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A REVISION OF THE GREENLAND SPECIES OF *PUCCINELLIA* PARL.

WITH CONTRIBUTIONS TO OUR KNOWLEDGE OF THE ARCTIC *PUCCINELLIA* FLORA IN GENERAL

BY

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WITH 114 FIGURES IN THE TEXT
AND 13 PLATES

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I. INTRODUCTION

The most exhaustive treatment of the Greenland Puccinellias hitherto published is probably that of JOH. LANGE in Conspectus Florae Groenlandicae (1880) with Supplements I (1887) and II (1892), the latter by L. KOLDERUP ROSENVINGE. Nine species, including a number of varieties, are enumerated, namely

Glyceria Borreri BAB.
— *vaginata* LGE.
— *maritima* (GORT.) WG.
— *arctica* HOOK.
— *Kjellmani* LGE.
— *Langeana* BERL.
— *vilfoidea* (AND.) TH. FR.
— *Vahliana* (LIEBM.) TH. FR.
— *angustata* (R. BR.) FR.

GELERT, in OSTENFELD's Flora Arctica I (1902), reduced the number to five, viz.

Glyceria Vahliana (LIEBM.) TH. FR., including *G. Kjellmani*
— *maritima* (HUDS.) WG., including *G. vilfoidea*
— *distans* (L.) WG., comprising *G. Borreri*, *G. arctica*, *G. vaginata*, and *G. maritima* var. *virescens* LGE.
— *angustata* (R. BR.) FR., including *G. vaginata* var. *effusa* ROSENV. (and the Old World *G. vaginata* f. *contracta* LGE.)
— *tenella* LGE. replacing *G. Langeana*.

From a modern point of view only a few of these alterations were justifiable, namely the uniting of *G. Kjellmani* with *G. Vahliana*, the separation of var. *virescens* from *G. maritima*, and the clear distinction between *G. vaginata* and its f. *contracta*. On the other hand, a number of the alterations were to the worse, especially that of establishing the monstrous collective *G. distans* including a series of widely different unities, none of which are identical with the southern *G. distans*. PORSILD (1920) did not accept the view of GELERT, and, in accordance with

HOLMBERG's determinations, split up GELERT's *G. distans* into three unities, viz.

Puccinellia retroflexa (CURT.) HOLMB.
— *arctica* (HOOK.) FERN. et WEATH.
— *angustata* var. *vaginata* (LGE.) HOLMB.

Another amendment was his reestablishment of *G. vilfoida* as *Puccinellia phryganodes* (TRIN.) SCRIBN. and MERRILL.

Some years later (1926) OSTENFELD's survey of the Greenland Flora appeared. In his list OSTENFELD enumerates six species of *Puccinellia*, among others *P. retroflexa borealis* HOLMB. However, from the distribution given it seems evident that this unity exactly covers GELERT's *Glyceria distans*. It was not HOLMBERG's intention, judging from his labelling, that his *P. retroflexa* ssp. *borealis* should comprise such different forms as were included by OSTENFELD.

HOLMBERG never completed his revision of the Greenland material, but from his determinations it is obvious that *P. arctica* (HOOK.) was not included in his *P. retroflexa* ssp. *borealis*, and that LANGE's *G. vaginata* was considered by HOLMBERG a variety belonging to *P. angustata*.

Since then large collections of *Puccinellia* have been brought home from various parts of Greenland, but no further contributions to the systematics of the Greenland representatives of the genus have appeared as yet.

The genus has been treated by different authors on the basis of material from other arctic and subarctic regions. In 1916 FERNALD and WEATHERBY's revision of the Northeastern American species appeared. Later on HOLMBERG revised the Scandinavian material, and at the same time he made comprehensive studies on material from the rest of the Old World arctic and boreal zones (1908, 1911, 1913, 1916, 1920, 1926 a, 1926 b, 1927). As mentioned above, he also commenced a revision of the Greenland material. In Fl. URSS II (1934) the genus *Puccinellia* is treated by V. KRECZETOWICH, who describes a number of species. A number of his new species from the arctic URSS were formerly recognized by HOLMBERG, but by him given merely varietal rank. In Fl. URSS II *Puccinellia Vahliana* was first transferred to *Colpodium*. HULTÉN, in his "Flora of Alaska and Yukon II" (1942), gives only a preliminary account of the genus, because most of his material was sent to Mr. SWALLEN, US National Museum, Washington, for determination. SWALLEN's revised list of the Alaskan species appeared in 1944. It comprises 13 species, six of which were new. POLUNIN, in his Flora of the Canadian Eastern Arctic (1940) as also in a paper on the South Greenland Flora (1943), contributes with some critical remarks on the nomenclature of some arctic Puccinellias.

The herbarium investigations, the results of which are presented in the present paper, merely aimed at dealing with the genus *Puccinellia* within Greenland. However, to secure a reliable identification of the Greenland forms, comparative studies on the *Puccinellia* Flora of the remaining parts of the Arctic were undertaken as far as the available material permitted. In case the identity of the Greenland species was questioned, it was necessary to clearly define extra-Greenland forms, too. Therefore, some hitherto disregarded or misunderstood East American forms have been proposed as new species.

On my dealing with the Old World Arctic connections of the Greenland Puccinellias, the Novaya Zemlyan forms invited a closer investigation, since they proved to comprise some hitherto only partially recognized types. As a result of these additional studies, a brief survey of the Novaya Zemlyan Puccinellias is appended to this paper.—Some additional results of the present investigation concerning the Western American representatives of the genus have recently been inserted in HULTÉN's Flora of Alaska and Yukon X. Suppl. (1950).

The present investigation is based on the material kept in the Copenhagen Botanical Museum, supplemented by material from the Museums of Oslo, Stockholm, Uppsala, and Lund, kindly placed at my disposal. Further, the Arctic Herbarium of Dr. M. P. PORSILD, comprising valuable Greenland collections, has been accessible to me. In addition, comprehensive collections, recently brought home by various Danish Greenland Expeditions, were kindly handed over to me for determination.

For my comparative studies on extra-Greenland species it has been of invaluable importance that Prof. E. HULTÉN, Ph. D., Riksmuseet Stockholm, willingly placed at my disposal his rich Alaskan collections containing material of the species recently described by SWALLEN.

II. REMARKS ON THE DIAGNOSTICATION OF PUCCINELLIAS

Within the grasses, the floral characteristics generally furnish the most distinctive diagnostically applicable features. However, the rather featureless appearance of the spikelets of *Puccinellia* may render difficult an immediate recognition of the individual species. Hence, some of the diagnostically useful characters will be briefly commented upon (cf. also CRÉPIN 1865, p. 265).

A conspicuous feature of the spikelets, though it can hardly be expressed exactly, is their property of being tight (e. g. *P. deschampsioides*) or loose (e. g. *P. vaginata*). The entire length of the spikelets varies according to the number of florets, which in all species is subject to great fluctuations. The glumes are of superior diagnostic value in spite of the fact that they may be exceedingly variable in size and shape, even in spikelets within one and the same panicle. Nevertheless, on inspecting a large number of spikelets, one will get a rather good impression of the total aspect of the spikelets from the glumal characteristics. The lemmas, though considerably less variable, are often too much alike in the different species to serve as a basis for identification to the same extent as the glumes. The pilosity of the nerves, apart from the cases of entirely glabrous lemmas, is diagnostically of limited value, as it may vary considerably. On the other hand, the hairs, respectively spinules, of the palea keels seem to be of supreme diagnostical value (FERNALD and WEATHERBY 1916 p. 4). Besides these conveniently estimated characteristics, the actual texture of the glumes and lemmas, not easy to describe exactly, may be of paramount importance; for instance *P. coarctata* has usually rather firm and indurate bracts as compared with the thin and translucent bracts of *P. vaginata* and *P. Rosenkrantzii*. The properties of the margins of the bracts seem to furnish diagnostic characters of great value (FERNALD and WEATHERBY l. c.). The edges of the glumes and lemmas may be erose-ciliolate or entire, characters which are only observable by means of a strong lens. Some sort of correlation between a hyaline texture and erose margins of the bracts might *a priori* be expected. However, such a correlation does not, in fact,

exist; thus, for instance, the firm bracts of *P. coarctata* are clearly erose-ciliolate, while the broadly hyaline-bordered ones of *P. Andersonii*, even when toothed, are devoid of cilioles, their border-lines bearing a striking resemblance to a thin tin-foil suddenly congealed.

The genus *Puccinellia* is generally distinguished from the related genus *Colpodium* by having rather stout rachilla joints, not conspicuously widened at the insertion of the florets. However, in some Old World species we find rachillae of the *Colpodium* type (e. g. *P. contracta*). Moreover, the rachilla may be tough, as in *P. vaginata*, or very fragile, as in *P. Andersonii*.

In some cases the shape of the pedicels and the mode of insertion of the glumes furnish good distinguishing characters. Slender pedicels are usually combined with an apparently opposite insertion of the glumes while incrassate pedicels are combined with more or less distinctly alternately inserted glumes. *P. Andersonii* and *P. coarctata* are good examples illustrative of the latter type.

The scabrosity of the panicle branches, often used as a key character, seems to be of minor value, at least as regards the Greenland species, for it often varies considerably within otherwise well circumscribed unities. However, the actual sort of scabrosity ranging from a pubescence-like indument of minute spinules (e. g. in *P. deschampsioides*) to an armament of coarse, though sparse, small teeth (e. g. in *P. coarctata*), seems to be a more reliable feature than the property of being scabrous or glabrous altogether. Nevertheless, it should be disregarded as a key-character, for the type can hardly be distinguished without some experience.

The shape of the panicle is of little value because the branches in certain species may be ascending or reflexed, according to the vigour and the developmental stage.

The length of the uppermost, panicle-bearing joint of the culm is comparatively constant and contributes much to the general appearance of the plant. When it is elongated, the culm appears naked in the upper part, i. e. leaf-bearing only at the base. In the opposite case the lower part of the panicle will not become fully exserted above the uppermost leaf-sheath.

The gross-morphology of the leaves is, no doubt, of diagnostic value, but is often difficult to utilise sufficiently in dried material. The relative length of the sheath in some cases should be evaluated. When the sheaths are short, the nodes are naked, when long, no nodes are visible. The ligule furnishes a reliable distinguishing character only in such extreme cases when it is acute—acuminate or, respectively, truncate—rounded. Its absolute length may vary considerably according to the vigour and growth conditions of the plant. Usually the ligules of the

upper stem leaves are the longer. In descriptive practice it seems convenient to give the ligule-characters of the upper stem leaves, and this procedure is followed by the present writer also. As to the leaf-blade, a clear distinction between flat, rolled, and folded leaves is not always possible, at any rate in herbarium material. Only the distinctly folded, abruptly pointed leaves are easily observed (e. g. *P. phryganodes*, *P. Langeana*). The narrow, evenly tapering, somewhat succulent leaves of some species (e. g. *P. deschampsioides*) usually become sulcate when dried. To what extent flat leaves will become rolled when dried, depends largely on their texture, which may be innate or due to environmental causes.

Within a genus like *Puccinellia*, where diagnostic characters are even vaguer than those encountered in most other gramineous genera, other characters than the commonly used gross-morphological ones should be sought for.

The systematical value of the leaf-anatomy in grasses, especially the epidermal structure, has been pointed out long ago (f. inst. GROB 1896, LOHAUSS 1905, PRAT 1932). So far such microscopic characters seem hardly to have been diagnostically evaluated. However, NANNFELDT (1935, p. 13) has shown that within the genus *Poa* the epidermal structure of the leaf varies according to the taxonomical section. Similar conditions were demonstrated within the genus *Glyceria* by CHURCH (1949 p. 161). It occurred to the writer that it might be worth while to study the possibilities of using epidermal characters in the distinction between species. This was all the more tempting since information of the epidermal structure is easily obtained. For the sake of direct comparison the upper stem leaves were constantly chosen for the investigations, although generally no essential difference as to epidermal type between the leaves of the culm and those of the innovations can be observed. The technique used is very simple: The grass leaf is boiled, first in alcohol and afterwards in water, for a few minutes. Small sections from the middle part of the leaf-blade are imbedded in Amann's lactophenol for microscopic examination. The examination supplied surprisingly positive results. Most species can be recognized on the basis of the epidermal structure, only. However, this statement does not suggest that the leaf-anatomy gives a better basis for identification than do the conveniently used floral characters. All obtainable characteristics should be considered together. Within polymorphous species the leaf-anatomy will not solve the problems definitely, though it will never be misleading, since it seems to display a variability usually paralleling gross-morphological (floral) characters. However, within some critical groups epidermal characters, as for instance the cell size, may indicate discontinuity, while the gross-morphology displays a more

continuous intergradation. Moreover, the epidermal structure may contribute to an arrangement of the species into natural groups.

Within the genus under consideration here the following epidermal features should be noted: Cell size and reticulation of the epidermal tissue. In this connection one easily comparable measurement should be emphasized, namely the length of the stomata guard-cells, which, within reasonable limits, seems to be constant for each species. The stomata are of approximately the same dimensions on either surface of the leaf, though sometimes a little shorter on the under side, even though their distribution and number may differ considerably. All the species investigated were provided with stomata on both leaf surfaces. While the upper side of the leaf is always abundantly supplied with stomata, the stomatal supply of the under side varies from group to group. Thus *P. Langeana s. l.* has comparatively few stomata, and *P. phryganodes* has exceedingly few or, in some cases, none at all.

Otherwise the two leaf surfaces may be much alike, or quite different. In describing the epidermal peculiarities, it is necessary to distinguish between the fields covering the assimilating tissue and the usually narrower stripes covering the vascular bundles, which, especially on the under side, are accompanied by strands of sclerenchymatous tissue. For the sake of simplicity these stripes are in the following pages denoted stereome bands, even if the fibres, especially on the upper side of the mestome strands, are often replaced by a mere large-celled transfusion tissue.

The epiderm of the grass leaf is built up of longitudinal cell rows composed of long cells and short cells. However, in some species such a differentiation into these two cell types is not quite clear or, in extreme cases, completely absent. Simplification of the epidermal structure seems to be a characteristic of high-arctic species.

The following details are of diagnostic value:

The stomata may be situated at the level of the epiderm or sunk into hollows, pits, and thus partially hidden by the adjacent cells.

The surface of the individual cells may be plane or marked with a protuberance, a papilla or wart. On the long cells of the assimilating fields the wart may be placed terminally at the distal end of the cell and directed obliquely forwards. In that case the wart will protrude above the proximal part of the next cell, and if it is adjacent to a stoma, it may appear as a rather conspicuous "stomatal flap". In case the wart is placed at a small distance from the end of the cell, no "stomatal flap" is formed. In some, preferably high-arctic, species no real warts are present, but the whole cell may be tumid, especially in its distal part, and then the club- or drop-shaped cells will lend to the leaf-surface a curious dewy or fluorescent hue. Such swollen cells may simulate, but should not be mistaken for, real papillae. Sometimes transitional

cell-forms are observed, i. e. tumid cells with a small wart placed on their most swollen distal part. The cell tissue covering the stereome bands always lacks stomata. Generally it is composed of linear long cells and ± isodiametrical short cells, but in exceptional cases all the cells may be of the same shape: long, or short, or intermediary ones. In some, commonly high-arctic, species the long cells are tumid and barrel-shaped. Curiously enough, sometimes no coincidence exists between the swelling of "stereome" cells and that of the "assimilating" cells. If the "stereome" cells, only, are tumid, their diameter may be up to three times larger than those of the assimilating fields (e. g. *P. Langeana*). This proportion is quite the opposite to that generally met with in grasses.

Some of the short cells of the epiderm of the upper side, chiefly of the stereome bands, are often transformed into spines. Such spines are usually well defined, though in rare instances transitions between warts and real spines may be found. Probably the presence or absence of spines is not always a reliable distinguishing character. The not spiniform short cells of the stereome bands, most typically found on the under side, are of interest. In some species they are always found singly, while in others they are also found in pairs. The two cells may be alike, but more often a square cell is accompanied by a smaller, in optical section lens-shaped, one.

The epidermal cells of the leaf margin attached to the non-vascular marginal stereome strand, which is always present, likewise seem to be of diagnostic value. Sometimes the margin is built up of rather elongated cells interrupted by short ones or by real spines, sometimes merely of uniform short cells.

Transverse sections of leaves have often been recommended as a help in the identification of grasses, especially when they are in a flowerless state (see f. inst. LEWTON–BRAIN, 1904). Within the genus *Puccinellia* such sections are of minor value, since they are often too much alike to be diagnostically applicable. Some features of the epidermal cells may, indeed, be observed in transverse sections, but only by inspection of the superficial configurations of the cells can the epidermal characters be fully evaluated. On the other hand, the rows of bulliform cells are conveniently observed in sections. Most of the Greenland Puccinellias usually have only one groove with bulliform cells on either side of the mid-rib. Some species characterized by flat leaves often have more rows, although narrower leaves with only two rows may be found, too. Therefore epidermal characters, not implying the bulliform cells, seem to be more applicable in the diagnostication of Puccinellias.

On the basis of the epidermal features briefly outlined here a key to the Greenland species is given below (p. 15 et. seq.).

III. THE GREENLAND SPECIES OF *PUCCINELLIA*[1])

Key to the Greenland *Puccinellia* and *Colpodium*.

A. Rachilla of spikelets slender, abruptly thickened at the insertion, of the florets. Joints after disarticulation with surface of fracture disk-like widened. Glumes long, reaching above the middle of the lower lemmas, thin, evidently plicate when dried:
Colpodium Vahlianum (Liebm.) Nevski

AA. Rachilla rather stout, not clearly thickened at the insertion of the florets. Joints scarcely widened at surface of fracture. Glumes commonly not reaching the middle of the lower lemmas, rarely longer, not plicate when dried: *Puccinellia.*

B. Glumes and lemmas entire or somewhat irregularly dentate, not ciliolate.

C. Anthers 1.5—2.5 mm long. Plant stoloniferous, with overground runners.

D. Lemmas glabrous. Keels of palea without spinules. Anthers not dehiscent, containing no good pollen. Innovations of the runners placed extra-axillarily (opposite the leaf-insertion), usually sprouting proleptically:
Puccinellia phryganodes (Trin.) Scribn. et Merr.

DD. Lemmas pilose on the nerves at base. Keels of palea spinulose. Anthers dehiscent, containing normal pollen. Innovations of the runners placed axillarily, usually sprouting from the axils of one-year-old leaves:
Puccinellia maritima (Huds.) Parl.

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[1]) The intricate question of the nomenclature of the genus has been elucidated by FERNALD and WEATHERBY (1916), HOLMBERG (1924), FERNALD (1926, p. 150), and SPRAGUE (1940, p. 82 and p. 84), who weigh the arguments for conserving the generic name of *Puccinellia* Parl. (PARLATORE 1848, p. 366) antedated by *Atropis* Rupr. (RUPRECHT 1845, p. 61, 64; GRISEBACH in LEDEBOUR 1853, p. 388).

CC. Anthers 0.5—1.0 mm long. Plant caespitose, without runners.

E. Lemmas 1.8—2.5 mm long, nerves prominent. Callus hairs absent. Keels of palea without spinules:
Puccinellia Langeana (Berl.) Th. S. ssp. *typica* Th. S.

EE. Lemmas 3.0—4.0 mm long, nerves not prominent. Callus hairs present. Keels of palea distantly spinulose:
Puccinellia Andersonii Swallen.

BB. Glumes and lemmas erose-ciliolate.

F. Keels of palea spinulose toward the apex, long-hairy toward the base.

G. Culms 15—30 cm tall. Panicle short, contracted, dark-violet. Lemmas acute—acuminate, hyaline bordered, copi ously hairy on the nerves from the base to one-third or half their length. Ligule acute. Anthers 0.6—0.8 mm long:
Puccinellia angustata (R. Br.) Rand & Redf.

GG. Culms 40—65 cm tall. Panicle large, spreading or drooping, green or somewhat purple. Lemmas subacute—obtuse, scarcely hyaline bordered, hairy on the nerves at base. Ligule truncate. Anthers 1.0—1.5 mm long:
Puccinellia groenlandica Th. S.

FF. Keels of palea spinulose toward the apex, glabrous or with a few spinules or hairs, not clearly ciliate, toward the base.

H. Glumes long, subequal, reaching $^1/_2$—$^3/_4$ of the lower lemmas. The 1st glume c. 3 mm long, often three-nerved:
Puccinellia Porsildii Th. S.

HH. Glumes shorter, usually not reaching the middle of the lower lemmas. 1st glume not exceeding 2 mm, one-nerved. 2nd glume sometimes conspicuously longer.

I. Glumes rather firm, usually inserted at different heights, apparently alternate. Pedicels ± thickened below the spikelet.

J. Glumes and lemmas acute—acutish. Leaves rolled, evenly tapering toward the apex. Culms and leaves stiffly erect. Plant conspicuously glaucous:
Puccinellia laurentiana Fern. et Weath.

JJ. Glumes and lemmas obtuse—truncate. Leaves folded and curved or flat and rather lax, abruptly pointed at apex. Culms geniculate. Plant ± glaucous:
Puccinellia coarctata Fern. et Weath.

II. Glumes thin, apparently opposite. Pedicels not thickened.

K. Culms foliiferous only in the lower part. Leaves rigid, rolled, glaucous; old basal sheaths scarious, shining. Spikelets ovate-lanceolate, tight, reddish purple, golden yellowish variegated. Palea usually exceeding the lemma:
Puccinellia deschampsioides Th. S.

KK. Culms foliiferous to above the middle. Leaves rather lax, flat, sometimes rolled and recurved, green or slightly glaucous. Old sheaths not scarious, decaying. Spikelets loose, greenish or purple. Palea not exceeding the lemma.

L. Glumes subequal, short, usually rounded at apex, convex on the back, obscurely nerved. Palea as long as the lemma. Upper leaf sheath usually subinflate.

M. Panicle compact, ovate, branches short, fasciculate. Spikelets densely crowded, ovate, whitish green, not conspicuously glossy:
Puccinellia coarctata var. *pseudofasciculata* Th. S.

MM. Panicle large, spreading; branches usually in pairs. Spikelets linear, ± purple, conspicuously glossy:
Puccinellia vaginata (Lge.) Fern. & Weath.

LL. Glumes conspicuously unequal, the 1st: small, narrow, acute, the 2nd: large, rounded or subtruncate, often subcarinate, thin and translucent, evidently nerved. Palea shorter than the lemma. Upper sheath not inflated.

N. High-grown; culms erect, slender. Panicle ± contracted, $^1/_5$—$^1/_4$ the length of the whole plant, branches in pairs, slender, ascending. Spikelets pedicelled:
Puccinellia Rosenkrantzii Th. S.

NN. Low-grown; culms geniculate at base, stout. Panicle pyramidal, $^1/_3$—$^1/_2$ the length of the whole plant, branches often fasciculate, stiffly spreading, stout. Spikelets appressed, the distal ones subsessile:
Puccinellia vaginata var. *paradoxa* Th. S.

Key to the Greenland *Puccinellia* and *Colpodium*, based on the epidermal characters of the leaf.

a. Epidermal cell tissue not differentiated into short cells and long cells: all cells in one and the same row of approximately equal length: *Colpodium Vahlianum* (figs. 53—54).

aa. Epidermal tissue, at least along the stereome bands of the lower side, differentiated into short cells and long cells: *Puccinellia.*

b. Epiderm of the two leaf surfaces differing as to wartiness: upper side with high warts, under side smooth or nearly so.

c. Warts about as high as wide. Stomata of under side numerous, deeply sunk into pits; entrance of pits $^1/_4$—$^1/_2$ the length of the guard-cells. Stomata 35—40 μ: *P. maritima* (figs. 75—76).

cc. Height of the warts about twice their width. Stomata of under side very few, often none, moderately sunk; entrance of pits $^2/_3$ the length of the guard-cells or larger. Stomata 30—35 μ: *P. phryganodes* (figs. 93—94).

bb. Epiderm of the two leaf surfaces not very much different as to wartiness: warty or smooth.

d. Leaf margin densely crenulated from uniform short cells, generally not exceeding twice their width, not spiny.

e. Epidermal tissue densely meshed, cells about 10 μ wide; stomata 30—35 μ. Cells of the assimilating bands neither papillose nor tumid, those of the stereome bands wider, often barrel-shaped; no spines: *P. Langeana* ssp. *typica* (figs. 55—56).

ee. Epidermal tissue more loosely meshed, cells about 20 μ wide, stomata 40—50 μ. Cells of the assimilating bands, especially on the upper side, warty or tumid and club-shaped. Stereome bands smooth or spiny.

f. Long cells of the assimilating bands ± tumid, club-shaped, sometimes slightly warty; short cells elongated, often hardly different from the long cells. Stereome bands generally not spiny: *P. Andersonii* (figs. 57—58).

ff. Long cells of the assimilating bands evidently warty, not tumid; short cells well-defined. Stereome bands often spiny: *P. vaginata* var. *paradoxa* (figs. 85—86).

dd. Leaf margin not crenulated, composed of elongated cells (3—8 times their width) intermingled with shorter ones or spines.

g. Epidermal tissue comparatively short-meshed, long cells of assimilating bands not much longer than the stomata; stomata 30—40 μ. Longest marginal cells rarely exceeding 4 times their width.

h. Leaves commonly folded. Warts of upper leaf surface low, not higher than wide, often much lower: *P. coarctata* (figs. 71—74).

hh. Leaves commonly flat. Warts of upper leaf surface high, up to twice their width: *P. coarctata* var. *pseudofasciculata.*

gg. Epidermal tissue not short-meshed, long cells of assimilating bands generally much longer than the stomata; stomata 40—55 μ. Longest marginal cells 5—8 times their width.

i. Upper leaf surface not distinctly and regularly warty; stomatal flaps generally lacking. Leaves commonly flat with more than two grooves of bulliform cells.

j. Epidermal cells narrow, (10—)15—20 μ wide, those of the upper leaf surface at least in part club-shaped, somewhat tumid. Stomata not evidently pitted: *P. angustata* (figs. 61—62).

jj. Epidermal cells wide, 20—25(—30) μ, not club-shaped. Stomata evidently pitted: *P. groenlandica* (figs. 69—70).

ii. Upper (and lower) leaf surface distinctly and regularly warty. Stomatal flaps present or wanting. Leaves commonly involute with only two grooves of bulliform cells.

k. Epidermal warts on upper leaf surface not actually terminal on the long cells, and not forwardly directed, thus forming no stomatal flap. Under side stomata scarcely pitted. Stomata (45—)50—55 μ: *P. vaginata* (figs. 87—88).

kk. Epidermal warts on upper leaf surface terminal on the long cells, $\pm$ forwardly directed, forming a stomatal flap. Stomata of under side of leaf evidently pitted; entrance of pits $^1/_2$—$^2/_3$ the length of the guard-cells. Stomata 40—50 μ.

l. Wartiness evident but rather inconspicuous, especially on the under side, often restricted to the short cells and the stomatal flaps. Short cells of the stereome bands of the under side most often singly: *P. Rosenkrantzii* (figs. 59—60).

ll. Wartiness of both leaf surfaces conspicuous and rather dense. Short cells of the stereome bands of under side most often in pairs.

m. Epidermal cells of under side of leaf, especially those of the stereome bands, somewhat tumid, and the warts therefore not well defined; stomatal flaps (of either leaf surface) with dilated base, as broad as the supporting cell: *P. laurentiana* (figs. 65—66).

mm. Epidermal cells of under side of leaf not tumid, warts well defined. Stomatal flaps with constricted base, narrower than the supporting cell.

n. Stomatal flaps semicircular, covering only the lens-shaped part of the stoma guard-cells. Under side: non-terminal warts of long cells inconspicuous or absent altogether:

P. deschampsioides (figs. 63—64).

nn. Stomatal flaps (especially of upper side) elongated, cylindrical, covering about half the stoma guard-cells. Under side: non-terminal warts of long cells conspicuous, numerous:

P. Porsildii (figs. 67—68).

Colpodium Vahlianum (LIEBM.) NEVSKI.

NEVSKI in Komarov Fl. URSS II (1934) p. 436.

Poa Vahliana LIEBMANN, Fl. dan. fasc. 41 (1845) tab. 2401.

Illustrations: LIEBMANN l. c.; LANGE in Kjellman & Lundström, Vega-Exp. Vetensk. Iaktt. I (1882) tab. 7; KOMAROV Fl. URSS II (1934) tab. 35, fig. 3; this paper, figs. 3—5 and 53—54.

Distribution within Greenland: fig. 101.

Perennial, caespitose. Foliage yellowish green. Culms straight, erect or prostrate, 2—3-leaved. Culm leaves 3—5 cm long, 2.0—2.5 mm wide, glabrous, flat and lax. Ligule 2.5—4.0 mm long, thin, acutish, often erose. During anthesis the panicle is only shortly exserted; in a mature state the uppermost joint is considerably elongated and the culm leaf-bearing in the lower half only. Panicle 3—5 cm long, contracted. Branches in pairs from the lower nodes, short, glabrous, ascending, bearing a few spikelets; upper part of the panicle racemose. Spikelets 6.0—7.5 mm long, lanceolate, purple, shining, 2—4-flowered. Rachilla slender, abruptly widened at the insertion of the florets. Glumes and lemmas very thin, translucent, irregularly folded when dried, purple in their lower part, whitish or yellowish in their upper part, erose. Glumes lanceolate, obtuse or subacute, 1st 3.0—3.5 mm long, 1-nerved, 2nd 3.5—4.0 mm long, 3-nerved. Lemmas broadly lanceolate, subacute, 5-nerved (the intermediary lateral nerves sometimes obsolete), copiously hairy on the back in the lower half, especially on the nerves, the internerves more sparsely hairy. Palea about $^1/_2$ mm shorter than the lemma, bifid at apex, the keels spinulose toward the apex, long-hairy toward the base. Anthers 1.0—1.2 mm long. Grain c. 2.0 mm long.

The above description is based on plants collected by J. VAHL in July 1836 near Niaqornat, Nûgssuaq Peninsula (Umanak District). There is no doubt that this collection represents the type material of *Poa*

Vahliana first described and pictured by LIEBMANN (Fl. dan. fasc. 41, tab. 2401 (1845)).

TH. FRIES (1869, p. 140) transferred it to *Glyceria*. Later on SCRIBNER and MERRILL (1910, p. 78) incorporated it in *Puccinellia*, a procedure followed by several authors. Not till 1934 was it placed with *Colpodium* by NEVSKI (Fl. URSS II, p. 436). Owing to the delicate texture of the bracts, the long subequal glumes, the strongly pilose lemmas, and the slender, abruptly thickened rachilla joints it agrees with *Colpodium*, if anything. Besides, in general appearance it bears a striking resemblance to some Asiatic species of *Colpodium*.

Nevertheless SCRIBNER and MERRILL (l. c.) thought that the plant was related to *Puccinellia alaskana*. On the assumption that some connection once existed between the two genera under consideration, precisely the *Puccinellia Langeana* Group (including *P. alaskana*, cf. p. 25) and *Colpodium Vahlianum* may be pointed out as possible connecting links. They seem both of them to represent primitive types within the respective genera, because of their morphological as well as cytological characters. The haploid chromosome number of both species is the basic one, n = 7.

The epidermal structure of the leaf of *Colpodium Vahlianum* is remarkable by the cell tissue not being differentiated into long cells and short cells (figs. 53—54). The marginal cells are short. As to the anatomical features of the leaf it seems even to come closer to the *Langeana* Group of *Puccinellia* than to Siberian representatives of the genus *Colpodium*, on which comparative investigations were undertaken. Thus the leaf-anatomical evidence strengthens the impression that *Colpodium Vahlianum* occupies a peculiar intermediate position between *Puccinellia* and *Colpodium*.

Within Greenland, *Colpodium Vahlianum* shows approximately the same distribution as *Puccinellia angustata*. Even though it is found as far north as Peary Land, it was not represented in THORILD WULFF's collections from the very north coast of Greenland. It is a decidedly calciphilous plant, and this may account for its absence over large distances. Also outside Greenland its "closed" area largely covers that of *Puccinellia angustata*, reaching Novaya Zemlya to the east and Hudson Bay to the west. In addition, it is recorded from Dickson Island off the mouth of the river Yenisei (TOLMATCHEV & PETKOV 1930, p. 155) and, extremely isolated, from Yakutsk at the mouth of Lena River (TOLMATCHEV 1930, p. 197). Outside its Arctic East American area it has recently been discovered by A. E. PORSILD (1945, p. 15) in western N. America, Mackenzie Mountains, Plains of Abraham, 6000 feet above sea-level "1.400 miles from the nearest known station of this plant".

In Greenland, *Colpodium Vahlianum* is not a halophilous plant and is always found some distance from the seashore. POLUNIN (1940, p. 86) likewise states that it grows in "non-saline habitats". However, as far as the Siberian occurrences are concerned, TOLMATCHEV (1932, p. (189), 1935, p. 16) holds it to be a seashore plant. From these contradictory statements it may be inferred that the species comprises ecologically different races.

Puccinellia Langeana (BERL.) TH. S. ssp. ***typica*** TH. S.

SØRENSEN in Hultén, Fl. Alaska and Yukon X, Suppl. (1950) p. 1710.

Glyceria Langeana BERLIN, Öfvers. Kongl. Vet.-Akad. Förh. 1884 N:o 7, p. 79.

Illustrations: KOMAROV, Fl. URSS II (1934) tab. 37, fig. 17; this paper, pl. 1; figs. 8—9 and 55—56.

Distribution within Greenland: fig. 102.

Perennial caespitose, glabrous, glaucous or purple-tinged. Culms 4—10 cm tall, vigorous, fistulose, erect or recurved. Cauline leaves 1(—2), blades 2—4 cm long, folded, abruptly contracted into a blunt apex, 1.0—2.0 mm wide (when flattened out). Ligule 1.5—2.0 mm long, acute, often irregularly toothed. Panicle 3—5 cm long; branches in pairs, glabrous, ascending, in vigorous specimens later on divaricate, with 3—6 appressed short-pedicelled spikelets, sometimes a third smaller one from the lower node. Panicle in the upper half simple, spike-like, often with subsessile or sessile spikelets; pedicels not thickened. Spikelets commonly intensely-purple, often variegated, 4—6 mm long, 3—7-flowered, florets loosely imbricate. Glumes and lemmas firm, distinctly nerved, narrowly white-bordered; margin entire. 1st glume 0.8—1.0 mm long, narrowly ovate, acute, ± keeled, 2nd glume 1.2—2.0 mm long, ovate-oblong, acute or subacute, 3-nerved. Lemmas of lower florets 2.0—2.3 mm long, of uppermost ones 1.5—1.8 mm long, oblong, obtuse or bluntly acute, 5-nerved, the mid-nerve reaching the very apex, the intermediate nerves not converging at apex, glabrous or rarely with some few hairs on the lateral nerves at base. Callus hairs absent. Palea as long as the lemma or a little shorter, truncate or indistinctly bilobate, keels completely glabrous. Anthers 0.4—0.6 mm long. Grains 1.2—1.4 mm long.

Specimen described: Disko Isl. Godhavn, leg. PAUL GELTING, July 17, 1946.

The taxonomy and nomenclature of the plant in question have been in dispute ever since it was first recognized. It was collected by the Swedish botanist K. BERLIN in 1883 at Kangâtsiaq in West Greenland, and in his plant list BERLIN entered it as *Glyceria Langeana* nov. sp. (BERLIN 1884, p. 79). A fairly exhaustive description of the plant is given.

Some years before LANGE had described and pictured his *Glyceria tenella* collected by KJELLMAN and LUNDSTRÖM at Rogatschew Bay,

Novaya Zemlya, and at Cape Grebeni, Waigatsch Island, during the Swedish Vega-Expedition (KJELLMAN och LUNDSTRÖM 1882, p. 313, tab. 6). GELERT (in OSTENFELD, Fl. Arct. I, p. 129 (1902)) was of opinion that the Greenland and the Novaya Zemlyan plant could not be kept apart, consequently he united them under the name first given to it, *Glyceria tenella* LGE.

HOLMBERG (in PORSILD 1920, p. 45), on referring the species to *Puccinellia*, evidently made no objection to GELERT's procedure. The identity of *Glyceria tenella* and *Glyceria Langeana* was not questioned until POLUNIN (1940, p. 83) maintained that the Greenland plant which GELERT in all probability had before him when describing *Glyceria tenella* for Fl. Arct., was not actually *G. tenella* of LANGE, but the N. American plant described by HOLM (1907, p. 337) as *Glyceria paupercula* well known to American authors as *Puccinellia paupercula* (HOLM) FERN. & WEATHERBY. *Glyceria tenella* LGE., according to POLUNIN, is an Old World Arctic species. Later POLUNIN (1943, p. 364) suggested that *Glyceria Langeana* BERL. is probably identical with *Puccinellia paupercula*, but owing to the absence of authentical material he does not settle the question definitely. An inspection of type material of BERLIN's plant has corroborated POLUNIN's suggestion. For the sake of priority the Greenland-Canadian Arctic plant should bear the name of *Puccinellia Langeana* (BERL.).

Since, so far, the identity of LANGE's *Glyceria tenella* is obscure the present author has carried out some studies aiming at clearing up the relation between this Old World species and the Greenland—N. American *Puccinellia Langeana.*

Only a single specimen (kept in the Riksmuseum, Stockholm) bearing the inscription of *Glyceria tenella* in LANGE's own handwriting is to be found in the Swedish Musei (cf. pl. 9). According to the label, it was collected by KJELLMAN and LUNDSTRÖM at Cape Grebeni in July 1875. The habit figure, accompanying the diagnosis of LANGE (KJELLMAN & LUNDSTRÖM, l. c. pl. 6) was not evidently based on this plant. However, this very specimen was the one that HOLMBERG with some reason, though actually not correctly, identified with *Glyceria Langeana* BERL.

As to LANGE's own conception of his *Glyceria tenella*, attention should be called to his remarks appended to the original diagnosis; here LANGE states that *Glyceria tenella* comes close to *Glyceria vaginata.* Later on LANGE (in HOLM 1885, p. 16), describing a *forma pumila* belonging to *G. tenella*, even suggested that *G. tenella* might represent depauperate forms of his Greenlandic *Glyceria vaginata.* These remarks unambiguously tell us that LANGE's conception of his *G. tenella* was not based on the Stockholm specimen, which HOLMBERG considered the type. Nobody would mistake this plant for *Puccinellia vaginata.*

A rather incomplete and badly preserved specimen of *G. tenella* f. *pumila*, determined by LANGE, is found in the Copenhagen Museum. Although a clear idea of *G. tenella* can hardly be obtained from this specimen, it seems evident that it is neither *Glyceria vaginata* nor *Puccinellia tenella* of HOLMBERG.

KRECZETOWICH (in Fl. URSS II, p. 483) has a description of an *Atropis tenella* (LGE.) which is undoubtedly based on plants differing greatly from the Stockholm type (i. e. *Puccinellia tenella* HOLMB.). He identifies it with HOLMBERG's *P. retroflexa* ssp. *borealis*.

Collections made by O. EKSTAM in 1907 in the very type locality of *Glyceria tenella*, viz. Cape Grebeni, Waigatsch Isl., seem to give the clue to the problem of the obscure *Glyceria tenella*. The collections comprise *Puccinellia retroflexa borealis* (by the present author identified with *P. coarctata* FERN. & WEATHERBY, cf. this paper p. 42) as well as another habitually similar *Puccinellia*, which in the opinion of the writer may be the true *Glyceria tenella*.

A close comparison of the HOLMBERG "type" and the EKSTAM plants with LANGE's drawings (pl. 6 in KJELLMAN & LUNDSTRÖM) has convinced me that at least some of the detail figures (figs. c, e, and f) were doubtless drawn from the Stockholm specimen (HOLMBERG's *Puccinellia tenella*) while the habit figures and the rest of the detail drawings may represent the EKSTAM plant. LANGE's description was evidently in the main based on the plants drawn in habit, though some passages refer to the other plant, viz. "foliis . . . . complicatis, obtuse et oblique mucronatis." "—floribus invicem remotis,—palea inferiore . . . . anguste albomarginata."

From the above unravelment it may be inferred that *Glyceria tenella* LANGE is a *nomen confusum*. Probably, according to the International Rules of Nomenclature, the Langean name should be rejected. However, I think it is sufficiently cleared up what LANGE actually meant by his *Glyceria tenella*. For that reason it seems to me more rational to retain the old name, though an emended description is needed. The plant in question clearly belongs to the species described by KRECZETOWICH (Fl. URSS II, p. 478 and p. 761) under the name of *Atropis pulvinata* (FR.). However, the type of FRIES's *Glyceria distans pulvinata* (Herb. norm. 5 : 90) from Varberg, Halland, South Sweden, seems to me to be a depauperate specimen belonging to *P. retroflexa* (CURT.) HOLMB. (cf. also HOLMBERG 1926 b, p. 218—19), and does not fit KRECZETOWICH' description, which was evidently based on the other specimen cited by him, viz. Pl. Finl. exs. 484 from Ekenäs, Tvärminne, South Finland. The latter matches the plants alluded to above, collected by EKSTAM at Cape Grebeni. Therefore, in the opinion of the

present writer *Atropis pulvinata* KRECZ., excluding the South Swedish "type", covers the real *Glyceria tenella* of LANGE (cf. also this paper p. 80).

EKSTAM brought home collections of this plant from Cape Grebeni and in addition *Puccinellia retroflexa borealis* HOLMB. and several other grasses, but not *Puccinellia tenella* HOLMB. TOLMATCHEV (1926) likewise investigated the flora of Waigatsch (incl. Cape Grebeni), but *Glyceria tenella* is not enumerated in his plant list. Why did these experienced botanists not succeed in finding the KJELLMAN-LUNDSTRÖM plant which HOLMBERG considered the true *Glyceria tenella*? Was it ever found there at all? Precisely the same plant (found in the Uppsala Museum) was collected by KJELLMAN at Pitlekaj on the north coast of Chukch Peninsula, originally determined by the collector as *Catabrosa algida.* It was later re-determined by HOLMBERG as *Puccinellia tenella.* This plant, like the Cape Grebeni specimen, was brought home by the Vega Expedition. Has some unfortunate confounding of labels occurred later on when the collections were mounted? I have tried to arrive at a definite solution of this question: Small soil particles still adhering to the roots of the herbarium specimens of the identical KJELLMAN plants labelled Cape Grebeni and Pitlekaj, respectively, and of the authentic Cape Grebeni plant collected by EKSTAM were secured and subjected to a careful investigation on a mineralogical basis. The investigation was kindly undertaken by H. GRY, Ph. D., of the Danish Geological Service. Dr. GRY succeeded in identifying more than ten significant heavy minerals. All three samples contained essentially the same assortment of minerals; however, the doubtful sample to be tested contains the mineral anatas, which is also present in the authentic Cape Grebeni sample, while it is not to be found in the Pitlekaj sample. In the opinion of Dr. GRY, this fact must be considered conclusive, and accordingly his verdict reads: There is no evidence to show that a mislabelling has taken place. Therefore, as a matter of consequence, we must accept the statement of the collector that the plant in question was really found at Cape Grebeni, Waigatsch Island.

Whatever this may be, this plant as also the Pitlekaj specimens belong to the species enumerated and minutely described by KRECZETOWICH (in Fl. URSS II, p. 480 (1934)) under the name of *Atropis paupercula* (HOLM). It is known to the Russian author only from Arctic East Asia, so that he, too, has not seen any specimens from the Waigatsch region. No doubt, KRECZETOWICH had a clear conception of the plant, and, consequently, his wrong determination of it gave rise to another mistake: He correctly recognized a related plant from St. Lorenz Bay at the Bering Strait as different from his *Atropis paupercula* and described it as a new species, *Atropis laeviuscula* (l. c. p. 762 et p. 483). This new

St. Lorenz plant is precisely the Greenland *Glyceria Langeana* BERL., syn. *Glyceria paupercula* HOLM.

Accordingly, *Atropis paupercula* of KRECZETOWICH (i. e. *Puccinellia tenella* of HOLMBERG concerning the Cape Grebeni type) represents a unity of its own. It has lately been described in HULTÉN's Fl. of Alaska and Yukon X (1950) p. 1710 under the name of *Puccinellia Langeana* ssp. *asiatica* TH. S.

Still another related plant should be considered here, viz *Puccinellia alaskana* SCRIBNER & MERRILL (1910, p. 78). It is restricted to Northwestern America. However, FERNALD and WEATHERBY (1916, p. 18) maintained that it occurs, in addition, in Eastern America around the St. Lawrence Gulf. And, as a consequence, it has figured in the current manuals of that region ever since. Nevertheless, the East American area should not be included in the range of *Puccinellia alaskana.* All records of *Puccinellia paupercula* and its var. *alaskana* of FERNALD and WEATHERBY from East America south of the northernmost part of Labrador refer, no doubt, to other species not yet fully elucidated. The ambiguousness of FERNALD and WEATHERBY's *P. paupercula* var. *alaskana* was formerly pointed out by HULTÉN (1937 b, p. 961), who proposed the name *Puccinellia pumila* var. *Fernaldii* for the East American plant. However, the East American material is not uniform. The bulk of it comes rather close to *Puccinellia pumila* (VASEY) HITCHC. *sensu* SWALLEN (1944, p. 22) (cf. also this paper p. 66). The real *Puccinellia alaskana*, on the other hand, seems to be rather closely related to *P. paupercula* HOLM, from which it cannot always be rationally kept apart (cf. also HULTÉN 1942, p. 238).

As a result of the investigations presented above, the relationships of the Greenland *Puccinellia Langeana* may be summed up as follows:

The Greenland *Puccinellia Langeana* figures as one of the constituents of a small group of closely related high-arctic Puccinellias ranging from West Greenland to Eastern Asia (and Waigatsch). The group comprises three unities, the areas of which overlap in the Bering Sea region. Since within this region the three unities intergrade imperceptibly into one another, they should, each of them, be given a subspecific rank, only. For the sake of priority *Puccinellia Langeana* must stand as the specific name. The unities here considered to be subspecies are as follows:

1) *Puccinellia Langeana* (BERL.) TH. S. ssp. *typica* TH. S. (in HULTÉN 1950, p. 1710), based on *Glyceria Langeana* BERL. (cf. this paper, pl. 1; figs. 8—9).

   Syn.: *Glyceria paupercula* HOLM; *Puccinellia tenella* HOLMBERG (pro parte); *Atropis laeviuscula* KRECZ.

Distribution: West Greenland, Arctic N. America to easternmost Asia (Chukch Peninsula).

2) *Puccinellia Langeana* (Berl.) Th. S. ssp. *asiatica* Th. S. (in Hultén 1950, p. 1710) (cf. this paper, pl. 9; fig. 10).
Syn.: *Puccinellia tenella* Holmberg (pro parte); *Atropis paupercula* Kreczetowich.
Distribution: Islands of Bering Sea, Eastern Asia, Waigatsch.

3) *Puccinellia Langeana* (Berl.) Th. S. ssp. *alaskana* (Scribn. & Merr.) Th. S. (in Hultén 1950, p. 1710), based on *Puccinellia alaskana* Scribner & Merrill (cf. this paper, fig. 11).
Distribution: Coastlands and islands of Bering Sea, Kamtchatka.

The geographical distribution of the three subspecies is shown in fig. 114.

A table of the differential characters of these subspecific unities has been published elsewhere (in Hultén 1950, p. 1709). For the sake of completeness the table is reprinted below:

	ssp. typica	*ssp. asiatica*	*ssp. alaskana*
culm:	stout	rather slender	slender
leaves:	narrow, folded, rigid	narrow, flat—folded, rather lax	broader ± flat, convolute only at apex
spikelets:	oblong, obtuse, in upper part of the panicle often sessile, intensely purple	ovate, obtuse, all pedicelled, greenish or dilute-purplish	elliptical-lanceolate, acute, in upper part of the panicle often subsessile, greenish or ± purplish
pedicels:	not thickened	slightly thickened	scarcely thickened
glumes:	subacute—acute	obtuse—truncate	acute-acuminate—subobtuse
lemmas:	obtuse—bluntly acute, slightly crooked	obtuse—truncate, conspicuously crooked	acute—acuminate, straight
nerves of lemmas:	parallel or slightly convergent, glabrous at base	conspicuously converging, sparsely hairy at base	parallel, ± copiously hairy at base
palea:	blunt, keels glabrous	blunt, keels glabrous or with a few spinules	bifid, keels spinulose-ciliate

The leaf-epiderm of the *Puccinellia Langeana* Group is very peculiar as compared with most other arctic Puccinellias. The leaf margins are finely crenulated from the short rounded marginal cells. The cell tissue of the epiderm is very narrow-meshed; however, the epidermal cells of the upper-side stereome bands are usually tumid and barrel-shaped. The under side of the leaf is rather uniformly narrow-celled.

The stomata are placed at surface level, not pitted, 30—40 μ long. The under side is more sparsely furnished with stomata than is the case in other arctic Puccinellias, *P. phryganodes* excepted, the stomata being restricted to a few rows along the stereome stripes, while the assimilating belts are devoid of stomata.

From a number of random investigations some differences between the three subspecific unities as to epidermal features can be pointed out: The marginal cells of ssp. *alaskana* are extremely short and regularly uniform, but somewhat less uniform in the other two.

The upper-side epiderm in ssp. *alaskana* is usually entirely built up of long cells, while in the other two ssp. short cells, though sometimes very sparse, are intermixed. A specimen intermediate between *alaskana* and *typica* showed a few short cells preferably restricted to the cell rows along the leaf margins.

Ssp. *alaskana* and ssp. *typica* generally have a smooth epiderm; ssp. *asiatica*, on the other hand, shows traces of papillae. However, wartiness seems chiefly to be a "western" characteristic, since ssp. *typica*, otherwise typical, from the Bering Sea region may be slightly papillose, too.

According to the leaf-anatomy, ssp. *alaskana* seems to be the most oustanding type within the group. As far as the leaf anatomy is concerned, it comes closer to *Colpodium Vahlianum* than does any other arctic *Puccinellia*. A relationship to the latter species was already suggested by SCRIBNER and MERRILL (1910, p. 78).

Puccinellia Langeana typica is more uniform than most of the Greenland Puccinellias. Nevertheless ROSENVINGE (1892, p. 732) described a var. *stricta* which seems to differ from the type only by its more vigorous growth; it is of no taxonomic value.

Puccinellia Andersonii SWALL.

SWALLEN, Journ. Wash. Acad. Sc. 34 (1944) p. 21.

Illustrations: This paper: figs. 6—7 and 57—58.
Distribution within Greenland: fig. 103.

Perennial, caespitose, glaucescent, the whole plant reddish tinged. Culms robust, geniculate, 10—20 cm long, 2-leaved, the uppermost sheath elongated, slightly widened. Blades glabrous, 3—5 cm long, 2 mm wide, folded, abruptly contracted at apex. Ligule 1.5—2.0 mm long, acute, decurrent. Panicle 4—6(—8) cm long, contracted; branches 2—3 from the lower nodes, glabrous, ascending, naked in their lower half, bearing (1—)2—5 short-pedicelled or subsessile spikelets; pedicels thickened, lustrous. Spikelets pink or a dilute purple 7—9 mm long, 4—7-flowered. Rachilla very fragile. Glumes evidently alternate-inserted, firm, the 1st 1.5—2.0 mm long, oblong, acute, one-nerved, the 2nd 2.0—3.0 mm long, broadly ovate, subacute or irregularly dentate, evidently 3-nerved. Lemmas 3.0—4.0 mm long,

acutish, comparatively thin whitish and translucent at apex, like the glumes entire, not erose-ciliolate, nerves evident, often intensely coloured, faintly pilose at base. Callus hairs present. Palea shorter than the lemma, bifid at apex, the keels faintly spinulose-ciliate in their distal part. Anthers 0.8—1.0 mm long. Grains 1.8—2.0 mm long.

Specimen described: NE. Greenland, Stormkap (76°49′ N. lat., 19°30′ W. long.) leg. Th. Sørensen Aug. 11, 1933, Nr. 2610.

Puccinellia Andersonii, recently described by Swallen (1944, p. 21), was previously known only from the type locality, Pt. Lay, Arctic Alaska. The present revision of the Greenland Puccinellias has shown that it is distributed over northern Greenland southward to c. 70° N. lat. on the west coast and to c. 73° N. lat. on the east coast. Formerly it was usually mistaken for *Puccinellia angustata*, in some cases for *Colpodium Vahlianum*.

Probably it has a continuous distribution along the Arctic coasts, connecting its Alaskan and its Greenland areas. At least two connecting occurrences were revealed by herbarium studies, viz. King William Island, Malerualik near Gjöa Harbour (68°40′ N. lat., c. 96° W. long.) leg. Knud Rasmussen Aug. 26th, 1927, and Ellesmere Land, Fram Fjord (76°23′ N. lat., 81°30′ W. long.) leg. H. G. Simmons Aug. 26th, 1899, Nr. 1633 (Herb. Oslo and Lund in part; dupl. in Herb. Copenhagen is *Puccinellia angustata*).

It seems to be absent from the Old World Arctic. A Novaya Zemlyan collection, which I was formerly inclined to class with *P. Andersonii* as a deviating variety (cf. Hultén 1950, p. 1712), I now think should be rightly considered to represent a distinct species (see this paper p. 73: *Puccinellia fragiliflora*).

In spite of some habitual similarity, no direct connection between *P. Andersonii* and *P. angustata* seems to exist. Technically *P. Andersonii* is readily distinguished by its almost glabrous palea keels as compared with *P. angustata*, in which the keels are copiously hairy. Otherwise its most striking features are (1) an opaque, fatty lustre of the spikelets due to the hue of the translucent upper part of the glumes and lemmas, (2) more or less thickened pedicels, which are pearly shining from the large and tumid epiderm cells, and (3) a distinctly alternate insertion of the glumes. Further, one peculiarity should be emphasized, namely (4) the fragility of the rachillae; possibly this accounts for the fact that the very distinctive plant has been entirely disregarded so far. For the majority of the herbarium specimens are so poorly preserved that very often only the glumes are left; intact spikelets are rarely seen.

Taxonomically *P. Andersonii* occupies a somewhat isolated position. Swallen did not find evidence of a closer relationship to any other species. The characteristic lustre of the pedicels and spikelets is a feature

which it has in common with *P. pumila*, as was already pointed out by SWALLEN. However, the different epidermal anatomy of the leaves of the two species in question does not speak in favour of a direct genealogic connection.

P. Andersonii has the alternate-inserted glumes and the thickened pedicels in common with *P. coarctata*. In fact, some northern types belonging to this strongly polymorphous species might at first sight be mistaken for *P. Andersonii*. However, by its epidermal leaf-anatomy *P. Andersonii* holds a position of its own within the Greenland *Puccinellia* flora (figs. 57—58). It is remarkable by its tumid, drop-shaped epidermal cells, which are generally not distinctly differentiated into long cells and short cells; the marginal cells are short and rounded, not unlike those of *Puccinellia Langeana* and *Colpodium Vahlianum*. As compared with the rest of the Greenland Puccinellias, *P. Andersonii* seems to represent a primitive type as far as the leaf anatomy is concerned.

Puccinellia Andersonii is an inhabitant of wet saline soils near the seashores. It is generally found in the *Puccinellia phryganodes* zone or next to it, though in some cases it may be able to thrive at a somewhat higher level.

Puccinellia angustata (R. BR.) RAND et REDF.

RAND and REDFIELD, Flora of Mount Desert Island, Maine (1894) p. 181 (cf. also FERNALD and WEATHERBY, Rhodora 18 (1916) p. 19).

Poa angustata R. BROWN, Chloris Melvilliana (1823) p. 29; Suppl. Parry's 1st Voyage (1824) p. 287.

Illustrations[1]): Fl. dan. fasc. 51 (1883) tab. 3006; KOMAROV, Fl. URSS II (1934) tab. 35, fig. 4; this paper: figs. 15—17 and 61—62.

Distribution within Greenland: fig. 104.

Perennial, caespitose, green; old basal sheaths whitish, scarcely shining. Culms stout, rigid, decumbent at the very base, 15—30 cm tall. Cauline leaves (1—)2; upper sheath longer than the blade. Blades 3—6 cm long, 1.5—2.5 mm wide, flat, nearly glabrous. Ligule 2.5—4.0 mm long, thin, acute. Panicle dense, erect, 6—10 cm long; branches stout, ascending, fascicled, longer and shorter ones from the same node, glabrous below, ± scabrous above, bearing up to 3—4 spikelets in their upper half. Spikelets intensely purple, pedicelled or the upper ones usually

[1]) The drawings in FERNALD and WEATHERBY, 1916, pl. 116, figs. 59—62, "P. angustata, from Disco, Greenland, T. M. Fries", are not representative of *P. angustata*. Except for the hairy keels of the palea the figures might represent *P. Andersonii*. I have not seen any specimen of the latter species collected by TH. M. FRIES. The specimens of *P. angustata* from Disko to which I have had access are quite ordinary and do not show the dentate bracts figured by FERNALD and WEATHERBY.

subsessile, 6—7 mm long, 3—4(—5)-flowered. The 1st glume 1.6—2.2 mm long, oblong-lanceolate, acute, 1-nerved, the 2nd 2.8—3.2 mm long, oblong, acute or indistinctly toothed, 3-nerved. Lemmas of lower florets 3.5—4.0 mm long, of uppermost florets 2.8—3.3 mm long, ovate-lanceolate, ± acuminate, obscurely 5-nerved, nerves at back copiously pilose in their lower half, whitish-translucent at apex; the internerves finely pilose at base. Callus hairs copiously present. Palea shorter than the lemma, bifid, the keels long-hairy below, spinulose at apex. Anthers 0.6—0.8 mm long. Grains 1.9—2.1 mm long.

Specimen described: W. Greenland, Svartenhuk, Tartûssaq (71°25′ N. lat.), leg. M. P. & Th. Porsild Aug. 3, 1911.

This species is the first arctic *Puccinellia* that was clearly recognized. As early as 1823 Robert Brown furnished an elaborate diagnosis of the plant. Nevertheless, until recent time it has been largely misapprehended and confounded with a number of species. Curiously enough Holmberg, on revising the Greenland material some thirty years ago, considered the well defined *Glyceria vaginata* Lge. a variety subordinate to *Puccinellia angustata*. Besides, two other good species only recently recognized, viz. *P. Andersonii* and *P. deschampsioides*, were included into *P. angustata*. When these false elements are removed, *Puccinellia angustata* remains a well defined species of grass.

It is outstanding among the New World Arctic Puccinellias by the palea keels being strongly hairy and the lemmas being copiously hairy on the nerves at the back; the internerves, also, may be slightly pubescent. It represents a taxonomically isolated type. The only existing relative seems to be the Arctic Siberian *Puccinellia contracta* (Lge.) (cf. this paper p. 77), which previously was simply included in *P. angustata* by most authors, though it was recognized by Holmberg (in schedula) as a distinct variety.

Kreczetowich (1934, p. 472) proposes a subsection (circle), *Boreales*, comprising *Atropis angustata* and *Atropis kurilensis* Takeda (i. e. *Puccinellia pumila* according to Swallen 1944, p. 22). However, there seems to be nothing to indicate any close relationship between these two species.

The geographical distribution of *P. angustata* is markedly high-arctic, comprising the northern part of the Canadian Archipelago, North Greenland southward to the 70th parallel, Spitsbergen, Northern Novaya Zemlya, and the northernmost part of Taimyr Peninsula. The easternmost specimen seen by me is from Eastern Taimyr, "Unterlauf d. Jami Neru (abt. 74°50′ N. lat., 106° E. long.) leg. A. Tolmatchew 14. VIII-1928" (cf. also Tolmatchev 1932, p. 98). In addition it occurs on the inhospitable Franz Joseph Land as the only representative of the genus (Hanssen and Lid 1932, p. 37).

The species varies to some extent, though the variation does not materially stir the impression of the species constituting a unity. A

somewhat deviating form is var. *decumbens* E. JØRGENSEN in sched. As far as I have been able to find out, it was never described. For that reason a description is inserted here, based on a Spitsbergen collection to which the varietal name was proposed by JØRGENSEN.

Puccinellia angustata var. *decumbens* E. JØRGENSEN in sched.

A speciei principali differt notis sequentibus: Habitu humili et prostrato, foliis angustis, rigidis, involutis, saepe recurvatis, panicula mercescente spiciformi contracta; glumis brevioribus, saepe minus acutis; lemmatibus in dorsi inferiore quarta parte pilosis. Palearum carinis sparse pilosis.

Type: Spitsbergen, Advent Bay, East side. leg. E. JØRGENSEN July 21, 1896 (Herb. Oslo and Copenhagen).

Differs from the main species in the following characters: Low and prostrate growth-form. Narrow, rigid, involute, often recurved leaves. Meagre, spikelike, contracted panicle. Shorter, often less acute glumes. Lemmas hairy on the nerves at back but only in their lower fourth. Keels of palea sparsely ciliate.

This variety seems to be restricted to Spitsbergen and Northeast Greenland. Specimens transitional to the main species are often met with in Spitsbergen material. The variety seems to be rare in Northeast Greenland. Only some few specimens from the northern part of Dove Bay are at hand. Even if they are not entirely matching the Spitsbergen type, they belong to the variety rather than to the main species. Specimens recently collected in Peary Land by K. HOLMEN show some traces of var. *decumbens*, though they come closer to the main species.

The plant from Kap Smith, Dickson Fjord, Spitsbergen, listed by DAHL and HADAČ (1941, p. 9) under the name of *Puccinellia tenella* (LGE.) HOLMB., is a dwarfish specimen of *P. angustata* var. *decumbens*.

The leaf epiderm of *Puccinellia angustata* is of a more simple type than generally found in Puccinellias (figs. 61—62). The cells are not, or very indistinctly, warty. The long cells are narrow and sometimes slightly tumid in their distal ends. Short cells, often rather few, are differentiated. The stomata of the upper side of the leaf are not pitted, those of the under side but slightly so. Stomatal flaps are not formed. The marginal cells are elongated. The epidermal anatomy of var. *decumbens* is largely like that of the main species.

Puccinellia angustata differs from the rest of the Greenland Puccinellias as to ecology by not being bound up with the seashore or with saline ground. It is generally one of the first plants to colonize on fresh moraines. Thus it was collected by P. FREUCHEN on the North Greenland nunataks.

Puccinellia deschampsioides nov. sp.

Perennis dense caespitosa glauca. Culmi 30—50 cm alti rigidi erecti foliis binis, superiore parte efoliata. Folia rigida convoluta, 3—8 cm longa. 1.5—2 mm lata marginibus asperis. Vagina brevis. Ligula c. 2 mm longa truncata decurrens. Vaginae emortuae persistentes nitentes albicantes vel subpurpurascentes. Panicula rigida 10—14 cm longa. Ramuli plerumque bini longi basi nudi purpurascentes densissime asperi erecto-adpressi, deinde rigido-squarrosi spiculis 5—15. Spiculae densae 4—7 mm longae floribus 3—5, rubro-violaceae aureo-variegatae nitentes vel interdum pruinosae. Gluma inferior 1.1—1.5 mm longa inconspicue uninervia subacuta, superior 1.8—2.1 mm longa obtusa—subacuta nervis obsoletis. Lemma 2.4—2.8 mm longum obtusum, vel subito acutata nervis inconspicuis, quarta inferiore parte nervis minute pilosis ad apicem aureo-translucens. Glumae et lemmata minute ciliolata. Palea longitudine lemmatis vel longior bifida, carinis dimidia superiore parte spinulosis, inferne glabris. Antherae 0.7—0.9 mm longae. (Grana 1.9—2.1 mm longa).

Type: Arfersiorfik Fjord, Sofia Havn, 68°20′ N.—53° 05′ W. along the border of the inland-ice, leg. M. P. Porsild, July 20, 1924 (Herb. Copenhagen).

Growing on dry clayey or gypsiferous soil.

Distribution: W. Greenland, Arctic N. America.

Illustrations: pl. 2; figs. 18—19 and 63—64.
Distribution within Greenland: fig. 105.

Perennial, densely caespitose, glaucous. Culms 30—50 cm tall, stout, erect 2-leaved, naked in their upper part. Leaves rigid, rolled, 3—8 cm long, 1.5—2.0 mm wide, scabrous at margin; sheaths short. Ligule c. 2 mm long, truncate, decurrent. Old withered sheaths persistent, shining, whitish or reddish. Panicle rigid, 10—14 cm long, branches commonly in pairs, elongated, naked below, purplish coloured, densely scabrous, stiffly ascending, finally horizontally spreading, bearing 5—15 spikelets. Spikelets tight, 4—7 mm long, 3—5-flowered, reddish-purple, golden-yellowish variegated, shining or pruinose. The 1st glume 1.1—1.5 mm long, indistinctly one-nerved, subacute, the 2nd 1.8—2.1 mm long, obtuse or subacute, indistinctly nerved. Lemmas 2.4—2.8 mm long, obtuse, or abruptly pointed, indistinctly nerved, delicately pilose on the nerves in their lower fourth, aureate-translucent at apex. Glumes and lemmas faintly ciliolate. Palea as long as lemma or longer, bifid at apex, keels spinulose in their upper half, glabrous toward the base. Anthers 0.7—0.9 mm long. (Grains 1.9—2.1 mm long).

P. deschampsioides is related to *P. Nuttalliana* (Schultes) Hitchc., from which it differs principally by its lower, more robust habit, indistinctly nerved glumes, firmer and not pointed lemmas, minutely spinulose, not ciliate, palea keels, and longer grains.

Judging by the available herbarium material, this hitherto disregarded species was first collected in 1870 by the Swedish botanist

S. BERGGREN, at Aulatsivik fjord, Egedesminde District[1]). Later on it has been brought home by several expeditions. LANGE referred it to his *Glyceria arctica*. GELERT, revising the material for Flora Arctica (OSTENFELD 1902), corrected LANGE's determinations and incorporated it in *Glyceria angustata*, and so did HOLMBERG twenty years later. PORSILD (1920, p. 45) obviously did not distinguish it from "*Puccinellia arctica*". His remarks given under this species, "One of the main plants of the clay-plains in the interior" no doubt refer to *P. deschampsioides*. However, some more recent collections he labelled "?*Puccinellia angustata*".

Owing to its decidedly xerophytic habit, *P. deschampsioides* is outstanding among all other Greenland Puccinellias. Small starved specimens may remind one of *Poa glauca* by their meagre contracted panicle. Vigourous plants cannot be mistaken for any other Greenland grass, distinguished as they are by large, but meagre and open pyramidal panicles with straight, spreading or reflexed branches. The small tight spikelets and the absence of hairs on the palea keels are characters which easily distinguish it from *P. angustata* and *P. groenlandica*.

From Søndre Strømfjord some specimens intermediate between *P. deschampsioides* and *P. groenlandica* are at hand. They show irregular pollen formation and may therefore be considered hybrids. Usually the two species are well defined.

Puccinellia deschampsioides is a character plant of dry clay plains and slopes and thrives in soils with a very high mineral content (BÖCHER 1949, p. 33). Occasionally it is found at the seashore, too.

The Greenland area of *P. deschampsioides* is confined to the middle part of the west coast, from about 67° to 71° N. lat. Especially to the south it is associated with the inner fjord regions.

From areas outside Greenland I have seen a single typical specimen from northernmost Labrador: Sugluk Bay, 62°15′ N. lat., 75°28′ W. long., leg. A. DUTILLY, Sept. 13, 1938, No. 6980x. ABBE (1936) in his

[1]) In the paper on his botanical investigations in Greenland, BERGGREN (1871) does not mention any *Puccinellia* from the Aulatsivik fjord; hence it may be inferred that he did not recognize our plant.—K. BERLIN, who investigated the same region twelve years later, obviously had a clear conception of *P. deschampsioides*, though he considered it to be an inland type of *P. vaginata*, as appears from his remarks on the latter species. The passage reads as follows (BERLIN 1884, p. 78): "*Glyceria vaginata* Lge.

Right up at the settlements and the Eskimo habitations, where it encounters some humus, it is a flexible and slender grass, but on the clayey shores at Sofiehamn in the interior of Auleitsivik Fjord and on the headland rich in clay banks between that fjord and Southeast Bay (Kisengiartak Naze) it is rigid and of a habit not unlike that of *G. angustata* (R. Br.) Fr., with which it may then be confused. The obtuse lemmata of *G. vaginata* Lge. prevent one from making mistakes." (Translated from the Swedish).

plant list of the Torngat Region, northeastern Labrador, reports no *Puccinellia* of this relationship; therefore, *P. deschampsioides* does not, probably, occur there.

Besides, it occurs in continental subarctic N. America. Thus a specimen from Great Bear Lake, north shore of McTavish Arm, leg. A. E. & R. T. Porsild Aug. 4. 1928, nr. 5168 (Nat. Herb. Canada nr. 37525) is hardly different from the Greenland plants and must be referred to this species.

Probably the species is absent from the Canadian Archipelago and Eastern coastal N. America.

As pointed out above, *Puccinellia deschampsioides* seems to be related to *P. Nuttalliana* and its allies of continental N. America. Studies of the leaf-anatomy fully corroborate this view. The leaf epiderm of *P. deschampsioides* is briefly characterized as follows (figs. 63—64): The upper side of the leaf is spiny. The short cells are equipped with a small forwardly directed wart, the long cells sometimes with a terminal or subterminal wart. The stomata are pitted and constantly supported with a semicircular stomatal flap. The marginal cells are elongated and intermixed with vigorous spines.

Puccinellia Rosenkrantzii nov. sp.

Perennis dense caespitosa viridis. Culmi numerosi graciles erecti, 30—45 cm alti, ad paniculam foliiferi. Folia caulina circa 3 plana, 5—12 cm longa, 2.0—2.5 mm lata subglabra. Ligula 2 mm longa truncata lacera. Panicula angusta, 12—18 cm longa, ramis binis ex eodem nodo, longis erectis, laevibus vel asperulis, apice spiculas 5—10 gerentibus. Spiculae 6—8(—10) mm longae, floribus 4—5(—7), virides vel deinde subviolaceae. Glumae tenues hyalinae, valde eroso-ciliolatae, insigniter inaequales: inferior 1.5—2.0 mm longa, uninervia, late lanceolata subacuta, superior 2.5—3.5 mm longa, obsolete trinervia, obovata ± truncata, saepe inconspicue carinata. Lemma 2.5—3.5 mm longum latum ovatum, subobtusum vel abrupte brevi-acuminatum obsolete 5-nervium; superiore tertia parte hyalinum pallidum. Pili calli adsunt, sed nervi lemmatis sparsissime pilosi tantummodo basi. Palea biloba, brevior quam lemma, carinae apicem versus remote spinulosa. Antherae 0.8—1.1 mm longae. Grana 1.7—1.9 mm longa.

Type: Nûgssuaq Peninsula, at Qapiortoq kitdleq, 70°30′ N. lat.—53°20′ W. long. leg. K. Jakobsen Aug. 12. 1948. Nr. 2443 (Herb. Copenhagen). Growing in outlets from the mud volcano.

Distribution: Only known from a few localities in Nûgssuaq peninsula, cf. fig. 106.

Illustrations: pl. 3; figs. 21 and 59—60.

Perennial, densely caespitose, green. Culms numerous, slender, erect, 30—45 cm tall, leaf-bearing to the panicle. Cauline leaves c. 3, flat, 5—12 cm long, 2.0—2.5 mm wide, nearly glabrous. Ligule 2 mm long, truncate, lacerate. Panicle narrow, 12—18 cm long; branches, 2(—3) from each node, elongated, erect, glabrous or slightly scabrous, bearing 5—10 spikelets in their distal part. Spikelets 6—8 (—10) mm long, 4—5(—7)-flowered, green, or, later on, violet-tinged. Glumes thin, hyaline, strongly erose-ciliolate, conspicuously unequal in length; the 1st 1.5—2.0 mm long, broadly lanceolate, subacute, one-nerved, the 2nd 2.5—3.0 mm long, obovate ± truncate, often slightly keeled, obsoletely three-nerved. Lemmas 2.5—3.5 mm long, broadly ovate, subobtuse or abruptly acuminate, obsoletely 5-nerved, their upper third pale and hyaline. Callus hairs present; the nerves of the lemmas very sparsely hairy at base. Palea bilobed, shorter than the lemma, the keels sparsely spinulose toward the apex. Anthers 0.8—1.1 mm long. Grain 1.7—1.9 mm long.

Puccinellia Rosenkrantzii seems to be related to *P. deschampsioides*, from which it differs i. a. in the following characters: Slender habit; the panicle less exserted, greenish; delicate texture of the bracts, especially of the glumes; glumes conspicuously unequal in length; palea shorter than the lemma; anthers up to 1.1 mm long.

This endemic species is only known from a few localities situated in the interior of the Nûgssuaq peninsula, West Greenland. It is named in honour of the geologist Professor A. ROSENKRANTZ, who has for several years devoted himself to an exploration of the Nûgssuaq peninsula and the coast-lands to the north thereof. All the plant material at hand as well as the information about the peculiar conditions prevailing in the localities are due to Prof. ROSENKRANTZ and his collaborators.

The plant in question is exclusively found in the immediate surroundings of mud-volcanoes, where it grows on the fresh deposits of fine-grained material from their outflow. In such localities it forms immense pure stands, which catch one's eye at a long distance by their green colour contrasting with the bare, bleak landscape. The materials ejected are derived from a substratum consisting of marine bituminous shales, covered by Quaternary deposits. The very craters of the volcanoes are foaming from escaping gasses, mainly methane and nitrogen. The muddy outflow is rich in mineral components. Analyses, kindly placed at my disposal by Prof. ROSENKRANTZ, show a large content of sodium accompanied by smaller contents of potassium and magnesium. The an-ions present are preferably chloride-, carbonate-, and hydrocarbonate-ions (cf. also ROSENKRANTZ 1940 a, 1940 b, 1942).

Puccinellia Rosenkrantzii forms large tufts; it is high-grown and of a slender habit. Otherwise it is distinguished by its thin glumes and lemmas and by the glumes being very unequal in size; the unequalness is merely due to the second glume being large, out of all proportion; in spite of its delicate texture it may be scabrous on the mid-nerve,

at the same time it is somewhat keeled. As to these glumal characters it may recall *P. vaginata* var. *paradoxa* (cf. this paper p. 47). However, it is doubtless more closely related to *P. deschampsioides*. Of special interest in this connection is the epidermal characters of the leaves (figs. 59—60). In fact it has not the strongly warty epiderm as is found in the latter species, but a closer examination of the type of the wartiness, for example the small papillae of the short cells and the character of the stomatal flaps, especially those of the under side of the leaf, will reveal the *P. Rosenkrantzii*-epiderm as a much simplified modification of the *P. deschampsioides* type. In accordance with the flat and soft appearance of the leaves as compared with those of *P. deschampsioides*, the cells are enlarged and the cell tissue more widely meshed.

On drier ground around the mud-volcanoes, *P. deschampsioides* and *P. angustata* likewise occur. Some few specimens transitional to these species are at hand. They have a defective development of pollen and may, accordingly, be considered hybrids.

The seashore Puccinellias of the region in question, viz. *P. vaginata*, *P. groenlandica*, *P. coarctata*, and *P. Andersonii*, to mention the species likely to be found on the mineral ground around the mud-volcanoes, were not represented in the rich collections from the *P. Rosenkrantzii* localities. Thus, these halophilous species are not, probably, able to endure the special mineral contents of the soil to which *P. Rosenkrantzii* is so excellently adapted.

Puccinellia Porsildii nov. sp.

Perennis caespitosa innovationibus intravaginalibus. Folia glaucescentia. Culmi basi decumbentes nodis 2—4, 30—50 cm alti. Folia caulina inferiora vaginis brevibus nodisque nudis instructa; vagina suprema multo longior sed paniculum non attingens. Laminae foliorum caulinorum 5—8 cm longae, 1.5—2.0 mm latae, convolutae, paginis superioribus scaberrimae. Ligula 2—3 mm longa, acutiscula. Panicula patens 10—15 cm longa ramulis binis distantibus gracilibus glabris subflexuosis, inferiores 7—10 cm longi, dimidio eorum longitudine nudi, spiculis 6—10 instructi, pedicellis gracilibus interdum paululum scabris. Spiculae lineari-lanceolatae 7—10 mm longae, 5—7-florae purpureae. Glumae tenues, inferior 3—4 mm longa, 1- vel 3-nervia, late lanceolata obtusa vel acutiuscula; superior 3.5—4.5 mm longa, oblonga obtusa 3—5-nervia. Lemmata 3—4 mm longa, ovato-oblonga truncato-obtusa, obscure 5-nervia, nervis tertio parte inferiore pilosis, pilorum callo praesente. Glumae lemmataque lutescentia hyalino-marginata eroso-ciliolata. Palea lata bifida lemmatibus aliquid brevior, carinae superiore tertia parte aliquantulum spinulosae. Antherae 1.3—1.6 mm longae. Grana nondum matura 2.0 mm longa.

Type: West Greenland, at the Arctic Station on S. Disko, on an abandoned chicken-run, covered with native grasses and herbs. Some chicken-food was introduced from Denmark. Leg. M. P. PORSILD Sept. 8, 1933. Specimen in the Herbarium of the University, Copenhagen.

Distribution: Only known from the type locality, cf. fig. 107.

Illustrations: pl. 4; figs. 20 and 67—68.

Perennial, caespitose, innovations intravaginal. Foliage glaucescent. Culms decumbent at base, 2—4-jointed, 30—50 cm tall. Lower stem-leaves with short sheath, leaving the nodes naked; uppermost sheath much longer, but not reaching the panicle. Blades of stem-leaves 5—8 cm long, 1.5—2.0 mm wide, convolute, scaberulous on the upper side. Ligule 2—3 mm long, acutish. Panicle open, 10—15 cm long, branches distant, in pairs, slender, glabrous, somewhat flexuose, the lower ones 7—10 cm long, naked in half their length, with 6—10 spikelets on slender, sometimes slightly scabrous pedicels. Spikelets linear-lanceolate, 7—10 mm long, 5—7-flowered, purple. Glumes thin, 1st 3—4 mm long, 1- or 3-nerved, broadly lanceolate, obtuse or acutish; 2nd 3.5—4.5 mm long, oblong, obtuse, 3- or 5-nerved. Lemmas 3—4 mm long, ovate-oblong, truncately obtuse, obscurely 5-nerved Nerves hairy in their lower third. Callus hairs present. Glumes and lemmata yellowish hyaline-bordered, erose-ciliolate. Palea broad, bifid, a little shorter than the lemma, the keels sparsely spinulose in their upper third. Anthers 1.3—1.6 mm long. Grain (not mature) 2.0 mm long.

The plant here proposed as a new species is named in honour of Dr. M. P. PORSILD, the founder of the Danish Arctic Station on Disko, who collected it at Godhavn, Disko island, in 1933. At that time it probably occurred in quantity; mass collection was at any rate undertaken, for duplicates are kept in several Scandinavian Musei. The specimens in question grew in a waste place, "a relinquished poultry yard". According to a note written on the label, PORSILD supposed that it was an introduced plant.

When in the summer of 1947 I visited Godhavn, Dr. P. GELTING, the present director of the Arctic Station, called my attention to a big and luxuriant *Puccinellia* growing together with other nitrophilous grasses around his residence. It turned out to be the same species as was collected by PORSILD fourteen years before. This fact shows that the plant still thrives well here, and that it is able to reproduce by self-sowing for years. Hence the plant is unlikely to have been introduced from temperate regions as a casual intermixture to chicken's fodder or the like. In this connection it seems of interest to note that the common European *Puccinellia distans*, so widely introduced to oversea localities by human agency, has never been found in Greenland. Probably it is unable to thrive in the far north. Thus, it may be inferred, an introduction of Puccinellias from southern latitudes is little probable. Moreoever, so far I have not succeeded in finding any diagnosticated

Puccinellia either from the northern or from the southern hemisphere that really matches our plant.

In fact, owing to its large pyramidal panicle with long and slender, somewhat flexuose, glabrous branches and long linear spikelets, it is a very remarkable grass. The glumes are longer than is usually the case within the genus *Puccinellia*. The relationships of *Puccinellia Porsildii* are obscure. It has technical characters in common with the Alaskan *P. glabra* Swallen, judging by the original description of that species. However, a closer comparison does not point to a real genealogic connection between the two species. Very large glumes, similar to those of *P. Porsildii*, though of a firmer texture, are found in the European, mainly Mediterranean, *P. festucaeformis* Parl. However, because of the epidermal anatomy of the leaves, which differs considerably from that of *P. Porsildii*, the similarity of these species must be due to convergence rather than to real affinity. After all, the leaf-anatomy seems to indicate that among the Greenland species it comes next to *P. deschampsioides*. The leaf-epiderm is of the type found in the latter species, though it is somewhat more markedly warty, at the same time as the stomata flaps are excessively developed (figs. 67—68). Therefore, *P. Porsildii* may represent an Arctic offshoot from the group centered around the American *P. Nuttalliana* Hitchc. The Western American *P. Cusickii* Weatherby, closely related to *P. Nuttalliana*, has the long anthers and the short leaf sheaths in common with our Greenland plant; besides, as to the leaf-epiderm, the two plants in question show a striking conformity. Otherwise, concerning a number of characters, they are far from being alike.

So far, *P. Porsildii* has only been found growing on manured soils around human habitations. Nevertheless, it may be an indigenous plant in Greenland. Some day it may be found in virgin localities at bird cliffs which would offer similar conditions to those prevailing in the place where the plant is known to thrive excellently. The tiresome and monotonous ornithocoprophilous grass vegetations have, no doubt, been largely disregarded by less experienced collectors. Thus they probably belong to the least known Greenland plant communities.

Puccinellia groenlandica nov. sp.

Perennis caespitosa viridis. Culmi e basi assurgente erecti, 50—65 cm alti usque apicem foliati. Folia caulina ca. 3, 6—12 cm longa, 2—3 mm lata plana supra aspera. Ligula 3 mm longa subtruncata. Panicula laxa 20—30 cm longa; ramuli remoti, ex eodem nodo bini (vel terni), erecto-divaricati, asperrimi inferne nudi, spiculis brevipedicellatis 20—30. Spiculae 7—10 mm longae 5—7-florae virides deinde violascentes. Glumae sat firmae, distincte uni- et trinerviae, superior saepe carinata

nervo medio asperulo; inferior 2.0—2.5 mm longa ovato-lanceolata subacuta, superior 2.5—3.0 mm longa ovata obtusa. Lemma 3.0—4.0 mm longum obtusum vel subobtusum 5-nervium, margine angusto hyalino erosociliolatum, inferiore tertia parte nervis pilosis. Palea bifida, lemmatis longitudine, carinis inferne longo-pilosis, superne spinulosis. Antherae 1.1—1.5 mm longae. Grana circiter 2.0 mm longa.

Type: "V. Gr. [W. Greenland], in locis argillosis humidis ad littus Itivnek, sinus Ikkatok"[1]) leg. J. VAHL Aug. 1832 (Herb. Copenhagen).

Growing on seashores and on refuse (hemerophilous).

Distribution: W. Greenland, cf. fig. 108.

Illustrations: Fl. dan. fasc. 44 (1858) tab. 2582 (in part, excl. the small specimen to the left); this paper figs. 34—35 and 69—70.

Perennial, caespitose, green. Culms erect from a decumbent base, 50—65 cm tall, leaf-bearing in their whole length. Cauline leaves c. 3, 6—12 cm long, 2—3 mm wide, flat, scabrous on the upper side; ligule c. 3 mm long, subtruncate. Panicle loose, 20—30 cm long, branches distant, 2(—3) from each node, ascending to divaricate, strongly scabrous, naked below, with 10—20 short-pedicelled spikelets. Spikelets 7—10 mm long, 5—7-flowered, greenish, growing violet-tinged. Glumes rather firm, distinctly one- and three-nerved, the 2nd often keeled with a slightly scabrous mid-nerve; the 1st glume 2.0—2.5 mm long, ovate-lanceolate, subacute, the 2nd 2.5—3.0 mm long, ovate, obtuse. Lemmas 3—4 mm long, obtuse or subobtuse, 5-nerved, narrowly hyaline-bordered, erose-ciliolate, nerves pilose at back in their lower third. Palea as long as the lemma, the keels long-hairy below, spinulose above. Anthers 1.1—1.5 mm long. Grain ca. 2.0 mm long.

Probably related to *Puccinellia macra* FERNALD and WEATHERBY, which plant is known to me only from the authors' description and illustrations. *P. groenlandica* differs from the latter species in the following characters: Leaf blades narrower, the upper ones shorter; fully exserted panicle; larger spikelets, the glumes and lemmas longer, more obtuse, rather firm; Grains considerably longer, c. 2 mm.

This Greenland plant was first depicted and described in 1858 by LANGE in Fl. dan. (fasc. 44, tab. 2582). LANGE identified it with *Glyceria maritima palustris* FR.; later (1880, p. 169; 1887 a, p. 140) he took it to belong to *Glyceria arctica* of HOOKER (Fl. Bor.-Americ. II, p. 248, tab. 229 (1840)). However, the identity of HOOKER's *Glyceria arctica* has been disputed, for the only information given about the origin of the plant is the laconic "Arctic sea coast. Dr. RICHARDSON". HOOKER fil. (1875, p. 237), in his map of arctic plant distribution, placed it in the Smith Sound Region.

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[1]) According to Dr. M. P. PORSILD (in lit.) the locality given by J. VAHL is erroneous. The locality should rightly be read Ikertôq, and is situated a short distance south of Holsteinsborg, c. 66°45′ N. lat. (cf. also HARTZ 1894 a).

According to SIMMONS (1913, p. 11), Dr. RICHARDSON, during the First Franklin Expedition, collected a few plants on Savage Islands off the south coast of Baffin Land. However, in the opinion of the present writer, the RICHARDSON plant in question was not collected in that place, for no *Puccinellia* of that region really corresponds to the drawing published by HOOKER. POLUNIN (1940, p. 85) suggests that a common plant of that region may represent the Hookerian *Glyceria arctica*. The plant alluded to by POLUNIN is, no doubt, the exceedingly slender and prostrate *Puccinellia*, closely related to *Puccinellia vaginata* (LGE.), and in the present paper (cf. p. 50), it is described as a new variety under the name of *P. vaginata* var. *elegans*. In my opinion this plant cannot be mistaken for HOOKER's *Glyceria arctica*, which, judging by the illustration, is a more robust and broad-leaved grass, also distinguished by a more rich-flowered panicle.

A. E. PORSILD (1939, p. 181) and likewise HULTÉN (1942, p. 234) identified a number of Alaskan specimens with *Glyceria arctica* HOOK. According to SWALLEN (1944) the Alaskan material, so determined, represents two distinct species, namely *Puccinellia grandis* and *Puccinellia borealis*, erected by the said author (cf. also HULTÉN 1951, p. 1715).

It was pointed out by HULTÉN that the Greenland "*Puccinellia* cfr. *arctica* (HOOK.)" differs from the Alaskan one. HOOKER states, for *Glyceria arctica*, "texture of the glumes thin and membranaceous", which fits the Alaskan species mentioned above, while the Greenland plant usually has rather firm glumes.

SIMMONS (1906, p. 158) determined several specimens from Ellesmere Land as *Glyceria distans* var. *arctica* (HOOK.) GELERT. However, SIMMONS's Ellesmere Land plants are merely luxuriant specimens of *Puccinellia angustata*.

OSTENFELD (1910, p. 33) determined a specimen (collected by A. H. LINDSTRÖM on the Gjöa Expedition) from Herschell Island off the Mackenzie Estuary as *Glyceria distans* f. *arctica* (HOOK.) GELERT, which unity, however, was likewise thought to comprise the deviating Greenland plant here under consideration. This Herschell Island-plant corresponds excellently to HOOKER's drawing, and, in the opinion of the writer, it actually represents the much disputed *Glyceria arctica* (cf. this paper p. 69). It seems to come next to *Puccinellia grandis* SWALL. Most of the RICHARDSON collections came from the lower Mackenzie Region, and thus it seems not unlikely that the type of *Glyceria arctica* was collected within this part of the Arctic sea coast.

For the Greenland plant, hitherto accepted as *Glyceria arctica* HOOK., though often given a varietal rank, only, I here propose the name of *Puccinellia groenlandica*. Within Greenland it is restricted to the central parts of the west coast, and it is not known to occur outside

this country. Among the Greenland Puccinellias it is distinguished by its large size and its long anthers. It has the ciliate keels of the palea in common with *Puccinellia angustata*; otherwise the two species are far from showing any relationship. *P. groenlandica*, as suggested above, is possibly related to *P. macra* FERN. and WEATHERBY of the Lawrence Bay Region. Unfortunately, for want of material, an investigation of the epidermal characters of the latter species could not be undertaken. In *P. groenlandica* the epidermal tissue of the leaves is rather wide-meshed, not distinctly warty, as otherwise found in species of the *Nuttalliana* group (figs. 69—70). Stomatal flaps are hardly developed. If it really belongs to the *Nuttalliana* group, it represents a somewhat deviating type.

The varieties (under *Glyceria arctica*) enumerated by LANGE (1880, p. 169) seem to be of minor importance; var. *laxa* is a slender shade-form, otherwise hardly deviating. The plant designated as var. *dasyantha* by LANGE seems to differ from the type by having thinner glumes, if anything, rather than by the pilosity of the lemmas, the character especially emphasized by LANGE. The var. *capillaris* possibly represents the hybrid *P. groenlandica* × *P. coarctata*. Some few other deviating specimens at hand seem to be hybrids with *P. deschampsioides* and *P. vaginata*, respectively. Usually such plants show defective or irregular pollen formation.

Luxuriant specimens of *P. coarctata*, commonly occurring on manured ground around human habitations, may well be mistaken for *P. groenlandica*. However, *P. coarctata* is distinguished by its shorter and usually somewhat alternately inserted glumes, shorter anthers, and by the spinules of the panicle branches, if present, being comparatively big and distant as compared with the delicate and dense spinules of *P. groenlandica*.

In addition, the two species differ as to chromosome number, *P. groenlandica* being an octoploid, $2n = 56$, and *P. coarctata* a hexaploid, $2n = 42$.

Puccinellia groenlandica is principally found near the seashore. It is a nitrophilous plant, forming luxuriant stands around human habitations. In such places it is found in abundance, growing in company with *P. coarctata* to the south, with *P. vaginata* to the north, these two accompanying species meeting within the area of *P. groenlandica*.

Puccinellia laurentiana FERN. et WEATH.

FERNALD and WEATHERBY, Rhodora 18 (1916) p. 14.

Illustrations: FERNALD and WEATHERBY l. c. pl. 115, figs. 33—38; this paper: figs. 22 and 65—66.

Distribution within Greenland: fig. 109.

Perennial, densely caespitose, glaucous. Culms 30—35 cm tall, erect, stiff and slender, two-leaved. Withered basal leaf-sheaths persistent, scarious, greyish; upper sheaths 5—8 cm long, not reaching the panicle. Blades 3—5 cm long, stiff and rolled, almost setiform, when flattened out ca. 1.5 mm wide, the margins rough like the back towards the apex; ligule 2—3 mm long, subacute, often lacerate, decurrent. Innovations numerous, their leaves long-sheathing (sheaths 8—10 cm long), blades rolled, setiform, about 12 cm long. Panicle 7—12 cm long ± pyramidal in a mature state, branches in pairs, rigid, slender, scabrous in their distal part, bearing 10—20 short-pedicelled spikelets. Spikelets dilute purple, lanceolate, at base evenly tapering into the thickened pedicel, 4—6.5 mm long, 2—4-flowered. Glumes slightly alternate-inserted, firm, with vigorous nerves, erose-serrulate, sometimes subcarinate with a few spinules on the back; the first 1.2—1.8 mm long, triangular-lanceolate, acute, one-nerved, the second 2.0—3.0 mm long, oblong, acutish, three-nerved. Lemmas firm, with a straw-coloured scarious margin, faintly erose-ciliolate, obscurely 5-nerved, subacute, 3.0—3.5 mm long, the nerves very faintly hairy at base. Callus hairs copiously present, short and silky. Palea as long as the lemma, bifid, the keels strongly spinulose in their upper half, glabrous or with a few long hairs in the lower part. Anthers 0.8—1.0 mm long. Grain 2.0 mm long.

Only Greenland specimen at hand: West Greenland: Ameralik Fjord, Eqaluit lat. 64°03′ leg. J. Lagerkranz 26. VIII. 1936 (Herb. Stockholm)

The single Greenland specimen at hand differs from the authentical *P. laurentiana* at my disposal, viz. No. 24899, Gloucester County, Belledune Point, Fernald and Pease July 30, 1922, and No. 507, Bonaventure County, Carleton, Fernald and Weatherby July 12, 1931, in the following characters: Culms less robust, lemmas less hairy on the back, and keels of palea nearly glabrous in their lower part.

Fernald and Weatherby (1916, p. 14) record *P. laurentiana* as "loosely caespitose" with panicle branches "nearly glabrous". However, the authentic specimens cited above, like our Greenland plant, are actually densely caespitose and with the panicle branches strongly scabrous, especially in their distal part.

Apart from the differences pointed out above, the Greenland plant agrees with *P. laurentiana.* Even the leaf-anatomy exactly matches that of the Canadian specimens. Within the Greenland *Puccinellia* flora it represents, no doubt, a type of its own, even if the identification may possibly be questioned. Even though it has distinguishing characters of its own, it may simulate an intermediate form between *P. deschampsioides*, to which it is obviously related, and *P. coarctata.* However, a hybridogenous origin due to a crossing between the two above-named species is far from indicated, for the plant is fully fertile, and, moreover, *P. deschampsioides* does not grow within reasonable distances from the only known Greenland locality.

Puccinellia coarctata FERN. et WEATH.

FERNALD and WEATHERBY, Rhodora 18 (1916) p. 13.

Syn. *Puccinellia retroflexa* ssp. *borealis* var. *virescens* HOLMBERG, Bot. Not. 1926 a p. 182.

Illustrations: FERNALD and WEATHERBY, l. c. pl. 115 figs. 28—32; KOMAROV, Fl. URSS II (1934) tab. 37 fig. 16; this paper, figs. 28—32 and 71—74.

Distribution within Greenland: fig. 110.

Perennial, caespitose, somewhat glaucous. Culms 15—30 cm tall, decumbent; uppermost internode much longer than the lower ones, rigid, erect or prostrate. Lower sheaths often reddish tinged. Culm leaves 2—3; blades 4—6 cm long, folded, 2—3 mm wide. Lower sheaths as long as the internodes, the uppermost much longer, not reaching the panicle. Ligule 1.0—1.5 mm long, rounded, minutely ciliolate, decurrent. Innovations often prolonged, ascending, many-leaved. Panicle 6—12 cm long, rigid. Branches glabrous below, slightly but coarsely scabrous above, 2—4 from each node, ascending or later on reflexed, the lower ones naked in their proximal half, bearing 5—15 pedicellate—subsessile, appressed spikelets. Pedicels somewhat thickend at apex. Spikelets whitish green or reddish tinged, 4—7 mm long, 3—6-flowered. Florets imbricately appressed. Glumes evidently alternate-inserted, rather firm, minutely ciliolate with 1 and 3 nerves. 1st glume 0.7—1.0 mm long. oblong, obtuse-subacute: 2nd glume 1.8—2.1 mm long, obovate-oblong, obtuse or broadly triangular at apex. Lemmas of lower floret 2.3—2.6 mm long, of uppermost ones 1.8—2.1 mm long, ovate-oblong rounded, firm, scarcely hyaline-bordered, ciliolate, obscurely 5-nerved, nerves appressed-pilose at base. Callus hairs present, short. Palea bifid, a little shorter than the lemma, the keels sparsely spinulose in their upper part. Anthers 0.6—0.8 mm long. Grains 1.4—1.6 mm long.

Specimen described: S. Greenland, Julianehaab District, Kiagtût leg. TH. SØRENSEN, July 22, 1947. Nr. 249.

HOLMBERG (1926 a, p. 182), on erecting his *Puccinellia retroflexa* ssp. *borealis*, cited *Glyceria conferta* LANGE, Fl. Dan. fasc. 49 (1877) tab. 2882, non FR. as a synonym (i. e. *Glyceria Borreri* of LANGE in Consp. Fl. Groenl. (1880) p. 167). The plant pictured by LANGE may therefore be regarded as the type. It is still kept in the Copenhagen Museum.

HOLMBERG revised the Greenland material in the Museum at that time. However, only some few sheets were referred to the subspecies proper, namely the material previously determined as *Glyceria Borreri* by LANGE (1880, p. 167) and ROSENVINGE (1892, p. 731). A much commoner Greenland plant, recorded by LANGE (1880, p. 168) as *Glyceria maritima* var. *virescens* and later (LANGE 1887, p. 298) as *Glyceria Borreri* var. *islandica*, was designated by HOLMBERG as *Puccinellia retroflexa* ssp. *borealis* var. *virescens*. HOLMBERG's choice of the Fl. dan. plant as an illustration of his new subspecies seems to be rather unfortunate. It represents a somewhat unique type so far only known

from a few places in Greenland, and apparently not found elsewhere. Scandinavian material determined by HOLMBERG as ssp. *borealis* seems to me to have more in common with var. *virescens* than it has with the Flora Danica type.

Now, the description of *Puccinellia coarctata* FERNALD & WEATHERBY (1916, p. 13) fits the Greenland material of var. *virescens*, and the single authentic specimen of this East American species available to me comes within the limits of variability of the Greenland *virescens*. Therefore, in the opinion of the writer, our Greenland *P. retroflexa* ssp. *borealis* should be referred to *P. coarctata* FERN. & WEATH. However, the Greenland material is not uniform, the most outstanding form being the typical ssp. *borealis* (*sensu* HOLMBERG), which seems to deserve special attention. But even this form is not always sharply distinguishable from *coarctata* (i. e. var. *virescens* HOLMBERG), and thus can be given a varietal rank, only. Its dense panicle, its short, fascicled branches with the spikelets densely crowded, and its broad leaves lend to it a pronounced habitual resemblance to a weakened *Puccinellia fasciculata* (TORR.) BICKNELL, syn. *Glyceria Borreri* BAB. (BICKNELL 1908, p. 197), which in some way justifies LANGE's determinations. On account of these characters, by which it differs from the rest of the polymorphic *P. coarctata*, it is re-established here as a unity of varietal rank as follows:

Puccinellia coarctata var. *pseudofasciculata* nov. var.

Perennis dense caespitosa viridis. Culmi geniculati 10—20 cm alti, eorum folia 2(—3) laminis vaginis aequilongis, 5—7 cm longis, 2.5—4 mm latis, planis glabris. Ligula 2.5—3 mm longa rotundata in vaginam modice dilatatam decurrens. Innovationes breves. Panicula supra vaginam supremam vix producta, ample florifera dense ovata, 3—6 cm longa. Ramuli breves inferne nudi, 4—6 ex eodem nodo, adscendentes serius subdivaricati glabri spiculis 10—20 dense aggregatis. Spiculae viridi-albicantes 4—5 mm longae, 4—5-florae, flosculis subdivaricatis neque dense imbricatis. Glumae tenues albicantes valde eroso-ciliolatae, inferior 0.7—1.1 mm longa, ovata obtusa uninervia, superior 1.2—1.5 mm longa, late ovata obtusa obscure 3-nervia. Lemmata flosculi inferioris 2.3—3.0 mm longa, superioris 1.9—2.2 mm longa, obovata obtusa eroso-ciliolata quinquenervia, basi nervis medianis et lateralibus sparsissime pilosa, pilis pro rate longis. Calli pili perpauci vel omnino absentes. Paleae lemmata aequantes, latae truncatae vel vix biloba. Carinae spinulis perpaucis superiore parte. Antherae 0.8—1.0 mm longae.

Type: West Greenland, Fiskernæs (63°05′ N. lat.) leg. C. HOLBØLL, Sept. 1837 (Fl. dan. tab. 2882) Herb. Univ. Copenhagen.

Distribution: SW. Greenland, cf. fig. 110.

Glyceria Borreri LANGE excl. var., Medd. om Grønl. 3 (1880) p. 167 (not *Glyceria Borreri* BABINGTON); *Puccinellia retroflexa* ssp. *borealis* (excl. varr.) HOLMBERG, Bot. Not. 1926 p. 182 (p. p.).

Illustrations: Fl. dan. fasc. 49 (1877) tab. 2882; this paper fig. 33.

Perennial, densely caespitose, green. Culms geniculate, 10—20 cm tall. Culm leaves 2(—3), blades as long as the sheaths, 5—7 cm long, 2.5—4 mm wide, flat, glabrous. Ligule 2.5—3.0 mm long, rounded, decurrent into the somewhat widened sheath. Innovations short. Panicle scarcely protruding above the upper sheath, many-flowered, dense, ovate, 3—6 cm long. Branches short, naked below, 4—6 from each node, ascending, later somewhat spreading, glabrous, with 10—20 densely crowded spikelets. Spikelets whitish-green, 4—5 mm long, 4—5-flowered. Florets somewhat spreading, not closely imbricate. Glumes thin, whitish, strongly erose-ciliolate. 1st 0.7—1.1 mm long, ovate, obtuse, 1-nerved; 2nd 1.2—1.5 mm long, broadly ovate, obtuse, obscurely 3-nerved. Lemmas of lower floret 2.3—3.0 mm long, of uppermost floret 1.9—2.2 mm long, obovate, obtuse, erose-ciliolate, 5-nerved, very sparsely hairy on the mid- and side-nerves at base, hairs comparatively long. Callus hairs few or absent altogether. Palea as long as the lemma, wide, truncate or scarcely bilobate. Keels with a few spinules in their upper part. Anthers 0.8—1.0 mm long.

HOLMBERG quite reasonably united the Greenland, Iceland, Faeroe, and N. Scandinavian material under his *P. retroflexa* ssp. *borealis* incl. varr. Probably his procedure of labelling the greater part of the Scandinavian material as ssp. *borealis* without adding any varietal designation, is due to the nearly glabrous panicle branches often met with in these plants. Certainly, the "type" of ssp. *borealis* has glabrous panicle branches, but this character seems to be of minor diagnostic value within the form-circle in question. In other respects most of the Scandinavian material comes close to the Greenland var. *virescens*. Thus an incorporation of extra-Greenland material into *P. coarctata* will not amplify the species to any great extent. Therefore in the opinion of the writer *P. coarctata* should include the greater part of the material of HOLMBERG's *P. retroflexa* ssp. *borealis*.

As to epidermal anatomy, *P. coarctata* occupies a position of its own among the Greenland Puccinellias (figs. 71—74). The epidermal tissue is comparatively short- and wide-meshed. The stomata are remarkably short, only 30—40 μ long, as compared with the width of the cell-rows. The surface of the epiderm is warty, though the height and density of the papillae may vary considerably. In some cases the papillae of the upper surface of the leaf are reduced to inconspicuous terminal protuberances of the long cells adjacent to the stomata. On the underside of the leaf at least some real stomatal flaps are indicated at the proximal end of the deeply pitted stomata. The leaf-margin is built up of moderately elongated cells irregularly intermingled with shorter ones or spinules. The only Greenland species which on the basis of the leaf-anatomy may be mistaken for *P. coarctata* is *P. vaginata* var. *paradoxa*.

The most decisive differential features of the epiderm of the latter plant as compared with *P. coarctata* are the longer stomata (40—50 μ as against 30—40 μ in *coarctata*) and the more uniform, rather short, marginal cells.

Recently HYLANDER (1945, p. 79) listed HOLMBERG's ssp. *borealis* as a mere variety belonging to *P. retroflexa* (CURT.) HOLMB. Actually *P. coarctata* (i. e. ssp. *borealis*) does not seem to be very closely related to *P. retroflexa*, even though transitional forms may occur. To the convenient gross-morphological distinguishing characters one more can be added: The leaf-epiderm of *P. retroflexa* is smooth with no stomatal flaps (figs. 97—98), while *P. coarctata*, as pointed out above, has a warty epiderm. Some few Scandinavian specimens determined by HOLMBERG as *P. retroflexa* ssp. *borealis* cannot be included in *P. coarctata*. The plants in question are distinguished from the latter species by their non-papillose leaf epiderm and by their narrower, acutish, often subcarinate glumes. In the opinion of the writer they belong to *P. retroflexa* (f. inst. Exs. Kneucker 513 cited by HOLMBERG (1926 b, p. 219) as ssp. *borealis*).

Still one minor unity has to be discussed here, viz. *P. retroflexa* ssp. *borealis* var. *vegeta* HOLMBERG. Specimens referred to this variety seem in most cases to be overnourished plants belonging to *P. coarctata* (cf. also HOLMBERG 1926 b, p. 220). However, some Iceland specimens are at hand which can hardly be taken to be conditionally modified plants, on account of their thin glumes and longer anthers, by which characters they approach var. *pseudofasciculata*. However, in contradistinction to this Greenland variety the Iceland plants in question have much reduced epidermal warts.

In northernmost Norway and the Kola Peninsula a deviating type occurs. It is doubtless the type alluded to by SCHOLANDER (1934, p. 95) when, in discussing the interrelations of some Greenland Puccinellias, he writes: "Forms of *P. retroflexa* HOLMBERG ..... in northernmost Scandinavia seem to pass imperceptibly into *P. angustata*." It differs from typical *P. coarctata* by having narrower glumes and lemmas, the keels of the palea conspicuously pectinately spinulose in their whole length (but not properly hairy as in *P. angustata*), and the colour of the panicle more or less purple (commonly greenish in *P. coarctata*). As to the leaf-anatomy it differs in the epiderm being smooth, the marginal cells shorter, and the stomata of the lower surface of the leaf being extremely pitted. This type was included in ssp. *borealis* by HOLMBERG. It may be related to *P. coarctata*, but, more likely, it comes closer to *P. retroflexa* (CURT.) HOLMB.; possibly it represents a distinct unit. However, I have not studied the question more closely.

Puccinellia coarctata, in accordance with the concept of the species here advocated, appears as an amphiatlantic subarctic type. Its distribution ranges from eastern N. America (coasts of Labrador, Newfoundland, and Quebec, according to FERNALD 1950, p. 110) in the west over southern and middle Greenland, Jan Mayen (according to JOHS. LID in lit.), Iceland, the Faeroes, northern Fennoscandia and Russia eastward to Waigatsch Island.

Is seems to be related to the West American *P. nutkaensis* (PRESL) FERN. & WEATH. Even as to their leaf-anatomy the two species are much alike.

Puccinellia vaginata (LGE.) FERN. et WEATH.

FERNALD and WEATHERBY, Rhodora 18 (1916) p. 14.
Glyceria vaginata LANGE, Fl. dan. fasc. 44 (1858) tab. 2583.

Illustrations: Fl. dan. fasc. 44 (1858) tab. 2583 and tab. 2582 in part (the small specimen to the left); this paper figs. 41 and 87—88.
Distribution within Greenland: fig. 111.

Caespitose perennial, but often not long-lived, green. Culms geniculate, 15—20 cm tall. Cauline leaves 1—2, the upper sheath reaching the panicle, subinflated, nearly smooth, slightly purplish tinged. Blades 4—6 cm long, 2—3 mm wide, flat and flaccid, the margins slightly scabrous. Ligule 0.8—1.0 mm long, rounded. Panicle 8—12 cm long, many-flowered, somewhat drooping. Branches 2(—3) from each node, scabrous, slender, ascending or spreading, not reflexed, floriferous nearly to the base, with 10—20(—25) short pedicelled spikelets. Spikelets linear-oblong, glossy, greenish or faintly purplish tinged, 5—8 mm long, 4—6-flowered, rather loose; rachilla tough. Bracts strongly erose-ciliolate, and, especially the glumes, very thin, translucent; the 1st glume 0.7—1.0 mm long, broadly ovate, obtuse, 1-nerved, the 2nd 1.4—1.8 mm long, suborbicular, obscurely 3-nerved. Lemmas of lower florets 2.4—2.6 mm, of upper florets 2.2—2.4 mm long, broadly obovata-truncate, obscurely 5-nerved, the nerves sparsely pilose at the very base. Palea wide, as long as the lemma or longer, obtusely bilobed, ciliolate, the keels sparsely spinulose toward the apex. Anthers 0.6—0.8 mm long. (Grains 1.7—1.9 mm long).

Specimen described: "in arenosis in propinquitate littoris territorii colon. Umanak. Juli 1836" leg. J. VAHL (Herb. Copenhagen). Type of *Glyceria vaginata* LANGE (Fl. dan. tab. 2583).

Puccinellia vaginata was described and excellently figured by LANGE in 1858 (Fl. dan. fasc. 44, tab. 2583). The plant is remarkable by its soft texture, by its large drooping panicle, which is hardly exserted above the apparently bad-fitting inflate upper sheath, and, finally, by its large, loose and conspicuously glossy spikelets. Thus it should be an easily recognizable plant. Nevertheless, it has been badly disregarded by later Greenland authors. GELERT (in OSTENFELD's Fl. Arct (1902) p. 127) included it in his monstrous *Glyceria distans*, while two decades

later HOLMBERG referred it to *Puccinellia angustata*, though ascribing to it varietal rank. On the other hand, FERNALD and WEATHERBY (1916, p. 14), at least formally, accepted it as a distinct species. PORSILD (1920, p. 44) evidently regarded it as a good species even if he did not discount HOLMBERG's procedure of listing it as a variety under *P. angustata.*

However, the adverse fate of the species is, no doubt, due to difficulties in rationally circumscribing it. The type described by LANGE is a most outstanding one out of a multitude of forms which at first sight might suggest a continuous intergrading into other species. Especially forms with a more condensed panicle, due to the rather short and stiff, or even reflexed branches, and with acute, distinctly nerved glumes will account for part of the difficulties alluded to above. However, *P. angustata* is easily distinguished from deviating forms of *P. vaginata* owing to the pronounced pilosity of the lemmas and the copiously hairy palea keels. On the other hand, where the areas of *P. vaginata* and *P. coarctata* overlap, viz. in the Nûgssuaq-Disko region in West Greenland and the Scoresby Sund region in East Greenland, these two species may easily be confounded.

A remarkable type, which may be taken to be an intermediate form between *P. vaginata* and *P. coarctata*, is described in detail below. It is at hand from several localities in the Nûgssuaq region. Owing to a number of peculiarities, even according to its leaf anatomy, it holds a position of its own. A comparison of this type with a comprehensive material of the highly variable *P. vaginata* and of *P. coarctata*, likewise variable, has convinced me that it is distinct from *P. coarctata*, but connected with *P. vaginata* by an unbroken series of intergrading forms. Consequently the plant in question must be classed with the latter species, though is seems worthy of a varietal name. The description reads as follows:

Puccinellia vaginata var. *paradoxa* nov. var.

Perennis caespitosa foliis viridibus. Culmi 12—20 cm longi, robusti, prostrati vel e basi decumbente erecti, internodis basalibus 1—2 brevissimis et singulo longo muniti. Folia eorum 2—3, summa longevaginata; laminae strictae, planae, 2—4 cm longae, 1.5—2.5 mm latae, apicibus cucullatae, faciebus superis scabriusculae, ceterum glabrae. Ligula 1.2—2.0 mm longa alba, truncata, decurrens. Panicula breviter exserta 6—10 cm longa, aperta, pyramidalis; rami e nodo inferiore 2—6, robusti, patentes, inferne laevissimi, superne scabri, inferiore tertia parte nudi, spiculis brevipedicellatis vel subsessilibus 2—15 adpressis. Pedicelli non incrassati. Spiculae virides vel colore luteolo aut purpureo indutae, 4.5—6.0 mm longae, 3—5-florae. Glumae tenues translucentes, distinctissime uni- et trinerviae, saepe

subcarinatae; gluma inferior 1.2—2.0 mm longa, angusta, acuta, superior 2.2—2.6 mm longa, obovata, rotundata vel subtruncata, valde eroso-ciliata. Lemmata tenuia, superiore dimidia parte translucentia, late oblonga, 2.5—3.0 mm longa, rotundata, eroso-ciliolata, obscure 5-nervia, nervis ad basin parum pilosis; pili calli praesentes. Palea c. 0.5 mm, brevior quam lemma, bifida et apice ciliolata, carinae apicem versus distanter spinulosae, glabrae aut pilis perpaucis longis basim versus munitae. Antherae 0.6—0.8 mm longae. Grana 1.8 mm longa.

Type: W. Greenland, Nûgssuaq Peninsula, Niaqornarssuk pr. Marrait (70°30′ N. lat.—54°12′ W. long.) leg. KNUD JAKOBSEN Sept. 3, 1950, Nr. 6100 (Herb. Copenhagen).

Distribution: Greenland, cf. fig. 111.

Illustrations: pl. 5; figs. 42—43 and 85—86.

Caespitose, perennial, foliage green. Culms 12—20 cm long, stout, prostrate or erect from a decumbent base, consisting of 1—2 very short basal and one long distal joint. Culm leaves 2—3, the uppermost long-sheathing; blades straight, flat, 2—4 cm long, 1.5—2.5 mm wide, cucullate at apex, slightly scabrous on the upper surface, otherwise glabrous. Ligule 1.2—2.0 mm long, white, truncate, decurrent. Panicle barely exserted, 6—10 cm long, open, pyramidal; branches 2—6 from the lower node, stout, patent, glabrous below, scabrous above, naked in their basal third, bearing 2—15 appressed, short-pedicelled or subsessile spikelets. Pedicels not thickened. Spikelets green, yellowish or purplish tinged, 4.5—6.0 mm long, 3—5-flowered. Glumes thin, translucent, distinctly one- and three-nerved, often subcarinate; the 1st 1.2—2.0 mm long, narrow, acute, the 2nd 2.2—2.6 mm long, very wide, obovate, rounded or subtruncate, strongly erose-ciliate. Lemmas thin, translucent in their upper half, broadly oblong, 2.5—3.0 mm long, rounded, erose-ciliolate, obscurely 5-nerved, the nerves faintly hairy at the base; callus hairs present. Palea c. 0.5 mm shorter than the lemma, bifid and ciliolate at apex, the keels distantly spinulose toward the apex, glabrous or with a few long hairs toward the base. Anthers 0.6—0.8 mm long. Grain 1.8 mm long.

Var. *paradoxa* may be mistaken for *P. coarctata*, but it can be distinguished by its comparatively large panicle and the somewhat glossy spikelets. The glumes, also, differ by being thinner, the lower one narrow and acute and often slightly keeled. Var. *paradoxa* seems to be a decidedly halophilous plant, usually associated with the seashore proper or with terraces and crevaces of rocky coasts washed by the salt spray of the surf. However, in one locality K. JAKOBSEN collected the plant at the border of a lake 200 m above sea-level.

ROSENVINGE (1892, p. 731) described a var. *effusa* under *Glyceria vaginata* as follows: "var. *effusa* L. K. R. *dense caespitosa, foliis involutis, vagina folii supremi medium culmi vix attingenti, inflorescentia effusa, ramis inferioribus horizontaliter patentibus, floribus mox deciduis.*" loc. W. Greenland: Claushavn.

No doubt ROSENVINGE's plant differs from the typical *P. vaginata*; the long-exserted panicle and the patent panicle branches lend to it an outer appearance somewhat reminiscent of that of *P. deschampsioides*. Its leaf-anatomy is like that of *P. vaginata*. Specimens of approximately the same type, though usually somewhat more closely related to typical *vaginata*, are at hand from some localities on Disko and Nûgssuaq. Thus var. *effusa* ROSENV. actually seems to represent one of the numerous local segregates from the *vaginata* stock, filling the space between the widely different extremes exemplified by the typical *P. vaginata* and its var. *paradoxa*.

As stated by PORSILD (l. c.) *P. vaginata* is the commonest of the Puccinellias in the northern parts of West Greenland, especially along the outer coasts. Only quite exceptionally is it found far from the seashore. It is strongly hemerophilous (cf. PORSILD 1932, p. 26) and forms dense, though hummocky carpets everywhere around human habitations.

The Greenlandic distribution of *P. vaginata* is remarkable. Besides the West Greenland area extending from about 69° N. lat. to about 78° N. lat., it inhabits an area in Northeast Greenland comprising the Kejser Franz Josephs Fjord and the Scoresbysund districts. Along the north coast proper and the northernmost part of the east coast it is absent.

It seems to be less common in the coastlands on the west side of Baffin Bay and, probably, does not extend so far northward as on the west coast of Greenland. The records by SIMMONS (1906, p. 158: *Glyceria distans* var. *vaginata*) from Ellesmere Land are probably all of them wrong. The specimens seen by me are, in fact, *P. angustata*. In the National Herbarium of Canada[1]) there is a specimen from Bylot Island (about 73° N. lat.), which locality possibly represents the northern limit of the species along the west coast of Baffin Bay, and some few specimens from southwestern Baffin Land and northernmost Labrador.

The rich material collected by M. O. MALTE along the coasts of Hudson Strait, from which several specimens were cited by POLUNIN (1940, p. 86) as "*P. angustata* var. *vaginata*" (MALTE's determinations), represents a type of its own, differing from the Greenland material. It might be taken for a distinct species, but farther to the west in the

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[1]) After the present treatise had been sent to the press, I received from Dr. A. E. PORSILD, Ottawa, the arctic *Puccinellia* material of the National Herbarium of Canada for revision. As to *P. vaginata*, American material of which is very poorly represented in the Scandinavian herbaria, the present description has been corrected in accordance with the greatly supplemented information about the distribution of the species. A few other improvements are likewise due to the results of the supplementary study of the Canadian material.

I am greatly indebted to Dr. A. E. PORSILD for his share in the corrections.

northern Hudson Bay area it passes into typical *P. vaginata*, which occurs as far west as the Mackenzie Delta.

I think the Hudson Strait type deserves varietal rank; it is described as follows:

Puccinellia vaginata var. *elegans* nov. var.

Differt a typo Groenlandiae notis sequentibus: Panicula longe exserta, ramis spiculiferis solum apicalibus; folii vagina superiore haud inflata, ligula elongata; spiculis majoribus, flosculis densius imbricatis, bracteis longioribus, neque vel vix eroso-ciliolatis. Antherae longiores (0.9—1.2 mm longae). Grana majore (2.0—2.3 mm longa).

Type: Wakeham Bay, Hudson Strait, leg M. O. MALTE, Aug. 29, 1927. Nat. Herb. of Canada 118455 (Duplicate in the Copenhagen Herbarium).

Distribution: Hudson Strait Area.

(Syn. *Puccinellia angustata* var. *vaginata*, on specimens determined by M. O. MALTE).

Illustrations: pl. 6; figs. 40 and 79—80.

Differs from the Greenland type in the following characters: Panicle long-exserted, its branches spikelet-bearing only at apex; upper leaf-sheath not inflated, ligule elongated; spikelets larger, florets rather closely imbricated; bracts longer, not, or very slightly, erose-ciliolate. Anthers longer (0.9—1.2 mm long). Grains larger (2.0—2.3 mm long).

As to the anatomical characters of the leaves *P. vaginata* is peculiar owing to its large-celled epiderm; the stomata guard-cells are longer than in any other species. In *P. vaginata typica* the cells of the leaf margin are of the elongated type, intermixed with short ones which are sometimes transformed into spinules. The warts of the long cells of the upper leaf-surface are not actually terminal and thus form no stomatal flaps. In var. *paradoxa* the leaf margin is built up of uniform short cells, and the warts of the long cells, especially those adjacent to the stomata, are placed nearly terminally, as is most often the case in *Puccinellia*. Besides, the cell tissue of var. *paradoxa* is somewhat more wide-meshed. The epidermal anatomy largely parallels the outer morphology of the plants so that specimens transitional between the extremes show an intermediate picture of the leaf epiderm. Var. *elegans* has a very large-celled epiderm, the warts on the upper side are much reduced and the under-side stomata are clearly pitted.

The varieties of *P. vaginata* may serve to exemplify the close correlation between morphology and leaf anatomy often met with in *Puccinellia*. Var. *paradoxa* resembles *P. coarctata*, while var. *elegans* has something in common with East American representatives of the col-

lective species *P. pumila* (*P. pumila* "var. *Fernaldii*" cf. p. 66). A comparison of the figures of the leaf epiderm, viz. figs. 85—86, 71—72, and figs. 79—80, 81—82, will elearly illustrate the said parallelism.

In spite of the embarrassing variation within *P. vaginata*, all its different forms have their thin glossy bracts and their comparatively long stomata in common.

The distributional area of *P. vaginata* is remarkable by its wide east—west extent, from East Greenland to somewhere west of the Mackenzie Delta, while its south—north extent is very limited; the plant follows the American continental north coast, but it seems to be absent from large parts of the Canadian Archipelago. More or less typical plants are at hand from the whole area while the described varieties are mainly restricted to the southern boundaries of the species[1]).

Puccinellia phryganodes (Trin.) Scribn. et Merr.

Lamson-Scribner and Merrill, Contr. U. S. Nat. Herb. 13 (1910) p. 78.

Poa phryganodes Trinius, Mem. Acad. Petersb. VI. Ser. I (1831) p. 389.

Illustrations: Th. M. Fries, Öfvers. Kongl. Vet.-Akad. Förh. Årg. 26 (1869) tab. 4 (Spitsbergen type, see below); Fl. dan. fasc. 49 (1877) tab. 2883 (Greenland type, see below); Fernald and Weatherby, Rhodora 18 (1916) pl. 114, figs. 7—11 (Greenland type); this paper, figs. 44—51 and 89—96.

Distribution within Greenland: fig. 112.

Perennial, forming loose tufts and slender epiterranean stolons, which produce short proleptically sprouting innovations inserted extra-axillarily opposite the leaf bases. Foliage of the tufts glaucescent, of the runners often verdant. Flowering culms procumbent, up to 15 cm long, 2-leaved; upper sheath elongated, reaching the panicle; blades 1—3 cm long, 1.5—2.0 mm wide, rigid, folded, abruptly pointed at apex, glabrous; ligule 1.0—1.3 mm long, acute or abruptly pointed. Blades of the runners more flaccid, up to 3—4 cm long, ligule 0.5—0.8 mm long, truncate.

[1]) When looking through the Spitsbergen *Puccinellia* material of the Oslo Botanical Museum, I provisionally determined a single collection as *P. vaginata*: Kingsbay (79° N. l.), Lovéns Inseln, leg. Dr. F. Schäfer, August 1923. As regards several characters it agrees with some East Greenland *P. vaginata*. However, the fact that its panicles have a decidedly reddish hue, in contradistinction to the purely bluish purple colour constantly observed in *P. vaginata* from Greenland, I now consider it eertain that it cannot be conspecific with *P. vaginata*. Recently Dahl and Hadač (1946 p. 9) have published the plant in question as *Puccinellia tenella* (Lge.) Holmb. (the locality is given as Ny-Ålesund). It is a unique plant, not belonging to any species known to me. According to Johs. Lid (in lit.) it was stated by the collector that the grass formed a close stand sized 2—3 square metres at the seashore. It can hardly be suspected to be a hybrid, for its pollen development is excellent, and its anthers dehisce. Possibly it is a distinct species which should be searched for by future collectors.

Panicle meagre, dilute-purple, 3—6 cm long; branches 2—3 from the lower node, slender, glabrous, stiffly ascending, later on reflexed, bearing 1—3 spikelets; pedicels scarcely thickened. Spikelets oblong, 6—11 mm long, 3—6-flowered. The 1st glume 1.5—2.0 mm long, lanceolate, obtuse, 1-nerved, the 2nd 2.5—3.0 mm long, oblong, obtuse, 3-nerved. Lemmas 3.5—4.5 mm long, oblong, obtuse or slightly emarginate with a distinct, narrow, whitish, entire border, obscurely 5-nerved, glabrous at base; callus hairs absent. Palea bifid, as long as the lemma or a little longer; keels without spinules or hairs. Anthers (1.3—)1.5—2.0 mm long, thin, containing no normal pollen, not dehiscent. Grains do not develop.

Specimen described: West Greenland, Sydostbugt (abt. 68°40′ N. lat., 51°20′ W. long.) leg. N. HARTZ, July 1880.

Puccinellia phryganodes is the only member of the genus that is distributed from the extreme south to the very north coast of Greenland. Nevertheless it can hardly be designated as circumgreenlandic, for the northeastern hiatus shown in the accompanying map (fig. 112) is, no doubt, real, as the plant was not found by KJELD HOLMEN, the botanist of the Peary Land Expedition 1948—50. Outside Greenland, also, it has a wide, though mainly high-arctic, distribution. It is the only Greenland *Puccinellia* of circumpolar range.

Judging from the literature (f. ex. ANDERSSON & HESSELMAN 1900, p. 72, HOLMBERG 1926 b, p. 222, POLUNIN 1940, p. 83, LID 1944, p. 101), the species has never been observed fruiting, and a careful examination of the available herbarium material seems to show that it is quite unable to reproduce sexually. The anthers never dehisce, and pollen formation does not normally take place (cf. HOLMBERG l. c.). On the other hand, it reproduces vividly by proleptic bulbil-like short shoots, formed extra-axillarily opposite the leaf bases from long above-ground runners (JOHANSSON 1910, p. 272, HOLM 1922, p. 10), especially when growing in places regularly flooded at high tide. Only at the upper border of the stands, where it is rarely or not at all submerged by the sea water, will it form cushions bearing flowering culms (PORSILD 1920, p. 43). POLUNIN (1940, p. 83), as formerly SCHOLANDER (1934, p. 95), states that it does not even flower in its northernmost localities. On the other hand, I think that the Greenland material may serve to show that the flowering intensity decreases again toward its southern limit. Collections from southernmost Greenland at any rate rarely contain flowering plants, while those from more northern regions comprise plenty of flowering specimens.

The material from the large circumpolar area is not uniform. JOHANSSON (1910, p. 272) calls attention to the larger panicle, longer spikelets, and the narrower glumes of the Greenland specimens as compared with the Spitsbergen ones, and suggests that there may be racial differences.

On a comparison of randomly chosen Greenland specimens with ANDERSON's minute description of the Spitsbergen plant (*Catabrosa vilfoidea* of ANDERSON, in MALMGREN 1862, p. 254), it will be immediately obvious that this description does not actually fit the Greenland *Puccinellia phryganodes*. Cytological investigations have shown that also the chromosome numbers differ: For the Spitsbergen plant FLOVIK (1938, p. 320) counted 2n = 28, which figure has lately been recorded for plants from northernmost Scandinavia, too, while the Greenland plant has 2n = 21.

As to floral characters, the Spitsbergen material seems to represent a unity of its own as compared with material from the rest of the Arctic. It is outstanding by the following characteristics: Pedicels thickened; glumes firm, concave, the side nerves of the 2nd glume obscure, distinct only at base; lemmas, like the glumes, comparatively short, concave in their whole length; keels of palea smooth.

In plants from other places the pedicels are hardly thickened, the glumes thin, ± flattened, the side nerves distinct; the lemmas usually flattened in their upper part; keels of palea finely papillose.

Even if the Spitsbergen material is disregarded, that from the remaining parts of the Arctic is not uniform. It differs in such a way that a general trend of variation around the Polar Basin can be demonstrated. This fact will be obvious if the current descriptions of the plant from various regions of the Arctic are compared. Information obtained from manuals of extra-Greenland floras supplemented with my own observations on Greenland material may be summed up for comparison as follows:

	Number of florets in the spikelet	Shape of the lemmas
Scandinavia (HOLMBERG 1926b, p. 222)	2–4	tapering toward the apex
URSS (KRECZETOWICH 1934, p. 470)	3–4	acutish or obtusish
Alaska (SWALLEN 1944, p. 18)	3–5	obtuse
Greenland (author's own observations)	3–6	obtuse—slightly emarginate

As will be seen, if we proceed from northern Scandinavia eastward along the Polar Basin as far as Greenland, an increase in the number of florets per spikelet and a broadening and rounding of the lemmas can be observed. At the same time the length of the spikelets increases, too, mainly because of the increased number of florets; however, also the glumes and the lemmas themselves tend to become longer.

As already pointed out, the Spitsbergen plant hardly fits with the above series; even though as to the characters in question it comes closest to the Scandinavian plant on account of its small spikelets.

The facts on record render it evident 1) that the Spitsbergen plant has no direct connection with the continental populations of the Old

World nor with the Greenland ones, 2) that the Spitsbergen material on the one hand and the Greenland material on the other constitute the extreme types within the collective species, and 3) that the circumpolar chain of variation is broken by the Atlantic Ocean.

Since from large stretches of the Arctic coasts only non-flowering specimens have been brought home by the expeditions from which material is available (e. g. Novaya Zemlya and the Siberian north coast), the range of the different types could not be further investigated unless distinguishing characters other than the floral ones were to be found. The bulbilliferous runners generally present in herbarium specimens are always of the same abnormal structure and therefore offer no distinguishing marks, though those of the Spitsbergen plants are usually the more slender. The epidermal anatomy of the leaves, on the other hand, shows a surprising variation, by means of which the material can be classified into four categories, which, too, are reasonably geographically delimited. Curiously enough, the epidermal variation does not parallel the sequence of floral variation which was illustrated by the rough succession as follows: Spitsbergen, Scandinavia, URSS, Alaska, Greenland. For the Spitsbergen and the Alaskan (Beringian) types have smooth or only slightly papillose epidermal cells, while the others have strongly papillose cells.

The property of having "smooth cells" seems to be correlated with a more loosely meshed and somewhat irregularly areolated epiderm, while that of "papillose cells" is correlated with a more densely meshed and exceedingly regularly areolated epiderm.

It should be noted that the variability as to the leaf-epiderm merely concerns the upper leaf-surface. The epiderm of the under side is largely of the same appearance throughout the species and differs from the rest of the genus in being very scantily supplied with stomata; actually rather often no stomata are found at all.

Within the "non-papillose" type on the one hand, and the "papillose"-type on the other, secondary types may be demonstrated as follows:

1) Non-papillose cell type:

a) Beringian plants have more or less tumid epidermal cells, which cause the leaf surface to look bladdery under the microscope.

b) Spitsbergen plants usually have no tumid epidermal cells. Occasionally the epiderm of the culm leaves, especially in plants from dry localities, may be somewhat papillose, but the warts are not by far so conspicuous as in the really papillose type. In this connection it is of special interest to note that the leaves of the runners are smooth, while in the really papillose type the runner leaves, also, are always papillose.

2) Papillose cell type:

a) Fennoscandian plants: the leaves have generally more than two grooves with bulliform cells, and hence the leaf surface is furrowed; the ridges are generally spinulose.

b) Greenland plants: the leaves generally have only two, rarely more, grooves with bulliform cells, and the leaf surface is often devoid of spinules; sometimes spinules are present along the stereome strands.

From the above survey of the epidermal characteristics it will be evident that also non-flowering specimens may be clearly referable to one or the other of the main types. If in exceptional cases it may be impossible on the basis of the leaf characters alone to decide to which of the secondary types a plant belongs, it will be of minor importance, as the geographical areas of two interdependent secondary types do not overlap.

Concerning the geographical distribution of the various types the following information should be added:

The flowerless specimens from the Siberian north coast (Taimyr Peninsula and East Siberia) have strongly papillose and spinulose leaf surfaces, and therefore I refer them preliminarily to the Fennoscandian type.

All the Novaya Zemlyan plants, with the exception of a single somewhat doubtful specimen from Matotchkin Shar, belong to the Spitsbergen type, while the available specimens from the Waigatsch Island are of the Fennoscandian type.

The Beringian type is restricted to the shores of the Bering Sea and its islands (St. Lorenz Isl., Pribilof Isl.), the Bering Strait, and the adjacent Alaskan Polar Sea coast.

The Greenland type is found comparatively unaltered in the Canadian Archipelago, the Hudson Bay Area, and to the west as far as easternmost Alaska.

The facts concerning the pattern of variation within the collective species can now be summed up as follows:

Key to the types of *Puccinellia phryganodes*.

a. Pedicels thickened; spikelets 2—4-flowered; glumes firm, concave, the 2nd 1.5—2.0 mm long, its side nerves obscure, distinct only at base; lemmas 2.5—3.0 mm long; keels of the palea smooth. Epidermal cells of the upper surface of stem leaves smooth or slightly papillose, those of the runners smooth, not tumid:

Spitsbergen type (type of *Catabrosa vilfoidea* Ands.) (figs. 50—51, 95—96).

Distribution: Spitsbergen, Bear Isl., Novaya Zemlya (excl. Waigatsch Isl.).[1])

aa. Pedicels not, or hardly, thickened, spikelets 2—6-flowered; glumes thin, ± flattened, the 2nd 2.0—3.0 mm long, distinctly 3-nerved; lemmas usually 3.0—4.0 mm long; keels of the palea papillose. Epiderm cells of upper leaf surface strongly papillose or tumid.

b. Epidermal tissue somewhat irregularly areolated, the cells tumid, often drop-shaped; sometimes, in addition, inconspicuous real papillae may be observed:
Beringian type (type of *Poa phryganodes* TRIN.) (figs. 46—47, 91—92).
Distribution: Coasts of Bering Sea and Bering Strait, Northwestern Alaska.

bb. Epidermal tissue very regularly areolated, the cells strongly papillose, not tumid.

c. Spikelets 2—4-flowered; lemmas tapering, acute or subacute, narrowly whitish-margined, the mid-nerve continuing to the very apex; usually more than two grooves with bulliform cells; the ridges spinulose:
Fennoscandian type (figs. 48—49, 89—90).
Distribution: Northernmost Fennoscandia, Polar Sea coasts of Russia (incl. Waigatsch Isl.) and West and East Siberia.

cc. Spikelets 3—6-flowered; lemmas oblong-obovate, obtuse or slightly emarginate, commonly broadly whitish-margined, the mid-nerve vanishing into the hyaline margin or into the notch; rarely more than two grooves; the ridges smooth or slightly spinulose:
Greenland type (figs. 44—45, 93—94).
Distribution: Greenland, Canadian Archipelago, coasts of the Polar Sea westward to eastern Alaska.

No floral key-characters are given for the Beringian type because of its intermediary position between the Fennoscandian and the Greenland type, though it comes nearest to the latter. It is at best distinguished by its peculiar leaf-epiderm.

[1]) A single collection in the Oslo Herbarium, labelled "Biscayers Hoek in Redbay, 7. August 1925, FRIDTJOV ISACHSEN" (NW. Spitsbergen) shows a distinct papillose epiderm and cannot, it is true, be distinguished from the Greenland material. I have disregarded this collection, suspecting that a mislabelling might have taken place. However, JOHS. LID (in lit.) assures me that the said locality cannot be doubted. I admit that this find is of principal importance. I dare not put forward any opinion regarding the possibility of a recent introduction from East Greenland. (Addition in the proofs).

As pointed out above, the Spitsbergen type in several respects constitutes a unity as compared with the others. The Spitsbergen plant was first described by ANDERSON (in MALMGREN 1862, p. 265), who named it *Catabrosa vilfoidea*. Shortly afterwards it was transferred to the genus *Glyceria* by TH. FRIES (1869, p. 139). SCRIBNER & MERRILL (1910, p. 781) supposed it to be identical with the Alaskan *Poa phryganodes* of TRINIUS, which was transferred to *Puccinellia* by these authors. Since then the ANDERSON name has disappeared from the literature.

Since, actually, *Poa phryganodes* TRIN. and *Catabrosa vilfoidea* ANDS. are not identical, there might be some reason to re-establish the ANDERSON name *vilfoidea* for the Spitsbergen plant. Irrespectively of what rank might be ascribed to it, I think that the re-establishment of it at present would serve no practical purpose. For cytological (as also some morphological) evidence would speak against the drawing of a line of division separating the Spitsbergen and the Fennoscandian types, both of them being tetraploids. At the same time it would seem absurd to unite the Fennoscandian and the Greenland type in contradistinction to the Spitsbergen one, when it is remembered that the Greenland plants are triploids.

If any nomenclatorial consequences were to be drawn from the present investigation, it would be to ascribe subspecific rank to each and all of the four distinguished types. However, I refrain from such a procedure, as it would only encumber the literature with epithets which no one would probably make use of.

It is well known that *Puccinellia phryganodes* does not reproduce from seed, and that its anthers contain no, or exceedingly little, full-grown pollen. HOLMBERG (1926 b, p. 222) found 2—4 per cent of good pollen in Scandinavian material. Investigations by the present author on Spitsbergen material have given approximately the same result, 1—5 per cent of good pollen being found. In spite of the deficient pollen formation, the anthers of the Spitsbergen and Scandinavian plants may look rather normal although they remain hidden behind the lemmas. In the Greenland material the male sterility has reached its extreme, for by far the majority of the Greenland flowering specimens have thin and shrivelled anthers containing only empty pollen grains; rarely 1—2 per cent of good pollen was found, or only in exceptional cases up to 4 per cent. (For the sake of completeness it should be added that a single somewhat deviating plant from SE. Greenland (Cape Tordenskjold, leg. R. BÖGVAD 21. VIII. 1932, No. 638), in some respects recalling the Fennoscandian type, showed a considerably better pollen development, even far surpassing that of the Old World plants. In this case the good (not empty) pollen grains were of a much varying

size. Otherwise, when good pollen is scarcer, the grains are usually of a more uniform size).

Another curious indication of the abandonment of the sexual mode of reproduction often met with in Greenland plants is the degeneration of the female organs, for the ovaries are abnormally small and the stigmas scarcely protrude above the lodiculae. Apparently the lodiculae, measuring about 0.8 mm, have not been subjected to a similar reduction. Plants from Arctic N. America, morphologically belonging to the Greenland type, often show normal female organs.

The Beringian Type, which with its tumid epiderm cells anatomically holds a position of its own, is remarkable, also, for its better pollen development. Two samples from Port Clarence, near Kotzebue Sound, whence the type of *Puccinellia phryganodes* originates (cf. HULTÉN 1942, p. 237), had about 50 per cent of good pollen, and none of the investigated plants had less than 15 per cent of good pollen. In accordance the anthers are thicker than those of plants from elsewhere. Nevertheless no dehiscent anthers were seen. However, in one plant, out of flower, exserted filaments were observed; as the anthers had been shed, it is doubtful whether they had dehisced. At least, the elongated filaments might indicate that, quite exceptionally, the pollen may have been liberated.

Looking for relatives of *P. phryganodes*, we involuntarily stop at *P.* (*Atropis*) *geniculata* (TURCZ.) KRECZETOWICH (1934, p. 759 and 471). The said author records it as an endemic of the coasts of the Sea of Okhotsk. The key-characters (l. c. p. 462), alluding to the shape of the lemmas, are rather vague, so it may easily be mistaken for *P. phryganodes*. However, a fragmentary specimen kept in the Riksmuseum, Stockholm, shows that the anthers dehisce, and develop normal pollen. The leaves are deeply furrowed on the upper side and several rows of bulliform cells are present; the ridges are densely papillose and more coarsely spiny than found in any *P. phryganodes*. By means of these leaf characters alone it can be kept apart from *P. phryganodes*. On the other hand, the epidermal texture of the under side of the leaf is in all essentials like that of the latter species. *P. geniculata* is said to have no stolons. However, I am inclined to think that occasionally it may become stoloniferous. For a curious stoloniferous plant collected by A. E. PORSILD at Qiqertariaq, Alaska, No. 1069, which I have had the opportunity to inspect, in my opinion cannot be anything but *Puccinellia geniculata* (cf. HULTÉN 1950, p. 1715). It bears mature seeds and dehisced anthers, and as to its leaf-anatomy it matches completely the authentic *P. geniculata*. Habitually it reminds one of *P. phryganodes*, and as such it was determined by the collector (A. E. PORSILD 1939, p. 181), but it reveals at once itself as a somewhat different plant owing to its stouter stature. Its rather short stolons are precisely of the type found in *P. phryganodes*.

If this plant is really *P. geniculata*, or, in other words, if a stoloniferous *P. geniculata* is to be accepted, this species differs even less from *P. phryganodes* than might be expected. However, the taxonomic value of the peculiarly constructed runners may probably be questioned, as will be discussed below.

The idea of *P. geniculata* representing the ancestral sexual stock from which the asexual *P. phryganodes* emanated, suggests itself. However after all, only cytological investigations in the Beringian material may furnish a clue to the genealogy and interrelationships of these plant species.

If really *P. phryganodes* had in some way descended from *P. geniculata*, the Siberian-Fennoscandian type might for anatomical reasons be regarded as the primary *P. phryganodes*. On the other hand, the comparatively good pollen formation found in the Beringian type would immediately be considered a primitive feature within an asexual species like *P. phryganodes*. Irrespectively of the correct solution of these problems, all evidence points to the Bering Sea Region being the original home of the species.

The present occurrence of the extreme types at either side of the Atlantic, viz. Spitsbergen and Greenland, would seem to indicate 1) that a direct connection of the two types across the North Atlantic was never established and 2) that, probably, the present types got differentiated comparatively late, after or during migrations by western and eastern routes along the shores of the Polar Sea.

The question as to what taxonomical significance can justly be ascribed to the peculiarly constructed runners found in *P. phryganodes* and *P. geniculata*, was merely touched upon above. Here some other known examples of extraaxillary sprouting are added for comparison.

Attention should first be called to the fact that runners similar to those of *P. phryganodes* occur in another *Puccinellia*, also, as was first observed by FERNALD and WEATHERBY (1916, p. 18). These authors thought that the East American plant recorded as *Puccinellia paupercula* var. *alaskana* occasionally produces runners "which are rarely developed at flowering season". A closer examination of some sheets of FERNALD's collections kept in the Copenhagen Museum, has convinced me that the stoloniferous plants represent a separate species (*P. ambigua* n. sp. cf. p. 64), which, especially according to its leaf anatomy, seems to be more closely related to the Alaskan *Puccinellia pumila* (VASEY) HITCHC. *s. str.* than to any eastern representatives of FERNALD's collective *P. paupercula* v. *alaskana*. However, apart from the runners, no signs of relationship between *P. phryganodes* and the stoloniferous plant

in question can be demonstrated. Thus, there seems to be evidence to prove that the property of extraaxillary sprouting has originated independently in different species by a sort of parallel mutation. At least the fact that the phenomenon is found in otherwise dissimilar species, seems to show that this vegetative characteristic is of minor taxonomical value.

This view may be said to have been implicitly accepted so far, since *P. phryganodes* is conveniently placed with *P. maritima* (HUDS.) in spite of a different construction of the runners in the two species (cf. JOHANSSON 1910). The leaf anatomy of these two species is principally of the same type, though easily distinguished.

From the investigations on the racial differences within *P. phryganodes* it was inferred that this species probably came from the Beringian sector. At present the areas of the two species actually overlap in NW. Europe[1]), but it seems unlikely that the purely Atlantic European *P. maritima* should have been segregated from the westward migrating asexual *P. phryganodes* stock. Thus, the origin of *P. maritima* is obscure. After all, there is a possibility of a migration along the Polar Sea coast from Eastern Asia to temperate Europe during an interglacial period. For if plants such as *Lathyrus maritimus* and *Honckenya peploides* migrated along this pathway, as held by TOLMATCHEV (1934), *Puccinellia maritima* (or a now extinct ancestor) may have done it, too.

An additional case of extraaxillarily sprouting innovations outside the genus *Puccinellia* should be briefly mentioned here, namely that of *Catabrosa aquatica*. A comparatively close generic relationship between *Catabrosa* and *Puccinellia* seems evident for morphological reasons, but it is not cytologically confirmed, for within *Puccinellia* x = 7 was constantly found as the basic chromosome number, while for *Catabrosa* x = 10 has been stated (AVDULOV 1931, p. 202). The runners of *Catabrosa aquatica* and of *Puccinellia phryganodes* principally represent one and the same type. Even if it might seem doubtful that this character, common to generically different species, should be of common origin, some old relationship between the two species is suggested by their apparent ability to hybridize. A most curious grass, kept in the Riksmuseum, Stockholm, I am inclined to interpret as the said hybrid. It was collected at "York Fort, Hudson Bay" (date and collector not indicated). Although the plant is too high-grown, it may

[1]) This fact does not appear from the modern Scandinavian literature (e. g. LID 1944 pp. 100—01, HULTÉN 1950b maps 224—25), the northernmost localities of *P. maritima* having not been registered. In the Scandinavian museums *P. maritima* is at hand from the Finmark, heads of Alten Fjord and Jarfjord (S. Varanger), both localities situated in about 70° N. lat. and, further, from Solowezki Isl. in the White Sea. KRECZETOWICH (1934 p. 470) likewise reports it from Arctic Russia.

recall *P. phryganodes*, and as such it was previously determined. The panicles are large and spreading, the numerous spikelets are small, 2—3-flowered; the glumes and lemmas are shorter and more arched than those of the true *P. phryganodes*. These deviating characters point to *Catabrosa*. Moreover, the epiderm cells of both leaf surfaces are tumid, a character which in *Catabrosa* is developed even to exaggeration. The anthers contain no good pollen. If this plant is really the said hybrid, its genesis must be due to a *Puccinellia* flower having been pollinated by foreign *Catabrosa* pollen. Canadian material of *P. phryganodes* usually has better developed pistils than has the Greenland material. Therefore, a latent capacity of the female organs to function cannot simply be disregarded.

Puccinellia maritima (Huds.) Parl.

Parlatore, Fl. Ital. I (1848) p. 370.

Poa maritima Hudson, Fl. Angl. (1762) p. 35.

Illustrations: This paper, figs. 52 and 75—76.

Distribution within Greenland: fig. 113.

Perennial, loosely tufted, forming robust prostrate or creeping leaf-bearing shoots, the nodes of which are covered by the overlapping leaf-sheaths. Foliage glaucous. Flowering culms decumbent at base, 15—25 cm tall, 3-jointed, with long, often reddish leaf sheaths. Blades 2—4 cm long, 1.5—2.0 mm wide, glabrous, folded, abruptly pointed. Ligule 1.5 mm long, rounded. Blades of innovations up to 8 cm long, 3 mm wide, their ligule c. 1 mm long. Panicle faintly reddish or purplish tinged, contracted, 4—6 cm long, its branches glabrous, 2—3 from the lower node, rather short, stiffly ascending, with 1—3 spikelets; pedicels incrassate. Spikelets 7—11 mm long, 4—6-flowered, glumes and lemmas firm, entire, not translucent. 1st glume 1.8—2.0 mm long, ovate, obtuse, 1-nerved, indistinctly keeled, the 2nd 2.0—2.5 mm long, broad-ovate, obtuse, 3-nerved. Lemmas 3.0—3.5 mm long, obovate, obtuse or truncately triangular at apex, obscurely 5-nerved, nerves hairy at back at the very base; callus hairs present, short. Palea densely ciliate on the keels, as long as the lemma, or the bifid apex protruding up to $^3/_4$ mm above the lemma. Anthers 2.0—2.5 mm long, polliniferous, dehiscent.

Specimen described: S. Greenland, Julianehaab District, Sermilik, (abt. 60°30′ N.—45°0′ W.) leg. Johs. Gröntved 29. VII. 1937. No. 1877.

Within Greenland *Puccinellia maritima* is restricted to the southernmost part of the west coast, i. e. to the region of the southern centre of the Old Norse colonization. Ostenfeld (1926, p. 19) entered it in his list of presumably introduced "Old Norse" plants. Later on Porsild (1932) supplied good evidence for reducing materially the number of introduced species. As to *Puccinellia maritima* Porsild states (l. c. d. 48): ". . . if this strictly W. European type could immigrate by

natural ways to New England and Newfoundland, it could quite as well so enter S. Greenland."

However, the present investigation seems to show that the plant was really brought to Greenland by man, in all probability by the Vikings about a thousand years ago. The arguments are as follows:

An examination of Eastern American material, conveniently taken to be *P. maritima*, has convinced me that the American plant is by no means identical with the European-Iceland-Greenland ones, which, though greatly varying, form a unity. American plants are easily distinguished from European ones by the bracts being more acutish, of a thinner texture, and often finely erose at the margin; besides, the anthers are shorter (HITCHCOCK, Manual 2nd ed., states 1.5—2.0 mm long). The European-Greenland plants have completely entire bracts and anthers measuring 2.0—2.5 mm long. Judging by herbarium material, the innovations of the American plants are comparatively short and ascending as compared with the long horizontal ones characterizing the European type.

Even non-flowering specimens can easily be distinguished on the basis of leaf-anatomical peculiarities as follows:

The American plant: Both leaf surfaces warty. Under side with stomatal flaps; entrance to stomatal pits only slightly contracted, almost as long as the guard cells (figs. 77—78).

The European-Greenland plant: Upper leaf surface warty, under side smooth. The under side without stomatal flaps, entrance to the stomatal pits strongly contracted, at most half the length of the guard cells (figs. 75—76).

Actually, the American plant does not belong to *Puccinellia maritima*. Thus it must be left out of consideration when we are to discuss the origin of the Greenland plant.

As is well known, the Old Norse colonization of Greenland was started from the Icelandic settlements. That *P. maritima* really came to Greenland by this way, is also indicated by the plant itself. The Greenland plant, as described above, has strikingly long paleas. Precisely the same peculiarity is often met with in Iceland material, but rarely observed in plants from the European continent.

P. maritima is still behaving almost like a foreigner in Greenland; most often it is found in a vegetative state, only, and when it does flower, it flowers so late in summer that the seeds will hardly have time to ripen. Actually, seeds were never seen in herbarium specimens. However, a lively propagation by runners will ensure the existence of

the plant for years, even for hundreds of years. Possibly it was able to fruit during the favourable climate epoch of the Norse colonization about one thousand years ago (cf. LAUGE KOCH 1945). Later on the climate deteriorated, and some 400 years ago the human inhabitants became extinct. Most likely *Puccinellia maritima* has not spread to new localities since then. (For the American plant so far known as *Puccinellia maritima*, see this paper p. 67).

IV. NEW AMERICAN SPECIES OF *PUCCINELLIA*

On dealing with the Greenland Puccinellias and their extra-Greenland relationships it is inevitable to inquire into taxonomical questions concerning East American species. However, a sound discussion of matters was seriously impeded by the fact that the N. American representatives of the genus are greatly in need of a revision. Therefore, some hitherto not clearly defined unities which were of special interest in connection with my Greenland studies, are here diagnosticated and proposed as new species.

Puccinellia ambigua nov. sp.

Perennis laxe caespitosa, stolonibus superficialibus flagelliformibus, e medio internodii emissis. Culmi 5—12 cm alti, erecti aut prostrati, vulgo bifoliati, vagina suprema quam lamina longior, inferiorem partem paniculae includens. Folia 2—4 cm longa, conduplicata, distensa ca. 1 mm lata, apice obtusa. Ligula 0.8—1.0 mm longa, obtusa—subacuta. Panicula linearis spiciformis, 2—4 cm longa; rami glabri ascendentes, e nodo inferiore 1—3, spiculis 1—5 appressis, brevi-pedicellatis aut sessilibus; pedicelli, si exstant, incrassati. Spiculae albescentes, nitentes, densae, 4.5—6 mm longae, 3—5-florae. Glumae firmae, curvatae, integrae, distincte nervigerae; inferior 1.8—2.0 mm longa, oblonga, subacuta, uninervata; superior 2.8—3.0 mm longa, oblongo-ovata, subacuta aut obtusa, trinervia. Lemmata 2.8—3.2 mm longa, subacuta aut obtusa, 5-nervia, dorso glabra, calli pilis minutis. Palea bifida, circiter lemmatis longitudine, carinae glabrae vel apicem versus spinulis paucis minutae. Antherae 0.5—0.7 mm longae. Grana ca. 2.0 mm longa.

Type: Prince Edward Island, Prince County, Alberton, damp brackish sand. July 11, 1912, FERNALD & ST. JOHN No. 6913 (Duplicate in the Copenhagen Herbarium).

Distribution: St. Lawrence Gulf Region.

Illustrations: pl. 7; figs. 37 and 83—84.

Perennial, loosely caespitose, forming flagelliform overground runners which produce short innovations from between the nodes. Culms 5—12 cm tall, erect

or prostrate, commonly 2-leaved, the uppermost sheath longer than its blade, enclosing the lower part of the panicle. Blades 2—4 cm long, folded, about 1 mm wide when flattened out, obtuse at apex. Ligule 0.8—1.0 mm long, obtuse—subacute. Panicle linear, spike-like, 2—4 cm long; branches glabrous, ascending, 1—3 from the lower nodes bearing 1—5 appressed, short-pedicelled or sessile spikelets; pedicels, when present, thickened. Spikelets whitish, shining, tight, 4.5—6 mm long, 3—5-flowered. Glumes firm, arched, entire, distinctly nerved, the 1st 1.8—2.0 mm long, oblong, subacute, 1-nerved, the 2nd 2.8—3.0 mm long oblong-ovate, bluntly acute or obtuse, 3-nerved. Lemmas 2.8—3.2 mm long, obtuse or subacute, 5-nerved, glabrous at back; callus hairs minute. Palea bidentate, about as long as the lemma, keels glabrous or with a few spinules toward the apex. Anthers 0.5—0.7 mm long. Grains c. 2 mm long.

P. ambigua is related to *P. pumila* (VASEY) HITCHC. from which it differs principally by its peculiar overground runners and by the much shorter anthers. The epidermal anatomy of *P. ambigua* is largely that of *P. pumila*, though the cells are somewhat less tumid than those of the latter species.

The type collection of *P. ambigua* was cited by FERNALD and WEATHERBY (1916, p. 19) as *P. paupercula* var. *alaskana*. Another specimen likewise kept in the Copenhagen Museum (Newfoundland, Conception Bay, Avalon Peninsula, salt marsh Killigrew's, FERNALD & WIEGAND Aug. 3, 1911, No. 4656) which was cited by these authors as *P. paupercula* (l. c. p. 18), likewise belongs to *P. ambigua*. Besides, a single specimen from the Stockholm Museum can be added, viz. New Brunswick: Gloucester Co., Grande Anse, dunes. June 16, 1938, leg. TURESSON & ALM (Swedish Forest Tree Exp. 1938, No. 164).

Probably all stoloniferous specimens of *P. paupercula* and its variety as understood by FERNALD and WEATHERBY belong to *P. ambigua*.

As stated by these authors (under *P. paupercula* var. *alaskana*), the runners much resemble those of *P. phryganodes*. However, in *P. phryganodes* the short bulbil-like lateral shoots of the runners are connate to the main axis throughout the whole length of the next internode, and, therefore, are seen to sprout opposite the leaf-bases. In *P. ambigua*, on the other hand, the axillary shoots are connate to the main axis only halfway up the next internode, and thus they sprout from the intervals between the nodes. In case no runners are developed, the curious mode of sprouting can still be used for a diagnostication, since it is found, too, at the bases of the flowering culms, a fact which can be easily demonstrated by removal of the lower leaf-sheaths (cf. fig. 1). Quite correspondingly, in *P. phryganodes* the innovation buds at the base of the culms are situated at the distal ends of the internodes, opposite the leaf bases. Apart from the runners, no common features of the two species can be demonstrated.

It should be pointed out here that the greater part of the East American *P. paupercula* var. *alaskana* of FERNALD and WEATHERBY, and probably part of *P. paupercula*, too, have rather little in common with the real *Gl. paupercula* of HOLM, i. e. *P. Langeana* ssp. *typica* of this paper (cf. p. 20). The plants in question are certainly related to the real *P. pumila* (VASEY) HITCHC. (cf. SWALLEN 1944, p. 22). HITCHCOCK

Fig. 1. *Puccinellia ambigua*. Basal part of flowering culm showing the situation of the rejuvenation buds. × 7.

(Manual 2nd ed. p. 80) records it simply as *P. pumila*. HULTÉN (1937, p. 96) proposed the name *P. pumila* var. *Fernaldii* for the plant pictured by FERNALD and WEATHERBY (l. c. pl. 117, figs. 68—72) as *P. paupercula* v. *alaskana*. But since the pictured plant came from Western America (British Columbia), the identity of var. *Fernaldii* seems unclear so far. In the present paper I provisionally use the Hulténian name for the East American non-stoloniferous plant. It seems to me to differ from the Western *P. pumila*, and possibly it deserves specific rank. Even as to the leaf-anatomy, it differs from *P. pumila vera* by the epidermal cells being but sparsely papillose and by the somewhat elongated marginal cells (cf. figs. 81—82). *P. pumila vera* has densely papillose and tumid epidermal cells, and its leaf margin is densely crenulated from the almost isodiametrical marginal cells.

Puccinellia americana nov. sp.

(*P. maritima* of American authors, not *Poa maritima* Huds.).

Perennis caespitosa glaucescens. Innovationes longae, multifoliatae, ascendentes. Culmi robusti, basi geniculati, 40—55 cm alti, 3—4-geniculati. Foliorum laminae 5—10 cm longae, 2.5—3.5 mm latae, conduplicatae, glabrae, marginibus tantum basin versus scabrae; vaginae laminas multo superantes. Ligula vigorosa 2.3—3.0 mm longa, obtuso-acutata, decurrens. Panicula exserta, 8—14 cm longa, ± contracta; rami e nodo inferiore 3—5, rigide ascendentes, subglabri, 3—8 cm longi, basi nudi, racemos spicularum 2—10 appressarum gerentes; pedicelli scabri, parum incrassati. Spiculae lineares, rubeolae, 7—12 mm longae, 5—9-florae. Glumae firmae. distincte nervigerae; inferior 1.5—2.2 mm longa, acutiuscula, (1—)3-nervia; superior obtusiuscula vel abrupte acutata, 2.5—3.2 mm longa, trinervia. Lemmata firma, minute marginibus ciliolata, 3.5—4.0 mm longa, obtusa vel abrupte in apicem obtusum acutata, 5-nervis; nervi basi usque ad tertiam vel dimidiam partem pubescentes. Palea sat firma, lemmatibus brevior, carinis ciliata. Antherae 1.5—1.7 mm longae. Grana 1.8 mm longa.

Type: National Herbarium of Canada Nr. 591/29, Fl. of New Brunswick, Anlac. July 25, 1929, M. O. Malte (Duplicate in the Riksmuseum, Stockholm).

Distribution: Northern Atlantic N. America.

Illustrations: Fernald and Weatherby, Rhodora 18 (1916) pl. 114 figs. 1—6; this paper, figs. 39 and 77—78.

Perennial, caespitose, glaucescent. Innovations long, many-leaved, ascending. Culms stout, geniculate at base, 40—55 cm tall, 3—4-jointed. Leaf blades 5—10 cm long, 2.5—3.5 mm wide, conduplicate, glabrous, scabrous merely at the margins toward the base; sheaths much longer than the blades. Ligule vigorous 2.3—3.0 mm long, bluntly acutish, decurrent. Panicle exserted 8—14 cm long ± contracted; branches 3—5 from the lower node, stiffly ascending, subglabrous, 3—8 cm long, naked below, bearing racemes of 2—10 appressed spikelets; pedicels scabrous, hardly thickened. Spikelets linear, reddish tinged, 7—12 mm long, 5—9-flowered. Glumes firm, distinctly nerved, 1st 1.5—2.2 mm long, acutish, (1—)3-nerved, 2nd obtusish or abruptly pointed, 2.5—3.2 mm long 3-nerved. Lemmas firm, minutely ciliolate at the margin, 3.5—4.0 mm long, obtuse or abruptly tapering to a blunt apex, 5-nerved; nerves pubescent at base to one-third or half their length. Palea rather firm, shorter than the lemmas, ciliate on the keels. Anthers 1.5—1.7 mm long. Grains 1.8 mm long.

Puccinellia americana differs from *P. maritima* (Huds.) Parl. mainly by the bracts being thinner, more distinctly nerved and often faintly erose at the margin, and by the anthers being shorter. As to

leaf-epidermal characters it differs radically from *P. maritima* (see this paper p. 62).

P. americana is probably not related to *P. maritima*. On the other hand it seems to occupy some intermediate position between East American forms of *P. pumila* s. l. and the *P. coarctata-fasciculata* group. Provisionally, I am inclined to place it with the latter because of its not quite entire bracts and its leaf-epidermal characters.

P. americana is the *P. maritima* of American authors. However, CHURCH (1949), who has found octoploid as well as hexaploid races in material of "*P. maritima*", reports morphologically different types, some of which are said to have entire bracts and comparatively long anthers. Thus there is a possibility that the European *P. maritima vera*, also, occurs on the American Atlantic coast as an introduced species, although the variation, alluded to by CHURCH, may well be met with within indigenous material belonging to *P. americana*. As to the delimitation of the American "*Puccinellia maritima*", FERNALD and WEATHERBY (1916, p. 8) state: "The American plant, however, varies so greatly in stature and size of the panicle and spikelets that we have been unable satisfactorily to divide the material." Most of the herbarium material studied by me was collected in New Brunswick and Nova Scotia by O. M. MALTE, 1929. Even this material from a comparatively restricted area fully corroborates the passage just quoted.

As the type of *P. americana* I have chosen one of the specimens which as to habit may recall our European *P. maritima*. Along with this "main" type, specimens are at hand with larger panicles, and longer, more evenly pointed and somewhat thinner bracts. Whether the latter type deserves varietal rank in contrast to *P. americana* as described above, I am unable to decide.

In connection with the pronounced polymorphy within this species, which is otherwise distinguished from the rest of the East American Puccinellias by a number of characters, it seems of interest to note that part of the material studied has shrivelled anthers containing merely defective pollen. Nevertheless, specimens collected in a sufficiently advanced stage show excellent seed formation. In some fruiting specimens the shrivelled undehiscent anthers are still to be found hidden behind the lemmas. These facts may suggest that the species comprises apomictic strains. CHURCH (1949, p. 160) has found irregularities in the meioses of American "*P. maritima*", but he does not regard it as an indication of apomictic reproduction.

Puccinellia arctica (Hook.) Fern. et Weath.

Fernald and Weatherby, Rhodora 18 (1916) p. 4, foot-note.

Glyceria arctica W. J. Hooker, Fl. bor. Am. II (1840) p. 248, tab. 229.

Illustrations: Hooker l. c.; this paper, pl. 8; fig. 38.

Perennial, caespitose. Culms stout, erect or geniculate at base, 20—25 cm tall, 2—3-leaved; the uppermost leaf-sheath elongated and somewhat dilated (ca. 3 mm in diameter); blades of culm-leaves 4—8 cm long, 1.5—2.0 mm wide at the base, evenly tapering toward the apex, deeply furrowed above, subglabrous, flat (somewhat rolled in a dried condition); ligule thin, obtuse often lacerate, 1.5—2.0 mm long. Panicle slightly exserted, 6—9 cm long, lanceolate-oblong, branches 3—5 from each node, short, slender, slightly scabrous, ascending, bearing 1—3 spikelets on slender pedicles. Spikelets green or purplish tinged, loose, 6—11 mm long, 5—9-flowered; Rachilla slender, flexuose, its joints ca. 1 mm long. Glumes and lemmas very thin, translucent, distinctly nerved, sometimes sinuously dentate, not erose-ciliolate. 1st glume 1.4—1.7 mm long, ovate, obtuse, one-nerved, 2nd glume 2.2—2.5 mm long, oblong, obtuse three-nerved; lemmas 3.0—3.2 mm long, broadly oblong, obtuse, strongly arched at base, 5-nerved, the nerves slightly pilose in their lower part. Callus hairs short. Palea as long as the lemma, bifid, the keels strongly ciliate, less so or even glabrous toward the base. Anthers 1.8—2.0 mm long.

Specimen described: America arct., Herschell Island (69°35′ N. lat., 138°50′ W. long) July 17, 1906 leg. A. H. Lindström (Iter arcticus Roald Amundsen (Gjöa-Expedition) 1903—1906). Ostenfeld 1910, p. 33, as *Glyceria distans* (L.) Wahlenb. f. *arctica* (Hook.) Gelert.

Glyceria arctica of Hooker has in the course of time been identified now with one, now with another arctic *Puccinellia* (cf. pp. 38—39). The plant described above is the only specimen I have come across that exactly matches Hooker's figure[1]). I think that the old drawing is admirably performed since it can hardly be mistaken for any other grass.

Puccinellia arctica, as described above, is doubtless closely related to *P. grandis* Swallen, and at first I was inclined to consider it an arctic, dwarfed form belonging to that species. However, apart from its low stature it differs in technical characters from the latter species in its obtuse, distinctly nerved bracts, its densely ciliate palea keels, and longer anthers. The said characters are also clearly observed in Hooker's figure.

I know of no other arctic *Puccinellia* the bracts of which are so thin and translucent at the same time as their nerves are so distinct.

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[1]) Additional specimens in the Nat. Herb. of Canada (cf. foot-note p. 49): Cape Dalhousie (129°55′ W.) A. E. & R. T. Porsild no. 2710; Atkinson Point (131°20′ W.) A. E. & R. T. Porsild no. 2549, no. 2547 (in part, with *P. vaginata*); Tuktuayaktoq (133° W.) A. E. Porsild no. 7404; Shingle Point (137°30′ W.) A. E. Porsild no. 7084 (in part, with *P. vaginata*).

The construction of the panicle, also, is unique by the slender and comparatively short, fascicled branches, each of them bearing only one to three spikelets.

As to leaf anatomy it comes exceedingly close to *P. grandis*.

The distribution of *P. arctica* is not known, so far. But I think it can be safely concluded that it does not reach Alaska to the west, for no finds are on record from that region (cf. HULTÉN: Fl. of Alaska and Yukon X, 1950); I likewise think that it is wanting in the Canadian Eastern Arctic, otherwise it would, no doubt, have been present in MALTE's rich collection from the Hudson Strait Area, so amply represented in the Scandinavian Herbaria. The specimen cited by GRÖNTVED 1936, p. 24 (Fifth Thule Expedition, No. 985 b, Keewatin Distr., Churchill) seems to me to belong to *Puccinellia lucida* FERN. & WEATH.

V. A SURVEY OF THE PUCCINELLIAS OF NOVAYA ZEMLYA AND WAIGATSCH

The studies carried out to elucidate the identity of *Glyceria tenella* LANGE caused me to undertake a thorough investigation of the Puccinellias of Novaya Zemlya and Waigatsch. As the revision happened to result in a somewhat altered conception of some species of that region, a brief survey of the Puccinellia flora of these Islands is appended.

Key to the Novaya Zemlya and Waigatsch Puccinellias.

A. Overground runners. Anthers 1.5—1.7 mm long, empty, not dehiscent. *P. phryganodes* (Trin.) Scribn. et Merr.

B. Glumes firm, concave, obscurely nerved. Keels of palea smooth. Epiderm cells of upper side of leaf not, or only slightly, papillose, sometimes tumid: *P. phryg.* Spitsbergen type.

BB. Glumes thin, ± flattened, distinctly nerved. Keels of palea papillose. Epiderm of upper side of leaf strongly papillose: *P. phryg.* Fennoscandian type.

AA. No runners. Anthers usually much shorter, rarely exceeding 1 mm, polliniferous.

C. Spikelets small, 3—5 mm long, whitish or dilute-purplish tinged. Lemmas 2.0—2.6 mm long, very slightly hairy or even glabrous at base. Anthers 0.5—0.7 mm long.

D. Bracts entire, their nerves prominent, those of the lemmas converging toward the apex: *P. Langeana* ssp. *asiatica* Th. S.

DD. Bracts ± erose-ciliolate, nerves not prominent, not converging.

E. Glumes firm, alternately inserted. Pedicels slightly thickened: *P. coarctata* Fern. et Weath.

EE. Glumes thin and glossy, oppositely inserted. Pedicels not thickened: *P. tenella* (Lge.) em. Th. S.

CC. Spikelets large, 4—7 mm long, intensely coloured. Lemmas 3—4 mm long, evidently hairy at back in their lower third. Anthers 0.7—1.4 mm long.

F. Spikelets all pedicelled; pedicels slender. Glumes thin throughout, translucent. Rachilla slender.

G. Glumes, especially the 1st, tapering toward the base, lanceolate or lanceolate-oblong, entire. Panicle branches glabrous, the pedicels sometimes with a few spinules. An 1.0—1.4 mm long. Culms geniculate. Plant strikingly slender and soft-leaved; loosely caespitose: *P. Palibinii* Th. S.

GG. Glumes dilated at base, ovate-orbicular, strongly erose-ciliolate. Panicle branches scabrous, et least in their distal part. Anthers 0.8—1.0 mm long. Culms erect or prostrate. Moderately robust plant; densely caespitose: *P. contracta* (Lge.) Th. S.

FF. Distal spikelets sessile or subsessile; pedicels vigorous. Glumes translucent only toward the margin. Rachilla stout.

H. Pedicels not or slightly thickened. Glumes approximately opposite-inserted, purple, scarious, corroded or ± erose-ciliolate at margin. Panicle contracted: *P. angustata* (R. Br.) Rand et Redf.

HH. Pedicels evidently thickened, claviform. Glumes ± alternate-inserted, herbaceous and greenish or yellowish at base, hyaline-bordered, entire or coarsely dentate not erose-ciliolate. Panicle spreading: *P. fragiliflora* Th. S.

Colpodium Vahlianum (LIEBM.) NEVSKI.

NEVSKI in Komarov, Fl. URSS II (1934) p. 436.

Glyceria Kjellmani LANGE in Kjellman & Lundström 1882 p. 314; *Puccinellia Vahliana* LYNGE 1923 p. 126.

Specimens examined:

Novaya Zemlya.

Head of Grebovii Fjord (ca. 73°0′ N. lat.) 28. VIII. 1921 Lynge (O)[1]; Fretum Matotchkin (73°19′ N. lat.) 7.—13. VIII. 1875 Kjellman & Lundström (U); Serebryanka Fjord, Alkefjell (ca. 73°30′ N. lat.) 25. VII. 1921 Lynge (O, H); Mashigin Fjord (ca. 74°40′ N. lat.): Mt. Nansen 10. VIII 1921 Lynge (O), Delta of Reidar River 29. VII. 1921 Lynge (O), Blomsterbugt 4. VIII. 1921 Lynge (O); S. of Arkangel Bay (ca. 75°50′ N. lat.)

[1]) For the abbreviations in brackets, see p. 109.

12. VIII. 1921 Lynge (O); Berkh Isl. (ca. 75°55′ N. lat.) 18. VIII. 1921 Lynge (O); Pankratyeff Penins. (ca. 76°5′ N. lat.) 19. VIII. 1921 Lynge (O).

Puccinellia Langeana (Berl.) Th. S. ssp. ***asiatica*** Th. S.

Sørensen, in Hultén, Fl. Alaska and Yukon X. Suppl. (1950) p. 1710.

Glyceria tenella Lange in Kjellman & Lundström 1882 p. 313 (pro parte); *Puccinellia tenella* Holmberg in sched. (p. p.); *Atropis paupercula* Kreczetowich in Komarov, Fl. URSS II (1934) p. 480. Cf. also this paper p. 20 et seq.

Illustrations: Lange l. c. tab. 6 figs. c, e, and f; this paper, pl. 9; fig. 10.

Specimens examined:

Waigatsch.

Cape Grebeni (69°38′ N. lat.) 30.—31. VII. 1875 Kjellman & Lundström (U).

Arctic Siberia.

Pitlekaj (67°5′ N. lat., 173°24′ W. long.) 28. IX. 1878 Kjellman (U) (*Catabrosa algida*, Kjellman 1882, p. 273).

Puccinellia fragiliflora nov. sp.

Perennis, dense caespitosa, lutescenti-viridis. Culmi crassi erecti vel prostrati, 10—15 cm alti, foliis basim versus 1—2. Laminae recurvatae, 2—3 cm longae, 1.5—2 mm latae, complicatae, abrupte contractae et ad apicem cucullatae. Ligula 1.0—1.5 mm longa, crassa et alba, subtruncata, irregulariter denticulatae. Panicula 3—4 cm longa, pyramidalis, ramis in paribus, 1—2 cm longis glabris, modice flexuosis divaricatis, spiculis 2—5 brevi-pedicellatis vel subsessilibus. Pedicelli subincrassati, sparse spinulosi. Spiculae 2—3-florae, 4—6 mm longae. Rachilla sat crassa fragillima. Glumae firmae, herbaceae, proximis partibus lutescenti-virides, ceterum purpureae marginibus hyalinis angustis sed distinctis, saepe grosse-dentatis, nervis crassis vigorosisque. Gluma inferior 1.2—1.6 mm longa, ovata, obtusa, uninervia. Gluma superior 2.0—2.6 mm longa, obovata, trinervia. Lemmata 2.8—3.2 mm longa, subtruncata purpurea, marginibus hyalinis lutescentibus, non ciliolata, 5-nervia, inferore tertia parte nervis piligeris. Palea lemma subaequans, bifida, carinae apicem versus spinulosae. basim versus longe-pilosae. Antherae 0.8—1.0 mm longae. Granum circiter 2.0 mm longum.

Type: Novaya Zemlya, Matotchkin Shar, leg. Otto Ekstam Aug. 13, 1905 (Herb. Lund).

Distribution: Novaya Zemlya; Chukch Peninsula.

Illustrations: pl. 10; figs. 13—14.

Perennial, densely caespitose, yellowish green. Culms stout, erect or prostrate, 10—15 cm tall, with 1—2 leaves near the base. Blades recurved, 2—3 cm long, 1.5—2.0 mm wide, folded, abruptly contracted and cucullate at apex, glabrous. Ligule 1.0—1.5 mm long, thick and white, subtruncate, irregularly toothed. Panicle 3—4 cm long, pyramidal; branches in pairs, 1—2 cm long, glabrous, slightly flexuose, divaricate, bearing 2—5 short-pedicelled or subsessile spikelets. Pedicels subincrassate, sparsely spinulose. Spikelets 2—3-flowered, 4—6 mm long; Rhachilla rather stout, very fragile. Glumes firm, herbaceous and yellowish green in their proximal part, otherwise purple with a narrow but distinct hyaline border, often coarsely toothed, their nerves thick and vigorous; the 1st glume 1.2—1.6 mm long, ovate, obtuse, 1-nerved, the 2nd glume 2.0—2.6 mm long obovate, 3-nerved. Lemmas 2.8—3.2 mm long, subtruncate, purple, yellowish hyaline-bordered, not ciliolate, 5-nerved, nerves pilose in their lower third. Palea about as long as the lemma, bifid, the keels spinulose toward the apex, long-hairy toward the base. Anthers 0.8—1.0 mm long. Grain about 2.0 mm long.

P. fragiliflora is doubtless related to *P. Andersonii*. Provisionally, I was inclined to take it as a variety of this species (cf. HULTÉN 1950, p. 1712). But even habitually it differs considerably from *P. Andersonii* by its loose, pyramidal panicle, and its smaller spikelets. Also its hairy, obtuse-truncate lemmas and the hairy palea keels must be pointed out as differential characters against *P. Andersonii*. However, it has the exceedingly fragile rhachis of the spikelet in common with *P. Andersonii*. Also the leaf anatomy of the two species is of the same type. In *P. fragiliflora*, however, the epiderm cells are less tumid than in *P. Andersonii*. In other respects, also, the epidermal peculiarities of *P. fragiliflora* are somewhat less pronounced than in *P. Andersonii*.

Superficially *P. fragiliflora* may recall a dwarfish *P. tenuiflora* (TURCZ.) but the leaf anatomy does not indicate any relationship between the two species. *P. tenuiflora* has a very densely meshed epidermal tissue and short stomata (25—30 μ as against 40—45 μ in *P. fragiliflora*). The epidermal anatomy would place *P. tenuiflora* with *Colpodium* rather than with *Puccinellia*.

So far only two localities of *P. fragiliflora* are known, viz. Novaya Zemlya, Matotchkin Shar (ca. 73°20′ N. lat., type locality) (Herb. Lund and Copenhagen), and arctic eastern Siberia, Irkajpij (68°56′ N. lat., 179°25′ W. long.) leg. KJELLMAN 12.—15. IX. 1878 (Herb. Uppsala) (*Glyceria vaginata* f. *contracta* (p. p.), KJELLMAN 1882, p. 273). Probably, the area of *P. fragiliflora* is restricted to the Old World Arctic, while *P. Andersonii* is a New World species, known to occur in arctic N. America from Alaska to Northern Greenland.

Puccinellia Palibinii nov. sp.

Perennis, laxe caespitosa, viridis. Culmi 10—20 cm longi, geniculati. gracillimi. Eorum folia plerumque bina, vaginis saepe quam internodia

brevioribus, laminis 2—4 cm longis, 1.5—2.0 mm latis, planis, mollissimis, glabris, gradatim angustatis. Ligula 1.5—2.0 longa, acuta, tenuis et alba. Panicula exserta. 4—6 cm longa, laxa. Rami bini tenues et graciles, glabri, 3—4 cm longi, ascendentes, superiore parte nudi, spiculis 3—6, quamdiu cum aliis comparantur, magnis, in pedicellis gracillimis. Spiculae laxae, purpureae, nitentes, 6—7 mm longae, 3—4-florae, rachillae graciles. Glumae tenuissimae, translucentes, integrae, non eroso-ciliolatae; inferior lanceolata vel oblongo-lanceolata, subacuta 1.5—2.5 mm longa. obscure uninervia; superior 2.5—3.2 mm longa, oblonga, obtusa, trinervia. Lemmata 3.0—4.0 (—4.5) mm longa, obscure 5-nervia, obtusa, interdum irregulariter erosa, sed haud ciliolata, dorso in parte inferiore tertia sparse pilosa. Palea lemma aequans, bifida, carinae apicem versus distanter spinulosae, basim versus sparse longe-pilosae, vel etiam glabrae. Antherae 1.0—1.4 mm longae.

Type: Novaya Zemlya, Matotchkin Shar, Pomorskaya, leg. B. Lynge Aug. 27, 1921 (Herb. Oslo).

Distribution: Novaya Zemlya.

Glyceria gracilis Palibin: Bull. Jard. Bot. Petersb. III. p. 46 (1903) Nomen nudum.—*Puccinellia angustata* var. *contracta* Holmb. in Lynge: Rep. Scient. Res. Norw. Exp. to Novaya Zemlya 1921 No. 13. (1923) p. 126.—*Glyceria Vahliana* Lange in Kjellman & Lundström: Vega Exp. Vetensk. Iaktt. Bd. I. (1882) p. 313.—*Atropis angustata* Kreczetowich in Komarov, Fl. URSS II (1934) p. 472 (p. p.).

Illustrations: pl. 11; fig. 12.

Perennial, loosely caespitose, green. Culms 10—20 cm long, geniculate, very slender. Culm leaves commonly two, the sheaths often shorter than the internodes, blade 2—4 cm long, 1.5—2.0 mm wide, flat, very soft, glabrous, evenly tapering. Ligule 1.5—2.0 mm long, acute, thin and white. Panicle exserted, 4—6 cm long, loose. Branches in pairs, thin and slender, glabrous, 3—4 cm long, ascending, naked in their lower part, bearing 3—6 comparatively large spikelets on slender pedicels. Spikelets loose, purple, shining, 6—7 mm long, 3—4-flowered; Rachilla slender. Glumes very thin, translucent, entire, not erose-ciliolate; the 1st glume lanceolate or oblong-lanceolate, subacute, 1.5—2.5 mm long, obscurely 1-nerved, the 2nd glume 2.5—3.2 mm long oblong, obtuse, 3-nerved. Lemmas 3.0—4.0(—4.5) mm long, obscurely 5-nerved, obtuse, sometimes irregularly erose but not ciliolate, sparsely haired on the back in their lower third. Palea as long as the lemma, bifid, the keels distantly spinulose toward the apex, sparsely long-hairy, or even glabrous, toward the base. Anthers 1.0—1.4 mm long.

In his preliminary list of Novaya Zemlyan plants, Palibin (1903, p. 46) records a *Glyceria gracilis* nov. sp. a description of which was postponed till a future publication. After having compared his material with herbarium specimens of the Copenhagen Botanical Museum, he admits (1906, p. 183) that *G. gracilis* is nothing but *Glyceria Vahliana.*

The Copenhagen material handed over to Palibin for comparison is doubtless derived from Kjellman's or Holm's Novaya Zemlyan

collections determined by LANGE. Unfortunately, the specimens identified by LANGE as *Glyceria Vahliana* do not, in fact, belong to this species. Curiously enough, LANGE (in KJELLMAN och LUNDSTRÖM 1882, p. 314) proposed a new name, *Glyceria Kjellmani*, for the Novaya Zemlyan plant identical with the Greenland *Glyceria Vahliana*, which will account for his misuse of the latter name for another plant. In fact, PALIBIN's first conception of his plant, as yet undescribed, was a sound one.

HOLMBERG, according to the labels, included LANGE's *Glyceria Vahliana* (i. e. PALIBIN's plant) into his *Puccinellia angustata* var. *contracta*, and, later on, KRECZETOWICH (in Fl. URSS II (1934) p. 472) lists *Glyceria gracilis* PALIB. simply as a synonym of *Puccinellia angustata*. In the opinion of the present writer, it should be separated from *P. angustata* as well as from *P. contracta* (see p. 77). Here I propose it as a separate species, *Puccinellia Palibinii*, as diagnosticated above.

As to differential characters compared with *P. angustata* on the one hand, and *P. contracta* on the other, the reader is referred to the key presented above.

The relationship of *Puccinellia Palibinii* is not quite clear. Not even the leaf anatomy seems to be fully conclusive. The stomata are comparatively large, usually 45—50 μ long, those of the under side somewhat shorter and strongly pitted, sometimes with a tumid wart protruding from the distal end of the adjacent long cells, but hardly forming a real stomatal flap. The short cells are not, or only exceptionally, warty. The marginal cells are of an intermediary type, neither isodiametrical nor much elongated, rarely reaching a length up to five times their width, intermixed with very minute teeth.

After all, the gross-morphology as well as the leaf anatomy seem to some extent to combine characters peculiar to *P. fragiliflora* on on the one hand and *P. contracta* on the other. However, owing to its slender habit, narrow and acutish glumes, long anthers, and larger stomata it differs from both of these species.

Judging by the available herbarium material, the geographical distribution of *P. Palibinii* is restricted to Novaya Zemlya.

Specimens examined:

Novaya Zemlya.

Medjuscharskji Isl. (70°59′ N. lat.) 8. VIII. 1882 Holm (H) (*Gl. Vahliana* Holm 1885, p. 15); Karamkola (72°23′ N. lat.) VIII. 1901 Alm (S); Sinus Besimannaja (72°53′ N. lat.) 2.—6. VII. 1875 Kjellman & Lundström (S, O) (*Gl. Vahliana* Kjellman & Lundström 1882, p. 313); Matotchkin Shar (ca. 73°10′ N. lat.): Vallis Matotschka 30. VIII. 1905 Ekstam (S), Pomorskaja 27. VIII. 1921 Lynge (O, H) (*P. angustata* var. *contracta* Holmberg in Lynge 1923, p. 126); Matotchkin Shar 27. VII.

1911 Enander (S); Serebryanka Fjord (ca. 73°30′ N. lat.) 23. VII. 1921 Lynge (O) (*P. Vahliana* Lynge 1923, p. 126); Krestovii Fjord (74°7′ N. lat.) 23. VII. 1921 Lynge (O) (*P. angustata* Lynge 1923, p. 125); Krestovii Bay (74°7′ N. lat.) 10. VIII. 1926 Steffen (H), a single culm among *P. angustata* (*Atropis angustata*, Steffen 1927, p. 329).

Puccinellia angustata (R. Br.) Rand et Redf.

Rand & Redfield, Flora of Mount Desert Island, Maine (1894) p. 181.

Atropis angustata Steffen 1927 p. 329 (p. p.); Kreczetowich in Komarov, Fl. URSS II (1936) p. 472 (p. p.).

Specimens examined:

Waigatsch.

Sinus Warneka (69°40′ N. lat.) 16. VIII. 1926 Steffen (P.).

Novaya Zemlya.

Matotchkin Shar (ca. 73°10′ N. lat.) 13. VIII. 1905 Ekstam (S); Belushii Bay (ca. 73°30′ N. lat.) 17. VII. 1921 Lynge (O); Serebryanka Fjord (ca. 73°30′ N. lat.) 23. VIII. 1921 Lynge (O) (*P. Vahliana* Lynge 1923, p. 126); Krestovii Fjord (74°7′ N. lat.) 27. VII. 1931 Lynge (O), 27. VII. 1921 Lynge (S, H) (probably represents the hybrid *P. angustata* × *P. Palibinii*, pollen very sparse, irregular, anthers not dehiscent), 10. VIII. 1926 Steffen (S); Machigin Fjord Rækvedbugten (74°40′ N. lat.) 5. VIII. 1921 Lynge (O); Eastern Krestovii Isl. (ca. 76°0′ N. lat.) 15. VIII. 1921 Lynge (O); Lichutin Isl. (ca. 76°0′ N. lat.) 16. VIII. 1921 Lynge (O); Paktusoff Isl. (74°24′ N. lat.) 6. VIII. 1897 Feilden (H) (*Poa arctica* Feilden 1898, p. 24).

Puccinellia contracta (Lge.) nov. comb.

Glyceria vaginata Lge. f. *contracta* Lge. in Kjellman: Vega Exped. Vetensk. Iakttagelser I. p. 273. (1882).

Puccinellia angustata v. *contracta* Holmberg in sched. (pro parte).

Perennis, dense caespitosa. Culmi ad basin decumbentes, 10—20 cm alti, uni- vel bifoliati, laminae 3—6 cm longae, 1.5—2 mm latae, planae, laxae, marginibus et paginis superioribus leviter scabris, ut apparet luteolo-virides. Ligula tenuis alba, ca. 2 mm longa, rotundata vel subacuta, saepe erosa. Panicula 3—6 cm longa, rami graciles, leviter scabri, adscendentes, plerumque terni e nodo inferiore, 1—5 spiculis in pedicellis gracilibus muniti. Spiculae purpureae, 5.0—6.5 mm longae, 3—4-florae. Glumae tenuissima, subhyalina, plerumque siccitate crispa, eroso-ciliata. Gluma inferior 1.5—1.8 mm longa, ovata, obtusa, indistincte uninervia; gluma superior 2.2—2.8 mm longa, obovata, rotundata, obscure trinervia. Lem-

mata 3.3—3.8 mm longa, ovata, obtusa vel subacuta, obscure 5-nervia, nervorum partibus inferioribus pilosis internervis pubescentibus. Palea lemma subaequans, carinae apicem versus spinulosae, ad basin pilis longis et crispis. Antherae 0.9—1.0 mm longae.

Type: Sibiria arctica, Pitlekaj (lat. 67°5′N.—long. 173°24′W.) leg. F. R. KJELLMAN, 28. IX. 1878 (Herb. Uppsala).

Distribution: Arctic Siberia, Novaya Zemlya, Arctic N. America.

Illustrations: pl. 12; figs. 23—25.

Perennial, densely caespitose. Culms decumbent at base, 10—20 cm tall, 1—2-leaved. Leaf blades 3—6 cm long, 1.5—2 mm wide, flat and flaccid, margins and upper side faintly scabrous, apparently yellowish green. Ligule thin, white, ca. 2 mm long, rounded or subacute, often erose. Panicle 3—6 cm long. Branches slender, faintly scabrous, ascending, usually three from the lower node, bearing 1—5 spikelets on slender pedicels. Spikelets purple, 5.0—6.5 mm long, 3—4-flowered. Rachilla slender, abruptly widened at the insertion of each floret. Glumes very thin, subhyaline, usually crumbled when dried, erose-ciliolate. The 1st glume 1.5—1.8 mm long, ovate, obtuse, indistinctly one-nerved; the 2nd 2.2—2.8 mm long, obovate, rounded, obscurely three-nerved. Lemmas 3.3—3.8 mm long, ovate, obtuse or subacute, obscurely 5-nerved, the nerves hairy in their lower third, the internerves pubescent. Palea about as long as the lemma, the keels spinulose toward the apex, long- and crisp-hairy toward the base. Anthers 0.9—1.0 mm long.

This grass was first described by LANGE (in Kjellman: Vega Exp. Vetensk. Iaktt., Bd. I (1882) p. 273) as follows:

"Glyceria vaginata J. Lge. f. contracta J. Lge. mscr.

»Folia latius linearia, semper plana; panicula florendi tempore contracta, subnutante; palea superior inferiore subbrevior. Ceterum cum planta Groenlandica convenire videtur«. (J. Lange in litteris).

Preobrascheni-ön; Irkajpi; Pitlekaj.

Öfverallt mycket sällsynt i strandkanten. (Everywhere very rare at the seashore)".

The Greenland plant in question is *Puccinellia vaginata*, from which it differs much more than suggested by LANGE.

HOLMBERG, revising the *Puccinellia* material of the Scandinavian Herbaria, did not accept *Glyceria vaginata* as a distinct species, but regarded it as a variety subordinated to *Puccinellia angustata*. *Glyceria vaginata* f. *contracta* LGE. was taken to be another variety of *P. angustata* (*P. angustata* var. *contracta* HOLMBERG in sched.). Probably it may be related to *P. angustata* rather than to *P. vaginata*. However, a closer examination reveals it to be a very remarkable grass, in certain respects combining characteristics of *Colpodium* TRIN. with those of *Puccinellia*: 1) It has the soft texture of the bracts met with in all the species of the Genus *Colpodium*, which often lends to the spikelets a wrinkled appearance when in a dried state. In *Puccinellia* the bracts may be thin,

even translucent and glossy, as for instance in *P. vaginata*, but they do not alter their appearance when dried; 2) The rachilla is thin and slender, thickened chiefly at the insertion of the florets. Rachillae of this type were found, too, in the *Colpodia* with two- or three-flowered spikelets. Of course, species with one-flowered spikelets cannot be directly compared as to the characteristic in question. In the genus *Puccinellia* the rachilla joints are generally of an approximately equal width throughout and are very inconspicuously widened at the articulations. However, a slender rachilla is found, too, in two other Arctic Siberian *Puccinellia*, viz. *P. Palibinii* (see p. 74) and, less pronounced, in *P. sibirica* Holmb. 3) As to the hairiness of the back of the lemmas, *P. contracta* likewise approaches *Colpodium*. In *Puccinellia* the hairs of the lemmas are generally restricted to the very nerves, though, admittedly, as an exception *P. angustata* sometimes has the internerves but sparsely hairy, too. In *P. contracta* the internerves are evidently hairy. Otherwise, strongly hairy internerves seem to be a characteristic peculiar to the *Colpodia*.

Holmberg (1927, p. 207), describing his *P. sibirica*, emphazised the soft texture of the bracts and the slender rachilla as peculiar to this species as compared with *P. angustata*. Curiously enough, *P. contracta*, which Holmberg considered a variety of *P. angustata*, was not included in the comparison.

The epidermal leaf-anatomy of *P. contracta* does not reveal any connection with the genus *Colpodium*. Within the genus *Puccinellia*, the leaf-anatomy of *P. contracta* points to a closer relationship to *P. angustata* than to *P. sibirica*, though it can be distinguished from *P. angustata* on the basis of its more short-meshed epidermal cell tissue, i. e. the marginal cells, long cells, and stoma guard-cells are shorter. In addition, it differs from *P. angustata* by having more numerous and more distinctly defined stomatal warts and by an intermixture of tumid semiglobular short cells, a cell type met with in several North Siberian—Beringian species, and most distinctly typified in *P. kamtschatica* var. *sublaevis*.

P. contracta ranges from Novaya Zemlya to easternmost Arctic Siberia. Nevertheless, no references to the plant are to be found in Fl. URSS (Vol. II (1934) *Gramineae*). The possibility exists that it was included in *Atropis angustata*, though this species is only reported from Novaya Zemlya.

Specimens examined:

Waigatsch.

Cape Grebeni (69°48′ N. lat.) 30.—31. VIII. 1875 Kjellman & Lundström (S, O, H) (*Gl. vaginata* f. *contracta* Lange in Kjellman & Lundström 1892, p. 314); 27. VIII. 1902 Ekstam (S, L).

Novaya Zemlya.

Olenje Isl. (70°29′ N. lat.) 24. VIII. 1882 Holm (S) (*Gl. Vahliana* HOLM 1885, p. 15).

Arctic Russia.

Chabarova (ca. 69°30′ N. lat., 60°10′ E. long.) 2. VIII. 1902 Ekstam (S).

Arctic Siberia.

Preobraschenie Isl. (74°45′ N. lat., 113°10′ E. long.) 24. VIII. 1878 Kjellman (S, U); Irkajpij (68°56′ N. lat., 179°25′ W. long.) 12.—15. IX. 1878 Kjellman (U); Pitlekaj (67°5′ N. lat., 173°24′ W. long.) 28. IX. 1878 Kjellman (U).

Arctic N. America. (Specimens in the Nat. Herb. of Canada, cf. foot-note p. 49).

Cape Dalhousie (70°20′ N. lat., 129°55′ W. long.) 7.—14. VIII. 1927 A. E. & R. T. PORSILD no. 2708; Liverpool Bay, Nicholson Isl. (70° N. lat., 129° W. long.) 15.—16. VIII. 1927 A. E. & R. T. PORSILD no. 2825; Cape Bathurst (70°35′ N. lat., 128°6′ W. long.) 26. VII. 1916 FRITS JOHANSEN field no. 544.

Puccinellia tenella (LGE.) nov. emend.

Glyceria tenella LANGE, in Kjellman & Lundström, Vega Exped. Vetensk. Iaktt. Bd. I. (1882) p. 313 (pro parte).

Glyceria tenella f. *pumila* LANGE, in Holm, Dijmphna-Togtets zool.-bot. Udbytte (1885) p. 16; *Atropis pulvinata* KRECZETOWICH, in Komarov Fl. URSS II. (1934) p. 478, and 761 (not *Glyceria distans* **pulvinata* FRIES).

Perennis laxe caespitosa pulvinum applanatum formans. Culmi graciles 5—15 cm longi prostrati vel geniculati internodiis binis, eorum inferior breve, vagina brevi, nodo nudo; superior multo longior vagina subinflata paniculam attingente. Ligula culmi foliorum ca. 1 mm longa, gracilis truncata minute lacerata; laminae 2—3 cm longae, eae innovationum aliquid longiores, 0.8—1.5 mm latae, plana aut siccitate involuta, gradatim in apicem attenuatae. Vaginae basales emortuae latissimae, hyalinae albidae lucidae. Panicula 3—5 cm longa, contracta vel deinde subdivaricata; rami bini, per anthesim inclusi, graciles subflexuosi angulares scabriusculi, 2—6 spiculas gerentes. Spiculae brevipedicellatae, ad apicem subsessiles oblongae, 3—5 mm longae 3—5-floriferae. Glumae et lemmata gracilia lucida eroso-ciliolatae. Glumae albido-virides nervis distinctis sed tenuissimis; inferior 1.0—1.5 mm longa, lanceolata vel ovato-lanceolata, subacuta vel obtusa uninervia; superior 1.5—2.0 mm longa, ovata trinervia. Lemmata imbricata 2.0—2.6 mm longa, ovalia-obovata rotundata aut subtruncata inferne viridia, alioquid purpurascentia sine margine translucente, obscure quinquenervia. Callus et nervi ad

basim minute pilosi. Palea lemma aequans, comparate lata emarginata vel truncata, apice eroso-ciliolata, carinae tota longitudine sparse spinulosae. Antherae 0.5—0.7 mm longae.

Neotype: Insula Waigatsch, Sinus Ljamtschina, leg. O. EKSTAM Aug. 19, 1907 (Riksmuseet, Stockholm).

Distribution: Polar Sea coasts of European Russia, coasts of the White Sea and the Finnish Bay.

Illustrations: LANGE (in Kjellman & Lundström) l. c. tab. 6 (in part, excl. figs. c, e, and f); KRECZETOWICH l. c. tab. 36 fig. 11; this paper pl. 13; figs. 26—27.

Perennial, loosely caespitose, forming flat cushions. Culms slender, 5—15 cm long, prostrate or geniculate, 2-jointed, the lower joint short, its sheath short, leaving the node naked, upper joint much longer, its sheath subinflate, reaching the panicle. Ligule of culm leaves about 1 mm long, thin, truncate, delicately lacerate; blades 2—3 cm long, those of the innovations somewhat longer, 0.8—1.5 mm wide, flat or, when dried, involute, tapering gradually towards the apex. Basal withered sheaths very broad, hyaline, whitish, shining. Panicle 3—5 cm long, contracted or later on somewhat spreading; branches in pairs, ascending, the lower pair enclosed during anthesis, slender, slightly flexuose, angular, scabridulous, bearing 2—6 spikelets. Spikelets short-pedicellate, subsessile towards the summit, oblong, 3—5 mm long, 3—5-flowered. Glumes and lemmas thin, shining, erose-ciliolate. Glumes whitish green, with distinct but very thin nerves: 1st 1.0—1.5 mm long lanceolate—ovate-lanceolate subacute or obtuse, 1-nerved; 2nd 1.5—2.0 mm long, ovate, 3-nerved. Lemmas imbricate, 2.0—2.6 mm long, oval-obovate, rounded or subtruncate, green below, otherwise purplish tinged, without translucent border, obscurely 5-nerved; callus and the nerves at base delicately hairy. Palea as long as the lemma, comparatively wide, emarginate or truncate, erose-ciliolate at apex, the keels sparsely spinulose throughout their whole length. Anthers 0.5—0.7 mm long.

The problem of the identity of LANGE's *Glyceria tenella* has been treated at length above (p. 20). Here only the results of this treatment will be recapitulated as follows:

1) The original description by LANGE was in all probability based in part on a plant which, according to LANGE's comments on his *Glyceria tenella*, does not actually belong to this species. The "wrong" plant alluded to is HOLMBERG's *Puccinellia tenella*. By the present author it has been described as *P. Langeana* ssp. *asiatica* (in HULTÉN 1950, p. 1710, see also this paper p. 25).

2) Which plant was considered by LANGE to be *Glyceria tenella*, seems clear, for more than once he emphasizes that it comes close to his *Glyceria vaginata*. One of the most conspicuous peculiarities of *P. vaginata* is doubtless its thin and glossy bracts, not found in HOLMBERG's *Puccinellia tenella*.

3) KRECZETOWICH (1934, p. 483) identified *Glyceria tenella* with *P. retroflexa* ssp. *borealis* HOLMBERG (*Atropis tenella* KRECZ.). This latter plant is distinguished by its rather firm bracts, and therefore, in the opinion of the present writer, it must be kept apart from *Glyceria tenella.*

4) Later collections from Waigatsch and southernmost Novaya Zemlya comprise specimens which would seem to agree with LANGE's conception of his *Glyceria tenella*, and they should reasonably be taken to belong to this species. No authentic specimen of the true *Glyceria tenella* seems to exist apart from a sheet of the depauperate f. *pumila* LGE. (in HOLM 1885, p. 16), which gives no good idea of the species. Therefore a normally developed specimen from a later collection is chosen for an emended description. Pl. Finl. Exs. 484, cited by KRECZETOWICH as typical of his *Atropis pulvinata*, is not identical with *Glyceria distans pulvinata* FRIES (Herb. Norm. 5:90), but belongs to the species here considered to be the true *Glyceria tenella* LANGE.

Sometimes it is only with difficulty that *Puccinellia tenella* can be distinguished from *P. coarctata* (*P. retroflexa borealis* HOLMB. see this paper p. 42) because in Waigatsch, as also in northernmost Fennoscandia, this latter highly polymorphic species is represented by forms of low stature and with smaller spikelets than are usually met with within the remainder of its area. However, these extreme forms of *P. coarctata* are still recognized by their thickened pedicels and alternately inserted, firm glumes. Additional differential characters of *P. tenella* as compared with *P. coarctata* are the following: Slender stature, slender panicle branches, thin and glossy glumes and lemmas, soft and evenly pointed leaves of a fresh green colour or at least less glaucous than in *P. coarctata*, and not distinctly folded as in the latter species.

The epidermal cells of the leaf of *P. tenella* are somewhat longer than usually found in *P. coarctata*, the stomata measuring 40—45(—50) μ as against (30—)35—40 μ in *coarctata.* The epiderm is but slightly warty, which, admittedly, is also the case in the Waigatsch type of *P. coarctata*, but the wartiness differs as to type in the two plants. In *P. coarctata* the rather deficient papillae are placed at the distal ends of the long cells adjacent to the stomata, as found in other races of this species, too. In *P. tenella* stomatal papillae are usually absent, but the isodiametric short cells, not accompanying the stomata, are papilla-like protruding, sometimes transformed into minute spinules. As to this characteristic *P. tenella* shows similarity to *P. kamtschatica* var. *sublaevis* HOLMB. (type collection). In this connection it can be mentioned that Alaskan specimens, which were referred by SWALLEN (1944, p. 23) to *P. kamtschatica* v. *sublaevis*, differ somewhat from the type as to leaf-

anatomy. The epiderm of the Alaskan plants is more conspicuously warty, both stomatal and short-cell papillae being copiously developed.

P. tenella may be related to the Eastern Asiatic *P. kamtschatica sublaevis*, as indicated by the anatomical characteristics. On the other hand it differs from that species by the bracts being evidently erose-ciliolate.

STEFFEN (1928, p. 330) reports *Atropis tenella* from Karmakulskij Ostrow. It may be the plant regarded here as the true *tenella*; unfortunately I have not been able to find out where STEFFEN's collections are found.

Specimens examined:

Waigatsch.

Yugor Shar (ca. 69°40′ N. lat.) Ekstam 10. VIII. 1907 (S); Sinus Warnek (ca. 69°40′ N. lat.) 14. VIII. 1907 (S); Sinus Ljamtschina (ca. 69°45′ N. lat.) 19. VIII. 1907 (S).

Novaya Zemlya.

Petuchowskoj Shar (70°34′ N. lat.) 28. VIII. 1882 Holm (H) (*Gl. tenella* f. *pumila* LANGE in Holm l. c.); Sinus Karmakulski (72°23′ N. lat.) 14. IX. 1901 Ekstam (S).

Puccinellia coarctata FERN. et WEATH.

FERNALD and WEATHERBY, Rhodora 18 (1916) p. 13.

Atropis tenella KRECZETOWICH in Komarow Fl. URSS II (1934) p. 483. Cf. this paper pp. 22, 42, 82.

Specimens examined:

Waigatsch.

Yugor Shar (ca. 69°40′ N. lat.) 9. VIII. 1902 Ekstam (S); Cape Grebeni (69°38′ N. lat.) 27. VIII. 1902 Ekstam (S).

Puccinellia phryganodes (TRIN.) SCRIBN. et MERR.

LAMSON-SCRIBNER and MERRILL, Contr. U. S. Nat. Herb. 13 (1910) p. 78.

Atropis phryganodes KRECZETOWICH in Komarov Fl. URSS II (1934) p. 480. Cf. also this paper p. 51 et seq.

Specimens examined:

Waigatsch. (Fennoscandian type, cf. p. 56).

Sinus Warnek (69°40′ N. lat.) 14. VIII. 1907 Ekstam (S); Sinus Ljamtschina (ca. 69°45′ N. lat.) 19. VIII. 1907 Ekstam (S).

Novaya Zemlya. (Spitsbergen type, cf. p. 55).

Sinus Rogatschew (71°23′ N. lat.) 21.—24. VII. 1875 Kjellman & Lundström (S); Sinus Karmakulski (72°23′ N. lat.) 18. VIII. 1901 Ekstam (S); Grebovii Bay, north side (ca. 73°0′ N. lat.) 2. IX. 1921 Lynge (O, H); Grebovii Bay, Veselago Isl. 29. VIII. 1921 Lynge (O) (forms a transition to the Fennoscandian type); Matotchkin Shar, Pomorskaya (ca. 73°10′ N. lat.) 27. VIII. 1921 Lynge (O, S); Matotchkin Shar, Belushii Fjord (ca. 73°20′ N. lat.) 16. VII. 1921 Lynge (O); Arkangel Bay, Fuglefjellet (ca. 75°50′ N. lat.) 13. VIII. 1921 Lynge (O).

VI. RELATIONSHIPS OF THE GREENLAND PUCCINELLIA FLORA

According to the present revision 12 species of *Puccinellia* are found in Greenland (*Colpodium Vahlianum* (Liebm.) Nevski, i. e. *Puccinellia Vahliana* of previous authors, not included). These 12 species do not, by far, constitute a unity of related types. On the contrary. They represent a number of widely different types within the genus, and, accordingly, their extra-Greenland connections are many-sided.

So far, the genus is in want of a monographic treatment. Among larger floristic manuals only Ascherson & Graebner, Synops. mitteleur. Fl. II, 1 (1900) and Komarov, Fl. URSS II (1934) have subdivided the genus into sections of lower taxonomic rank. However, for a study of the Greenland representatives of the genus the Old World treatments will naturally be of limited use, only, for within Greenland an American rather than a Eurasian element prevails. Since no general survey of the lower systematic units within the genus is at hand, a preliminary attempt at a natural grouping of the arctic representatives of the genus is outlined below. It was done chiefly to serve as a starting point for discussions of the extra-Greenland connections of the Greenland *Puccinellia* Flora and its origin. However, the grouping should merely be regarded as preliminary.

The grouping arrived at is as follows:

1) Langeana Group. Low-grown, glabrous plants. Bracts entire (not erose) prominently veined. Epidermal tissue of the leaves very densely meshed, marginal cells isodiametric, rounded; warts lacking or very inconspicuous.

Represented only by *P. Langeana* (Berl.) Th. S., comprising three types to which subspecific rank has been ascribed (see this paper p. 25). According to morphological as well as cytological evidence (so far known) this group seems to be the most primitive one within the arctic Puccinellias. Probably the very primary type is best illustrated by ssp. *alaskana* (Scribn. & Merr.), which in some respects approaches *Colpodium Vahlianum.*

Chromosome number known: 2n = 14, *P. Langeana* ssp. *typica*, Greenland (JØRGENSEN et al. 1953).

An exclusively arctic group, absent from the Atlantic Sector (East Greenland, Spitsbergen, Fennoscandia).

2. Pumila Group. Probably at best typified by *P. pumila* (VASEY) HITCHC. and *P. kamtschatica* var. *sublaevis* HOLMB., both of them natives of the subarctic Beringian Region. Generally low-grown, glaucous and glabrous caespitose plants, by rare exceptions forming epiterranean runners. Spikelets and pedicels somewhat shining, bracts entire or nearly so, not markedly nerved. Epidermal cells ± warty, the short cells often semiglobular, tumid, sometimes transformed into minute blunt spinules; marginal cells rather short, though generally not isodiametrical.

Besides the two above-named species, the following ones should be included: *P. triflora* SWALL., (?) *P. Hultenii* SWALL. (Alaska); *P. pumila* var. *Fernaldii* HULT., *P. ambigua* TH. S., (Eastern America); (?) *P. kamtschatica* var. *aspera* HOLMB. (Eastern Asia). Furthermore, the Novaya Zemlyan *P. tenella* (LGE.) TH. S. most likely belongs to this group: it is rather atypical, forming a transition to the *Coarctata* Group.

Chromosome numbers known: 2n = 42, 56, "*P. paupercula* var. *alaskana*" and "*P. paupercula*", respectively, Atlantic N. America (CHURCH 1949), both of them doubtless belonging to sp. coll. *P. pumila* (cf. HITCHCOCK 1950, p. 40, and this paper p. 66).

This arctic—subarctic group is not represented in Greenland, Spitsbergen, and Fennoscandia.

3. Andersonii Group. Low-grown, glabrous, caespitose plants. Culms often decumbent. Glumes rather firm, often roughly dentate, not erose. Epidermal tissue of the leaves rather deficiently differentiated into long cells and short cells; the cells ± tumid, drop-shaped; marginal cells short. These epidermal characteristics are best exemplified in the Arctic American-Greenland *P. Andersonii* SWALL., less pronounced in the Old World *P. fragiliflora* TH. S. Next to these two species the Novaya Zemlyan *P. Palibinii* TH. S., too, may be referred to this group.

Chromosome number known: 2n = 56, *P. Andersonii*, Greenland, Peary Land (HOLMEN 1952).

Distribution high-arctic, circumpolar, though not represented in Spitsbergen.

4) Angustata Group. Low or medium-sized, subglabrous, caespitose plants. Glumes ± erose, lemmas strongly hairy at back, keels of

palea copiously hairy. Epidermal tissue clearly differentiated into long cells and short cells; long cells not, or slightly, tumid, indistinctly warty at the distal ends adjacent to the stomata; marginal cells elongated, sparsely intermixed with spinules.

High-arctic group comprising only two species, the amphi-Atlantic *P. angustata* (R. Br.) Rand et Redf. and the Asiatic *P. contracta* (Lge.) Th. S.

Chromosome numbers known: 2n = 42, *P. angustata*, Spitsbergen (Flovik 1938), East and West Greenland (Jørgensen et al. 1953), Peary Land (Holmen 1952).

The group has a circumpolar distribution, though, probably, with large gaps in Siberia and western N. America. Not represented in Fenno-scandia.

5. Nuttalliana Group. The widely distributed American *P. Nuttalliana* (Schult.) Hitchc., though not an arctic plant, may serve to typify the group. Otherwise the species to be discussed here comprise merely the farthest northward-pushing representatives of a continental temperate American element.

High-grown ± scabrous, caespitose plants, generally of a xerophytic habit. Panicles large, many-flowered, the branches scabrous. Bracts hyaline-bordered, usually inconspicuously veined, erose. Leaf-epiderm excellently differentiated into long and short cells. Cells strongly warty; the wart of the distal end of the long cells generally forwardly directed so as to form a stomatal flap which covers part of the pitted stomata; marginal cells elongated, intermingled with vigorous curved spines.

Alaska-Yukon representatives of this group are: *P. grandis* Swall., *P. borealis* Swall., *P. glabra* Swall., *P. interior* Th. S.; further *P. arctica* (Hook.) Fern. et Weath. of the Mackenzie Region. Also the East American(-Greenland) *P. laurentiana* Fern. et Weath. is clearly related to *P. Nuttalliana*. Typical representatives among the Greenland species are *P. deschampsioides* Th. S., *P. Porsildii* Th. S., and *P. Rosenkrantzii* Th. S.; less typical is *P. groenlandica* Th. S., which in some measure approaches the *Coarctata* Group, too.

Chromosome numbers known: 2n = 56, *P. Nuttalliana*, Eastern America, *P. laurentiana*, Eastern America (Church 1949); *P. deschampsioides*, *P. Rosenkrantzii*, *P. groenlandica*, W. Greenland (Jørgensen et al. 1953).

As far as the arctic species are concerned, the *Nuttalliana* Group seems to be restricted to the New World. To what extent the group is represented in continental Asia, is unknown to me. The continental subarctic *P. tenuiflora* (Turcz.) Krecz., which has formerly been confounded with North American species of the *Nuttalliana* Group,

has no connection with this or any other of the groups enumerated in this paper.

6) Distans Group. Doubtless related to the previous group. Medium-grown, slender, caespitose plants of a less xerophytic habit. Panicles large, many-flowered. Spikelets small; bracts thin, truncate, erose. Leaf anatomy of a similar type to that of the preceding group, the epiderm is more narrow-celled and less warty and spiny (cf. figs. 99—100).

A group of a chiefly temperate distribution, exemplified by the widely distributed polymorphic Old World *P. distans* (L.) PARL. and *P. Hauptiana* (TRIN.) KRECZ. spreading to the subarctic region (Siberia, Alaska). Possibly the artic *P. sibirica* HOLMB., though somewhat deviating, should most correctly be placed with this group. No Greenland representatives.

Chromosome numbers known: 2n = 14, *P. distans*, Southern Russia (AVDULOV 1931); 2n = 28, *P. distans*, Baltic Germany (STÄHLIN 1929), Roumania (TARNAVSCHI 1938 ex Á. & D. LÖVE 1948), Sweden (BERNSTRÖM ex Á. & D. LÖVE 1948); 2n = 42, *P. distans*, Denmark (?) (AVDULOV 1931), Sweden (BERNSTRÖM ex Á. & D. LÖVE 1948).

7) Coarctata Group. Medium-grown, stout, somewhat glaucous plants with sparsely branched panicles. Culms often decumbent or prostrate. Innovations often ± elongated with long-sheathing leaves. Glumes rather firm, erose-ciliolate. Epidermal cells of both leaf surfaces generally warty. The warts near the stomata not so decidedly forwardly directed as to form well defined stomatal flaps. Epidermal tissue comparatively wide- and short-celled; marginal cells rather short.

The group chiefly comprises temperate-subarctic species. Besides *P. coarctata* FERN. et WEATH. the likewise amphi-Atlantic *P. fasciculata* (TORR.) BICKN., the East American *P. americana* TH. S. (cf. also p. 68), and further *P. nutkaensis* (PRESL) FERN. et WEATH. of Western N. America belong to this group. As a somewhat deviating type, *P. retroflexa* (CURT.) HOLMB. of temperate-subarctic Atlantic Europe may possibly be placed in this group. It differs *inter alia* by its leaf-epiderm being devoid of warts or nearly so.

In western Europe the interrelationships between this and the preceding group seem to be rather complex and obscure (cf. JANSEN & WACHTER 1935, 1940).

Chromosome numbers known: 2n = 28, *P. fasciculata*, England (RUTLAND 1941); 2n = 42, *P. retroflexa*, Sweden (BERNSTRÖM ex Á. & D. LÖVE 1948), *P. coarctata*, W. Greenland (JØRGENSEN et al. 1953), 2n = 56 "*P. maritima*", Atlantic N. America (CHURCH 1949), doubtless

P. americana, as the plant was reported to have erose lemmas and short anthers.

8) Vaginata Group. Low- or medium-grown, slender, caespitose plants. Culms decumbent. Panicles large, with comparatively large spikelets. Bracts thin, glossy, strongly erose-ciliolate. Leaf-epiderm rather large-celled; stomata longer than in any other group studied; warts few and inconspicuous, usually subterminal on the long cells, forming no real stomatal flaps; marginal cells usually elongated.

Arctic group, comprising only the highly variable *P. vaginata* (Lge.) Fern. et Weath. (Greenland, Arctic N. America).

Chromosome number known: 2n = 56, *P. vaginata* and var. *paradoxa*, W. Greenland (Jørgensen et al. 1953).

9) Maritima Group. Somewhat glaucous, glabrous, loosely caespitose plants with stout decumbent culms. Innovations much elongated, forming epiterranean runners. Panicles meagre, spikelets comparatively large; bracts entire. Anthers longer than generally found in *Puccinellia* (1.5—2.5 mm long). Epiderm tissue rather short-meshed, marginal cells slightly elongated. Epidermal cells of the upper side of the leaves conspicouosly warty or even entirely devoid of warts, sometimes tumid. The under side of the leaf without warts, its stomata deeply pitted, sometimes entirely wanting.

Besides by the Atlantic-European (and Greenland) *P. maritima* (Huds.) Parl., the group is represented by the high-arctic circumpolar *P. phryganodes* (Trin.) Scribn. et Merr. and the Eastern Asiatic Beringian *P. geniculata* (Turcz.) Krecz.

Chromosome numbers known: 2n = 21, *P. phryganodes*, East and West Greenland (Jørgensen et al. 1953); 2n = 28, *P. phryganodes*, Spitsbergen (Flovik 1938), Scandinavia (Nygren ex Jørgensen et al. 1953); 2n = 56, *P. maritima*, Sweden (Bernström ex Á. & D. Löve 1948); 2n = ± 60, *P. maritima*, Portugal (Castro & Fontes 1946); 2n = 63, *P. maritima*, England (Maude 1940); 2n = 70, *P. maritima*, Germany North Sea coast (Tischler 1937).

(Church (1949) states 2n = 42, 56 of "*P. maritima*", Atl. N. America; the identity of the plants in question should be verified; possibly we are here concerned with *P. americana*, cf. p. 68).

VII. DISCUSSION OF THE IMMIGRATION HISTORY OF THE GREENLAND PUCCINELLIA FLORA

In the preceding chapter a grouping of all the arctic Puccinellias was attempted in order to demonstrate the various relationships of the Greenland species. In the following pages their immigration history will be discussed[1]). The main sources from which conclusions can be drawn as to what happened to the plants in the past are those of the present geographical distribution of the species, their extraneous connections, and their biological properties such as requirements as to growth conditions and mode of dispersal (cf. also RAUP 1941). As the various species differ considerably in regard to these qualifications, each individual species will be treated separately.

Although a number of questions concerning the historical plant geography of the Greenland Puccinellias must be left to future investigators, I think that the improved delimitation of the species arrived at has contributed to throwing new light upon some problems of plant migration in the Arctic.

A still unsolved problem is that of the survival of the plants during the ice ages. Owing to the composition of the Greenland flora we shall, no doubt, have to adopt the hypothesis of glacial plant refugia. Details of the argumentation will not be dealt with here; I will content myself to refer the reader to the brief survey of viewpoints given by GELTING in his inspiring treatise "Uber pleistozäne Pflanzenrefugien in Grönland" (1941). GELTING is of opinion that an assumption of the survival of the plants merely during the last glacial epoch will not suffice to give a clue to the present distribution of the plant species, and we are therefore compelled to take into account the probability of the existence of North Greenland plant refugia during earlier glaciations together with an ancient, direct, exchange of plants between the two Worlds. A similar point of view was advocated by NORDHAGEN (1935) and by NANNFELDT (1935, 1940) for the Scandinavian artctic-alpine flora.

[1]) After this manuscript had been finished, the treatise of T. W. BÖCHER (Dec. 1951) on "Distributions of Plants in the Circumpolar Area etc." appeared. Therefore the viewpoints set forth in this latter paper have not been dealt with.

WEGMANN (1941) submitted the question of Greenland plant refugia to a critical revision from a geological point of view. He admits that during the Ice Age(s?) ice-free ground may well have existed, and mentions several topographical conditions which would prevent a complete ice covering of largely glaciated regions. On the other hand, he wants the botanists to demonstrate that plants may really thrive there. Otherwise, he makes a reservation as to the existence of ice-free lowlands, because, he maintains, the mere absence of visible traces of glaciers does not in itself prove that the land was not ice-covered. Not even earth profiles showing decomposition to considerable depths are decisive, either.

Recently SCHWARZENBACH (1951) has contributed to the discussion of glacial plant survival in East Greenland from an ecological point of view. He investigated to what degree the flora and vegetation at various altitudes would be influenced by a lowering of the snow-line. No doubt his considerations, which cannot be discussed in detail here, deserve attention. On the basis of investigations of the vegetation at different altitudes he argues that even rather considerable climatic changes, involving a lowering of the snow-line by c. 600 metres, would hardly materially influence the qualitative composition of the flora. But since, for the present, nothing definite is known about the situation of the snow-line during the Ice Age, the question of the conditions of plant life is still unsolved.

As emphasized by WEGMANN (l. c.), the question of plant refugia is principally a problem to be dealt with by botanists, even if geologists may contribute with advice and corrections. I think that the reserved standpoint held by WEGMANN should be regarded as a sound reproof to plant geographers who are inclined to support clear botanical arguments with geological evidence of doubtful cogency.

When in the following pages the immigration routes and the history of the Greenland Puccinellias are discussed, the problems of glacial survivals will often be encountered. The question of geological evidence of ice-free areas is not entered upon for good reasons. If, nevertheless, the existence of plant refugia is postulated, it is done simply because the present distribution of species seems to bear witness of former conditions the exact proof of which will probably never be obtained.

The Langeana Group (cf. p. 85).

Puccinellia Langeana. Within Greenland *P. Langeana* is restricted to the middle part of the west coast. Here, as also along the arctic coasts of N. America, including the southern part of the Canadian Archipelago, it is represented by ssp. *typica.* If the species really originated in the Beringian Region as indicated by the supposedly primi-

tive ssp. *alaskana* occurring there, its primary migration along the N. American coast to Greenland may well be of very early date, and it seems not out of the question that it survived the last two glaciations in the Archipelago and on the very Greenland coast. Something would speak in favour of *P. Langeana* being an early immigrant into eastern Arctic America, since it would give a clue to the present subspecific differentiation of the American-Greenland ssp. *typica* as compared with the other subspecies of Beringian distribution. During an advance of the North American ice shields *P. Langeana* was probably destroyed along the coast to the west of the Archipelago. The isolated East American-Greenland population became ssp. *typica*. The present occurrence of this plant in western Arctic America, then, is due to a new westward migration. Consequently its fusion with ssp. *asiatica* and ssp. *alaskana* would be of comparatively recent date. The fact that pure and mixed types are found together within one and the same area around the Bering Sea seems to me to materially support the hypothesis that the types now forming well defined subspecies were actually separated for ages (cf. fig. 114). Otherwise, merely one intermediary type might be expected to occur in the Bering Sea region.

I think that *P. Langeana* is a rather rare plant within its Greenland range and that it is evidently not favoured by the present Greenland conditions. At least it is often absent from places where it might be expected to be found. It generally grows in company with *Puccinellia phryganodes*, and quite intuitively one gets the impression that it suffers from intense competition from the latter, more aggressive, species. Similar observations were made by POLUNIN, who states that "it is often ousted by *P. phryganodes* and *Carex ursina*" (1940, p. 84). However, especially on meagre soils it seems able to hold its own.

The climatic conditions of to-day are probably less favourable to the plant than those of the past when it immigrated into Greenland. Its Greenland distribution would suggest that it is favoured by a continental climate, and I think it should be properly considered a continental relic of very old date. On the other hand, *P. phryganodes* is probably a much younger plant in Greenland (cf. p. 103 et seq.). When invading Greenland, this aggressive species very likely gained ground at the expense of *P. Langeana*.

The Andersonii Group (cf. p. 86).

Puccinellia Andersonii. The present revision has shown that *P. Andersonii* is fairly widely distributed in northern Greenland. Although its extra-Greenland distribution is but little known so far, I think it safe to state that NE. Greenland is the easternmost outpost of the species,

as it is absent from Spitsbergen. The westernmost known locality is still Pt. Lay, northernmost Alaska.

Next to it comes *P. fragiliflora*, so far only known from easternmost arctic Siberia and Novaya Zemlya. If we assume that once in the past these two related species differentiated from a common ancestral stock in the Bering Sea region, the pattern of this pair of species in some degree matches that of *P. Langeana* ssp. *typica* and ssp. *asiatica*, respectively. However, while *P. Langeana typica* did not spread beyond West Greenland, *P. Andersonii* pushed even as far as NE. Greenland.

P. Andersonii seems to be a more hardy and cold-resistant plant than *P. Langeana*, and it is somewhat less exclusively associated with the seashore proper than the latter. When these facts are duly considered, there seems to be no compelling reason to suppose that the migration histories of the two species are alike. A warm interglacial period must have been inimical to a decidedly arctic plant like *P. Andersonii*. HULTÉN (1937 a, p. 54) thinks that plants of a distributional type similar to that of *P. Andersonii* survived the supposedly warm interglacial preceding the Riss (Illinoian) glaciation on the American Arctic shelf.

If the Canadian Archipelago was not covered with ice during the Riss glaciation, as geological evidence seems to show, the "wintering" of the extremely arctic plants there in itself presents no problem of paramount importance.

However, exceedingly few decidedly high-arctic plants have a range of distribution similar to that of *P. Andersonii*. Most of the really western high-arctic plants occurring in Greenland are restricted to the northwestern part of the country. That is to say, the last interglacial (supplemented with the postglacial) time was of too short duration for the majority of the western survivors to spread as far eastward as Peary Land and the remaining part of NE. Greenland. *P. Andersonii*, as an exception, reached East Greenland, and hence it may be inferred that it must have spread comparatively rapidly along the north coast of Greenland during the last interglacial period. I think it did not occur there prior to that time; for if so, it would probably have reached Spitsbergen, too.

It should be pointed out here that as to type of distribution only two additional species, viz *Taraxacum phymatocarpum* and *Taraxacum pumilum*, can be directly compared with *P. Andersonii*. A rapid migration of these latter species will appear natural when the construction of their achenes, well adapted to long-distance dispersal, is considered.

If an explanation of the migratory power of *P. Andersonii* is searched for, two properties of the plant should probably be emphasized: in the first place, *P. Andersonii* belongs to the seashore plants the migration of which evidently is hardly impeded by obstacles such as fjords, moun-

tains, or valley glaciers. Secondly, the exceedingly fragile spikelet-rachilla will probably favour epizoic spreading of the seeds by means of birds and mammals, first and foremost the arctic fox deserves attention since it has the custom of straggling hundreds of miles along the seashore, searching for food. When touching the mature panicles of the grass, the woollen fur of the fox will get sprinkled with the easily detached grains. What this means for the dispersal of the plant, needs no further comments. *P. Andersonii* no doubt reached East Greenland prior to the last glaciation. Judging from the map (fig. 103), it is wanting over large stretches of the very north coast of Greenland. Even future investigations cannot be expected to alter the picture on essential points. *P. Andersonii* seems to be a calciphilous plant, as is also *Colpodium Vahlianum*. As to their distribution in Greenland the two species show a striking similarity (cf. fig. 101).

The Angustata Group (cf. p. 86).

Puccinellia angustata. The geographical distribution of *P. angustata* is unique among the Arctic Puccinellias, reaching from the Canadian Archipelago to northernmost Taimyr. It is one of the most extremely high-arctic plants that exists. It is the only *Puccinellia* of common occurrence in Grant Land and Grinnell Land and the very north of Greenland. In Spitsbergen and northern Novaya Zemlya only *P. phryganodes* reaches similar high latitudes. In Franz Josef Land it is the only *Puccinellia* found.

This range of distribution, comprising the northernmost dry land on the Earth, would indicate that once in the past *P. angustata* occupied an unbroken area, later on split up by the intrusion of the Greenland Sea. Even if a geological argument for such a land connection has never yet been demonstrated (cf. WEGMANN 1948), I think that *P. angustata* is highly suggestive of it. However, the case of *P. angustata* is not by far unique. More examples of approximately the same distribution might be added: for instance *Colpodium Vahlianum*, *Poa abbreviata*, *Poa Hartzii*, *Poa arctica* ssp. *caespitans* (NANNFELDT 1940, p. 71), *Eriophorum triste* (LÖVE 1950 a, p. 34), and *Carex ursina*, to mention only some gramineous plants (cf. also NORDHAGEN 1935, p. 143 et seq., NANNFELDT 1940, p. 39 et seq.). They are typical representatives of the "eo-arctic" flora element (TOLMATCHEV 1932, p. 58), assumed to have inhabited non-glaciated coast-lands along the Polar Ocean north of the ice-shields during the successive glaciations.

Plant species of this type of distribution will hardly be able to extend their range under the present climatic conditions of the northern hemisphere, for to the east and west of their area no land exists that would come within their climatic southern limit.

It seems obvious that the critical periods of such plant species were the interglacials rather than the ice ages themselves. Especially to plants with halophilous properties, which have no opportunities to escape too high temperatures by withdrawing to the mountain regions, warm periods of the interglacials may be fatal. In this connection it should not be forgotten that the only *Puccinellia* of the said distribution is much less of a halophyte than are the rest of the Greenland representatives of that genus.

During a supposedly warm prolonged interglacial preceding the Riss glaciation *P. angustata* and the species accompanying it must have had refuges within their distributional area of to-day. The western part of the Canadian Archipelago or a hypothetical N. American shelf devoid of mountains would not to the same extent as N. Greenland and Spitsbergen offer the plants possibilities of escaping too high temperatures. That is why, in the opinion of the writer, the northernmost mountainous countries must be considered the headquarters of extremely high-arctic plants during a warm interglacial. At the same time as the psychrophilous plants survived in the extreme North, an intercourse of western and eastern elements across northern Greenland probably took place.

The hypothesis advocated here has something in common with that of GELTING (1941), but I think it is materially substantiated when the recent distribution of the species exemplified by *P. angustata* and their supposed history are added to the evidence emphasized by GELTING. The mere existence in North Greenland of the plants discussed here seems to me sufficient in itself to demonstrate that the land was never completely covered by ice, for they could not have immigrated from elsewhere (cf. also HADAČ 1948, on the history of some arctic Iceland plants).

At what time the land connection of NE. Greenland and Spitsbergen was broken, we do not know. However, there seems to be clear botanical evidence that this important event took place prior to the last interglacial (cf. also the discussion on *P. phryganodes*, p. 103). If this be accepted, at least a hundred thousand years have elapsed since the East Greenland and the Spitsbergen populations of *Puccinellia angustata* were separated. On this background a study of the variation pattern of the two populations gains topicality. From Spitsbergen a var. *decumbens* JØRGENSEN (cf. this paper p. 30) has been distinguished, although transitions to the main type are to be found. Even if its rank of a distinct variety be questioned, it stands as an expression of a trend of variation. A similar variation is found within the NE. Greenland population, for here, too, types that come close to vər. *decumbens* occur, while the variation within the NW. Greenland population takes another direction. That is to say that the genetic constitution of the populations

has not probably changed ever since they became isolated by the intrusion of the Greenland Sea.

The facts pointed out above seem to reveal *P. angustata* as a very old and rigid strain within the otherwise extremely plastic genus. Its taxonomically isolated position is pointed out above (p. 29). The only supposedly related species in existence is *P. contracta* (p. 77) from Novaya Zemlya and Eastern Arctic Siberia. The scanty information available about the ecology of the latter species seems to show that it is a seashore plant. In Novaya Zemlya, where *P. contracta* and *P. angustata* meet, the former is restricted to the southern, the latter mainly to the northern part of the island. The interrelation of these two species is obscure. As pointed out above, in some characteristics *P. contracta* approaches the *Colpodia*, which, I think, suggests a great antiquity of this species, too. Each of the two species, grouped together by me, exhibits primitive characteristics of their own, and, therefore, in spite of an obvious superficial conformity, a real tribal affinity may well be questioned.

The Nuttalliana Group (cf. p. 87).

Evidently the Greenland species of this group are not, all of them, directly related to one another. For morphologic-taxonomical reasons they must be considered partly of central N. American, partly of eastern N. American origin.

Puccinellia deschampsioides. This species, like *P. Nuttalliana*, is a steppe plant rather than a seashore plant. Its Greenland area is mainly restricted to the dry and relatively warm, strongly continental hinterlands of the middle part of the west coast (cf. BÖCHER 1949, 1952). Besides, it is known from northernmost Labrador, Sugluk Bay. This locality is situated within one of "The supposed nunataks of northeastern Canada" mapped by VICTORIN (1938, p. 513, fig. 20). In the southern Hudson Bay Region a slightly deviating type occurs. Apparently, it is absent from the Atlantic coast regions of Labrador and the Lawrence Gulf Region.

It may well be argued that the distribution of *P. deschampsioides* is not really discontinuous since the species occurs in Labrador. Nevertheless, it should, no doubt, be classed with the Labrador-Greenland plants of western affinity, the relict nature of which has been discussed by ABBE (1936, p. 126). That *P. deschampsioides* really is an early inhabitant of Greenland, seems indicated, too, by the fact that it has relatives there which are not found elsewhere.

It seems evident that a connection once existed between the population now occurring in subarctic Central N. America and the Greenland one. This former connection most likely dates back to an inter-

glacial during which northern America had a warmer and dryer climate than that prevailing to-day.

The present climate of the West Greenland fjord areas doubtless offers conditions more favourable to xerophilous plants than are met with elsewhere in eastern arctic America (cf. BÖCHER 1948, 1950). When it is taken into consideration that to-day *P. deschampsioides* is able to thrive over areas of flat land in the Greenland fjord regions (cf. PORSILD 1920, p. 45 on "*P. arctica*", BÖCHER 1949, p. 33), it does not seem absurd to suppose that even during glacial times the plant has held its own in places with a favourable exposure. On southern slopes the insolation may well have compensated for a temperature fall of such minor magnitudes as may be expected to have accompanied the ice ages. According to computations quoted by FLINT (1948, p. 456), during the glacial maxima the mean annual temperature was only 4°—7° C. lower than at present.

Puccinellia Porsildii. The origin of *P. Porsildii* is obscure. Its relationship to *P. deschampsioides* cannot reasonably be doubted, but this fact cannot, admittedly, be taken as a proof that it is really a plant indigenous to Greenland. It is only known from culture-influenced ground around the settlement of Godhavn, where it has been able to hold its own ever since it was first collected in 1933. The fact that the plant normally produces ripe seeds, does not, actually, suggest a casual introduction from elsewhere.

Puccinellia Rosenkrantzii is an endemic of the Nûgssuaq peninsula, where it occurs in large quantities on the fresh deposits around the mud volcanoes (cf. p. 34). Although this plant has some morphologic characters in common with *P. vaginata*, its leaf anatomy clearly points to a closer relationship to *P. deschampsioides.* Probably it was segregated from the original *P. deschampsioides* stock as a response to the special conditions caused by the mineral outflow from the mud volcanoes. The age of the peculiar geological phenomenon is unknown. The present mud-eruptions are found at an altitude of ca. 150 m. According to DAN LAURSEN (1950, p. 125 et seq.), the upper marine limit at Nûgssuaq lies 200—300 m above sea-level. The corresponding transgression of the sea is correlated with the Scandinavian Yoldia Sea and is thus considered to be of early post-glacial age.

Puccinellia groenlandica. This endemic of W. Greenland is probably of interglacial age. No close relative can be pointed out, but it may be related to *P. laurentiana*, or possibly to *P. macra* of the Lawrence Bay Region. It is a more coast-bound plant than is *P. deschampsioides.* Its distribution is restricted to the continental parts of W. Greenland,

although it does not avoid the outer coast stretches, especially to the north.

Probably it became isolated during a period of glaciation, while its allies, conspecific or not, along the unsheltered American coast were destroyed under the Labrador ice-shield.

Puccinellia laurentiana. As a Greenland inhabitant this species is so far only known from a single find (SW. Greenland). The specimen in question deviates somewhat from the Lawrence Bay type. The possibility exists that the Greenland strain has got a stamp of its own by being isolated for ages. However, if it is really indigenous to Greenland, it seems curious that it should only have been collected once.

The Coarctata Group (cf. p. 88).

Puccinellia coarctata. This species is of subarctic, amphi-Atlantic distribution. It ranges from the coasts of southern Labrador and Newfoundland over Greenland, the North Atlantic islands (Iceland, Jan Mayen, the Faeroes), and Northern Fennoscandia to Waigatsch.

P. nutkaensis, a species of the northern Pacific coasts, seems to be rather closely related to *P. coarctata.* The possibility of a direct genealogical connection between these two species probably exists. They represent a species-pair which completely fits in with the group of Atlantic-Pacific plants pointed out by HULTÉN (1937 a, p. 63—64). This group preferably comprises seashore plants, the Atlantic and Pacific populations of which, it is true, often differ somewhat so as to form pairs of varietal, subspecific, or even specific rank. *P. coarctata-nutkaensis* is paralleled e. g. by *Ligusticum scoticum-Hultenii*, though the distribution of the latter pair falls a little farther to the south. Another parallel is *Carex Lyngbyei* and ssp. *cryptocarpa* mapped by RAYMOND (1951, p. 12). HULTÉN assumes a Beringian origin of such species, and he thinks that they reached the Atlantic during the great (Mindel-Riss) Interglacial. This view accepted, *P. coarctata* is of American rather than of European origin.

Within Greenland a number of local types can be discerned, even though they can hardly be kept definitely apart. This fact seems to indicate that the species survived the last glaciation split up into small isolated populations. Such local types are found on the Nûgssuaq peninsula, and at the head of Godthaabsfjord, W. Greenland, in the Julianehaab District, S. Greenland; in the Angmagssalik District and in the Kejser Franz Josephs Fjord Region, SE. and NE. Greenland, respectively. As will be seen, the morphologically distinguished types are associated with regions whence other botanical evidence of glacial plant refugia is at hand (cf. GELTING 1934, BÖCHER 1948, DAHL 1950). Especially along the West Coast a fusion of the different forms has taken place

in post-glacial time, when the isolated populations colonized the whole coast line.

Within the genus *Puccinellia* we have another example of boreal amphi-Atlantic distribution, namely that of *P. fasciculata*, a species related to *P. coarctata*. It may be said to replace the latter to the south, as it is indigenous both on the Atlantic coast of the northern United States, and in England and the Channel Region of the European Continent. Additional cases of amphi-Atlantic boreal seashore plants are given by FERNALD (1929, p. 1501), who considers the peculiar distribution to date back to the last interglacial. Also the ordinary Faeroe-Norwegian type of *P. coarctata* may well have survived the last glaciation on the Norwegian west coast. For NORDHAGEN (1935, p. 155 et seq.) is of opinion that besides extreme North Fennoscandian refugia, facing the Polar Sea, a West Norwegian unglaciated coast-land is also indicated.

On the other hand, as emphasized by HULTÉN (1937, p. 64), seashore plants are conspicuous by their unusual migratory power, and, therefore, it seems not unlikely that the seashore plants as to their migration history should be looked upon from quite another angle than for instance the arctic alpine plants.

At any rate, the possibility of a geologically recent interchange of halophilous plants between the continental and the insular coasts bordering the North Atlantic cannot be neglected. Thus Á. and D. LÖVE (1947) mention *Cakile edentula*, occurring outside its American range in Iceland and the Faeroes, as an example of long-distance dispersal effected by the sea.

The Vaginata Group (cf. p. 89).

Puccinellia vaginata. The provenance of *P. vaginata* is obscure since no obvious relatives seem to exist. If we consider the groups enumerated above, *P. vaginata* seems to come closest to species of the Pumila Group on the one hand and to those of the Coarctata Group on the other. The two described varieties approach, each of them in its own way, the said groups.

On discussing the history of the species, we have to make up our mind as to the question of paramount importance: Does *P. vaginata* represent an ancient or a modern line of evolution within the genus? I am inclined to adhere to the latter alternative, and if this view is correct, it may be assumed that *P. vaginata* originated as a hybrid between species belonging to different groups, followed by a chromosome doubling. At least the large cell-size peculiar to *P. vaginata* would seem to support such a hypothesis. A crossing between *P, coarctata* ($2n = 42$) and *P. Langeana* ($2n = 14$) would be cytologically acceptable; the doubled hybrid would get $2n = 56$, the number found in *P. vaginata*. However,

for morphological reasons some *P. pumila*-form, rather than *P. Langeana*, may be supposed to have contributed to the creation of *P. vaginata*.

If, on the other hand, *P. vaginata* is an ancient species, its ancestors and relatives must have perished without leaving other descendants within the unglaciated areas in eastern and western America. This seems to be even more contrary to all probability than the hypothesis of hybridisation set forth above. Moreover, *P. vaginata* is an exceedingly variable species, which fact I think does not point to the species being the last survivor of an otherwise extinct group.

Recently *Nygren* (1951) published an account of some crossing experiments which, he thinks, show that *Melandryum triflorum* is an amphidiploid hybrid between *M. affine* and *M. apetalum*. Accordingly *M. triflorum* must be of recent date, as is also indicated by its being restricted to Greenland. Like *Puccinellia vaginata*, *Melandryum triflorum* is a polymorphic species which locally has differentiated special types. Such local types, sometimes astonishingly recalling *M. affine*, were found by me in the inner fjord regions of Northeast Greenland in the immediate neighbourhood of stands of *P. vaginata* around old Eskimo sites. Another striking parallelism between *Melandryum triflorum* and *Puccinellia vaginata* is evidenced by conformity in ecological requirements: *M. triflorum*, like *P. vaginata*, has hemerophilous as well as halophilous properties and is usually found in the upper *Puccinellia vaginata* zone at the seashore.

However, when and where *P. vaginata* originated is still an open question. As to the first problem, when *P. vaginata* came into existence, I only wish to call attention to the possibility of the plant having obtained its wide distribution, especially its Greenland areas, in comparatively recent time by the agency of man, as will be discussed below. As to the second point, the place of origin, we can only guess, but the northern coastlands of eastern North America, so amply bestowed with a varied *Puccinellia* flora, may be pointed out as a possible region of derivation. At any rate East Greenland cannot be supposed to be its original home, and thus it must have reached this outlying region by migration. I think it followed the tracks of the colonising Eskimos.

As regards its Greenland distribution, *P. vaginata* belongs in the bicentric species (cf. GELTING 1934, p. 264) which are generally considered to represent an ancient element in the flora. I think this point of view can be accepted in broad features, at any rate as a fruitful hypothesis. On the other hand, the hypothesis does not, probably, hold true as far as *P. vaginata* is concerned. I here want to call attention to the fact that *P. vaginata*, unlike the greater part of the bicentric species, is a hemerophilous plant. Therefore, the possibility that the

plant may have spread rapidly by the agency of man in comparatively recent time, should be duly considered. According to kind verbal information from J. TROELS-SMITH, M. A., who is familar with the Greenlanders' mode of living, the soft straw of the *P. vaginata* sods is harvested by the Eskimos and used for manufacturing small baskets and other nicknacks. Moreover, when travelling by sledge, the Eskimos bring with them bunches of the straw. Before its use for domestic purposes the spikelets are removed.—Likewise, CHR. VIBE, M. Sc., who has for years made zoological investigations in Northwest Greenland, tells me that a sack with hay, usually consisting of Puccinellias from the surroundings of the habitations, forms part of the indispensable sledge equipment of the Thule Eskimos. According to VIBE the Polar Eskimos mainly use the hay for internal lining of kamiks.

To what degree such an availability to the natives, as reported by the said authorities on Greenland conditions, may influence the dispersal, of our plant, needs no further comments.

From my own investigations in Northeast Greenland it can be stated that even here *P. vaginata* is mainly, if not exclusively, found in the neighbourhood of old relinquished Eskimo sites. Further, two additional facts, concerning the floristics of Northeast Greenland should be emphasized in this connection: First, *Matricaria ambigua*, a rather rare plant, is found growing together with *P. vaginata* near ancient Eskimo habitations in all its known localities. Secondly, *Chrysosplenium tetrandrum*, too, in its only known East Greenland localities (Clavering Ø) is likewise found on former culture-influenced soil at the old Eskimo house ruins. According to POLUNIN (1940, p. 269 and p. 360), within the Canadian Archipelago the two latter species are especially found round past and present Eskimo sites. All these facts seem to furnish cogent evidence that *Puccinellia vaginata*, as also the other two plants, were brought from Northwest Greenland to the Kejser Franz Josephs Fjord region in the east by the Polar Eskimos.

It is known from archæological investigations that the Eskimos in the past colonized along the north coast of Greenland and down the east coast, where they lived for centuries.

A summary of all known data about the Eskimo colonization of Greenland is given by LAUGE KOCH (1945, p. 299—336) in his paper on the climatic changes in Greenland and the Polar Basin during the last thousand years. More than once Greenland was invaded by Eskimos, who followed travelling routes over Ellesmere Land to Northwest Greenland. From here the migration proceeded to the south along the west coast and to the northeast along the north coast. It is beyond doubt that Northeast Greenland was colonized by Eskimos migrating around

the north of Greenland, and, in all probability, the east coast was reached by the Eskimos more than once. It is only as to the exact times of the migrations that uncertainty still prevails. The North Greenland conditions down through the ages are summarized by LAUGE KOCH as follows (l. c., p. 334): "It must be taken for granted that for different periods within the last 1000 years the North Greenland fjords have been free of ice in the summer and have thus afforded conditions for a much better hunting of marine animals than that known for the period 1876—1921. The periods from c. 1000 to 1200 and from 1400 to some time in the 16th century may be assumed to have been favourable for a migration around the north of Greenland."

From these statements it may be inferred that for climatic reasons *Puccinellia vaginata* was able to thrive in northernmost Greenland at the time of the Eskimo migrations. During the subsequent deterioration of the climate it became extinct there, while it was still favoured by the conditions of the sheltered fjord regions of East Greenland.

The continuous human occupation of the Thule region on the northwest coast up to the present time has probably offered suitable conditions for the survival of this highly culture-favoured plant in its northernmost localities on the Greenland west coast, where to-day it is exposed to rather severe climatic conditions.

As suggested above, herbarium studies seem to indicate that *P. vaginata* is a rather rare plant on the coasts along the west side of Baffin Bay, while it is one of the commonest plants on the Greenlandic side. This peculiarity may well be due to the different intensity of colonisation and communication along the two opposite coasts. Hardly any other North Greenland plant is so closely associated with man's fouling of the seashores as is *P. vaginata.*

To sum up the above considerations on the history of *Puccinellia vaginata*: The weedy properties of the plant in connection with the agency of man give the clue to the wide range of *P. vaginata*, which for morphological and taxonomical reasons may be considered a young species. Its wide east—west range largely conforms with the past and recent travelling routes of the Eskimos. Thus its regional distribution does not seriously interfere with the assumption that the species may be of glacial or even post-glacial date.

The Maritima Group (cf. p. 89).

Puccinellia phryganodes. This species has a wider distribution in Greenland than any other *Puccinellia.* It is absent only in the extreme north and northeast, and, more surprisingly, along the coast stretches south of Scoresby Sund including the Kangerdlugssuaq fjord complex (cf. BÖCHER 1938, p. 219). Its total range is likewise remarkable.

the species being the only circumpolar representative of the genus. The wide range of this species seems all the more surprising when it is taken into consideration that it never produces seed and accordingly must have spread exclusively by means of vegetative diaspores. It is preferably a high-arctic plant. On the other hand, it pushes comparatively far to the south, especially in East America, whence it is recorded as far south as the 56th and the 45th parallel at the Labrador and Keewatin coasts, respectively (FERNALD and WEATHERBY 1916, p. 9).

The species is not uniform throughout its circumpolar area, a fact which was treated at length above (p. 55). The main result of this treatment may be summarized as follows:

For morphological reasons four types or races have been distinguished, which are also geographically separated and thus may conveniently be designated according to their distribution as follows: 1) a Spitsbergen (-Novaya Zemlyan) type, 2) a Fennoscandian (-Siberian) type, 3) a Beringian type, and 4) a Greenland (-American) type.

None of these types are fruiting. The closely related seminiferous species, *P. geniculata*, is a native of the Beringian Sector, which fact in itself may suggest that *P. phryganodes* originated there, too. The variation pattern of *P. phryganodes* seems to support the hypothesis that the plant, migrating westward and eastward from this centre, reached its outposts toward the Atlantic in Spitsbergen—Norway and Greenland, respectively. For the types facing the Atlantic represent each in its own way the very extremes within a stepwise altered form series. This hypothesis is also materially supported by cytological evidence in so far as the Spitsbergen and the Scandinavian plants are found to be tetraploids, while the Greenland plants are triploids. These facts unquestionably prove that *P. phryganodes* never crossed the Atlantic (Greenland) Sea.

It now only remains to discuss the age and history of the species. There are plant-geographical evidence to show that *P. phryganodes* is of a comparatively young date, notwithstanding its wide range. It did not occur in the Atlantic Sector of the Arctic prior to the breaking-in of the Greenland Sea. Even the decidedly high-arctic Spitsbergen type was not present in Spitsbergen during the period of the hypothetic North Atlantic land connection, since it is not found in North Greenland to-day. That is to say that it did not reach Spitsbergen till late Quaternary times. For, as discussed above (p. 95, *P. angustata*), the botanical evidence of the reality of that land connection probably up to the Mindel-Riss Interglacial should hardly be disregarded. Probably, what is now the Spitsbergen type represents a strain forced northward in the Novaya Zemlya region along the Siberian coast, which owing to the regression of the sea has followed a more northern path than

that of the present day. That Novaya Zemlya at a certain period during the Quaternary time acted as a definite western barrier to seashore plant dispersal from the East, seems indicated by the distribution of three other Puccinellias, viz. *P. contracta*, *P. fragiliflora*, and *P. Langeana* ssp. *asiatica*, all of them common to arctic eastern Siberia and Novaya Zemlya, and not found in Spitsbergen.

A lowering of the oceanic water level by at least 100 m during the maximum glaciation, is generally accepted (HULTÉN 1937, p. 33), as a result of which Novaya Zemlya and the surrounding shelf would become a northward protruding peninsula of the Euro-Siberian continent.

Raised marine flats of late glacial age are found in Novaya Zemlya and Spitsbergen at altitudes of 300—400 m. (GRØNLIE 1924, KULLING 1936). Consequently, the distribution of dry land was radically altered. Novaya Zemlya got separated from the continent by 250—300 km (GRØNLIE l. c., p. 98).

Not till the intrusion of the Arctic Ocean into the basins of the Kara Sea and the Barents Sea, was the pathway westward along the seashore opened (cf. also TOLMATCHEV 1926, p. 152). It may be assumed that a new, more southern, strain of *P. phryganodes* (the Fennoscandian type), migrating along the continental coast from the east, now made its way to the Scandinavian Atlantic coast, and even to the Baltic (cf. LINDBERG 1928, 1941).

TOLMATCHEV (1930, p. 201 et seq., 1936) on the basis of phyto- (and zoo-) geographical evidence considers the Kara Sea to have been dry land as late as early postglacial time, for he does not accept the survival of biota in Novaya Zemlya during the last ice age[1]). However, as demonstrated by LYNGE (1933), lichens may have survived on Novaya Zemlya as well as on Spitsbergen. The fact that the *P. phryganodes* of Novaya Zemlya and that of the continental coast and Waigatsch are racially different, seems to me to indicate that even vascular plants found refugia there.

In the light of the above migration hypothesis, the question how *P. phryganodes* reached Spitsbergen and Bear Island becomes topical.

The overground rooting runners of *P. phryganodes* are, no doubt, excellently adapted for dispersal by way of the sea even over long distances. In winter the stands are imbedded in the ice covering (the

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[1]) In this connection, the following passage by TOLMATCHEV (1932 p. 50, footnote) is worth noting: "It is interesting that within Novaya Zemlya *Erysimum Pallasii* is restricted to the area that was not touched by the last progressive phase of glaciation." (translated). The nearest locality known is eastern Taimyr, at a distance of ca. 1500 km (cf. also TOLMATCHEV 1930, p. 195, fig. 8). Thus, the passage seems to indicate that even TOLMATCHEV possibly does not entirely reject the supposition of plant survival in Novaya Zemlya during the last ice-age.

ice foot). At high tide and storm the ice may break up and the loosened floes of ice containing uprooted plants or detached runners and bulbils are carried away by the sea currents. The ice floes may be washed ashore on a distant coast, and, when melting in the summer, the contents are discharged. Even in case of the plant fragments being unloaded into the very sea water near the shore, they are likely to be washed ashore like seaweeds. The vegetative diaspores are undoubtedly able to tolerate salt water for a long time. In case of favourable conditions at the landing place the plant will, no doubt, be able to colonize. In this connection it is noteworthy that the plant sometimes behaves like a real seaweed. Thus KRUUSE (1912, p. 280 and p. 304) reports that at the daily high tide the stands were usually submerged to a depth of one metre.

The supposition that *P. phryganodes* was carried from Novaya Zemlya to Spitsbergen by the sea, seems not hazardous when the current conditions of the Spitsbergen Sea are considered. The west coast of Novaya Zemlya is washed by a northward directed current, which gradually bends westward and southward along the southeast coast of Spitsbergen.

I do not think that the transport of *P. phryganodes* to Spitsbergen is an everyday happening. But it may well have happened once or a few times during Nature's long-lasting experiment.

At what time *P. phryganodes* reached Spitsbergen is, of course, still an unsolved question. HADAČ (1947) is of opinion that a few Spitsbergen inland occurrences of *P. phryganodes* and some other strand plants, supposedly of a relic nature "probably date back to the final phase of the last Ice Age", and "thus seem to support the theory of LYNGE (1939) on the survival of plants during the Ice Age in Spitsbergen" (l. c. p. 70).

The fact that the Spitsbergen race of *P. phryganodes* never reached NE. Greenland by sea, cannot be surprising, for the ice-drift along the east coast of Greenland is mainly fed from the ice masses of the central part of the Polar Basin.

The Greenland *P. phryganodes* doubtless came from the west. As pointed out above, this species cannot belong to the really ancient Greenland inhabitants. Probably it reached Greenland and spread along the whole coast line prior to the last glaciation, probably during the last interglacial. For its present distribution seems to speak against a postglacial immigration. The arguments are as follows: 1) During a postglacial period of ameliorated climate it may possibly have been able to reach the Kejser Franz Josephs Fjord Region, migrating around the north of Greenland. However, if this was really the case, it would no doubt have left scattered stands behind it in sheltered localities at

the south coast of Peary Land and the adjacent fjords, where it is definitely known to be absent to-day. 2) A postglacial migration around the south of Greenland to the northeast coast north of Scoresby Sund is out of the question, for the sea currents, especially along the east coast, are extremely adverse to a migration route like that. I therefore think that probably *P. phryganodes* survived the last ice age in West and East Greenland, but became extinct on the north coast.

The Greenland-American type is probably less hardy than the Spitsbergen type. As far as is known, it is wanting in Grant Land and Grinnell Land (POLUNIN 1940, p. 83). At the same time its common occurrence in southernmost Greenland and its spreading to subarctic Eastern America would likewise seem to indicate innate "southern" properties of that plant. In this connection attention should be called to the distribution of the Spitsbergen type. It is found in the extreme north of Spitsbergen (SCHOLANDER 1934, p. 95) and within the Novaya Zemlyan area it is restricted to the high-arctic zone, i. e. to the islands of Novaya Zemlya proper, although there seems to be no insurmountable obstacles preventing it to cross the narrow straits separating the northern islands from Waigatsch and the European north coast. That only the Fennoscandian type is represented here, may be due to the high-arctic Spitsbergen type being uncapable of competing with the more southern Fennoscandian type.

The peculiarities of the distribution of the different types occurring in the Atlantic sector, seems to me to clearly indicate that the Spitsbergen type differs physiologically from the others, being a plant of decidedly "high-arctic" properties. Thus there is nothing contradictory in supposing that *P. phryganodes* survived the last glaciation in Novaya Zemlya and possibly in Spitsbergen, too, while the same species became extinct in northernmost Greenland even if plant refugia were left unglaciated, simply because in the latter place it was represented by a less hardy type.

The absence of *P. phryganodes* from the Blosseville Kyst south of Scoresby Sund may simply be due to topographical conditions. According to BÖCHER (1933, p. 17), the mountains descend steeply into the sea, and thus the common seashore plants will have no possibilities of existence. Other shore plants such as *Stellaria humifusa*, *Honckenya peploides*, and *Cochlearia arctica* (*groenlandica*) are likewise wanting along stretches of this barren coast, though, like *P. phryganodes*, they are found both to the south and to the north thereof.

However, in the Kangerdlugssuaq fjord complex in the middle of Blosseville Kyst, places suitable for *P. phryganodes* are probably not completely wanting. Therefore, the absence of *P. phryganodes* there may well be due to immigration difficulties. The drift ice is not forced into

the inner fjord ramifications, where the most favourable conditions for the formation of clayey or sandy strandflats are found. When such suitable localities are wanting along the outer coast within long distances, the possibilities for a colonization from ice-borne diaspores must be extremely small. I therefore suppose that *P. phryganodes* is absent from the Kangerdlugssuaq fjord because it was not landed there in a proper place ever since the recession of the inland ice.

Within the Atlantic sector of the Arctic, *P. phryganodes* is wanting in Jan Mayen (Johs. Lid in lit.) and in Iceland (cf. Löve 1950a, 1950b). This small gap in the circumpolar area of the species is, no doubt, accounted for by the fact that the sea currents are adverse to an immigration by way of ice-borne propagules from the existing sources to the east and the west. The non-occurrence of *P. phryganodes* in Iceland may be taken as a further indication of a comparatively young age of the plant in the Atlantic sector. Á. and D. Löve (1947, p. 20) suggest that "At least 55 % of the present flora ... have survived the latest ice invasion and perhaps the whole Ice Age in Iceland". *P. phryganodes* might be expected to be among the survivors, if it ever happened to come there.

Puccinellia maritima. This European species is undoubtedly a foreigner within the Greenland flora. As demonstrated above (p. 63), it was in all probability introduced from Iceland by the Old Norsemen about one thousand years ago. It is still restricted to the region of the southern Old Norse settlement, the so-called *eystri byggd*, i. e. Eastern Homesteads. It may be said to have become naturalized, as it is found on sandy and clayey seashores far from the old house ruins. But it is by no means a common plant (cf. Polunin 1943, p. 365). It seems to produce no ripe seeds, and its overground innovations are not by far sufficiently specialized for long distance dispersal, as are those of *P. phryganodes.* The plant has hardly gained new ground to any great extent since the epoch of the ancient colonization. Therefore it may be termed a modern relic in Greenland.

As a result of the above considerations on the origin, immigration, and Greenland age of the *Puccinellia* species the following historic-geographical elements may be pointed out:

1) An old-Pleistocene (eo-arctic), amphi-Atlantic, high-arctic element, comprising

P. angustata (and *Colpodium Vahlianum*).

2) A middle-Pleistocene, western, arctic-continental element, comprising

P. deschampsioides, *P. Langeana.*

3) A young-Pleistocene, north-western, high-arctic element, comprising *P. Andersonii*, *P. phryganodes*.

4) A middle- or young-Pleistocene, south-western, subarctic element, comprising *P. coarctata*, *P. groenlandica*, *P. laurentiana*.

5) An autochthonous, Greenland, arctic element, possibly of post-glacial origin, comprising

P. Rosenkrantzii (and *P. Porsildii*, very doubtful).

6) An anthropochorous, western, arctic element, introduced by the colonising Eskimos, comprising

P. vaginata.

7) A European, boreal element, introduced by the old Norsemen, comprising *P. maritima*.

VIII. LIST OF THE GREENLAND SPECIMENS EXAMINED

(Cf. the maps figs. 101—14).

In the following pages the examined Greenland specimens are listed. The spelling of the place-names is in most cases that of the original labels, which often is not in full accordance with the present official spelling (confer p. 146). If the latter spelling should have been employed, the identification of the specimens in question would, no doubt, be rather difficult.

In order to facilitate, for the reader, the location of the specimens cited, these are listed in accordance with the phyto-geographical districts proposed by OSTENFELD (1926, p. 20). The inserted map (fig. 2) showing the districts is reprinted from OSTENFELD's paper. Within each district the quoted specimens are listed in an approximate south-north sequence.

At the beginning of the mention of the individual species the records found in taxonomic and floristic papers are quoted in so far as it has been possible to find out what species were referred to by the various authors. Some few older records appearing in papers dealing with collections not represented in the Scandinavian museums are omitted, as for instance those of DURAND et al. (1863), BROWN of Campster (1868), HART (1880), and MEEHAN (1893).

In the maps showing the Greenland distribution of the species only localities of herbarium specimens examined by me have been marked.

In the list the following abbreviations of the various Botanical Museums and Herbaria are used:

H — Botanical Museum of the University, Copenhagen.
L — Botanical Museum of the University, Lund.
O — Botanical Museum of the University, Oslo.
P — Herbarium M. P. Porsild.
S — Herbarium of Riksmuseet, Stockholm.
U — Botanical Museum of the University, Uppsala.

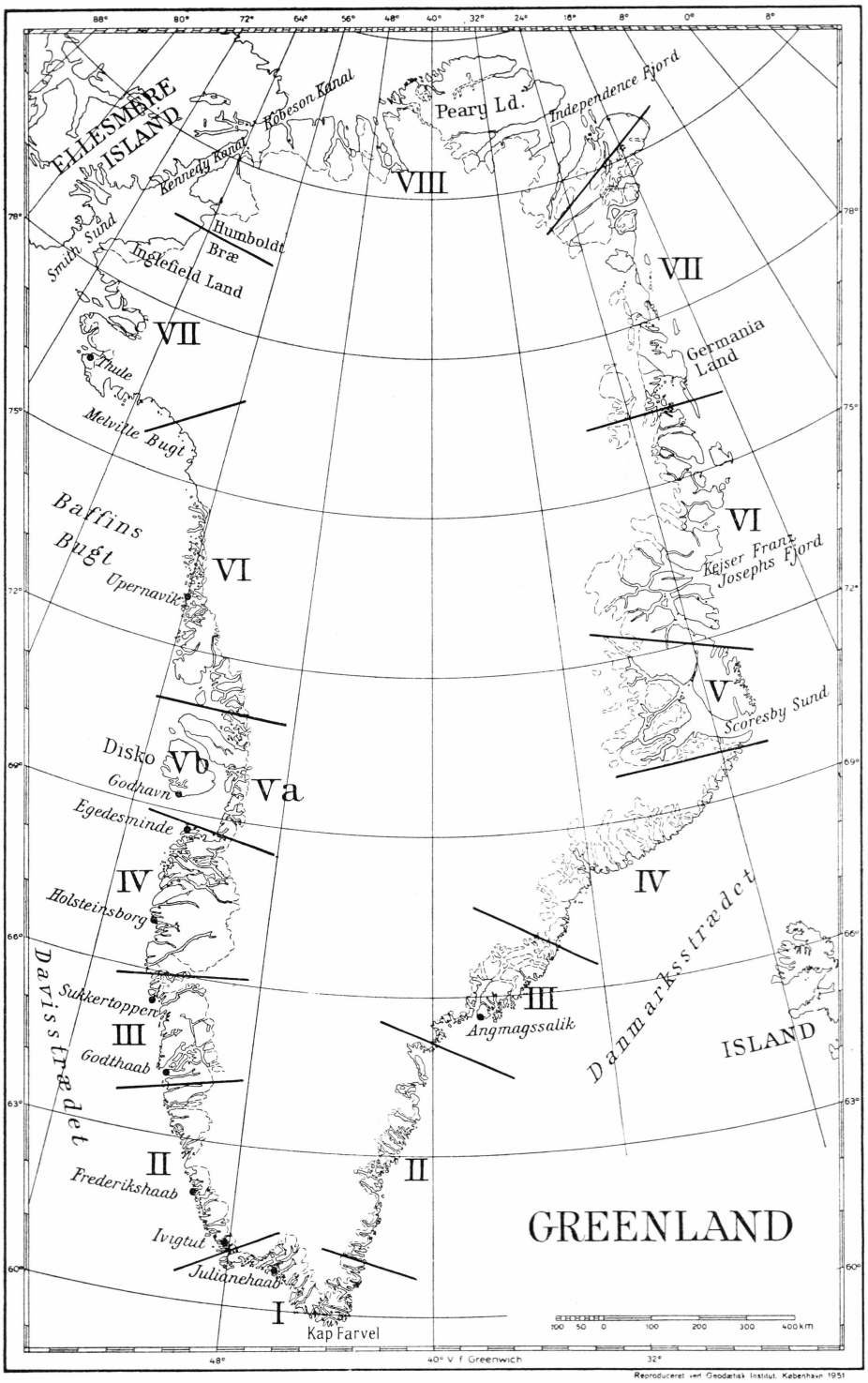

Fig. 2. Phytogeographical Districts of Greenland, reprinted after OSTENFELD 1926.

Colpodium Vahlianum (Liebm.) Nevski.

Poa Vahliana: Fl. dan. fasc. 41 (1845) tab. 2401. *Glyceria Vahliana:* Lange 1880, p. 171; 1887, p. 300; Gelert 1902, p. 126; Kruuse 1905, p. 202; Porsild 1910a, p. 242; 1912, p. 368; Hartz & Kruuse 1911, p. 410. *Puccinellia Vahliana:* Porsild 1920, p. 42; Ostenfeld 1925, p. 10; A. E. Porsild 1926, p. 171 (pro maj. parte); Seidenfaden 1931, p. 21; Vaage 1932, p. 71; Sørensen 1933, p. 156; Gelting 1934, p. 212; Seidenfaden & Sørensen 1937, p. 101. *Glyceria Kjellmani:* Nathorst 1884a, p. 43; Lange 1887, p. 299. *Gl. Kjellmani* var. *angustifolia:* Rosenvinge 1892, p. 732.

West Va.

Sarqaq Valley, 10.IX. 1947 K. Jakobsen 1000, 1001 (H); Pâtût, 9.VIII. 1929 A. E. Porsild (H); Atâ, 26,VII. 1913 M. P. Porsild (H, P); Alianaitsunguaq, 4.VIII. 1921 A. E. Porsild (H, P); Aussivik, 27.VII. 1913 M. P. Porsild (H, P); Quvnilik, 13. IX. 1947 H. Ødum 1085 (H); Marrak, 15.VII. 1902 M. P. Porsild (S), 18.VII. 1902 M. P. Porsild 204 (H, P), 215 (P); Marrait, 14., 17., and 18. IX. 1947 K. Jakobsen 1036, 1041, 1058, 1092 (H); Umanak, J. Vahl (H); Sarfarfik, 12. and 14.VII. 1947 Th. Sørensen (H); Ekorgfat [Ikorfat], 3.VIII. 1888 S. Hansen (H); Ikorfat, 17.VII. 1947 K. Jakobsen 338 (H); 28.VIII and 1. and 8. IX. 1947 Th. Sørensen (H); Kangilia, 25.VII. 1947 K. Jakobsen 473, 474 (H); Tunorssuaq, 29.VIII. 1947 K. Jakobsen 919 (H); Niakornak, VII. 1836 J. Vahl (Type) (H); Niaqornat, 1.VIII, 28.VIII. and 2. IX. 1947 K. Jakobsen 539, 908, 948a, 949 (H).

West Vb.

Nordfjord Kingua, 28.VII. 1913 Th. Porsild (H); Nordfjord, Storedal, 9.VIII. 1923 A. E. Porsild (S, P); Stordalen, mud volcano, 30.VII. 1948 A. Rosenkrantz (H); Assuk, 12.VII. 1871 Th. M. Fries (S); Kuganguak, 12.VII. 1902 M. P. Porsild 156 (H); 27.VII. 1913 M. P. Porsild (H); Ignaguak, 20.VII. 1902 M. P. Porsild (H); Mouth of Gieseckes Dal, 23.VII. 1902 M. P. Porsild (H); Harön, 11. and 12.VIII. 1883 A. G. Nathorst (S, H); Hare Ø, south side, 22.VII. 1909 M. P. Porsild (P); Hare Ø, Erkua, 23.VII. 1909 M. P. Porsild (S); Hare Ø, Umivik, 21.VII. 1921 A. E. Porsild (H, P).

West VI.

Ubekendte Ejland, Igdlorssuit, 21.VII. 1929 M. P. & R. T. Porsild (H, P); Upernavik Ø, 23.VII. 1921 A. E. Porsild (P); Svartenhuk, Kukdal, 8.VII. 1950 K. Jakobsen 4479 (H); Svartenhuk, Tartussak, 3.VIII. 1911 M. P. & R. T. Porsild (P); 20.VII. 1929 M. P. & R. T. Porsild (P); 22.VII. 1935 M. P. Porsild (H, P).

West VII.

Thule, Valley of the great land-glacier, 2.—3.VIII. 1950 K. Jakobsen 5303, 5592, 5602, 5608 (H); Murchison Land, Mac Cormick Bay, 7. IX. 1921 J. Noe Nygaard (H).

East V.

Jameson Land, 5.VIII. 1891 N. Hartz (H); Hurry Inlet, "Liverpool Kyst", 7.VIII. 1900 C. Kruuse (H); Hurry Inlet, Ryders Dal, 1900 N. Hartz (H).

East VI.

Cape Peterséns, 9.VIII. 1930 J. Vaage (O); Traill Ø, Maanedal, 23.VI. 1932 Th. Sørensen 3354, 3362 (H); 4.VII. 1932 Th. Sørensen 3353 (H); Ella Ø, Cape Elisabeth, 8.VIII. 1930 J. Vaage (O); Ella Ø, east side, 26.VII. 1932 Th. Sørensen 3355 (H); Geographical Society Isl., N. of Rudbecksfjellet, 19.VIII. 1930 J. Vaage (O); Ymer Ø, Carl Jacobsen Bugt, 31.VII. and 11.—12.VIII. 1932; Th. Sørensen 3360 (H, S) 3356, 3358 (H); Ymer Ø, Mountains W. of Carl Jacobsen Bugt, 11.—12.

VIII. 1932 Th. Sørensen 3357, 3359 (H); Ymer Ø, Cape Humboldt, 3.VIII. 1930 J Vaage (O); Strindberg Peninsula, Nordfjord, 12.VIII. 1931 Th. Sørensen 3361 (H); Hold with Hope, South Coast, (73°28′ N. lat.), 17.VIII. 1934 Th. Sørensen 5099 (H); (73°30′ N. lat.), 14.VIII. 1934 Th. Sørensen 5174 (H); Hold with Hope, Cape Broer Ruys, 11.VIII. 1934 Th. Sørensen 5453 (H); Hold with Hope, Knudshoved, 9.VIII. 1934 Th. Sørensen 5428 (H); Jacksonöya, 31.VII. 1929 J. Vaage (O); Hudson Land, Røjevand, 24.VII. 1933 Th. Sørensen 5428 (H); Home Foreland, Cape Stosch, 24.VII. 1930 J. Vaage (O); VIII. 1932 Th. Sørensen 4540 (H); Wordie Glacier, South coast, 30.VII. 1930 G. Seidenfaden 869 (H); Clavering Isl., Granatdal, 19.—20.VII. 1933 Th. Sørensen 4541, 4542, 4543 (H); Clavering Isl., Elvsborg pr. Cape Mary, 21.VII. 1929 G. Seidenfaden 3 (H); Wollaston Foreland, Cape Herschel, 30.VII. 1929 J. Vaage (O); Wollaston Foreland, Landingsdalen, 21.VII. 1930 J. Vaage (O); Sabine Ø, 1900 C. Kruuse (H); Hochstetter Foreland, Nanok, 8.VIII. 1933 Th. Sørensen 2622, 2623 (H).

East VII.

C. F. Mourier Fjord, north side, 15.VIII. 1933 Th. Sørensen 2624 (H); Head of V. Clausen Fjord, 14.VIII. 1933 Th. Sørensen 2625 (H); Klægbugt, north side, 13.VIII. 1933 Th. Sørensen 2626, 2627 (H); East of Cape Amelie, 12.VIII. 1933 Th. Sørensen 2628, 2629 (H).

North VIII.

Heilprin Land, Etukussuk Valley, 25.VII. 1949 K. Holmen (H); Peary Land, Brøndlund Fjord, 4.—5.VIII. 1949 K. Holmen (H); I. C. Christensen Land, E. of Neergaard River, 8. III. 1949 A. Sahlertz (H).

Puccinellia Andersonii SWALL.

Glyceria angustata: Porsild 1910a, p. 242 (pro parte). *Puccinellia angustata:* Vaage 1932, p. 71 (pro min. parte); Sørensen 1933, p. 155 (pro parte); Gelting 1934, p. 210 (pro parte); Seidenfaden & Sørensen 1937 (pro parte). *Glyceria distans:* Porsild 1910b, p. 262 (pro parte). *Puccinellia Vahliana:* A. E. Porsild 1926, p. 171 (pro min. parte).

West Va.

Kugssinerssuaq, 9.VII. 1932 J. Gröntved 124 (H); Atâ, 15.VII. 1932 J. Gröntved 122 (L); Atanikerdluk, 10.—11.VIII. 1921 A. E. Porsild (H); Marrak, 15.VII. 1902 M. P. Porsild 179, 180 (H); Marrait, 17. IX. 1947 K. Jakobsen 1035, 1036b (H); 14.VIII. 1948 K. Jakobsen 2446 (H); 9. IX. 1948 K. Jakobsen 2766, 2774 (H); 6. IX. 1951 A. Rosenkrantz 6152 (H); Niaqornarssuk pr. Marrait, 12. IX. 1948 K. Jakobsen 2874 (H); 3. IX. 1950 K. Jakobsen 6090, 6092, 6096, 6097, 6098, 6099, 6100a (H); Ikorfat, 14.—15.VII. 1947 K. Jakobsen 294, 324a (H); 22.VII. 1947 K. Jakobsen 424b (H); 26.VIII. 1947 Th. Sørensen (H); Delta of the Itivdleq River pr. Niaqornat, 1.VIII. 1947 K. Jakobsen 542, 543, 544b (H); Umanak, 23.VIII. 1934 J. Lagerkranz (S).

West Vb.

Head of Nordfjord, 3.VIII. 1902 M. P. Porsild 490 (H); Kuganguak, 27.VII. 1913 M. P. Porsild (P); Kuganguaq Valley, mud volcano, H. Ødum and A. Rosenkrantz 4.VIII. 1947 608 (H); Hare-Øen, Erkua, 23.VII. 1909 M. P. Porsild (P).

West VI.

Svartenhuk, Uvdlisaut, 30.VI. 1950 K. Jakobsen 4322a (H).

West VII.

Thule Station, 27.VII. 1940 G. Thorlaksson (P).

East VI.

Ymer Ø, Botanikerbugten (Carl Jacobsen Bugt), 31.VII. 1932 Th. Sørensen 3366 (H, S); 10.VIII. 1932 Th. Sørensen 3368 (H); 16.VIII. 1932 Th. Sørensen 3363 (H. S), 3370 (H); Myggbukta, 28.VIII. 1929 J. Vaage (O); Wollaston Foreland, Cape Borlasse Warren, 14.VIII. 1900 N. Hartz 310 (in part) (H); Clavering Ø, Dry River, 7.VII. 1932 P. Gelting (H).

East VII.

Germania Land, Stormkap, 11.VIII. 1933 Th. Sørensen 2610 (H); Skærfjord, Head of Klægbugt, 13.VIII. 1933 Th. Sørensen 2612 (H).

North VIII.

Brøndlund Fjord, 8.VIII. 1947 K. Holmen 677 (H).

Puccinellia angustata (R. Br.) Rand et Redf.

Glyceria angustata: Fl. dan. fasc. 51 (1883) tab. 3006, 1, 2; Berggren 1871, p. 867; Lange 1880, p. 171; 1887, p. 300; Berlin 1884, p. 78; Nathorst 1884a, p. 27, 43; 1884b, p. 88; Hartz 1895, p. 349; Gelert 1902, p. 128 (pro parte); Kruuse 1905, p. 202; Ostenfeld 1905, p. 68; Simmons 1909, p. 99; Ostenfeld & Lundager 1910, p. 14; Porsild 1910a, p. 242 (pro parte); 1910b, p. 262 (pro parte); 1912, p. 268; Hartz & Kruuse 1911, p. 410, 424. *Puccinellia angustata:* Porsild 1920, p. 44 (excl. var. *vaginata*); Ostenfeld 1923a, p. 197; 1923b, p. 232; 1925, p. 9; Seidenfaden 1931, p. 20 (pro parte); Vaage 1932, p. 71 (pro parte); Sørensen 1933, p. 155 (pro parte); Gelting 1934, p. 210 (pro parte); Seidenfaden & Sørensen 1937, p. 100 (pro parte), fig. 37, p. 103. *Glyceria distans:* Simmons 1909, p. 100. *Puccinellia retroflexa* ssp. *borealis:* Sørensen 1943, p. 50 (pro parte). ? *Poa annua:* Buchenau & Focke 1874, p. 56.

West IV.

Kisengiartak, 8.VIII. 1883 A. Berlin (S); Sarpiursak, 26.VIII. 1870 S. Berggren (L, U).

West Va.

Atanikerdluk, 24.VII. 1913 M. P. Porsild (H); Igpiarsuk, 19.VII. 1902 M. P. Porsild 258 (H, P); Ata, 11.VII. 1923 El. Ekman (S); 15.VIII. 1932 J. Gröntved 121 (H); 125 (S); Aufarssuaq, Qapiortoq kitdleq, 18.VIII. 1948 K. Jakobsen 2476 (H); Angmartusut, Qaersut-Jæger-Dalen, 22.—25.VIII. 1951 A. Rosenkrantz 6155, 6156 6160 (H); Angmartusut, Agatkløften, 8.VIII. 1951 A. Rosenkrantz 6162a (H); 15.VIII. 1951 A. Rosenkrantz 6153a (H); Kutsiaq, 2.VIII. 1948 (alt. 12—1400 m) K. Jakobsen 2414 (H); Sarfarfik, 19.VIII. 1947 Th. Sørensen 445, 447 (H); Patorfik, 27.VII. 1921 M. P. Porsild (H, P); Ujaragtorsuak, 31.VII. 1921 M. P. & A. E. Porsild (H, P); Ikorfat, 14. and 17.VII. 1947 K. Jakobsen 294 and 356 (H); 26.VIII. 1947 Th. Sørensen 501 (H); Kuk angnertunek 1.VIII. 1921 M. P. Porsild (H, P); Inter Kangilia and Serfat, 22.VII. 1947 K. Jakobsen 421a (H); Kangilia, 25.VII. 1947 K. Jakobsen 491 (H); Angnertuneq, 27.VII. 1947 K. Jakobsen 478, 479 (H); Niaqorssuaq, 27.VII. 1947 K. Jakobsen 481 (H); Delta of the Itivdleq River pr. Niaqornat, 1.VIII. 1947 K. Jakobsen 544c (H); Itivdleq Valley, 3.VIII. 1947 K. Jakobsen 553 (H); Niaqornat, 2. IX. 1947 K. Jakobsen 938, 945, 946, (H); 5. IX. 1947 K. Jakobsen 960, 962 (H); Pujortoq pr. Niaqornat, 14.VII. 1951 A. Rosenkrantz 6144, 6145 (H); Umanak, 25.VII. 1921 A. E. Porsild (P).

West Vb.

Kuganguaq, 4.VIII. 1947 A. Rosenkrantz 609 (H); Kuganguaq Valley, 27.—29.VII. 1898 M. P. Porsild 497 (H, P); Asuk, 21.VII. 1934 J. Lagerkranz (S);

31.VII. 1934 M. P. Porsild (H, O); Igdlutjait, 10.VII. 1871 Th. M. Fries (U); Harön, 11.VIII. 1883 A. G. Nathorst (S).

West VI.

Svartenhuk, Tartusak, 3.VIII. 1911 M. Porsild (H); Svartenhuk, Savit, 25.VI. 1950 K. Jakobsen 4180 (H).

West VII.

Cape York, Ivssugigsok, 27.VII. 1883 A.G.Nathorst (S); 29.VII. 1950 C. Skou & A. Rosenkrantz 5288 (H); Cape York, Thule, 31.VII. 1914 P. Freuchen; Thule, 14.VIII. 1936 F. Salomonsen (H); 3.VIII. 1950 A. Rosenkrantz 5583 (H); Wolstenholme Sound, Thule, 26.VII. 1916 L. Koch (H); Wolstenholme Sound, Agpat and Umanak, 5.—8.VIII. 1905 K. Balle (H); Olriks Fjord "Steenstrups Havn" 31.VII—1.VIII. 1950 K. Jakobsen 5181, 5191; Foulke Fjord, near Etah, 16.VIII. 1898 H. G. Simmons 236 (O, L); Etah, 8.VIII. 1923 J. Dewey Soper 111348 (L, P); Foulke Fjord, Reindeer Point, 11.—12.VIII. 1899 H. G. Simmons 1527 (O); Inglefield Land, VII. 1924 R.A. Robinson (P).

East V.

Jameson Land, 3. and 5.VIII. 1891 N. Hartz (H, P); Jameson Land, Cape Hooker, 28.VI. 1933 Th. Sørensen 570, 571 (H); Jameson Land, Cape Stewart, 7.VII. 1933 Th. Sørensen 577 (H); Liverpool Land, Cape Hope, 25.VII. 1933 Th. Sørensen 574 (H); Liverpool Land, East side of Hurry Inlet, "Kalkdal" 7.—10.VII. 1933 Th. Sørensen 573, 575, 576, 578 (H); Scoresbysund, Fame-Øerne, 11.VIII. 1924 O. Hagerup (H); Hurry Inlet, Ryders Dal, 1900 N. Hartz (S).

East VI.

Vega Sound, 18.VIII. 1899 A. G. Nathorst (S); Ella Ø, Cape Elisabeth, 8.VIII. 1930 J. Vaage (O); Geographical Society Isl., Sanddalen, 18.VIII. 1930 J. Vaage (O); Hold with Hope, South Coast, 14.—17.VIII. 1934 Th. Sørensen; 5100, 5109, 5175 (H); Moskusokse Fjord, Vassdalen, 19.VIII. 1929 J. Vaage (O); 6.VIII. 1930 J. Vaage (O); Moskusokse Fjord, Mt. Ramsay, 14.VIII. 1930 G. Seidenfaden 1022 (H); Moskusokse Fjord, Ankerplassen, 18.VIII. 1929 J. Vaage (O); Strindberg Peninsula, Nordfjord, 11.VIII. 1931 Th. Sørensen 3392 (H); Loch Fyne, Røyevatnet, J.Vaage 25.VII. 1930 (O); Hudson Land, W. side of Loch Fyne, 24.VII. 1933 Th. Sørensen 4537 (H); Clavering Fjord, Cape Stosch, 24.VII. 1930 J. Vaage (O); Home Foreland, Cape Stosch, 24.VII. 1933 Th. Sørensen 5436 (H); Clavering Isl., Eskimonæs, 17.VII. 1933 Th. Sørensen 4538 (H); Clavering Isl., Granatelv, 18.—19.VII. 1933 Th. Sørensen 4533, 4534, 4535 (H); Clavering Isl., Revet, 22.VII. 1930 J. Vaage (O); Zackenberg, 16.VIII. 1949 M. Westergaard 63 (H); Cape Borlasse Warren, 14.VII. 1900 N. Hartz 310 (in part) (H); Cape Wynn, 20.VII. 1930 J. Vaage (O); Kuhn Isl., Cape Maurer 7.VIII. 1933 Th. Sørensen 2595, 2596, 2597, 2616 (H); Hochstetter Foreland, Nanok, 8.VIII. 1933 Th. Sørensen 2598, 2599 (H).

East VII.

Koldewey Isl. N. of Trækpas, 10.VIII. 1933 Th. Sørensen 2600, 2601, 2602, 2603, 2604, 2606 (H); Danmarkshavn, 15.VII. 1905 A. Lundager 1174 (H); 9.VIII. 1907 A. Lundager 370 (H); 10.VIII. 1907 A. Lundager 363 (H); 20.VII. 1908 A. Lundager 1282, 1283 (H); Germania Land, Stormkap, 11.VIII. 1933 Th. Sørensen 2607, 2608, 2609 (H); Germania Land, Lille Snenæs, 12. and 15.VII. 1908 A. Lundager 1852 (H, O), 1976 (H); Kulhøj Nunatak, 10.V. 1908 P. Freuchen 2001 (H); Ymer Nunatak, 24.V. 1908 P. Freuchen (H); Head of Klægbugt, 13.VIII. 1933 Th. Sørensen 2611 (H); East of Cape Amelie, 12.VIII. 1933 Th. Sørensen 2613 (H), 2614 (H, S), 2615, 2882 (H).

var. *decumbens:* Maroussia, 21.VII. 1908 A. Lundager 1372 (H); Danmarkshavn, 10.VIII. 1907 A. Lundager 267 (H).

North VIII.

Washington Land, Putlersuak, 13.VIII. 1921 L. Koch (H); Dragon Point, 19.VIII. 1917 Th. Wulff (H); Gunnar Anderson Valley, 6.VII. 1917 Th. Wulff (H); John Murray Island, 3.VII. 1917 Th. Wulff (H); Hyde Fjord, 18.V. 1907 I. P. Koch 290 (H); Börglum River c. 17 km N. of Brøndlunds Fjord, 5.VIII. 1949 K. Holmen (H); East End of Midsommersø, 23. II. 1949 P. Jonsen (H); Bröndlunds Fjord, 24.VII. 1949 K. Holmen (H); 2.VIII. 1947 K. Holmen 657b (H); 31.VIII. 1947 K. Holmen 633 (H); Cove N. of Cape Harald Moltke, 20. X. 1948 K. Holmen (H); 82°10′ N. lat. [Cape Peter Henrik W. of Hagen Fjord] 11.VII. 1907 I. P. Koch 284 (H).

Puccinellia coarctata Fern. et Weath.

Glyceria maritima: Berlin 1884, p. 78; Eberlin 1887, p. 331; Holm 1887, p. 291; Rosenvinge 1892, p. 732 (exl. var.). *Gl. maritima* f. *minus:* Lange 1887, p. 299. *Gl. maritima β virescens:* Lange 1880, p. 168; Berlin 1884, p. 78. *Gl. maritima* var. *arenaria:* Berlin 1884, p. 78; Lange 1887, p. 299 (pro parte); Abromeit 1899, p. 101. *Gl. Borreri* var. *islandica:* Lange 1887, p. 298; Rosenvinge 1892, p. 731. *Gl. arctica:* Holm 1887, p. 291 (pro parte). *Puccinellia* (?) *arctica:* Polunin 1943, p. 364. *Glyceria distans:* Gelert 1902, p. 127 (pro parte); Kruuse 1906, p. 278; Porsild 1910a, p. 242 (pro min. parte). *Gl. angustata:* Gelert 1902, p. 128 (East Greenland plants); Kruuse 1906, p. 279; Porsild 1910b, p. 262 (pro parte). *Puccinellia angustata:* Björlykke 1932, p. 7; Böcher 1933, p. 10 (plants from Angmagssalik Distr.); Seidenfaden 1933, p. 93; Sørensen 1933, p. 155 (pro min. parte); Lagerkranz 1950, p. 66. *Pucc. retroflexa:* Porsild 1920, p. 43; Björlykke 1932, p. 8; Böcher 1933, p. 10; Seidenfaden 1933, p. 94. *Pucc. retroflexa* ssp. *borealis:* Porsild 1930, p. 12; Devold & Scholander 1933, p. 149. *Pucc. retroflexa* var. *borealis:* Lagerkranz 1950, p. 67. *Pucc. paupercula:* Polunin 1943, p. 364.

var. *pseudofasciculata* Th. S.

Glyceria conferta: Fl. dan. fasc. 49 (1877) tab. 2882. *Glyceria Borreri:* Lange 1880, p. 167; Rosenvinge 1892, p. 731 (excl. var.); 1896b, p. 235.

West I.

Umanarsuak (Cape Farvel), 9.VIII. 1881 Sylow (H, U); Nunarsuak, V.—VI. 1890 E. Lundholm (H); Frederiksdal, 1.VIII. 1889 E. Lundholm (H, S); Friedrichsthal, 28.VIII. 1883 A. Berlin (S, U); Sinus Amitsok, 27.VIII. 1883 A. Berlin (S, H); Ujarssurssuit, Prins Christian Sund, VII. 1829 J. Vahl (H); Igdlorssuit, Prins Christians Sund, 21.VII. 1925 A. E. & M. P. Porsild (H, P); Cape Egede (Kangek), S. side of Sermesok, 18. IX. 1876 A. Kornerup (H); Sinus Tasermiut, VIII. 1829 J. Vahl (H, U); Uiluvit, Tasermiut Fjord, 28.VII. 1925 A. E. & M. P. Porsild (H, P); Sermilik, 29.VII. 1937 J. Gröntved 886 (H); Tasermiutsiaq, Tasermiut Fjord, 28. VII. 1925 A. E. & M. P. Porsild (P); Sydprøven, 12.—14.VII. 1937 N. Polunin 10293 (Brit. Mus.); Tiningnertok, Tasermiut IX. 1889 N. Hartz (H); Julianehaab, IX. 1827 J. Vahl (H); IX. 1837 C. Holbøll (H); 7.—8.VII. 1937 N. Polunin 10107 (Brit. Mus.); Eqaluit, Igaliko Fjord, 9.VIII. 1937 J. Gröntved 1888 (H); Tunugdliarfik, Narssaq, 10.—13.VII. 1937 E. Dahl (O); Igaliko, VIII. 1828 J. Vahl (H); 24. VIII. 1883 A. Berlin (S, U); 4.VIII. 1937 J. Gröntved 1885 (H); Between Igaliko and Julianehaab, 26.—27.VIII. 1937 N. Polunin 11361 (Brit. Mus.); Gl. Qagssiarssuk,

Igaliko Fjord, 4.—8.VIII. 1937 N. Polunin 10821 (Brit. Mus.); Tunnuarmiut, Tunugdliarfik Fjord, 16.VII. 1937 E. Dahl (O); 17.VII. 1937 J. Gröntved 1890 (H); 15.VIII. 1888 L. K. Rosenvinge (H); Kordlortoq, Tunugdliarfik Fjord, 21.VII. 1937 J. Gröntved 1887 (H); Qagsiarssuk, 27.VII. 1937 J. Gröntved 1889 (H); Kiagtut, Tunugdliarfik Fjord, 10.VIII. 1925 A. E. & M. P. Porsild (H); 22.VII. 1947 Th. Sørensen 249 (H).

var. *pseudofasciculata:* Ilua, 1889 E. Lundholm (H); Itivdliatsiak, 11.VIII. 1888 L. K. Rosenvinge (H).

West II.

Ivigtut, 15.VIII. 1918 E. Lindhard (H); Groenedal pr. Ivigtut, 20.VIII. 1883 A. Berlin (S); Ivigtut Isblink, 5.VIII. 1938 J. Lagerkranz (S).

var. *pseudofasciculata:* Fiskernæsset, IX. 1837 C. Holbøll (Type) (H, U).

West III.

Sinus Ameralik, VIII. 1830 J. Vahl (H); Colonie minor Narsak, 28.VIII. 1936 J. Lagerkranz (S); Colonie Godthaab, 19., 22., and 26.VIII. 1936 J. Lagerkranz (S); Kapisilik, 2.VIII. 1932 J. Iversen (H); Kangersunek below Igdlorssuit, 20.VIII. 1932 J. Iversen (H); Kuksuk sinus, Baals Revier, VII. 1830 J. Vahl (H); Sukkertoppen, 16.VIII. 1884 Warming & Holm (H, S, U); Sukkertoppen, Skibsvarden SW, 25.VII. 1941 Else Petersen (P).

West IV.

Holsteinborg, Holbøll (U); S. of Sarfarssuak, Nordre Strømfjord, 5.VIII. 1918 A. E. & M. P. Porsild (P); Egedesminde, 2.VIII. 1947 Th. Sørensen 289 (H); Head of Sydostbugten, VII. 1890 N. Hartz (H).

West Va.

Claushavn, 1.VIII. 1892 P. H. Sørensen (H); Pâtût, 25.VII. 1913 M. P. Porsild (P); Atâ, 25.VII. 1913 M. P. Porsild (H); Ivilik, 15.VII. 1902 M. P. Porsild 169 (H, S, P); Umanaitsiak, 13.VIII. 1893 E. Vanhöffen 133 (H).

West Vb.

Godhavn, VIII. 1923 El. Ekman (S); Godhavn, near Arktisk Station, 29.VIII. 1927 M. P. Porsild (H, S); Godhavn, Sorte Sand, 17.VIII. 1934 J. Lagerkranz (S); Kuganguak, 27.VII. 1913 M. P. Porsild (in part) (H); Hare Ø, Fugleholm at Niakua, VII. 1909 M. P. Porsild (P).

East II.[1]

Cape Tordenskjold, Sydhavn, 21.VIII. 1932 R. Bøgvad 629 (H); Tingmiarmiut: Brattneset, 8.VIII. 1932 Devold & Scholander (O); Akorniarmiut: Finnabu, 10. VIII. 1931 B. Björlykke (O); Umivik, Eskimo site 20.VIII. 1931 B. Björlykke (O).

East III.

Kung Oskars hamn, 5. IX. 1883 A. Berlin (S, H, U); Tasiusak, Huspynt, 26.VIII. 1902 C. Kruuse (H, S); Regio Angmagssalik, 1.VIII. 1946 J. Lagerkranz (S); Colonie minor Ingmikartok, 2.VIII. 1946 J. Lagerkranz (S); Ingmikertak, 7.VIII. 1902 C. Kruuse (H); Tunak, 6.VIII. 1902 C. Kruuse (H); Kingak, 4.VIII. 1902 C. Kruuse (H); Kingorsuak, 23.VII. 1902 C. Kruuse (H).

East V.

Scoresbysund, 19.VIII. 1946 J. Lagerkranz (S).

East VI.

Ymer Ø, Botanikerbugten, 6 km inland 6.VIII. 1932 Th. Sørensen 3364 (H).

Puccinellia deschampsioides Th. S.

Glyceria vaginata: Berlin 1884, p. 78 (pro parte); Lange 1887, p. 298 (pro parte); Rosenvinge 1892, p. 731 (pro parte); Hartz 1894, p. 43 (pro parte). *Glyceria arctica:* Rosenvinge 1892, p. 732 (pro parte); Hartz 1894, p. 40, 43; Kruuse 1898, p. 396 (pro parte). *Puccinellia arctica:* Porsild 1920, p. 44 (pro parte). *Glyceria angustata:* Gelert 1902, p. 128 (pro parte). *Puccinellia deschampsioides:* Böcher 1949, p. 33; 1952, p. 49; Böcher & Larsen 1950, p. 9.

West IV.

Søndre Strømfjord, N. side, Itivdlinguak, 13.VIII. 1941 M. P. Porsild (P); 24.VII. 1946 T. Böcher (H); Søndre Strømfjord, Store Saltsø, 8.VIII. 1946 T. Böcher (H); Head of Søndre Strømfjord, 1.VIII. 1927 C. O. Erlanson 2561 (S); 27.VII. 1946 T. Böcher (H); Søndre Strømfjord, Lille Saltsø, 20.VIII. 1946 T. Böcher (H); Søndre Strømfjord, Bredesand, Ørkendalen, 14.VIII. 1946 T. Böcher (H); Søndre Strømfjord, margin of inland ice, 26.VIII. 1946 T. Böcher (H); Mt. Keglen, 19.VIII. 1946 T. Böcher (H); Mt. Hassel, 22.—24.VIII. 1946 T. Böcher (H); Søndre Strømfjord, Aerodromen 28.VIII. 1946 T. Böcher (H); At Fjeldet Pingo, 1.VII. 1884 J. A. D. Jensen (H); Arfersiorfik Fjord, Qingua 19.VII. 1924 M. P. Porsild (H, S, P); Auleitsivik Fjord, 17.VII. 1870 S. Berggren (S); Arfersiorfik Fjord, "Sofia" Havn, at the border of the inland ice, 20.VII. 1924 M. P. Porsild (Type) (H. S. P); Disko Bay, country within the isle Qeqertarsugssuk, 15.VIII. 1932 J. Gröntved 131 (H); Kisengiartak, 8.VIII. 1883 A. Berlin (H, L); Kingua Orpiksuit, VII. 1890 N. Hartz (H); Grønne Ejlande, 31.VII. 1949 P. Gelting (H); Orpigsok Fjord, N. side, 30.VII. 1949 P. Gelting (H); Disko Bay, Seqineqarajugtoq, 11.VIII. 1932 J. Gröntved 133 (H); Kangersuneq, head of fjord, 29.VII. 1949 P. Gelting (H).

West Va.

Jakobshavn Distr. Tasiusak, 1902 M. C. Engell (H); Claushavn, Lerbugten, VII. 1890 N. Hartz (H); Jakobshavn, 4.VIII. 1892 P. H. Sørensen (H); Naujat, 12. VII. 1948 K. Jakobsen 2171 (H); Sarqaq Valley, 7.—13. IX. 1947 K. Jakobsen 964a, 964b, 970, 971, 978a, 1019, 1023, 1025f (H); 29.VI.—4.VII. 1948 K. Jakobsen 2051, 2056, 2057, 2058, 2088, 2089, 2090 (H); Kardlunguak, 31.VII. 1890 N. Hartz (H); Kingigtok, VIII. 1890 N. Hartz (H); Kugssinerssuaq, 9.VII. 1932 J. Gröntved (H); Marrait, 13. IX. 1948 K. Jakobsen 2873 (H); 4. IX. 1951 A. Rosenkrantz 6161 (H); Niaqornarssuk pr. Marrait, 3. IX. 1950 K. Jakobsen 6087, 6088, 6089, 6091, 6094 (H); Aufarssuaq, Qapiortoq kitdleq, 17.VIII.—2. IX. 1948 K. Jakobsen 2456, 2485, 2486, 2487, 2492a, 2496, 2733, 2733a, 2733b (H); Angmartusut, Agatkløften, 8.—30.VIII. 1951 A. Rosenkrantz 6153, 6157, 6158, 6162 (H); Sarfarfik, 13.VIII. 1947 Th. Sørensen 364 (H); Tunorssuaq Valley, 29.—31.VIII. 1947 K. Jakobsen 925, 936a, 936b (H); Itivdleq pr. Niaqornat, 1.VIII. 1947 K. Jakobsen 544a (H); Itivdleq Valley, 3.VIII. 1947 K. Jakobsen 551, 552, 565 (H).

Puccinellia groenlandica Th. S.

Glyceria (*maritima* var.) *palustris:* Fl. dan. fasc. 44 (1858) tab. 2582. *Glyceria arctica:* Lange 1880, p. 169 (incl. var.); 1887, p. 299 (incl. var.); Berlin 1884, p. 78; Holm 1887, p. 291 (pro parte); Rosenvinge 1892, p. 732 (incl. var.) (pro parte); 1896a, p. 71; Kruuse 1898, p. 396 (pro parte). *Puccinellia arctica:* Porsild 1920, p. 44 (pro parte); A. E. Porsild 1926, p. 171 (?). *Glyceria conferta:* Abromeit 1899, p. 100. *Glyceria distans:* Gelert 1902, p. 127 (pro parte). *Puccinellia groenlandica:* Böcher 1949, p. 33; 1952, p. 49.

West III.

Ameralik Fjord, Kilaersarfik in Ameragdla, 17.VIII. 1931 M. P. Porsild (H, P); Ameralik Fjord, Itivdlek, Qingua, 17.VIII. 1931 M. P. Porsild (H, P); Kuksuk, Baals Revier, VII. 1830 J. Vahl (H, U).

West IV.

Søndre Strømfjord, Itivdlinguak, 24.VII. 1946 T. Böcher (H); Asivigsuak, S. branch of Sønder Strømfjord, 10.VIII. 1884 J. A. D. Jensen (H); Head of N. branch of Søndre Strømfjord, 27.VII. 1946 T. Böcher (H); Head of Søndre Strømfjord, 27.VII. 1946 T. Böcher (H); Søndre Strømfjord, Mt. Hassel, 27.VII. 1946 T. Böcher (H); Itivdleq Fjord, Qingua, 5.VIII. 1926 M. P. Porsild (S, P); Itivnek, sinus Ikkatok [Ikertôq], VIII. 1832 J. Vahl (Type) (H, U); Iqertoq Fjord, Maligiaq, 31.VII. 1914 M. P. & A. E. Porsild (H, P); Holsteinborg, 1.VIII. 1871 Th. M. Fries (U, O, H); 1.VIII. 1884 Warming & Holm (H); 1.VIII. 1947 Th. Sørensen (H); Sofiehamn, 6.VIII. 1883 A. Berlin (S, H); Akugdlek, VII. 1890 N. Hartz (H); Kisengiartak, 8.VIII. 1883 A. Berlin (S, U); Egedesminde, 2.VIII. 1947 Th. Sørensen (H); Christianshaab, 28.VII. 1870 S. Berggren (S); 26.VII. 1884 Warming & Holm (H, S, U); VII. 1890 N. Hartz (H); 24.VII. 1924 M. P. Porsild (H, S, U, P); 25. IX. 1948 K. Jakobsen 2868b (H).

West Va.

Tasiusak, Jakobshavn Distr., 1902 M. C. Engell (H); Jakobshavn, 4.VIII. 1892 P. H. Sørensen (H); Sarqaq, 13. IX. 1947 K. Jakobsen 1034a, 1034b (H); Kardlunguak, 31.VII. 1890 N. Hartz (H); Pâtût, 8.VIII. 1921 A. E. Porsild (H); Insula Umanatsiak, VII. 1834 J. Vahl (H); Umanak, 27.VI. 1892 E. Vanhöffen (H); 8.VII. 1921 S. J. Enander (S); Kutsiaq, 13.VIII. 1947 Th. Sørensen (H); Kaersuarssuk, 29.VII. 1921 A. E. Porsild (P); Delta of Itivdleq River pr. Niaqornat 1.VIII. 1947 K. Jakobsen 546 (H).

West Vb.

Godhavn, near Arktisk Station, 19. IX. 1947 Th. Sørensen (H).

West VI.

Svartenhuk, Savit, 25.VI. 1950 K. Jakobsen 4155 (H).

Puccinellia Langeana (BERL.) TH. S. ssp. *typica* TH. S.

Glyceria Langeana: Berlin 1884, p. 79; Lange 1887, p. 299; Rosenvinge 1892, p. 732 (incl. varr.); 1896, a p. 71; Kruuse 1898, p .395. *Glyceria tenella:* Gelert 1902, p. 129. *Puccinellia tenella:* Porsild 1920, p. 45; A. E. Porsild 1926, p. 171 (?); Lagerkranz 1950, p. 67. *Glyceria vilfoidea:* Berlin 1884, p. 80 (pro parte). *Glyceria angustata:* Porsild 1910b, p. 262 (pro parte).

West III.

S. Isortok, south side, below Nukagpiaq, 4.VIII. 1941 M. P. Porsild (P); Sukkertoppen, sea-shore, 15.VII. 1895 C. Ostenfeld Hansen (H, P).

West IV.

Kangaitsiak, 30.VI. 1883 A. Berlin (Type) (S, U); Qeqertarssuatsiaq, South Coast, 13.VIII. 1918 M. P. & A. E. Porsild (S, P); Agpiletok, 22.VII. 1897 C. Kruuse (H, P); Egedesminde, Kullen, 25.VIII. 1897 C. Kruuse (H); Ikamiut, 9.VIII. 1883 A. Berlin (S, L); Isle in Sydostbugten, VII. 1890 N. Hartz (H); Christianshaab, Laksebugt, South Coast, 23.VII. 1949 P. Gelting (H); Lerbugten S. of Claushavn, 27.VII. 1949 P. Gelting (H).

West Vb.

Godhavn, Udkiggen, 22.VII. 1909 M. P. Porsild (S); 22.VII. 1909 J. Noe Nygaard 4127 (H, P); Godhavn, 3. IX. 1917 A. E. Porsild (H, S); 3.VIII. 1923 El. Ekman (S); Godhavn, Sorte Sand near Arktisk Station, 11.VIII. 1913 Th. Porsild (H, P); 29.VIII. 1927 M. P. Porsild (P); 1929, R. T. Porsild (H, P); 17.VII. and 5.VIII. 1934 J. Lagerkranz (S) (O, S); 27.VII. 1936 Å. Jensen (H, P); 27. and 28.VII. 1937 A. E. Porsild (S, P); 16.VII. 1938 M. P. Porsild (P); 17.VII. 1946 P. Gelting (H); 18. IX. 1947 Th. Sørensen (H); Kuanit, E. of Røde Elv, 28.VIII. 1932 J. Gröntved 134 (in part) (H); Hare Ø, Umivik, VII. 1909 M. P. Porsild (H, P); Hare Ø, Erkua, 23.VII. 1909 M. P. Porsild (H, P).

Puccinellia laurentiana Fern. & Weath.

West III.

Ameralik Fjord, Eqaluit, 26.VIII. 1936 J. Lagerkranz (S).

Puccinellia maritima (Huds.) Parl.

Glyceria maritima: Lange 1880, p. 169 (excl. varr.); Gelert 1902, p. 126 (pro parte). *Gl. maritima* var. *arenaria:* Rosenvinge 1892, p. 732 (pro parte); 1896b, p. 239. *Puccinellia maritima:* Polunin 1943, p. 365.

West I.

Sinus Tassermiut, VIII. 1829 J. Vahl (H); Tasermiutsiak in Tasermiut, 5. IX. 1889 N. Hartz (H); Sermilik Fjord, 29.VII. 1937 J. Gröntved 1877 (H); Singitok, W. side of "Julianehaab Land", 5. IX. 1901 G. Meldorf (H); Strandingsfjorden, 11. IX. 1948 C. A. Jørgensen (H); Itivdliatsiak, 11.VIII. 1888 L. K. Rosenvinge (H).

West II.

Arsuk Fjord, Eqaluit, 11. IX. 1937 E. Dahl (O); Narssalik, 12. IX. 1927 J. Eugenius (H).

Puccinellia phryganodes (Trin.) Scribn. et Merr.

Glyceria vilfoidea: Fl. dan. fasc. 49 (1877) tab. 2883; Berggren 1871, p. 864, 872; Lange 1880, p. 170; 1887, p. 300; Berlin 1884, p. 78 (pro parte); Nathorst 1884a, p. 27, 41, 43; 1884b, p. 88; Eberlin 1887, p. 331; Holm 1887, p. 291; Rosenvinge 1892, p. 732; 1896a, p. 101; Hartz 1894, p. 40, 46; 1895, p. 349; Abromeit 1899, p. 101; Dusén 1901, p. 60; Porsild 1902, p. 194, 223; 1912, p. 368; Hartz & Kruuse 1911, p. 342, 360. *Atropis vilfoidea:* Rowlee & Wiegand 1897, p. 422. *Glyceria maritima:* Kruuse 1898, p. 394; Gelert 1902, p. 126 (pro parte). *Gl. maritima* var. *vilfoidea:* Kruuse 1906, p. 279; Hartz & Kruuse 1911, p. 410, 424. *Gl. maritima* f. *vilfoidea:* Kruuse 1905, p. 201. *Gl. maritima* var. *arenaria:* Lange 1880, p. 168; 1887, p. 299 (pro parte); Berlin 1884, p. 78 (pro parte); Rosenvinge 1892, p. 732 (pro parte). *Gl. maritima* var. *reptans:* Simmons 1909, p. 100; Porsild 1910a, p. 242; 1910b, p. 262. *Gl. maritima* f. *reptans:* Ostenfeld & Lundager 1910, p. 14. (p. p.). *Gl. tenella:* Porsild 1912, p. 368. *Puccinellia phryganodes:* Porsild 1920, p. 43; 1930, p. 12; Ostenfeld 1923a, p. 197; 1923b, p. 232; 1925, p. 9; A. E. Porsild 1926, p. 171; Seidenfaden 1930, p. 18; 1931, p. 20 (p. p.); 1933, p. 94; Björlykke 1932, p. 7; Lid 1932, p. 12; Vaage 1932, p. 71; Böcher 1933, p. 10; 1938 table 6; 1952, p. 49; Devold & Scholander 1933, p. 148; Sørensen 1933, p. 156; 1943, p. 50; Gelting 1934, p. 211; Seidenfaden & Sørensen 1937, p. 101; Polunin 1943, p. 365; Lagerkranz 1950, p. 67.

West I.

Sinus Amitsok, 27.VIII. 1883 A. Berlin (S); Prins Christians Sund, Igdlorssuit, 21.VII. 1925 A. E. & M. P. Porsild (H, S, P); Kangigdlek Kingua in sinus Ilua, 25.VIII. 1881 Sylow (H, O, U); Ilua, 1889 E. Lundholm (H); Sinus Tassermiut, VIII. 1829 J. Vahl (H); Unartok, 31.VIII. 1948 C. A. Jørgensen (H); Skerry at Upernivik Ø, near Sardloq Ø, 7.VIII. 1937 J. Gröntved 1880 (H); Ekaluit, Igaliko Fjord, 9.VIII. 1937 J. Gröntved 1878, 1882 (H); Narssaq, Tunugdliarfik Fjord, 11.VII. 1937 J. Gröntved 1881 (H); Tassiussaq, Sermilik Fjord, 29.VII. 1937 J. Gröntved 1879 (H).

West II.

Bjørnedal, Arsuk Fjord, 13.VII. 1925 A. E. & M. P. Porsild (H, P).

West III.

Ekaluit in Ameragdla, Ameralik, 22.VII. 1895 C. Ostenfeld Hansen (O); Colonie Godthaab, 22.VIII. 1936 J. Lagerkranz (S); Godthaab, 29.VII. 1947 C. A Jørgensen & Th. Sørensen (H).

West IV.

Søndre Strømfjord, Itivdlinguaq, 24.VII. 1946 T. Böcher (H); Søndre Strømfjord, Nakajanga, 21.VII. 1946 T. Böcher (H); Umanarsuk Øen, pr. Holsteinborg, 2.VIII. 1886 Th. Holm (H); At the foot of Præstefjæld, Holsteinborg, 4.VIII. 1886 L. K. Rosenvinge (H); Itivnek, Ikertok Fjord, 13.VIII. 1884 Warming & Holm (H); Auleitsivik-Fjorden, 17.VII. 1870 S. Berggren (S); Itiflak, 7.VIII. 1883 A. Berlin (S); Isle in Sydostbugten, VII. 1890 N. Hartz (H); Kingua Orpiksuit, VII. 1890 (H); Egedesminde, 30.V. 1948 K. Jakobsen 2884 (H); Egedesminde, Spækholmen, 28.VII. 1884 Warming & Holm (H); Christianshaab, 26.VII. 1884 Warming & Holm (H); Diskobugt, Grønne Ejlande, 22.VII. 1949 P. Gelting (H).

West Va.

Akatout (Rodebay, Jakobshavn), 1867 R. Brown, Whympers Exp. (H); Rodebay, 18.VI. 1892 P. H. Sørensen (H); Eke, 20.VII. 1913 Th. Porsild (P); Kekertarsunguit Ilua, Jakobshavn Distr., 1902 M. P. Porsild (H); Sarqaq, 13. IX. 1947 K. Jakobsen 1025f (H); 30.VI. and 11.VII. 1948 K. Jakobsen 2061 and 2164a (H); Atanikerdluk, 16.VII. 1871 Th. M. Fries (S, U, O, H); 29.VII. 1934 M. P. Porsild; Kugssinerssuak, 25.VII. 1927 M. P. Porsild (S, U, P); 30.VII. 1934 J. Lagerkranz (S); Ata, 17.VII. 1932 J. Gröntved 126 (H); Marrak, 15.VII. 1902 M. P. Porsild (H, S); (Col. minor) Nugssuaq, 26.VIII. 1947 A. Rosenkrantz 904, 905, 906 (H); Eqaluit, 14.VIII. 1947 K. Jakobsen 806, 829 (H); Umiartorfik, 18.VIII. 1947 K. Jakobsen 864 (H); Ikerasak, 5.VII. 1892 E. Vanhöffen 135 (H); Kuk (Kome), 26.VII. 1921 A. E. Porsild (P); 23.VIII. 1947 Th. Sørensen (H); Patorfik, 27.VII. 1921 A. E. Porsild (H, P); Ikorfat, 20.VII. 1947 K. Jakobsen 392 (H); 31.VIII. 1947 Th. Sørensen (H); Inter Kangilia et Serfat, 22.VII. 1947 K. Jakobsen 421b (H).

West Vb.

Godhavn, 4.VII. 1870 S. Berggren (S); 31.VII. 1891 J. A. Björling (S); 4.VII. 1909 J. Noe Nygaard (P); 2. IX. 1919 M. P. Porsild (S); 3. IX. 1919 A. E. Porsild (H); 13. IX. 1932 J. Gröntved 130 (H); Godhavn, Sorte Sand, 11.VIII. 1913 Th. Porsild (P); 17.VII. and 5.VIII. 1934 J. Lagerkranz (S); Ungorsivikbugten, 14. IX. 1898 M. P. Porsild (H); Saitok-Skæret off Diskofjord, 24.VIII. 1902 M. P. Porsild 912 (H); Head of Nordfjord, 3.VIII. 1902 M. P. Porsild (H); Unatoarsuk, 14.VIII. 1883 A. G. Nathorst (S); Harön, 11.VIII. 1883 A. G. Nathorst (S); Hare Ø, Fugleholmen at Niakua, VII. 1907 M. P. Porsild (P).

West VI.

Svartenhuk, Serfarssuit Bugt, 17.VII. 1929 M. P. & R. T. Porsild (H); Simiutap kua, 14.VIII. 1947 H. Ødum (H); Ingnerit Fjord, 2.VIII. 1911 M. P. & R. T. Porsild (H, P); Siuterqut in Uvkusigssat Fjord, 18.VIII. 1950 K. Jakobsen 5777, 5783 (H); Laksefjord, 16. VIII. 1911 A. Lundager 1563 (H); Upernivik Øen, northernmost point, 9. IX. 1931 F. Johansen (H); Tasiusak, 22.VII. 1883 A. G. Nathorst (S); Saitok Øen, 21. VIII. 1931 F. Johansen (H); Ikerasarsuak Øen, 17.VIII. 1931 F. Johansen (H); Sardlia Øen, 23.VII. 1931 F. Johansen (H).

West VII.

Cape York, Ivsugigsok, 25.VII. 1883 A. G. Nathorst (S); Wolstenholme Sound, 22.VIII. 1916 L. Koch (H); Breaks, Carey Øer, 10.VIII. 1936 F. Salomonsen (H); Foulke Fjord, in rupibus prope litus ad Reindeer Point, 11.—12. VIII. 1899 H. G. Simmons 1489 (O); Inglefield Land, Rensselaer Bay, 20.VII. 1921 J. Noe Nygaard (H).

East I.

Kangerdlugsuatsiak, Møretun, 3.VIII. 1932 Devold & Scholander (O); Kangerdlugsuatsiak, Nordpollen, 1. IX. 1932 J. Devold (O); Smalfjorden, Straumen, 8. IX. 1932 J. Devold (O).

East II.

Igutsat Fjord, N. coast, 27.VIII. 1932 R. Bøgvad 704 (H); Cape Tordenskjold, 21.VIII. 1932 R. Bøgvad 638 (H); South Point at the mouth of Napasorsuak, 17.VIII. 1932 R. Bøgvad 593 (H); Tingmiarmiut, Brattneset, 8.VIII. 1932 Devold & Scholander (O); Tingmiarmiut, Lomvatnet, 2.VIII. 1931 B. Bjørlykke (O); Tingmiarmiut, Tvihamna, 9. IX. 1932 J. Devold (O); Vestfjord N. of Ikerasak, 22.VII. 1932 R. Bøgvad 218 (H); Umanak, Inafjord western branch, 15.VIII. 1931 Th. Vogt (O); Akorniarmiut, Imarsvik, 27.VIII. 1931 B. Bjørlykke (O); Akorniarmiut, Dronning Mariedalen, 4.VIII. 1931 B. Bjørlykke (O); Dronning Mariedalen, 24.VII. 1932 Devold & Scholander (O); Finnsbu, 14. and 17.VIII. 1932 Devold & Scholander (O); 9.VIII. 1931 B. Bjørlykke (O); Eidsdalen, 25.VIII. 1931 B. Bjørlykke (O); Kvanndalen, 18.VIII. 1932 J. Devold (O); Umivik, Eskimo site, 20. VIII. 1931 B. Bjørlykke (O).

East III.

Kung Oscars hamn, 5. IX. 1883 A. Berlin (S); Angmagssalik Col. (Tasiusak), 6. IX. 1932 T. Böcher 633 (H); Umivik Ø at Angmagssalik Fjord, 29.VII. 1933 R. Bøgvad 1021 (H); Tasiusak, 22.VIII. 1899 C. Kruuse (H); Ingmikertorajik, 25.VI. 1902 C. Kruuse (H); Kingorsuak, 23. and 24.VII. 1902 C. Kruuse (H).

East V.

Turner Sund, Odden, VII. 1900 C. Kruuse 499 (H); Dunholm, VII. 1900 N. Hartz (H); 30.VII. C. Kruuse 409 (H); Gaasefjord, 2.VI. 1892 N. Hartz (H); Gaaseland, 10.VIII. 1891 N. Hartz (H); Danmarks Ø, 4.VII. 1892 N. Hartz (H); VIII. 1892 N. Hartz (H); Danmarks Ø, "Willow-skerries", 23.VIII. 1933 E. Tulinius 583 (H); Røde Ø, VIII. 1891 N. Hartz (H); Jameson Land, "Cape" Hooker, 29.VI. 1933 Th. Sørensen 581 (H); Jameson Land, near Cape Stewart, 3.VIII. 1891 N. Hartz (H); Head of Hurry Inlet, 8.VII. 1933 Th. Sørensen 582 (H); Nordvestfjorden IX. 1891 N. Hartz (H).

East VI.

Antarctic hamn, 11.VIII. 1930 J. Vaage (O); Traillöya, Holms bukt, 11.VIII. 1929 J. Vaage (O); Head of Röhss Fjord, north side, 14.VIII. 1930 J. Vaage (O);

Röhss Fjord, Strømstedet, 29.VII. 1932 Th. Sørensen 3351 (H); Traillöya, Veganeset, 7.VIII. 1929 J. Vaage (O); Geographical Society Isl., Husbukta, 8.VIII. 1929 J. Vaage (O); Geographical Society Isl., Sanddalen, 18.VIII. 1930 J. Vaage (O); Ymer Ø, Carl Jacobsen Bugt, 16.VIII. 1932 Th. Sørensen 3350 (H); Dusén Fjord Cape Graah, 17.VIII. 1929 J. Vaage (O); Myggbukta, 1. and 21.VIII. 1929 J. Vaage (O); 1.VIII. 1930 J. Vaage (O); Head of Moskusoksefjord, north side, 15.VIII. 1929 G. Seidenfaden 267 (H); Strindberg Peninsula, Nordfjord, 11.VIII. 1931 Th. Sørensen 3352 (H); Strindberg Peninsula, Geologfjord, 18.VIII. 1929 G. Seidenfaden 346 (H); Loch Fyne Mouth, east side, 26.VII. 1930 J. Vaage (O); Cape Stosch, VIII. 1932 M. Køie 4539 (H); Clavering Isl. Lerbugten (Tyroler Fjord) 24. and 25.VII. 1949 M. Westergaard 12, 25 (H); Payer Land, Zackenberg, 16.VIII. 1949 M. Westergaard 71, 72 (H); Cape Herschel, 18.VII. 1930 J. Vaage (O); Königin Augusta Thal, 12.VII. 1899 P. Dusén (S); Landingsdalen, 28.VII. 1929 J. Vaage (O); Sabine Isl., 9.VII. 1899 A. G. Nathorst (S); 11.VII. 1900 C. Kruuse (H); Kuhn Isl., Cape Maurer, 7.VIII. 1933 Th. Sørensen 2617 (H).

East VII.

Danmarkshavn, 4.IX. 1907 A. Lundager 1782 (H); Germania Land, Stormkap, 11.VIII. 1933 Th. Sørensen 2618 (H); Skærfjord, Head of Klægbugt, 13.VIII. 1933 Th. Sørensen 2619 (H, S); Skærfjord, East of Cape Amelie, 12.VIII. 1933 Th. Sørensen 2620, 2621 (H).

North VIII.

Washington Land, Puttersuak, 13.VIII. 1921 L. Koch (H); Hendrik Island, SW. coast, 21.VII. 1917 Th. Wulff (H, S).

Puccinellia Porsildii TH. S.

Vb.

Godhavn, near Arktisk Station, 8. IX. 1933 M. P. Porsild (Type) (H, S, O, P); 19. IX. 1947 Th. Sørensen (H).

Puccinellia Rosenkrantzii TH. S.

West Va.

Aufarssuaq Valley, Qapiortoq kangigdleq, 6.VII. 1951 A. Rosenkrantz 6151, 6159 (H); Aufarssuaq Valley, Qapiortoq kitdleq, 12.VIII. 1948 K. Jakobsen 2441, 2442, 2443 (Type) (H); 17.VIII. 1948 K. Jakobsen 2459a (H); 19.VIII. 1948 K. Jakobsen 2488, 2489; 2490, 2492b, 2497, 2498 (H); 12. IX. 1947 H. Ødum 1083, 1084, 1087 (H); Marrait, camping place, IX. 1950 A. Rosenkrantz 6119, 6120 (H).

Puccinellia vaginata (LGE.) FERN. et WEATH.

Glyceria vaginata: Fl. dan. fasc. 44 (1858) tab. 2583; Berggren 1871, p. 868, 872; Lange 1880, p. 168; 1887, p. 298 (pro parte); Berlin 1884, p. 78 (pro parte); Nathorst 1884a, p. 43; Holm 1887, p. 291; Rosenvinge 1892, p. 731 (incl. var. *effusa*) (pro parte); Hartz 1894, p. 43 (pro parte); Abromeit 1899, p. 101. *Gl. distans:* Kruuse 1898, p. 395; 1905, p. 201; Gelert 1902, p. 127 (pro parte); Porsild 1910a, p. 242 (pro maj. parte); 1910b, p. 262 (pro parte); 1912, p. 368; Rikli 1910 Tafel 48 B; Hartz & Kruuse 1911, p. 410, 424. *Gl. distans* f. *arctica:* Ostenfeld 1905, p. 68. *Gl. angustata:* Dusén 1901, p. 60. *Puccinellia angustata:* Seidenfaden 1931, p. 20 (pro

parte); Vaage 1932, p. 71 (pro parte); Gelting 1934, p. 210 (pro parte). *Pucc. angustata* var. *vaginata:* Porsild 1920, p. 44; Lagerkranz 1950, p. 66. *Pucc. angustata* var. *effusa:* Sørensen 1933, p. 155. *Glyceria tenella:* Simmons 1909, p. 99. *Puccinellia retroflexa* ssp. *borealis:* Ostenfeld 1923a, p. 197; 1925, p. 10; Sørensen 1943, p. 50 (pro parte).

West IV.

Kangaitsiak, 30.VII. 1883, A. Berlin (S); Sarpiursak, 1870 S. Berggren (L); Sarkardlek, 17.VI. 1891 J. A. Björling (S, U); Inter Ikamiut et Egedesminde, 9. VIII. 1883 A. Berlin (S); Egedesminde, 11.VII. 1870 S. Berggren (S, U); 29.VII. 1884 Warming & Holm (S); 5.VIII. 1891 J. A. Björling (S); 10.VII. 1894 P. H. Sørensen (H); Egedesminde, Tupilaq Øen, 30. IX. 1948 K. Jakobsen 2886 (H); Maneetsok, 11.VIII. 1883 A. Berlin (S); Nordostbugt, 1921 A. E. Porsild (P).

var. *paradoxa:* Grønne Eilande, 22.VII. 1949 P. Gelting (H); Christianshaab, 26.VII. 1884 Warming & Holm (H); Kronprinsens Eilande, 20.VII. 1949 P. Gelting (H).

West Va.

Lerbugten, Claushavn, VII. 1890 N. Hartz (H); Tessiursak, 31.VII. 1870 S. Berggren (S, U); Sandbugten, 31.VII. 1870 S. Berggren (S); Claushavn, 9, 10, and 12.VIII. 1870 S. Berggren (S); Jacobshavn, 25.VII. 1884 Warming & Holm (H, U, P); Jacobshavn, Pakitsup illordia, 26.VII. 1947 P. Gelting (H); Eqe, 4.VII. 1949 de Lesse (Paris); Atanikerdluk, 29.VII. 1934 J. Lagerkranz (S); Atanikerdluk, 24.VII. 1913 M. P. Porsild (P); Sarqaq, 11.VII. 1948 K. Jakobsen 2166a (H); Manek, VII. 1890 N. Hartz (H); Kugsinerssuak, VII. 1909 M. P. Porsild (P); Kugsinerssuak, 30. VII. 1934 J. Lagerkranz (S, U); Atâ, 5.—6.VII. 1913 M. P. Porsild (H, P); Atâ, 15.VII. 1932 J. Gröntved 122 (H); Igpiarsuk, 19.VII. 1902 M. P. Porsild 258 (H); Marrait, 9. IX. 1948 K. Jakobsen 2765 (H); Kugssuaq, 13. VIII. 1947 K. Jakobsen 808 (H); Eqaluit, 14.VIII. 1947 K. Jakobsen 829 (H); Inter Eqaluit et Nuvfiumaneq, 15.VIII. 1947 K. Jakobsen 812 (H); Nuvfiumaneq, 16. VIII. 1947 K. Jakobsen 818 (H); Ikerasak, 25.VII. 1892 E. Vanhöffen (H); Umanaitsiak, Umanak, VII. 1834 J. Vahl (H); Tuapagssuit, 21.VIII. 1947 K. Jakobsen 884 (H); Umiartorfik, 18.VIII. 1947 K. Jakobsen 855 (H); Umanak, VII. 1836 J. Vahl (Type) (H); 9.—12.VII. 1921 S. J. Enander (S); 7.VIII. 1947 Th. Sørensen (H); Umanak, Nukorsak, VII. 1836 J. Vahl (H); Kuk, 23.VIII. 1947 Th. Sørensen (H); Patorfik, 27.VII. 1921 A. E. Porsild (H, P); Sarfarfik, 13.VIII. 1947 Th. Sørensen 358 (H); 19.VIII. 1947 Th. Sørensen 448 (H); Ikorfat, 31.VII. 1921 A. E. Porsild (H); 20.VII. 1947 K. Jakobsen 382, 384, 385, 386 (H); 15.VII. 1947 K. Jakobsen 324, (H); 26.VIII. 1947 Th. Sørensen 326 (H); 31.VIII. 1947 Th. Sørensen 495 (H); Serfat, 22.VII. 1947 K. Jakobsen 401, 402 (H); Inter Kangilia et Serfat, 23.VII. 1947 K. Jakobsen 421b (H); Niaqornat, 2. IX. 1947 K. Jakobsen 940, 941, 943, 952 (H); Nugssuaq Settlement, 26.VIII. 1947 A. Rosenkrantz 903, 904, 905 (H); 23.VII. 1951 A. Rosenkrantz 6149 (H).

var. *paradoxa:* Naujat, 12.VII. 1948 K. Jakobsen 2167, 2168 (H); Sarqaq, 11.VII. 1948 K. Jakobsen 2164, 2165, 2166b (H); Marrait, 17. IX. 1947 K. Jakobsen 1036, 1069 (H); Niaqornarssuk prope Marrait, 16. IX. 1947 K. Jakobsen 1077b (H); 3. IX. 1950 K. Jakobsen 6093, 6100 (Type) (H); Tuapagssuit, 21. VIII. 1947 K. Jakobsen 886 (H); Ikerasak, 9.VII. 1929 M. P. Porsild (P); Ikorfat, 28.VIII. 1947 Th. Sørensen 511 (H); Niaqornat, clayey ground at a lake, alt. 210 m, 1.VIII. 1947 K. Jakobsen 539 (H); Nugssuaq Settlement, 26.VIII. 1947 A. Rosenkrantz 901 (in part) (H).

West Vb.

Godhavn, 20.VII. 1884 Warming & Holm (H); 28.VII. 1905 G. Kleist (S, L); 28.VIII. 1923 El. Ekman (S); 19. IX. 1947 Th. Sørensen (H); Godhavn, Arktisk Station, 4.VIII. 1929 R. T. Porsild (H); 8.VIII. 1946 P. Gelting (H); Godhavn, Blæsedalen, 20.VII. 1946 P. Gelting (H); Kvanit, East of Røde Elv, 28.VIII. 1932 J. Gröntved 134 (L); Sinigfik, 12.VIII. 1929 R. T. Porsild (H); Saitok Skæret, off Diskofjorden, 24.VIII. 1902 M. P. Porsild 914 (H); Ujaragssugssuk, 14.VII. 1898 M. P. Porsild 985 (H); 3.VIII. 1908 M. Rikli (S); Kutdlisat at Vajgattet, VIII. 1890 N. Hartz (H); 8.VII. 1902 M. P. Porsild (O, P); Stordalen, 30.VII. 1948 A. Rosenkrantz 2940 (H); Nordfjord, Kingua, North Side, 3.VIII. 1902 M. P. Porsild 511, 508 (P); Kamavit, 3.VII. 1902 M. P. Porsild 433 (P); Nordfjord, Nordre Kagsimavit, 31.VII. 1902 M. P. Porsild 438 (U, P); N. Disko, Asuk, 31.VII. 1934 M. P. Porsild (H); Kuganguak, 27.VII. 1913 M. P. Porsild (in part) (H); At the Mouth of Giesecke Dal 24. VII. 1902 M. P. Porsild (P); Harön, 11. VIII. 1883 A. G. Nathorst (S).

var. *paradoxa:* Nordfjord, Perdlertut, 23.VIII. 1949 P. Gelting (H).

West VI.

Head of Arfsaq Fjord at Marmoralik, 17.VII. 1951 A. Rosenkrantz 6146 (H); Qaumarujuk Fjord Qingua, 27.VII. 1935 M. P. Porsild (P); Qalagtoq, Upernivik Ø, 15.VII. 1950 K. Jakobsen 4532 (H); Sagdliaruseq, Qioqe Peninsula, 15.VII. 1950 K. Jakobsen 4556 (H); Qingussaq, 18.VII. 1951 A. Rosenkrantrz 6147, 6148 (H); Qeqertarssuaq, Nugatsiaq, 11.VIII. 1950 K. Jakobsen 5666 (H); Svartenhuk, Itsako, 29.VIII. 1950 K. Jakobsen 6049, 6051, 6053 (H); Qaumarujuk Fjord, Wegeners Station 28.VII. 1935 M. P. Porsild (P); Svartenhuk, Manitsoqut, 24.VII. 1935 M. P. Porsild (P); Svartenhuk, Tartussaq Bugt, 22.VII. 1935 M. P. Porsild (P); Simiutap kua, 14.VIII. 1947 H. Ødum 896 (H); Uvkusigssat Fjord, Siuterqut, 18.VIII. 1950 K. Jakobsen 5771, 5779, 5780, 5781 (H); Ingnerit Fjord, 2.VIII. 1911 M. P. & Th. Porsild (H); Prøven, 21.VII. 1886 L. K. Rosenvinge (H); Sarfiorfik, 14.VII. 1891 J. A. Björling (U); Upernivik Distr. 31: Kangek, 31.VIII. 1886 Ryders Expedition (H); Kaersorsuak, 12.VII. 1891 J. A. Björling (S); Upernivik, Smedeøen, 30.VII. 1931 Fr. Johansen (H); Upernivik, VIII. 1834 J. Vahl (H); 18.VII. 1886 Th. Holm (S); 20.—22.VIII. 1923 El. Ekman (S); VII.—VIII. 1931 Fr. Johansen (H); Col. Upernavik, 21.VII. 1950 K. Jakobsen 4669, 4716 (H); Tasiussaq, 4.VIII. 1916 Th. Wulff (H); 8.VIII. 1950 K. Jakobsen 5413 (H); Paornagusit at Tasiussaq, 9.VIII. 1950 K. Jakobsen 5481 (H); Kraulshavn, 23.VII. 1950 K. Jakobsen 4853, 4867 (H).

var. *paradoxa:* Upernavik Ø, 23.VII. 1921 A. E. Porsild (P); Svartenhuk, Uvdlisaut, 30.VI. 1950 K. Jakobsen 4322 (H); Svartenhuk, Itsako, 29.VIII. 1950 K. Jakobsen 6052 (H); Nord-Prøven, Narssak, 23.VIII. 1923 El. Ekman (L); Kaerssorssuak, 21.VI. 1936 C. Vibe (H).

West VII.

Cape York, Thule, 31.VII. 1914 P. Freuchen (H); Near Thule, 11.VIII. 1943 M. P. Porsild (P); Wolstenholme Sound, Thule, 26.VII. 1916 L. Koch (H); North Star Bay, near Thule, 11.VIII. 1943 M. P. Porsild (P); Olrik Fjord, Store Delta, 30.VII. 1950 K. Jakobsen 5053, 5054 (H); Olrik Fjord, "Steenstrups Havn", 29.VII. 1950 K. Jakobsen 4984, 5040, 31.VII: 5164, 5180 (H); Foulke Fjord, near Etah, 11.—12.VIII. 1899 H. G. Simmons 1478 (L, O).

East V.

Liverpool Land, East side of Hurry Inlet, 10.VII. 1933 Th. Sørensen 572. 579 (H); Head of Hurry Inlet, 8.VIII. 1933 Th. Sørensen 580 (H).

var. *paradoxa:* Hurry Inlet, 10.VIII. 1900 N. Hartz (H, U).

East VI.

Head of Röhss Fjord, 14.VIII. 1930 J. Vaage (O); Röhss Fjord, at the sound, south side, 14.VIII. 1930 J. Vaage (O); Lyell Land, Cape Hedlund, west coast, 20. IX. 1931 Th. Sørensen 3367 (H); Lyell Land, Cape Hedlund, east coast 15. IX. 1931; Th. Sørensen 3371 (H); 17.VII. 1932 3372 (H, S); Ella Ø, 17.VIII. 1930 G. Seidenfaden 1057 (H); Ella Ø, Cape Elisabeth, 8.VIII. 1930 J. Vaage (O); Geographical Society Ø, 15 km W. of Husbukta, 17.VIII. 1930 J. Vaage (O); Ymer Ø, Botanikerbugten, 4.VIII. 1932 Th. Sørensen 3369 (H, S); Kjerulfs Fjord, 11.VIII. 1899 A. G. Nathorst (S); 13.VIII. 1899 P. Dusén (S); 13.VIII. 1929 J. Vaage (O); Head of Kaiser Franz Joseph Fjord, SE. side, 11.VIII. 1899 A. G. Nathorst (S); Wollaston Foreland, Cape Herschel, 30.VII. 1929, 17. and 29.VII. 1930 J. Vaage (O); Zackenberg, 11.VIII. 1949 M. Westergaard (H); Revet, 21.VIII. 1949 M. Westergaard (H).

var. *paradoxa:* Gael Hamke Bay, Terneskær 1, 26.VII. 1933 Th. Sørensen 4532 (H).

IX. CLAVIS SPECIERUM PUCCINELLIAE ET COLPODII E GROENLANDIAE

A. Rachilla spicularum gracilis, ad insertionem flosculorum abrupte incrassata; articuli ad superficiem fracturae disciformiter dilatati. Glumae longae, medium lemmatis inferioris superantes, subtiles, siccitate evidenter plicata. *Colpodium Vahlianum* (Liebm.) Nevski.

AA. Rachilla sat robusta, ad insertionem flosculorum haud evidenter incrassata; articuli ad superficiem fracturae parum dilatati. Glumae plerumque medium lemmatis inferioris non aequantes, raro longiores, siccitate non plicatae. *Puccinellia* Parl.

B. Glumae lemmataque integra vel aliquantulum irregulariter dentata, neque ciliolata.

C. Antherae 1.5—2.5 mm longae. Planta stolonifera, stolonibus epigaeis.

D. Lemmata glabra. Palearum carinae sine spiculis. Antherae non dehiscentes, sine bono polline. Innovationes extraaxillares foliorum insertionibus oppositae, plerumque e stolonibus juvenilibus proleptice orientes.
P. phryganodes (Trin.) Scribn. et Merr.

DD. Lemmata ad basin nervorum pilosa. Palearum carinae spinulosae. Antherae dehiscentes cum bone polline. Innovationes axillares ut solet e stolonibus anni praeteriti orientes. *P. maritima* (Huds.) Parl.

CC. Antherae 0.5—1.0 mm longae. Planta caespitosa stolonibus nullis.

E. Lemmata 1.8—2.5 mm longa, nervis prominentibus, calli pili desunt. Palearum carinae sine spiculis.
P. Langeana (Berl.) Th. S. ssp. *typica* Th. S.

EE. Lemmata 3.0—4.0 mm longae, nervis non prominentibus. Calli pili praesentes. Palearum carinae spiculis distantibus.
P. Andersonii Swall.

BB. Glumae lemmataque eroso-ciliolata.

F. Palearum carinae versus apicem spinulosae, versus basin longe-pilosae.

G. Culmi 5—30 cm alti. Panicula brevis, contracta, obscure violacea. Lemmata acuta—acuminata, marginibus hyalinis latis, in nervis e basi usque ad tertiam vel dimidiam partem longitudinis copiose pilosa. Ligula acuta. Antherae 0.6—0.8 mm longae. *P. angustata* (R. Br.) Rand et Redf.

GG. Culmi 40—65 cm alti. Panicula patens vel nutans, viridis aut purpurascens. Lemmata subacuta—obtusa, vix marginibus hyalinis, in nervis ad basin pilosa. Ligula truncata. Antherae 1.0—1.5 mm longae. *P. groenlandica* Th. S.

FF. Palearum carinae apicem versus spinulosae; basin versus aut glaberrimae, aut spiculis singulis et remotis munitae, aut (rarius) pilis remotiusculis, neque plane pilosae.

H. Glumae longae, subaequales, lemmatis inferioris partem $^1/_2$—$^3/_4$ attingentes. Gluma inferior ca. 3 mm longa, saepe trinervis.
P. Porsildii Th. S.

HH. Glumae breviores, plerumque medium lemmatis inferioris non attingentes. Gluma inferior 2 mm non excedens, uninervia, gluma superior interdum conspicue amplificata.

I. Glumae sat firmae, plerumque ad altitudinem diversam insertae, quasi alternantes. Pedicelli sub spiculis plus minus incrassati.

J. Glumae lemmataque acuta vel acutiuscula. Folia convoluta, apicem versus gradatim angustata. Culmi et folia rigida erecta. Planta perspicue glauca.
P. laurentiana Fern. et Weath.

JJ. Glumae lemmataque obtuso-truncata. Folia conduplicata et curvata aut plana et sat flaccida, apicibus abrupte acutatis. Culmi geniculati. Planta plus minus glauca.
P. coarctata Fern. et Weath.

II. Glumae subtiles, ut apparet oppositae. Pedicelli non incrassati.

K. Culmi inferiore parte tantum foliiferi. Folia rigida involuta glauca. Vaginae basales emortuae scariosae nitentes. Spiculae ovato-lanceolatae densae rubescenti-purpureae, aureo-luteo variegatae. Palea plerumque lemma superans. *P. deschampsioides* Th. S.

KK. Culmi ad supra medium foliiferi. Folia sat flaccida plana, interdum involuta et recurvata viridia aut leviter glaucescentia. Vaginae vetustae non scariosae, marcescentes. Spiculae laxae viridescentes aut purpureae. Palea lemma non superans.

L. Glumae subaequales breves, plerumque apicibus rotundatis, dorso convexae, obscure nervosae. Palea lemma aequans. Vagina folii supremi nonnumquam subinflata.

M. Panicula compacta ovata ramis brevibus fasciculatis. Spiculae dense aggregatae, ovatae albescenti-virides, neque evidenter nitidae. *P. coarctata* var. *pseudofasciculata* Th. S.

MM. Panicula magna divaricata ramis plerumque binis. Spiculae lineares purpureae, perspicue nitentes.
P. vaginata (Lge.) Fern. et Weath.

LL. Glumae evidenter inaequales, inferior parva angusta acuta, superior magna rotundata vel subtruncata, saepe subcarinata, subtilis et translucent, plane nervigera. Palea lemmate brevior. Vagina superior non inflata.

N. Planta alta, culmi erecti graciles. Panicula plus minus contracta, quintam usque ad quartam partem longitudinis plantae aequans. Rami in paribus, graciles ascendentes. Spiculae pedicellatae. *P. Rosenkrantzii* Th. S.

NN. Planta humilis, culmis ad basin geniculatis, crassis. Panicula pyramidalis, tertiam vel dimidiam partem plantae aequans. Rami saepe fasciculati, rigide, divaricati, crassi. Spiculae appressae, distales subsessiles.
P. vaginata var. *paradoxa* Th. S.

X. CLAVIS PUCCINELLIARUM IN NOVAJA ZEMLJA ET WAIGATSCH CRESCENTIUM

A. Stolones foliiferae superficiales praesunt. Antherae 1.5—1.7 mm longae, steriles, non dehiscentes.
P. phryganodes (Trin.) Scribn. et Merr.

B. Glumae firmae, concavae, obscure nervosae. Palearum carinae laeves. Cellulae epidermales folii paginae superioris non vel vix papillosae, interdum tumidae.
P. phryganodes. Spitsbergen type.

BB. Glumae tenues, plus minus complanatae, distincte nervigerae. Palearum carinae papillosae. Epidermis folii paginae superioris valde papillosae. *P. phryganodes.* Fennoscandia type.

AA. Stolones absunt. Antherae plerumque multo breviores, raro 1 mm excedentes, polliniferae.

C. Spiculae parvae, 3—5 mm longae, albescentes vel dilute purpurascentes. Lemmata 2.0—2.6 mm longa, parum pilosa vel etiam ad basin glabra. Antherae 0.5—0.7 mm longae.

D. Bracteae integrae, earum nervi prominentes, earum lemmatum apicem versus convergentes.
P. Langeana ssp. *asiatica* Th. S.

DD. Bracteae plus minus eroso-ciliolatae, nervi non prominentes, non convergentes.

E. Glumae firmae, alterne insertae. Pedicelli subincrassati.
P. coarctata Fern. et Weath.

EE. Glumae tenues, micantes, opposite insertae. Pedicelli non incrassati. *P. tenella* (Lge.) em. Th. S.

CC. Spiculae magnae, 4—7 mm longae, vehementer coloratae. Lemmata 3—4 mm longae, inferiore tertia parte dorsi perspicue pilosa. Antherae 0.7—1.4 mm longae.

F. Spiculae omnes pedicellatae; pedicelli graciles. Glumae ubique tenues, translucentes. Rachilla gracilis.

G. Glumae, praesertim inferior, basin versus angustatae, lanceolatae vel lanceolato-oblongae, integrae. Paniculae rami glabri, interdum pedicelli spinulis perpaucis muniti. Antherae 1.0—1.4 mm longae. Culmi geniculati. Planta insignite gracilis atque folia mollia; laxe caespitosa. *P. Palibinii* Th. S.

GG. Glumae ad basin dilatatae, ovato-orbiculares, fortiter eroso-ciliolatae. Rami paniculae scabri, saltem in partibus superioribus. Antherae 0.8—1.0 mm longae. Culmi erecti vel prostrati. Planta sat robusta, dense caespitosa. *P. contracta* (Lge.) Th. S.

FF. Summae spiculae sessiles aut subsessiles; pedicelli vigorosi. Glumae solum ad margines translucentes. Rachilla crassa.

H. Pedicelli non perspicue incrassati. Glumae ad basin paene opposita, purpureae, scariosae, ad margines erosae vel plus minus eroso-ciliolatae. Panicula contracta.
P. angustata (R. Br.) Rand et Redf.

HH. Pedicelli plane incrassati, claviformes. Glumae plus minus alternate insertae, ad basin herbaceae viridescentes vel lutescentes, marginibus hyalinis, integris vel grosse dentatis, neque eroso-ciliolatis. Panicula sparsa. *P. fragiliflora* Th. S.

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XII. SUMMARY

The Greenland material of *Puccinellia* has long been in need of a thorough revision (Chapt. I.).

Some morphological characteristics of paramount importance in the identification of species are discussed. Besides, it is demonstrated that the epidermal anatomy of the leaves yields good distinguishing characters, which seem to be of general taxonomical applicability (Chapt. II).

Within Greenland twelve species have been distinguished, four of which are new to science, viz. *P. deschampsioides* Th. S., *P. Porsildii* Th. S., *P. Rosenkrantzii* Th. S., and *P. groenlandica* Th. S. (Chapt. III).

Some hitherto insufficiently known East American Puccinellias are proposed as new species, viz. *P. americana* Th. S., and *P. ambigua* Th. S. (Chapt. IV).

A survey of the Novaya Zemlyan and Waigatsch *Puccinellia* flora is appended. The following species are new: *P. Palibinii* Th. S., *P. fragiliflora* Th. S. New emendments and combinations are: *P. tenella* (Lge.) em. Th. S., and *P. contracta* (Lge.) Th. S. (Chapt. V).

The total number of arctic representatives of the genus are arranged in natural groups according to gross-morphological and leaf-anatomical characters. Preliminarily, nine groups are distinguished, seven of which are represented in Greenland (Chapt. VI).

The origin and migration history of the Greenland species are discussed, and, hypothetically, seven historic-geographical elements are demonstrated (Chapt. VII).

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XIV. INDEX OF PLANT NAMES

Puccinellia and *Colpodium*, incl. synonyms and incorrectly applied names. Valid names are marked by an asterisk. Page numbers in heavy type indicate descriptions of species or varieties.

Other plants mentioned in the text are given in small type.

XV. CORRECT SPELLING OF USED PLACE-NAMES IN GREENLAND

By E. Holtved

Used on labels[1]:	Correct spelling:
Agpiletok	Augpilagtoq
Akatout	Oqaitsut (: Rodebay)
Akorniarmiut	Akorninarmiut
Akugdlek	Akugdleq
Alianaitsunguaq	Alianaitsúnguaq
Amitsok	Amitsoq
Angmartusut	Angmartusût
Antarctic hamn	Antarctics Havn
Arfsaq Fjord	?
Asivigssuak	Aussivigssuaq
Assuk	Asuk
Auleitsivik	Aulatsivik
Brønlund Fjord	Jørgen Brønlunds Fjord
Børglum River	Børglum Elv
Cape —	Kap —
Cape Borlasse Warren	Kap Borlase Warren
Carl Jacobsen Bugt	Karl Jakobsens Bugt
Clavering Isl.	Clavering Ø
Danmarkshavn	Danmarks Havn
Disko Bay	Disko Bugt
Dusén Fjord	Duséns Fjord
Ekaluit	Eqaluit
Ekorgfat	Ikorfat
Erkua	Erqua
Fiskernæs	Fiskenæsset
Gael Hamke Bay	Gael Hamkes Bugt
Geographical Society Isl.	Geographical Society Ø

[1]) Confer p. 109.

Groenedal	Grønnedal
Grønne Ejlande	Grønne Ejland
Hareø, Harøn	Hareøen
Hendrik Island	Hendriks Ø
Hochstetter Foreland	Hochstetters Forland
Holms bukt	Holms Bugt
Home Foreland	Home Forland
Hyde Fjord	Frederick E. Hyde Fjord
Igpiarsuk	Igpiarssuk
Igdlutjait	Igdlutsiait
Ignaguak	Ingnanguaq
Ikerasarsuak	Ikerasarssuaq
Ikkatok, Iqertoq	Ikertôq
Imarsvik	Imarsivik
Ingmikartok, Ingmikertak	Ingmikêrtoq
Ingmikertorajik	Ingmikêrtorajik
Isortok	Isortoq
Itiflak	Itivdleq
Itivdliatsiak	Itivdliatsiaq
Itivdlinguak	Itivdlínguaq
Itivnek	Itivneq
Ivsugigsok	Ivssugigsoq
Jacksonöya	Jackson Ø
Jacobshavn	Jakobshavn
John Murray Island	John Murray Ø
Kaersorssuak	Qaersorssuaq
Kaersuarssuk	Qaersuarssuk
Kagsimavit	Qagssimavît
Kamavit	Qámavît
Kangaitsiak	Kangâtsiaq
Kangek	Kangeq
Kangerdlugsuatsiak	Kangerdlugssuatsiaq
Kangersunek	Kangersuneq
Kangigdlek	Kangigdleq
Kardlunguak	Qardlúnguaq
Kekertarsunguit	Qeqertarssúnguit
Kiagtut	Kiagtût
Kingak	Qingâq
Kingigtok	Kingigtoq
Kingorsuak	Qíngorssuaq
Kingua	Qíngua
Kisengiartak	?
Koldewey Isl.	Store Koldewey
Kordlortoq	Qordlortoq
Kronprinsens Eilande	Kronprinsens Ejland
Kuanit, Kvanit	Kuánit
Kuganguak	Kûgánguaq
Kugssinerssuak	Kugssinerssuaq

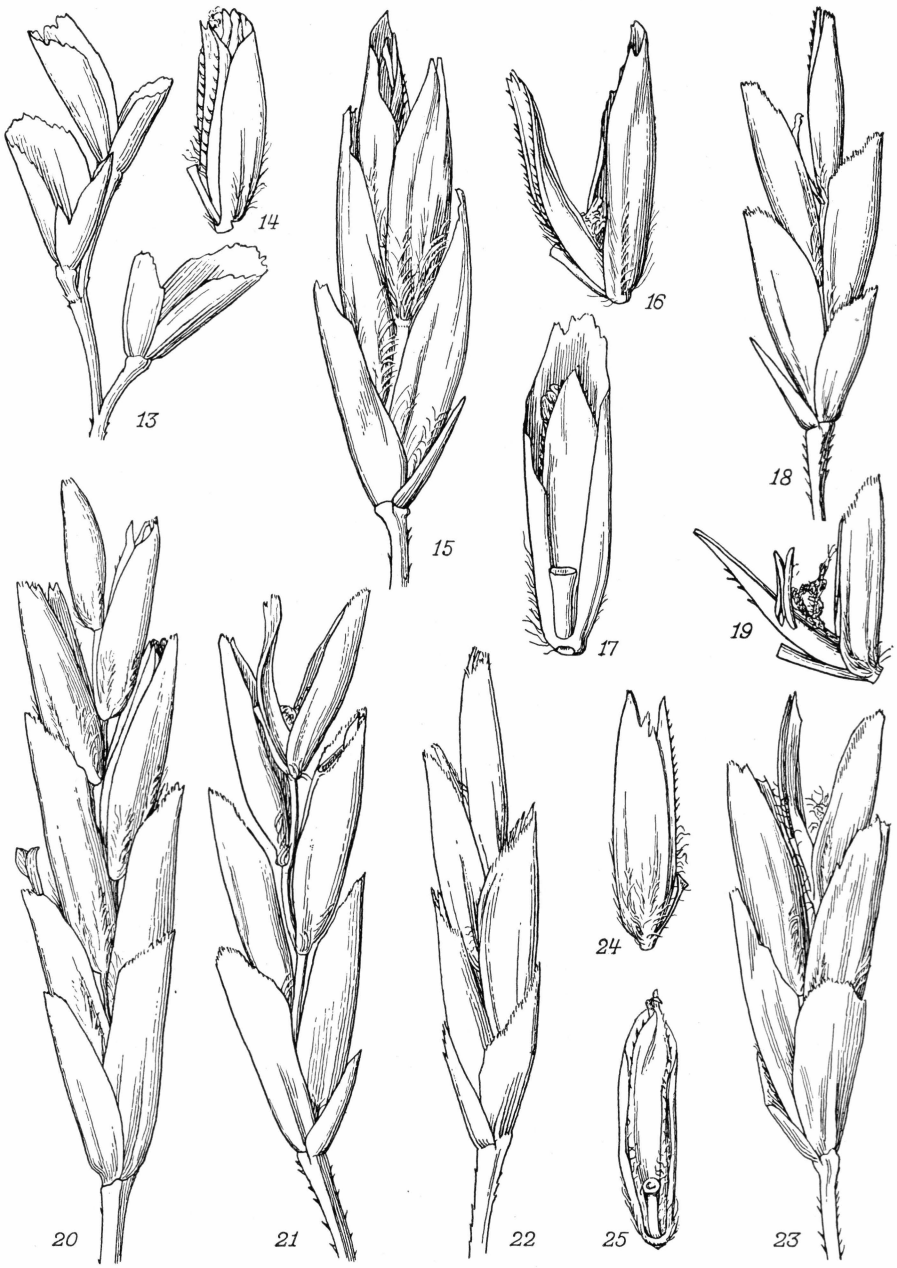
Kugssuaq	Kûgssuaq
Kuhn Isl.	Kuhn Ø
Kuk, Kome	Kûk
Kuk angnertunek	Kûk angnertuneq
Kukdal	Kûk (dal: valley)
Kuksuk	Qugssuk
Kung Oskars hamn	Kong Oscars Havn
Kutdlisat	Qutdligssat
Kutsiaq	Kûtsiaq
Königin Augusta Thal	Dronning Augustadalen
Maneetsok	Manîtsoq
Manek	Mánik
Manitsoqut	Manîtsorqut
Marmoralik	Marmorilik
Marrak	Marraq
Moskusokse Fjord	Moskusoksefjord
Mt. Hassel	Hassells Fjeld
Mt. Keglen	Keglen
Mt. Ramsay	Ramsays Bjerg
Nakajanga	Nákajanga
Napasorsuak	Napassorssuaq
Narsak	Narssaq
Niakornak	Niaqornaq
Niakua	Niaqua
Nugatsiaq	Nûgâtsiaq
Nugssuak	Nûgssuaq
Nukorsak	Nûkavsak (?)
Nunarsuak	Nunarssuaq
Olrik Fjord	Olriks Fjord
Orpiksok	Orpigsôq
Orpiksuit	Orpigssuit
Pakitsup illordia	Pâkitsup ilordlia
Paornagusit	?
Payer Land	Payers Land
Putlersuak, Puttersuak	Putdlerssuaq (?)
Qingua	Qíngua
Qioqe	Qîoqe
Rensselaer Bay	Rensselaer Bugt
Rudbecksfjellet	Rudbecks Bjerg
Sabine Isl.	Sabine Ø
Saitok	Sâtoq
Sarfarssuak	Sarfarssuaq
Sarkardlek	Sarqardleq
Sardlia	Sârdlia
Sarpiursak	Sarpiussaq

Savit	Savît
Sermesok	Sermersôq
Simiutap kua	Simiútap kûa
Singitok	Singîtsoq
Sofia Havn, Sofiehamn	Sofias Havn
Southeast Bay	Sydostbugten
Strindberg Peninsula	Strindbergs Land
Tartussak	Tartûssaq
Tassermiut	Tasermiut
Tasermiutsiak	Tasermiutsiaq
Tasiusak, Tassiursak	Tasiussaq
Tiningnertok	Tiningnertôq
Traillöya	Traill Ø
Tunak (Tunok)	Tunoq
Tunnuarmiut	Tunuarmiut
Tupilaq	Tupilak
Tyroler Fjord	Tyrolerfjord
Ubekendte Ejland	Ubekendt Ejland
Ujaragtorsuak	Ujaragtôrssuaq
Ujarssurssuit	Ujaragsugssuit
Umanaitsiak, Umanatsiak	Ũmánâtsiaq
Umanak	Ũmánaq (except for the colony Umanak)
Umanarsuak	Ũmánarssuaq
Umanarsuk	Ũmánârssuk
Umivik	Umîvik
Unartok	Ũnartoq
Upernavik Ø	Upernivik Ø
Vega Sound	Vega Sund
Wolstenholme Sound	Wolstenholme Fjord
Wordie Glacier	Wordies Gletscher
Ymer Isl., Ymer Ø	Ymers Ø
Ymer Nunatak	Ymers Nunatakker

FIGURES 3—52

SPIKELETS AND FLORETS

Figs. 3—5: *Colpodium Vahlianum*, W. Greenland, Nûgssuaq, Atâ, leg. M. P. Porsild 26.VII. 1913. Figs. 6—7: *Puccinellia Andersonii*, NE. Greenland, Germania Land, Stormkap, leg. Th. Sørensen 11.VIII. 1933 (no. 2610). Figs. 8—9: *P. Langeana* ssp. *typica:* 8: W. Greenland, Kangâtsiaq, leg. A. Berlin 3.VI. 1883 (type); 9: W. Greenland, Godhavn, leg. P. Gelting 17.VII. 1946. Fig. 10: *P. Langeana* ssp. *asiatica*, Waigatsch, Cape Grebeni, leg. Kjellman & Lundström 30.—31.VII. 1875. Fig. 11: *P. Langeana* ssp. *alaskana*, Aleutian Isl., Amlia, leg. Eyerdam 10.VII. 1932 (no. 1272). Fig. 12: *P. Palibinii*, Novaya Zemlya, Matotchkin Shar, Pomorskaya, leg. B. Lynge 27.VIII. 1921 (type). × 10.



Figs. 13—14: *Puccinellia fragiliflora*, Novaya Zemlya, Matotchkin Shar, leg. O. Ekstam 13.VIII. 1905 (type). Figs. 15—17: *P. angustata*, W. Greenland, Svartenhuk, Tartûssaq, leg. M. P. Porsild 3.VIII. 1911. Figs. 18—19: *P. deschampsioides*, W. Greenland, Arfersiorfik Fjord, Sofia Havn, leg. M. P. Porsild 20.VII. 1924 (type). Fig. 20: *P. Porsildii*, W. Greenland, Godhavn, leg. M. P. Porsild 8. IX. 1933 (type). Fig. 21: *P. Rosenkrantzii*, W. Greenland, Nûgssuaq, Qapiortoq kitdleq, leg. K. Jakobsen 12.VIII. 1948 (no. 2443, type). Fig. 22: *P. laurentiana*, W. Greenland, Ameralik Fjord, Eqaluit, leg. J. Lagerkranz 26.VIII. 1936. Figs. 23—25: *P. contracta:* 23—24: Chukch Penins., Pitlekaj, leg. F. R. Kjellman 28. IX. 1878 (type); 25: Preobraschenie Isl., leg. F. R. Kjellman 24.VIII. 1878. × 10.

Figs. 26—27: *Puccinellia tenella*, Waigatsch, Sinus Ljamtschina, leg. O. Ekstam 19.VIII. 1907 (neotype). Figs. 28—33: *P. coarctata*. 28: Newfoundland, St. John Isl., leg. M. L. Fernald et. al. 31.VII. 1925 (no. 27363); 29: E. Greenland, Angmagssalik, leg. J. Lagerkranz 1.VIII. 1946; 30: S. Greenland, Tunugdliarfik Fjord, Kiagtût, leg. Th. Sørensen 22.VII. 1947; 31: NE. Greenland, Ymer Isl., Botanikerbugt, leg. Th. Sørensen 6.VIII. 1932 (no. 3364); 32: Waigatsch, Cape Grebeni, leg. O. Ekstam 27.VIII. 1902; 33: var. *pseudofasciculata*, W. Greenland, Fiskernæsset, leg. C. Holböll IX. 1837 (type). Figs. 34—35: *P. groenlandica:* W. Greenland, Sinus Ikertôq, leg. J. Vahl VIII. 1832 (type). ×10.

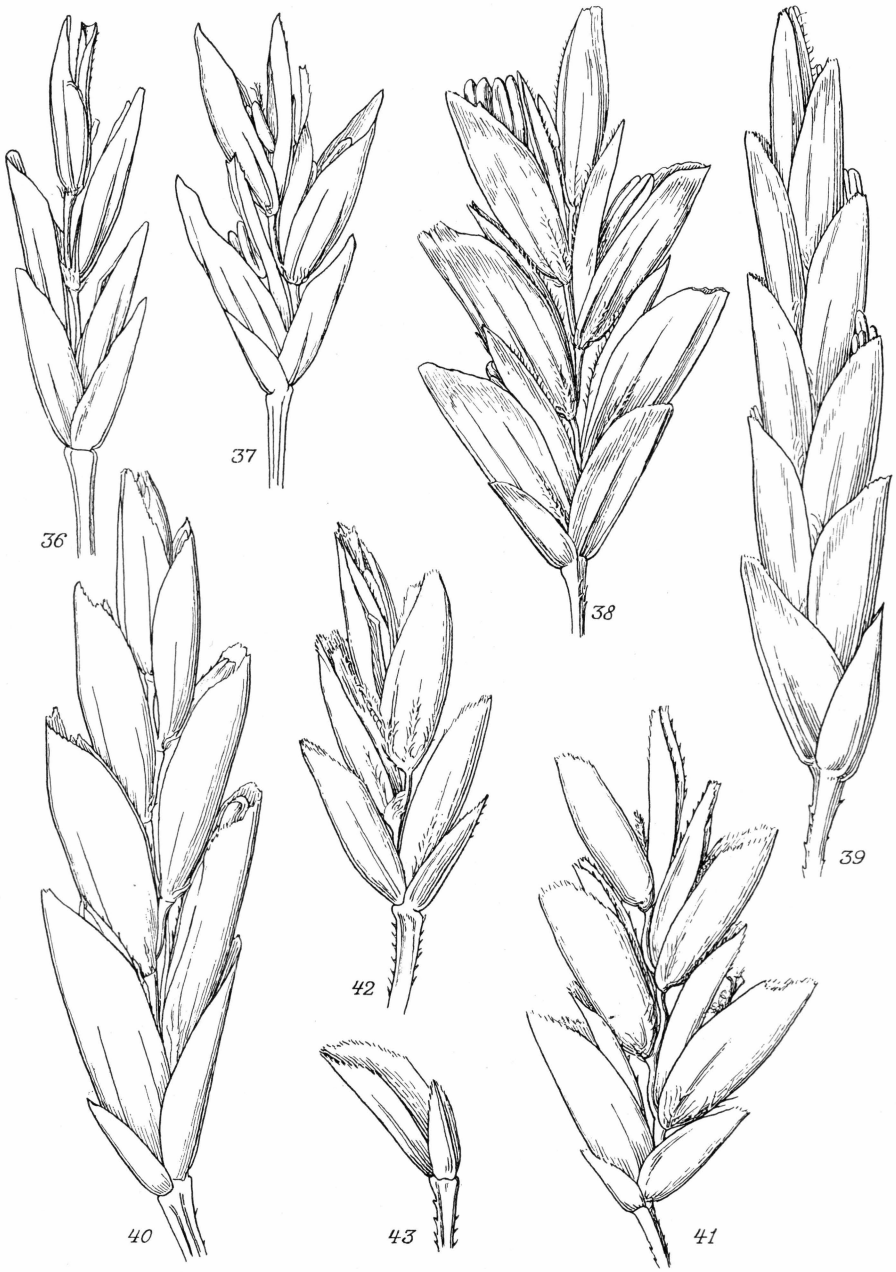


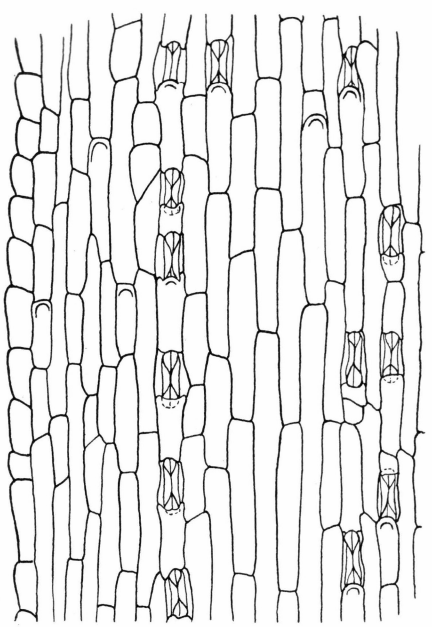
Fig. 36: *Puccinellia pumila* "*Fernaldii*", E. Quebec, Rimouski County, small isl. E. of Cape Original, Bic, leg. Fernald & Collins 6.VII. 1906 (no. 168). Fig. 37: *P. ambigua*, Prince Edward Isl., Alberton, leg. Fernald & St. John 11. VII. 1912 (no. 6913, type). Fig. 38: *P. arctica*, America arctica, Herschell Isl., leg. A. H. Lindström 17. VII. 1906. Fig. 39: *P. americana*, New Brunswick, Anlac, leg. M.O.Malte 25.VII. 1929 (no. 591/29, type). Figs. 40—43: *P. vaginata*. 40: var. *elegans*, Hudson Strait, Wakeham Bay, leg. M. O. Malte 29. VIII. 1927 (no. 118455, type). 41: W. Greenland, Umanak, leg. J. Vahl VII. 1836 (type). 42—43: var. *paradoxa*, W. Greenland. Nûgssuaq, Niaqornarssuk pr. Marrait, leg. K. Jakobsen 3. IX. 1950 (no. 6100, type). × 10.

Figs. 44—51: *Puccinellia phryganodes* (spikelet, rachilla joint with lemma). 44—45: Greenland Type, W. Greenland, Sydostbugt, leg. N. Hartz VII. 1890. 46—47: Beringian Type, Aleutian Isl., Ogliuga Isl., leg. I. Murie 22.VII. 1936 (no. 2108). 48—49: Fennoscandian Type, Varanger Fjord, Nyborg, leg. F. Krok 28.VII. 1898. 50—51: Spitsbergen Type, Spitsbergen, Advent Bay, leg. H. Resvoll-Dieset 16. IX. 1908. Fig. 52: *P. maritima*, S. Greenland, Sermilik Fjord, leg. J. Gröntved 29.VII. 1937 (no. 1877). × 10.

FIGURES 53—100

LEAF EPIDERM

Left: Upper side of the leaf, area cut out along the leaf margin.
Right: Under side of the leaf, area cut out along a vascular bundle situated to the left of the row(s) of stomata. × 200.



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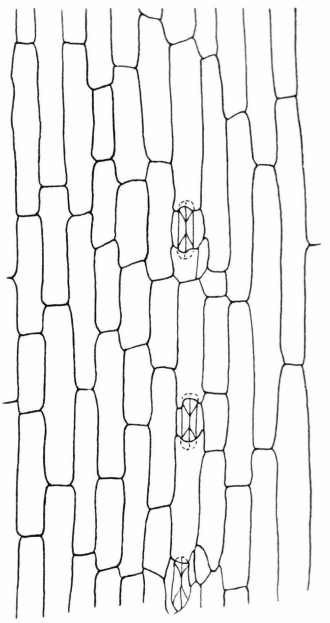

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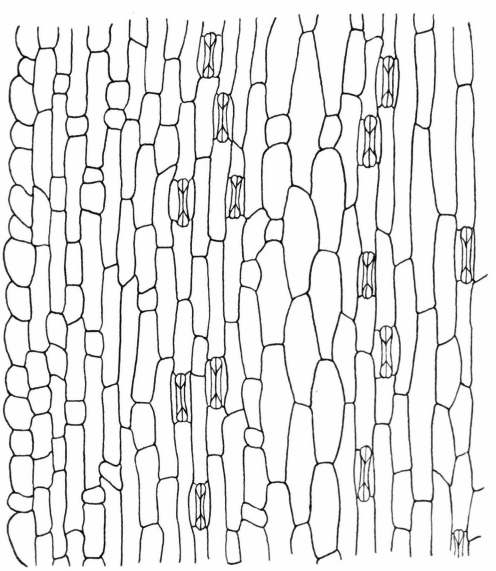

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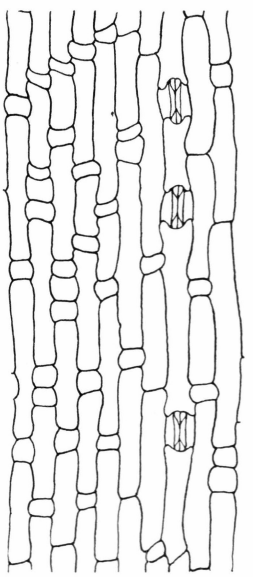
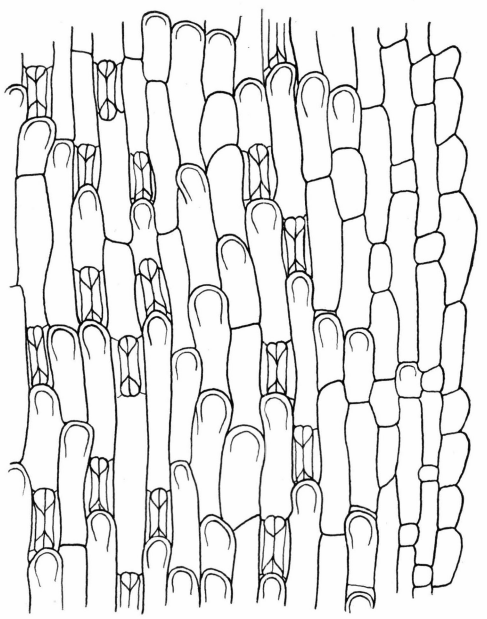


56

Figs. 53—54: *Colpodium Vahlianum*, W. Greenland, Nûgssuaq, Atâ, leg. M. P. Porsild 26. VII. 1913.

Figs. 55—56: *Puccinellia Langeana* ssp. *typica*, W. Greenland, Godhavn, leg. P. Gelting 17. VII. 1946.



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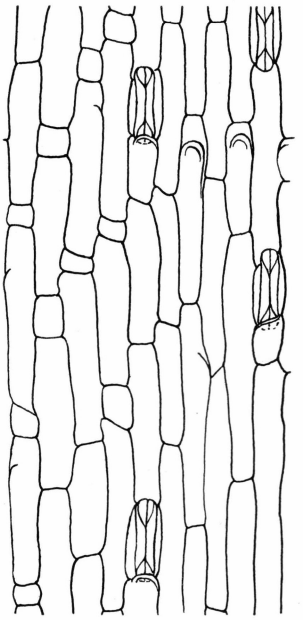

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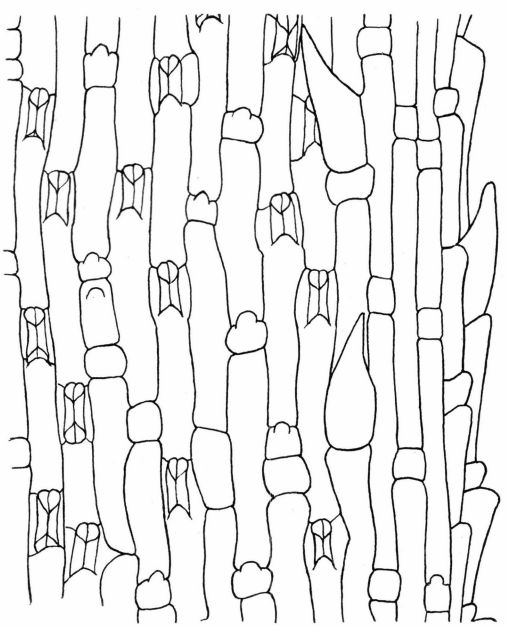

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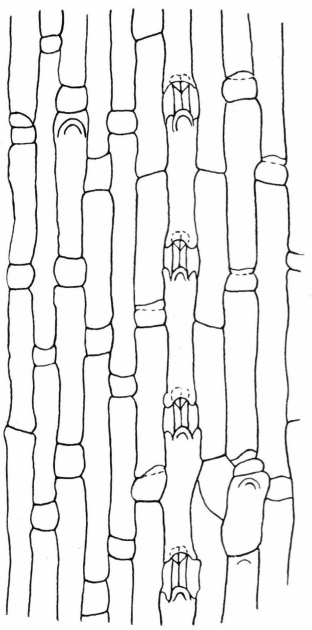

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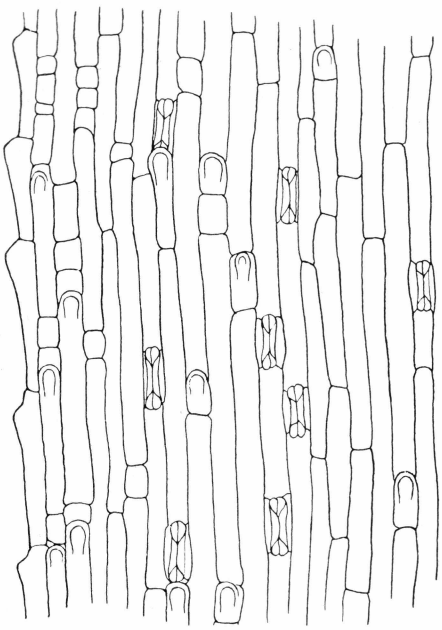
Figs. 57—58: *Puccinellia Andersonii*, NE. Greenland, Germania Land, Stormkap, leg. Th. Sørensen 11.VIII. 1933 (no. 2610).

Figs. 59—60: *Puccinellia Rosenkrantzii*, W. Greenland, Nûgssuaq, Qapiortoq kitdleq, leg. K. Jakobsen 12.VIII. 1948 (no. 2443, type).



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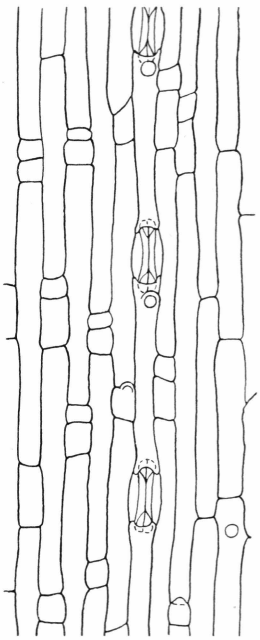

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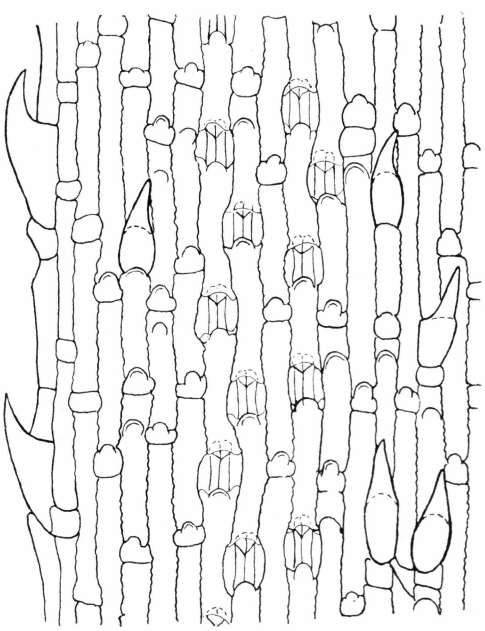

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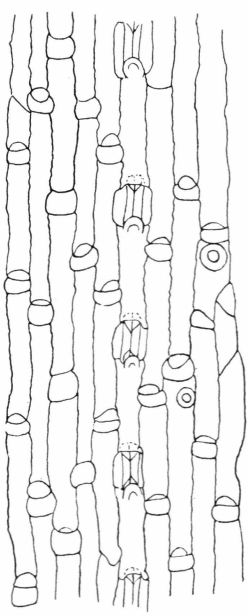

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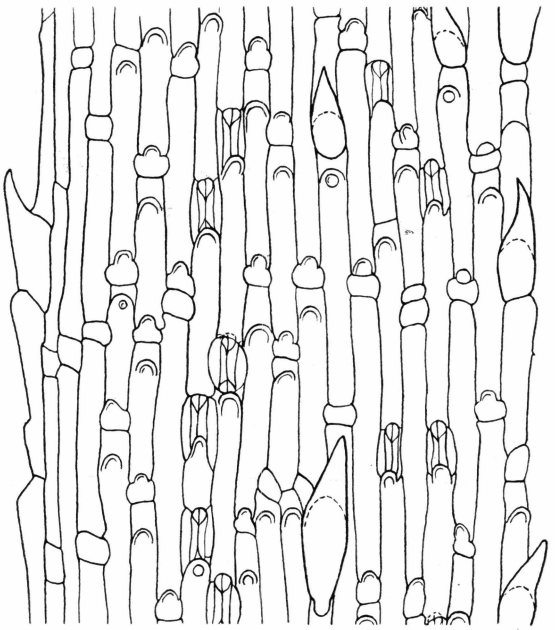
Figs. 61—62: *Puccinellia angustata*, W. Greenland, Svartenhuk, Tartûssaq, leg. M. P. Porsild 3.VIII. 1911.

Figs. 63—64: *Puccinellia deschampsioides*, W. Greenland, Arfersiorfik Fjord, Sofie Havn, leg. M. P. Porsild 20.VII. 1924 (type).



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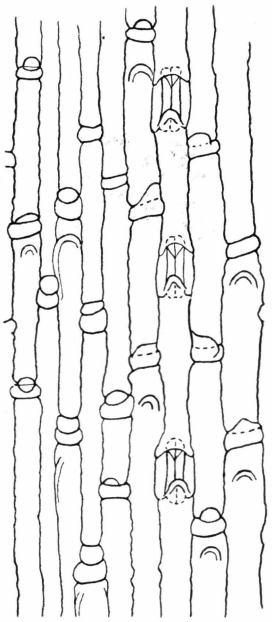

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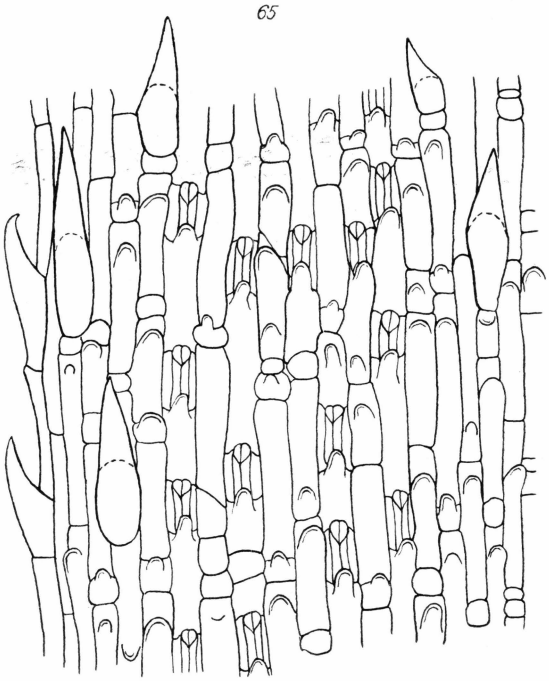

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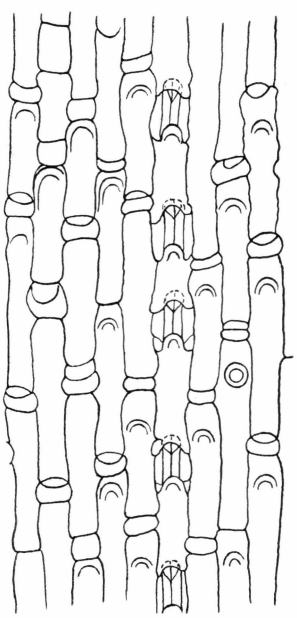

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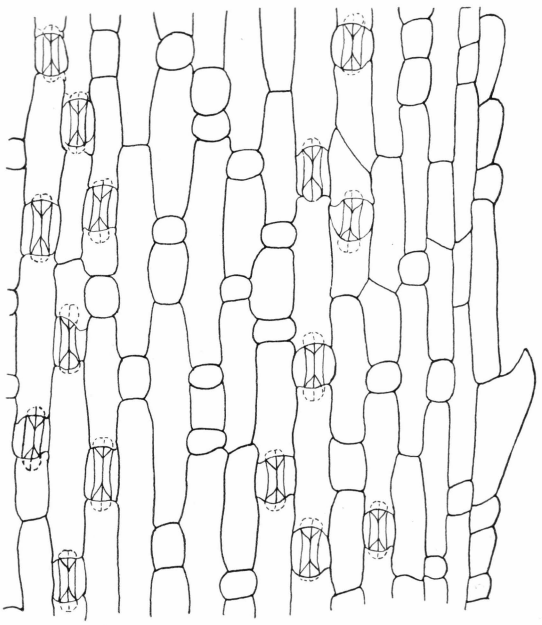
Figs. 65—66: *Puccinellia laurentiana*, SW. Greenland, Ameralik Fjord, Eqaluit, leg. J. Lagerkranz 26. VIII. 1936.

Figs. 67—68: *Puccinellia Porsildii*, W. Greenland, Godhavn, leg. M. P. Porsild 8. IX. 1933 (type).



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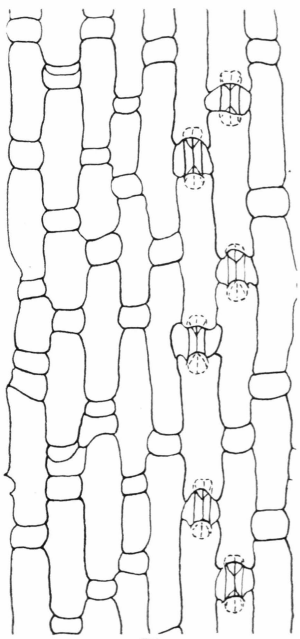

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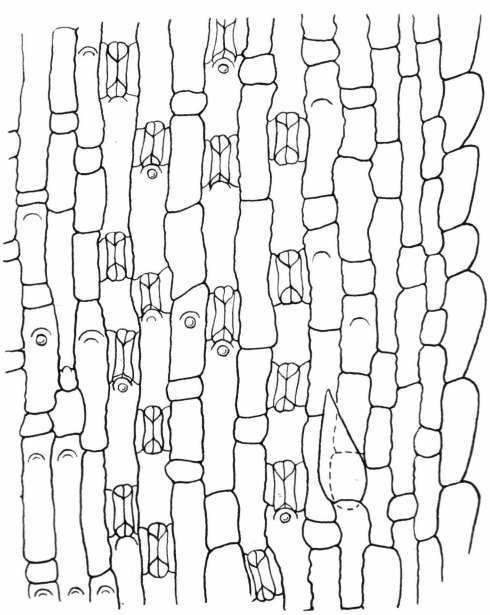

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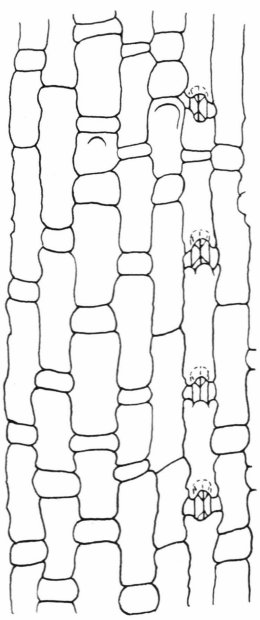
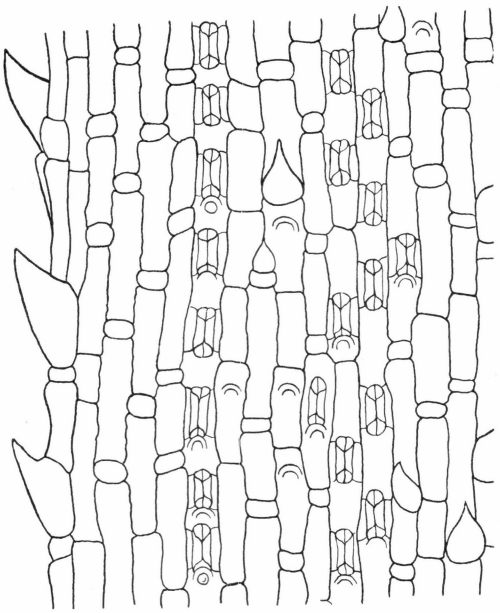


72

Figs. 69—70: *Puccinellia groenlandica*, W. Greenland, Egedesminde, leg. Th. Sørensen 2.VIII. 1947.

Figs. 71—72: *Puccinellia coarctata*, SE. Greenland, Kap Tordenskjold, leg. R. Bøgvad 21.VIII. 1932 (no. 629).



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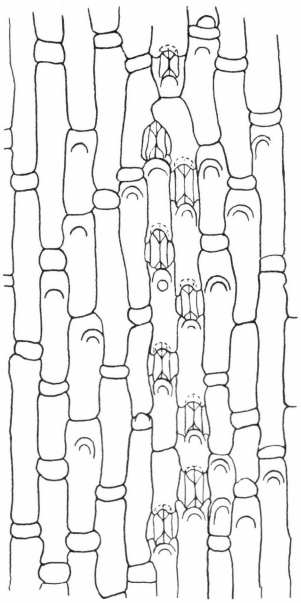

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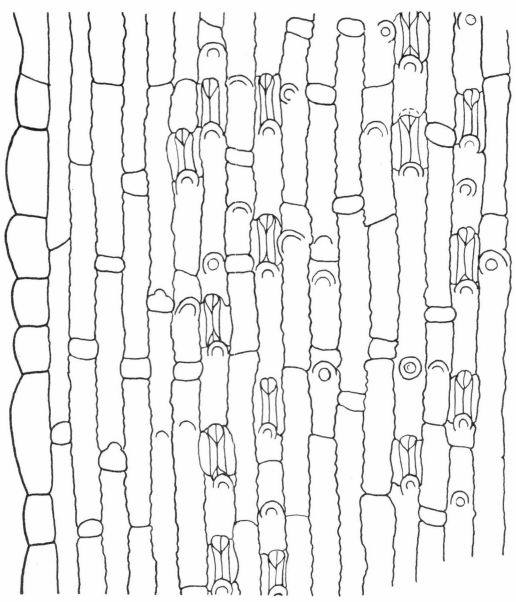

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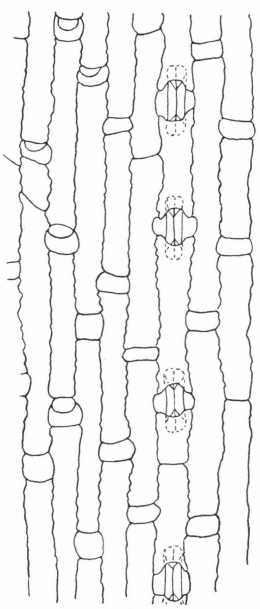

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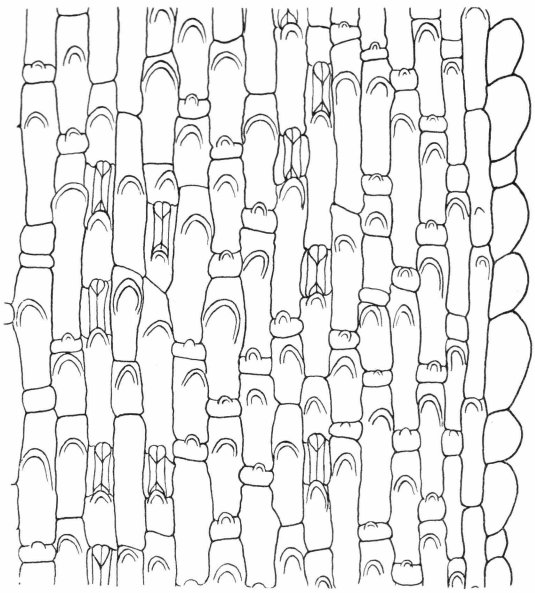
Figs. 73—74: *Puccinellia coarctata*, Newfoundland, St. John Isl., leg. M. L. Fernald et al. 31.VII. 1925 (no. 27363).

Figs. 75—76: *Puccinellia maritima*, S. Greenland, Sermilik Fjord, leg. J. Gröntved 29.VII. 1937 (no. 1877).



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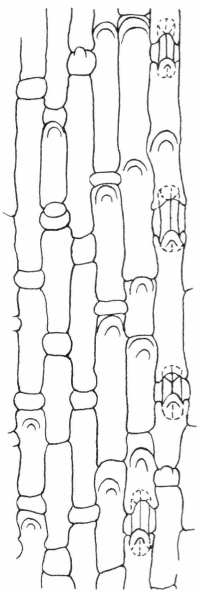

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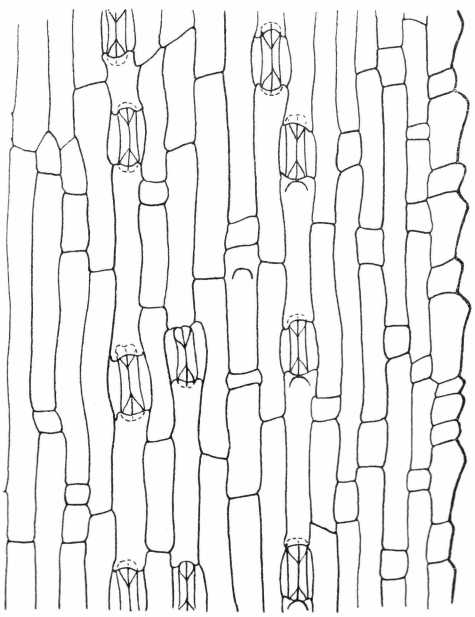

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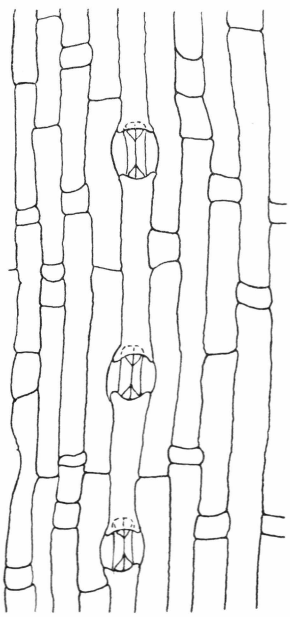
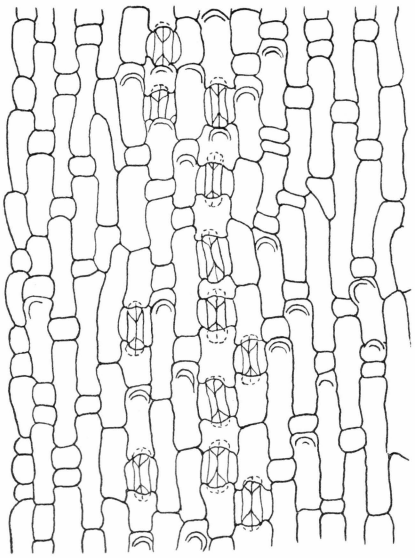


80

Figs. 77—78: *Puccinellia americana*, New Brunswick, Anlac, leg. M. O. Malte 25. VII. 1929 (no. 591/29, type).

Figs. 79—80: *Puccinellia vaginata* var. *elegans*, Hudson Strait, Wakeham Bay, leg. M. O. Malte 29. VIII. 1927 (no. 118455, type).



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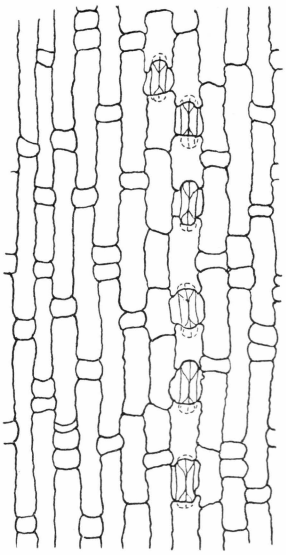

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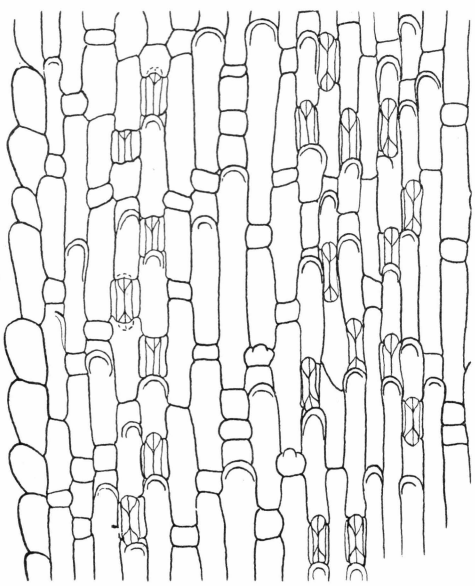

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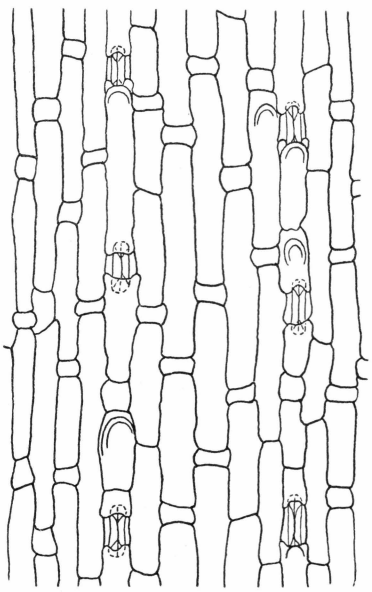
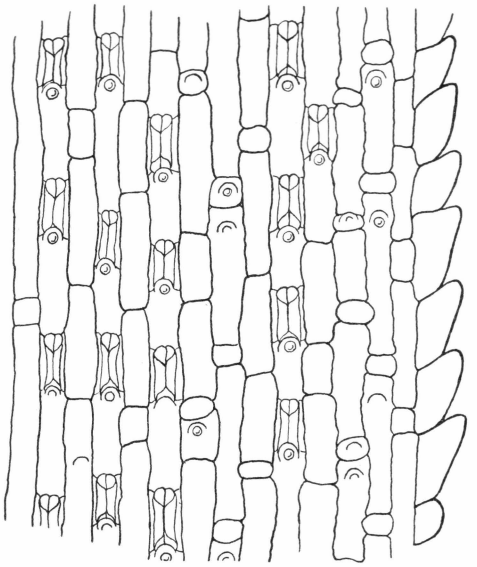


84

Figs. 81—82: *Puccinellia pumila* "*Fernaldii*", Eastern Quebec, Rimouski County, small isl. E. of Cap Original, Bic, leg. Fernald & Collins 6.VII. 1906 (no. 168).
Figs. 83—84: *Puccinellia ambigua*, Prince Edward Isl., Alberton, leg. Fernald & St. John 11.VII. 1912 (no. 6913, type).



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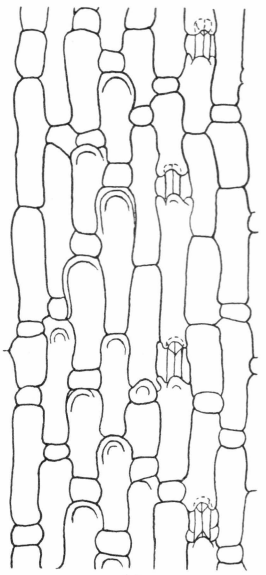

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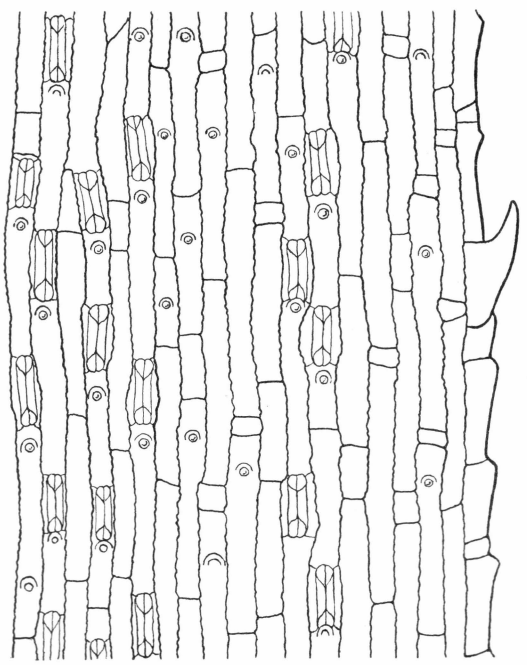

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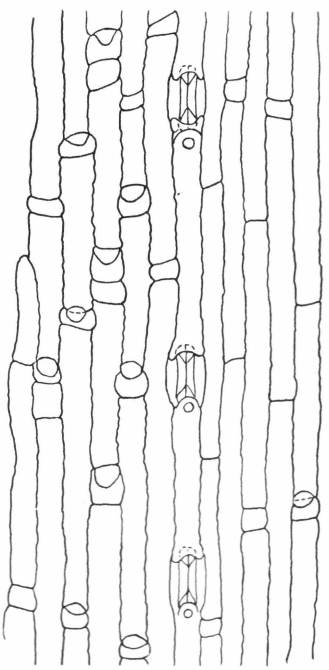

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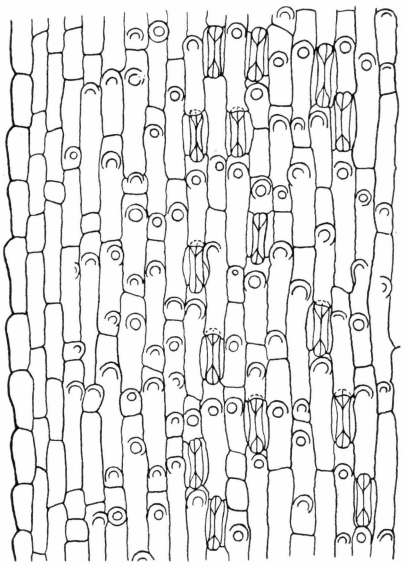
Figs. 85—86: *Puccinellia vaginata* var. *paradoxa*, W. Greenland, Nûgssuaq, Niaqornarssuk pr. Marrait, leg. K. Jakobsen 3. IX. 1950 (no. 6100, type).
Figs. 87—88: *Puccinellia vaginata*, W. Greenland, Umanak Distr., Qaumarujuk Fjord, leg. M. P. Porsild 27. VII. 1935.



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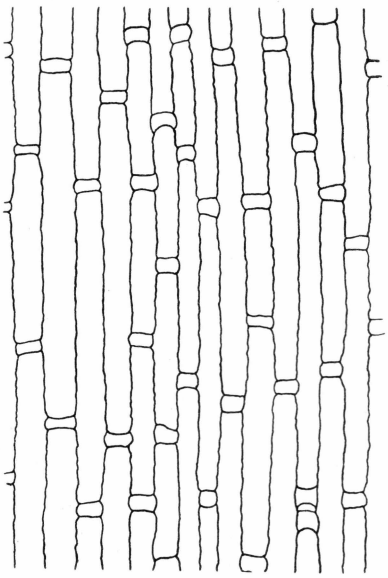

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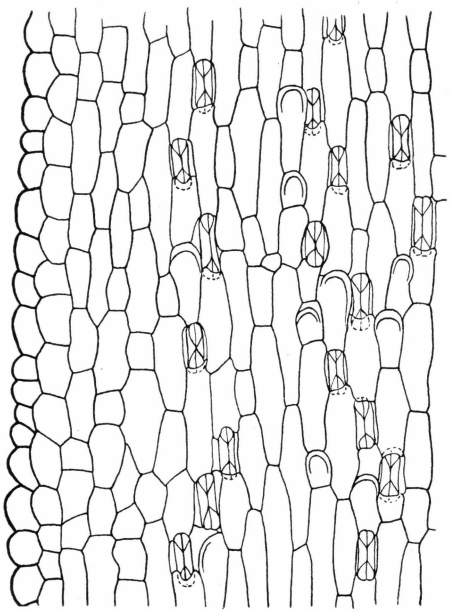

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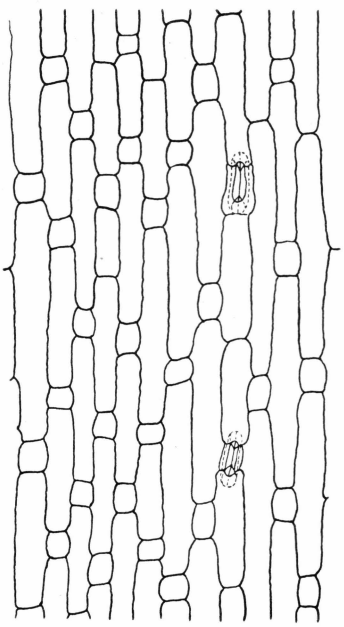

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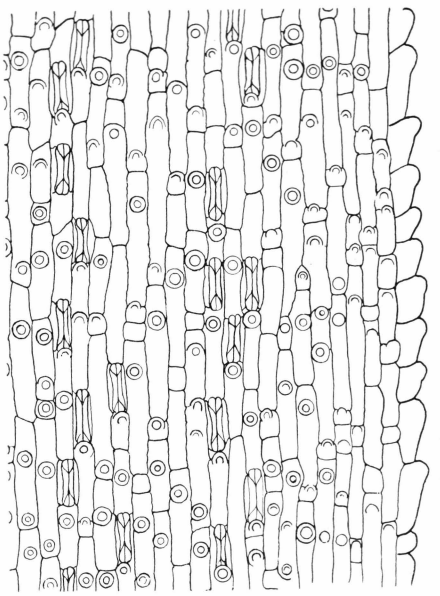
Figs. 89—90: *Puccinellia phryganodes* Fennoscandian Type, Varanger Fjord, Nyborg, leg. F. Krok 28.VII. 1898.

Figs. 91—92: *Puccinellia phryganodes* Beringian Type, Aleutian Isl., Ogliuga Isl., leg. I. Murie 22.VII. 1936 (no. 2108).



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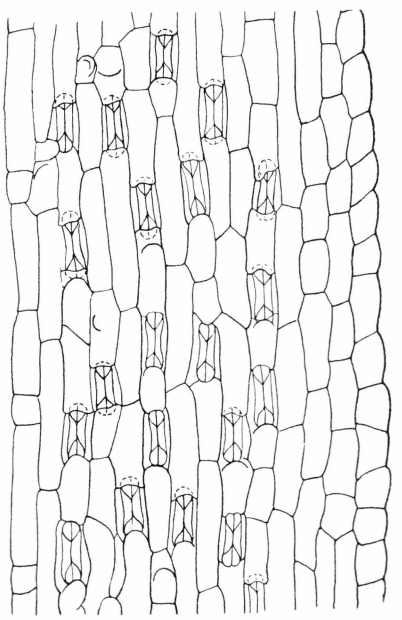

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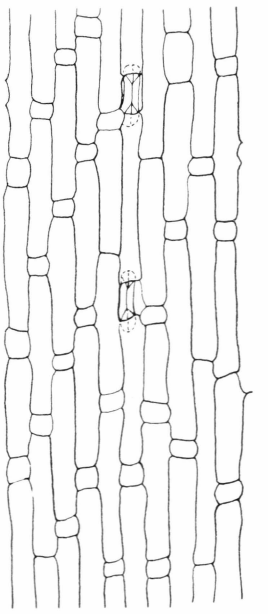

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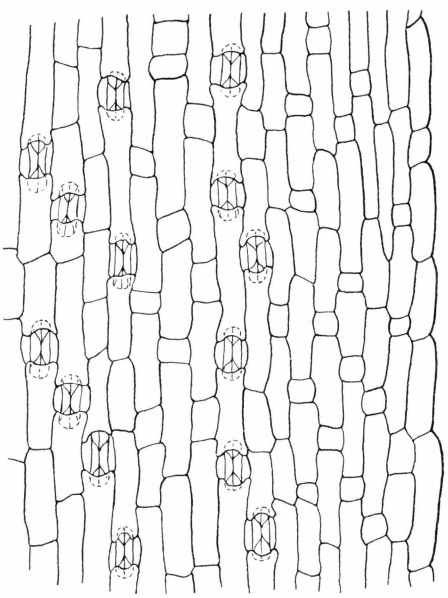
Figs. 93—94: *Puccinellia phryganodes* Greenland Type, W. Greenland, Nùgssuaq, Ikorfat, leg. Th. Sørensen 31. VIII. 1947.

Figs. 95—96: *Puccinellia phryganodes* Spitsbergen Type, Spitsbergen, Advent Bay, leg. H. Resvoll-Dieset 16. IX. 1908.



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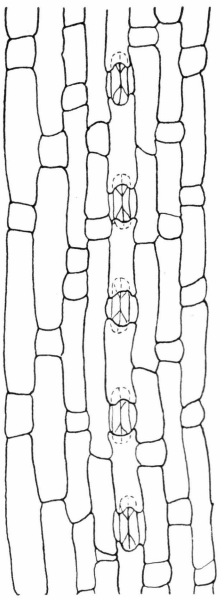

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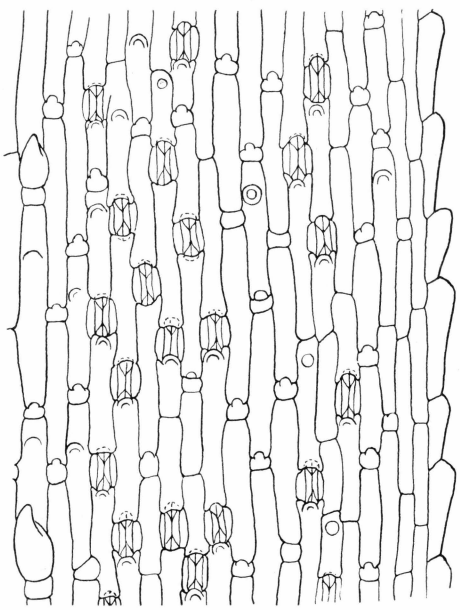

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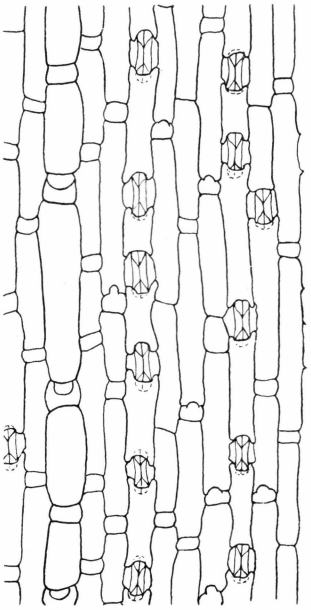


100

Figs. 97—98: *Puccinellia retroflexa*, S. Sweden Varberg, leg. J. A. Gabrielsson 1881.
Figs. 99—100: *Puccinellia distans*, Denmark, Funen, Ullerslev, leg. Sv. Andersen 22. VI. 1950.

FIGURES 101—114

MAPS OF DISTRIBUTION

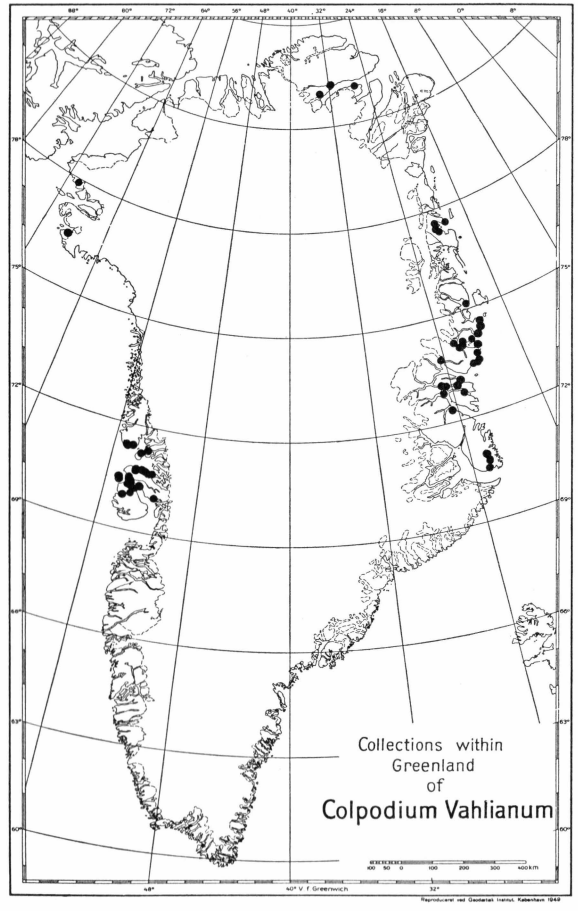


Fig. 101.

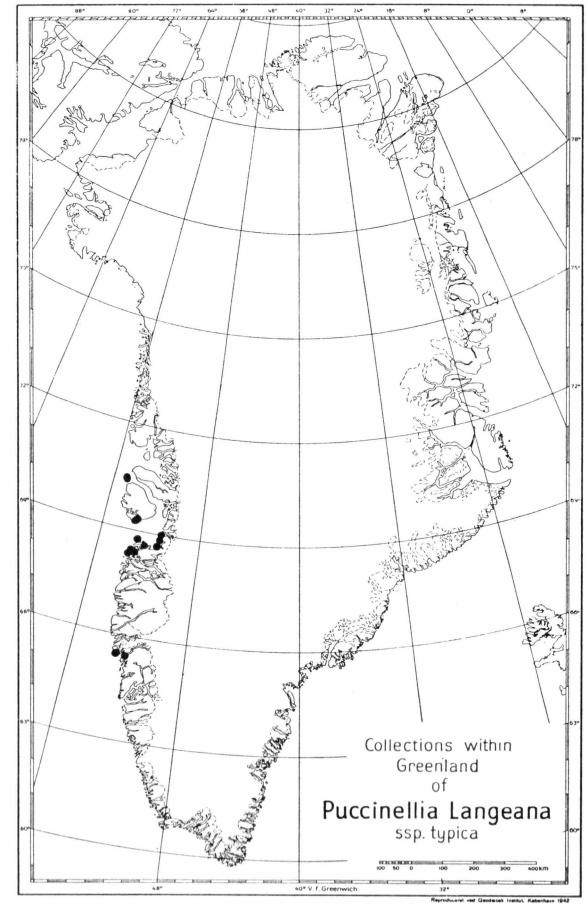


Fig. 102.

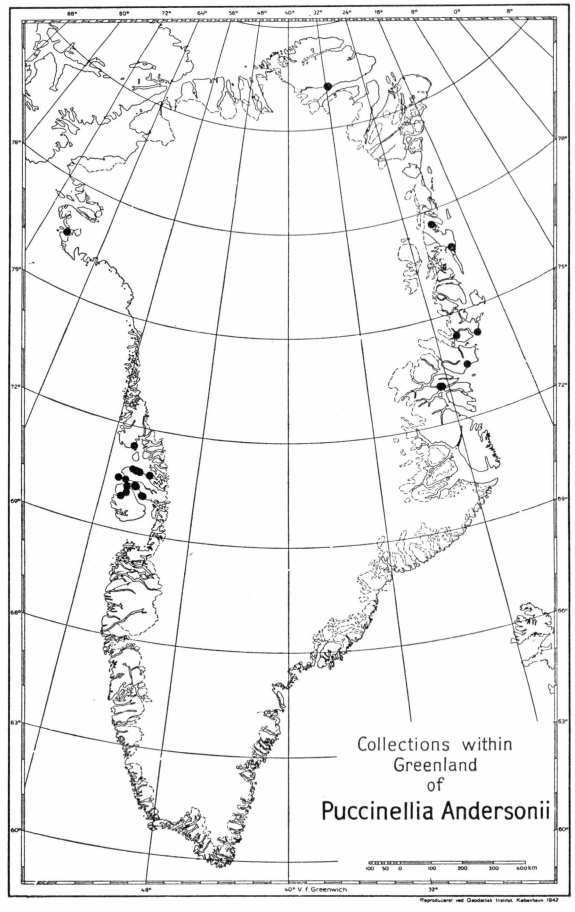


Fig. 103.

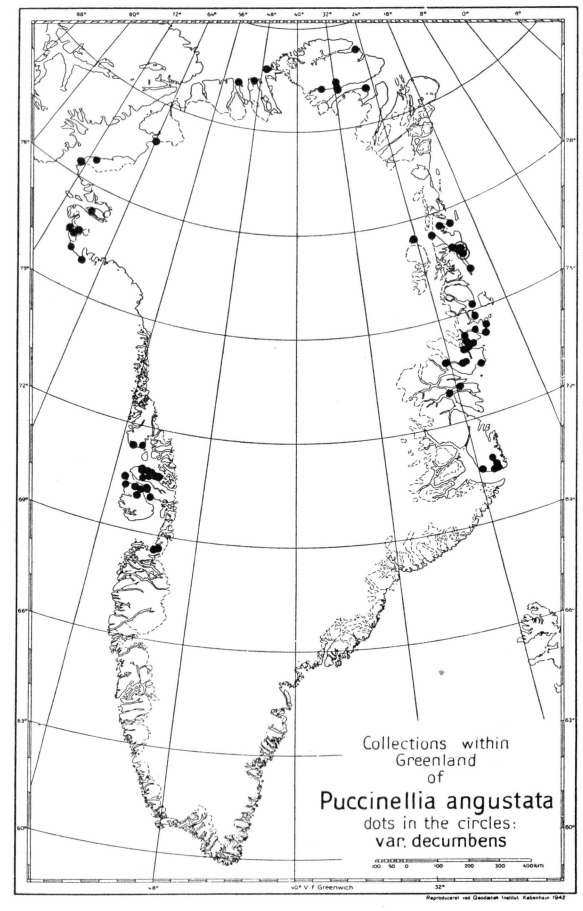


Fig. 104.

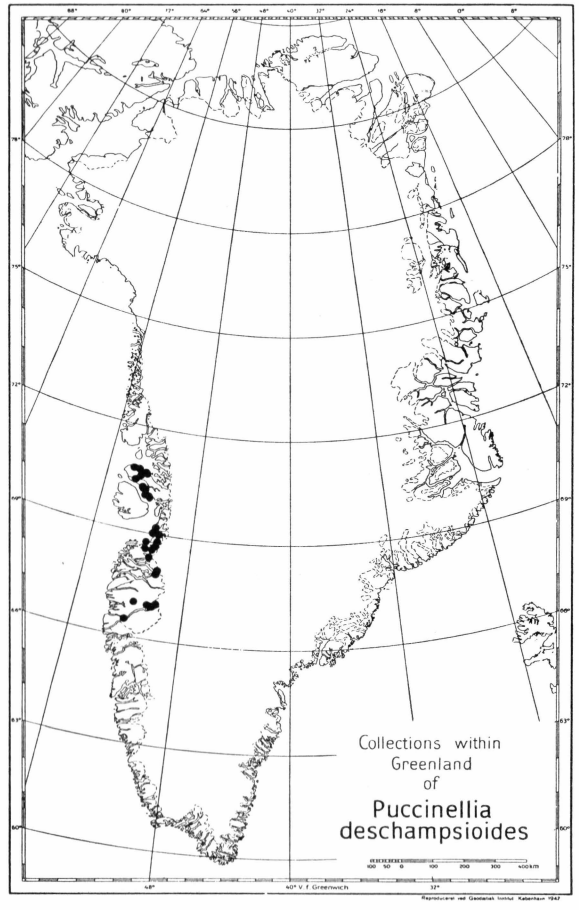


Fig. 105.

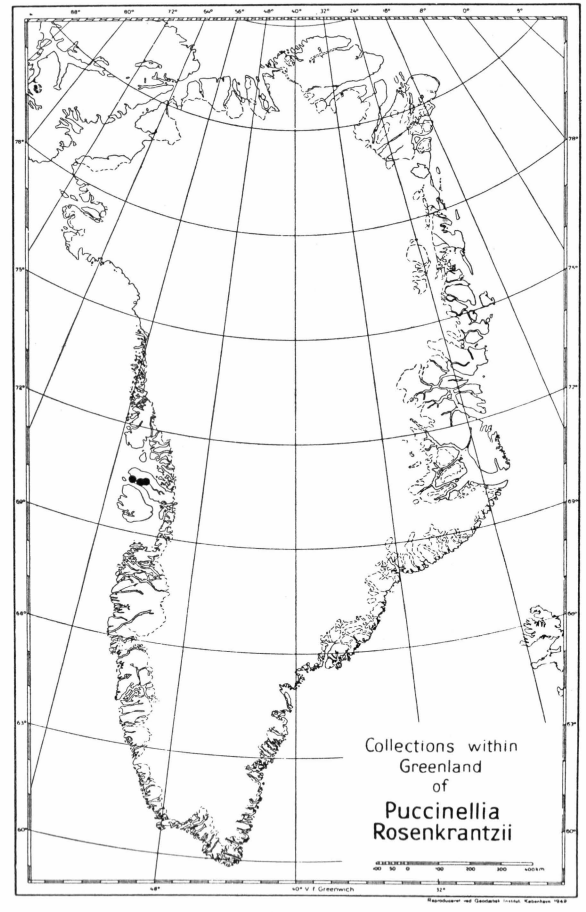


Fig. 106.

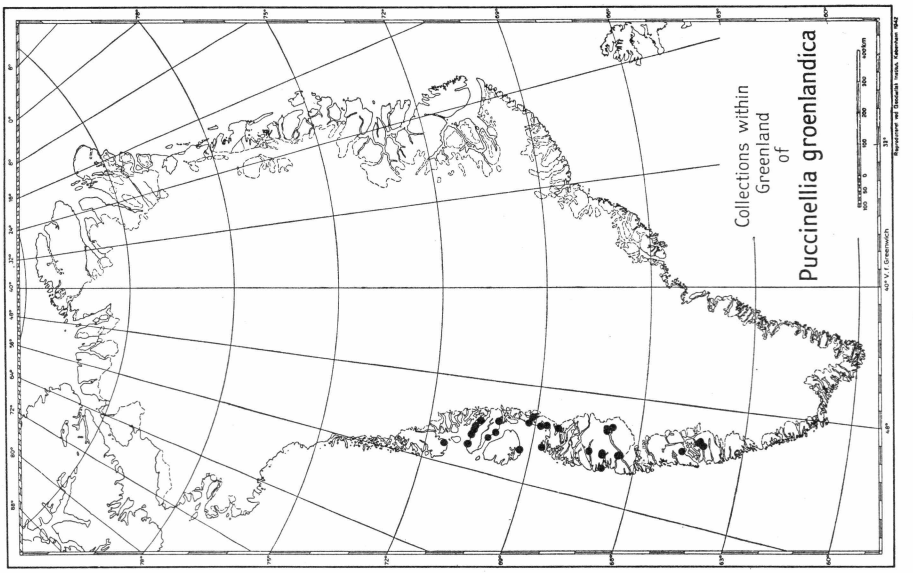


Fig. 108.

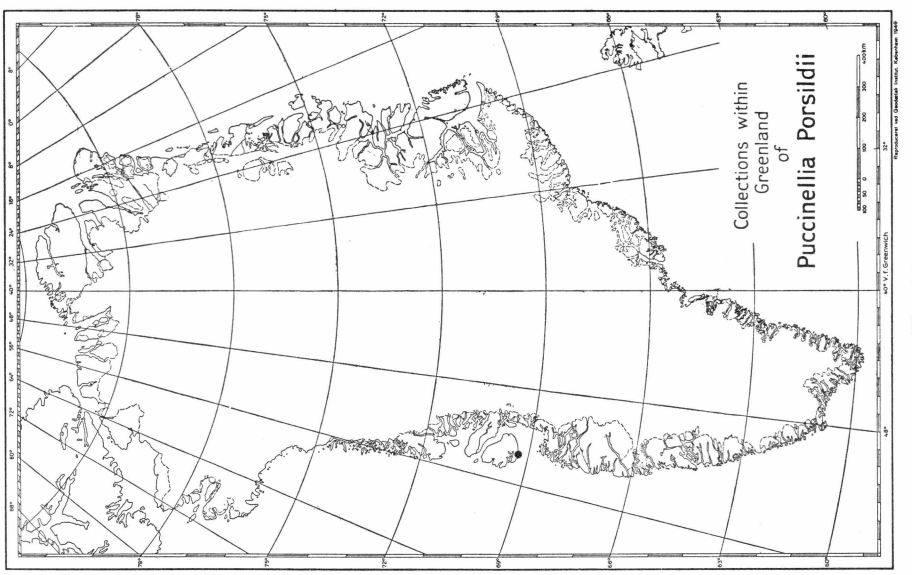


Fig. 107.

Fig. 109.

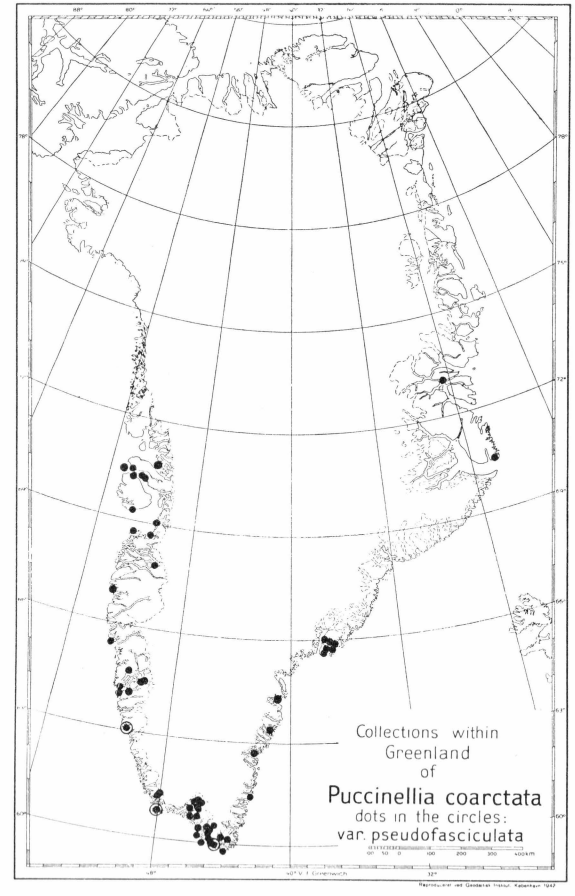


Fig. 110.

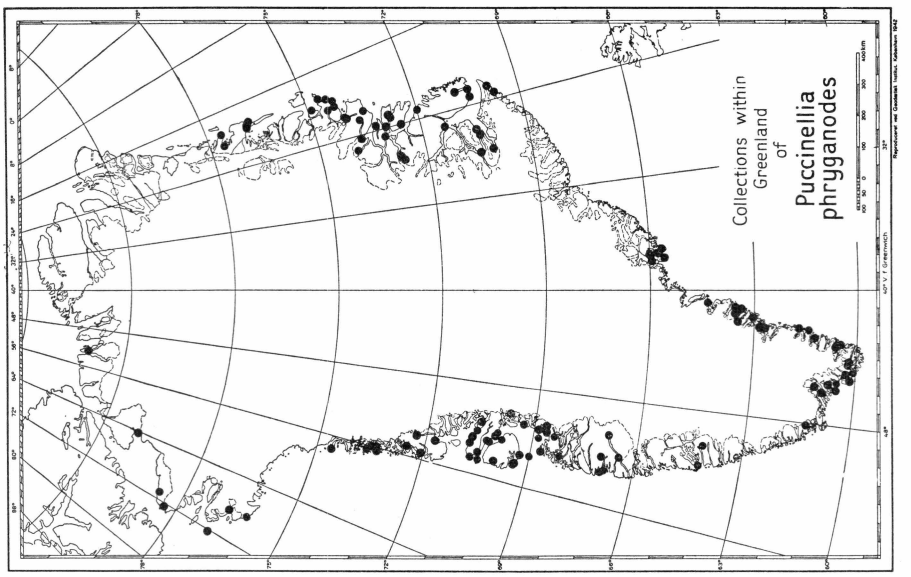


Fig. 112.

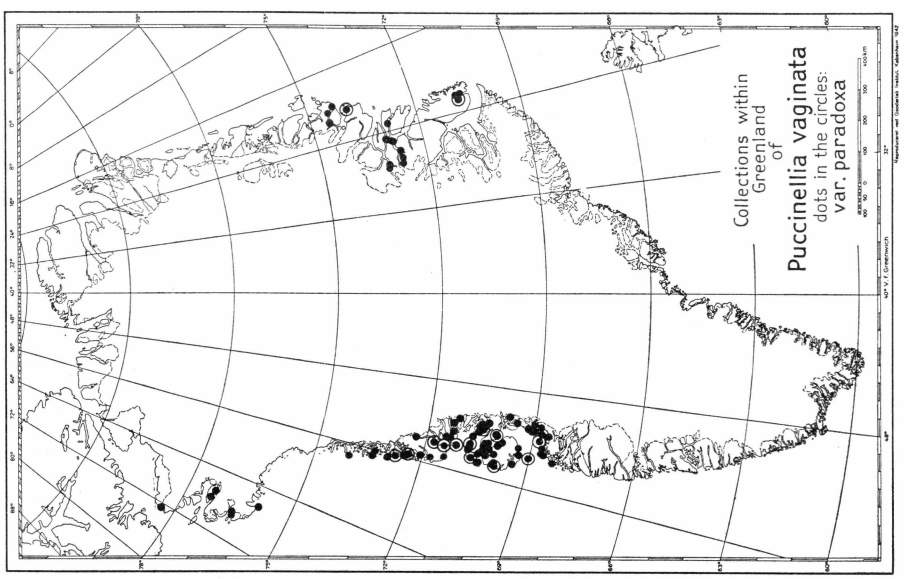


Fig. 111.

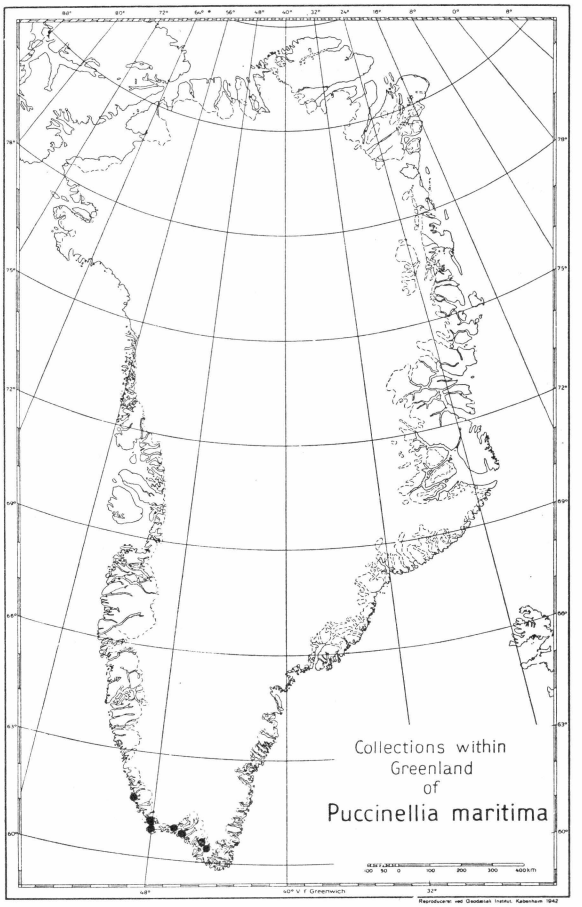


Fig. 113.

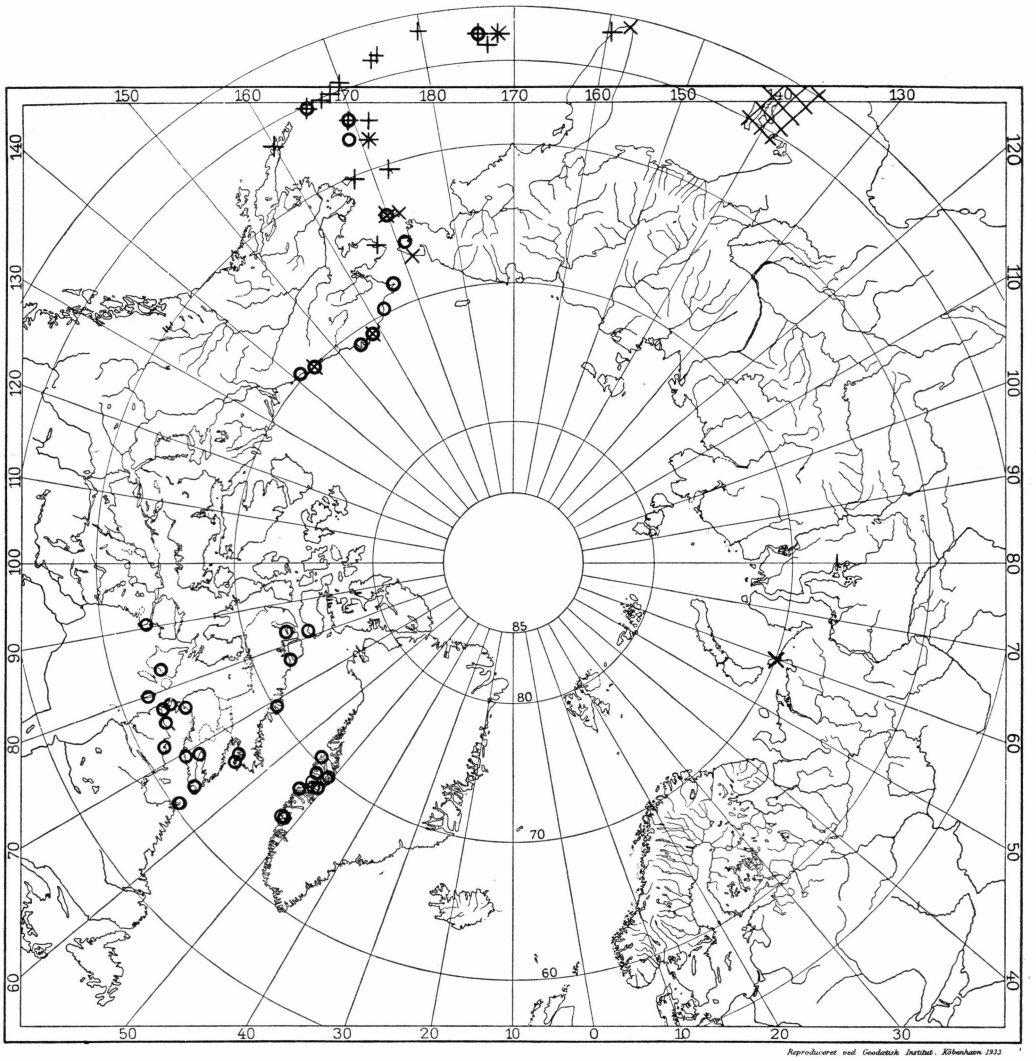


Fig. 114. Map showing the geographical distribution of *Puccinellia Langeana:* circle (○) ssp. *typica;* cross (×) ssp. *asiatica;* plus sign (+) ssp. *alaskana.*
The individual localities refer to specimens examined by the author; Specimens which combine characters of different subspecies are indicated by combined symbols. The hatched East Asiatic Area of ssp. *asiatica* refers to the distribution of "*Atropis paupercula*" given by KRECZETOWICH (Fl. URSS II (1934) p. 480).

PLATES

Plate 1.

Puccinellia Langeana ssp. *typica*. Above: W. Greenland, Godhavn, leg. P. Gelting 17.VII. 1946; below: W. Greenland, Kangâtsiaq, leg. A. Berlin 30. VI. 1883 (type collection). × $^1/_2$.

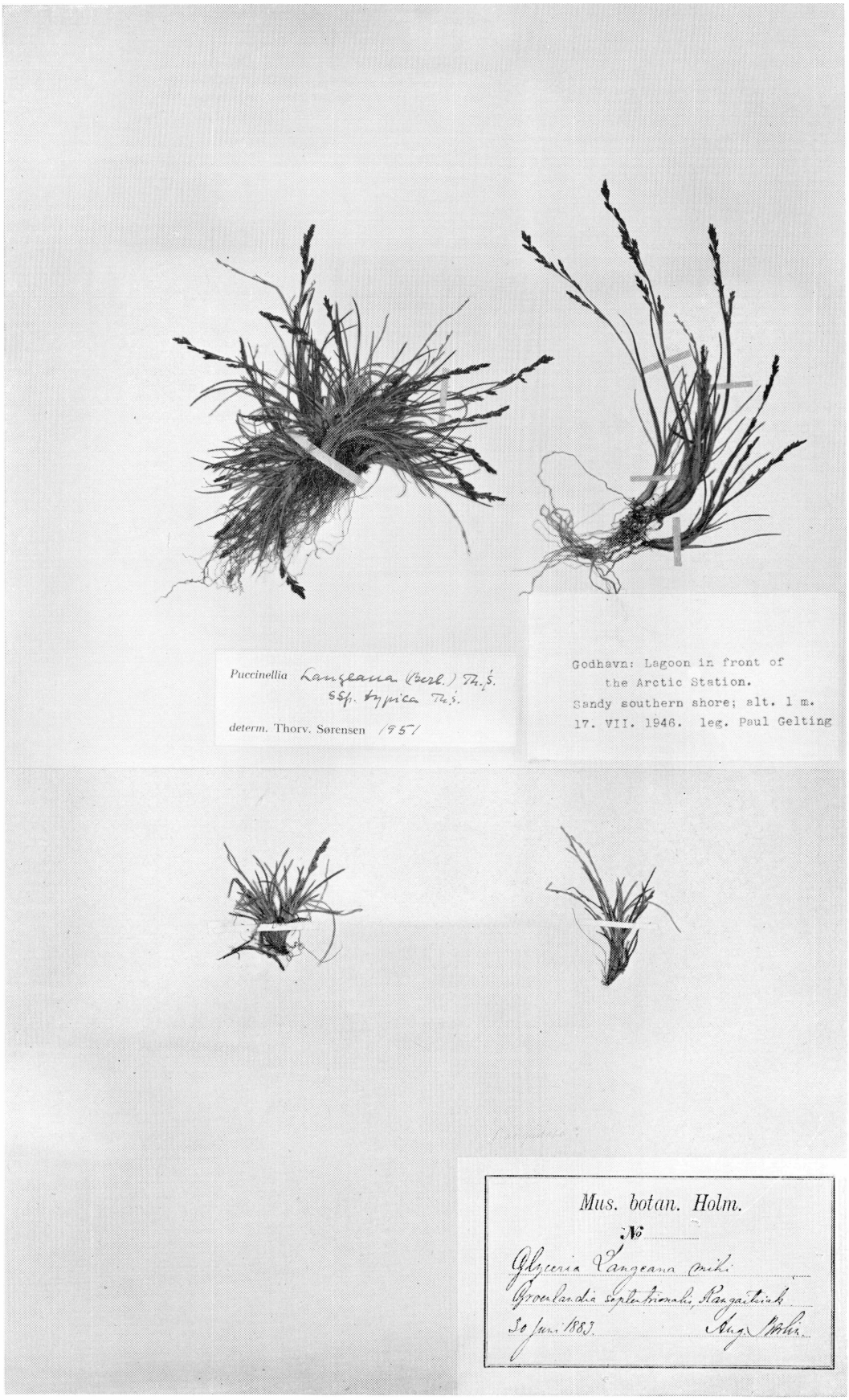

Puccinellia Langeana (Berl.) Th.S.
ssp. typica Th.S.
determ. Thorv. Sørensen 1957
Godhavn: Lagoon in front of
the Arctic Station.
Sandy southern shore; alt. 1 m.
17. VII. 1946. leg. Paul Gelting
Mus. botan. Holm.
№
Glyceria Vangeana Grisb.
Groenlandia septentrionali, Rangaitsiak
30 Jun. 1883. Aug. Stolpe

Plate 2.

Puccinellia deschampsioides. W. Greenland. Arfersiorfik Fjord, Sofia Havn, leg. M. P. Porsild 20.VII. 1924 (type). × ½.


MUSEUM HOTANICUM HAUNIENSE
Puccinellia deschampsioides Th. F.
Type
determ. Thorv. Sørensen 1/50
DEN DANSKE ARKTISKE STATION.
DISKO, GRØNLAND.
? Puccinellia angustata (R.Br.) Rand & Redf.
GROENL. OCCID. Arfersiorfik Fjord,
„Sofia"s Havn ved 68° 20' N. 51° 5' W.
ved Randen af Indlandsisen.
d. 20/7 1924.
Morten P. Porsild.

Plate 3.

Puccinellia Rosenkrantzii. W. Greenland, Nûgssuaq, Qapiortoq kitdleq, leg. K. Jakobsen 12.VIII. 1948 (type). × ½.

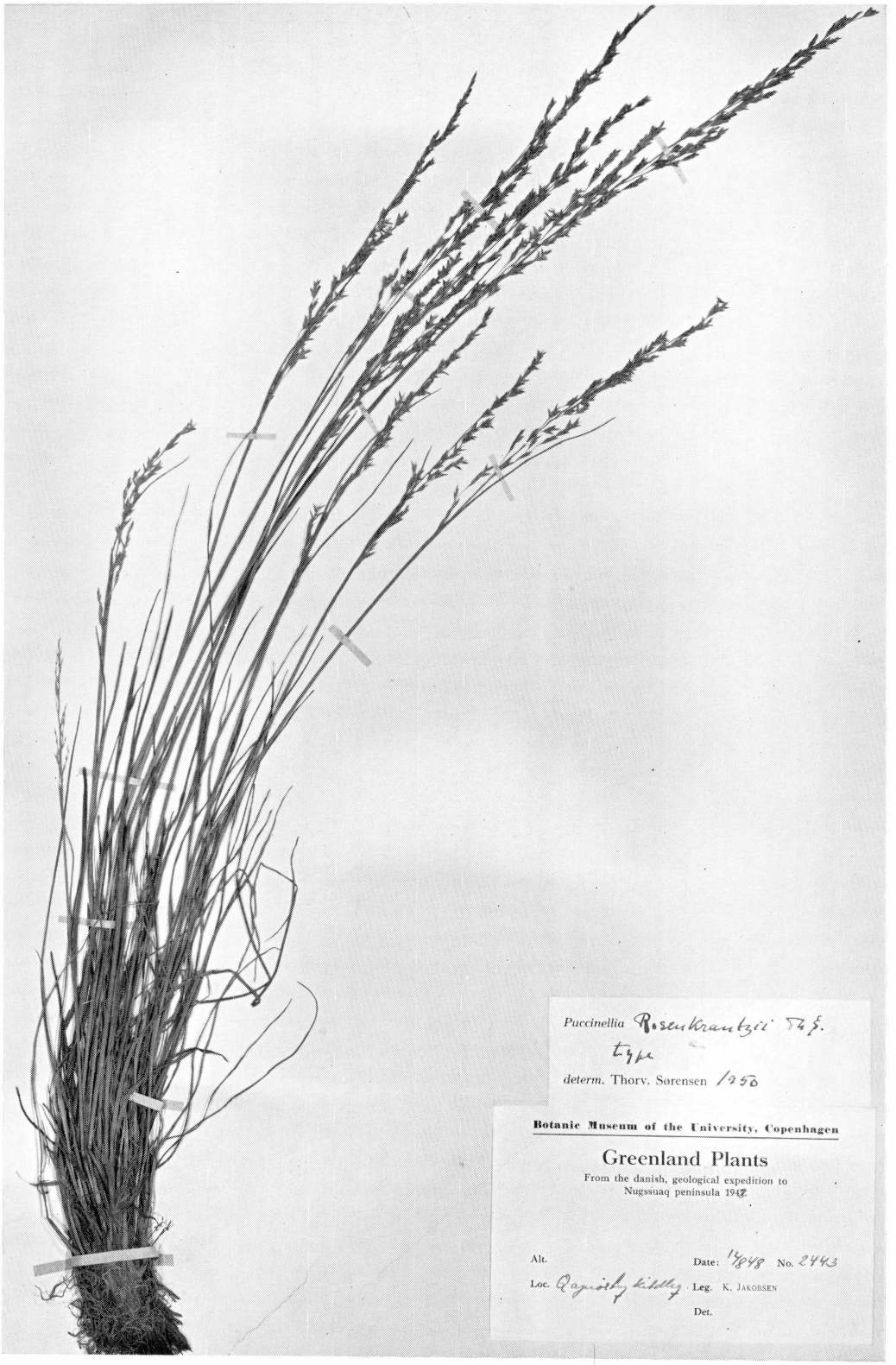

Puccinellia Rosenkrantzii Sørs.
type
determ. Thorv. Sørensen 1950
Botanic Museum of the University, Copenhagen
Greenland Plants
From the danish, geological expedition to Nugssuaq peninsula 1947
Alt.
Date: 13/8 48 No. 2443
Loc. Qaqiatsy kibdly
Leg. K. JAKOBSEN
Det.

Plate 4.

Puccinellia Porsildii. W. Greenland, Godhavn, leg. M. P. Porsild 8. IX. 1933 (type). × 1/2.

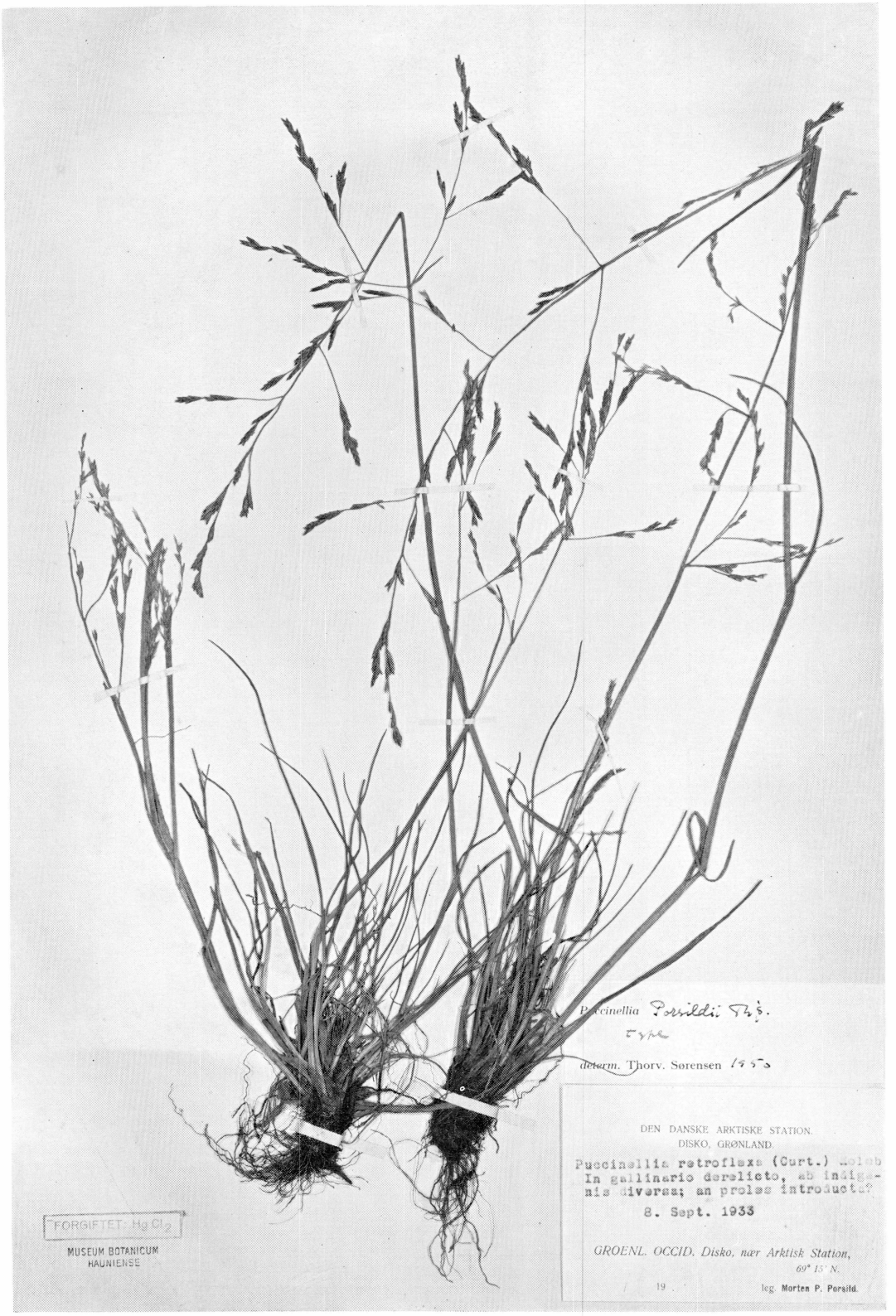
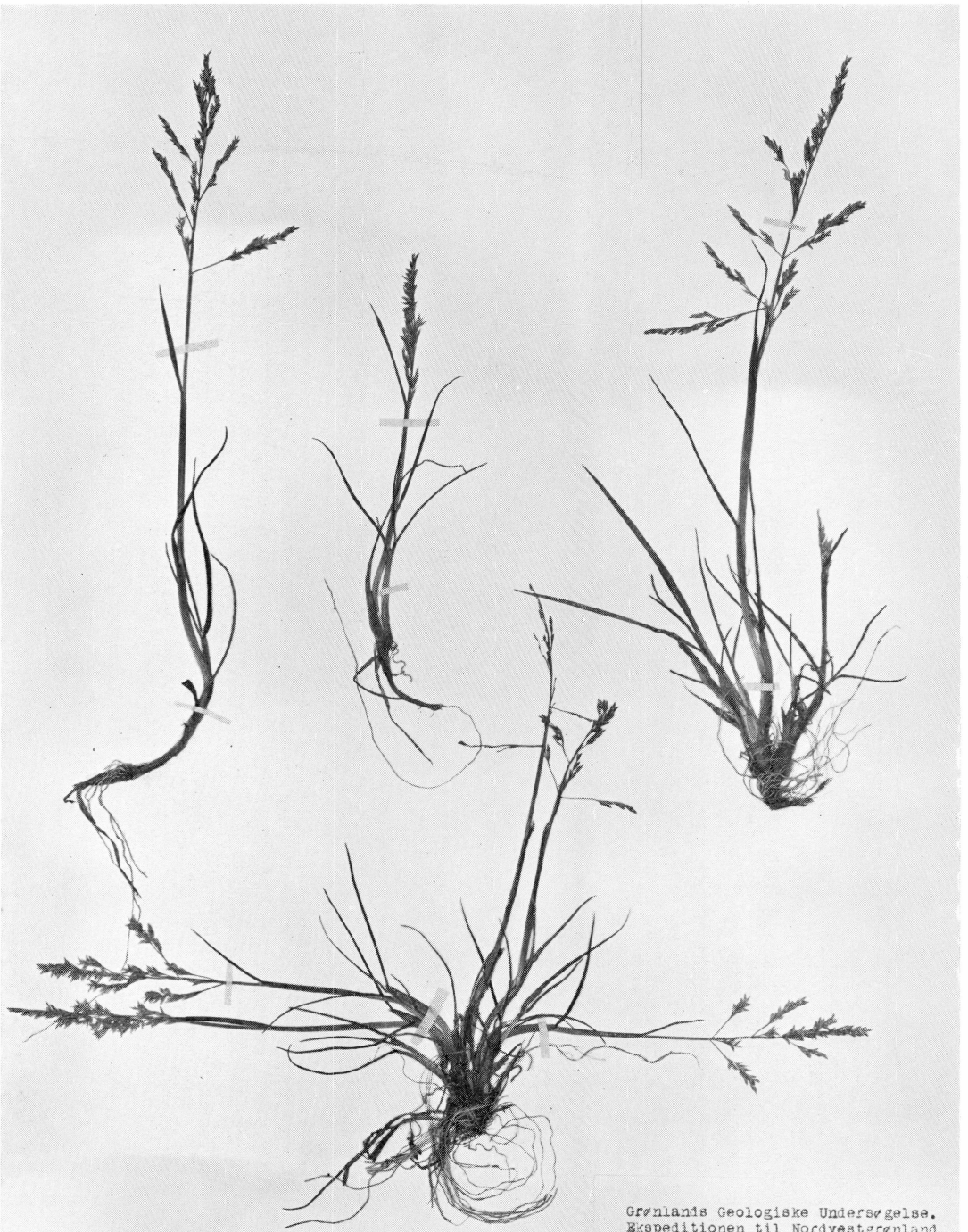

Puccinellia Porsildii Th.S.
Type
determ. Thorv. Sørensen 1933
DEN DANSKE ARKTISKE STATION.
DISKO, GRØNLAND.
Puccinellia retroflexa (Curt.) Wolob
In gallinario derelicto, ab indige-
nis diversa; an proles introducta?
8. Sept. 1933
GROENL. OCCID. Disko, nær Arktisk Station,
69° 15' N.
19 . .
leg. Morten P. Porsild.
FORGIFTET: HgCl2
MUSEUM BOTANICUM
HAUNIENSE

Plate 5.

Puccinellia vaginata var. *paradoxa*. W. Greenland, Nûgssuaq, Niaqornarssuk pr. Marrait, leg. K. Jakobsen 3. IX. 1950 (type). × ½.



Grønlands Geologiske Undersøgelse.
Ekspeditionen til Nordvestgrønland
1950.

Puccinellia vaginata (Lge.) Fern. & Wieg.
var. *parvula* Th. S.
determ. Thorv. Sørensen 1951

nr. 6100

Niaqornarssuk ved Marrait.
Lat. 70°30'. Long. 54°12'.
Nugssuaq Halvøen.
Leg. K. Jakobsen. 3/9 1950.

Plate 6.

Puccinellia vaginata var. *elegans*. Hudson Strait, Wakeham Bay, leg. M. O. Malte 29. VIII. 1927 (type). × 1/2.


Distributed by
NATIONAL HERBARIUM OF CANADA
No. 118455
National Herbarium of Canada
FLORA OF QUEBEC
Puccinellia angustata (R. Br.) Rand & Redf.
var. vaginata Holmb. ex Porsild
Hab. and Loc. Wakeham Bay, Hudson Strait 61° 40' N. 72° 5' W.
Collector, M. O. Malte
Aug. 29, 1927
Puccinellia elegans Th. Sør.
type!
determ. Thorv. Sørensen 1928
MUSEUM BOTANICUM
HAUNIENSE

Plate 7.

Puccinellia ambigua. Prince Edward Isl., Alberton, leg. Fernald & St. John 11.VII. 1912 (type). × ½.


FLORA OF PRINCE EDWARD ISLAND
PRINCE COUNTY
No. 6713.
Stoloniferous!
Damp brackish sand, Alberton.
M. L. Fernald and Harold St. John,
July 11, 1912.
Puccinellia ambigua Th. S.
type
determ. Thorv. Sørensen 1951.
MUSEUM BOTANICUM
HAUNIENSE

Plate 8.

Puccinellia arctica. Arctic America, Herschell Isl., leg. A. H. Lindstrøm 17.VII. 1906. × ½.


Puccinellia arctica (Hook.) Fern. & Wieghtl.
determ. Thorv. Sørensen 1951.
Herb. Univers. Christianiensis.
ter arctic. Roald Amundsen (Gjöa-Expedition)
1903—1906.
America arct., Herschell Island
Lat. N. 69° 35'
Long. W. 138° 50'
leg. A. H. Lindström.

Plate 9.

Puccinellia Langeana ssp. *asiatica*. Waigatsch, Cape Grebeni, leg. Kjellmann & Lundstrøm 30.—31.VII. 1875. × $^1/_2$.

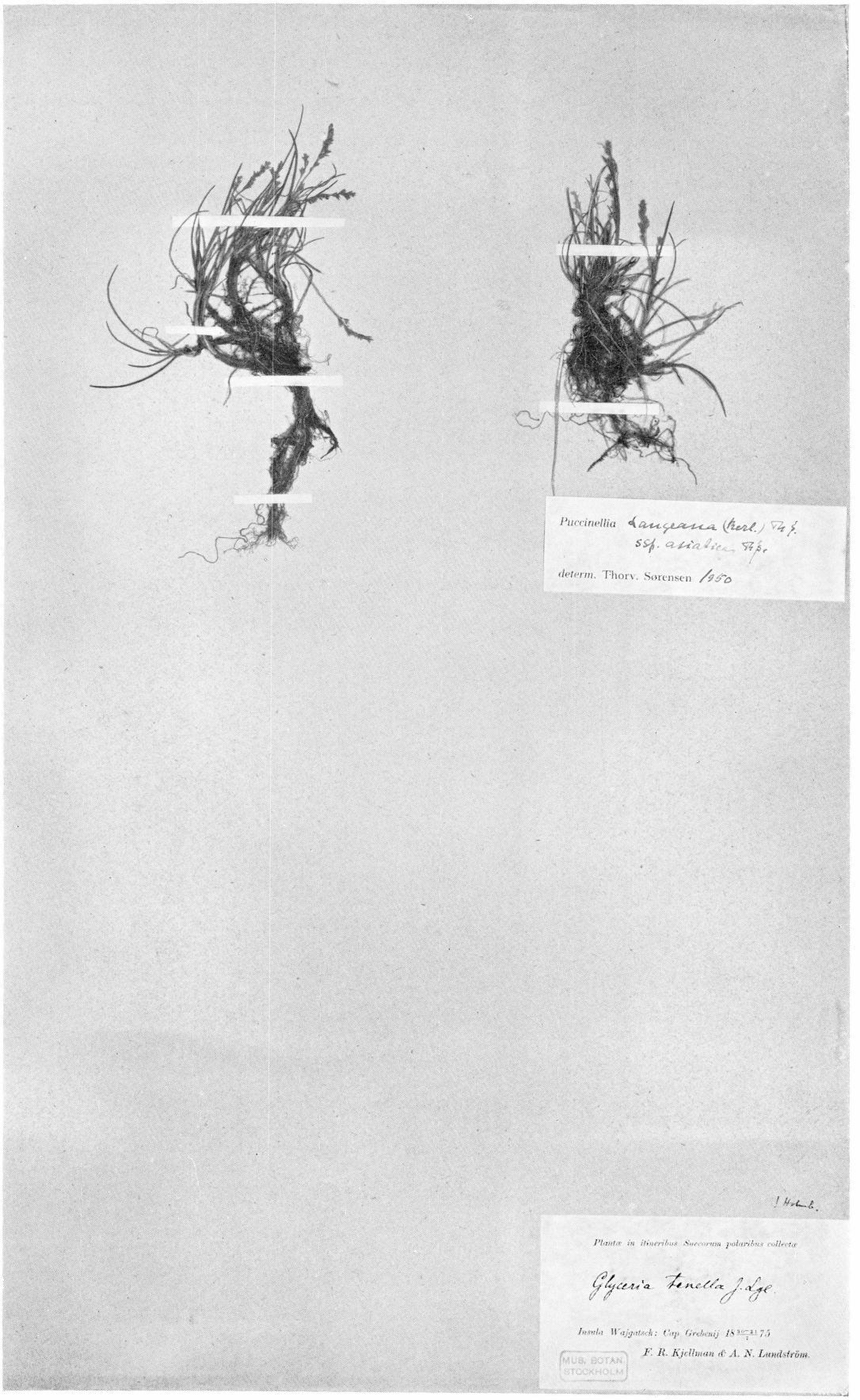

Puccinellia Langeana (Kcrl.) Th. S.
ssp. arctica Th. S.
determ. Thorv. Sørensen 1950
Plantæ in itineribus Succorum polaribus collectæ
Glyceria Fenella J. Lge.
Insula Wajgatsch: Cap Grebenij 18 30-31/7 75
F. R. Kjellman & A. N. Lundström.
MUS. BOTAN. STOCKHOLM

Plate 10.

Puccinellia fragiliflora. Novaya Zemlya, Matotchkin Shar, leg. O. Ekstam 13. VIII. 1905 (type). × $^1/_2$.

Puccinellia fragiliflora Th. S.
Type
determ. Thorv. Sørensen 1951.

Flora Rossiae Arcticae.

Alopecurus borealis (Trin.) Simm.

Nova Zemlia: Matotschkin Schar.

13/8 1905 Otto Ekstam.

Plate 11.

Puccinellia Palibinii. Novaya Zemlya, Matotchkin Shar, Pomorskaya, leg. B. Lynge 27.VIII. 1921 (type). × $^1/_2$.


Puccinellia Palibiniana Th. Sør.
type
determ. Thorv. Sørensen 1951
Herb. Univers. Christianiensis.
Puccinellia angustata
(R. Br.) Rand et Redf.
var. contracta (Hgl.) Holmb.
Novaia Semlja
Lynge
det. Holmberg
Puccinellia
Nov. Semlja: Bomorskaja
27. 8. 1921
Lynge

Plate 12.

Puccinellia contracta. Chukch Penins., Pitlekaj, leg. F. R. Kjellman 28. IX. 1878 (type). × 1/2.

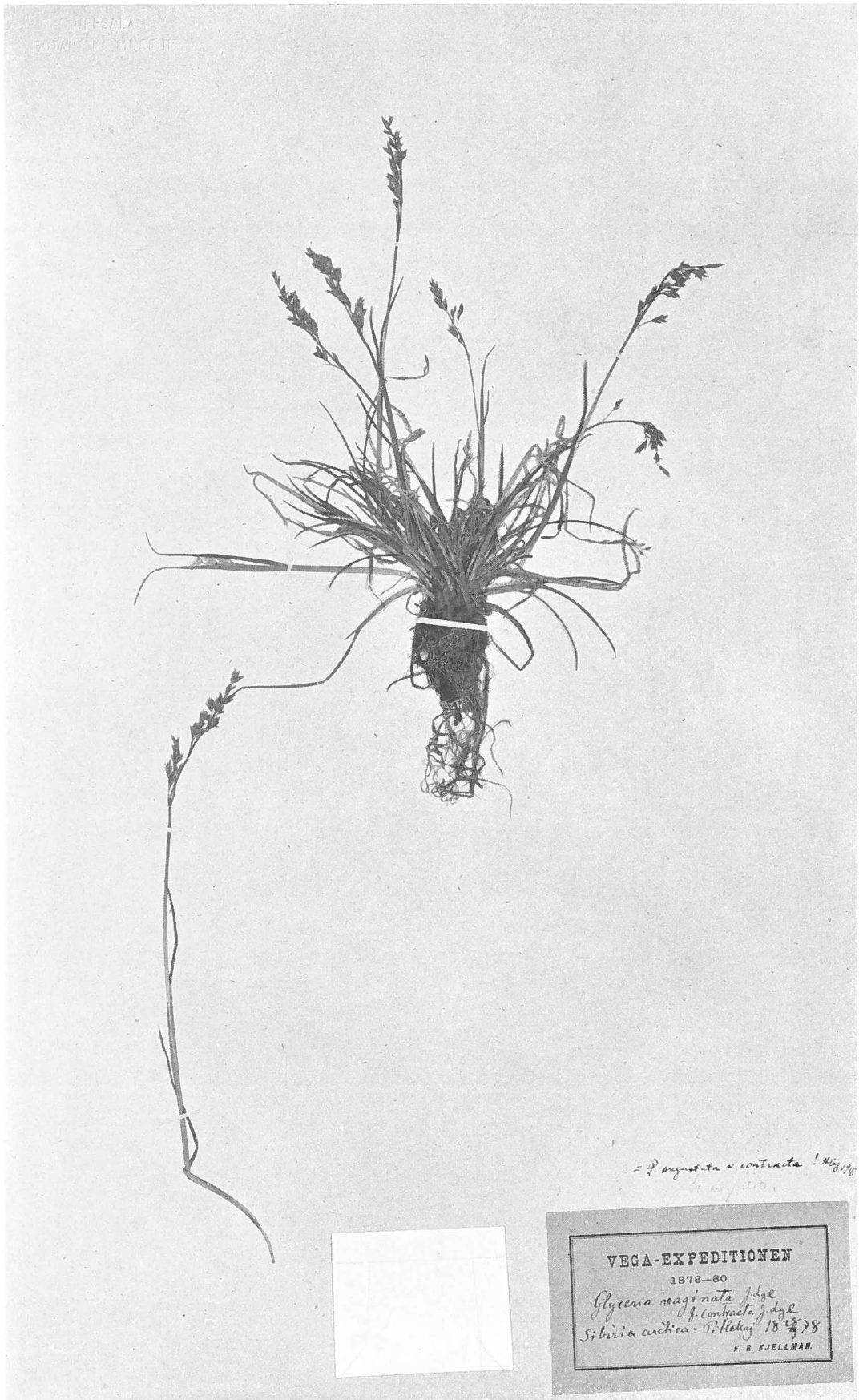
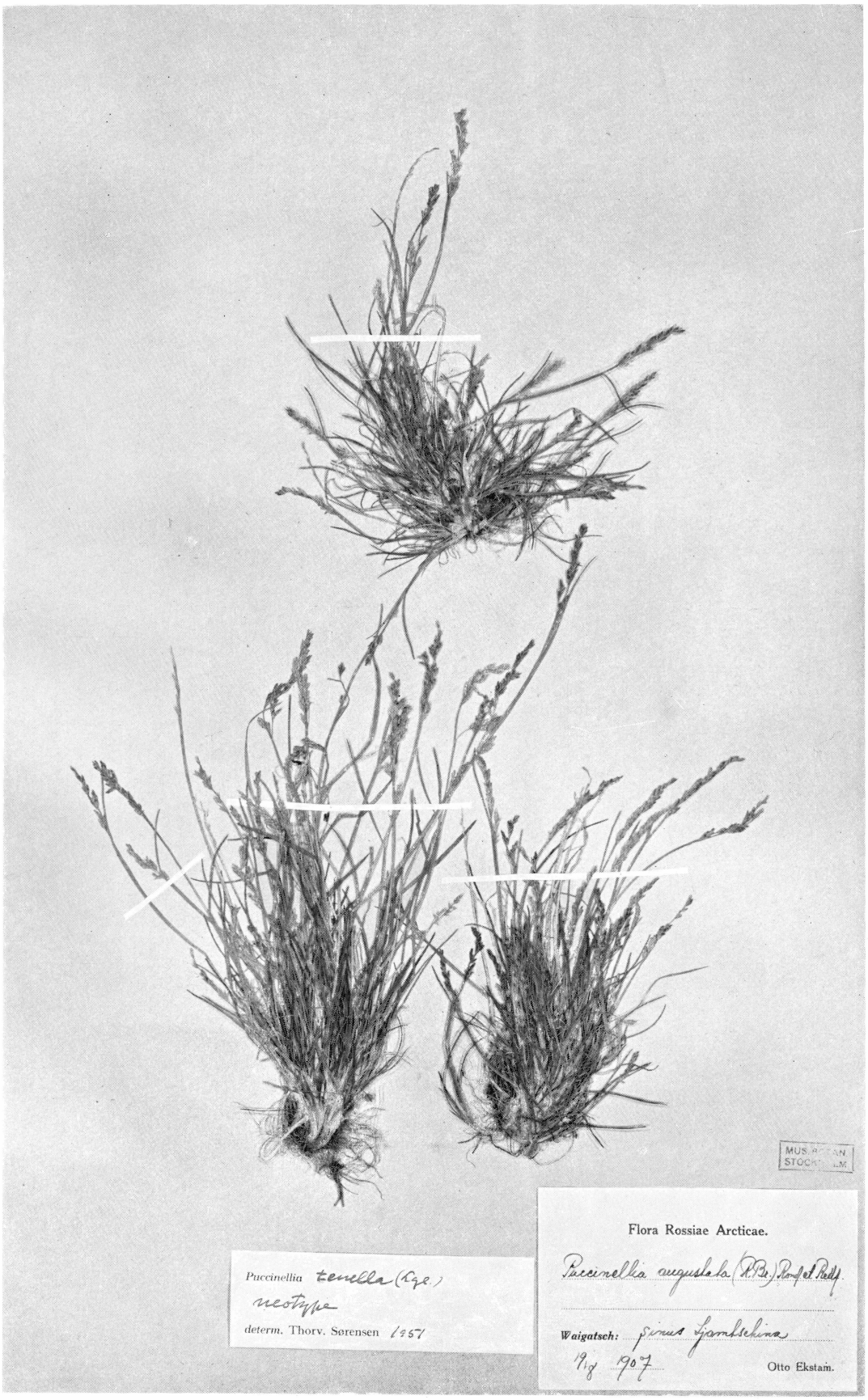

= P. angustata v. contracta ! Hg 1926
VEGA-EXPEDITIONEN
1878–80
Glyceria vaginata Jdze
β. contracta Jdze
Sibiria arctica. O. Nordenskj. 18 28/8 78
F. R. KJELLMAN.

Plate 13.

Puccinellia tenella. Waigatsch, Sinus Ljamtschina, leg. O. Ekstam 19. VIII. 1907 (neotype). × 1/2.


MUS
STOCK
M
Puccinellia tenella (Lge.)
neotype
determ. Thorv. Sørensen 1957
Flora Rossiae Arcticae.
Puccinellia angustata (R.Br.) Rupr. et Roshy
Waigatsch: Sinus Spasskaja
19/8 1907
Otto Ekstam.