE). I have adopted Ehrhart's specific epithet.

Taxonomical notes

1. *Racomitrium elongatum* is close to *R. ericoides* and has previously been mixed up with that taxon. However, the two taxa are usually easily separated both in the field and in the laboratory, and they should be treated as two species. In areas where both taxa occur, mixed stands are innumerable. This is the case in western and central part of Trøndelag, Central Norway, where the two plants frequently grow together; and I have collected several mixed stands in North Wales, Great Britain. There are also many mixed stands in herbarium specimens from Central Europe, the Faeroe Islands, Iceland, and western North America (see p. 21f.). A beautiful mixed stand including *R. elongatum*, *R. ericoides* and *R. canescens* (USA, Washington: King County, Lawton 2370 - WTU) first awoke my suspicion that the European *R. ericoides* is composed of two distinct taxa (Fig. 5; 16 a, c; 18 d-f; 22-23)! Indeed, the European and western North American plants of *R. elongatum* are - as far as I can find - identical. It is interesting to note that the variable *R. ericoides* also occurs with similar plants in these two areas.

2. When dry, the branchlets of *R. elongatum* are recurved at their apex; the branchlets of *R. ericoides* are erect-spreading. *Racomitrium elongatum* is more papillose and usually more pilose than *R. ericoides*, and the cushions are consequently greyer. In the field *R. elongatum* can be differentiated from *R. ericoides* by the colour and general appearance as well as by the above-mentioned characteristics of the branchlets, and the recurved or reflexed - often almost squarrose - hyaline leaf apices; *R. ericoides* mostly has erect-flexuose hyaline leaf points; the appearance of the hyaline point is a reliable distinguishing character between the two taxa (Fig. 6 A). Moreover, the point of *R. elongatum* is mostly chalky white as in *R. canescens*; the point of *R. ericoides* is mostly pellucide probably due to the absence of papillae, but in some areas (notably the continental parts of North America) the point of *R. ericoides* is more papillose and whitish. The point of *R. elongatum* is broad and distinctly decurrent down the margin of the lamina, whereas the point of *R. ericoides* is more capillaceous and never much decurrent (Fig. 12). The point of *R. elongatum* is often more denticulate than in *R. ericoides*, but this character is variable and not always useful. The lamina cells of *R. elongatum* are mostly more strongly

papillose than those of *R. ericoides*, and in Europe and western North America the species can usually be distinguished on the basis of differences in leaf papillosity (Fig. 22 e-g, 23 e-g). But in districts where the point of *R. ericoides* is more papillose the same also applies to its lamina cells. The best distinguishing character between *R. elongatum* and *R. ericoides* is probably found in the structure of the basal marginal cells. In *R. elongatum* the marginal cell row immediately above the alar cells is made up of relatively short, sinuose and (often strongly) incrassate cells, and the cells of the marginal cell rows in lower part of the lamina are mostly short. In *R. ericoides* one to several marginal cell rows immediately above the alar cells are made up of short or (usually!) long esinuose and hyaline or slightly incrassate cells, and the cells of the marginal cell rows in the lower part of the lamina are mostly relatively long. These differences are very striking in mixed stands (Fig. 16 a, c), and serve to distinguish between epilose plants of *R. elongatum* and *R. ericoides*. A certain variation is present, and the differences should be studied on the basis of a number of specimens from different areas. When differences in colour and general appearance as well as in hyaline points, papillosity and cell structure are applied to collections of *R. elongatum* and *R. ericoides* it is usually easy and always possible to distinguish between them.

3. Sometimes *R. elongatum* is less regularly pinnate or even almost unbranched. Such plants are usually robust and strongly papillose - and consequently more grey than usual, and have broader leaves with shorter costa. These plants are easily interpreted as being intermediate between *R. elongatum* and *R. canescens*. But this is not the case. In *R. canescens* the group of alar cells are rather large, and the marginal cells just above the alar cells are esinuose, hyaline and mostly elongate; in the above-mentioned plant the group of alar cells are small and the marginal cells just above the alar cells are sinuose, incrassate and short as in *R. elongatum*. The structure of the costa and the papillosity of the leaves and hyaline point are also similar to *R. elongatum* and different from *R. canescens*. The plant integrates with pinnate *R. elongatum*; it is probably a modification of the type (mod. *subpinnatum-vel-subsimplex-pilosum*) or a minor genetic variant. I have seen several collections from western North America (Washington, Idaho, Montana, British Columbia, Alberta), but it is also found in Africa (Madeira)

and Europe. I have found one mixed stand between the above plant and *R. canescens* [Canada, British Columbia: Paulson Bridge on Rte 3 between Castlegar and Christina Lake, Schofield & Otto 67204 (ALTA)].

4. From Canada [British Columbia, near Langford, Vancouver Island, Schofield 44007 (UBC)] I have seen rich material of a curious plant. It is tentatively referred to *R. elongatum*, but if more material turns up it should be treated as a taxon of its own. Like *R. muticum* it seems to be unable to produce leaves with distinct hyaline point. This is evident from the fact that it is mixed with strongly pilose *R. elongatum* (Fig. 10 A); the difference between the two plants was seen in the field, and the observant collector noted on the label: "Form without hair point, a single colony surrounded by typical material" (the 'typical material' is named *R. canescens* var. *ericoides* and the actual plant form, *epilosa*). The leaves of the epilose plant are closely imbricate and the point not recurved. It is remarkable that the apex of the leaves is brittle and the majority is broken at the tip. Like *R. elongatum* the plant has short, sinuose and incrassate marginal cells just above the alar cells, and the leaf cells and papillosity are similar to that taxon.

5. Sporophytes are much less frequent in *R. elongatum* than in *R. ericoides*; already Dillenius (1741: 369) noted (with regard to *Bryum hypnoides*, *hirsutiae canescens*, *vulgare* var. *cum foliis magis reflexis*): "... in qua varietate capsulae rarius observantur."

6. The first contemporary author to distinguish between *R. canescens* and *R. ericoides* was Heinonen (1971). She did not, however, distinguish between two European *ericoides* taxa (*R. elongatum* and *R. ericoides* sensu this paper). From herbarium specimens (H) it is clear that Heinonen's (1971) Fig. 2 and 6 represent *R. ericoides*, whereas Fig. 4 and 8 represent *R. elongatum*. Otherwise it is not easy to find out which taxon is presented in the different Figures (Fig. 15 seems to be *R. elongatum*). Both *R. elongatum* and *R. ericoides* are known from Finland, but they grow in widely separated areas; *R. elongatum* is found along the southern coast, while *R. ericoides* grows in Inari Lapland near the Norwegian frontier (Heinonen 1971: Fig. 65 and locality list p. 150).

Ecology

Racomitrium elongatum is usually found in warm and exposed sites; sometimes it grows on limestone. This is opposite to *R. ericoides* which is often found in shady humid, less calcareous localities. In areas where both taxa occur there are many localities of *R. ericoides* where *R. elongatum* is absent; more rarely the opposite is the case. But in a wide range of habitats *R. elongatum* grows together with *R. ericoides*, and mixed stands are numerous both in Europe and North America.

Distribution (Fig. 26)

European specimens of *R. elongatum* have been seen from Caucasus and Krim; Central and South Europe, and from the Atlantic coast and islands from Portugal to North Norway; in Europe it has not been found in the Arctic. It is present in Madeira, and is, besides *R. ericoides*, the only taxon of the group known from Africa. In Greenland there are a few sites in the South, and at an Arctic warm spring on the East coast. In North America it is verified from a few localities in the East including the Great Lakes Basin. In the West it has a wide distribution along the Pacific coast from California to southeastern Alaska, and in the Rocky Mountains. - Southernmost locality, Portugal: Madeira, Pico Ariero, ca. 32°20'N; northernmost locality, Norway: Troms, Karlsøy, Burøysund, ca. 70°00'N.

List of selected localities (see also "Mixed stands")

USA, California: Humboldt Co., on rock along small stream, Sec. 5, R3E, T3N, Norris 8638 (UBC, WTU); Del Monte Co., Smith River district, Darlingtonia, Parks 24275 (WTU); Sonoma Co., gully slope 1 mi NE of Baxman Ranch buildings, 10 mi inland from Plantation, Koch 527 (WTU). - Oregon: Rainbow, on bank of McKenzie R., Lane Co., Schofield & Lyford 60129 (ALTA); Camp Meriwether Bay Scout Camp, Tillamook Co., 45°30'N, 125°W, Carpenter 620 (UBC). - Idaho: Squaw Cr., Avery Ranger District, St. Joe National Forest, Mueggler, Anderson & Robinson 8M-10(H); Bonner Co., Daubenmire 4313 (WTU); Clearwater Co., near confluence of North Fork of Clearwater River and Beaver Creek, 13.VII. 1972 Steele (WTU); Idaho Co., Lochsa River Canyon vic. Hellgate Creek, 4 mi NE of Lowell, 21 mi E of Kooskia, Stickney 1591 (WTU); Atlanta, Boise Nat'l Forest, Elmore Co., MacFadden 18712 (WTU). - Wyoming, Yellowstone Park, Smiley 126 (WTU). - Montana: Flathead Co.,

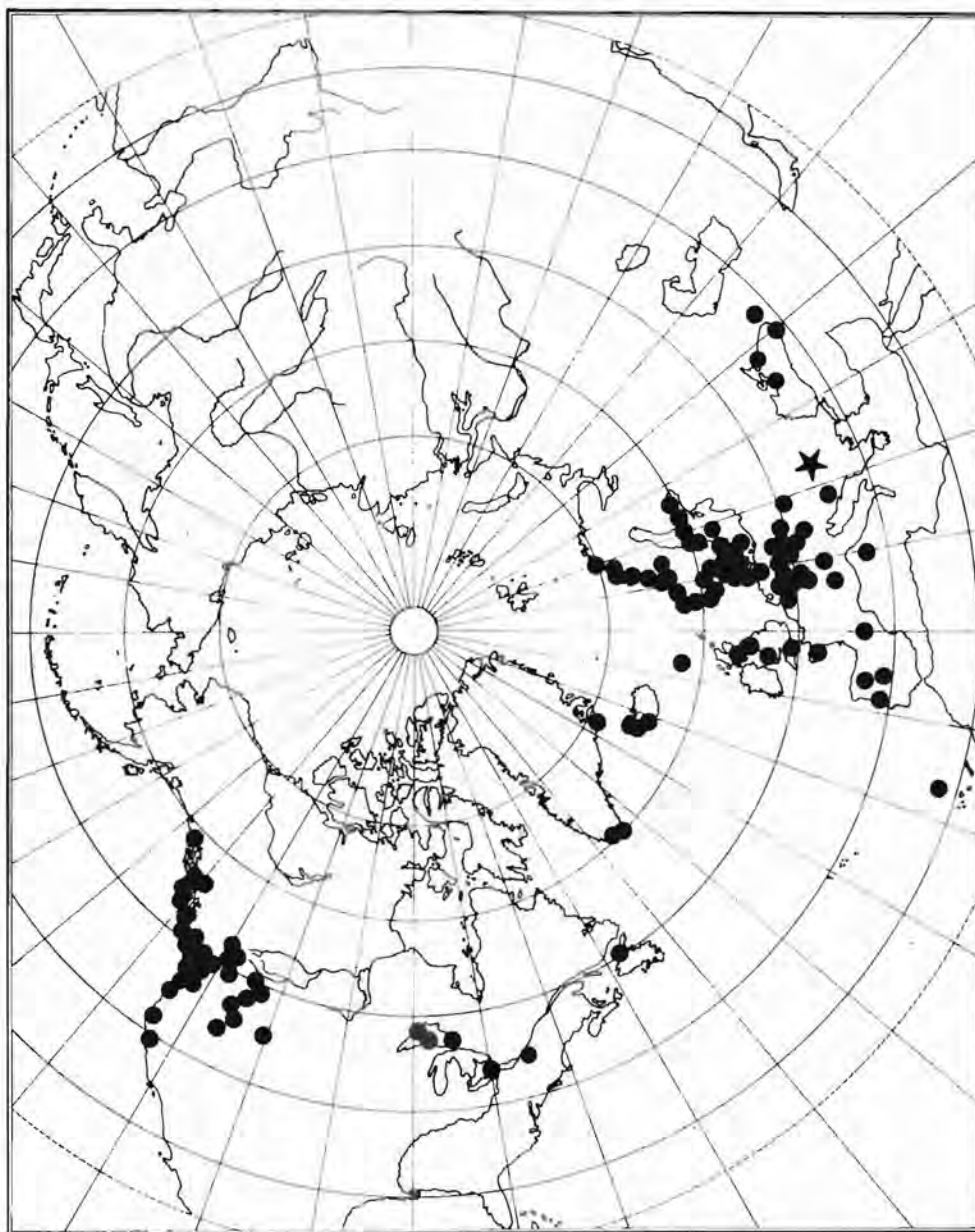


Fig. 26. Distribution of *Racomitrium elongatum* based on herbarium specimens. ● ordinary station, ★ locality inexact.

Avalanche Creek, Schofield 11673 (WTU); Glacier Co., Glacier Ntn'l Pk., 10 mi W of St. Mary Riv. crossing at St. Mary, Sunrift Gorge, 48°40'N, 113°36'W, Vitt 22004 (WTU). - Washington: Lewis Co., Mt. Rainier, Stevens Canyon Road, Box Canyon area, Lawton 4862 (WTU); in quarry near Kalama, Cowlitz Co., Schofield 36334 (UBC); Tenino stone quarry, Tenino, 20.VI.1951 Herre (UBC); Jefferson Co., Queets River Valley, near Humes Glacier, Fry 600 (WTU); Tacoma, near Spanaway Lake, ca. 47°05'N, 122°26'W, 20.XI.1940 Fry (UBC); Mason Co., Seattle, 20.VII.1890 Piper (UBC); Cascade Mts., upper valley of the Nesqually, 6.IV.1898 Allen (H, UBC); Snohomish Co., 8 mi E of Silverton along road, Ireland 7316 (UBC); Olympic Mts., Elwha River valley, Fry 606 (WTU). - Alaska: SE corner of Gilbert Island, by Blue Mouse Cove, Glacier Bay, Worley & Boas 10738 (UBC). - New York: Hamilton Co., along Raquette River at Buttermilk Falls, 5 mi S of Long Lake Village, Hermann 15805 (ALA). - CANADA, British Columbia: Vancouver Isl., Thetis Lake, Flowers 7784 (ALTA); subalpine slopes of Mt. Cain, N of Schoen Lake, 50°14'N, 126°20'W, Price & Halbert 6867 (ALTA); Beacon Hill Park, Victoria, Hill 559 (H); largest of King Inlet, 50°10'N, 125°08'W, Schofield 64324 (ALTA); E of Vancouver, 3 mi W of Alder Grove beside Hwy. 1, Vitt 4618 (ALTA); Hope, 23.VIII.1928 Fry (WTU); Keith Anchorage Area, Kwakshua Channel, NW Calvert Island, 51°40'N, 128°08'W, Schofield & Williams 27101 (UBC); Selkirk Mtns., Nelson Range, Kootenay Pass, ca. 49°10'N, 117°00'W, Horton 8009 (ALTA); Mt. Revelstoke Summit, 51°03'N, 118°08'W, Landals & Scotter 845 (ALTA); Wells Gray National Park, ca. 12 mi SW of Blue River Sta., Fish Lake Hill, Ahti 13903 (H); ca. 6 mi S of Hwy 37 crossing over Nass R., ca. 55°58'N, 129°03'W, Schofield 64952 (UBC). - Alberta: Waterton Lakes Natl. Park, W side of Cameron Lake, Bird 6386 (ALTA, H). - Ontario: 39th milepost N of S. Ste. Marie, Sharp OM562 (WTU); Sibley Prov. Park in vic. of Look-out 17 mi E of Port Arthur, Garton 10189 (H); Lake Superior, Canadian Musci 130 (H); Goulais Point, N shore of Lake Nipissing, Brassard 9095 (NFLD); Sparrow Lake, Simcoe Co., Cain 1034 (WTU). - Michigan: Manganese Gorge, Copper Harbour, 31.VIII.1937 Conrad (WTU); Keweenaw Co., 1 mi S of Copper Harbour, Ireland 4972 (H); Siskowit, Isle Royale, 9.I.1910 Cooper (ALTA). - Newfoundland: Bonne Bay area, Gros Morne, 49°35'-36'N, 57°46'-49'W, Brassard et al. 7418 (NFLD). - GREENLAND. Julianehåb distr., Chr. IV Ø, Qasigissat, 60°06'N, 44°07'W, Jacobsen 9376 (C); Chr. IV Ø, Tasiusaq, 60°06'N, 43°47'W, Gravesen & Hansen 66-993 (C); Angnikitsaq, Itivdlukasik, 60°06'N, 44°12'W, Gravesen & Hansen 66-943 (C); Prins Christian Sund, Qugdlugissat, 60°05'N, 43°12'W, Hansen, Kliim-Pedersen & Øllgård 67-172 (C); Knighton Bugt, 69°22'N, 24°43'W, 18.VIII.1972 Andersson (C). - ICELAND. Isafjord, Dagverdardal, 25.VII.1938 Andersen (C); Tingvallasletten, summer 1951 Møller (C); Budir, 24.VII.1897 Jonsson (C); Skarddalur II.VII.1896 Stefansson (C). - ENGLAND. Alston, Cumberland, IX.1887 Baker (BM); near Long Cross, South Hants, 20.VII.1957 Paton (OXF); Dorset, IV.1880 Wood (OXF); Ben Lawers, VII.-68 Fraser (OXF). - PORTUGAL. Madeira, Pico Ariero, Coleridge 128 (BM); S. Pedro do Sul (Beira alta), 11.VI.1930 Allorge (G); Arried, de Coimbra-Pinhais do Penedo da Meditacao a S. Ant. dos Olivais, VI.1917 Ervid (G). - SPAIN. Salamanca, 16.IV.1913 L... (TRH); Prov. Léon, Ponferrada, in monte Castro de Columbrieros, 23.IV.1933 Rothmaler (JE). - FRANCE. Pyrenees centrales, environs de Luchon, IX.1856 Zetterstedt (O); Morbihan, between la Trinite and Muzillac SE of Vannes, 25.VI.1954 Størmer (O); Vale of Chamouni, X.1859 Boswell (OXF); les pierres dans les lieux secs a Planois (Basse-sur-le-Rupt.), environs de Vagney (Vosges), V.1860 Pierrat (G); Corsica centr., infra ovilia "del Timozzo", Mt. Rotundo, 11.VII.1880 Levier (TRH). -

BELGIUM. Anvers, 30.V.1883 Vandenbroeck (TRH); Hockoy, 27.X.1898 Slodden (G). - W. GERMANY. Wolfartsweier bei Carlsruhe in Baden, s.a. Bausch (G); Westfalen, ... bis Bielefeld, 20.IX. 1888 Holler (TRH); Bayern, Fichtelgebirge, bei Silberhaus, VII.1903 Mönkemeyer (JE); Rheinland, bei Xanten, IV.1884 Winter (JE); Oberhessen, Kr. Alsfeld, Erbenhausen, Heidebrachland, 24.IV.1950 Hupke (JE); Holstein, Elmshorn, 20.III.1907 Timm (JE). - E. GERMANY. Sachsen, Johann-Georgenstadt, 21.VII.1965 Manitz (JE); Eibenstock, Abt. 63 südl. Harzweg, 24.VII.1964 Wagner (JE); Frankenberg, 8.IX.1918 Kästner (JE); bei Dresden, s.a. Hübner (JE); Thüringen, Eisenach, 13.IV. 1933 Krüger (JE); Gotha, Boxberg, 24.VI.1907 Krüger (JE); Brandenburg, Neu-Ruppin hinter dem Alt-Ruppiner Chausseehause, IV.1872 Warnstorf (JE); bei Triglitz in der Prignitz, X.1904 Japp (JE). - AUSTRIA. Steiermark, Alt-Aussee, 19.IX.1908 Fleischer (JE). - SWITZERLAND. Graubünden, Val Roseg, VI.1883, herb. Schliephacke (JE); bei Siglistorf, 1862 Geheeb (JE). - CZECHOSLOVAKIA. Bohemia, Montes Krkonose, in saxia montis Kotel, X.1948 Pilous (G); Bohemia merid. distr., Susice, montes Sumava, reg. Povydrí, prope locum Cenkova inter pagum Otygl et Udolí, X.1969 Zemanova (G); Nordböhmen, Isergebirge, bei der Hohenhabsburg, VIII.1903 Matouschek (JE); Riesengebirge, IX.1880 Schulze (JE). - ROMANIA. Siebenbürgen, Retezat-Gebirge, Theu Bucura, 26.VI.1901 Györffy (O). - YUGOSLAVIA. Bosnien, bei Celebié, 8.IX.1904 Straka (G). - POLAND. Mons Babia Gora, 7.X.1963 Wojterski (OXF); Montes Gorce, in monte Waksmundzka, 22.X. 1956 Lisowski (O); Bieszczady Zachodnie, prope vicum Wetlina, 17.V. 1955 Lisowski (G). - TURKEY. Districtus (Sandschak) Trapezunti, in ditione vici Eseli prope oppidum Goerele (Elehu), 19.VII.1907 Handel-Mazzetti (H); do., in ditione vici Fol Koei (ad austro-occid. Trapezunti) in glareis minarum Efkiar et Topuk, 12.VII.1907 Handel-Mazzetti (H). - USSR. Krym, by Alušta, 23.VIII.1926 Poplavskaia (H); Caucasus, Krasnodar-distr., between Gelendzhik and Mihajlovskij pass, 24.VII. 1927 Zinova (O); Radscha, in monte Bereleti pr. Uzeri, 3.VII. 1877 Brotherus (H). - DENMARK. Jylland, Ribe amt, Fanø plantage, 18.VIII. 1976 Størmer (O); Sjælland, Gilleleje, 16.IV.1897 L.K.R. (O); Bornholm, Sandvig, VII.1914 Kopsch (JE). - SWEDEN. Skåne, Kiflinge, VIII.1891 Möller (TRH); Bohuslän, Strömstad, VIII.1913 Vrang (TRH); Småland, Tenhult, 2.VII.1890 Arvén (TRH); juxta Jelle prope Upsaliam, 25.V. 1855 Zetterstedt (TRH); Gotland, Visby, 17.IV.1888 Johansson (UPS); Stockholm, 1857 Lindgren (TRH); Jämtland, Ragunda sn., ex. herb. Strömholm (S); Torne L., Torneträsk-området, Kuokel, II.VIII. 1954 Holmen, Mårtensson & Persson (UPS). - FINLAND. Åland, Saltvik, Kvarnbo, 7.IX.1961 Cedercreutz (H); Turku, Ispoinen, Ispoisten kartanosta N, 30.IV.1962 Suominen (H); Helsingfors, Tali å, 11.X.1866 Lindberg (H).

3. *Racomitrium pygmaeum* Frisvoll spec. nov. - Fig. 14 A,
16 g, 18 b, 27-29

Caulis 0,5-1,5(2,5) cm altus. Folia acute carinata, stramineoviridia, cum pilo epapilloso maxima ex parte circa 1,5 mm longa; margo apicem versus recurvatus; costa a lamina valde limitata, usque ad apicem folii ducens; cellulae foliorum admodum forte papillosae, opacae.

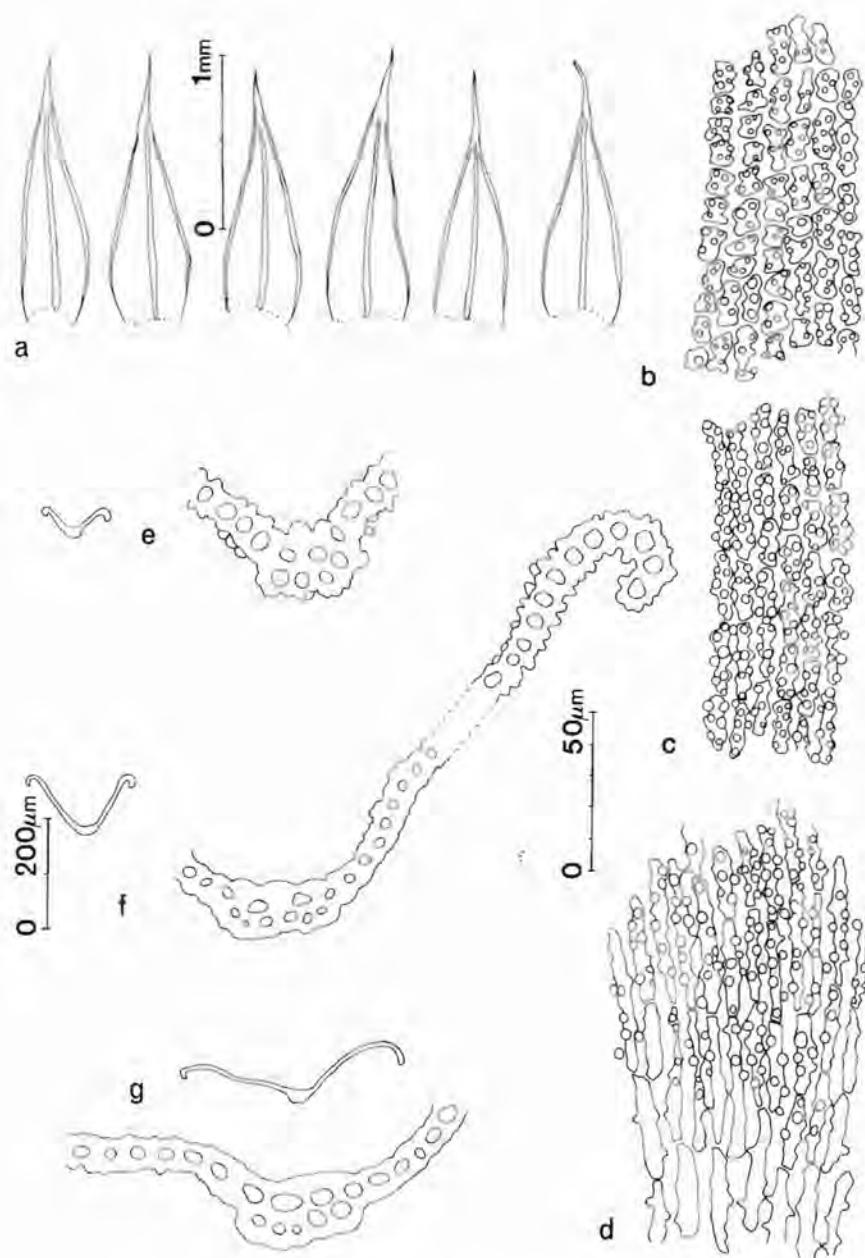


Fig. 27. *Racomitrium pygmaeum*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. - Holotype (UBC).

Holotype: Canada, British Columbia: On SW exposed slope near Little Deamond Head, Garibaldi Park, at timberline, 5950 ft., Aug. 18, 1961 E.B. Peterson No. BP118 (UBC-B2144; Fig. 16 g, 18 b, 27-28).

Stem (Fig. 28) 0.5-1.5(2.5) cm, decumbent, olive-yellow, subpinnately branched, sometimes pinnately branched or almost simple; rhizoids abundant.

Leaves (Fig. 14 A, 27 a) to 1.75 mm long including hair-point, but mostly about 1.5 mm long and 0.5 mm broad at the broadest part, yellowish especially at the base and on the costa, imbricate and not or slightly twisted when dry, erect-spreading to slightly recurved when moist, ovate-lanceolate and gradually tapering towards apex, sharply keeled in upper part, not plicate; margin recurved towards apex but often not or slightly recurved at base, costa in most leaves unbranched, reaching towards apex, in lower part sharply delimited and not situated in a leaf furrow, 35-55 μ m wide (dorsal view), often slightly papillose and spinulose towards base; alar cells (Fig. 16 g) small (8-20 x 5-10 μ m), of 3-5(6) cell rows, cells not or only a little inflated and cross walls often thick, marginal cells just above the alar cells thinwalled and often moderately elongate, marginal cell row including alar cells with up to 15 esinuose cells, marginal cells above the esinuose basal cells short, incrassate and strongly papillose; basal lamina cells (Fig. 27 d) elongate (15-40 x 4.5-5.5 μ m), longitudinal walls not thicker than cell lumens, papillose with relatively large (\pm 4.5 μ m broad) papillae except for the basal 2-3 cell rows which are epapillose, middle and upper cells (Fig. 27 b-c) short (6-15 x 6-10 μ m), comparatively coarsely and densely papillose, opaque; hairpoint (Fig. 18 b) erect-flexuose, in upper leaves comparatively long, subulate, slightly denticulate, never much decurrent down margin of lamina, slightly to indistinctly papillose in lower part or epapillose in all parts.

Inner perichaetial leaves in piliferous specimens non-piliferous, acute, and crenulate-dentate. Sporophyte unknown.

Taxonomical notes

1. *Racomitrium pygmaeum* is smaller than the other taxa in the section. It is most similar to *R. ericoides* with a slightly

papillose hairpoint (European and western North American material). It differs from *R. ericoides* inter alia in the coarsely papillose, yellowish and opaque cells in the middle and upper part of the leaf. The opaqueness of the cells is striking, and it is often difficult to distinguish between the cells. The costa and the cell walls in the available material are yellowish coloured. The costa is sharply delimited in lower part of the leaf (Fig. 27 e-g); in *R. ericoides* the costa is indistinct and situated in a broad leaf furrow. Unlike *R. ericoides*, the marginal cells above the esinuose and hyaline basal cells are not elongate, and they are strongly sinuose and papillose. When the papillosity of the lamina is considered, it is surprising that the hairpoint is almost or completely epapillose. I have only seen plants with long subulate-flexuose point in the upper leaves (mod. *pilosum-vel-subepilosum*), but probably the species also occurs as mod. *epilosum*. Most plants are irregularly pinnately branched (mod. *subpinnatum*), and the branchlets are variable but usually short. Some quantitative characteristics of *R. pygmaeum*, e.g. the predominant

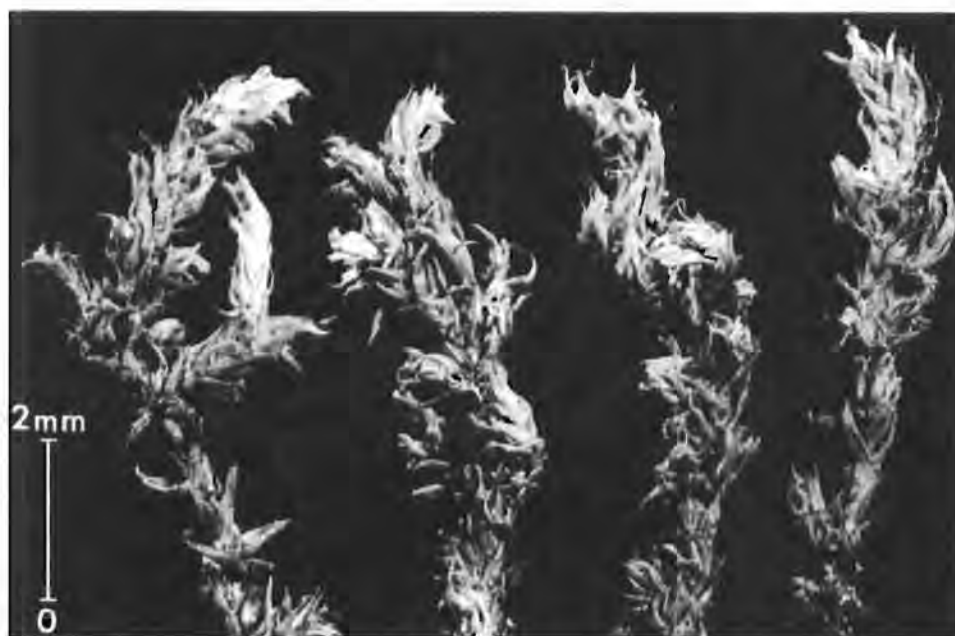


Fig. 28. *Racomitrium pygmaeum*. Plants from the holotype (UBC).
(Phot. P. Fredriksen.)

yellowish colour and abundant occurrence of rhizoids, may not be constant. But the taxon has a number of qualitative characteristics in the structure and appearance of cells, papillae, hairpoint and costa, and these characters serve to distinguish it from *R. ericoides*.

2. The papillosity of the cells in *R. pygmaeum* resembles that in *R. elongatum*, but the appearance of the basal marginal cells and the hairpoint is different; moreover, *R. elongatum* is a larger taxon, and like *R. ericoides* its costa is situated in a leaf furrow.

3. As compared with *R. muticum*, *R. pygmaeum* has e.g. coarsely papillose leaf cells, long hairpoint, slightly or not inflated alar cells, and the margin which is recurved towards apex. Both taxa are yellowish coloured. The other species in the group are unlikely to be confused with *R. pygmaeum*. Mixed stands between *R. pygmaeum* and other species in the group were not located. However, several collections of *R. elongatum*, *R. ericoides* and *R. muticum* from nearby localities were observed (Fig. 4).

Ecology

Little is known about the ecology of *R. pygmaeum*. The labels show that the five known collections grew on open ground, alpine site, 7000 ft.; in alpine heath community, 6250 ft.; on SW exposed slope at timberline, 5950 ft.; on rock along trail, 1981 m; on exposed earth, 8000 ft.

Distribution (Fig. 29)

The species is only known from alpine sites in a limited area in Washington and British Columbia, western North America. - Southernmost locality, USA: Washington, Glacier Peak area, ca. 48°06'N; northernmost locality, Canada: British Columbia, Garibaldi Park, ca. 50°N.

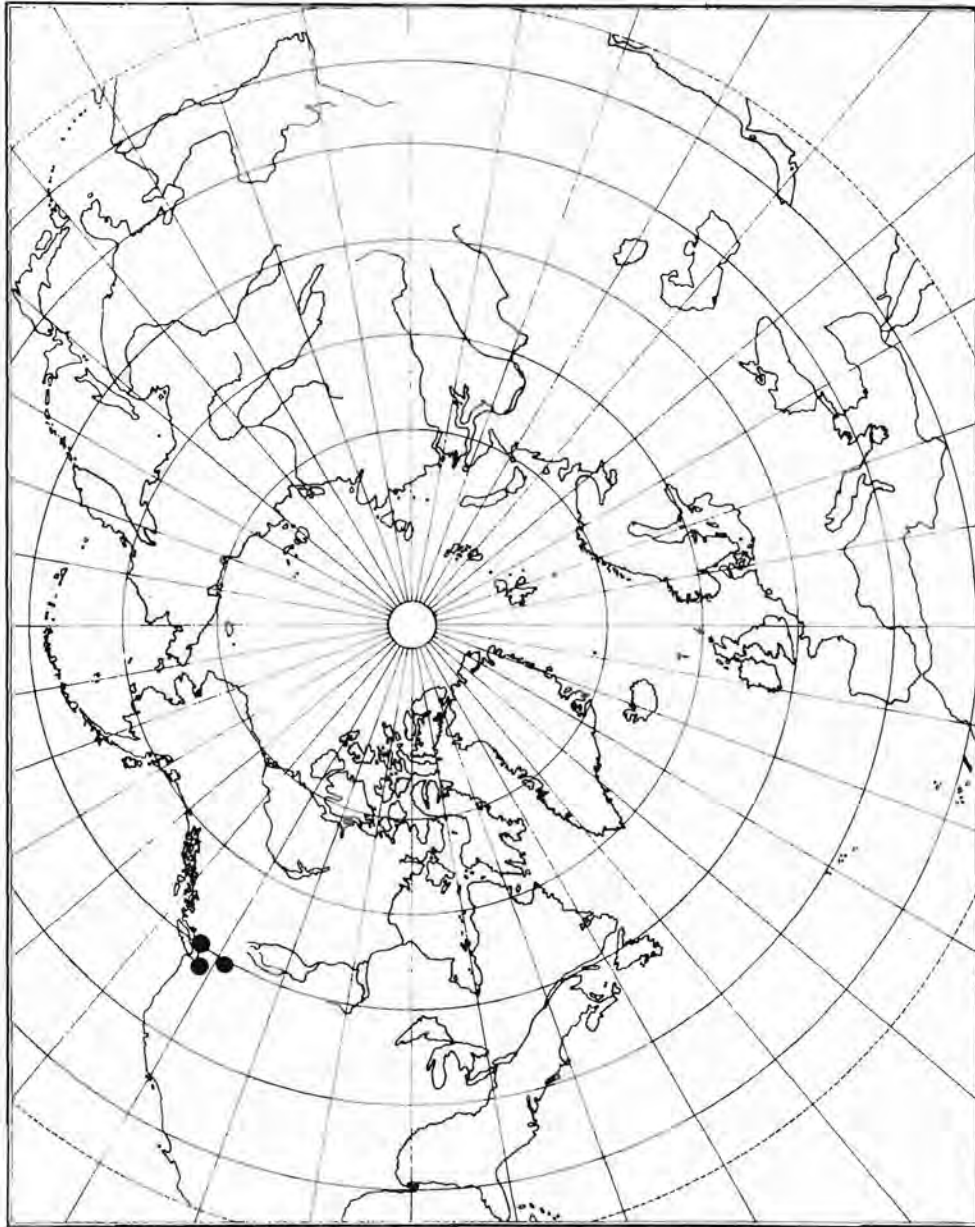


Fig. 29. Distribution of *Racomitrium pygmaeum* based on herbarium specimens.

List of localities

USA, Washington: Snohomish Co., Glacier Peak area, ca. 2 mi NNE of White Pass (near SW side of Whitechuck glacier), in alpine heath community, aspect S 15 E, elev. 6250 ft., 11.VIII.1971 G.W. Douglas 3031 (ALTA). - CANADA, British Columbia: Selkirk Mountain Range, Kokanee Glacier Park, Lemon Creek Trail to Sapphire Lakes, on open ground, alpine site above 7000 ft., 15.VII.1977 B.C. Tan & J. Ensing 77-799 (TRH, Fig. 14 Aa); do., rocky margin and slides of Kokanee Lake, along the trail, 1981 m, 24.VII.1977 B.C. Tan & J. Ensing 77-1111 (UBC, Fig. 14 Ab); Bugaboo Glacier Provincial Park, trail to Cobalt Lake (Blue Lake), on exposed earth, 8000 ft., 21.VIII.1977 B.C. Tan & J. Ensing 77-1800 (UBC, Fig. 14 Ac).

4. *Racomitrium barbuloides* Card. - Fig. 9 A, 13 A; 17 b, d;
19 a-b, h; 30, 32, 46 C

Racomitrium barbuloides Card., Bull. Herb. Boiss. ser. 2,8: 336. 1908. - Type: Corée [South Korea], île Quelpaert [Cheju do], 1906 R.P. Faurie no. 296 (PC, lectotype nov.; H-BR, isolectotype - Fig. 46 C).

Stem (1)3-5(7) cm, brownish except for the uppermost part (ca. 0.5-2 cm) which is olive-yellow or darker olive-coloured, often pinnately branched but not infrequently quite simple.

Leaves (Fig. 13 A, 30 a) to 3 mm including hairpoint, but often much shorter, strongly flexuose or contorted when dry, recurved or erect-spreading when moist, ovate-lanceolate to triangular, gradually tapering towards apex, sharply keeled to channelled in upper part, in vigorous specimens lamina undulate in upper part and slightly plicate in lower part; margin usually narrowly recurved to 1/2-3/4 the length of the leaf, in mod. *epilosum* sometimes on one side only; costa in most leaves unbranched and reaching towards apex; alar cells (Fig. 17 b, d) rarely much inflated, of 5-7 cell rows, 3 narrowing to 1 supra-alar cell row extends as a border high up the margin, in vigorous specimens (mod. *pinnatum-pilosum*) to 30-50 esinuous cells in the marginal row including alar marginal cells, in depauperate specimens - including the type - (mod. *subsimplex*-(sub)*epilosum*) 20-30 cells in the marginal row; basal lamina cells (Fig. 30 d) narrow, elongate (35-60 x 2.5-4.5 µm) and strongly incrassate with longitudinal walls usually thicker (± 4 µm) than cell lumens, papillose with low narrow (± 2.5 µm broad) papillae or nearly epapillose, the basal cells contrasting sharply with the comparatively short

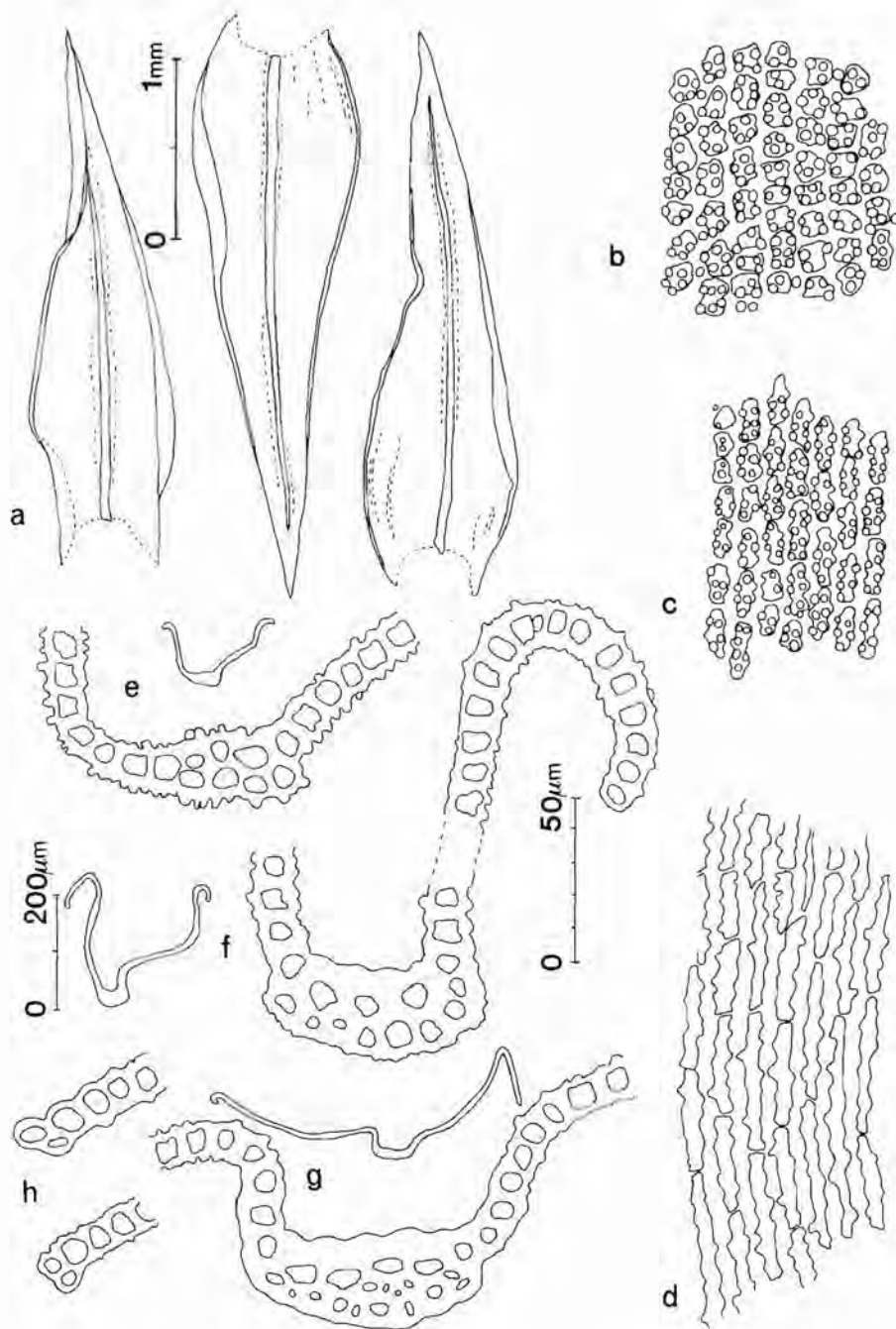


Fig. 30. *Racomitrium barbulooides*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. h. Cross sections of bistratose margin. - Japan: Ehime pref., Nii-gun, Sumino-cho, Tonaru, 20.IV.1954 Noguchi 49505 (NICH). Mixed stand between *R. barbulooides* and *R. japonicum*, cf. Fig. 9 A and 31.

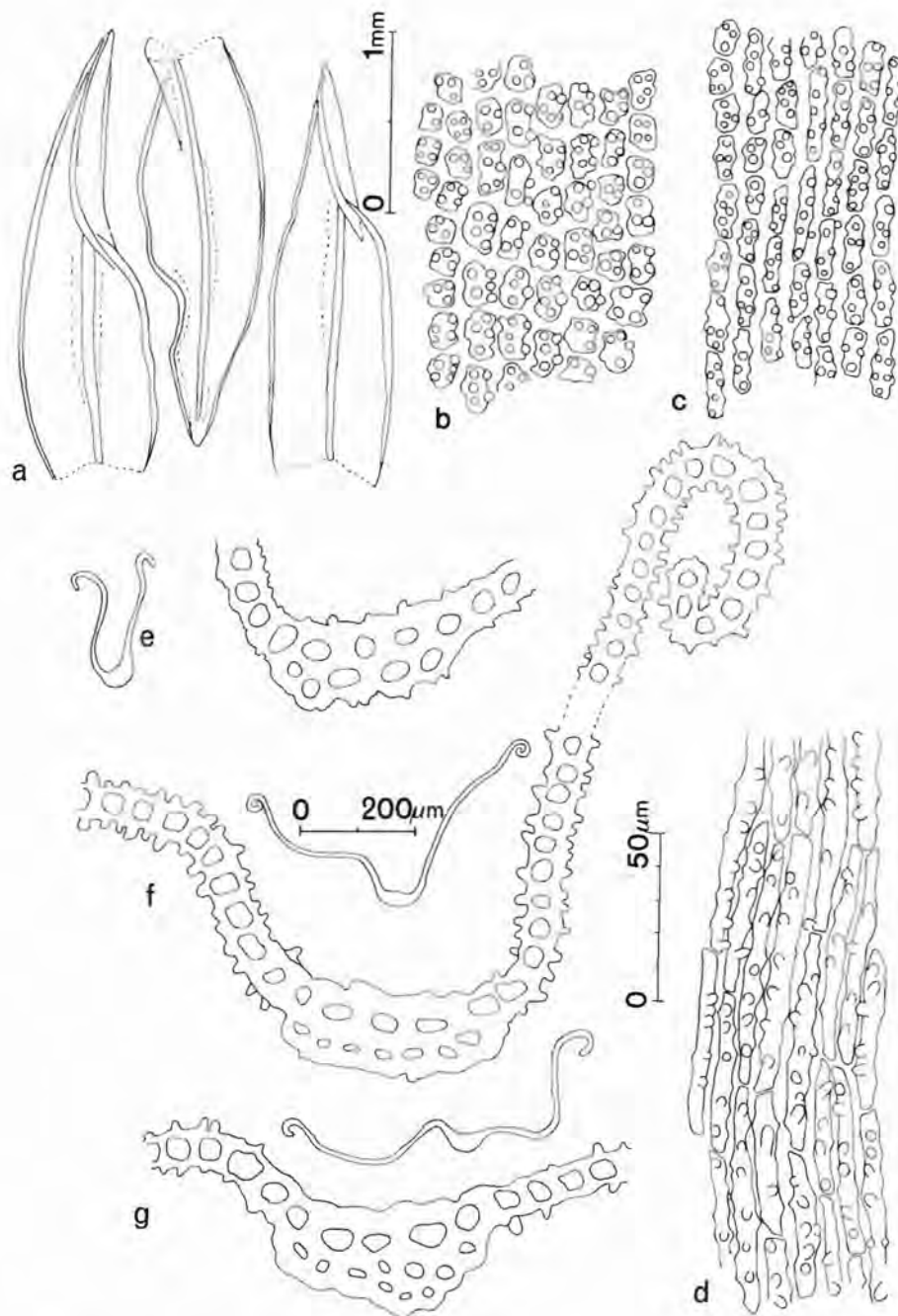


Fig. 31. *Racomitrium japonicum*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. - Noguchi 49505 (NICH), cf. Fig. 30.

and wide (10 x 6 or 7 x 7 μ m) slightly papillose cells in the upper 3/4 of the leaf (Fig. 30 b-c); hyaline hairpoint (Fig. 19 a-b, h) sometimes absent and apex rounded, sometimes very long and flexuose, capillaceous, often sharply denticulate and/or spinulose, and with scattered papillae towards the extreme apex, in vigorous specimens longly decurrent with elongate cells down margin of lamina.

Inner perichaetial leaves in piliferous specimens obtuse to acute, epiliferous; costa as in vegetative leaves but weaker. Spores 11-15 μ m.

Nomenclature and typification

Racomitrium barbuloides has no synonyms (except perhaps *R. *subcanescens* C. Müll. which is a nomen nudum). I have selected a specimen from Cardot's herbarium in Paris as the lectotype of the name. According to Noguchi (1974: 346) syntypes of *R. barbuloides* - Faurie no. 120 and 296 - also are present at KYO.

Taxonomical notes

1. *Racomitrium barbuloides* is a variable plant. Sometimes it is vigorous and regularly pinnate with long branchlets and strongly pilose leaves (mod. *pinnatum-pilosum*); sometimes it is depauperate and sparsely branched or without branchlets and epilose (mod. *simplex-vel-subsimplex-epilosum*). The material can be grouped into two taking these characteristics as a basis; and there seem to be few intermediates between the groups. It is noteworthy that the leaves either have long hairpoints or are epilose and often rounded at the apex. Most of the other taxa in the group usually have some pilose leaves even in seemingly epilose specimens; this was not observed in *R. barbuloides*. The type of *R. barbuloides* belongs to the epilose group (mod. *epilosum-vel-subepilosum*). The structure of the leaves of the two groups are similar: Constant features are the basic form of the leaves, the long and narrow basal lamina cells which contrast with the short and wide cells of the upper part of the lamina, the structure of the alar cells including the bordering marginal supra-alar cells, and the margin which is shortly and narrowly

recurved. Therefore, *R. barbulooides* is regarded as a taxon which varies little microscopically but which, macroscopically, is strongly modified by the habitat. However, the two phenotypes may be genetically distinct and grow together in mixed stands. The plants should be studied in the field to clarify the situation.

2. Many Japanese specimens of *R. barbulooides* mod. *pinnatum-pilosum* were named *R. canescens* var. *ericoides*. But the leaf margin of *R. ericoides* is recurved towards the extreme apex, whereas in *R. barbulooides* it is recurved to about 3/4 the length of the leaf. Like *R. barbulooides* some modifications of *R. ericoides* have predominantly short cells in the greater part of the leaf, with some rows of elongate basal cells. But the basal cells of *R. ericoides* are not so incrassate as the same cells in *R. barbulooides*, and they are usually more distinctly and coarsely papillose. *Racomitrium ericoides* usually has elongate marginal cells above the alar cells, but the border is much less distinct than in *R. barbulooides*. The leaf apex of *R. ericoides* never becomes broadly obtuse as in *R. barbulooides* mod. *simplex-epilosum*. The structure of the hairpoint of the two taxa is also different. *Racomitrium ericoides* is rare in Japan, but mixed stands between them probably occur.

3. *Racomitrium elongatum* is more papillose than *R. barbulooides*, and has no border of elongate hyaline cells above the alar cells.

4. *Racomitrium japonicum* is easily distinguished from *R. barbulooides* by the wider, more papillose basal cells, the stout costa and hairpoint, and the margin which is broadly recurved towards the apex. Regarding the difference between *R. barbulooides* and *R. muticum*, see the latter species.

5. Excellent illustrations of *R. barbulooides* have been presented by Noguchi (1974, Fig. 3: 5-8 [mod. *pilosum*, called *R. canescens* var. *ericoides*], 9-17 [mod. *epilosum*, called *R. canescens* var. *epilosum*, from 'isotype' of *R. barbulooides*]); and Iwatsuki and Mizutani (1977: Plate 11, no. 150 [mod. *pinnatum-pilosum*, called *R. canescens* var. *ericoides*]).

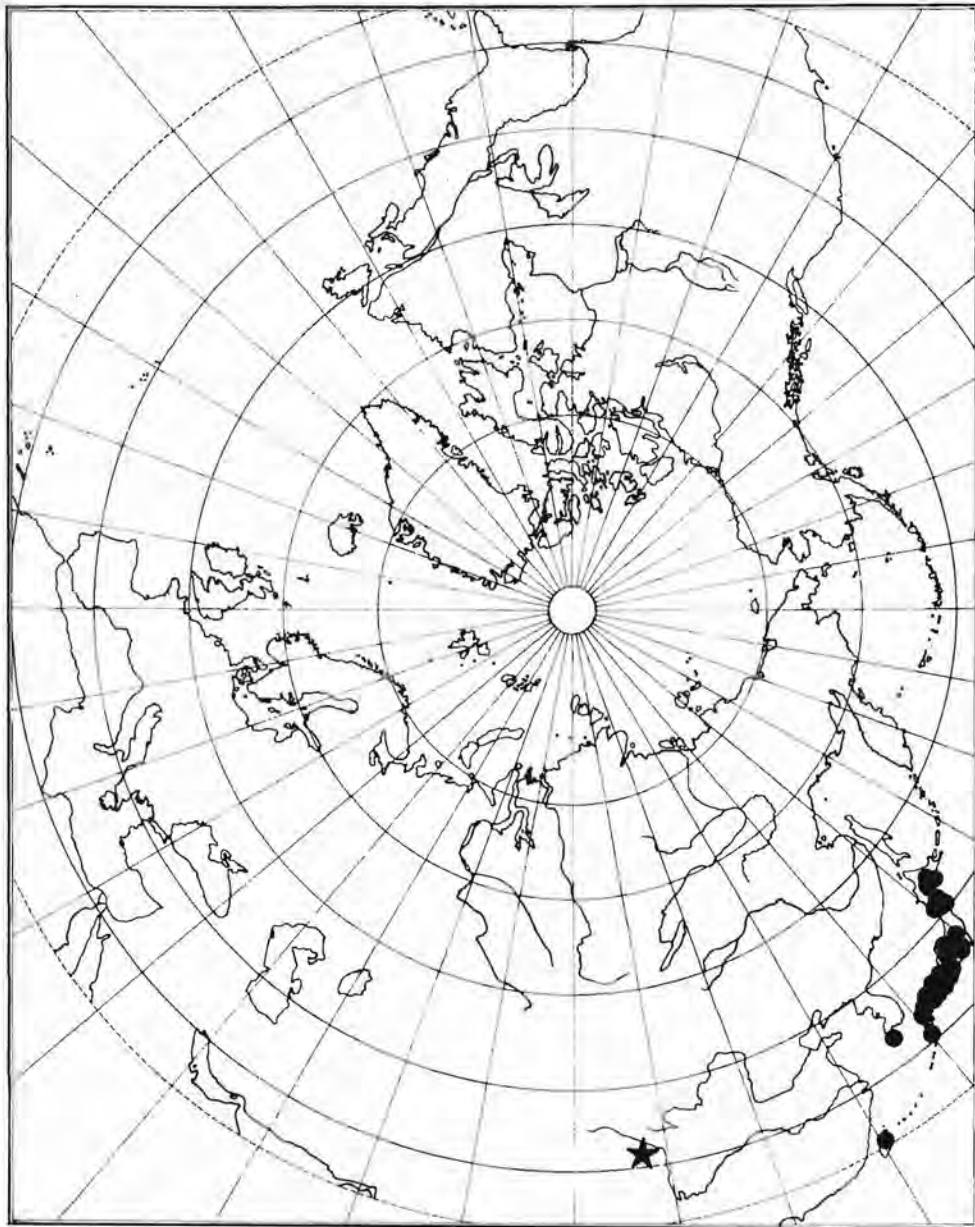


Fig. 32. Distribution of *Racomitrium barbuloides* based on herbarium specimens. ● ordinary station, ★ locality inexact.

Ecology

According to the labels *R. barbuloides* is collected from soil, dry and moist rocks, and stones.

Distribution (Fig. 32)

Racomitrium barbuloides is common in Japan. It is also found in single collections from South Korea, and China: Taiwan and eastern Thibet. It probably has a wide distribution in the area. - Southernmost locality, China: Taiwan, 22-25°N; northernmost locality, Japan: Hokkaido, Mt. Daisetsu Nature Park, ca. 43°39'N.

List of selected localities (see also "Mixed stands")

JAPAN, Hokkaido: Kamikawa distr., Mt. Daisetsu Nature Park, 2.5 km S of Mt. Hakuuntake, Takanegahara, Koponen 15145 (H); Prov. Iburi, Mt. Usu, 4.IX.1965 Kakaki (H). - Honshu: Aomori pref., Mt. Hakkoda, Odake, Noguchi 34967 (NICH); Mt. Iwaki, 2.VIII.1907 Uematsu (H); along trail near the Hiyama River, Kami-Arisu, Sumitamachi, Iwate pref., Inoue: Bryophyta Selecta Exsiccata No. 45 (H); Nagano pref., Shimoina-gun, Kamisato-mura, Beppu, Ikeda & Maezawa 78 (NICH, ex herb. Noguchi 30572); Mt. Fuji summit, VIII. 1954 Hadano (NICH, ex herb. Noguchi 33829); Mie pref., Nakajima 208 (NICH, mosses of Japan 24959); Nara pref., Mt. Misen, Nakajima 3031 (NICH, mosses of Japan 29076); Wakayama pref., Ohdaigahara, Tutiga 490 (NICH, ex herb. Noguchi 9824); Tottori pref., Mizoguchi, Noguchi 4276 (NICH); Sandan-kyo, Hiroshima pref., 20.XI.1976 Ando (H). - Shikoku: Mt. Ishizuchi, 5.IX.1906 Kono (H, Japanese Musci 243); Tokushima pref., Ohboke, Noguchi 43017 (NICH); Kochi pref., Tosayama-mura, Noguchi 33585 (NICH). - Kyushu: Nagasaki pref., Mt. Unzen, Noguchi 33105 (NICH); Kumamoto pref., Kikuchi-gun, Suigen-mura, Kikuchi-suigen, near Yamanoie, 20.III.1956 Imae & Miyata (NICH, mosses of Japan 37579); Ohita pref., Mt. Yufu, Noguchi 13669 (NICH); isl. Yakushima, VII.1933 Hasimoto (NICH, ex herb. Noguchi 8656). - SOUTH KOREA. Ile Quelpaert [=Cheju do], Faurie 296 (PC, H-BF - Fig. 46 C). - CHINA. Taiwan, Prov. Toityn, Mt. Nôkô, 5. & 6.VIII. 1926 Sukuki (H). - Thibet orientale, 1870 Abbe David (BM, H-BR).

5. *Racomitrium muticum* (Kindb. in Macoun) Frisvoll stat. nov. -
Fig. 9 B, 14 B, 16 f, 18 h, 33-34

Racomitrium brevipes Kindb. in Macoun var. *muticum* Kindb.
in Macoun, Bull. Torr. Bot. Cl. 17: 272. 1890. - *Racomitrium canescens*
(Hedw.) Brid. var. *muticum* (Kindb. in Macoun) Macoun et Kindb., Cat.

Canad. Pl. 6: 77. 1892. - *Racomitrium canescens* (Hedw.) Brid. [subsp.]
★ *R. muticum* (Kindb. in Macoun) Kindb., Eur. N. Am. Bryin. 2: 236.
1898 ('1897'). - Type: Canada, British Columbia, Gold Range, Griffin
Lake, 6500 ft., Aug. 1889 J. Macoun (S, lectotype nov. - Fig. 16 f
and 33, isolectotype).

Stem (1)2-5(9) cm, brownish or blackish except for the
uppermost part (ca. 0.5-2 cm) which is light olive coloured, often
with a rusty-red tinge, subpinnately to pinnately branched, occasio-
nally irregularly branched to unbranched.

Leaves (Fig. 14 B, 33 a) to 2.5 cm but often shorter, most-
ly imbricate and often strongly twisted and curled when dry, erect-
spreading to recurved when moist, triangular to narrowly ovate-lan-
ceolate, gradually tapering towards a narrow apex, sharply keeled in
upper part, often strongly plicate; margin narrowly recurved from
base to 3/4 the length of the leaves; costa yellowish, in most leaves
unbranched and reaching towards apex, at central dorsal side of the
leaf with high and distinct back, dorsal side towards base with papil-
lae and/or spinulae; alar cells (Fig. 16 f) yellowish and sharply
delimited, of 4-6 cell rows, marginal alar cells, and often the other
alar cells, rounded and inflated, marginal cells just above the alar
cells mostly elongate and hyaline, marginal cell row including alar
cells with up to 15(-20) esinuose cells; basal laminal cells (Fig.
33 d) elongate (20-50 x 3-5 μ m), longitudinal walls usually as wide
as the cell lumens, papillose with low and narrow papillae except
for the basal 3-5 strongly yellowish cell rows which are epapillose,
middle and upper cells (Fig. 33 b-c) rectangular (10-20 x 3-6 μ m),
papillose with low and narrow, sometimes indistinct papillae; hair-
point (Fig. 18 h) absent or sometimes present as a short (to 200 μ m),
not always quite hyaline, slightly papillose apex.

Inner perichaetial leaves membranous, and crenulate-den-
tate in upper part; costa as in vegetative leaves but weaker. Spores
9-11 μ m (only one fertile coll. known).

Nomenclature and typification

Racomitrium muticum has no taxonomical synonyms. I have
selected a specimen from Kindberg's herbarium as the lectotype of

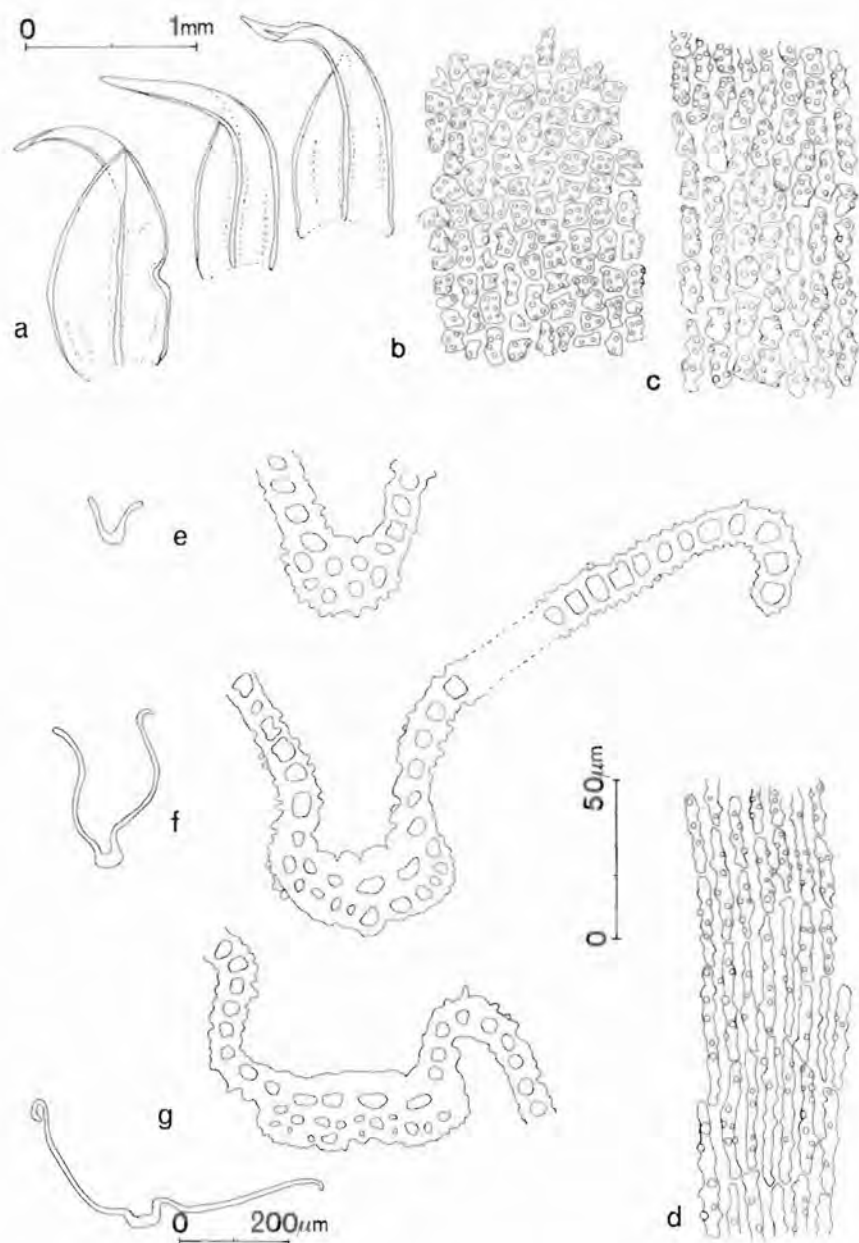


Fig. 33. *Racomitrium muticum*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. - Lectotype (S).

the name. The following citations given by Steere and Crum (1977: 186f.) are erroneous: "*Racomitrium canescens* Brid. var. *muticum* Kindb., Bull. Torrey Club 17: 272. 1890" and "*Racomitrium ericoides* B. & Sch. var. *muticum* Kindb. n. var. in Macoun, Bull. Torrey Club 17: 272. 1890" err cit. pro *Racomitrium brevipes* Kindb. in Macoun var. *muticum* Kindb. in Macoun.

Taxonomical notes

1. *Racomitrium muticum* is a stenotypic taxon which is easy to identify both micro- and macroscopically. Like *R. barbuloides* it has a narrowly recurved margin to about 3/4 the length of the leaves. But otherwise the appearance of the two taxa is rather different. *Racomitrium muticum* seems unable to develop a long hyaline hairpoint. In *R. muticum* the group of alar cells is sharply delimited, unlike *R. barbuloides* where it is more elongate and indistinctly delimited. The characteristic supra-alar border of *R. barbuloides* is indistinct or absent in *R. muticum*. The costa of *R. muticum* possesses two distinct characteristics: At the dorsal side the back of the costa is high (Fig. 33 e-g); in the other taxa of the group the back of the costa is less high especially in the lower middle part of the leaf. Moreover, the basal dorsal part of the costa is papillose and/or spinulose in *R. muticum*, whereas in the other taxa (except probably *R. pygmaeum*) it is indistinctly papillose and/or spinulose to smooth.

2. The above characteristics also separate *R. muticum* from epilose *R. ericoides*. The latter species has more ovate-lanceolate leaves than *R. muticum*; moreover, the leaves of *R. ericoides* are less crisp when dry, and they are broader towards the apex. Regarding the difference between *R. muticum* and *R. pygmaeum*, see the latter taxon. - The other taxa of the group are not likely to be confused with *R. muticum*.

Ecology

According to the labels *R. muticum* is collected from the following habitats: among rocks, rocky ground, moist rock face on slope, moist humus on rock, base of rocks on open slope; on soil, on

soil on boulders, among boulders of moraine; alpine terraces, cliff shelf; dry slopes, dampish slope, on humus on open heath slope, tundra slope; alpine heath meadow; exposed humus at margin of snow melt pool.

Distribution (Fig. 34)

Racomitrium muticum is known from western North America (Washington, British Columbia, SE Alaska) and Japan. - Southernmost locality, Japan: Honshu, Chubu Sangaku Nat. Park, ca. 36°36'N; northernmost locality, USA: Alaska, Red Mountain, Muir Inlet area, Glacier Bay, ca. 59°00'N.

List of localities (see also "Mixed stands")

USA, Washington: Cascade Mts., VII.1924, VIII.1925, VII.1927 Grant (H, O); Lewis Co., Mt. Rainier N. Park, Reflection Lake area, Lawton 4880 (WTU), 9.VIII.1909 Forster (WTU); do., above Paradise Inn, trail to Alta Vista, Ireland 7901 (UBC); Clallam Co., Appleton Trail from Olympic Hot Springs, 30.VII.1962 Schofield, Ireland & Boas (UBC); Snohomish Co., Mt. Pilchuck, Lawton 4540 (WTU), 29.XI.1947 Eyerdam (WTU), Schofield & Worley 35392 (UBC); Big Four, Schofield, Ireland & Boas 18551 (UBC, cfr.); Chelan Co., Washington Pass on North Cascade Hwy, trail to Blue Lake, Schofield 63345 (UBC); Meadin? [sic], Mt. Washington, Ireland 1964 (UBC); above Mt. Baker Lodge, Mt. Baker, 2.X.1960 Krajina (UBC); Watcom Co., Austine Pass area, Mount Baker area, Schofield 57201 (O, UBC), 12483 (UBC). - Alaska: Trail from rd. at Jamestown Bay (E of Sitka) to Mt. Verstovia, 57°3.6'N, 135°15.9'W, Worley & Thorpe 3386 (UBC); Baranof Isl., Mt. Yanouski NE of Davidof L., Worley & Hamilton 9863 (H, UBC); vic. of upper end of Plotnikof Lake, 56°35'N, 134°51'W, Worley & Thorpe 4092 (UBC); mouth of Lake Diana, 56°53'N, 135°02'W, Worley, Sharp & Iwatsuki 3961 (UBC); E margin of Davidof Lake, Worley & Hamilton 9812 (UBC); Mitkof I., Crystal Lake area above Blind Slough S of Petersburg, Worley & Schofield 8508 (UBC); Red Mountain, Muir Inlet area, Glacier Bay, Worley 13309 (UBC). - CANADA, British Columbia: Vancouver Island, trail leaving Camelson Lake trav. S to summit of Mt. Arrowsmith, Halbert 4008 (UBC); Strathcona Provincial Park, Forbidden Plateau, trail to Mt. Albert Edward, Halbert & Price 6297 (UBC), Boas 1569 (UBC), trail to summit of Mt. Becker, 49°39'N, 125°12'W, Halbert 4228 (UBC); Mt. Albert Edward, Price & Halbert, 6408, 6451 (UBC); subalpine slopes of Mt. Cain N of Schoen Lake, 50°14'N, 126°20'W, Price & Halbert 6828, 6904a (ALTA, UBC), 6889 (ALTA); Green Mountain ca. 25 mi W of Cassidy, 49°03'N, 124°20'W, Halbert & Price 3382-A, 3382-B (UBC); Mt. Seymour, near Second Pump Peak, Vancouver, Schofield 16002 (UBC); Mt. Garibaldi, Perry 1927 (UBC); Whistler Mt. slopes [50°N, 122°W], Schofield & Jamieson 47204 (ALTA, UBC), Schofield & Worley 35524 (UBC); outrider from Custer Ridge and Thompson peak, overlooking Maselpanik Creek,

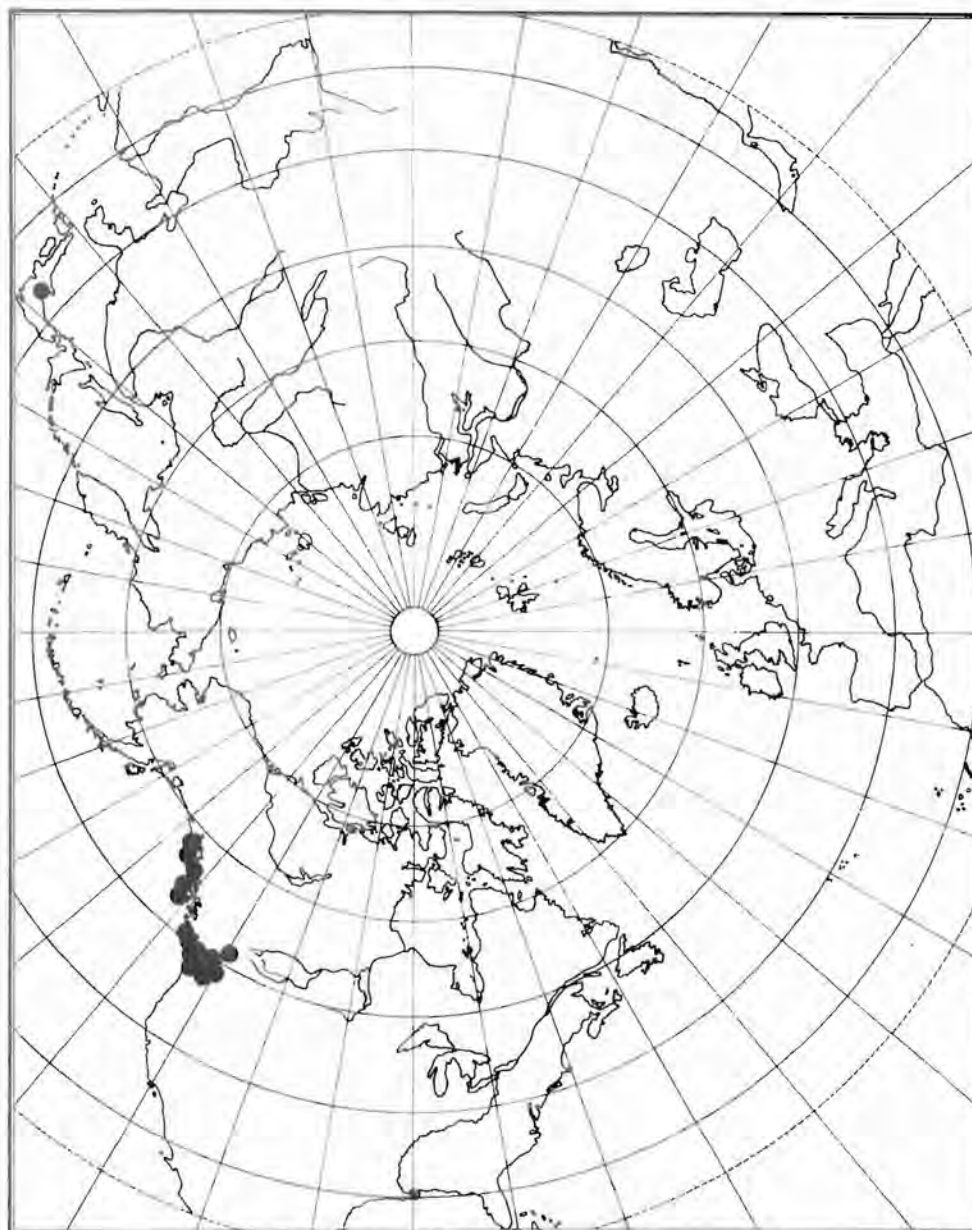


Fig. 34. Distribution of *Racomitrium muticum* based on herbarium specimens.

N. Cascade Mts., 49°03'N, 121°17'W, Schofield & Pinder-Moss 57377 (UBC); Grouse Mtn., 49°24'N, 123°05'W, Peterson 97 (UBC); Kootenay region, headwater of Lyle Creek, trail follows the Whitewater Creek behind Rettallack ghost town on New Denver - Kaslo Hwy., Tan & Teng 78-580 (WTU); Dam Mountain, 28.VIII.1959 Krajina (UBC); Queen Charlotte Islands, Moresby Isl., mountain at W end of Mosquito Lake, 53°05'N, 132°10'W, Schofield 25463 (UBC); Takakia Lake, ab. 10 mi S of Moresby Logging Camp, ridge on SE end of lake, Schofield 24948 (UBC); mountain directly above Tasu townsite, 52°45'N, 132°02'W, Schofield 34900; Graham Isl., mountain just S of Van Inlet head, Schofield & Sjörs 32238 (UBC); Mt. Needham area, Foster & Bigg (UBC). - JAPAN, Honshu: Toyama pref., Nakashinkawa-gun, Tateyama-cho, Chubu Sangaku Nat. Park, Mt. Tateyama, Murodo, Koponen 15817, 16086 (H).

6. *Racomitrium japonicum* Doz. et Molk. - Fig. 9 A, 13 B, 17 a, 19 c-d, 20 E, 31, 35, 46 A-B

Racomitrium japonicum Doz. et Molk., Musci Frond. Ined. Archipel. Indici 5: 130. 41. 1847. - *Grimmia japonica* (Doz. et Molk.) Mitt., Trans. Linn. Soc. London Bot. ser. 2,3: 158. 1891. - Type: Japonia, s.a. Siebold (L, holotype; H, isotype - Fig. 46 A).

Racomitrium iwasakii Okam., J. Coll. Sc. Imp. Univ. Tokyo 38: 13. 6. 1916 ('*Iwasakii*'). - *Racomitrium canescens* (Hedw.) Brid. var. *iwasakii* (Okam.) Ihs., Cat. Moss. Japan 79. 1929. - Type: [Japan] Yeso, Ishkari, Noppora-mura, 3. May 1914 Iwasaki (NICH no. M 33766, lectotype nov.); Prov. Shiribeshi, Otaru, 10. May 1915 Iwasaki (NICH, O, no. M 37765, syntypes - Fig. 46 B).

Racomitrium barbuloides Card. var. *brevipilum* Dix., Rev. Bryol. Lich. 7: 107. 1934. - Type: Kooraimon, Prov. Ryonei, Manchuria, 5. Aug. 1930 M. Kobayasi (BM-herb. H.N. Dixon no. 3967, holotype - Fig. 13 Bb).

Racomitrium canescens (Hedw.) Brid. fo. *viridi-senile* Sak., Bot. Mag. Tokyo 51: 794. 1937. - *Racomitrium canescens* (Hedw.) Brid. var. *viridi-senile* (Sak.) Sak., Musci Jap. 64. 1954. - Type: [Japan] Prov. Higo, Oono, 20. Dec. 1936 K. Mayebara (MAK-herb. K. Sakurai No 9231, holotype).

Stem robust, (1)2-5(6) cm, the whole shoot sometimes brownish or blackish, but usually the uppermost part (ca. 0,5-2 cm) olive-coloured, often simple but also pinnately or subpinnately branched; rhizoids usually abundant along the whole shoot and at the leaf bases.

Leaves (Fig. 13 B, 31 a) to 3 cm including hairpoint but often smaller, mostly imbricate and slightly contorted or spirally

twisted round the stem when dry, erect-spreading to recurved when moist, from a sub-rectangular base gradually tapering towards apex, sharply keeled in upper part, slightly plicate, sometimes slightly undulate in upper part; margin broadly recurved from base to apex; costa reaching towards apex, sometimes split in upper part; alar cells (Fig. 17 a) of 6-10 sharply delimited and conspicuous cell rows made up of large (10-20 x 40-70 μm) inflated cells, marginal cell row including alar cells with up to 20 esinuose cells; basal leaf cells (Fig. 31 d) elongate (40-60 x 4.5-6.5 μm), strongly papillose with large papillae which are higher than wide (10 x 4.5 or 7 x 3.3 μm), gradually changing into shortly rectangular or mostly irregularly quadratic (11 x 7 or 10 x 10 μm), or sometimes transversely rectangular (4.5 x 9 μm) cells (Fig. 31 b-c) which are papillose with low and narrow (2.2 μm wide) papillae; hairpoint (Fig. 19 c-d) stout, mostly broad and short, strongly spinulose and denticulate and slightly or not papillose.

Inner perichaetial bracts in piliferous specimens mostly obtuse; costa as in vegetative leaves but weaker. Spores 7-10 μm .

Nomenclature and typification

The oldest name of the taxon is *R. japonicum*; the holotype specimen at L includes original notes and drawings. The protologue includes a comprehensive table (Dozy and Molkenboer 1847: Tab. 41). The taxon was later named *R. iwasakii*, the protologue of that name also includes a figure (Okamura 1916: Fig. 6). This characteristic taxon has been neglected in recent times, and the name *R. japonicum* is not mentioned in the latest revision of *Racomitrium* in Japan (Noguchi 1974).

Taxonomical notes

1. *Racomitrium japonicum* varies only a little. The plants are usually robust, but more gracile plants are also found. *Racomitrium barbuloides* and *R. japonicum* are common in the same area, and according to herbarium specimens they frequently grow together and in mixed stands in Japan (Fig. 9 A, 30-31). They are so different

that it is easy to distinguish between them (see p. 93). *Racomitrium japonicum* does not seem to be closely related to any other taxon in the group.

2. Sometimes the point of *R. japonicum* is badly developed or quite absent, the leaf apex is cucullate, and the costa is shorter than usual and often split at the upper end. This modification is of special interest for the following reason: *R. japonicum* has a very distinctive leaf base including the structure of the alar cells and the basal and laminal cells with their different papillae. In this particular taxon it is self-evident that specimens with narrow leaf apex and long, stout hyaline hairpoint (mod. *pilosum-vel-longipilum*) and specimens with obtuse, cucullate apex, shorter costa, and short or no point (mod. *subepilosum-vel-epilosum*) are environmental modifications of the same taxon. It is less obvious that the other taxa in the group occur with similar modifications (Fig. 12-15). This relates the *strictum* problem in the *R. canescens* group: In *R. canescens* subsp. *canescens* the corresponding modification is inter alia described as *R. mollissimum* (= *R. canescens* var. *strictum*, hence the term) and *R. tortuloides*. Var. *strictum* is a similar modification of *R. canescens* subsp. *canescens* as is the above-mentioned modification of *R. japonicum*. The type of *R. barbuloides* is a *strictum* modification, and nobody has hitherto noticed the points of resemblance between the type of *R. barbuloides* and its mod. *pilosum-vel-longipilum-pinnatum* sensu this paper. *Racomitrium elongatum* very rarely produces modifications with short or no point and cucullate leaf apex, whereas *R. ericoides* often produces plants with epilose leaves; indeed (although not quite correct), the leaves of *R. conso-cians* (= *R. ericoides*) were stated to be "slightly rounded as well as slightly hollow at apex" (Stirton 1907). *Racomitrium panschii* often occurs as a *strictum* modification, which is sometimes difficult to distinguish from the same modification of *R. canescens*; however, it is less papillose in all parts of the leaf, and especially at the base. *Racomitrium muticum* has no macroscopical hyaline point, and has often been named *R. canescens* var. *strictum* by North American bryologists.

Ecology

According to the sparse information noted on some labels, *R. japonicum* has been collected from rocks, from sandy soil, and from soil by side of ditch along road.

Distribution (Fig. 35)

Racomitrium japonicum is common in Japan, and is found in SE Siberia, Korea, China, and North Vietnam. It is probably more common in The Far East than the distribution map indicates. - Southernmost locality, Vietnam: Tonkin, ca. 22°N; northernmost locality, Japan: Hokkaido, Isl. Rishiri, Mt. Rishiri, ca. 45°10'N.

List of selected localities (see also "Mixed stands")

JAPAN, Hokkaido: Kitami prov., Isl. Rishiri, in the summit area of Mt. Rishiri, Iwatsuki 1829 (NICH); Ishikari prov., Mt. Tairoku in the Tokyo Univ. forest near Yamabe, Iwatsuki 1176 (NICH); do., Jozankei, Noguchi 30350 (NICH); Yezo, Sapporo, 28.IV.1893 Miyabe (H). - Honshu: Prov. Rikuzen, Mont Zao, 15.X.1907 Iishiba (H); Mt. Gassan, 31.VII.1910 Uematsu (H); Tsuruga, s.a. Ankarkrona (H); Mt. Fuji, 25.VII.1907 Kono (H); Tokio, s.a. Matsumura (H); Ise, Mt. Kokuzu, s.a. Kawasaki (H); Owase pref., Mie, Kayama 307 (NICH, ex herb. Noguchi 30925); prov. Izu, isl. Miyake, II.1907 Gono (H); pref. Aichi, 25.I.1949 Takaki (H); prov. Hoki, Mt. Daisen, 19.VI.1906 Kono (H); Shimane pref., Mino-gun, Toyoda-mura, 1952 Saito (NICH, ex herb. Noguchi 26877). - Shikoku: Ehime pref., Kamiukena-gun, Nakatsu-mura, Mimidedake, 14.X.1954 Yamanaka (NICH, ex herb. Noguchi 34143). - Kyushu: Kumamoto pref., Kikuchi-gun, Suigen-mura, Hukuba, VIII.1955 Inoue (NICH, mosses of Japan 37684); Miyazaki-ken, Nichinan-shi, Kusubaru, 20.IV.1976 Mizutani [H, Bryoph. exsicc., Fasc. 1 (1977) no. 26, ed. Iwatsuki & Mizutani]; Oita, Shimoke, Fukayabakei, VII.1947 Noguchi [H, O; Musci Jap., ser. 2(1948) no. 61, ed. Hattori]; Nagasaki, Juassojawa, 30.XII.1860 Wichura (H). - KOREA. s.loc., VIII.1922 Sakurai (H). - USSR. Regio austo-ussurensis, in saxo arenosis in valle fl. Lantshicke prope Vladivostok, 4.IX.1927 Oxner (BM). - CHINA. Mandschuria, 1896 Komarov (H); prov. Anhwei, Hwangshan, near Tang Kou, Chen etc. 6542 (H); prov. Kwitschou, montis Tschuenning-schan prope urbem Kweiyang [Kuei-yan], Handel-Mazzetti 2060a (H); Hochan, IV. & V.1910 Lourton (H); Man Choei Lo, 10.-13.V.1910 Lourton (H); prov. Hunan, prope urbem Lingling (Yungtschoufu), Handel-Mazzetti 2236 (BM, H); Li Ka Wei prope Schang Hai, 1908 Henry (H). - VIETNAM. Tonkin, ... Bavi, V.1888 Balansa (H).

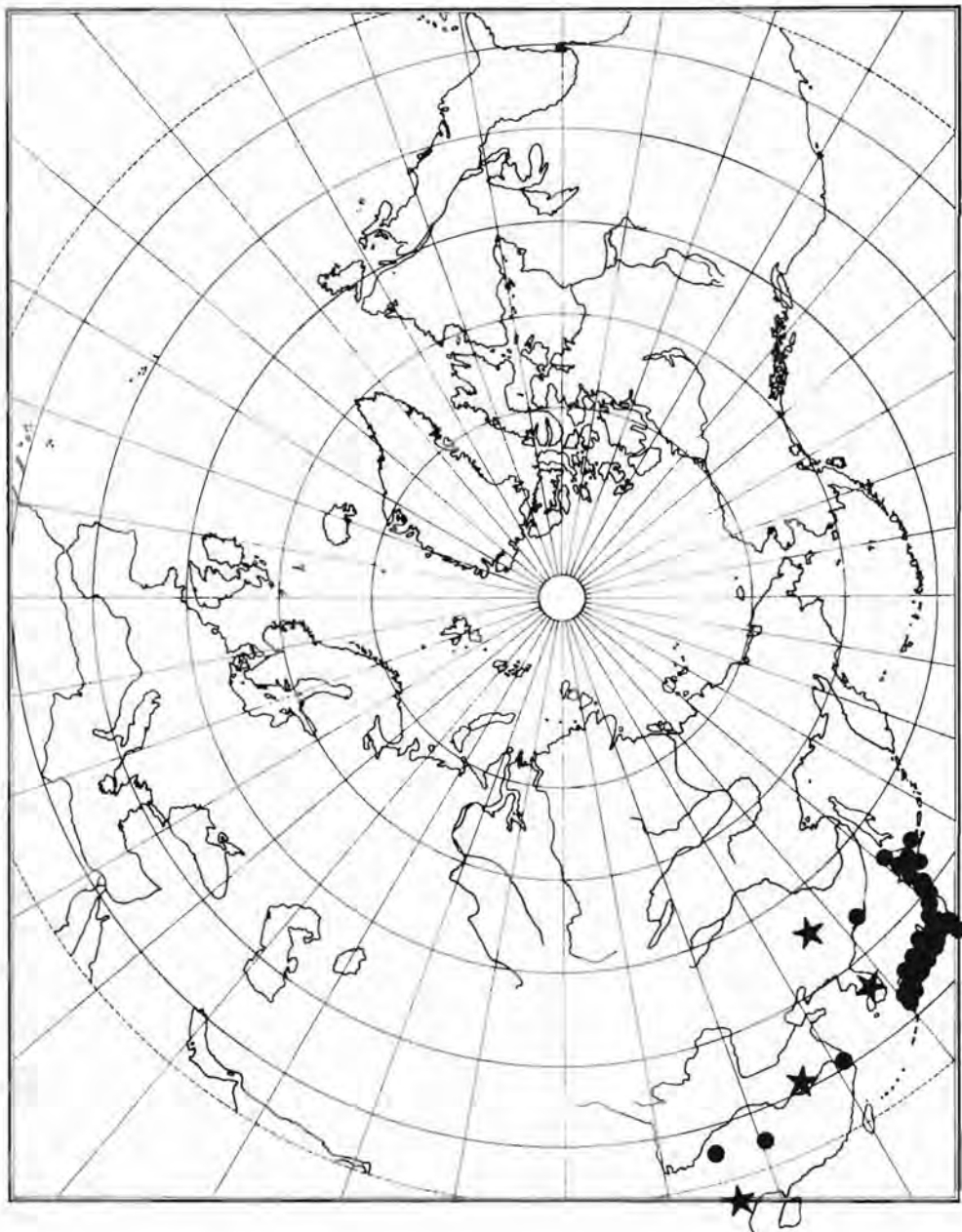


Fig. 35. Distribution of *Racomitrium japonicum* based on herbarium specimens. ● ordinary station, ★ locality inexact.

D. Subsect. *Canescens* Frisvoll subsect. nov.

Folia ovato-lanceolata vel elliptica, in partem superiorem obtuse carinata; maximam partem foliorum costa furcata vel ramosa, usque ad tres partes foliorum longitudine percurrans; papillae in partem superiorem laminarum foliorum maxima ex parte admodum maior.

Type species: *Racomitrium canescens* (Timm ex Hedw.) Brid.

In my opinion the taxa in subsect. *Canescens* are less similar to the ancestors of *Racomitrium* sect. *Racomitrium* than the taxa in subsect. *Ericoides* (q.v.). The long unbranched costa of the sharply keeled leaves in subsect. *Ericoides* has evolved into a shorter branched costa resulting in the more obtusely keeled leaves in subsect. *Canescens*. The costa of the inner perichaetial leaves in subsect. *Canescens* are longer than in vegetative leaves and mostly unbranched, indicating that the shorter branched costa of the vegetative leaves is a derived characteristic (see Kanda 1975: 263, regarding similar structures in *Campyliadelphus*, Amblystegiaceae); the leaf form and keeling correlate to the length and structure of the costa.

7. *Racomitrium canescens* (Timm ex Hedw.) Brid.

After *R. ericoides* s.l. and *R. panschii* have been segregated from *R. canescens* the latter is still polymorphous. It is made up of a southern taxon and a northern taxon; in SE Norway the two taxa commonly grow together in mixed stands; and this may be the case in many other districts. Based on this observation it appears that two species are at hand. However, it seems that the two taxa intergrade to some extent in some areas, and it may prove difficult to refer all specimens to either the northern or the southern taxon. The taxa occupy different geographical ranges, and are separated at the subspecies level.

Key to the subspecies of *Racomitrium canescens*

- A. Plant mostly robust; leaves slightly to (usually) distinctly falcate along the whole shoot, and especially at the stem apex

(Fig. 7 B, 8, 11), ovate to broadly ovate-lanceolate, often very obtusely keeled and cucullate in upper part (Fig. 36); hyaline point mostly broadly subulate and not or moderately flexuose, embracing parts of the upper lamina (sometimes short or absent and then leaf strongly cucullate and shoot not falcate - Fig. 15 A, 44 A-B), rarely decurrent down margin of lamina (Fig. 36 a), often denticulate and spinulose towards the extreme apex (Fig. 19 i, 48 B) a. subsp. *canescens*

- B. Plant mostly less robust; leaves slightly or (usually) not falcate (Fig. 7 B, 8, 11), ovate-lanceolate to broadly ovate-lanceolate, often less obtusely keeled in upper part (Fig. 37, 42); hyaline point mostly subulate and flexuose, and only in (strongly) xeromorphic modifications embracing a corresponding part of the upper lamina (sometimes short or absent and then leaf less cucullate - Fig. 15 B, 48 A), decurrent down margin of lamina (Fig. 37 a), often moderately denticulate and spinulose towards the extreme apex (Fig. 19 k) b. subsp. *latifolium*

- ā. *Racomitrium canescens* (Timm ex Hedw.) Brid. subsp. *canescens* - Fig. 3, 5, 7 B, 8, 11 A, 15 A, 16 h, 19 i, 36, 38 b: 2, 7; 39, 44 A-B, 48 B, 49 B, 51

Trichostomum canescens Timm ex Hedw., Spec. Musc. 111. 1801 (*T. canescens* Timm, Fl. megap. prodr. 215. 1788 nom. inval.). - *Bryum canescens* (Timm ex Hedw.) Hoffm. ex With., Syst. Arr. Brit. Pl. ed. 4,3: 808. 1801 (*B. canescens* Hoffm., Deutschl. Flora 2: 41. 1796 nom. inval.). - *Racomitrium canescens* (Timm ex Hedw.) Brid., Mant. Musc. 78. 1819. - *Grimmia canescens* (Timm ex Hedw.) C. Müll., Syn. I: 807. 1849. - *Racomitrium ericoides* (Brid.) Brid. var. β. **canescens* (Timm ex Hedw.) Lindb., Act. Soc. Sci. Fenn. 10: 547. 1875 nom. illeg. prior. ut spec. - *Grimmia *ericoides* (Brid.) Lindb. var. β. **canescens* (Timm ex Hedw.) Lindb., Musci Scand. 29. 1879 nom. illeg. prior. ut spec. - *Racomitrium canescens* (Timm ex Hedw.) Brid. fo. **vulgare* Chal., Grimm. tatr. 114. 1882 ('*vulgaris*') nom. illeg. - *Racomitrium canescens* (Timm ex Hedw.) Brid. var. **vulgare* (Chal.) Loeske, Laubm. Eur. I: 190. 1913 nom. illeg. - *Racomitrium canescens* (Timm ex Hedw.) Brid. fo. **eu-canescens* Mönkem., Laubm. Eur. 379.

1927 nom. illeg. - *Racomitrium canescens* (Timm ex Hedw.) Brid. var. **eucanescens* (Mönkem.) Sak., Bot. Mag. Tokyo 51: 140. 1937 nom. illeg. - Type: *Trichostomum canescens*, ~~Engelm.~~ [hard to read], 1797 [Schwaegrichen] (G-HEDW./SCHWAEGR. 430/1, neotype nov. - Fig. 48 B).

Racomitrium canescens (Hedw.) Brid. var. β *prolixum* Bruch et Schimp. in B.S.G., Bryol. Eur. 3: 147. 271 β . 1845 (fasc. 25-28 Mon. 12. 8 β). - *Racomitrium canescens* (Hedw.) Brid. fo. *prolixum* (Bruch et Schimp. in B.S.G.) Chal., Grimm. tatr. 114. 1882. - *Grimmia *ericoides* (Brid.) Lindb. var. *prolixa* (Bruch et Schimp. in B.S.G.) Hess., Medd. Grønland 43: 177. 1910. - *Racomitrium canescens* (Hedw.) Brid. fo. *ericoides* (Brid.) Chal. subfo. *prolixum* (Bruch et Schimp. in B.S.G.) Mönkem., Laubm. Eur. 380. 1927. - *Racomitrium ericoides* (Brid.) Brid. fo. *prolixum* (Bruch et Schimp. in B.S.G.) Frahm et Walsemann, Mitt. Arbeitsgem. Geobot. Schleswig-Holstein u. Hamburg 23: 93. 1973 nom. inval. bas. non cit. - Type: [W. Germany] Bei Carlsruhe, s.a. Al. Braun (BM-Herb. Bruch/Herb. Schimperianum Proprium, lectotype nov. - Fig. 49 B).

Racomitrium mollissimum Philib., Rev. Bryol. 12: 22. 1885. - *Racomitrium canescens* (Hedw.) Brid. var. ϵ *strictum* Schlieph. ex Limpr., Laubm. Deutschl. 1: 811. 1889 (*R. canescens* var. *strictum* Schlieph. in litt. 1883). - *Grimmia canescens* (Hedw.) C. Müll. [var.] *stricta* (Schlieph. ex Limpr.) Williams, Bull. New York Bot. Gard. 2: 361. 1902. - *Grimmia *ericoides* (Brid.) Lindb. var. *stricta* (Schlieph. ex Limpr.) Möll., Bot. Not. 1907: 142. 1907. - *Racomitrium canescens* (Hedw.) Brid. [subsp.] *R.* ^{II}*mollissimum* (Philib.) Amann, Fl. Mouss. Suisse 2: 144. 1918 ('1912'). - *Racomitrium canescens* (Hedw.) Brid. var. *strictum* Schlieph. ex Limpr. fo. **eustrictum* Loeske, Laubm. Eur. I: 189. 1913 ('eustricta') nom. illeg. - *R. canescens* (Hedw.) Brid. fo. *strictum* (Schlieph. ex Limpr.) A. Abr. in A. Abr., Sav.-Ljub. et Smirn., Opredel. list. mchov Arct. SSSR 345. 1961 nom. inval. bas. non cit. - Type: Schweiz, val. d'Annivers-en-Valais, 1800-2000 m in rupibus sileceis, VIII.1884 H. Philibert (H, lectotype nov. - Fig. 44 A; O, isoelectotype).

*Grimmia *ericoides* (Brid.) Lindb. var. **canescens* (Hedw.) Lindb. fo. **brevipila* Lindb. et H. Arn. in H. Arn., K. Svensk. Vet.-Akad. Handl. 23(10): 101. 1890 nom. nud. - Original collection: [USSR] Jenisei, Uskij mys, 61°25' n. lat., på stranden af en å, 5.VII.1876 H. Wilh. Arnell (UPS).

Racomitrium tortuloides Herz., Bull. Herb. Boiss. ser. 2,

2: 404. A-H. 1902. - *Racomitrium canescens* (Hedw.) Brid. fo. *tortuloides* (Herz.) Loeske, Laubm. Eur. 1. 190. 1913. - *Racomitrium canescens* (Hedw.) Brid. var. **tortuloides* (Herz.) Pilous, Preslia 29: 158. 1957 nom. inval. bas. non cit. - Type: [Schweiz] Kistenpasses zwischen Linth- und Rheintal in der Nähe des in Gesteinstrümmern versickernden Abflusses des Muttensees, ca. 2450 m, 30. Juni 1900 Herzog (JE, lectotype nov. - Fig. 44 B; HBR, syntype).

Racomitrium canescens (Hedw.) Brid. var. *longipilum* Warnst., Krypt. Fl. Brandenburg 2: 315, 5a-b p. 320. 1904. - *Racomitrium canescens* (Hedw.) Brid. fo. *longipilum* (Warnst.) Mönkem., Laubm. Eur. 380. 1927. - Type: "Bei Savarone (Südtirol) auf Alpenweiden bei 1200 m von Kalkhoff 1900 gesammelt" (Warnstorf l.c., type not seen).

Racomitrium canescens (Hedw.) Brid. var. *dolomiticum* Kern, Jahresber. Schles. Ges. Vaterl. Cult. Abt. II b, 83: 11. 1906. - Type: Italy, Auf weicher Kalkerde, auf einer Felsgruppe am Aufstiege von Paneveggio nach dem Rollepasse, Palagruppe, 1900 m, 16. VII. 1899 Kern (HBR, lectotype nov.).

Racomitrium canescens (Hedw.) Brid. fo. *nanum* Glow., Jahrb. d. Naturhist. Landesmus. Kärnten H. 28: 174. 1908 ('*nana*'). - Type: [Austria] Kärnten, Kaiser-Franz Josef-Höhe bei Heiligenblut, 2400 m, 31. Juli 1905 Glowacki (GJO, holotype).

Racomitrium canescens (Hedw.) Brid. var. **vulgare* (Chal.) Loeske fo. *pilosum* Loeske, Laubm. Eur. I: 189. 1913 ('*pilosa*'). - Type: not indicated.

Racomitrium canescens (Hedw.) Brid. var. **vulgare* (Chal.) Loeske fo. **subepilosum* Loeske, Laubm. Eur. I: 189. 1913 (excl. Fig. 60 a-b = *R. ericoides*) ('*subepilosa*') hom. illeg. [*R. canescens* var. *ericoides* fo. *subepilosum* Warnst. 1899 = *R. elongatum*]. - Type: not indicated.

Racomitrium canescens (Hedw.) Brid. var. **vulgare* (Chal.) Loeske fo. **epilosum* Loeske, Laubm. Eur. I: 189. 1913 ('*epilosa*') hom. illeg. [*R. canescens* fo. *epilosum* (H. Müll.) Chal. 1882 = *R. ericoides*]. - Type: not indicated.

Racomitrium canescens (Hedw.) Brid. var. *glaciale* Amann, Bull. Murithienne 40: 49. 1919. - Type: [Schweiz] Graubünden, Alp Murtér, Basse-Engadine, 2500 m, 16. Juli 1918 Amann (ZT, lectotype nov. - Bryotheca Helvetica 94.2.34 - Fig. 15 Ab).

Racomitrium canescens (Hedw.) Brid. fo. *latifolium* Vilh., Věstn. Král. Česk. Spol. Nauk Tr. 2, 1925(5): 17. 1925 ('*latifolia*'). - Type: [Czechoslovakia] Tatris, Malá Studená Dolina, rupes sub Pêt

Ples, 1919, Vilhelm (PRC, holotype).

Racomitrium canescens (Hedw.) Brid. var. *arenicola* Torka, Moosfl. Grosspolen in Deutsche wiss. Zeitschr. Polen H. 9: 127. 1927. - *Racomitrium canescens* (Hedw.) Brid. fo. *arenicolum* (Torka) Podp., Consp. 297. 1954. - Type: Sanddünen bei Sipiory (POZ, lectotype nov.; JE, PRC, syntypes. - Bryotheca Posnaniensis no. 29).

Racomitrium canescens (Hedw.) Brid. var. *muticum* Pilous, Preslia 29: 158. 2: 6-7. 1957. ('mutica') hom. illeg. [*R. canescens* var. *muticum* (Kindb. in Macoun) Macoun et Kindb. 1892 = *R. muticum*]. - Type: [Czechoslovakia] "Příbram, Žežice, na pastvišti u Kraftova mlýna; Hostinné, na zdi u splavu na Labi u Dobré Mysli, leg. Zd. Pilous" (Pilous l.c., type not seen).

Stem (1)3-6(10) cm (Fig. 8), brownish except for the uppermost part (ca. 1-2 cm) which is greyish green, irregularly branched, sometimes unbranched or pinnately branched.

Leaves (Fig. 15 A, 36 a) slightly to distinctly falcate along the whole shoot, and especially at the stem apex (Fig. 7 B), to 2.8 mm including hairpoint but often shorter, imbricate when dry, spreading to recurved when moist, ovate to broadly ovate-lanceolate, fairly abruptly narrowed towards apex, very obtusely keeled in upper part, slightly plicate; margin broadly recurved from base to apex; costa in most leaves forked or branched, mostly reaching to 1/2-3/4 the length of the leaf; alar cells (Fig. 16 h) of 3-5 cell rows, at margin often rounded and inflated, marginal cells just above the alar cells usually hyaline, marginal cell row including alar cells with up to 20(-30) esinuose cells; basal leaf cells (Fig. 36 d) elongate (30-50 x 4.5-6.5 µm), strongly papillose with large (± 5.5 µm broad) papillae except for the basal 0-3 cell rows which are often epapillose, middle and upper cells (Fig. 36 b-c) rectangular (10-25 x 5-10 µm), strongly papillose; hairpoint (Fig. 19 i) usually present, often broad and long and embracing parts of the upper lamina, usually slightly or not decurrent down margin of lamina, not capillaceous, often serrulate and spinulose, strongly papillose with high (to 15 µm) papillae towards apex, back of hairpoint in lower half with large and regularly arranged papillae.

Inner perichaetial leaves in pilose specimens mostly acute or hyaline-piliferous; costa mostly longer than in vegetative leaves, usually unbranched. Spores 8-10 µm.

Nomenclature and typification

It has proved difficult to select a type of *Racomitrium canescens*. The basionym of *R. canescens* is *Trichostomum canescens* (Hedwig 1801). When describing the species Hedwig (1801) gave four references; below they are quoted in chronological order.

(a). "*Bryum hypnoides hirsutiae canescens vulgare* Dill. h. musc. 368. t. 47. f. 27." (Dillenius 1741). It is likely that the modern use of the epithet *canescens* originates from Dillenius' polynomial. However, Dillenius listed many phrase-names as synonyms (see p. 11); the oldest one including the word *canescens* (from *canus* = grey) is *Muscus capillaris, lanugine canescens, pediculis tenuibus oblongis, capitulis in mucrones longos recta sursum exporrectis* (Ray 1696: 31). Dillenius (1741) described and figured what he considered to be three elements within the actual polynomial, viz. (I) the main species *Bryum hypnoides, hirsutiae canescens, vulgare* (his. Fig. 27 A-D); (II) var. *cum fol. magis reflexis* (Fig. E), and (III) var. *strigosior* (Fig. F-G). According to Lindberg (1875: 548, 1883: 28) the specimens in Dillenius' herbarium corresponding to Fig. 27 A-B, F-G are *Racomitrium heterostichum*, and the specimens corresponding to Fig. 27 C-E are *R. ericoides* (Lindberg interpreted Fig. 27 A-C as *R. canescens*). The *R. canescens* group was poorly understood by Lindberg. I have studied the relevant material in Dillenius' herbarium (OXF-DILL, H-SOL): Of eight plants or tufts referred to the main species in the herbarium one is *R. heterostichum* (Hedw.) Brid. s.str., one is *R. elongatum*, and six are *R. ericoides*; of seven plants referred to var. *cum foliis magis reflexis* five are *R. elongatum* and two are *R. canescens* (subsp. *canescens*); and the six plants referred to var. *strigosior* are all *R. heterostichum* (Fig. 2, 38). Thus, of the 21 plants or tufts glued to the sheet as no 27 A-G by Dillenius, seven are *R. heterostichum*, six are *R. elongatum*, six are *R. ericoides*, and two are *R. canescens*. The two plants of *R. canescens* are similar to Hedwig's (1801) *Trichostomum canescens* (see below), and they could perhaps be selected as the lectotype of that name, but this is unsatisfactory as most parts of Dillenius' species belong to three other *Racomitrium* taxa; and the two plants which belong to *R. canescens* were by Dillenius (1741) referred to a variety which was not mentioned by Hedwig (1801).

(b). "*Hypnum canescens pilosum* Weiss [sic] Pl. crypt. Fl.

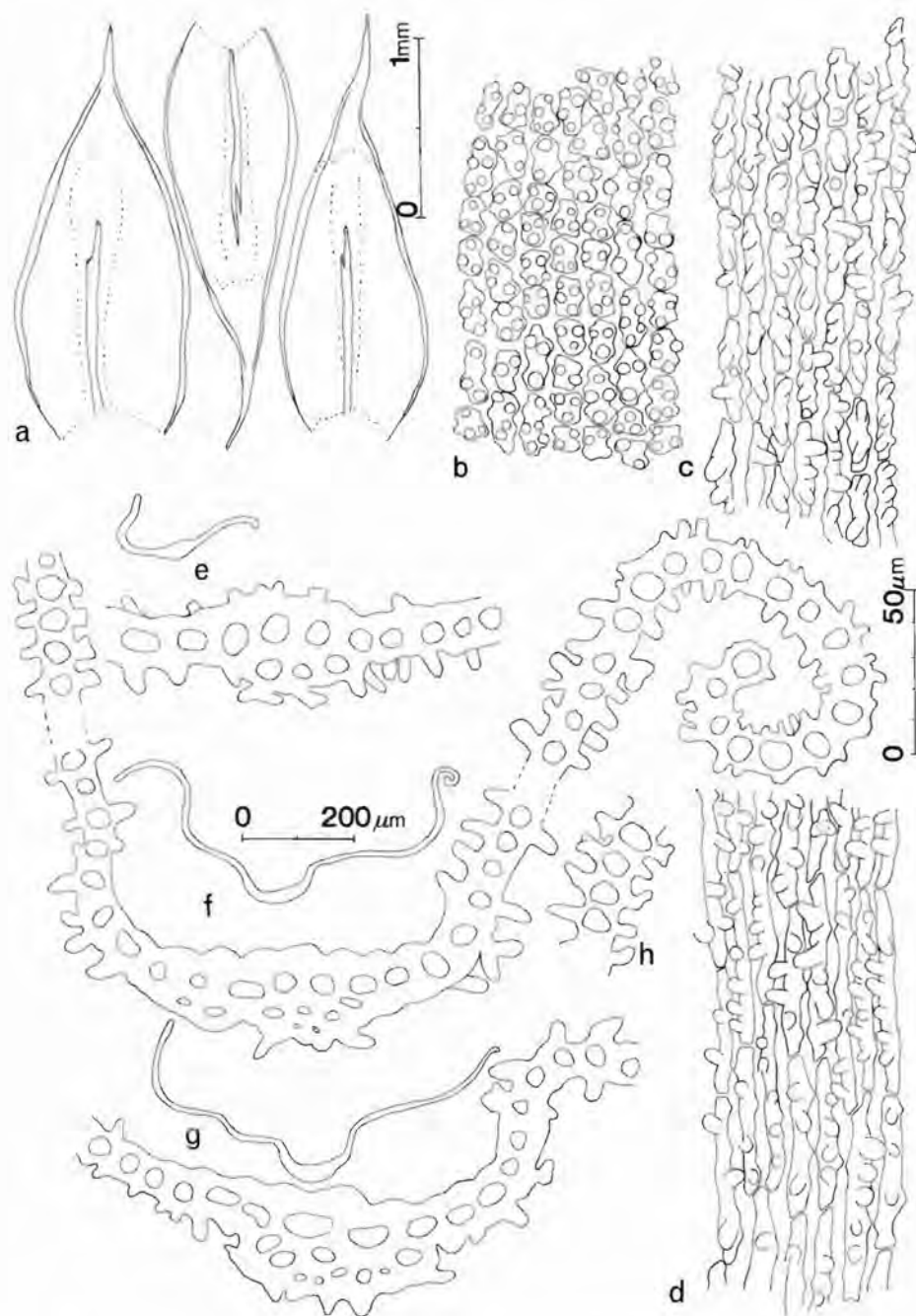


Fig. 36. *Racomitrium canescens* subsp. *canescens*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. h. Cross section of lamina including multifiform papillae. - Norway: ST, Selbu, Hyttbakken, 29.VII.1981 Frisvoll (TRH). Mixed stand between *R. canescens* subsp. *canescens* and *R. canescens* subsp. *latifolium*, cf. Fig. 37.

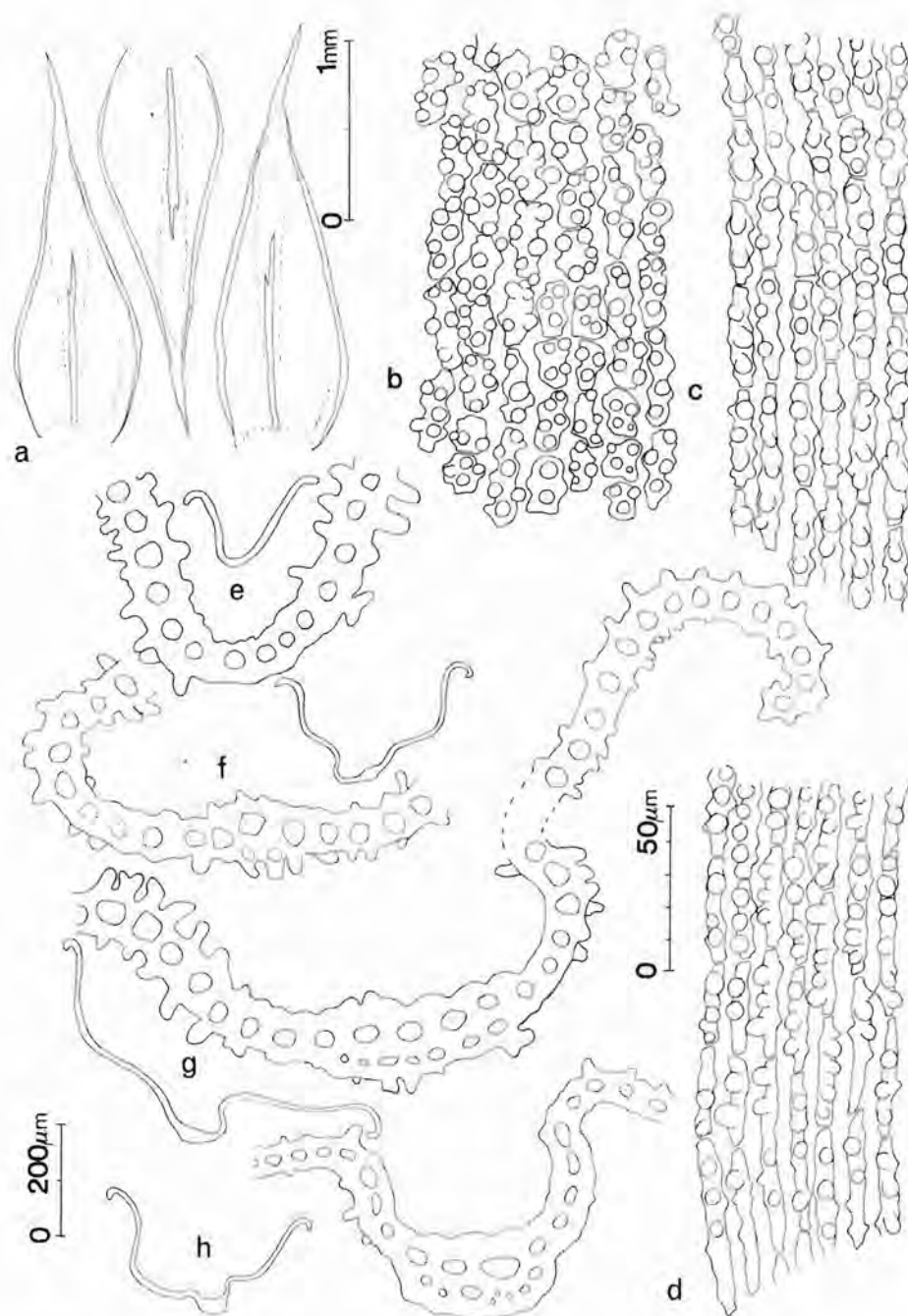


Fig. 37. *Racomitrium canescens* subsp. *latifolium*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e. Leaf cross section from above the costa. f-h. Cross sections from the upper, middle and basal part of the leaf. - Frisvoll 29.VII. 1981 (TRH), cf. Fig. 36.

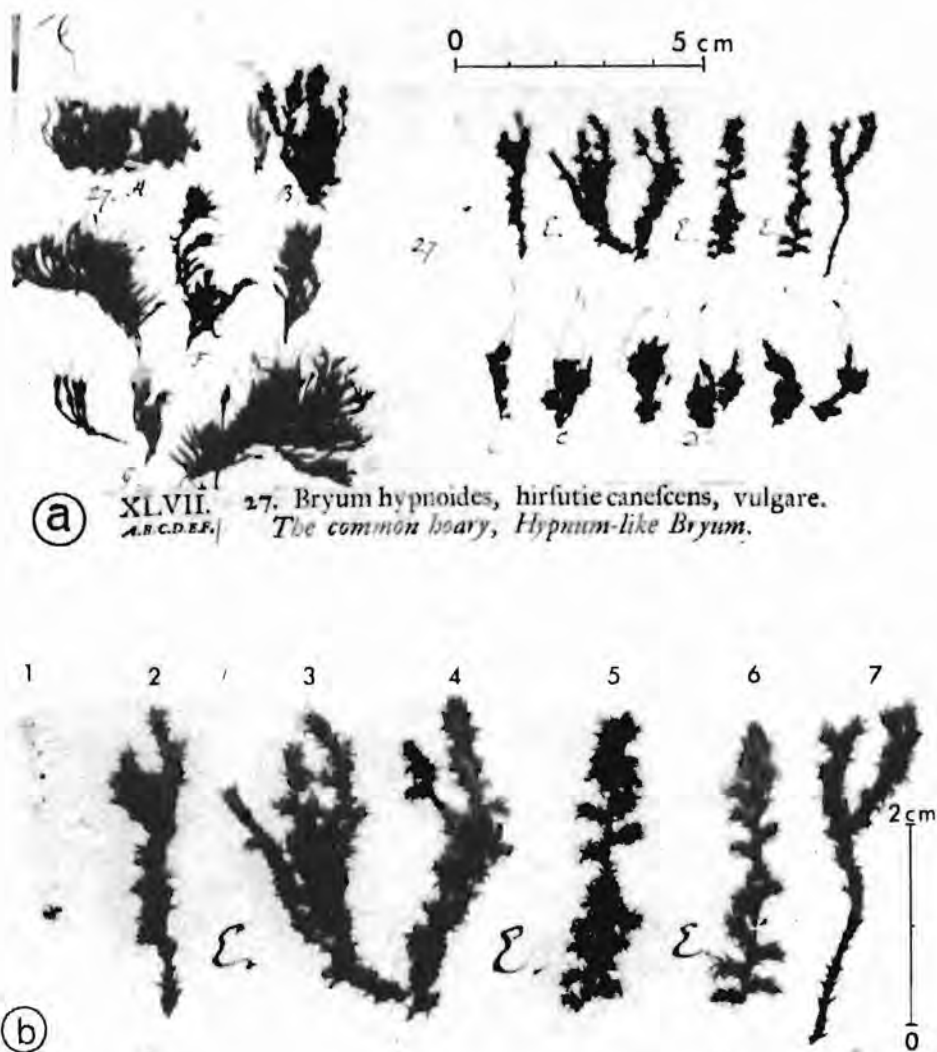


Fig. 38 a. *Bryum hypnoides*, *hirsutiae canescens*, *vulgare* Dill. (OXF-DILL). A-D. The main species. E. Var. *cum foliis magis reflexis*. F-G. var. *strigosior*. - A, F-G. *Racomitrium heterostichum*. B. *R. elongatum* (the small shoot to the left removed by Lindberg, and now in H-SOL, is *R. heterostichum*). C-D. *R. ericoides*. E. *R. canescens* and *R. elongatum* (cf. magnification). b. *Bryum hypnoides*, *hirsutiae canescens*, *vulgare* var. *cum foliis magis reflexis* Dill. (OXF-DILL). 1, 3-6. Lectotype of *Grimmia ericoides* fo. *squarrosa* Lindb. (= *Racomitrium elongatum*; plant 1 mostly removed and now in H-SOL). 2, 7. *R. canescens* subsp. *canescens*.

Gott. p. 213.β." (Weis [sic] 1770). In this work only one synonym is listed, viz. that of Dillenius (1741) quoted above. - The first author employing *canescens* as a specific epithet in a binomial combination and in the current sense was probably Timm (1788); he listed *Trichostomum canescens* including two synonyms: The first reference is the polynomial of Dillenius (1741), see above. The other reference is "β. *Hypnum canescens, pilosum*" of Weis (1770); the *Hypnum canescens, α hirsutum* of Weis (op.cit.) is usually cited as a synonym of [*Racomitrium*] *lanuginosum* sensu Hedwig (1801). I have not seen original material of *Hypnum canescens pilosum* Weis; according to Sayre (1977) Weis' collections are probably at GOET; a request to borrow the material was without result. However, Weis' (1770) paper considered cryptogams at Göttingen (Niedersachsen, W. Germany close to the E. German border). I have seen some collections from the area (JE), and they are similar to Hedwig's *Trichostomum canescens* (see below).

(c). "Hedw. St. Cr. III. p. 5. t. 3." (Hedwig 1792). The table referred to (Fig. 3) is a coloured plate of one large and two small plants named *Trichostomum canescens* (one of the small plants is identical with the large one). Two synonyms are cited, viz. those of Dillenius (1741) and Weis (1770).

(d). "Brid. muscol. II. p. 123." (Bridel 1798). Bridel has numerous references to his *Trichostomum canescens*, i. a. Dillenius (1741), Weis (1770), Timm (1788), and Hedwig (1792) quoted above. The relevant material in Bridel's herbarium (B) is heterogeneous; 17 specimens named *Racomitrium* or *Trichostomum canescens* are glued to 5 herbarium sheets; of these seven specimens are *R. heterostichum* s.str.; six specimens are *R. canescens* sensu Hedwig (1792, 1801); one specimen is *R. canescens* (Hedw.) plus *R. elongatum* plus *R. heterostichum* s.str.; one specimen is *R. canescens* (Hedw.) plus *R. ericoides*, and two specimens are *R. ericoides*. A lectotype of *Trichostomum canescens* can not be selected among Bridel's specimens, because those which are dated and in accordance with Hedwig (1792, 1801) were collected too late (1803, 1811, oct. 1813, 1820).

Trichostomum canescens Hedw. 1801 could most properly be typified by a specimen in Hedwig's herbarium. In the Hedwig-Schwaegrichen herbarium (G) there are at least seven specimens of the *R. canescens* group: (1) Four robust branched plants of *R. elongatum* plus two small shoots of *R. canescens* sensu Hedwig. This specimen (G 430/2) is labelled "*Racomitrium ericoides* Schrad. a. a Schradero. b.

a Funkio var. *canescentis*." The collector and locality is missing. (2) A second specimen (G 430/3) is labelled by Hedwig "*Bryum hypnoides hirsutiae virescens fasciculare alpinum* Dill. [1741] Musc. 370. t. 47. f. 28. *Bryum hypnoides* Linn. [1763] Spec. ed. II. 1584. var. β ". The material in Dillenius' herbarium (OXF) bearing the above Dillenian name is *Racomitrium fasciculare*, but the Hedwig specimen is *R. elongatum*. (3) A fine specimen (G 732/23) labelled by Hedwig "*Bryum hypnoides ericae facie, capsulis barbatis alpinum* Dill. Musc. 371. t. 47. f. 31 *Bryum hypnoides* Linn. Spec. ed. II. 1584. 21. var. γ ." The material in Dillenius' herbarium (OXF) bearing the above name is selected as the lectotype of *Racomitrium ericoides* (q.v.), but the Hedwig specimen is *R. canescens*. (4) A fine specimen (G 732/21) labelled (by ?) "*Bryum hypnoides antheris erectis caule erectiusculo, ramis lateralibus fertilibus* Linn. Sp. pl. 2. p. 1584. n. 21. *Bryum hypnoides polycephalon lanuginosum montanum* Dill. H. M. 372. t. 47. f. 32." Dillenius' and Linnaeus' species is *Racomitrium lanuginosum*, but the Hedwig specimen is *R. canescens*. (5) A small specimen (G 732/28 p.p.) labelled "*Trichostomum lanuginosum*" is *Racomitrium ericoides*. The collector and locality is unknown. (6) A small specimen (G 732/16 p.p.) labelled "*Trichostomum heterostichum* alp. ... 800" is *R. canescens*. The collector is unknown. (7) A fine specimen (G 430/1) labelled "*Trichostomum canescens Engelm. [*] 1797*". According to G. Columb-Duplan, who has tested the plant, the original label is written by Schwaegrichen. It is possible that Hedwig saw this specimen before he died (February 1799). The specimen is *R. canescens* sensu Hedwig.

In the absence of original material the illustration of *Trichostomum canescens* by Hedwig (1792: Tab. III) is of great value (Fig. 3). This table is a coloured plate of a plant which represents *R. canescens* s.l. and not *R. ericoides* s.l.; the plant is irregularly and sparsely ramified, the leaves are not sharply keeled as in *R. elongatum* and *R. ericoides* s.l., and the hairpoints are long, broad towards apex and not flexuose. From Hedwig's works it is clear that he was familiar with the ecology and occurrence of his *Trichostomum canescens*: "Locus: apria, elatiora, arenosa, siccitateque sterilia, late diffusa grege inhabitat vix non ubique" (Hedwig 1792: 7); "Lata grege inhabitat loca elatiora, aprica, arenosa, siccitate sterilia, maxime montosarum regionum Europae" (Hedwig 1801: 111).

*) see p. 108.

Johannes Hedwig was born in Brasov (Romania) in 1730; he went to Wien (Austria) in 1766 and then to Pressburg (= Bratislava, Czechoslovakia) and Zittau (E. Germany) before he came to Leipzig in 1752, 22 years old; he moved to Chemnitz (= Karl Marx-Stadt) after 1759 and returned to Leipzig in 1781, 51 years old; he died in Leipzig in 1799, 69 years old (Florschütz 1960).

Hedwig lived in a limited area in the southern parts of today's East Germany from 22 years old until he died. From this it can be concluded that Hedwig's (1792, 1801) *Trichostomum canescens* is the *Racomitrium canescens* which grows in the area; this may be a legitimate inference for all Hedwig's (1801) species which are common in that district and for which no specific locality is given.

I have seen all collections of *R. canescens* coll. from Jena (JE); there are many collections from districts mainly S, SW, and W of Leipzig (e.g. Harz, Eichsfeld, Eisenach, Gotha, Weimar, Jena, Gera, Thüringer Wald, Fichtelgebirge, Erzgebirge, Leipzig). The taxon must be common in the area, although it seems to be infrequent below 200 m a.s.l. Plants of *R. canescens* from the area are usually robust, and the leaves are more or less falcate; the hairpoint is distinct and mostly embraces parts of the upper lamina. Some collections from other areas (e.g. SE Norway, the Alps, the Pyrenees, Caucasus) have more strongly falcate leaves with broader hairpoint embracing a greater part of the upper lamina. These differences may be genotypical, but it is impossible to distinguish between the above plants at any taxonomic level. As long as the original material is missing the Schwaegrichen specimen dated 1797 is selected as the neotype of *Trichostomum canescens* (see p. 142); it confirms well with Hedwig (1792: Tab. III).

Two collections in BM (Herb. Dawson Turner/Herb. Hookerianum 1867) may represent original Hedwig material (the specimens are glued to a large sheet including 14 different collections): (a) 2. Dr. R.A. Hedwig, [collected or, more likely, received by Turner] 1801; (b) 4. Dr. Schwaegrichen, 1802. The Schwaegrichen specimen is similar to the neotype, and the two could be part of the same collection. The specimen which is associated with the name of J. Hedwig's son probably originates from J. Hedwig's herbarium; the specimen is similar to the neotype of *Trichostomum canescens*.

Taxonomical notes

1. The frequent mod. *longipilum-vel-pilosum* of *Racomitrium canescens* subsp. *canescens* is easy to place; the plants are robust and the leaves are wide and typically concave, and falcate along the whole shoot; the hairpoint embraces much of the upper part of the lamina, and is not decurrent down the margin. The extreme mod. *brevipilum-vel-epilosum* is very different in appearance: The shoots are thin and the leaves are almost elliptical, spoonshaped and cucullate, and not falcate; the hairpoint is present as a short straight point or is lacking (Fig. 15 A, 44 A-B). Such extreme plants are only found in districts where *R. canescens* subsp. *canescens* mod. *pilosum-vel-longipilum* also occurs, and the identity of the plants is established by numerous intermediates. They are inter alia described as *R. mollissimum* = *R. canescens* var. *strictum*, and *R. tortuloides* (see also p. 103). Loeske (1930: 228) considered that such plants were missing in Fennoscandia: "Bemerkenswerterweise wird var. *strictum* oder eine ihr ähnliche Form aus Fennoskandien nicht erwähnt." But this is not the case. From SE Norway I have seen several herbarium specimens which match the type of *R. mollissimum* [e.g. Oppland: Nordre Land, Dokka, 7.VIII.1960 Størmer (O). - Buskerud: Ringerike, Tyristranden, Nakkerud, 24.X.1888 Bryhn (O)]; *R. canescens* subsp. *latifolium* is so far not found in these regions.

2. It should be stressed that the large, broad papillae of the basal cells of *R. canescens* are unique within the species group concerned, and they serve to identify aberrant modifications; moreover, they are usually preserved even in old and partly destroyed material. The cell structure of the leaves of subsp. *canescens* is relatively constant, but in mod. *brevipilum-vel-epilosum*, and also in strongly xeromorphic modifications, the cells may be short in the whole leaf except at the base.

3. From SE Norway (Hedmark: Rendalen, 6 km SE of Finstad, 12.IX.1980) I have several collections from a mixed stand between two plants which both are referred to *R. canescens* subsp. *canescens* in this paper (Fig. 11 A). One of the plants has distinct hairpoints (mod. *pilosum*), whereas the other has short or no points (mod. *brevipilum-vel-epilosum*). The former is considered as the typical plant with regard to the habitat; both plants are robust and have typically falcate leaves; they are mixed with fine material of *R. canescens*

subsp. *latifolium*!

4. In some districts plants of *R. canescens* subsp. *canescens* with narrower leaves and narrower and somewhat flexuose and decurrent hairpoint seem to dominate. These plants resemble *R. canescens* subsp. *latifolium*. For the difference between these plants and subsp. *latifolium*, see the latter taxon. For the difference between *R. canescens* and *R. elongatum*/*R. ericoides*/*R. panschii*, see the latter species.

5. Heinonen (1971) did not distinguish between two taxa within *R. canescens*; according to herbarium material Fig. 1 and 5 refer to subsp. *latifolium* and Fig. 3 and 7 refer to subsp. *canescens*; otherwise it is difficult to distinguish between the two subspecies in the different figures, but Fig. 9-12 is probably subsp. *canescens*. In Finland subsp. *canescens* is common in the south, whereas subsp. *latifolium* is found in the north.

Ecology

Racomitrium canescens subsp. *canescens* seems to tolerate basic conditions better than the other taxa in the group, and it is often found on limestone or other calcareous rocks. Otherwise it grows on sandy soil, rocks and boulders. In SE Norway it is common along roadsides.

Distribution (Fig. 39)

Racomitrium canescens subsp. *canescens* is found in scattered localities in USSR: the Yenisey valley, Altai, the Ural mountains and Caucasus. In Europe it is a common moss except in the extreme southern and northern parts. Subsp. *canescens* is mainly found south of the area of subsp. *latifolium*, but in SE Norway they grow together. In North America subsp. *canescens* occurs both in the East and the West where it mainly grows south of the area of subsp. *latifolium*. - Southernmost locality, USA: Colorado, San Juan Country, ca. 15 mi SW of Silverton, ca. 37°50'N; northernmost locality, USSR: Murmansk distr., Lotta (Luttojoki), Sonkijärvi, ca. 68°30'N.

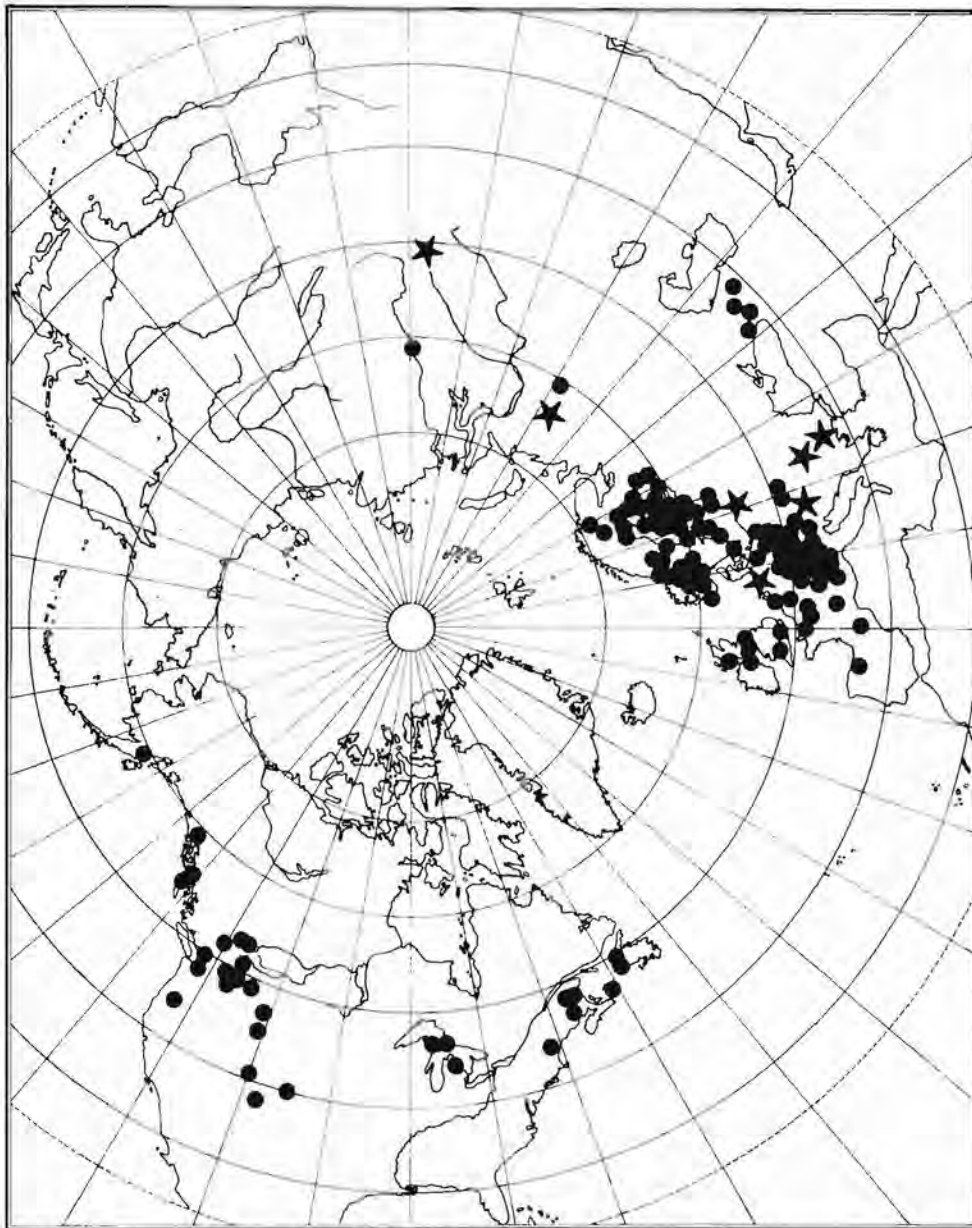


Fig. 39. Distribution of *Racomitrium canescens* subsp. *canescens* based on herbarium specimens. ● ordinary station, ★ locality inexact.

List of selected localities (see also "Mixed stands")

USA, Oregon: Elk Rock, Multnomac Co., Sheldon 11885 (ALTA); Lane Co., along Ore. Route 58, 10 mi NW of Oakridge, Hermann 22858 (WTU). - Washington: On summit of Cooks Ridge, Foster 2433 (WTU). - Idaho: Bonner Co., at Dickensheet Campground, SW corner of Preist Lake, Vitt 7196 (ALTA, H). - Utah: Duchese Co., Uinta Mts., E. Mirror Lake, Flowers 4027 (ALA). - Colorado: Silverton, pass between Silverton and Durango, 22.VII.1931 Fry (WTU); Boulder Co., Indian Peak area, W slope of Arapahoe Pass, 13.VIII.1973 Komarkova (ALTA); Niwot Ridge, 7 mi W of Ward, Hermann 27438 (ALTA); Grand Co., Rocky Mtn. Ntn'l Pk., Red Mtn. Trail, 10.5 mi N of W Park Entrance on Hwy. 34, Vitt 15290 (ALTA). - Wyoming: Teton National Park, Cascade Trail, Lawton 1764 (WTU); Yellowstone National Park, near Old Faithful geyser, 15.VIII.1925 Fry (WTU). - Montana: Glacier National Park, 6 mi inside park ground from east entrance, St. Mary's near picnic ground, Lawton 1208 (WTU); Flathead Co., Middle Fork, Flathead River $\frac{1}{2}$ mi E of West Glacier, Glacier National Park, Hermann 18218 (WTU); Neihart, Little Belt Mts., 6.VIII.1888 Williams (ALTA). - Alaska: Wrangell Island, abt. 8.5 mi S of Wrangell, Worley 7543 (UBC); along Mud Bay, Nr. Haines, Chilkat Peninsula, Worley 12008 (UBC); Newhalen, Summit Mt., Iliamna Bay - Rocky, Thomas 51-51 (WTU). - Michigan: Alger Co., NW of Chapel Falls, Vitt 1161 (ALTA); Chase S. Osborn preserve of the Univ. of Michigan, Sugar Isl., Chippewa Co., Steere 3488 (WTU). - New Hampshire: Gate, White Mountain Notch, IX.1905 Farlow (O). - CANADA, British Columbia: Sage Cr. Falls, Flathead, 20.VII.1957 Davidson (UBC); Copperkettle Co., Hazelwood 1 (UBC); Creston area, just W of Creston on Hwy 3, 46.4 mi E of Jct. of Hwys 3 & 6 S of Salmo, $49^{\circ}08'N$, $116^{\circ}38'W$, Vitt 22304 (ALTA, UBC); Cinema Camp Site, Cariboo District, Boas 321 (UBC); Sumas Mts., near Kilgard, Schofield 28468 (UBC); Kicking Horse Canyon near Spiral Tunnel Tea House, Crum & Schofield 4403 (WTU); bei Rosebery, 10.V.1927 MacFadden (WTU). - Alberta: Mountain Park area, just N of Cardinal River divide, 12.4 mi S of Cadomin, Vitt 10889 (WTU); near Moraine Lake, Banff National Park, Crum & Schofield 3889 (WTU); Red Rock Creek, Waterton Lakes Natl. Park, Bird 6426 (ALTA). - Ontario: Lake Superior, Sands, Points aux Pins, 5.VIII.1869 Roy (H). - New Brunswick: York Co., 2 mi N of Tweedside, ca. $45^{\circ}38'N$, $67^{\circ}01'W$, Ireland 13049 (ALTA, WTU); Restigouche Co., along railroad tracks 1 mi N of Kedgwick, ca. $47^{\circ}39'N$, $67^{\circ}21'W$, Ireland 14583 (ALTA). - Nova Scotia: Inverness Co., Cape Breton Highlands National Park, summit of North Mountain, NE of Inverness, $46^{\circ}48'N$, $60^{\circ}42'W$, Ireland 11839 (ALTA). - Newfoundland: St. George's District, sandy point St. George's Bay, Hancock & Butler 197 (ALTA); mouth of Clark's Brook, near Benoit's Cove, Bay of Islands, Brassard 12042 (NFLD). - GREAT BRITAIN. Minehead, Somerset, 1872 Gillford (OXF); Suffolk, 1807 Eagle (BM); Dyke Hill, XI.1854 Hemmings (BM); Newcastle, s.a. V. C. (BM); Kilmory, Isle of Rhum, 13.IV.1961 Dennis (BM); Newlands corner, Surrey, summit of Downe, 1.X.1893 Monington (BM). - SPAIN. Pirineos Centrales, Bielsa, valle de Pineta suelo descubierta, 26.VI.1955 Casas (O); Pirineos Centrales, Lérida, Vall de S. Nicolau, Aiguestortes, en la Ermita del S. Esperit, 2.VII.1959 Casas (O); in montis Asturiarum inter Cangas de Tinea et Leitariegos, 17.VII.1878 Levier (TRH). - FRANCE. Pyrenées centrales, environs de Luchon, IX.1856 Zetterstedt (O); Calvados, s.a. De Brebisson 76 (TRH); Montagnes de l'Auvergne, 4.VI.1883 Grasilien (TRH); Fontainebleau, s.a. Kleinhaus (TRH); Vale of Chamouni, X.1859 Boswell (OXF); Dept. Isère, Rhonetal östlich Lyon, Umgebung vor Cremieu, Verna, 13.VII.1975 Hafellner (BM). - BELGIUM. Marche, Demaret 3102A

(O); à Auseremme, 4.XII.1887 Zonglet (TRH). - NETHERLANDS. Minen by Katwejk a Zee, I.1840 Dozy (TRH). - W. GERMANY. Wolfartsweir bei Carlsruhe in Baden, s.a. Bausch (G); Hessen, auf dem Ramsberge bei Lauback, III.1902 Roth (G); in valle Rhenana [Rhein] prope St. Goar, Herpell 1873 (BM); Mering bei Augsburg, s.a. Holler (O); Regensburg, dürre Hänge am Reinhausener Galgenberg, V.1904 Familler (G); Oberfranken, Buch am Forst, 1902 Brückner (TRH). - E. GERMANY. Dresden, s.a. Rabenhorst (O); prope Löwenberg, Silesiae, Dresler 1873 (BM); Vogtland, bei Hundshübel, V.-08 Spindlen (TRH); Potsdam, 1872 Cartwright (OXF). - POLAND. Ad viam in sicco pineto, Pila, 29.V.1953 Lisowski (O); prope Stanislawow, 11.X.1962 Karczmarz (O). - CZECHOSLOVAKIA. Bohemia, prope oppidum Hostinne, V.1948 Pilous (G); Böhmen, Plan bei Tabor, Herbst, 1897 Bauer (G); Slovakia orient, distr. Presov, montes Cerchovske pohori, prope pagum Baranie pod Lysou, 28.V.1973 Zemanova (G); Hohe Tatra, Grüner-See, 8.VIII.1906 Györffy (O). - AUSTRIA. Prope Krems, Baumgartner 399 (O); Tyrol, Gries-Sellrain, Lawalree 13355 (O); Kärnten, Klagenfurt, VIII.1881 Burchard (TRH). - SWITZERLAND. Cambrena Glacier moraine, Bernina Pass, Grisons, 13.VII.1927 Trotter (BM). - ITALY. Tyrol, Rovada pres Trento, 1875-1876 Hampe (G); prov. Cemensis, Vergosa pr. Comum, 8.III.1898 Artaria (TRH); Intragna, Val Intrasca (Verbanum), 6.VI.1897 Corti (TRH); Campodolcius allo Spluga, VII.1906 Corti (O). - HUNGARY. Hungaria occidentalis - septentrionalis, Comit. Trentschin ad Nemes Podhrad, s.a. Holuby (BM). - BULGARIA. Vitosa planina, Dragalevsko blato, 19.VII.1908 Podpera (TRH). - ROMANIA. Transsilvania, Unokö, 15.VIII.1888 Demeter (TRH); Siebenbürgen, Comit. Kolozs, Jegenye fierdö, Köveshegy, 12.V.1901 Györffy (O). - FINLAND. Ab., Turku, 5.VI.1933 Auer (H); St., Ikaalinen, 16. VIII.1964 Suominen (H); ES, Savitaipale, Hyrkkälä, 25.VII.1967 Vitikainen (H); Kb., Suojärvi, Pöponsaari, 8.VII.1912 J. Koponen (H); KP, Kanuus, 3.VII.1964 Suominen (H); Obu., Kemi, Selkosaari, 26.VI.1904 Buch (H); Ks., Taivalkoski, Taivalvaara, Ahti 10834 (H); KemL, Sodankylä, Yli-Kitinen, 28.VIII.1962 Ohenoja (H). - SWEDEN. Skåne, Sandskogen, Ystad, V.1912 Jönsson (TRH); Gotland, Gothen, 11.VII.1872 Zetterstedt (UPS); Gotska Sandön, 17.-20. VIII.1903 Johansson (UPS); Värmland, Skillingmark, 23.VI.1937 Stenholm (TRH); Uppland, Järlåsa, 21.V.1945 Gjærevoll (TRH); Uppsala, Jella, 25.V.1855 Zetterstedt (TRH); Jämtland, ad saxa parociae Stugun, 9.IX.1916 Öhrstedt (TRH); Norrbotten, Nederluleå sn., Hertsølandet, 21.VII.1960 Lönnquist (UPS); Hietaniemi sn., Ylikoski, 12. VIII.1963 Lönnquist (UPS). - USSR: Murmansk distr., Luttojoki, Sonkijärvi, 25.VI.1921 Roivainen (H); Karelia, par. Pälkjärvi, 12.VII.1876 Brotherus & Hjelt (H); Estland, Kreis Harrien, Nömme bei Reval, 3.VII.1910 Wasmuth (H); Livland, Kreis Riga, W vom Titurgkanal SW von Depkinshof bei Riga, 14.IX.1908 Mikutowicz (H); Livland, Insel Ösel, zwischen dem Jerwe-Krug und dem Meere, W von Arensburg, 24. VII.1907 Mikutowicz (H); Kurland, Kreis Talsen, in der Mitte der Grossen Insel des Angern-Sees, 22.V.1906 Mikutowicz (H); prov. Perm, Deneshkin, s.a. Koller (H); Galizia, pr. Javoroviam, Woloszczak 399b (O). Caucasus: Lars ad fl. Terek, 25.V.1881 Brotherus (H); in monte Kasbek, 28.V.1881 Brotherus (H); Dagestania astr., versus fontes fl. Samur, VI.1860 Ruprecht (H); in ripa fl. Rion pr. Uzeri, 8.VII.1877 Brotherus (H); Teberda, 23.VIII.1955 Abramova (H). Siberia, Jenisei, Uskij mys, 61°25'N, 5.VII.1876 Arnell (UPS); Altai, distr. Svejvorsk pr. Kolivarski Savod, 7.VII.1913 Kusnezow (H); in tragastu inter Aspatty et Kadrin, 28.VIII.1914 Grano (H).

- b. *Racomitrium canescens* (Timm ex Hedw.) Brid. subsp. *latifolium* (C. Jens. in J. Lange et C. Jens.) Frisvoll stat. nov. - Fig. 6 B, 7-8, 11, 15 B, 16 b, e; 19 k, 37, 40, 42, 48 A, 51, 52

Racomitrium canescens (Timm ex Hedw.) Brid. [var.] β , *latifolium* C. Jens. in J. Lange et C. Jens., Medd. Grønland 3(2): 345. 1887. - Type: Grønland ["Specimen groenlandicum sine indicatione loci specialis adest in herb. musei haun.!" (Lange & Jensen l.c.)] (C, holotype - Fig. 48 A).

Plant usually less robust than subsp. *canescens* (Fig. 7 B, 8). Leaves (Fig. 15 B, 37 a, 42 a) imbricate, slightly or (usually) not falcate, erect-flexuose, ovate-lanceolate, obtusely keeled in upper part; margin, costa, alar cells (Fig. 16 b, e) and basal cells mostly as in subsp. *canescens*, but cells sometimes less papillose with lower papillae (Fig. 37, 42); hairpoint (Fig. 19 k) mostly present, subulate and usually flexuose and not embracing a greater part of the upper lamina, decurrent down margin of lamina, strongly papillose towards the extreme apex, variably but usually moderately denticulate and spinulose towards apex.

Nomenclature and typification

The first validly described subordinate taxon referred to *R. canescens* was var. *brevisetum* Brid. 1826. Var. *brevisetum* is probably a synonym of *R. heterostichum* s.str. (see p. 144).

The next name and varietal epithet introduced in the group was *R. canescens* var. *prolixum* Bruch et Schimp. in B.S.G. 1845. Although the lectotype of the name in some characteristics is similar to the northern taxon, var. *prolixum* is rejected as the name of the taxon (see p. 157f.).

The third available name is *R. canescens* var. *latifolium* C. Jens. 1887. It is based on a Greenland specimen, and the material is unambiguous. I have seen all of the Greenland collection of *R. canescens* coll. at Copenhagen (C), and *R. canescens* subsp. *canescens* probably does not occur in Greenland. The epithet *latifolium* is adopted as the name of the northern taxon within *R. canescens*. But the meaning of the epithet - viz. broad-leaved - does not fit the plant well, as it is usually more narrow-leaved than subsp. *canescens*.

Taxonomical notes

1. The mod. *pilosum* of *R. canescens* subsp. *latifolium* from northern districts is easy to identify. The plants are 'gracile and the leaves are ovate-lanceolate and slightly concave, and mostly not falcate; the hairpoint is flexuose and embraces only a small part of the upper lamina and is decurrent down the margin of the lamina. The decurrence of the hyaline point tends to be most conspicuous in older leaves. The mod. *longipilum* has the same orientation and structure of leaves and hairpoints, although it may look more similar to subsp. *canescens*. The mod. *brevipilum-vel-epilosum* of subsp. *latifolium* has less oval and concave leaves than the same modification of subsp. *canescens* (Fig. 15). In a broad belt across SE Norway mixed stands between subsp. *canescens* and subsp. *latifolium* are frequent (Fig. 7 B, 8) and the differences between them are striking. In the field it is possible to study mixed stands including modifications of both taxa, and see how long hairpoints in dry sites gradually change into short points in moist sites; the taxa have a parallel variation amplitude, and the identification problems within *R. canescens* sect. *Canescens* are well documented. In plants from mixed stands (Fig. 36-37) it is possible to find microscopic differences between subsp. *canescens* and subsp. *latifolium*: Apart from differences in the leaf form and the hyaline point, subsp. *canescens* is usually more strongly papillose towards the extreme base of the leaves, and the papillae in the whole leaf including the hairpoint are often higher. But the microscopic characteristics are variable within the different modifications of both taxa, and I have not been able to find conclusive microscopic differences between them.

2. In some areas the differences between subsp. *canescens* and subsp. *latifolium* seem to be less pronounced; this is e.g. the case in parts of Germany. But subsp. *latifolium* seems to be rare or absent from Central Europe, and typical specimens of the taxon from that area have not been seen. Many American specimens are difficult, especially from the Rocky Mountains area. The problematic collections have more lanceolate leaves and narrower hairpoint than the collections which obviously belong to subsp. *canescens*; but in general they are as robust as subsp. *canescens* and have more or less falcate leaves. I have referred the majority of these collections to subsp. *canescens*.

3. In Svalbard (Dickson Land, between Svenskehuset and Hagahytta, 20.VIII.1973) I have collected material from a mixed stand between *R. canescens* subsp. *latifolium* and an aberrant plant which resembles it (Fig. 11 B). The aberrant plant is more olive-coloured and has shorter, more rigid and fragile hairpoints, and narrower leaves.

4. The Japanese specimens of *R. canescens* are gracile and the leaves are not or slightly falcate and often contorted; although they are slightly different from European and North American material of subsp. *latifolium* they should be referred to that taxon. The Sikkim specimen is different from subsp. *latifolium* in having small papillae in the whole leaf; the form and structure of shoots and leaves resembles that taxon more than subsp. *canescens*. The Himalaya population of *R. canescens* is very isolated, and more material is needed in order to establish the taxonomical position of the plant.

Distribution (Fig. 40)

Subsp. *latifolium* is found in northern Europe including Svalbard, Jan Mayen and Iceland; Greenland; northern parts of North America following the Cascade range south to Washington in the West; eastern Siberia, Japan, and Sikkim. It is probably present in the large gap between the Kola peninsula in European USSR and Kolymsk in Siberia. - Southernmost locality, Sikkim, ca. 27°30'N; northernmost locality, Canada: Ellesmere Isl., head of Tanquary Fiord, ca. 80°25'N.

List of selected localities (see also "Mixed stands")

USA, Washington: Scamania Co., Mt. St. Helens, Schofield 40100 (UBC); Mt. Rainier, 18.VIII.1919 Flett (UBC). - Alaska: Vic. of Nunatak Knob, E shore of Muir Inlet, Glacier Bay, Worley 10428 (UBC); adjacent to the Moose Pass - Kenai road, about 10 mi W of the Chugach National Forest Boundary, Kenai Pen., Lutz 50-37 (UBC); Richardson Highway, Big Delta to Anchorage near McCallum, at 221 mile post, 63°15'N, 145°36'N, Svihla 4093 (WTU); Alaska Range District, Mt. Hayes Quadrangle, beside Castner Glacier, mile 217.2 on the Richardson Highway, ca. 22 mi NNW of Paxson, Hermann 21164 (WTU); adjacent to mile 219 Richardson Highway in front of Castner Glacier, Lutz 50-173 (UBC); Killik river quad., Lake Kaniksrak, 68°11'N, 154°09'W, Murray 5670 (UBC); Portage Cove Campground, Port Chilkoot (1 mi S of Haines) W shore of Lynn Canal, 59°13.5'N, 135°25.5'W, Worley 4410 (UBC); Yakutat Bay, Neleate 1779 (TRH); Hiddenglacier, Russel fiord, Coville

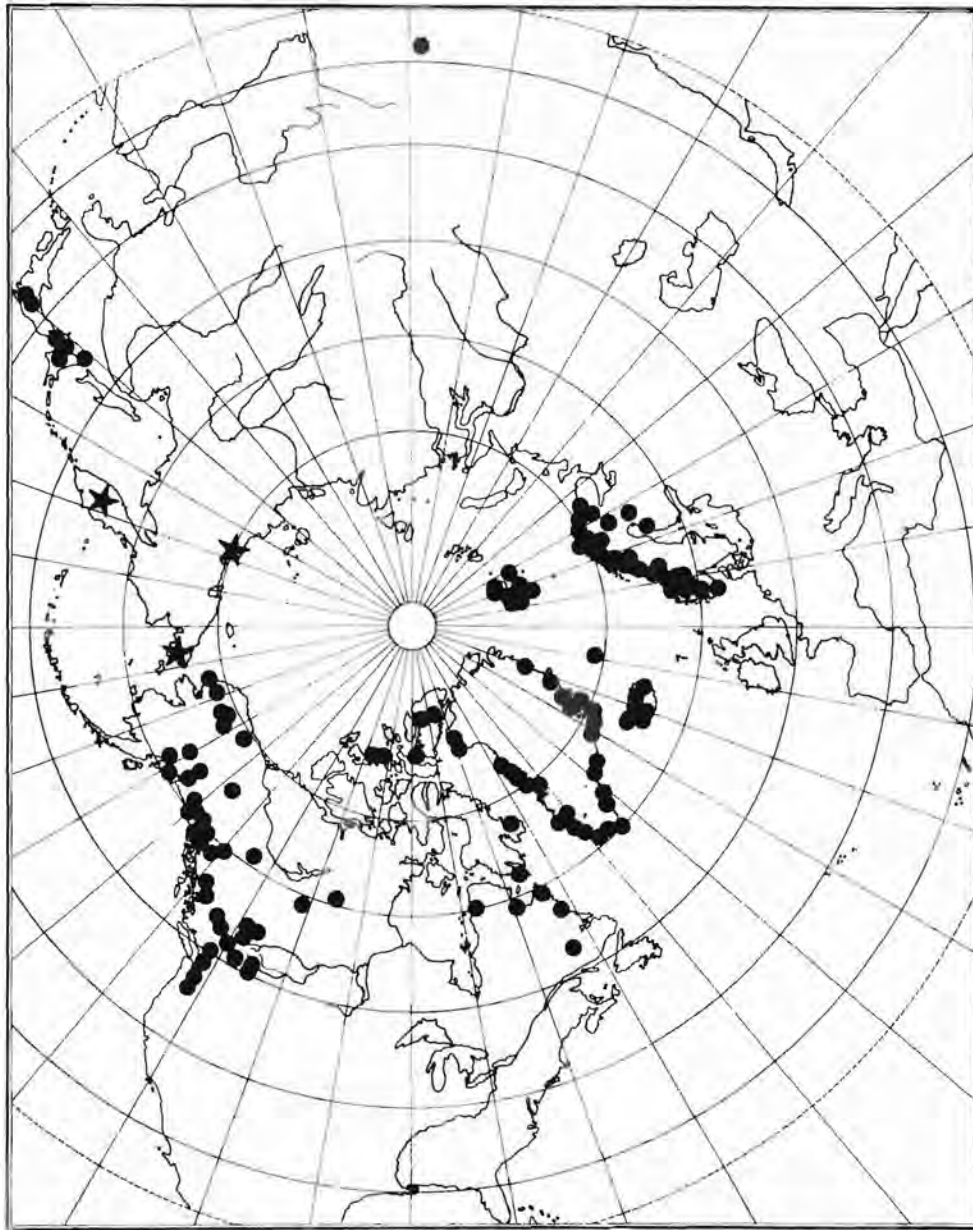


Fig. 40. Distribution of *Racomitrium canescens* subsp. *latifolium* based on herbarium specimens. ● ordinary station, ★ locality inexact.

& Kearney 99 (TRH); Brooks Range, Lake Peters - Lake Schrader, 69°20'N, 145°W, Steere, Mårtensson & Holmen 60-1094 (UBC); Bering Strait Distr., Ogotoruk Creek Drainage, 60°05'-12'N, 165°32'-47'W, 20.VI.1959 Johnson, Viereck & Melchior (ALA). - CANADA, British Columbia: Mt. Matier, trail foll. 3 lakes, E of Pemberton, Schofield 56808 (UBC); Cariboo District, Westpass Lake, Boas 410 (UBC); Elizabeth Mine, Lillooet area, 29.VII.1961 Dill (UBC); about 9 mi W of Wells, near Stanley, Schofield 38986 (UBC); Birch Mt., Teresa Isl., Atlin Lake, NW slope of N. Knoll, 59°N, 133°W, Buttrick 50 (UBC); Fairmont hot springs, on Hwy. 95 along Fairmont Creek, just E of hot springs resort, Vitt 18152 (UBC); Bulkey Range, Boas 683 (UBC); near Continental Divide on Banff - Windermere Highway, Kootenay National Park, Crum 3415 (WTU). - Alberta: Mt. Edit Cavell, 18 mi by road SW of Jasper, near base of Angel Glacier, Crum 3667 (WTU); Banff National Park, Consolation Lake, 3.VII.1937 Bjorkman (WTU); Jasper National Park, Signal Mountains, Ostafichuk 451-24 (ALTA); Richardson Lake area in NE Alberta, Maurene Stick s.n. (ALTA); Mountain Park area, just N of Cardinal River divide, 12.4 mi S of Cadomin, Vitt 10884 (ALTA). - YUKON: Kluane National Park, NW end of Bates Lake, Douglas 5796 (ALTA); Gribbles gulch at mile post 120 on Haines Hwy., 60°18'N, 137°00'W, Vitt 12742 (ALTA); Dezadeash area, E sloping face of Mtn. to W of Lake, 60°26'N, 137°07'W, Vitt 12692 (ALTA); Mt. to W of Dempster Hw. at mile post 39.9, 64°28'N, 138°15'W, Vitt 7938 (ALTA). - North West Territories: Eastern Great Slave Lake Region, 60°57'N, 105°31'W, Johnson, Harris & Traynor 878 (ALTA); Mackenzie Mtns., Liard Range, SE ridge of Mtn. at 4990 ft., NW of Sawmill Mtn., 60°54'N, 123°57'W, Horton 10768 (ALTA); Broughton Island, vicinity of settlement, 67°33'N, 64°02'W, Fife 1556 (NFLD); Melville Isl., 7 mi NW of King Point, 75°28'N, 105°55'W, Steen S-154 (ALTA); Bathurs Island, 3 mi NW of Graham Moore Bay, 75°35'N, 102°25'W, Steen S-435 (ALTA); Baffin Isl., Perry Bay, Meta Incognita Pen., 61°58'N, 66°30'W, Fife 1276 (NFLD); Ellesmere Isl., Kong Oscars Land, Gaasefjord, 76°50'N, Simmons 3371 (O); Van Hauen Pass, 81°07'N, 86°55'W, Brassard 2867 (ALTA, NFLD); head of Tanquary Fiord, 81°25'N, 76°55'W, Brassard 3152 (NFLD). - Labrador: Churchill Falls, Bridge Camp area, 53°36'N, 64°19'W, Brassard 5392 (NFLD); 6510 (ALTA, NFLD); Noodleook Fiord, 59°55'-56'N, 64°22'-23'W, Weber 1511 (ALTA, NFLD); NW corner of Tasisuak Lake, 56°39'N, 63°07'W, Hancock 1107, 1117 (NFLD); - Quebec: Nouveau-Quebec, environs de Puvirnituk (= Povungnituk), Bournierias 704406 (H); near Tasiuq, Leaf Basin area, SW coast of Ungava Bay, 58°40'N, 69°59'W, MacInnes 5282 (NFLD). - GRØNLAND. Julianehåb distr., Pamiagdlok, Anordliuitsok, 60°04'N, 44°16'W, Jacobsen 8008 (C); Kangerdluarssuk, 61°06'N, 46°12'W, Milan Petersen 46 (C); Nigerdleq, 62°04'N, 49°20'W, Bolt Jørgensen & Larsson 66-1775 (C); Jensens Nunataker, Hornblenderyggen, 31.VII.-7.VIII.1967 Gjærevoll & Ryvarden (C); Godthåb distr., Ameragdla, 64°15'N, 50°12'W, Lewinsky 73-22 (C); N coast of Kangiussaq at the inner sharp end of the Evighetsfjord, 65°53'N, 52°15'W, 4.VII.1958 Holmen (C); head of Søndre Strømfjord, 67°00'N, 50°40'W, Holmen 69-189 (C); Disko Island, Taserarssuk, 69°21'N, 52°58'W, Harmsen 216 (C); Svartenhuk Pen., Umiarfik Fjord, 71°58'N, 54°45'W, Holmen 12328 (C); Upernivik Isl., Inukavsait Fjord, Niagornanguaq, 72°20'N, 52°24'W, Jacobsen 14991 (C); Thule, 76°30'N, 68°45'W, IX.1954 Fristrup (C); Red Cliff Pen., 77°40'N, 69°30'W, 18.IX.1954 Fristrup (C); Skjoldungen distr., Itivdlerssuaq, Lange næs, 63°23'N, 41°24'W, Lewinsky 70-475 (C); Angmagssalik distr., Isertoq, 65°39'N, 38°24'W, Lewinsky 71-637 (C); Kangerdlugssuaq distr., Mikis Fjord, 68°10'N, 31°32'W, Lewinsky 71-600 (C); Jameson Land, Kap Steward, 70°26'N, 22°40'W, 1.VIII.1951 Andersen (C); Nathorst Land, T-Sø, 72°52'N, 25°05'W, Holmen 18813

(C); Payers Land, Tyrolerfjord, 74°37'N, ca. 22°W, VIII.1948 Brock (C); Germania Land, Mørkefjord, Rypefjell, 76°56'N, 20°18'W, 15.VIII.1939 Gelting (C). - ICELAND. Reykjavik, 1.VI.1809 Hesselbo (C); Geysir, 15.VII.1948 Holmen (C); Bildudalur, VI.1883 Hansen (C); Halsakofi, N of Vatna Jökul, Davidsson 87 (C); Akureyri, W for kollegiet "Edda", 5.VII.1971 Pedersen (C); Langorvatn, 26.VII.1951 Grøntvedt (C). - FINLAND. Om., Jakobstad, Fäboda, sanddyn, 16.IX.1914 Arvonen (H); Ok., Kajaani, 23.IX.1956 Ahti (H); PP, Kemijärvi, 30.VII.1964 Suominen (H); EnL., Enontekiö, Vuontisjärvi, Vitikainen 3088 (H); Li., Utsjoki, Kevo, 13.VII.1966 Heinonen (H). - SWEDEN. Lule L., regio Sarjekensis, alpe Pärtefjäll, 16.IX.1902 Jensen & Arnell (UPS); Torne L., Jukkasjärvi sn., Kuåtotjåkko-området, Allesvagge, VIII.1945 Mårtensson (UPS); Karesuando sn., Pältsa-området, vid Pältsastugan, 25.VII.1948 Mårtensson (UPS). - USSR. Lapponia murmanica: Peninsula piscatorum, Tsip novolok, VII.1885 Brotherus (H); ad fl. Voronja, 7.VII.1887 Brotherus (H); ad fl. Olanka, 13.VII.1887 Brotherus (H). Siberia: Regio Jakutsk, distr. Kolymask, 1905 Schulga (H). Kamchatka: Cantschatka centr., Avgudakällan, 1926 Malaise (H); Kupferinsel, s.a. Dybovski, distr. Rehman (H); in montibus ad fl. Ananna, 30.VIII.1926 Malaise (H); Kamtschatka, s.a. Nelson (BM). Chukotka, 3.VIII.1976 Abramova (O). - SIKKIM. 12000 ft., Hooker 306 (BM). - JAPAN. Honshu: Mt. Fuji, VIII.1909 Gono (H). - Hokkaido: Yezo, Iburi, Mt. Tarumai, 20.V.1921 Takenaki (H); Prov. Soya, Isl. Rishiri, summit of Mt. Rishiri, 10.VIII.1954 Hasegawa (H).

8. *Racomitrium panschii* (C. Müll.) Kindb. - Fig. 7 A, 14 C, 16 d, 17 c, 19 e-g, j; 20 C-D, 41, 43, 47 B, 48 C

Grimmia (*Dryptodon*) *panschii* C. Müll., Zweite Deutsch. Nordpolexp., 1869-1870 Kapt. Koldewey 2: 72. 1874 ('Panschii'). - *Racomitrium panschii* (C. Müll.) Kindb., Eur. N. Am. Bryin. 2: 236. 1898 ('1897'). - Type: Grønland or., Sabine Island, [74°30'N, 19°00'E, VI.-VII.1870] A. Pansch, com. C. Müller 1890 (S, lectotype nov. - Fig. 17 c, 19 e-f, 48 C).

Grimmia **ericoides* (Brid.) Lindb. var. *robusta* Lindb. et H.W. Arn. in H.W. Arn., K. Svensk. Vet.-Akad. Handl. 23(10): 101. 1890. - *Racomitrium canescens* (Hedw.) Brid. var. *robustum* (Lindb. et H.W. Arn. in H.W. Arn.) Par., Ind. Bryol. 1072. 1898. - Type: Siberia, Jenisei, Dudinka, 69° 35' n.lat., på den torra tundran, 30.VII.1876 H. Wilh. Arnell no. 247a (UPS-Herb. H.W. Arnell, lectotype nov., isolectotype; H-SOL, isolectotype - Fig. 47 B); Tolstoinos, 70°10' n.l., 30.VIII.1876 H. Wilh. Arnell no. 247b (H-SOL, UPS, syntypes).

Stem (2)4-5(11) cm, brownish or blackish except for the uppermost 2-10 mm which are olive-coloured or sometimes green, little branched, often unbranched or rarely pinnately branched, the branchlets frequently forming new main stems, easily breaking off.

Leaves (Fig. 14 C, 41 a) to 2.8 mm but often much shorter, imbricate and closely appressed when dry, erect-spreading when moist, usually not flexuose, ovate-lanceolate to (sub-)elliptical, gradually tapering towards apex, obtusely keeled in upper part, slightly plicate; margin broadly recurved from base to apex; costa in most leaves forked or branched, reaching to 1/2-3/4 the length of the leaf; alar cells (Fig. 16 d, 17 c) of 2-4 cell rows, a few marginal cells above the alar cells esinuose, to 10(-20) esinuose cells in the marginal row including alar cells, marginal alar cells often rounded and inflated; basal leaf cells (Fig. 41 d) elongate (45-70 x 4.5-6.5 μ m), papillose with large (\pm 5 μ m broad) papillae except for the basal 2-4 cell rows which are often epapillose, middle and upper laminal cells (Fig. 41 b-c) mostly rectangular (15-25 x 7-12 μ m), distinctly papillose; hairpoint often short and broad (Fig. 19 e-f, j) but sometimes long and narrow (Fig. 19 g), usually not strongly flexuose, mostly directed towards the apex of the stem, irregularly denticulate and/or spinulose, papillose to slightly papillose in lower half, epapillose or nearly epapillose in upper half, back of hairpoint in lower half with narrow and irregularly arranged papillae.

Inner perichaetial leaves in pilose specimens with short or no hyaline point, acute to obtuse, crenulate-dentate in upper part; costa mostly unbranched. Spores 9-12 μ m (only one coll. with capsules known).

Nomenclature and typification

The located type material of *Racomitrium panschii* is very sparse (see p. 165f.); according to Buchenau and Focke (1874) it was probably collected in June or July 1870. The taxon has previously been reported as *Grimmia* or *Racomitrium panschii* only from the type locality. It has rarely been referred to in the literature; the original description and diagnosis was repeated by Lange and Jensen (1887), and the taxon was listed in Index Bryologicus (Paris 1905) and Index Muscorum (Wijk et al. 1967). Müller (1874) compared the new taxon with [*Racomitrium*] *aciculare* (Hedw.) Brid. and robust [*Schistidium*] *apocarpum* (Hedw.) Bruch et Schimp. in B.S.G., but Kindberg (1898) placed it in *Racomitrium* 2. *Canescentia* [*Racomitrium* sect. *Racomitrium*] together with "*R. canescens* Weis., \star *R. subfasciculare*

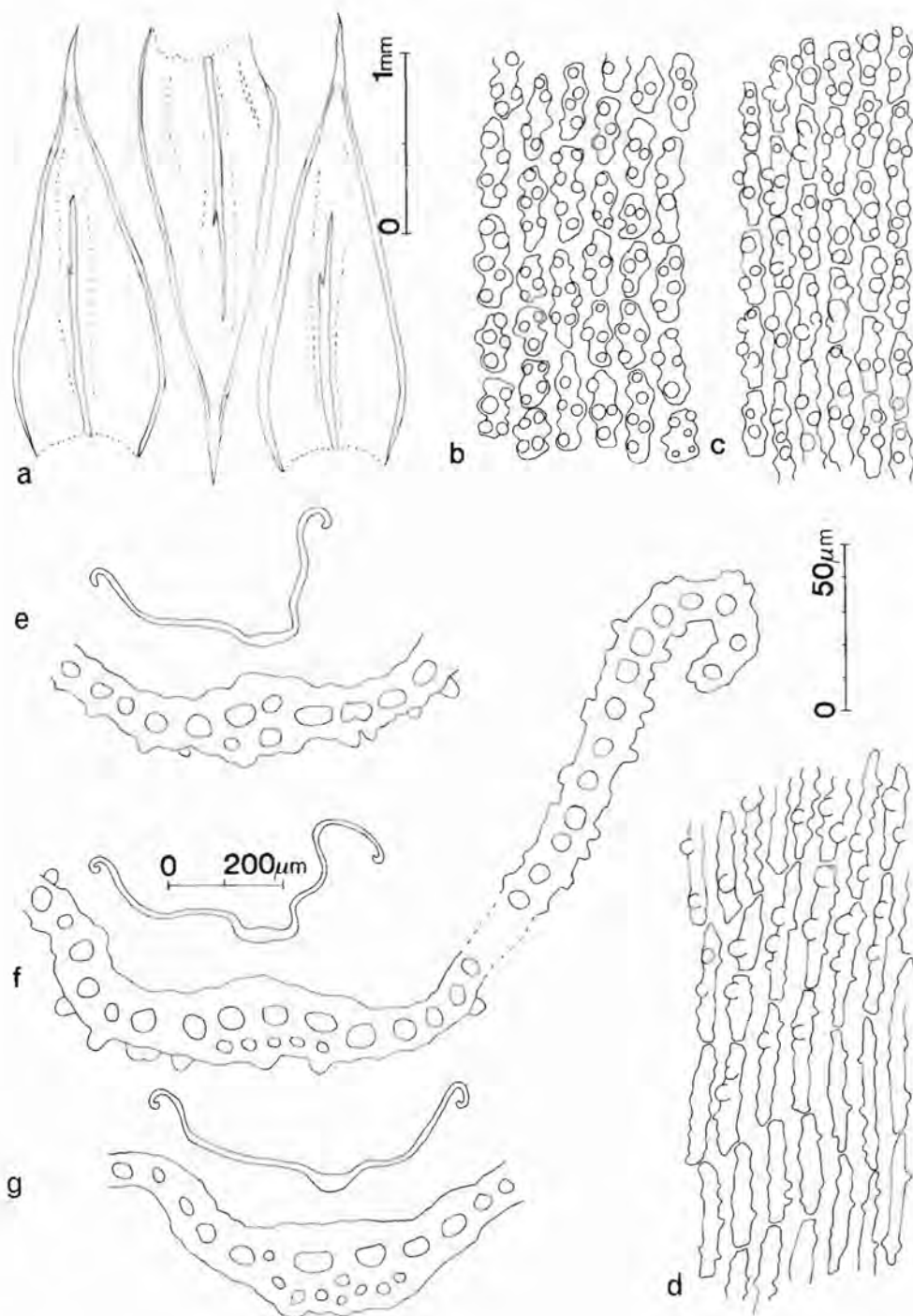


Fig. 41. *Racomitrium panschii*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. - Norway: Svalbard, Kongressfjellet S, 17. VIII.1973 Frisvoll (TRH). Mixed stand between *R. panschii* and *R. canescens* subsp. *latifolium*, cf. Fig. 42.

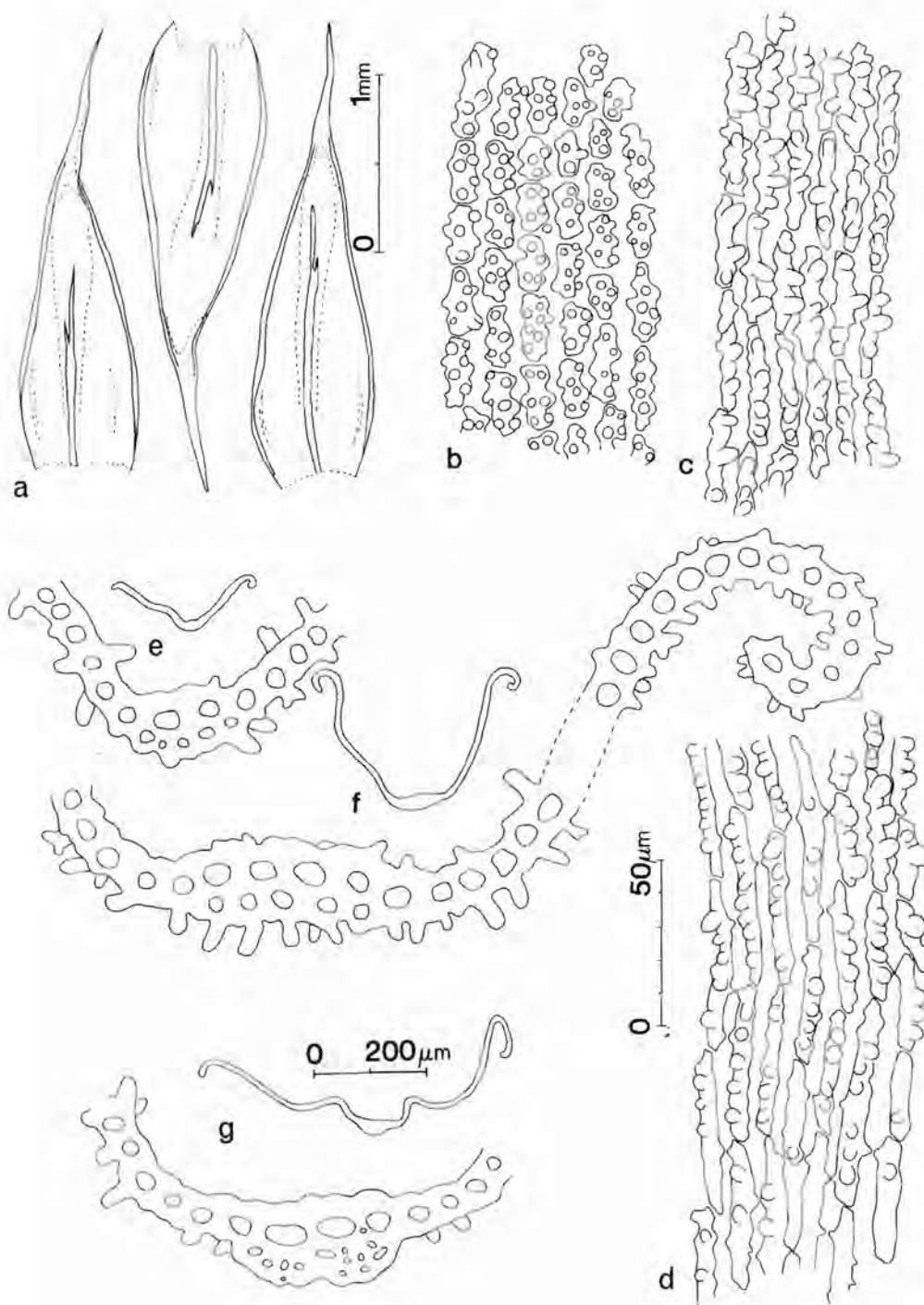


Fig. 42. *Racomitrium canescens* subsp. *latifolium*. a. Leaves. b-d. Cells from the upper, lower middle, and central basal part of the leaf. e-g. Cross sections from the upper, middle and basal part of the leaf. - Frisvoll 17.VIII.1973 (TRH), cf. Fig. 41.

Kindb. n. subsp., and **R. muticum* Kindb." From Müller's (1874) description and diagnosis it is impossible to deduce that *Grimmia panschii* belongs to the *Racomitrium canescens* group. But the 'diagnosis' given by Kindberg (1898) is adequate: "Differs from *R. canescens*: Leaves subovate obtuse with very short acumen without hairpoint or faintly hyaline at apex, faintly papillose. Tufts low blackish ... Stem without nodose branches" (my italics). The characters of leaves and hairpoint exclude *R. canescens*, and the description of the stem excludes *R. ericoides*.

I have not been able to verify that the botanical part in "Die Zweite Deutsche Nordpolarfahrt ..." (See Müller 1874) was published in 1873 as stated by Wijk et al. (1969); the year 1874 is printed on the title page of the complete edition, and is used here.

Taxonomical notes

1. *Racomitrium panschii* is usually less robust than *R. canescens* subsp. *canescens*, and the leaves are not falcate as in that taxon. Both taxa mostly have slightly flexuose hairpoint, but the point of *R. canescens* subsp. *canescens* is much more papillose and embraces a greater part of the upper leaf lamina. The shape of the leaves of *R. panschii* is probably slightly more similar to *R. canescens* subsp. *canescens* than to subsp. *latifolium*, and especially *R. canescens* subsp. *canescens* mod. *brevipilum-vel-epilosum* and *R. panschii* may be very similar. Therefore, *R. panschii* is probably more closely related to *R. canescens* subsp. *canescens* than to subsp. *latifolium*. The distribution areas of *R. panschii* and *R. canescens* subsp. *canescens* hardly overlap, but they perhaps grow together in the Altai region, Siberia.

2. *Racomitrium canescens* subsp. *latifolium* and *R. panschii* often grow together (Fig. 41-42); they may look similar, but there are a number of constant differences between them, in the colour of the cushions and plants, the branching habit, and the structure of the leaves including cells, hairpoint and papillae (see Frisvoll 1983 a).

3. The leaves in two specimens labelled "Regio Amur, Zei, (1) fl. Avalakan, 1911 Kuseneva" (H), and (2) "ad loc. Oksion, 1911 Kuseneva" (H) are flexuose and slightly plicate and have long flexuose

hairpoint, and the plants are highly and irregularly ramified. The cells in the whole leaf are long, incrassate and distinctly porose, and there is a border of up to 25 esinuose and elongate cells at the basal margin including marginal alar cells. These specimens are close to *R. panschii*. I have seen a typical *strictum* modification of *R. panschii* labelled "Regio Amurensis, Zei, 1911 Krikidoroff" (H), and typical pilose material from "Amur, reg. fl. Seja, Tukuringra in monte inter fl. Giljin et fl. Rakinda, 1915 Kuseneva" (H). More material from the district is needed in order to establish the status of the aberrant plant; it may be genetically distinct.

Ecology

Racomitrium panschii is a plant of the northern tundra where it grows in a wide range of habitats (Frisvoll 1983 a). In SE Siberia it grows "in sylva mixta" according to some labels.

Distribution (Fig. 43)

Racomitrium panschii has a circumpolar, mainly arctic distribution. It is not present in the large herbarium material of *R. canescens* coll. from Norway, but it may occur in northern Scandinavia. One specimen labelled "[E. Germany] Thüringen, bei Ruhla, 19.V.1902 Krieger" (JE) is typical *R. panschii* mod. *subpinnatum-brevipilum*; it is inter alia mixed with *Kiaeria glacialis* (Berggr.) Hag. *Kiaeria glacialis* does not occur in Central Europe (Mönkemeyer 1927), and I consider that a confusion has been made with arctic material. - Southernmost locality, USSR: Siberia, reg. Transbaikalis, monte Ssochondo [Sokhondo], ca. 49°57'N (two unlocalized stations in the Altai mountains may be from the same or from marginally more southern latitudes); northernmost locality, Greenland: Peary Land, Sverdrup Isl., Mascaret Inlet, 83°00'N.

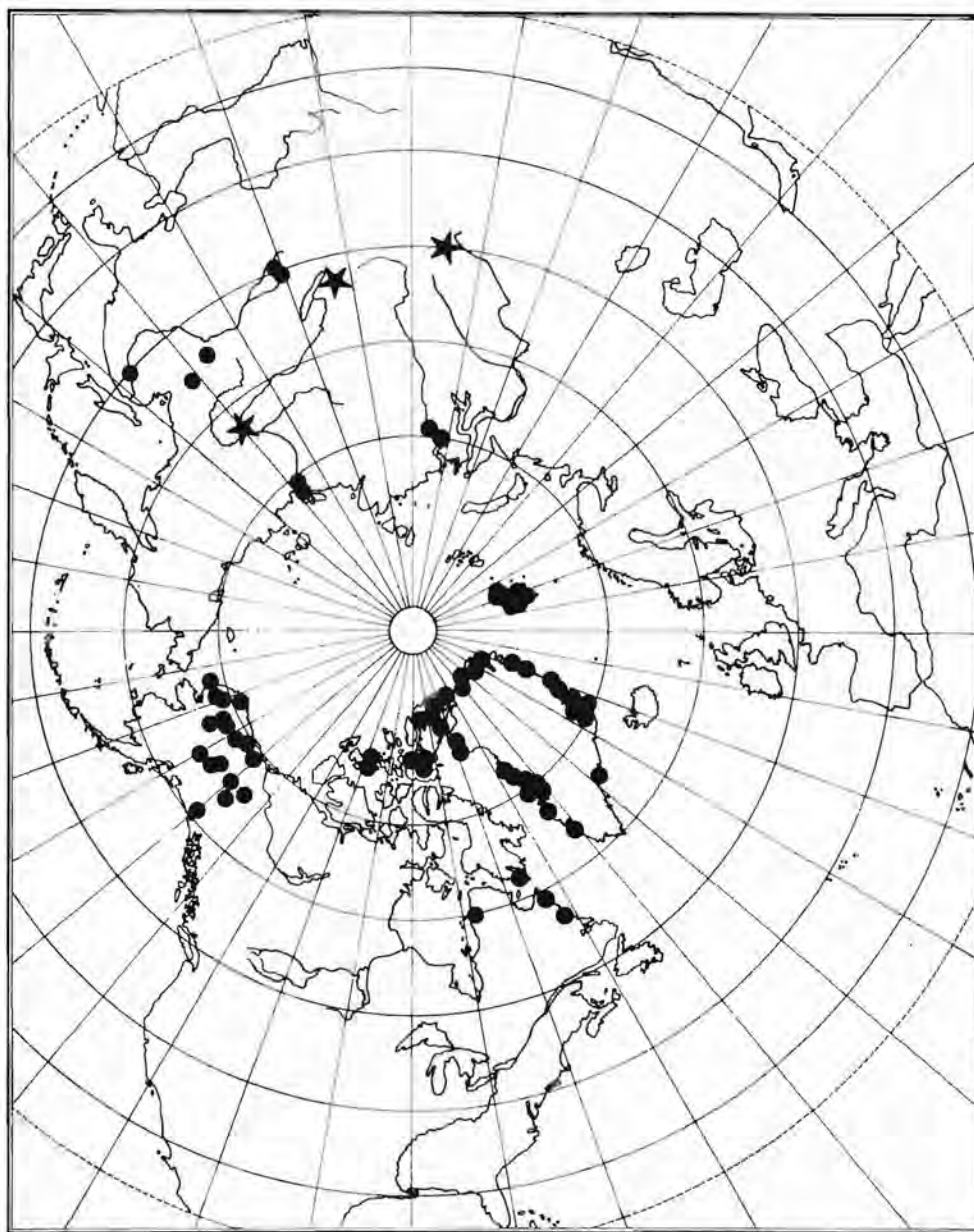


Fig. 43. Distribution of *Racomitrium panschii* based on herbarium specimens. ● ordinary station, ★ locality inexact.

Localities of *R. panschii* (see also "Mixed stands")

USA, Alaska: Big Delta Quad., Chena River 45 mi E of Fairbanks, 64° 52'N, 146°44'W, Viereck 7846 (ALA, cfr.); Central River District, Circle Quadrangle, Banks of Eagle Creek, Berry Camp, 104 mi NE of Fairbanks, Hermann 21012 (H); Survey Pass Quad., Alatna River, "Hedwaters Lake", 67°53'N, 155°05'W, Murray 5202, 5425, 6323 (ALA); in vicinity of Ogotoruk Creek and its mouth, south of Cape Thompson, Chukchi Sea, near southwest end of Brooks Range, 68°07'N, 165°55'W, Steere 63-498 (ALA); southwest end of Chandler Lake, Endicott Mountains, Brooks Range, 68°12'N, 152°47'W, Steere 17844, 18347, 18582 (ALA), 18557 (ALA, UBC); Killick River Quad., Kurupa Lake, 68°22'N, 154°39'W, Murray 5912A (ALA); Philip Smith Mountain Quad., Yukon River - Prudhoe Bay Haul Road, Mi 220, just E of Galbraith L., 68°30'N, 149°25'W, Murray 77-458 (ALA); in vicinity of Noluck Lake, northern slope of De Long Mountains, Brooks Range, 68°47'N, 160°W, Steere 63-316 (ALA); Driftwood Camp, near headwaters of Utukok River, north slope of De Long Mountains, Brooks Range, 68°53'N, 161°10'W, Smith A119 (ALA); Brooks Range, Peters Lake, 69°19'N, 145°03'W, 27.VII.1960 Steere, Holmen & Mårtensson (O, Bry. Arct. Exsicc. 86); Meade River Post (Coal Mine) and vicinity, 70°57'N, 157°27'W, Crum 20265 (ALA). - CANADA, Yukon: St. Elias Mts., Steele Glacier and vic., Hazard valley, D. & B. Murray 2481 (ALA); Mt. Klotz, at headwater of Ogilvie River, 65°21'N, 140°05'W, Vitt 7625 (ALTA); Tombstone Mt. area, in cirque basin with two tarn lakes 6.5 mi NE of Tombstone Mt., 64°29'N, 138°33'W, Vitt 10679 (ALTA); Southern Richardson Mts., "Le-nense" Lake, 2 mi E of Doll Creek, 66°03'N, 135°38'W to 66°22'N, 135°34'W, Horton 6046 (ALTA), Vitt 16414 (ALTA); British Mts., ca. 10 km E of Yukon - Alaska boundary, NW of Firth river, 69°06'N, 140°45'W, Vitt 18634 (ALTA). - Labrador: Vicinity of NW shore of Tasisuak Lake, 56°39'N, 63°08'W, Hancock 1063 (NFLD); Fraser River, ca. 5 km W of head of Tasisuak Lake, 56°40'N, 63°15'W, Hancock 1177 (NFLD); Tasiuyak Arm of Nachvak Fiord, rocks along Nackvak River, 59°02'N, 64°03'-04'W, Weber 1618 (ALTA, H, NFLD). - Quebec: Nouveau-Quebec, environs de Puvirnituq (= Povungnituk), Bournierias 704417 (H). - North West Territories. Baffin Island: Perry Bay, Meta Incognita Pen., 61°58'N, 66°30'W, Fife 1135 (NFLD). - Melville Island: Bailey Point, Parker 66a, 67h (NFLD); 75°52'N, 108°53'W, 1.IV.1974 Parker (NFLD); W side of Bridgeport Inlet, 75°03'N, 108°56'W, Maddison & Steen 1707 (ALTA); ab. 11 km NW of Bridgeport Inlet, 75°09'N, 109°03'W, Maddison & Steen 1731 (ALTA). - Devon Island: Trulove lowland, 75°40'N, 84°40'W, Peterson 2521 (ALTA), Vitt 5369, 6995 (ALTA), 6711 (ALA, ALTA), Pakarinen 238 (ALTA, H); Scogan lowland, W end of lowland, 75°43'N, 84°22'W, Vitt 6593, 7117 (ALTA), cliffs E of waterfall on S side of lowland, 75°45'N, 84°02'W, Vitt 6581, 6977, 6978, 7121 (ALTA). - North Kent Island, ca. 76°50'N, VII.1901 Simmons (O). - Ellesmere Island: Kong Oscars Land, Gaasefjord, 76°30'N, VIII.1901 Simmons (O); Havnefjord, 76°30'N, VIII.1900 Simmons (O); Isachsens Fjord, ca. 78°N, VI.1899 Isachsen (O); Bedford Pim Isl., 78°40'N, VII.1899 and 24.VII.1899 Simmons (O); Framshavn, 78°45'N, VI.1899 Simmons (O); Eskimopolis, 78°45'N, VI.1899 Simmons (O); - Van Hauen Pass, ca. 81°07'N, 86°55'W, Otto Fd. Camp, Brassard 2767 (NFLD); N end of Van Hauen Pass, Longton 1456 (NFLD); head of Tanquary Fiord, 81°25'N, 76°55'W, Brassard 3059, 3096, 3289, 3326 (ALTA, H, NFLD); vicinity of Hazen Camp, N shore of Lake Hazen, ca. 81°49'N, 71°18'W, Mt. Umingmak, Longton 2102 (NFLD); do., Mt. McGill, Longton 1934, 1997 (NFLD); vicinity of Alert weather station, 82°30'N, 62°20'W, Brassard

8191, 8203 (NFLD); do, shoulder of Dean mountain, Brassard 8167 (H, NFLD), 8203 (H). - GREENLAND W: Alangordlia, 63°39'N, 50°43'W, VIII. 1956 Fabritius (C); Søndre Strømfjord, Itivdlinguaq, Holmen 3184, 3186 (C); head of Søndre Strømfjord, 67°N, Holmen 4116, 4137c, 4353f (C); Arveprinsens Ejland, Ivnaq, 69°48'N, 51°14'W, Holmen & Mogensen 71-1068 (C); head of Kangerdluarssuk Fjord, Esersutilik, 71°17'N, 51°32'W, Holmen 13824, 16600 (C); Kangerdluarssuk Fjord, Kangerdlugs-suakavsak, 71°22'N, 51°40'W, Holmen 14820a (C); Claushavn, 1870 Berggren (H, TRH); Jakobshavn, 69°13'N, 51°06'W, Holmen 15957 (C); Pakitsoq, Berggrens Havn, 69°31'N, 50°45'W, Holmen & Mogensen 71-2028 (C); Disko Fjord, Kangerdluarssuk, 69°30'N, 53°33'W, Holmen 14115, 14461 (C); Diskofjord, Egalunguit Itivnerit, 69°32'N, 53°40'W, Porsild 2638 (C), - Disko Island: Blæsedal, Harmsen 51 (C); Skarvefjeld, 2.VII.1898 Porsild (C); Unartuarssuks, 15.-16.VII.1898 Pedersen (C); Qutdligssat, 70°05'N, 53°W, Holmen 16512 (C); Godhavn, 69°15'N, 53°33'W, Holmen 14013, 14382 (C), Holmen & Mogensen 71-284 (C), 19. VII.1898 Simmons (H), Steere 62-102 (C); Kekertak, [69°31'N, 54°15'W], 14.IX.1886 coll. ignot. (C); Taserarssuk, 69°21'N, 52°58'W, Harmsen 216 (C). - Nugssuaq Pen.: Itipilua, 70°19'N, 50°33'W, Jacobsen 725 (C); Itipilua qaga, 70°20'N, 50°40'W, Jacobsen 697, 715 (C); Taserarssuaq, 70°20'N, 52°00'W, Holmen 16249 (C); Auvfarssuaq Dal, Tasingortarssua, 70°27'N, 52°40'W, Holmen 12422, 12493 (C); Agatdal, højsletten mellem Jeepkløft og Rundetårn, 23.VIII.1958 Rosenkrantz (C); Agatdal ved Sill Sø, 70°35'N, 53°07'W, 12.VIII.1954 Rosenkrantz (C); Sarfarfik, Qapiortoq kitdleg, 70°40'N, 52°27'W, Jacobsen 661 (C); Nugssuaq, 70°41'N, 54°36'W, Holmen 15640 (C); Kutsiaq, 70°41'N, 52°30'W, Jacobsen 739 (C); Kangilia, 70°45'N, 53°26'W, Holmen 8007 (C), Jacobsen 442 (C); Ikorfat, 70°45'N, 53°07'W, Jacobsen 322 (C); Qernertuarssuit, 70°50'N, 54°05'W, Jacobsen 586 (C). - Umanak Fjord, Ququgdlugssuit, 70°46'N, 51°17'W, Holmen & Mogensen 71-1604 (C); Agpat, 70°57'N, 51°55'W, Holmen & Mogensen 71-1680 (C). - Qioqe Pen., Kangerdluarssuk Fjord, Qagortokavsak, 71°12'N, 52°12'W, Holmen 12792, 12805 (C); Kangerdluarssuk Fjord, Qeqertag Isl., 71°18'N, 51°46'W, Holmen 12827 (C); Akuliaruseq, 71°20'N, 51°37'W, Holmen 12554, 12679 (C); Inukavsait Fjord, 71°19'N, 52°16'W, Holmen 12723, 12731, 16299 (C); do., Sagliaruseq, 71°19'N, 52°16'W, Holmen 13121 (C). - Uperviik Isl.: Uperviik Næs, 71°11'N, 53°03'W, Holmen 16815 (C); Inukavsait Fjord, Niaqornanguaq, 72°20'N, 52°24'W, Holmen 14933 (C). - Svarthuk Pen.: Aputitupqagai, VI.1949 Berg (C); Uvdlisaut, 71°26'N, 54°02'W, Holmen 10172 (C); Itsako, 71°39'N, 53°50'W, Holmen 10353 (C); Umiarfik Fjord, 71°58'N, 54°45'W, Jacobsen 16637, 17218 (C); Umiarfik Fjord, Amitsog, 71°49'N, 55°25'W, Holmen 12012 (C); Umiarfik, Simiutap kua, 71°59'N, 54°40'W, Schuster & Damsholt 66-1610, 66-1627, 66-1631 (C); Umiarfik Fjord, Qornoq, 72°02'N, 54°40'W, Holmen 13072 (C). - Bunden af Kangerdlugssuak, [73°43'N, 55°33'W], 18.IX.1886 Ryders Exped. (C). - Uvdle, Wolstenholme Fjord, Thule District, 76°35'N, 68°25'W, Seidenfaden UW 116 (C); Thule distr., Carey Isl., VIII.1956 Fristrup (C); Kangerdlugssuak, S side of Inglefield Bay near Academy Bugt, 77°23'N, 67°W, Schuster 45849, 45981a (C); Kanak [= Qanaq = Thule, 77°28'N, 69°12'W], Schuster 45468 (C); Kangerdluarsuk (Igdlorssuit), W side of Bowdoin Bugt, 77°33'N, 68°35'W, Schuster 45792 (C). - GREENLAND E: Angmagssalik distr., Qigertivaq, 66°06'N, 37°13'W, Holmen 69-620 (C); Liverpool Land, Hvalrosbugt, 70°30'N, 21°58'W, 22.VII.1951 Andersen (C); Runde Fjeld, [70°32'N, 28°37'W], 12.V.1892 Hartz (C). - Scoresby Sund: Gåseland, Faxe Sø, 70°15'N, 29°W, Holmen 19091, 19492 (C); Gaasefjord [70°12'N, 27°00'W], 2.VII. 1892 Hartz (C); Hekla Havn (Elvdal), [70°27'N, 26°16'W], 12. VIII. and 17.IX.1891 Hartz (C); Havnen, 18.VIII.1924 Hagerup (C); Hurry

Inlet, [70°53'N, 22°30'W], 7.VIII. and 30.VIII.1899 Dusén (C); Rypefjord SW coast, 71°02'N, 27°45'W, Holmen 19022 (C); Nordvestfjord, NW Renland, NE side of Point 1340 on SW side of Edward Bay, 71°27'N, 27°21'W, Halliday B41b/71 (C); Charcots Land, 71°54'N, 29°W, Holmen 18390, 19140, 19151, 19440, 19582 (C); Mestervig, Noret, 72°14'N, 23°55'W, Holmen 18541 (C); Nathorst Land, T-Sø, 72°52'N, 25°05'W, Holmen 18679, 18697, 19190 (C). - Traill Isl., at Vega Sund, 72°45'N, 23°W, Sørensen 219 (C); Geographical Society Isl., 72°44'N, 22°30'W, Holmen 18113, 18123 (C); Kap Franklin, [73°15'N, 22°15'W], 30.VIII.1899 Dusén (C); Hold ved Hope, 20.VII.1891 Hartz (C); Hold ved Hope, S coast, 73°21'N, 21°03'W, Sørensen 42 (C); Holland Island, 73°36'N, 20°20'N, Sørensen 6 (C). - Clavering Ø: Eskimonæs, 74°06'N, 21°20'W, 25.VI.1932 Gelting (C); Dødemandsbugten, 74°07'N, 21°W, Holmen 4493 (C); Djævlekløften, 74°20'N, 20°30'W, Holmen 359 (C); Lerbugt, 74°25'N, Holmen 487e (C). - Payers Land, Revet, 74°22'N, 21°50'W, Holmen 5425 (C); Payers Land, Tyrolerfjord, 74°37'N, ca. 22°W, VIII.1948 Brock (C, H); Daneborg, 74°18'N, 20°12'W, Holmen 4602 (C). - Wollastone Foreland: 74°18'N, 20°12'W, Holmen 4541 (C); Mt. Zackenberg, 74°28'N, 20°35'W, 26.VII.1950 Holmen (ALTA, C, H); do., 74½°N, Holmen 511 (C); Mt. Aucella, 74½°N, 20°50'W, Holmen 5526 (C). - Kuhn Isl., Bastian Bay, 74°58'N, 20°02'W, 8.VIII.1933 Sørensen (C), Vestre Elv, [76°47'N, 18°50'W], 18.VII.1908 Lundager (C); Germania Land, Mørkefjord, Rypefjeld, 76°56'N, 20°18'W, 15.VIII.1939 Gelting (C); Norske Island, 79°12'N, 17°50'W, 15.VIII.1933 Seidenfaden (C). - GREENLAND N: Peary Land, 79°08'N, 14.VI.1907 Koch (C); Parker Snow Bay, VI.-VII.1916 Hovey (O); Kap May, 16.VII.1917 Wulff (C); S coast of Independence Fjord, Kap Glacier, 81°50'N, 32°30'W, Holmen 7106 (C, H, O); do., Saxifraga Dal, 81°51'N, 32°W, Holmen 6341, 7013 (C); Vildtlandets vestlige del (Navy Cliff Land), [81°35'N, 35°30'W], 3.VIII.1912 Freuchen (C); N coast of Independence Fjord, Kap Ejnar Mikkelsen, 81°56'N, 33°20'W, Holmen 7277 (C); do., Diabasholmene, 82°00'N, 32°40'W, Holmen 7899 (C); East Coast, Herlufsholm Strand northern part, 82°42'N, ca. 21°W, Troelsen 6970, 7663, 8557 (C); Sommerdalen [82°29'N, 49°30'W], 14.VII.1917 Wulff (C, II. Thule-Exp. Grønland. Nordkyst 1916-1918); I.P. Koch Fjord, Strømstedet, "Nya Chipp Inlet" [82°51'N, 44°45'W], 1916-1918 Wulff (C); Lemming Fjord, 82°55'N, 45°20'W, 16.VI.1917 Wulff (C); Sverdrup Isl., Mascaret Inlet, 83°00'N, 45°00'W, Ellitsgård 7990 (C). - USSR: Altai, Dschankantae in den Tschuja Alpen, 20.VIII.1915 Grano (H); Altai, Taraktai-jugum, 2.VIII.1909 Korsky (H); Jenisei, Dudinka, 69°35'N, 30.VII.1876 Arnell (UPS); Jenisei, Tolstoinos, 70°10'N, 30.VIII.1876 Arnell (UPS); reg. Irkutensis, distr. Chamar-Daban in valle fl. Utulika, prope Schubutjusk, 27.VII.1927 Smirnov (H); gub. Irkutsk, Tunka, in valle fl. Tunka, 11.VIII.1926 Smirnov (H); prov. Jakutsk, fl. Tuingra, 1909 Sokolov (H); prov. Jakutsk, in valle fl. Orlyk, 1909 Sokolov (H); Jakutsk, Jabloruj shrebet, fl. Udjuma, 24.VIII.1911 Kuseneva (H); in valle flum. Lena, Kumachsur, 70°30'N, 19.VII.1898 Nilsson-Ehle & Arnell (UPS); in valle fl. Lena, Bulkur, 28.VIII.1898 Nilsson-Ehle & Arnell (UPS); Lena Mündung, Tit Anj, 4.IX.1901 Cajander (H). - Reg. Transbaikalis: distr. Verchneudinskij, prope pag. "Jamarovka" in sylva mixta, 30.VI. and 5.VII.1912 Zolotuchina (H); with imm. sporo-phytes); prope fl. Jamarovka in sylva mixta, 11.VII.1904, Michno (H); am Jamarovkaflusse, VII.1903 Michno (H); distr. Akschinsk, prope fl. Rumyla, Goletz, 1913 Smirnov (H); mons Ssochondo, 28.VI.1913 Smirnov (H). - Regio Amur.: Zei, fl. Avalakan, 1.VIII.1911 Kuseneva (H); Zei, ad loc. Oksion, 14.VIII.1911 Kuseneva (H); fl. Seja, Tukuringra in monte inter fl. Giljin et fl. Rakinda, 18.VII.1915 Kuseneva (H); basin of river Zeya, route from astronomic point Vozdviženskoe to

the lake Toko in the Jakutsk distr., river Dzikatratra, 22.VII.1911 Prochorov & Kuzeneva (H; with imm. sporophytes); Zei, 30.VII.1911 Krikidoroff (H); bassin des Amurflusses am Kunguraflusse, 28.VII.1910 Kvaschum-Samain (H). - Reg. Primorskaja, in valle fl. Aldoma, 3.VII.1912 Sokolov (H). - NORWAY: Svalbard, many collections (Frisvoll 1983 a).

X. TAXA EXCLUDED FROM THE GROUP

1. *Racomitrium austro-canescens* Dus. 1907.
2. *Racomitrium canescens* (Timm ex Hedw.) Brid. subsp. *delamarei* Ren. et Card. in *Delamarei*, Ren. et Card. 1888.
3. *Racomitrium canescens* (Timm ex Hedw.) Brid. var. *lutescens* Lesq. et Jam. 1884.
4. *Racomitrium canescens* (Timm ex Hedw.) Brid. var. *yezo-alpinum* Sak. 1937.
5. *Racomitrium canescens* (Timm ex Hedw.) Brid. fo. *erythrophyllum* Sak. 1937.

For comments on these taxa, see below.

XI. AN ANNOTATED LIST OF THE BASIONYMS PROPOSED IN THE GROUP

Names in the *Racomitrium canescens* group have originally been referred to the three genera *Grimmia* Ehrh. ex Hedw., *Racomitrium* Brid. and **Trichostomum* Hedw. ex Hedw. nom. rejic. In the following list the fourteen specific epithets, viz. *austro-canescens*, *barbuloides*, *brevipes*, *canescens*, *consocians*, *elongatum*, *ericoides*, *iwasakii*, *japonicum*, *mollissimum*, *panschii*, *pygmaeum*, **subcanescens*, and *tortuloides*, have been arranged in alphabetical order without regard to the generic names. It is of interest to separate the forms assigned to *Racomitrium canescens* var. *ericoides*, and they have been listed alphabetically under the varietal epithet. Otherwise the epithets of subspecies, varieties and forms follow alphabetically and mixed under the respective species epithets. When type material has been studied this is described and commented on. Not validly published or illegitimate names are always marked with an * asterisk (cf. Wijk et al. 1959: XXVIII). A few taxa and new combinations were originally published with an asterisk to indicate a subspecific rank; in this paper this is indicated with an open ★ asterisk. The correct basio-

nym of the taxa as conceived in the present paper have been spaced out. The place and date of publication, the synonyms, and the origin of the type material are mentioned unless these facts are given under the respective epithets in the taxonomical part. It has proved difficult to establish the taxonomical identity of a name by means of the protologue only, and primarily only those taxa of which type material has been studied are cited in synonymy (Tab. 3). Exceptions are those taxa whose protologue (including figures and references) points out some important distinguishing characteristics (e.g. nerve structure); reference merely to branching habit and the length of the hyaline point has not been decisive for the interpretation of a taxon. A few names of which material named by the author (but not type material) has been studied, have been referred to a certain species (see p. 167f.). Of a total of 46 subordinate names, one variety and two forms were originally assigned to *R. ericoides* (as *Grimmia*); one variety was assigned to *R. barbuloides*, and one variety was assigned to *R. brevipes* which itself belongs to the *R. heterostichum* group; the other subordinate names were all assigned to *R. canescens* included var. *ericoides*.

Tab. 3. A survey of the number of valid and invalid names proposed in the *Racomitrium canescens* group, and of the corresponding types; illegitimate names such as var. *vulgare and fo. *eu-*ericoides* instead of var. *canescens* and fo. *ericoides* have not been included. Val.d. = Validly described. R.c. gr. = *Racomitrium canescens* group.

Names of	Names		Validly		*Nom.		Type located		Type not loc.		Excluded from R.c. gr.
	No.		described	inval.	Val.d.	*Nom.	Val.d.	*Nom.	Val.d.	*Nom.	
species	13	12	1	11	-	1	1	1	1	1	
subsp.	2	2	-	2	-	-	-	-	-	-	1
var.	24	17	7	11	-	6	7	2			
fo.	20	16	4	11	1	5	3	1			
Sum	59	47	12	35	1	12	11	5			
		(59)		36		23					
				(59)							

In the list there are six nomenclatural synonyms, viz. *R. canescens* fo. *epilosum*, *R. canescens* var. *ericoides* fo. **eu-ericoides*, *R. canescens* fo. **eu-canescens*, *R. canescens* var. *strictum*, *R. canescens* var. *strictum* fo. **eustrictum* and *R. canescens* fo. **vulgare*; the list also includes five references, viz. *R. canescens* var. *ericoides*, *R. canescens* var. *muticum*, *R. canescens* var. *robustum*, *Grimmia *ericoides* var. **canescens*, and *G. *ericoides* var. **canescens* fo. **epilosa*; the above names are not included in Tab. 3.

Racomitrium austro-canescens Dus., Ark. Bot. 6(10): 25. T. 5:12-15. 1907. - Type: [Argentina] Patagonia australis, In territ. Rio Chico, 1896-1897 J.B. Hatcher (S, holotype - Fig. 44 C). - Plants with the habit of strongly xeromorphous *R. lanuginosum* (Hedw.) Brid., up to 5 cm, very dense, much branched; main branches pinnately branched; leaves long and narrow (3.2 x 0.6 mm), gradually tapering towards a long, hyaline hairpoint; margin on one side recurved towards the hyaline apex, less recurved on the other side, sharply keeled to channelled from base to apex, slightly plicate; costa percurrent, simple and chlorophyllous from base to about $\frac{1}{2}$ the length of the hyaline point; leaf cells long and narrow (60 x 5 μ m) in basal half, shorter (20 x 6 μ m) in upper part, strongly incrassate, papillose in the whole leaf with low papillae; auricles absent, but 1 row of yellow, esinuose marginal cells extending as a border of approximately 30 cells up along the margin; point $\frac{1}{4}$ - $\frac{1}{2}$ the total leaf length, decurrent down margin of lamina, sharply dentate, teeth acute and pointing towards apex (not recurved as in *R. lanuginosum*), slightly papillose, the papillae of the point more distinct than the papillae of the chlorophyllous part of the leaf. - In the protologue it is stated that this taxon is close to *R. canescens*, a view held by all subsequent authors (see e.g. Brotherus 1924). But *R. austro-canescens* is different from species in the *R. canescens* group e.g. in the form of the leaves, and the structure of cells, auricles, costa, papillae, and hairpoint. It is principally similar to *R. lanuginosum* in all these features; but there are some differences which justify *R. austro-canescens* as a distinct taxon. The leaf point of *R. lanuginosum* is aptly described as erose-dentate (Nyholm 1956, Noguchi 1974) with teeth hooked with high papillae; the leaf cells are often said to be epapillose except at the hyaline point (e.g. Lawton 1971), but the cells, including cells at back of costa, are often papillose with low papillae. A collection labelled "Australia, New South Wales: Mount Kosciusko

State Park, Snowy Mountains; trail from Rawson Pass to Lake Cootapatamba, 6900 ft. alt., 23 March 1968 C.F. Yocom, W.A. Weber & D. McVean" (H; as *R. canescens*) exactly matches the type of *R. austro-canescens*, see also the description of *R. canescens* by Scott and Stone (1976). *Racomitrium austro-canescens* may be a southern hemisphere taxon in the *R. lanuginosum* group worthy of specific rank. It may be identical with *R. lanuginosum* var. *pruinsum* Wils. in Hook. f. 1854 = *R. pruinsum* (Wils in Hook. f.) C. Müll. 1869. The *R. lanuginosum* group may also be in need of a taxonomic revision.

RACOMITRIUM BARBULOIDES Card. 1908. - Lectotype (PC), isolectotype (H-BR, Fig. 17 d, 19 h, 46 C). - Plants about one cm, little branched; leaves contorted when dry, from fairly narrow base gradually tapering towards apex; margin narrowly recurved towards 1/2-2/3 the leaf length on one side, and flat or slightly recurved on the other side; costa simple and reaching towards apex; cells in basal 1/4-1/5 of the leaves elongate, very narrow and slightly papillose, in upper part short, wide and more papillose; auricles made up of ca. 5 rows of hyaline cells, supra-alar cells hyaline and elongate, marginal cell row including alar cells with about 25(-30) esinuose cells; hyaline point usually absent, but when present it is made up of 3-4 yellowish and papillose cells (mod. *subsimplex-subepilosum-vel-epilosum*). - This is the only name of a taxon which is common in Japan and its adjacent regions. The probable identity of the depauperate and (sub)epilose type material, and the luxurious phases of the taxon is discussed in the taxonomical section.

Racomitrium barbuloides var. *brevipilum* Dix. 1934. - Holotype (BM, Fig. 13 Bb). The basal leaf cells are papillose with tall papillae; the auricles are conspicuous and made up of about 7 rows of large hyaline or yellowish cells; the margin is broadly recurved towards apex; the hyaline point is usually distinct and stout, strongly spinulose, and epapillose (mod. *simplex-brevipilum*). - The variety has little in common with *R. barbuloides*; it is a synonym of *R. japonicum*. The name is not a *nomen invalidum* as stated by Wijk et al. (1967).

RACOMITRIUM BREVIPES VAR. *MUTICUM* Kindb. in Macoun 1890. - Lectotype, isolectotype (S, Fig. 16 f, 33). - The diagnosis ["Leaves without a hairpoint; cells yellow; costa absent" (sic)] is inadequate and in-

correct: Plants irregularly to subpinnately branched, light brown-green in lower part and green with a rusty-red tinge in uppermost 5 mm; leaves triangular to ovate-lanceolate, usually strongly plicate in the lower part, irregularly contorted when dry, recurved when moist; margin narrowly recurved to 2/3 the length of the leaves; costa strong, single and reaching towards apex; cells in basal part long and narrow, papillose with rather large papillae, basal 1-2 cell rows wide, yellowish and epapillose, in upper part cells short, and papillose with low and narrow papillae; auricles distinct, often long-decurrent and inflated; hyaline point absent (mod. *subpinnatum-epilosum*). This is the only basionym of a taxon which is common in western North America; it is a species of its own.

TRICHOSTOMUM CANESCENS Timm ex Hedw. 1801. - Neotype (G, Fig. 48 B). - No original Hedwig material of this taxon has been located, nor have other collections been found which are suitable for lectotype material (see pp. 111ff.). Hedwig (1792, 1801) described and figured the European taxon of the group which is different from *R. ericoides* s.l. (and more precisely the southern taxon within *R. canescens*); Hedwig's name is adopted for that taxon. Tab. III (Hedwig 1792) includes one big (28 cm!) and two small (5 and 3.5 cm) plants; the larger of the small plants is identical with the big one. Otherwise, there are figures of two leaves, male and female inflorescences, archegonia and antheridia, sporophytes including seta, capsule with calyptra and peristome, one large peristome tooth, and spores. The original is coloured (Fig. 3). - In the absence of original plant material I have selected a Schwaegrichen specimen as the neotype of *Trichostomum canescens*. It is made up of a few robust, irregularly branched shoots about 2.5 cm high, which are glued to a small sheet. The leaves are slightly falcate and ovate-lanceolate with short, branched costa. The hairpoint embraces a well-defined part of the upper lamina and is slightly decurrent down margin of lamina; it is strongly papillose, and denticulate and spinulose towards apex. A few immature sporophytes are present. - The type is a mod. *subpinnatum-longipilum-vel-pilosum*.

Racomitrium canescens var. **alpinum* Meyran, Ann. Soc. Bot. Lyon 39: 55. 1915 ('*alpina*') nom. nud. - Original collection: France, "Savoie, Aiguilles Rouges (Payot)" (not seen).

Racomitrium canescens fo. *angustifolium* Vilh. 1925. - Holotype (PRC).
- The type material is collected from dry soil and mixed with *Pogonatum* sp. The plants are ca. 3 cm and mostly pinnately branched with sharply keeled leaves, long costa and distinct, flexuose and little papillose point. The specimen belongs to *R. ericoides* (mod. *subpinnatum-brevipilum-vel-subepilosum*).

Racomitrium canescens var. *aquaticum* Mat., Ber. naturw.-med. Ver. Innsbruck 28: 95. 1903 ('*aquatica*'). - *Racomitrium canescens* var. **vulgare* fo. *epilosum* subfo. *aquaticum* (Mat.) Podp., Consp. 298. 1954.
- Type: Austria, "In der Melack bei Praxmar (Sellrain), 1600 m, 13. VIII.1896" (not seen). - In the protologue the plants assigned to var. *aquaticum* are said to be erect and 8½ cm high, and have very few branches, and leaves without hairpoint. Loeske (1930: 228) placed var. *aquaticum* close to var. *strictum*; on the basis of the branching habit this is likely. But original material should be seen before this is definitely established; *R. canescens* is very rarely entirely without hyaline point, whereas this is often the case with *R. ericoides*.

Racomitrium canescens var. *arenicola* Torka 1927. - Lectotype (POZ), syntypes (JE, PRC). - The type material has grown in a sandy habitat and is abundant with rhizoids. The leaves are imbricate, broad, and obtusely keeled in upper part; the costa is usually forked and reaches to 1/2-2/3 the length of the leaves; the leaf cells are short except at the base, and they are strongly papillose; the point is either absent or long and broad. - The name is a synonym of *R. canescens* subsp. *canescens* (mod. *subsimplex-brevipilum-vel-subepilosum*).

Racomitrium canescens var. *brevifolium* Kindb. 1888. - Holotype (S). - Diagnosis: "foliis submuticis" (sic). Label description: "var. foliis breviter acuminatis, muticis vel rarissime breviter piliferis". The plants in the type are up to 6 cm long and have grown in a muddy, probably periodically inundated, habitat; they are pinnately branched and brownish except for the uppermost 1 cm which is greenish. The leaves are broad and long-decurrent, and they are sharply keeled and slightly plicate; the costa is simple and reaches into apex; the cells are papillose with low, small papillae; the point is absent or distinct, and when present it is narrow and slightly papillose. - According to a label it seems that Kindberg originally assigned this

collection to *R. canescens* var. *ericoides* and *R. canescens* subsp. *subfasciculare*. The collection falls well within the variation amplitude of European *R. ericoides* (mod. *pinnatum*-*subepilosum*).

Racomitrium canescens [var.] *β. brevisetum* Brid., Bryol. Univ. 1: 210. 1826. - Type: "In Europa passim. In Bavaria [Bayern, W. Germany] Schrank. In Thuringia [Thüringen, mid Germany] Bridel". Diagnosis: "pedunculis brevissimis". - No specimen named var. *brevisetum* is present among the rich material of the *R. canescens* group in Bridel's herbarium (B). Nor was I able to locate any specimen of *Gymnostomum canescens* Schrank, which is cited in synonymy of var. *brevisetum*. However, of 17 collections of *R. canescens* in Bridel's herbarium, 7 are *R. heterostichum* (see p. 115). *Racomitrium heterostichum* has distinctly shorter seta than *R. canescens* coll., and most of the specimens in Bridel's herbarium are fertile; var. *brevisetum* is probably a synonym of *R. heterostichum*.

Racomitrium canescens var. **calcicola* Meyran, Ann. Soc. Bot. Lyon 39: 55. 1915. nom. nud. - Original collection: France, "Lyonnais: massif du Mont-d'Or (D.)" (not seen). - This is probably *R. canescens* subsp. *canescens*, which often grows on calcareous substrate (see e.g. Poelt and Wriessnegger 1973: 57).

Racomitrium canescens var. **compactum* Röhl, Deutsch. Bot. Monatsschr. 4: 105. 1886 nom. nud. - Original collection: No specific locality is given, but the article deals with "Thüringer Laubmoose" (not seen).

Racomitrium canescens subsp. **R. delamarei* Ren. et Card. in Delamare, Ren. et Card., Ann. Soc. Bot. Lyon 15: 110. 1888 ('*Delamarei*'). - *Racomitrium delamarei* (Ren. et Card. in Delamare, Ren. et Card.) Ren. et Card., Rev. Bryol. 19: 87. 1892. - Type: [America sept., isl.] Miquelon (PC, holotype - Fig. 47 A; TRH, isotype). - Stem to 4 cm, yellowish brown, irregularly but strongly and partly pinnately branched. Leaves closely appressed, lanceolate, sharply keeled, slightly plicate; margin little recurved to 2/3 the leaf length, mostly on one side only; cells long and narrow in the whole leaf, faintly papillose; auricles absent, but 1-2 hyaline cell rows extending as a border up along the margin; hairpoint absent. - The structure of the leaves including cross section (see Lawton 1971) clearly indicates that this taxon is a synonym of *R. fasciculare* (Hedw.) Brid.

Racomitrium canescens var. *dolomiticum* Kern 1906. - Lectotype (HBG).
- The protologue includes some important characteristics ("Blaugrüne Färbung der rasen, sehr kurze breite Haarspitze oder völlig haarlos, Rippe nur halb, ..."), which indicate that *R. canescens* is present. The lectotype specimen is in accordance with the description. It has grown in a muddy habitat ("wicher Kalkerde"), and belongs to *R. canescens* subsp. *canescens* mod. *subsimplex-subepilosum*. It is similar to e.g. *R. mollissimum* and *R. tortuloides*.

Racomitrium canescens var. *epilosum* H. Müll. 1865. - Lectotype (JE, Fig. 49 A); syntype (MSTR). - H. Müller's (1865) printed label description ("Haarlose Abart der graublätterigen Zackenmütze") is valid according to I.C.B.N. Art. 31 (Stafleu et al. 1978), and the author citation "H. Müll. ex Midle (1869)" used by most authors is erroneous. The name soon became widely used for epilose or subepilose modifications of all taxa in the *R. canescens* group. It is very interesting that the type material - both the lecto- and syntype - is a mixture of closely intermingled plants of *R. ericoides* and *R. elongatum*. - The material of *R. elongatum* mostly has leaves with long hairpoint which is typically recurved and strongly denticulate and papillose, the points are somewhat shorter near the shoot apex; microscopical, the leaves are strongly papillose and the marginal cells above the alar cells are short, sinuose and incrassate. - The materiale of *R. ericoides* mostly has epilose leaves in the upper part of the shoots, but some plants have long, flexuose, slightly denticulate and slightly papillose hairpoints down the stems; microscopical, the leaves are slightly papillose and the marginal cells above the alar cells are thinwalled, elongate and yellowish-hyaline. - The *R. ericoides* (mod. *subpinnatum-subepilosum*) element corresponds best to the protologue and is selected as the lectotype of the variety. See also *R. canescens* fo. *epilosum* Chal.

Racomitrium canescens var. **epilosum* Fitzg. et Bott., Nuov. Giorn. Bot. Ital. 13: 67. 1881 *hom. illeg.* [*R. canescens* var. *epilosum* H. Müll. 1865]. - Type: Italy, "dell'Appennino di Soraggio in Garfagnana ... in Valle delle Pozze sotto le Tre Potenze, Levier" (not seen). - It is stated that this is a new epithet and not the same as var. *epilosum* H. Müll. From the inadequate protologue it is impossible to deduce whether this variety belongs to *R. canescens* or *R. ericoides* s.l., but if it is completely epilose it probably belongs to *R. ericoides* s.str.

Racomitrium canescens fo. *epilosum* Chal. 1882. - (a). Within the species concerned, this is the earliest use of the epithet *epilosum* at the forma level. In the excellent work of Chalubinski (1882) *R. canescens* was divided into four forms, viz. fo. **vulgaris*, fo. *prolixa*, fo. *ericoides*, and fo. *epilosa*. However, there are no references to previous authors. With regard to fo. *ericoides* and fo. *prolixa* it may be concluded that the basionyms of these distinctive epithets are *Trichostomum ericoides* (Web.) ex Brid. and *Racomitrium canescens* var. *prolixum* Bruch et Schimp. in B.S.G. It is more uncertain whether fo. *epilosum* Chal. should be interpreted as a new epithet, or as a new combination of var. *epilosum* H. Müll. I have chosen the latter alternative. (b). Venturi and Bottini (1884) listed "var. *epilosum* H. Müll; Fitzg. et Bott." in synonymy of *R. canescens* var. *ericoides*; and in a footnote they stated that they considered *R. canescens epilosum* to be a form of var. *ericoides*. The var. *epilosum* H. Müll. is not a nomenclatural synonym of var. *epilosum* Fitzg. et Bott., and any new combination at the forma level will here be nomenclaturally obscure. (c). Lindberg and Arnell (1890) reported *Grimmia *ericoides* var. **canescens* fo. *epilosa* from Siberia. They did not refer to previous authors, and the form was not described. One authentic specimen (UPS-herb. H.W. Arnell no. 245a) is *R. ericoides* (mod. *subpinnatum-subepilosum*). (d). Brotherus (1899: 213) named two Japanese specimens *R. canescens* var. *ericoides* fo. *epilosa* without any references. This is *R. barbuloide*s according to herbarium material (H-BR). (e). Paris (1902) named a Japanese specimen *R. canescens* fo. *epilosa* H. Müll.; this appears to be the first time it is definitely stated that a fo. *epilosum* is considered a nomenclatural synonym of var. *epilosum* H. Müll. Taxonomically, the Japanese specimen is probably *R. barbuloide*s or *R. japonicum*. (f). Loeske (1913) listed *R. canescens* var. **vulgare* fo. *epilosum*, and stated (p. 190) that such a form also occurs in var. *ericoides*; he did not refer to previous authors, but stressed that the epithet should be used "ohne Autorenbezeichnung". Although Loeske (1930) made a subtle distinction between "Form" (= taxon or modification?) and "forma" (as taxonomic rank), I have ascribed this and the other parallel - previously unpublished - form names to Loeske.

Racomitrium canescens fo. **epilosum* Loeske 1913 hom. illeg. - Type: not given. - Originally this form was assigned to var. **vulgare*; it

must be interpreted as *R. canescens* mod. *epilosum*, see also *R. canescens* fo. *epilosum* Chal. and *R. canescens* fo. *pilosum* Loeske.

Racomitrium canescens var. *ericoides*, see *Trichostomum ericoides*.

Racomitrium canescens var. *ericoides* fo. *canum* Zett. ex Möll. 1931. - Lectotype (UPS). - The epithet originates from the *R. canescens* fo. *ericoides cana* Zett., Rev. Grimm. Scand. 131. 1861, which I do not regard as a binomial combination. The only reference in Zetterstedt (1861) is to a specimen from "[Norvegia] Voss præfecturæ Bergensis a Blytt" which I have not seen. Möller (1931: 141) also refers to Zetterstedt's "Grimmieæ et Andreææ exsiccata" no 38, which is labeled *R. canescens* fo. *ramosior ericoides cana*, but called fo. *ericoides pilifera* in the table of contents. The specimens (TRH, UPS) are pinnately branched and have a denticulate recurved hairpoint and long costa; it is *R. elongatum* (mod. *pinnatum-pilosum*). Möller (1931) cited var. *longipilum* Warnst. in synonymy of fo. *canum*. However, the former epithet is associated with *R. canescens* (subsp. *canescens*) contrary to the intention of Zetterstedt (1861) and Möller (1931).

Racomitrium canescens var. *ericoides* fo. **eu-ericoides* Loeske 1913 nom. illeg., is a superfluous name of fo. *ericoides*.

Racomitrium canescens var. *ericoides* fo. *muticum* Zett. ex Möll. 1929. - Lectotype (UPS). - The epithet *muticum* originates from the *R. canescens* fo. *ericoides mutica* Zett., Rev. Grimm. Scand. 131. 1861, which I do not regard as a binomial combination. Zetterstedt's specimens - "Grimmieæ et Andreææ exsiccata" no. 40a, b (TRH, UPS) - are *R. ericoides* [mod. (sub)pinnatum-subepilosum (40a) and mod. subpinnatum-epilosum (40b)]. Möller (1931) cited var. *epilosum* H. Müll. 1865 in synonymy of his fo. *muticum*, which may be considered a superfluous name of fo. *epilosum* (H. Müll.) Chal. 1882.

Racomitrium canescens var. *ericoides* fo. *subepilosum* Warnst. 1899. - Holotype (JE). - In the description it is stated that the stems have numerous branches, and that the stem leaves have long or short hairpoint which is smooth at the upper end. The type material has grown in a muddy place and corresponds well with the description; moreover, the points are recurved and not flexuose, and the marginal cells above the alar cells are short, sinuose and incrassate. - The form is a synonym of *R. elongatum* (mod. *subpinnatum-subepilosum-vel-pilosum*).

Podpera (1954) made the combination *R. canescens* var. **vulgare* fo. *subepilosum* (Warnst.) Podp., which is contrary to the protologue. See also *R. canescens* fo. **subepilosum* Loeske.

Racomitrium canescens var. *ericoides* fo. *submuticum* Zett. ex Möll. 1931. - Lectotype (UPS). - The epithet originates from the *R. canescens* fo. *ericoides submutica* Zett., Rev. Grimm. Scand. 131. 1861, which I do not regard as a binomial combination. Zetterstedt's exsiccate specimen (no. 39a; TRH, UPS) is made up of much fertile *R. ericoides* (mod. *subpinnatum-subepilosum*) plus a fragment of sterile *R. elongatum* (mod. *pinnatum-pilosum*); the *R. ericoides* element corresponds to the protologue and is selected as the lectotype of the form. Möller (1931) cited [*R. canescens* var. *ericoides*] fo. *subepilosum* Warnst. in synonymy of his fo. *submuticum*, but the type material of the former name is *R. elongatum*.

Racomitrium canescens fo. *erythrophyllum* Sak., Bot. Mag. Tokyo 51: 141. 1937. - Type: Japan, Hokkaido, Prov. Ishikari, Berg Daisetsu in Alpiner Lage, Juli 1936 M. Tsujibe (MAK-herb. K. Sakurai No. 9213, holotype). - When the form was described it was assigned to var. **eucanescens*. The plants in the type are reddish ("in toto dilute rubiginoso" acc. to the protologue), and this colour is never predominant in plants of the *R. canescens* group. Moreover, the leaves are epilose, lanceolate and without auricles; the cells in the whole leaf are long and narrow, and *canescens*-papillae are absent. - Everything indicates that fo. *erythrophyllum* belongs to *R. fasciculare* (Hedw.) Brid.

Racomitrium canescens fo. **eu-canescens* Mönkem. 1927 nom. illeg., is a superfluous name of fo. *canescens*.

Racomitrium canescens fo. **eustrictum* Loeske 1913 nom. illeg. - Originally listed as a form of var. *strictum* it is a superfluous name of fo. *strictum*.

Racomitrium canescens var. *glaciale* Amann 1919. - Lectotype (ZT, Fig. 15 Ab). - The plants are 0.5-2 cm, somewhat branched and blackish. The leaves are obtusely keeled and the costa is branched and reaches to 2/3-3/4 the length of the leaves; the lamina cells are short except at the base, and strongly papillose; hyaline point if present is short and papillose and similar to the points in the type of

R. mollissimum (q.v.). - Var. *glaciale* is regarded as a synonym of *R. canescens* subsp. *canescens* (mod. *subsimplex*-*subepilosum*), and it is accordingly not "eine Gletscherschlamform der var. *ericoides*" as supposed by Loeske (1930: 228).

Trichostomum canescens [var.] b **gracile* Schleich., Cat. Plant. Helv. Ed. 2. 31. 1808 ('1807') nom. nud. - Type: not given. - This is the first subordinate epithet introduced in the group.

Racomitrium canescens fo. *immersum* H. Wint. 1910. - Holotype (JE). - Originally, fo. *immersum* was listed below "b) *epilosum*". From the protologue ("... bis 8 cm lang, sehr locker beblättert ...") it was impossible to state whether the form belonged to *R. canescens* or *R. ericoides* (the ecology excluded *R. elongatum*), but holotype material is *R. ericoides* (mod. *subpinnatum*-*subepilosum*).

Racomitrium canescens var. *intermedium* Vent. et Bott. 1884. - Type: not seen. - In the protologue it is stated that var. *intermedium* is distinguished from var. *ericoides* by its narrower leaves and longer hairpoint. "*R. ericoides* DNtrs. Epil. p. 672!" is cited as a synonym of var. *intermedium*; according to the description ("... ramulis lateralibus abbreviatis numerosis pinnatim ramulosi. Folia tenuia, lanceolato-subulata, valde carinata, ... apiculo dentato, canescente, ... ad ramulorum apicem in sicco saepius falcata.") *R. ericoides* sensu De Notaris (1869) is *R. elongatum*. It is likely that *R. elongatum* is more common than *R. ericoides* in the area in question. Var. *intermedium* is considered to be a synonym of *R. elongatum*.

RACOMITRIUM CANESCENS VAR. *LATIFOLIUM* C. Jens. in J. Lange et C. Jens. 1887. - Holotype (C, Fig. 48 A). - The gracile plants of the type have leaves which are obtusely keeled, and costa which reaches to 1/2-3/4 the length of the leaves. The cells are strongly papillose, with typical coarse *canescens* papillae in the lower part; the hairpoint is narrow and decurrent down margin of lamina, and strongly papillose with tall papillae; some points have fewer papillae towards the apex. - It is a mod. *subsimplex*-*brevipilum*. The epithet is adopted for the northern taxon within *R. canescens*.

Racomitrium canescens fo. *latifolium* Vilh. 1925. - Holotype (PRC). - The leaves are broad and obtusely keeled, with short and branched costa; the point is strongly papillose with tall papillae. - The form is a mod. *subsimplex*-*pilosum* of *R. canescens* subsp. *canescens*.

Racomitrium canescens var. *longipilum* Warnst. 1904. - Type: not seen. - The protologue includes a figure of one leaf with short costa and long and broad, denticulate and papillose falcate point. Moreover, Warnstorf (1913: 307) refers to Mikutowicz' *Bryotheca Baltica* no. 472, which is present in many herbaria (e.g. BM, TRH). The exsiccate plants have falcate and obtusely keeled leaves with branched costa reaching to 1/2-3/4 the length of the leaves; the leaf cells are strongly papillose with tall papillae from the base to the apex; the point embraces up to 1/2 the total length of the leaves, it is highly papillose with irregular papillae to more than 15 μ m long. - The taxon is a mod. *longipilum* of *R. canescens* subsp. *canescens*.

Racomitrium canescens var. *lutescens* Lesq. et James, Man. Moss. N. Am. 151. 1884. - Type: USA, "on shaded rocks, California, Bolander" (not seen). - Var. *lutescens* is usually given as a synonym of *R. varium* (Mitt.) Jaeg. (cf. Wijk et al. 1967).

Racomitrium canescens var. **muticum* Vent., Rev. Bryol. 6: 55. 1879 nom. nud. - Original collection: Italy, "Rabbi, in supraalpinis" (not seen). - Loeske (1930) cited var. *muticum* Vent. in synonymy of var. *epilosum* H. Müll. (q.v.), and this is very probable.

Racomitrium canescens var. *muticum* (Kindb. in Macoun) 1892, see *R. brevipes* var. *muticum*.

Racomitrium canescens var. **muticum* Pilous 1957 hom. illeg. - Type: not seen. The description of the leaves included costa ("Costa medium versus evanida."), and the figure of two leaves clearly shows that this taxon is a mod. *brevipilum*-vel-*epilosum* of *R. canescens* (subsp. *canescens*); the leaves are stated to be long-decurrent, but this feature is variable within the species.

Racomitrium canescens fo. *nanum* Glow. 1908. - Holotype (GJO). - The depauperate shoots have obtusely keeled and distinctly papillose leaves, with branched short costa and a very papillose point; they do not differ from *R. canescens* subsp. *canescens* (mod. *subsimplex-pilosum*).

Racomitrium canescens fo. **nigrum* Bauer, Deutsch. Bot. Monatsschr. 18: 180. 1900 ('nigra') nom. nud. - *Racomitrium canescens* var. **vulgare* fo. *epilosum* subfo. **nigrum* (Bauer) Podp., Consp. 298. 1954. - Original collection: "Am schwarzen Teich bei Bleistadt auf Waldboden" (not seen). I have not found the locality on any map, but the article

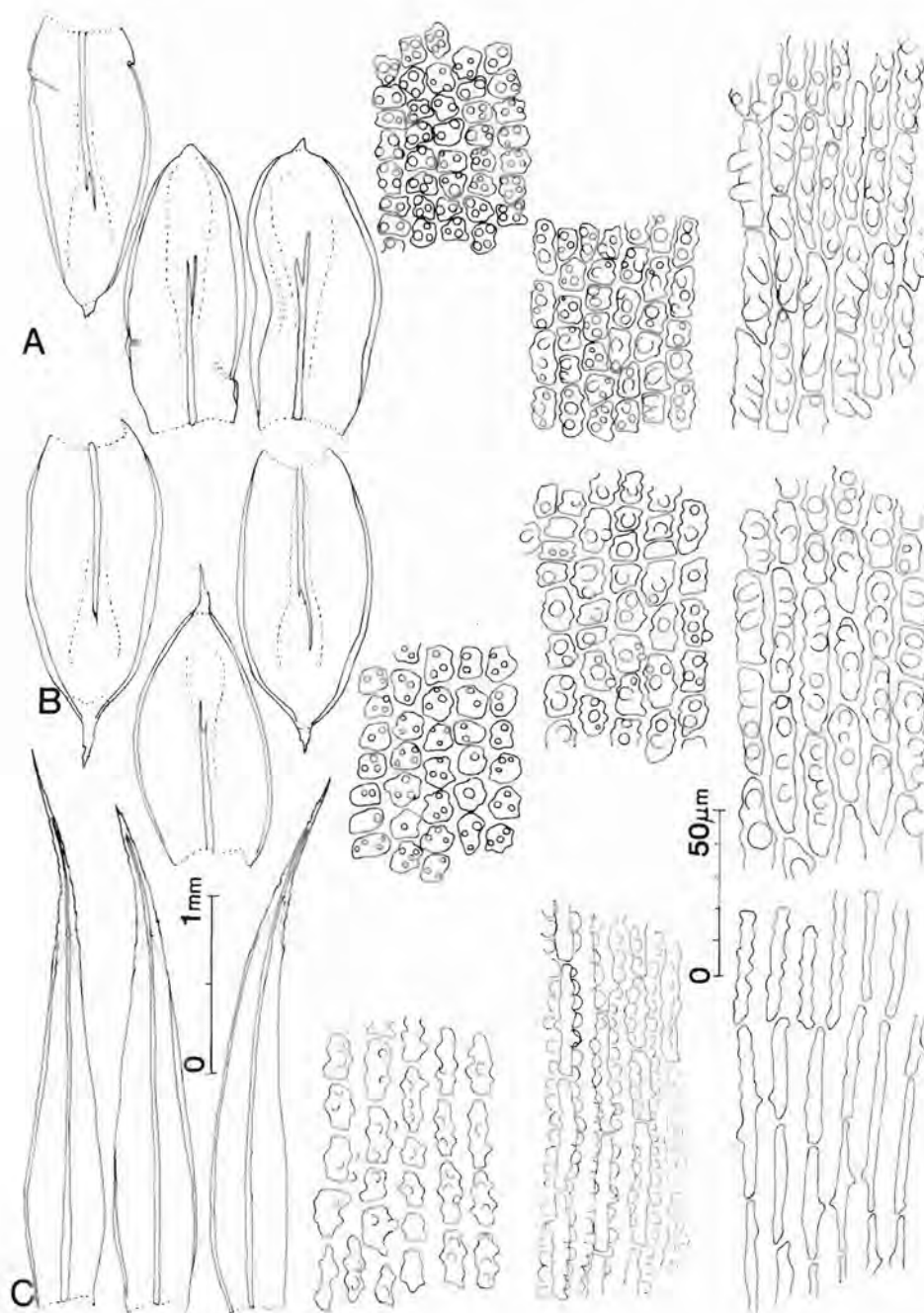


Fig. 44. A. *Racomitrium mollissimum* Philib.; lectotype (H). B. *R. tortuloides* Herz.; lectotype (JE). C. *R. austro-canescens* Dus.; holotype (S). - Leaves; and cells from the upper, lower middle, and central basal part of the leaf.

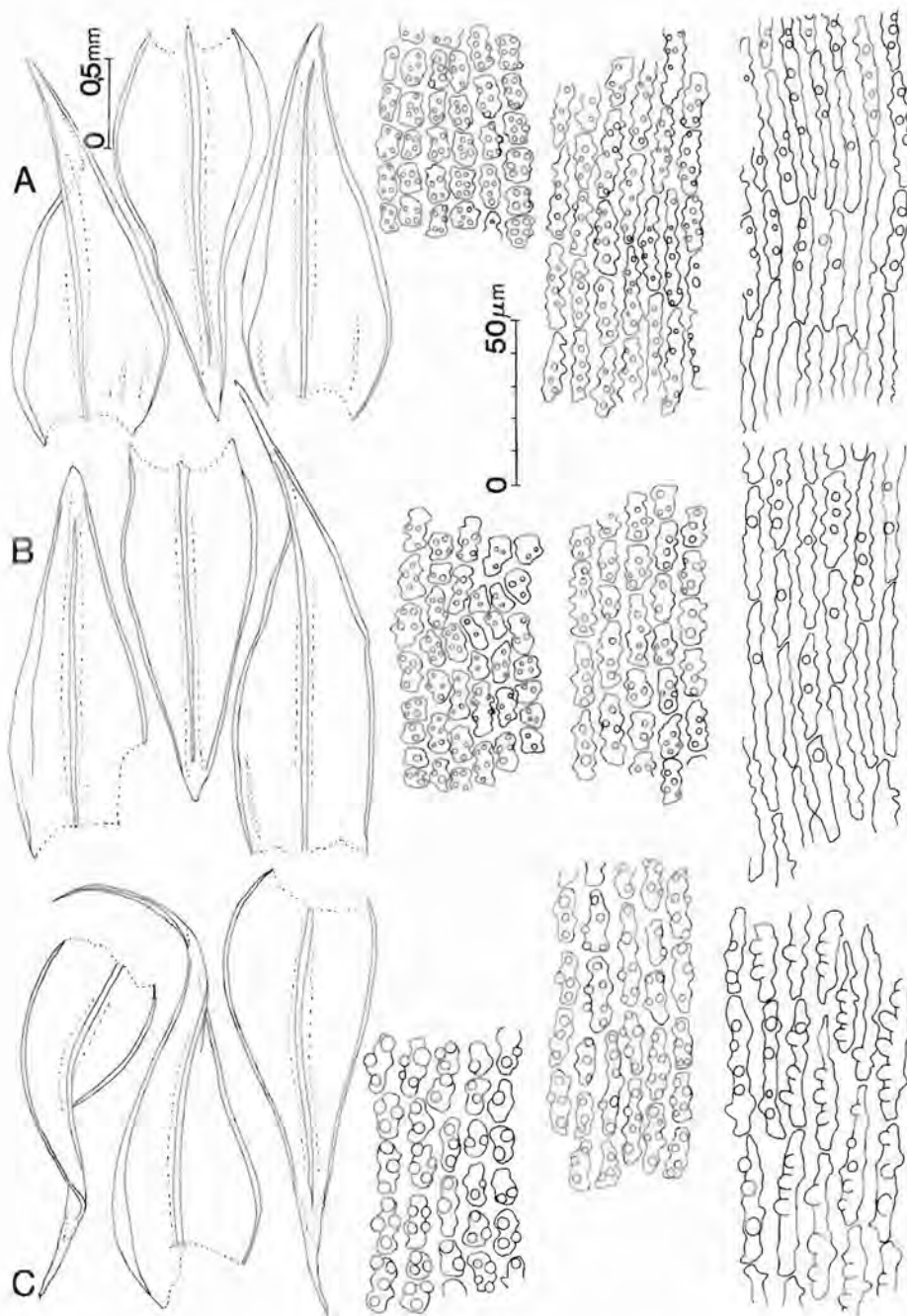


Fig. 45. A. *Trichostomum ericoides* Brid.; lectotype (OXF-DILL). B. *Racomitrium consocians* Stirt.; syntype (BM). C. *R. elongatum* Frisvoll; holotype (TRH). - Leaves; and cells from the upper, lower middle, and central basal part of the leaf.

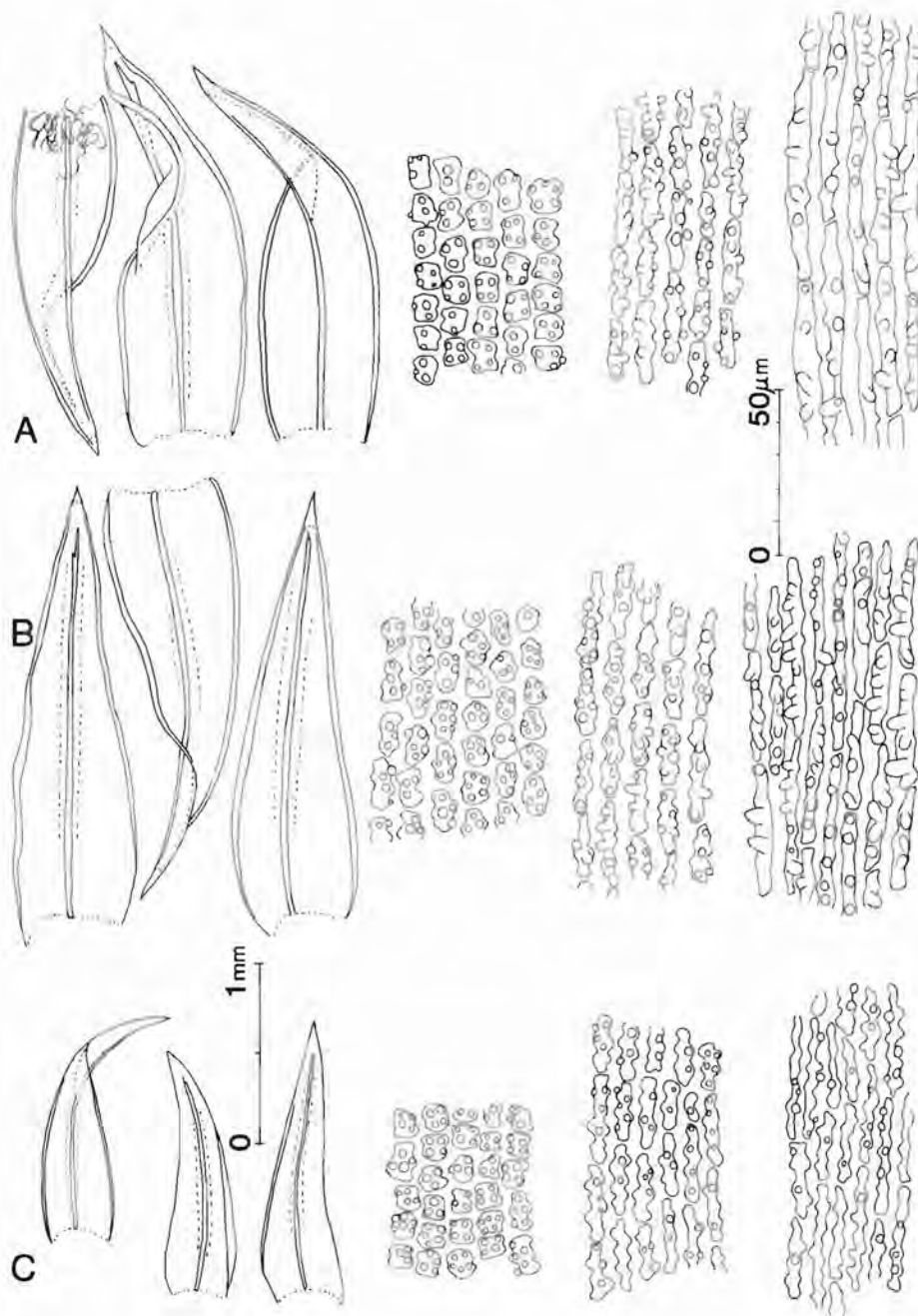


Fig. 46. A. *Racomitrium japonicum* Doz. et Molk.; isotype (H). B. *R. iwasakii* Okam.; syntype (NICH). C. *R. barbulooides* Card.; isolectotype (H-BR). - Leaves; and cells from the upper, lower middle, and central basal part of the leaf.

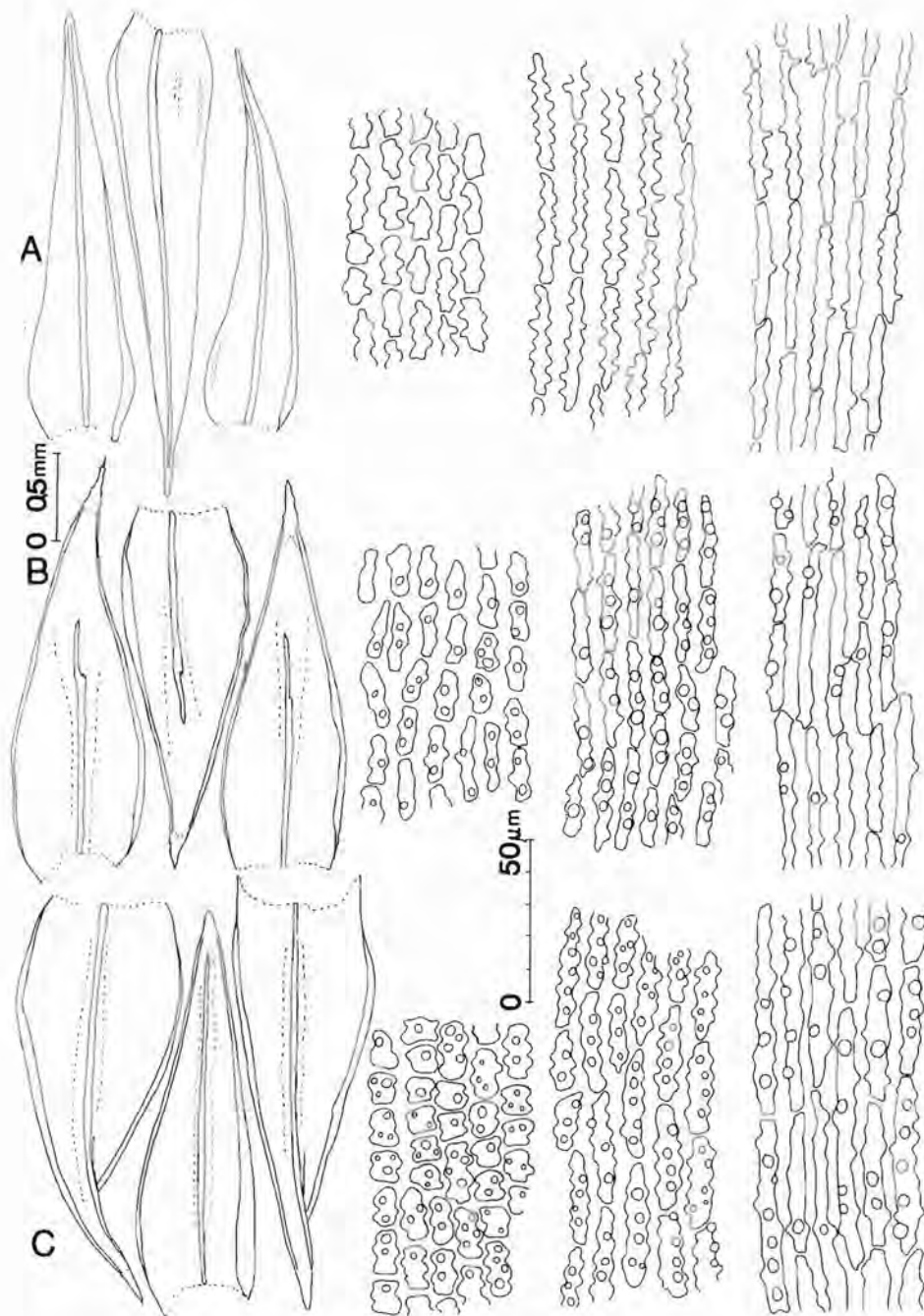


Fig. 47. A. *Racomitrium canescens* subsp. *delamareii* Ren. et Card.; holotype (PC). B. *Grimmia ericoides* var. *robusta* Lindb. et H.W. Arn.; isolectotype (H-SOL). C. *Racomitrium canescens* subsp. *subfasciculare* Kindb.; lectotype (S). - Leaves; and cells from the upper, lower middle, and central basal part of the leaf.

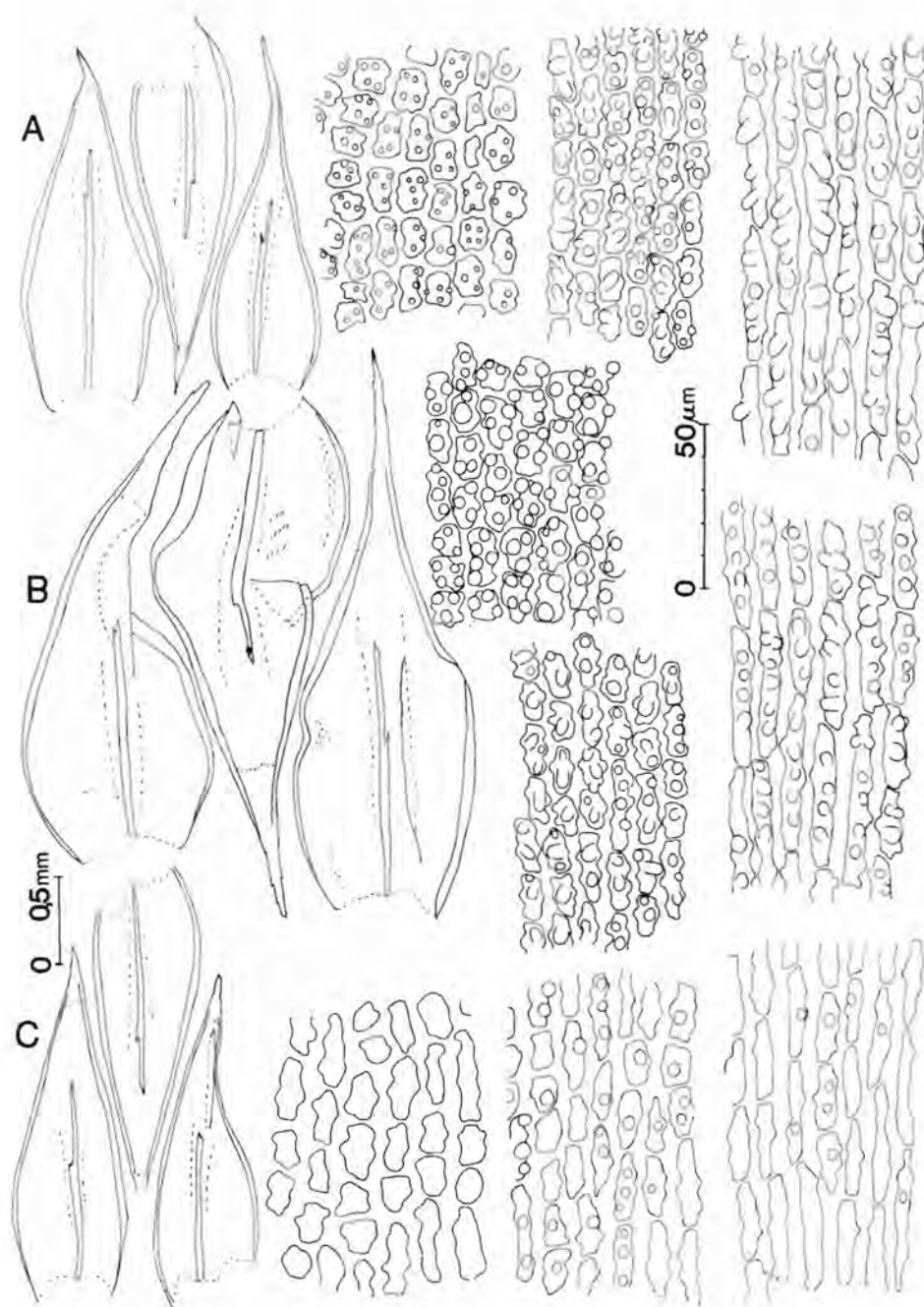


Fig. 48. A. *Racomitrium canescens* var. *latifolium* C. Jens.; holotype (C). B. *Trichostomum canescens* Hedw.; neotype (G-HEDW./SCHWAEGR.). C. *Grimmia panschii* C. Müll.; lectotype (S), papillae partly destroyed in upper part of the leaves. - Leaves; and cells from the upper, lower middle, and central basal part of the leaf.

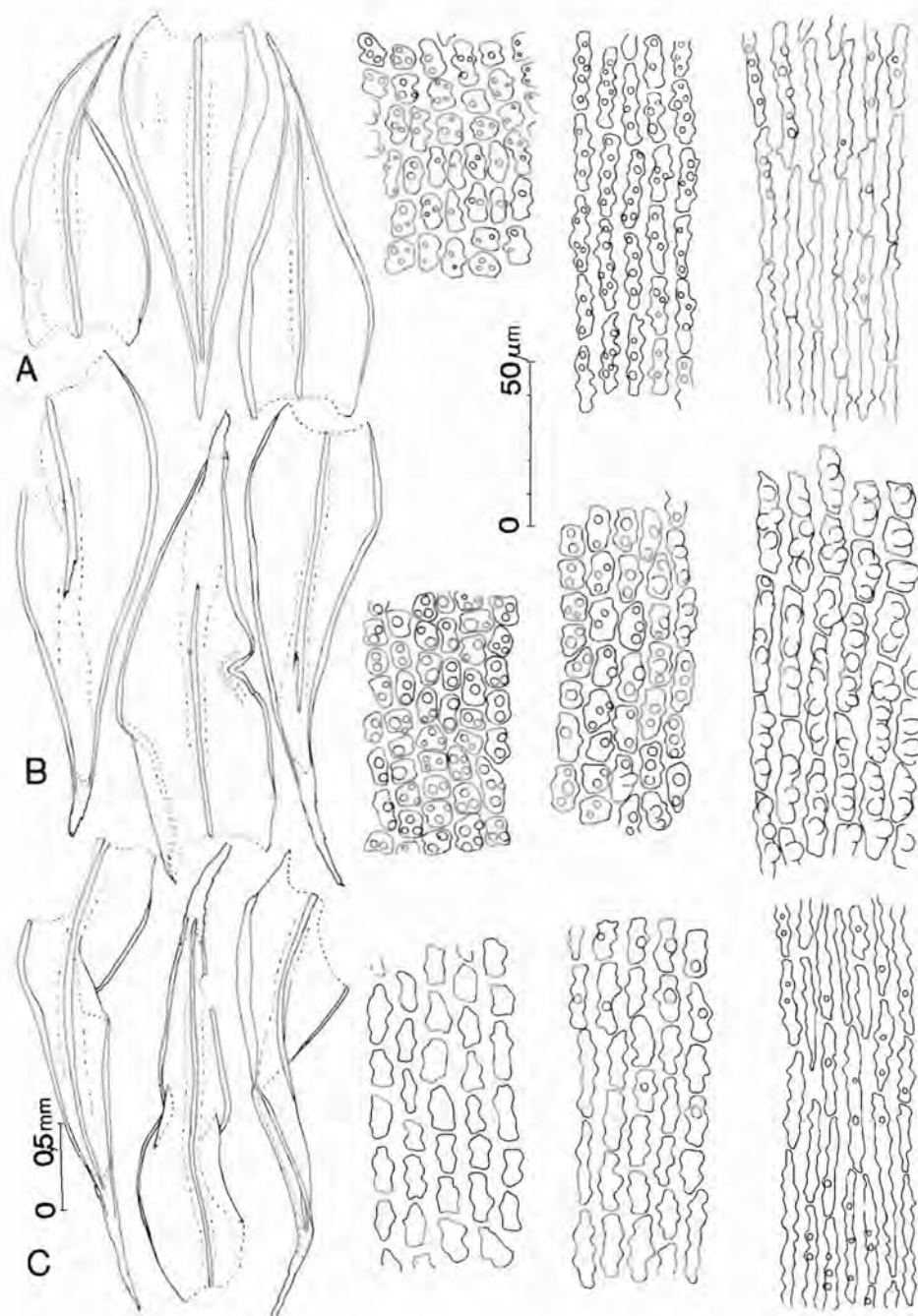


Fig. 49. A. *Racomitrium canescens* var. *epilosum* H. Müll.; lectotype (JE). B. *R. canescens* var. *prolixum* Bruch et Schimp.; lectotype (BM). C. *Grimmia ericoides* fo. *squarrosa* Lindb.; lectotype (OXF-DILL), papillae partly destroyed. - Leaves; and cells from the upper, lower middle, and central basal part of the leaf.

deals with "... der Moosflora Westböhmens und des Erzgebirges."

Racomitrium canescens fo. *pilosum* Loeske 1913. - Type: not given.
- Originally this form was assigned to var. **vulgare*; it must be interpreted as a strongly pilose modification of *R. canescens* subsp. *canescens* similar to var. *longipilum* Warnst. Loeske (1913: 189) listed *R. canescens* var. **vulgare* fo. *pilosum*, fo. **subepilosum* (q.v.) and fo. **epilosum* (q.v.) and stated (p. 190) that these forms could also be recognized in var. *ericoides* (see p. 31). However, I do not consider that this statement validates the combinations in question.

Racomitrium canescens var. *prolixum* Bruch et Schimp. in B.S.G. 1845. - Lectotype (BM-Herb. Bruch/Herb. Schimperianum Proprium, Fig. 49 B). - From the branching habit described in the diagnosis ("Innovationibus annosis ramulosis, novellis simplicibus.") it is impossible to deduce whether var. *prolixum* belongs to *R. canescens* or *R. ericoides* s.l. But the illustrations (Mon. Tab. VIII: β 1, β 1b) are clearly made from plants referable to *R. canescens*. A probable type has been located; the collection is labelled: "*Racomitrium canescens* var. *prolixum* Br. Eur., bei Karlsruhe, Al. Braun". There is strong evidence that this really is original material (regarding the history of Braun's life, see e.g. Caspary 1877): (1) Alexander C.H. Braun partly grew up in Karlsruhe in Baden (W. Germany). After several years of study in various places he returned to Karlsruhe and stayed there from 1832 to May 1846, later he lived in Freiburg, Giessen and Berlin. *Racomitrium canescens* var. *prolixum* was published in 1845. (2) He was a friend of Philip Bruch at Zweibrücken, the senior author of *Bryologia Europaea*; Bruch had helped him with the mosses since Braun was 14 years old. The actual specimen has been in Bruch's herbarium. It is glued to a herbarium sheet including six other collections of *R. canescens* coll.; only one of these is dated, the date is June 1837. It is likely that the other collections are older or of similar age (Bruch died in 1947). (3) Braun was a great friend of W.P. Schimper, the second author of *Bryologia Europaea*. [W.T. von Gümbel was only responsible for the drawings, and did not contribute any descriptions of new taxa (Stafleu & Covan 1976: 373).] The herbarium sheet is now in Schimpers herbarium. It is clear that one or both authors of *Bryologia Europaea* saw the collection before var. *prolixum* was published; and since it fits the illustration completely, the specimen may have served as the model of the variety; it is selected as the

lectotype of var. *prolixum*.

Var. *prolixum* has usually been cited as a subordinate taxon associated with *R. ericoides* (*R. canescens* var. *ericoides*). This is probably due to a statement in the protologue that var. *prolixum* is a modification of var. *ericoides*: "Var. γ [*ericoides*] ... zeich sich besonders auf sandigen und trockenen Haiden; kommen diese Haiden zufällig unter Wasser, oder dehnen sich die Rasen auf feuchte Stellen oder unter Schattiges Gebüsch and, dann entsteht leicht die var. β [*prolixum*]." - But the lectotype specimen is similar to *R. canescens*: Plant gracile, to 9 cm, little branched to unbranched, the branches commented on and illustrated in the protologue are present. Leaf ovate-lanceolate, obtusely keeled; costa branched, reaching to 1/2-2/3 the length of the leaves; point variable, from short and broad to subulate, not flexuose, scarcely decurrent down margin of lamina, dentate and strongly papillose with high papillae. It is a mod. *simplex-vel-subsimplex-brevipilum-vel-epilosum*. - I have seen a number of collections of *R. canescens* from Baden including Karlsruhe. Typical coarse plants of *R. canescens* subsp. *canescens* occur in the area, as well as more gracile plants similar to var. *prolixum*; these gracile plants sometimes have the aspect of the northern taxon within *R. canescens* s.str. However, typical plants of the northern taxon seem to be lacking in Central Europe, and I consider that var. *prolixum* is a synonym of *R. canescens* subsp. *canescens*.

Two other collections named "*Racomitrium canescens* β *prolixum* Br.eur." by one of the authors of *Bryologia Europaea* are of some interest: (1) "... Vogesen: mis. Dr. Schimper, 1856" (G-Herb. J. Müller, Argov./herb. Barbey-Boisser); (2) "Vogesen: Dr. Schimper" (G). Both collections represent typical material of *R. elongatum*; they are pinnately branched in the lower part and less branched to unbranched in the upper part, and although they fit the description they do not fit the original illustrations of var. *prolixum*.

Racomitrium canescens fo. *pseudofasciculare* Möll. 1931. - Lectotype (S). - Originally this form was assigned to var. *strictum*. All specimens mentioned in the protologue have been studied; the specimens including the lectotype represent typical material of *R. ericoides* (mod. (sub)*pinnatum-subepilosum*). The lectotype of *R. canescens* subsp. *subfasciculare* Kindb. was named *R. canescens* fo. *pseudofasciculare* by Möller according to two labels dated 1927 and 1928.

Racomitrium canescens fo. *radicans* Feld, Ber. Naturh. Ver. d. preuss. Rheinl. u. Westf. 1926: 67. 1927. - Type: W. Germany, "Am Brühnehang (Weg nach Rhadern)" (not seen). - The protologue concentrates on the occurrence of rhizoids, which is a variable feature, and it is not possible to state whether the form should be referred to *R. canescens* or (more likely) to *R. ericoides* s.l.

Racomitrium canescens fo. *repens* Vilh. 1925. - Holotype (PRC). - Most plants are pinnately branched; the leaves are sharply keeled with long and simple costa; the points are long and subulate, and flexuose and little papillose. It is typical *R. ericoides* (mod. sub-pinnatum-pilosum).

Racomitrium canescens fo. *rivulare* Timm ex Loeske 1930. - Type: not seen. - According to the protologue the prime characteristics of this form are the numerous branches, the low papillae, the very long costa ("... die längsten Rippen, die sich hier vielfach bis nahe der Blattspitze verfolgen liessen."), and the aquatic habitat. A collection labelled "*Racomitrium canescens* vergens ad v. *strictum* Schlieph. (var. *rivulare* Lske in herbar.) ... 28/7 1907 Loeske" (JE) is referable to epilose *R. ericoides* from a wet habitat. The taxon is included in *R. ericoides* s.l., and on the basis of the aquatic habitat and the above Loeske collection it is included as a synonym of *R. ericoides* (mod. *epilosum-vel-subepilosum*).

Racomitrium canescens var. *robustum*, see *Grimmia* **ericoides* var. *robusta*.

Racomitrium canescens var. *strictum* Schlieph. ex Limpr. 1889, is a nomenclatural synonym of *R. mollissimum* (q.v.).

Racomitrium canescens fo. **subepilosum* Loeske hom. illeg. - Type: not given. - Loeske (1913) listed *R. canescens* var. **vulgare* fo. **subepilosum*, and stated (p. 190) that such a form also occurs in var. *ericoides*. Within *R. canescens*, fo. *subepilosum* Loeske is an illegitimate homonym of *R. canescens* var. *ericoides* fo. *subepilosum* Warnst. (q.v.). Loeske (1913: Fig. 60 a-b) figured two leaves of his *R. canescens* fo. **subepilosum*. It is not stated whether they belong to var. **vulgare* or var. *ericoides*; but the leaves are narrowly keeled with long costa, and I consider that they originate from *R. ericoides*. Several collections (duplicates) named *R. canescens* fo. *subepilosum*

by Loeske [(E. Germany) Thüringen, Arnstadt, in Tale der Wilden Gera, 1911, leg. B. Kramer, Best. Loeske (JE); also distributed as no. 834 *R. canescens* var. *ericoides* fo. *subepilosa* Warnst. ("misit Loeske") in E. Bauer: Musci europaei exsiccati (1911)] is *R. ericoides*; the labels of two of these collections are written by Loeske; the leaves of Fig. 60 a-b (Loeske 1930) confirm well with the leaves in the collections in question. - I have not seen material named var. **vulgare* fo. **subepilosum* by Loeske, but the taxon must implicitly be interpreted as subepilose *R. canescens*.

Racomitrium canescens subsp. *subfasciculare* Kindb. 1898. - Lectotype, syntypes (S, Fig. 47 C). - One of the three original collections is furnished with a label description ("Differt foliis indistincte papilloso (ut in *R. fasciculare*) epilosis vel rarissime brevissimo pil. instructis.") almost identical with the diagnosis (see below). - Most of this collection is *R. ericoides*: Plants subpinnately branched; leaves narrowly ovate-lanceolate, sharply keeled; costa simple, reaching towards apex; cells with low papillae, basal marginal cells above the alar cells hyaline; point often present in upper leaves, papillose with low papillae. - There are also some shoots of *R. canescens* subsp. *latifolium*: Plants irregularly branched; leaves broadly ovate-lanceolate, obtusely keeled; costa branched and ceasing below apex; cells with high papillae; small points mostly present, papillose with high papillae. - The diagnosis of subsp. *subfasciculare* ("Leaves fainter papillose [than *R. canescens*], muticous or with very short hairpoints.") matches the material of *R. ericoides* better than that of *R. canescens* subsp. *latifolium*; consequently the *R. ericoides* (mod. *subpinnatum*-*subepilosum*) element is selected as the lectotype of the subspecific name.

Racomitrium canescens fo. *subsecundum* Latzel, Magyar Botanikai Lapok 29: 119. 1930 ('*subsecunda*'). - *Racomitrium canescens* var. **vulgare* fo. *epilosum* subfo. *subsecundum* (Latzel) Podp., Consp. 298. 1954. - Type: Hungary, "Im Steinbruch bei Bernstein st., leg. Latzel" (not seen). - The diagnosis ("Folia subhomomalla.") does not allow a satisfactory placing of the taxon. But it is probably *R. canescens* subsp. *canescens* which usually has homomallous leaves.

Racomitrium canescens var. *uliginosum* Farn., Atti Ist. Bot. Univ. Pavia ser. 2, 1: 333. 1888. - *R. canescens* var. **vulgare* fo. *uligi-*

nosum (Farn.) Podp., Consp. 298. 1954. - Type: Italy. "Dintorni di Pavia nei Boschi del Ticino, sopra terreno siliceo, in luogo uliginoso, Marzo 1888" (not seen). - The protologue ("Caulis ramulis lateralibus brevibus acutiusculis. Folia acumine pellucido longissimo.") is inadequate, and it is uncertain whether the variety belongs to *R. canescens* or *R. elongatum*; it is not likely to belong to *R. ericoides*.

Racomitrium canescens var. **viridis*. - Loeske (1913: 190) mentions this name: "Was man bisher z.B. als v. *epilosum* [H. Müll.], *subepilosum* [Warnst.], *viridis*, *muticum* [Kindb. in Macoun] usw. unterschied, sind Formen, die sich teils decken, teils schneiden, teils ganz verschieden sind!" I have not met with this epithet elsewhere, and Loeske (l.c.) does not accept it as a name of a taxon. One collection labelled *R. canescens* fo. *viridis* (Thüringen, Inselberg im Thür. Walde, 15.VII.1919 P. Janzen - JE) is *R. elongatum*.

Racomitrium canescens fo. *viridi-senile* Sak. 1937. - Holotype (MAK). - The inadequate diagnosis ("Planta in toto viridi-senilis.") is supplied by a plentiful type collection consisting of little branched plants of up to 4 cm. The leaves are moderately contorted with strongly papillose basal cells and percurrent costa; the point is long and slightly flexuose, and dentate, spinulose and not papillose. - The form represents typical material of *R. japonicum* (mod. *subsimplax-pilosum*).

R. canescens fo. **vulgare* Chal. 1882 nom. illeg. This is a superfluous name of *R. canescens* fo. *canescens*.

Racomitrium canescens var. *yezo-alpinum* Sak., Bot. Mag. Tokyo 51: 141. 1937. - Type: Japan, Hokkaido, Prov. Ishikar, Berg Daisetsu, in alpine Lage, Juli 1936 M. Tsujibe (MAK-Herb. K. Sakurai no. 9217, lectotype fid. U. Mizushima; no. 9229, syntype). - Of this name I have seen both type collections: (a). No. 9217 has been selected as the lectotype by Mizushima, sept. 18.1967; according to the label he named the specimen "*Racomitrium lanuginosum* (Hedw.) Brid. + [added later with a different type-writer] *R. fasciculare* (Hedw.) Brid.?" The question mark indicates that Mizushima doubted whether *R. fasciculare* was present in the collection. On the basis of his publication (Mizushima 1973) *R. canescens* var. *yezo-alpinum* is considered

synonymous with *R. lanuginosum* by Iwatsuki and Noguchi (1979). By examining the specimen carefully I have found that almost everything in the packet is *R. fasciculare*, whereas *R. lanuginosum* is present as two small shoots and two small fragments. - (b). No. 9229 has been named *R. lanuginosum* by Mizushima, sept. 18.1967, according to a label. The packet contains material of epilose *R. fasciculare* mixed with a number of shoots of pilose *R. lanuginosum*. - From the protologue it is evident that Sakurai (1937) described both species: "Folia ... subobtusata vel subacuta [= *R. fasciculare*], rarius [sic] hyalina [= *R. lanuginosum*]." As the major part of the type material, and almost everything in the proposed lectotype is *R. fasciculare*, it is reasonable to give *R. canescens* var. *yezo-alpinum* as a synonym of that species, as did Noguchi (1974). This choice is also more in accordance with the protologue. It seems that Mizushima, who selected the lectotype, did not distinguish satisfactorily between *R. lanuginosum* and *R. fasciculare*. Mizushima's choice should be rejected, and *R. canescens* var. *yezo-alpinum* should be regarded as a synonym of *R. fasciculare* (Hedw.) Brid.; no. 9217 is accepted as the lectotype of the variety.

Racomitrium consocians Stirt. 1907. - Lectotype (GL), syntype (BM, Fig. 45 B). - The plants in the type material are subpinnately branched; the leaves are sharply keeled with the costa simple and reaching towards apex; the cells are papillose with low papillae; the hairpoint is absent or small in the lower leaves and long at the stem apex, it is papillose with low papillae. - *Racomitrium consocians* is conspecific with *R. ericoides* (mod. *subpinnatum-subepilosum*). Stirton (1907) stressed the short cells in upper part of the leaves, which he compared with the cells of *R. heterostichum*; however, I do not find the cell structure of *R. consocians* remarkable.

TRICHOSTOMUM ERICOIDES (Web.) ex Brid. 1801. - Lectotype (OXF-DILL, Fig. 24, 45 A). - Regarding the origin and history of the epithet *ericoides*, see "Pre-Hedwigian history", p. 10ff., and "*Racomitrium ericoides*: Nomenclature and typification", p. 63ff. - Plants 5-7 cm, regularly pinnate, dark-coloured except for the uppermost one mm which is dark olive-coloured; branchlets not recurved; leaves sharply keeled in upper part, plicate, slightly papillose; margin broadly recurved from base to apex; costa unbranched, long; alar cells of 5-6 cell rows, supra-alar cells mostly elongate (as are the sinuose

cells further up the margin and the cells in the adjacent marginal rows), thin-walled, ca. 10-13 esinuose cells in the marginal cell row including alar cells; basal laminal cells elongate (30-50 x 4-5 μ m), upper cells rectangular (8-16 x 5-8 μ m); hairpoint often distinct, erect-flexuose, in basal part indistinctly papillose, in upper part epapillose, at shoot apex frequently missing. Fertile with 9 capsules including operculae. Probably grown in a muddy, somewhat moist habitat. - In 1724 Dillenius in Ray reported the plant called *Muscus trichoides montanus* etc. (see p. 11f.) from "Widna"; this was certainly the same plant that Dillenius (1741) named *Bryum hypnoides*, *Ericæ facie*, etc. and reported from "Widhva, Cambris". The material was probably collected by Dillenius when he visited Snowdon in 1726 (Richards 1979, and in litt.), and is 257 years old (1983).

Racomitrium ericoides var. **canescens* Lindb. 1875 nom. illeg., see also *Trichostomum canescens*. - It was Lindberg's (1867, 1875, 1879) idea to treat *R. canescens* as a variety of *R.* (or *Grimmia*) *ericoides*, and for some time most Fennoscandian bryologists accepted this. The reasoning was that a densely ramified stem is usual in the species group concerned, and that all such species occur with less branched plants, which are correctly considered to be varieties: "Omnes species hujus sectionis generis ramulis densis et brevibus distinctæ sunt. Qua causa var. *ericoides* per analogiam mihi videtur forma typica speciei et hujus var. simplex vel subsimplex, e loco humidioris orta, s.d. *Rh. canescens*. Formas analogas ceteræ species sectionis nobis præbent, quæ ut varietates merito consideratæ sunt." (Lindberg 1867: 553). Möller (1931) agreed with Lindberg, but remarked that it was more appropriate to retain *canescens* as the main form, partly because the name has priority and partly because it was in common usage. Wijk et al. (1967) state that Lindberg made the combination *Racomitrium ericoides* var. *canescens* in the above quotation, but no such combination is presented. "... var. simplex vel subsimplex, ..." is used by Lindberg (l.c.) as words describing variation in branching habit, and not as varietal epithets.

*Grimmia *ericoides* var. **canescens* fo. **brevipila* Lindb. et H.W. Arn. 1890 nom. nud. - Original collection (UPS). - The plants assigned to this form have short costa and obtusely keeled leaves with broad papillose point; they belong to *R. canescens* subsp. *canescens* (mod. *subsimplex-brevipilum*).

*Grimmia *ericoides* var. **canescens* fo. **epilosa* Lindb. et H.W. Arn. 1890, see *Racomitrium canescens* fo. *epilosum*.

*Grimmia *ericoides* var. *robusta* Lindb. et H.W. Arn. 1890. - Lectotype (UPS), isoelectotype (H-SOL, Fig. 47 B), syntypes (H, UPS). - Plants with leaves narrowly ovate-lanceolate, and broad towards apex, in upper part obtusely keeled; costa usually branched and reaching to 1/2-2/3 the length of the leaf; point long and broad, and dentate and spinulose, papillose towards apex with narrow and acute, irregularly arranged papillae. - The variety is regarded as synonymous with *Racomitrium panschii* (mod. *subsimplex-pilosum*). The material is slightly more robust than most material of *R. panschii*, but otherwise they resemble each other; the differences may have a genetical basis, but may also be due to local conditions. A collection from Bulkur in the Lena valley reported as *Grimmia ericoides* var. *robusta* (UPS) by Arnell (1913) is similar to the type material, while one from Kumachsurs in the same valley reported as *G. ericoides* var. *canescens* (UPS) is less robust and almost identical with Svalbard material of *R. panschii*. The latter collection indicates that var. *robusta* rather is a modification than a distinct genotype.

*Grimmia *ericoides* fo. *squarrosa* Lindb. 1883. - Lectotype (OXF-DILL, Fig. 38 b: 1, 3-6; 49 C). - Lindberg (1883) did not describe the form, but referred to Dillenius' (1741: 369; Tab. 47, Fig. 27 E) variety *Bryum hypnoides*, *hirsutiae canescens*, *vulgare* var. *cum foliis magis reflexis* which includes both a description and a figure. Of the seven herbarium plants referred to the actual variety (Herb. fol. 117, no 27 E), five are *R. elongatum* (mod. *pinnatum-pilosum*) and two are *R. canescens*. The *R. elongatum* element is considered the lectotype of fo. *squarrosa*.

Racomitrium iwasakii Okam. 1916. - Lectotype, syntype (NICH, Fig. 46 B). - Plants pinnately to irregularly branched; rhizoids abundant at stem and leaf bases; costa simple and reaching towards apex; cells in basal 1/5 of the leaf elongate and strongly papillose with tall papillae, in upper 4/5 cells slightly elongate with low and narrow papillae; auricles very distinct, of 7-8 rows of large, inflated cells; hairpoint stout, dentate and spinulose, almost epapillose. - The taxon is conspecific with *R. japonicum* (mod. *subsimplex-brevipilum*).

RACOMITRIUM JAPONICUM Doz. et Molk. 1847. - Holotype (L), isotype (H, Fig. 46 A). - Plants about 4 cm, little branched; rhizoids abundant from stem and leaf bases; leaves when dry from slightly to strongly contorted; costa reaching towards apex and sometimes split at the upper end; lamina cells in lower 1/4 of the leaf elongate and strongly papillose with tall papillae, in upper 3/4 quadratic to slightly elongate with low, narrow papillae; auricles very distinct, of 7-8 partially inflated cell rows; hairpoint distinct, dentate and spinulose and almost epapillose. The type material is a mod. *subsimplex-pilosum*. - This is the oldest name of a species which is common in Japan and its adjacent regions.

Racomitrium mollissimum Philib. 1885. - Lectotype (H, Fig. 44 A). - The plants in the type have grown in a sandy habitat and are abundant with rhizoids. The leaves are imbricate and closely appressed, especially at the shoot apex where the shoots become wider and almost bud-like; moreover, the leaves are ovate to narrowly elliptical, and plicate with a broadly recurved margin, obtusely keeled and cucullate. The costa is branched and reaches to 3/4 the length of the leaves. The auricles are distinct and made up of ca. 4 cell rows. The cells in the basal 1/4 of the leaves are long and wide, and strongly papillose with high and broad - sometimes forked - papillae; in upper 3/4 the cells are irregularly quadratic and papillose with smaller papillae. Because the plants have grown in a wet habitat the cell walls are thin. The hairpoint is absent or (mostly) short; when present the whole point is papillose with large papillae. - The basal cells including the structure of auricles and papillae are typical of *R. canescens*, as is the structure of costa and hairpoint. *Racomitrium mollissimum* is a modification of *R. canescens* subsp. *canescens* (mod. *subsimplex-brevipilum-vel-subepilosum*) from certain habitats (see also *R. japonicum*, Note 2). Regarding Loeske's (1930) view on *R. mollissimum* (= *R. canescens* var. *strictum*), see p. 17.

GRIMMIA PANSCHII C. Müll. 1874. - Lectotype (S, Fig. 17 c, 19 e-f, 48 C). - The main part of the type was probably destroyed in Berlin during world war II. I have seen a scanty isotype which C. Müller sent to N.C. Kindberg in 1890; it consists of 7-8 badly preserved pieces about 1 cm long. The type has grown (or has been deposited?) in a muddy place, and a majority of the leaves are partially destroyed

or rotten; it seems to have been a mod (sub)*simplex-pilosum*. The material can be referred to subsect. *Canescens* on account of its obtusely keeled leaves with short, slightly forked costa, but it is so sparse and in so poor condition that it is hardly suitable as the type of a species name. However, after studying and illustrating the type material I am convinced that it does refer to this taxon. The distinction between *R. canescens* and the other, more northern species in the subsection is mainly due to differences in the form, structure and papillosity of the leaves included the hyaline point. The microscopical characters of the type material may be summed up as follows: (a). Parts of some shoots have a few leaves with fairly long hyaline point which is directed towards the apex and not flexuose. The leaves are smaller and narrower than in most collections of the northern species, and they are comparatively strongly keeled; but they are gradually narrowed towards the apex, and I have collections from Svalbard which are similar to the type of *R. panschii*. (b). The papillae are low in the whole leaf, and it is unlikely that this is due to the bad state of the type. Similar, partly destroyed plants of *R. canescens* still have high papillae on most hairpoints and laminae, and the shoot and leaf form typical of that species remain unchanged. (c). The hyaline point is broad and slightly decurrent down the margin of lamina; it is denticulate in the manner of the northern taxon, and frequently spinulose. (d). The point is slightly papillose, especially so towards the extreme apex, on the teeth and along the margin; this condition is typical of the northern taxon. Moreover, the point is characteristically papillose at the dorsal base, having irregularly arranged, narrow but fairly high papillae. The point seem to be the best preserved part of the leaves. The interpretation of the type of *R. panschii* rests on the structure of the point including papillae (Fig. 19 e-f). (e). The arctic species is probably common in the type district; but *R. canescens* subsp. *latifolium* is also present there. However, the type of *Grimmia panschii* has several prime microscopic characteristics in common with the northern taxon, whereas no such characteristic points to *R. canescens*. Therefore, I have adopted *R. panschii* as the name of the northern species in subsect. *Canescens*.

RACOMITRIUM PYGMAEUM Frisvoll 1980, see p. 83ff.

Racomitrium subcanescens C. Müll. in Jaeg. et Sauerb., Ber. S. Gall. Naturw. Ges. 1877-78: 419. 1880 (Ad. 2: 683) *nom. nud.* - Original collection: "Japonia, Shuno in terra, Henon 1874" (not seen). - This is probably *R. barbuloides* or *R. japonicum*.

Racomitrium tortuloides Herz. 1902. - Lectotype (JE, Fig. 19 i, 44 B; HBR, syntype). - Plants grown in a muddy place and filled with mud and sand, the whole cushion dark-coloured, 1-3 cm. Leaves imbricate and closely appressed, perfectly ovate, abruptly narrowed into a hyaline point, obtusely keeled and cucullate; margin broadly recurved; costa weak, reaching to 3/5 the leaf length, usually branched; auricles of 3-5 cell rows; cells in the basal 1/4 of the leaf long, strongly papillose with large, wide papillae, in the upper 3/4 cells quadratic to shortly rectangular and papillose with smaller papillae; hairpoint distinct, strongly papillose and often spinulose. - *Racomitrium tortuloides* has many characteristics in common with *R. mollissimum*, and I regard both as synonyms of *R. canescens* subsp. *canescens* (mod. [*sub*]simplex-brevipilum-vel-subepilosum).

XII. TAXA WITHOUT LOCATED TYPE MATERIAL

The following 22 taxa (including 11 *nom. inval.*, and excluding *Trichostomum canescens* and *R. canescens* var. *lutescens*) probably belong to the *R. canescens* group, and 8 of them have also been placed in synonymy of *R. canescens* subsp. *canescens*, *R. ericoides* or *R. elongatum*, but so far type material has not been studied. Those who have access to some of these types are requested to search for possible type material, and to send such specimens on loan. Abbreviations: *R. h.* = *R. heterostichum* s.l.; *R. v.* = *R. varium*.

Racomitrium canescens var. **alpinum* Meyran 1915
R. canescens var. *aquaticum* Mat. 1903
R. canescens var. *brevisetum* Brid. 1826 (= *R. h.*?)
R. canescens var. **calcicola* Meyran 1915
R. canescens var. **compactum* Röhl 1886
R. canescens var. **epilosum* Fitzg. et Bott. 1881
R. canescens var. **vulgare* fo. **epilosum* Loeske 1913 (= cc)
R. canescens var. *intermedium* Vent. et Bott. 1884 (= el)

R. canescens var. *longipilum* Warnst. 1904 (= cc)
R. canescens var. *lutescens* Lesq. et James 1884 (= *R. v.*)
R. canescens var. **muticum* Vent. 1879
R. canescens var. **muticum* Pilous 1957 (= cc)
R. canescens var. **nigrum* Bauer 1900
R. canescens var. **vulgare* fo. *pilosum* Loeske 1913 (= cc)
R. canescens fo. *radicans* Feld 1927
R. canescens fo. *rivulare* Loeske 1930 (= er)
R. canescens var. **vulgare* fo. **subepilosum* Loeske 1913 (= cc)
R. canescens fo. *subsecundum* Latzel 1930
R. canescens var. *uliginosum* Farn. 1888
*R. *subcanescens* C. Müll. in Jaeg. et Sauerb. 1880
Trichostomum canescens Timm ex Hedw. 1801 (= cc)
T. canescens var. **gracile* Schleich. 1808

For comments on these taxa, see "An annotated list of the basionyms proposed in the group".

APPENDIX. THE *RACOMITRIUM CANESCENS* GROUP IN NORWAY

Five taxa of the *R. canescens* group occur in Norway, viz. *R. ericoides*, *R. elongatum*, *R. canescens* subsp. *canescens*, *R. canescens* subsp. *latifolium*, and *R. panschii*. The taxa show characteristic distribution patterns within the area. I have made extensive collections of *R. canescens* coll. in Hedmark north of Rena, Sør-Trøndelag, Nord-Trøndelag, Svalbard and Jan Mayen. Otherwise the herbarium material used in this study is almost identical with that revised by Heinonen (1971).

A. The Mainland

Four taxa of the *R. canescens* group occur in the Norwegian mainland, viz. *R. ericoides*, *R. elongatum*, *R. canescens* subsp. *canescens* and *R. canescens* subsp. *latifolium*. Heinonen (1971: Fig. 64-65) mapped the distribution of *R. ericoides* and *R. canescens* in Fennoscandia including Norway; I have divided these two taxa and their corresponding maps into four.

Racomitrium ericoides (Fig. 50 left) is found in all counties. It is most frequent in oceanic and suboceanic areas, but can also be found in the climatically continental eastern parts of Hedmark, compare Heinonen (1971: Fig. 65) and Fig. 50.

Racomitrium elongatum (Fig. 50 right) has a western and southern distribution in Norway. It may be compared with some species mapped by Størmer (1969); it evidently belongs to his *Mnium undulatum* group (q.v.) which comprises several species growing in dry habitats (e.g. *Antitrichia curtipendula*, *Grimmia pulvinata*, *Tortula muralis*).

Racomitrium canescens subsp. *canescens* (Fig. 51 left) has an eastern and southern distribution in Norway. The distribution patterns of *R. elongatum* and *R. canescens* subsp. *canescens* are almost complementary north of the southern parts of Østlandet. *Racomitrium canescens* subsp. *canescens* probably occurs further north in Norway, cf. Fig. 39. The material from shifting sand in Rogaland is not quite typical, but are nearer to subsp. *canescens* than to subsp. *latifolium*.

Racomitrium canescens subsp. *latifolium* (Fig. 51 right)



Fig. 50. Distribution of *Racomitrium ericoides* (left) and *R. elongatum* in the Norwegian mainland based on herbarium specimens.

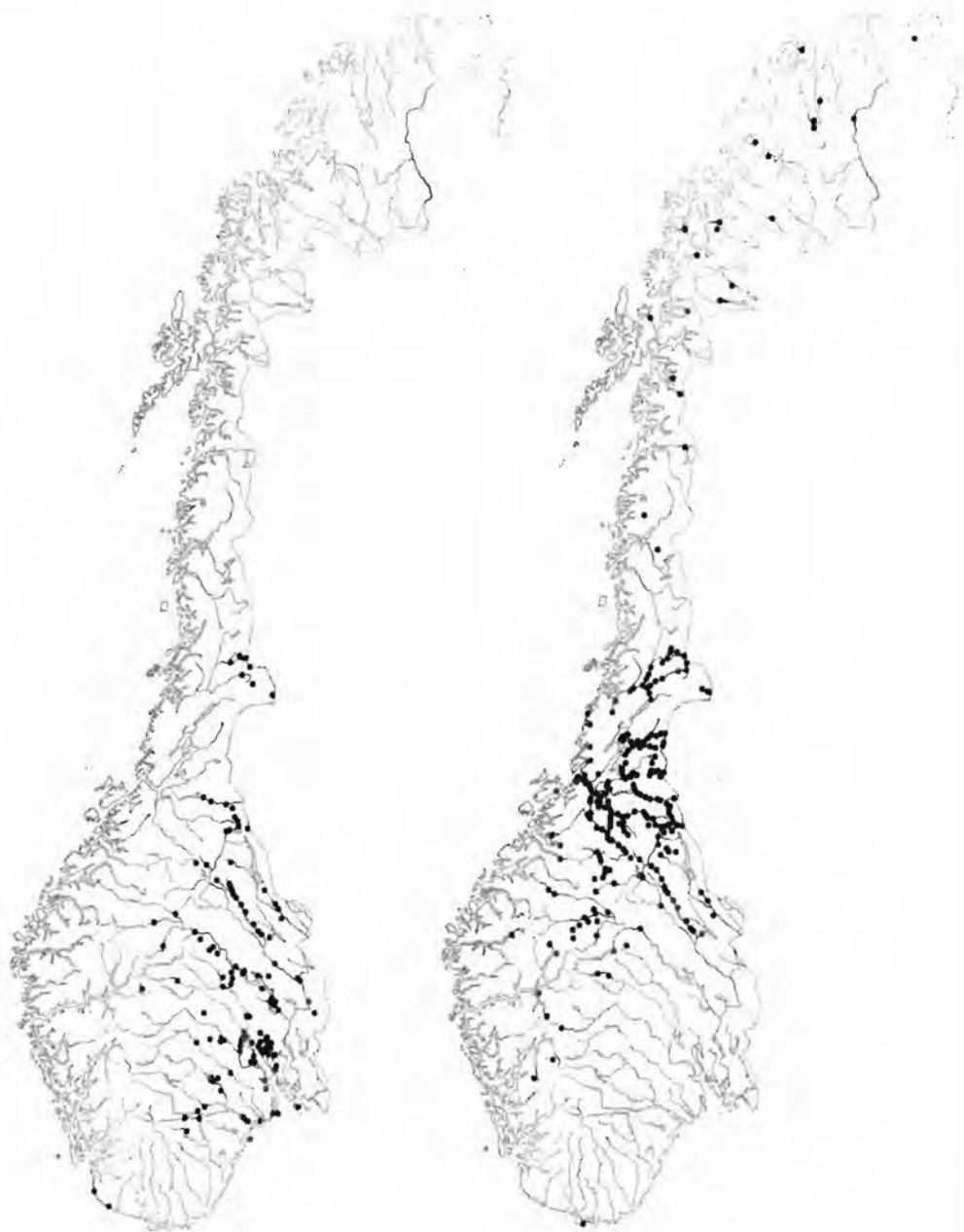


Fig. 51. Distribution of *Racomitrium canescens* subsp. *canescens* (left) and *R. canescens* subsp. *latifolium* in the Norwegian mainland based on herbarium specimens.

has a northern distribution in Norway, following the Langfjella mountain range south to Hardanger. However, it is probably more common in southern areas of the mountains and in coastal areas of Vestlandet.

B. Svalbard

Three taxa of the *R. canescens* group occur in Svalbard, viz. *R. ericoides*, *R. canescens* subsp. *latifolium* and *R. panschii*. All taxa are widespread in the Archipelago. The history, taxonomy, ecology and distribution of the taxa in Svalbard are dealt with in a separate paper (Frisvoll 1983 a).

C. Jan Mayen

Two taxa of the *R. canescens* group occur in Jan Mayen, viz. *R. ericoides* and *R. canescens* subsp. *latifolium* (Frisvoll 1983 b).

Racomitrium ericoides is, besides *R. lanuginosum*, the most common bryophyte in Jan Mayen; it occupies extensive areas of plains, hillsides and mountains as deep, almost pure mats. It seems that the rainy foggy weather conditions at Jan Mayen are very favourable for the growth of *R. ericoides*.

Racomitrium canescens subsp. *latifolium* is rare in Jan Mayen (Fig. 52), occurring only in dry micro-habitats. It is usually mixed with *R. ericoides*.

Localities: Grønberget, 18.VIII.1930 Lid (O); summit of Scoresbyberget, 5.VIII.1930 Lid (O); Jacobsendalen, 23.VIII.1972 Frisvoll (TRH); Valberget, 23.VIII.1972 Frisvoll (TRH); summit of Neumayerberget, 1.VIII.1930 Lid (O); above Bjørnholet, 25.VIII.1972 Frisvoll (TRH); Blinddalen, 25.VIII.1972 Frisvoll (TRH); Oppdalen 16.VIII.1972 Frisvoll (TRH).

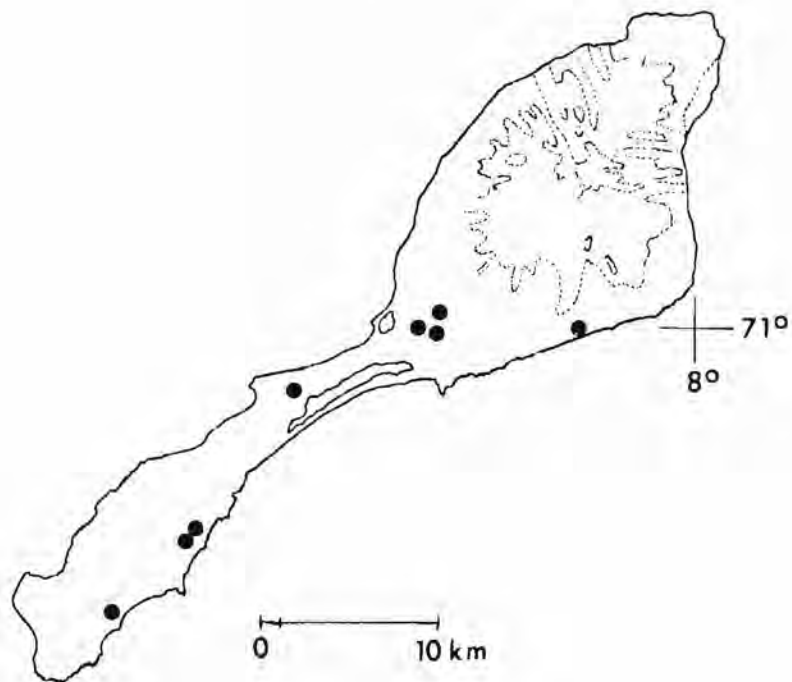


Fig. 52. Distribution of *Racomitrium canescens* subsp. *latifolium* in Jan Mayen based on herbarium specimens.

ACKNOWLEDGEMENT

I am grateful to the directors and curators at the herbaria mentioned in Chapter II for the loan of specimens; to S. Sivertsen for translating the diagnoses into Latin and for comments on some nomenclatural problems; to P. Geissler for help with problems concerning material in the Hedwig/Schwaegrichen herbarium; to J. Lewinsky for help with problems concerning some locality names from Greenland; and to R. Baadsvik for inking the drawings.

VIII. REFERENCES

- Arnell, H.W. 1913. Zur Moosflora des Lena-Tales. Bericht über die im Jahre 1898 von Herrn Doktor H. Nilsson-Ehle an der Lena gesammelten Moose. *Ark. Bot.* 13(2): 1-94.
- Bauhin, C. 1623. *Pinax theatri botanici*. Ed. II., 1671. [XXIV] + 518 [+ 22] pp. Basileæ.
- Boerhave, H. 1720. *Index alter plantarum quae in horto academico Lugduno-Batavo aluntur*. 320 + 270 pp. Lugduni Batavorum.
- Bremer, B. 1981. A taxonomic revision of *Schistidium* (Grimmiaceae, Bryophyta) 3. *Lindbergia* 7: 73-90.
- Bridel, S.-E. de. 1798. *Muscologia recentiorum seu analysis, historia, et descriptio methodica omnium muscorum frondosorum hucusque cognitorum ad normam Hedwigii*. Tom II(1). X + 222 pp. Gothae, Parisiis.
- 1801. *Animadversiones in Muscologiae Recentiorum tomum secundum, ab ipso auctore propositae*. *Journ. für Bot.* 1800 1(2): 268-299. Göttingen.
 - 1826. *Bryologia universa seu systematica ad novam methodum dispositio, historia et descriptio omnium muscorum frondosorum hucusque cognitorum cum synonymia ex auctoribus probatissimis*. Vol. I. XLVI + 856 pp. Lipsiae.
- Britton, J. 1922. Friedrich Ehrhart and his exsiccatae. *Journ. of Bot.* 60: 318-327.
- Brotherus, V.F. 1899. Neue Beiträge zur Moosflora Japans. *Hedwigia* 38: 204-247.
- 1924. Musci. Unterklasse Bryales. II. Spezieller Teil. 1. Reihe Fissidentales - 8. Reihe Eubryales. pp. 143-478 in A. Engler (ed.), *Die natürlichen Pflanzenfamilien*. Ed. 2. 10. Band. Leipzig.
 - 1925. Musci. Unterklasse Bryales. II. Spezieller Teil. 9. Reihe Isobryales - 14. Reihe Dawsoniales; Nachträge und Verbesserungen zu band 10 und 11. pp. I-IV, 1-542 in A. Engler (ed.), *Die natürlichen Pflanzenfamilien*. Ed. 2. 11. Band. Leipzig.
- Bruch, P., W.P. Schimper & T. Gumbel. 1845. *Bryologia Europaea seu genera muscorum Europaeorum monographice illustrata. - Racomitrium*. Vol. III: 135-147. 262-271. (Fasc. 25-28: 1-13; 1-2, 1-8). Stuttgartiae.

- Buchenau, F. & W.O. Focke. 1874. Gefässpflanzen. pp. 12-61 in F. Buchenau (ed.), *Botanik in Die Zweite Deutsche Nordpolarfahrt in den Jahren 1869 und 1870 unter Führung des Kapitän Karl Koldewey*. 2. pp. 1-137. Leipzig.
- Caspary, R. 1877. Alexander Braun's Leben. *Flora* 60: 433-442, 445-457, 465-471, 497-507, 513-519.
- Chalubinski, T. 1882. *Grimmieae Tatrenses*. 118 pp., 18 pl. Varsaviae.
- Crum, H.A. & L.E. Anderson. 1981. *Mosses of Eastern North America*. Vol. 1-2. 1328 pp. New York.
- Deguchi, H. 1978. A revision of the genera *Grimmia*, *Schistidium* and *Cosciodon* (Musci) of Japan. *Journ. Sci. Hiroshima Univ. Ser. B, Div. 2*, 16: 121-256.
- De Notaris, G. 1869. *Epilogo della briologia Italiana*. XXIV + 781 pp. Genova.
- Dillenius, J.J. 1719. *Catalogus plantarum sponte circa Gissam nascentium, cum appendice*. 240 + 174 pp. Francofurti ad Moenum.
- 1741. *Historia muscorum in qua circiter sexcentæ species veteres et novæ ad sua genera relatæ describuntur et iconibus genuinis illustrantur cum appendice et indice synonymorum*. XVI + 576 pp., 85 pl. Oxonii.
- Dixon, H.N. 1896. *The student's handbook of British mosses*. Ed. III. 1924. XLVIII + 582 pp., 63 pl. Reprint by Wheldon & Wesley, Codicote, 1970.
- Dozy, F. & J.H. Molkenboer, 1847. *Musci frondosi inediti archipelagi Indici, sive descriptio et adumbratio muscorum frondosorum in insulis Java, Borneo, Sumatra, Celebes, Amboina, nec non in Japonia nuper detectorum minusve cognitorum*. Fasc. 5: 129-160, pl. XLI-L. Lugduni-Batavorum.
- Düll, R. 1980. Die Moose (Bryophyta) des Rheinlandes (Nordrhein-Westfalen, Bundesrepublik Deutschland). *Decheniana, Beihefte* 24: 1-365.
- Florschütz, P.A. 1960. Introduction to Hedwig's "Species Muscorum", pp. I-XXXII in J. Cramer & H.K. Swann (eds.), *Historia naturalis classica*. Tom. XVI. "Johannes Hedwig. Species Muscorum Frondosorum". Weinheim.
- Frisvoll, A.A. 1978. The genus *Tetraplodon* in Norway. A taxonomic revision. *Lindbergia* 4: 225-246.

- Frisvoll, A.A. 1980. Møte med Dillenius. *Muséla* 6: [9-11].
- 1983 a. Revision of Svalbard bryophytes. II. The genus *Racomitrium*. *Lindbergia* 9(1).
 - 1983 b. Bryophytes from Jan Mayen, including 25 species new to the island. *Bryologist* 85.
- Gangulee, H.C. 1972. *Mosses of eastern India and adjacent regions - a monograph*. Fasc. 3. XV + 830 pp. Calcutta.
- Hedwig, J. 1792. *Descriptio et adumbratio microscopico-analytica muscorum frondosorum (Stirpes cryptogamicae)*. Vol. III. 100 pp., 40 pl. Lipsiae.
- 1801. *Species Muscorum Frondosorum*. VI + 353 pp., 77 pl. In: J. Cramer & H.K. Swann (eds.), *Historiæ naturalis classica*. Tom. XVI. "Johannes Hedwig. Species Muscorum Frondosorum". Reprints of later starting point books for botanical nomenclature, Vol. 3. Weinheim, 1960.
- Heinonen, K. 1971. *Racomitrium canescens* (Hedw.) Brid. and *R. ericoides* (Hedw.) Brid. (Bryophyta, Grimmiaceae) in northwestern Europe. *Ann. Bot. Fennici* 8: 142-151.
- Hoffmann, G.F. 1796. *Deutschlands Flora oder Botanisches Taschenbuch, Zweyter theil für das iahr 1795. Cryptogamie*. 200 pp., 14 pl. Erlangen.
- Iwatsuki, Z. & M. Mizutani. 1977. *Coloured illustrations of bryophytes of Japan*. VIII + 405 pp., 48 pl. Osaka.
- Iwatsuki, Z. & A. Noguchi. 1979. Index Muscorum Japonicorum supplementum 1973-1978. *Journ. Hattori Bot. Lab.* 46: 235-255.
- Jones, G.N. 1933. Grimmiaceae. pp. 1-65 in A.J. Grout (ed.), *Moss flora of North America north of Mexico*. Vol. II(1). Newfane, Vermont.
- Kanda, H. 1975. A revision of the family Amblystegiaceae of Japan. I. *Journ. Sci. Hiroshima Univ. Ser. B, Div. 2*, 15: 201-276.
- Kindberg, N.C. 1898 ('1897'). (*Species of*) *European and N. American Bryineæ (Mosses) (synoptically described)*. Part 2. (*Acrocarpous*). pp. 153-410. Linköping.
- Koponen, T. 1968. Generic revision of Mniaceae Mitt. (Bryophyta). *Ann. Bot. Fennici* 5: 117-151.
- Lange, J. & C. Jensen. 1887. *Cryptogamae cellulares. A. Muscineae. - Conspectus florae Groenlandicae. Pars secunda*. *Medd. Grønland* 3: 309-443.

- Lawton, E. 1971. The genus *Rhacomitrium* in America. *Journ. Hattori Bot. Lab.* 35: 252-262.
- Lindberg, S.O. 1863. Granskning af mossorna uti Vaillant's Botanicon parisiense. *Öfvers. Kongl. Vet.-Akad. Förh.* 20(8): 455-460.
- 1867. Förteckning öfver mossor, insamlade under de svenska expeditionerna till Spitsbergen 1858 och 1861. *Öfvers. Kongl. Vet.-Akad. Förh.* 23: 535-561.
 - 1875. Hepaticæ in Hibernia mense Julii 1873 lectæ. *Act. Soc. Sci. Fenn.* 10: 467-559.
 - 1879. *Musci Scandinavici in systemate novo naturali dispositi.* 50 pp. Upsaliae.
 - 1883. *Kritisk granskning af mossorna uti Dillenii Historia muscorum.* 59 pp. Helsingfors.
- Lindberg, S.O. & H.W. Arnell. 1890. *Musci Asiae Borealis.* Beschreibung der von den Schwedischen Expeditionen nach Sibirien in den Jahren 1875 und 1876 gesammelten Moose mit Berücksichtigung aller früheren Bryologischen Angaben für das Russische Nord-Asien. 2. Laubmoose. *Kongl. Svenska Vet.-Akad. Handl.* 23(10): 1-163.
- Linnaeus, C. 1745. *Flora suecica.* XVI + 419 pp. Stockholmiae.
- 1753. *Species plantarum.* Tom. I-II. 1200 pp. Holmiae. In: "Carl Linnaeus. Species plantarum. A facsimile of the first edition 1753. Volume I. With an introduction by W.T. Stearn". London, The Ray Society No. 140. 1957. "Volume II. With an appendix by J.L. Heller and W.T. Stearn". London, The Ray Society No. 142. 1959.
 - 1755. *Flora suecica, Editio altera aucta et emendata.* XXXII + 464 pp. Stockholmiae.
- Loeske, L. 1913. *Grimmiaceae. Die Laubmoose Europas.* I: 1-XVI, 1-207. Berlin-Schöneberg.
- 1930. *Monographie der Europäischen Grimmiaceen.* *Bibl. Bot.* 101: I-IX, 1-236. Stuttgart.
- Margadant, W.D. 1972. Notes on the nomenclature of Musci (Communicationes Biohistoricae Ultrajectinae n. 33). *Lindbergia* 1: 121-129.
- Milde, J. 1869. *Bryologia Silesiaca. Laubmoos-Flora von Nord- und Mittel-Deutschland, unter besonderer Berücksichtigung Schlesiens und mit Hinzunahme der Flora von Jütland, Hol-*

- land, der Rheinpfalz, von Baden, Franken, Böhmen, Mähren und der Umgegend von München. IX + 410 pp. Leipzig.
- Miller, H.A. 1979. The phylogeny and distribution of the Musci. pp. 11-39 in G.C.S. Clarke & J.G. Duckett (eds.), *Bryophyte systematics*. London.
- Mitten, W. 1859. Musci Indiæ Orientalis; an enumeration of the mosses of the East Indies. *Journ. Proc. Linn. Soc. Suppl. Bot.* 1: 1-171.
- Mizushima, U. 1973. On *Racomitrium canescens* var. *yezo-alpinum* Sak. *Journ. Jap. Bot.* 48: 317-318 (in Japanese, not seen).
- Möller, H. 1931. Lövmoossornas utbredning i Sverige. XI. Grimmiaceæ 1. *Hydrogrimmia*, *Coscinodon*, *Schistidium*, *Racomitrium*. *Ark. Bot.* 24 A(2): 1-177.
- Mönkemeyer, W. 1927. Die Laubmoose Europas. Ergänzungsband. *Andreaeales - Bryales*. Dr. L. Rabenhorsts *Kryptogamen-Flora von Deutschland, Österreich und der Schweiz* IV(IV): I-X, 1-960. Leipzig.
- Müller, C.('K'). 1874. Laubmoose. pp. 62-74 in F. Buchenau (ed.), *Botanik in Die Zweite Deutsche Nordpolarfahrt in den Jahren 1869 und 1870 unter Führung des Kapitän Karl Koldewey*. 2. pp. 1-137. Herausgegeben von dem Verein für die Deutsche Nordpolarfahrt in Bremen. Leipzig.
- Noguchi, A. 1974. Musci Japonici. X. The genus *Racomitrium*. *Journ. Hattori Bot. Lab.* 38: 337-369.
- Nyholm, E. 1956. *Illustrated moss flora of Fennoscandia*. II. Musci. Fasc. 2: 85-189. Lund.
- Okamura, S. 1916. Contributiones novae ad floram Bryophyton Japonicam. Pars secunda. *Journ. Coll. Sc. Imp. Univ. Tokyo* 38: 1-100.
- Paris, E.-G. 1902. Musci Japonici a R.P. Faurie anno 1900 lecti. *Bull. Herb. Boiss.* ser 2, 2: 918-933, 988-993.
- 1905. *Index Bryologicus sive enumeratio muscorum ad diem ultimam anni 1900 cognitorum adjunctis synonymia distributioneque geographica locupletissimis*. Ed. II., Vol. IV. 368 pp. Paris.
- Petiver, J. 1695. *Musei Petiveriani, centuria prima, rariora naturæ continens: viz. animalia, fossilia, plantas, ex variis mundi plagis advecta, ordine digesta, et nominibus propriis signata*. 15 pp. Londini.

- Podpera, J. 1954. *Conspectus muscorum Europaeorum*. 697 pp. Praha.
- Poelt, J. & E. Wriessnegger. 1973. Die Laubmoose *Racomitrium canescens* und *R. ericoides* und ihre Verbreitung im südlichen Österreich. *Herzogia* 3: 53-58.
- Ray, J. 1696. *Synopsis methodica stirpium Britannicarum*. Ed. II. 346 pp. Londini.
- 1724. *Synopsis methodica stirpium Britannicarum*. Ed. III. 482 pp. Londini. In "John Ray: Synopsis methodica stirpium Britannicarum. Editio tertia. 1724; Carl Linnaeus: Flora Anglica. 1754 & 1759." Facsimiles with an Introduction by William T. Stearn. London, The Ray Society No. 148. 1973.
- Richards, P.W. 1979. A note on the bryological exploration of North Wales. pp. 1-9 in G.C.S. Clarke & J.G. Duckett (eds.), *Bryophyte systematics*. London.
- Röhling, J.C. 1800. *Moosgeschichte Deutschlands. 1. Die Beschreibung aller in Deutschland entdeckten Moosarten enthaltend*. XLI + 436 pp. Bremen.
- Ruppius, H.B. 1718. *Flora Jenensis*. - ... edita multisque in locis correcta et aucta. 311 pp. Francofurti & Lipsiae, 1726.
- Sakurai, K. 1937. Beobachtungen über japanische Moosflora. XIVb. *Bot. Mag. Tokyo* 51(604): 133-141.
- Sayre, G. 1959. *Dates of publications describing Musci, 1801-1821*. 102 pp. New York.
- 1977. Authors of names of bryophytes and the present location of their herbaria. *Bryologist* 80: 502-521.
- Scheuchzer, J.J. 1703. *Itineris alpini. Descriptio secunda, anni MDCCIII. Editio novissima*. pp. 65-144 in *Itinera per Helvetiae alpinas regiones facta annis MDCCII, MDCCIII, ... MDCCXI*. Lugduni Batavorum. 1723.
- 1723. *Itineris alpini. Descriptio septima, anni MDCCIX. Nunc primum edita*. pp. 467-520 in *Itinera per Helvetiae alpinas regiones facta annis MDCCII, MDCCIII, ... MDCCXI*. Lugduni Batavorum.
- Schimper, W.F. 1860. *Synopsis muscorum Europaeorum praemissa introductione de elementis bryologicis tractante*. CLIX + 733 pp., 8 pl. Stuttgartiae.
- Schrader, H.A. 1794. *Spicilegium florae Germanicae. Pars prior*. 194 pp. Hannoverae.

- Schuster, R.M. 1966. *The Hepaticae and Anthocerotae of North America east of the hundredth meridian*. Vol. 1. XVII + 802 pp. New York, London.
- Scott, G.A.M. & I.G. Stone. 1976. *The mosses of Southern Australia*. XV + 495 pp. London.
- Smith, A.J.E. 1978. *The moss flora of Britain and Ireland*. 706 pp. Cambridge.
- Stafleu, F.A. 1971. *Linnaeus and the Linnaeans. The spreading of their ideas in systematic botany, 1735-1789*. XVI + 386 pp. Utrecht.
- Stafleu, F.A. & R.S. Cowan. 1976. Taxonomic literature. A selective guide to botanical publications and collections with dates, commentaries and types. Vol. I: A-G. *Regnum vegetabile* 94: I-XL, 1-1136.
- Stafleu, F.A., V. Demoulin, W. Greuter, P. Hiepko, I.A. Linczevski, R. McVaugh, R.D. Meikle, R.C. Rollins, R. Ross, J.M. Schopf & E.G. Voss. 1978. *International code of botanical nomenclature*. XIV + 457 pp. Utrecht.
- Stearn, W.T. 1973. Ray, Dillenius, Linnaeus and the Synopsis methodica Stirpium Britannicarum. pp. 1-90 in John Ray. *Synopsis methodica stirpium Britannicarum. Editio tertia. 1724. Carl Linnaeus. Flora Anglica. 1754 & 1759. Facsimiles with an Introduction by William T. Stearn*. London, The Ray Society no. 148.
- Steere, W.C. 1978. The mosses of Arctic Alaska. *Bryophyt. Bibli.* 14: I-X, 1-508.
- Steere, W.C. & H.A. Crum. 1977. New combinations and new taxa of mosses proposed by Nils Conrad Kindberg. *Mem. New York Bot. Garden* 28(2): 1-220.
- Stirton, J. 1907. New and rare mosses from the west of Scotland. *Ann. Scott. Nat. Hist.* 1907(63): 171-180.
- Størmer, P. 1969. *Mosses with a western and southern distribution in Norway*. 288 pp. Oslo.
- The Times Atlas of the World. Comprehensive edition. 1977. Ed. 5.*
- Timm, J.C. 1788. *Florae Megapolitanae prodromus exhibens plantarum ducatus Megapolitano-Suerinensis spontaneas*. XVI + 284 pp. Lipsiae.
- Tournefort, M.P. 1698. *Historie des plantes qui naissent aux environs de Paris, avec leur usage dans la medecine*. [copy of

- pp. 496-507]. Paris.
- Turner, D. 1804. *Muscologia hibernica spicilegium*. XI + 200 + XIV pp., XVI pl. Yermuthæ, Londoni.
- Vaillant, S. 1727. *Botanicon Parisiense ou denombrement par ordre alphabetique des plantes, qui se trouvent aux environs de Paris*. 205 pp., 33 pl. Leide & Amsterdam.
- Venturi, G. & A. Bottini. 1884. Enumerazione critica dei muschi Italiani. *Atti Soc. Critt. Ital.* 3: 153-227. - Copie separate. 79 pp. Varese.
- Vilhelm, J. 1925. Monografie rodu *Racomitrium* v Československu. *Věstn. Král. Česk. Spol. Nauk Tr.* 2, 1925(5): 1-35.
- Warnstorf, C. 1913. Zur Bryo-Geographie des Russischen Reiches. Eine Erinnerung an Dr. E. Zickendrath. *Hedwigia* 53: 184-320.
- Weber, G.H. 1778. *Spicilegium florae Goettingensis*. 288 pp. Gothae.
- Weis, F.W. 1770. *Plantae cryptogamicae florae Gottingensis*. XII + 334 pp. Gottingae.
- Wijk, R. van der, W.D. Margadant & P.A. Florschütz. 1959. Index muscorum 1. (A-C). *Regnum vegetabile* 17: I-XXVIII, 1-548.
- 1967. Index muscorum 4. (P-S). *Regnum vegetabile* 48: 1-604.
- 1969. Index Muscorum 5 (T-Z, Appendix). *Regnum vegetabile* 65: I-XII, 1-922.
- Zetterstedt, J.E. 1861. *Revisio Grimmerum Scandinaviae*. 139 pp. Upsaliae.

