Chapter 14

Vegetation and Flora

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The vegetation of Ogotoruk Valley is divided into eight types as follows: *Eriophorum* tussock, *Dryas* fell-field, *Eriophorum—Carex* wet meadow, *Eriophorum—Carex* solifluction slope, ericaceous shrub polygon, *Dryas* step and stripe, *Carex bigelowii* high-center polygon, and saline meadow. Another group of highly diverse plant communities growing on snow-bed sites, gravel bars and benches, talus slopes and rock outcrops, marine strands, and on transitional sites between types is not aggregated into types because of high stand-to-stand diversity. Each vegetation type is composed of a group of characteristic species, many of which occur in more than one type. All vegetation units blend with each other at their margins in a continuous manner; thus, the boundaries around any community are regarded as arbitrary. The mosaic of habitats in the area includes broad wet meadows, dry fell-fields, talus slopes, precipitous cliffs and rock outcrops, gravel bars and benches, snow beds, tundra ponds, and strands. Each habitat is modified locally by frost action, permafrost, local relief, parent-material differences, drainage patterns, irregular snow accumulation, and animal activity.

About 300 species of vascular plants, 100 byrophytic species, 81 lichens, and an undetermined number of fleshy fungi are included in the terrestrial flora.

The primary objectives of the terrestrial botanical study in the Ogotoruk Creek—Cape Thompson area were to collect and enumerate the species of vascular plants, lichens, and mosses and to describe qualitatively and quantitatively the vegetation of the Ogotoruk Creek watershed. Ecological investigations of factors controlling plant distribution in the area were also carried out. This chapter presents detailed information relative to the primary objectives.

Botanical investigations in the Ogotoruk Creek—Cape Thompson area were initiated in June 1959. Most of the specimens were collected during that summer, and qualitative descriptions of the vegetation were made at that time. During the summer of 1960, additional collections were made, the vegetation of previously established vegetation plots was analyzed quantitatively, and investigations of geobotanical processes were begun. Initiated in 1960, studies on geobotanical processes were continued in 1961. A cytotaxonomic survey of the vascular-plant species which was started in 1962 is still in progress.

Considerable information relevant to the objectives stated above was accumulated during the first three summers. Since no comparable study of the flora or vegetation of northwestern Alaska has previously been undertaken, our studies provide the first detailed information on this phytogeographically important area. Most of the previously undertaken studies of the arctic Alaskan flora and vegetation have neglected the coastal portions of Alaska bordering the Bering and Chukchi seas.

Floristic work in arctic Alaska has been summarized by Hultén (1940) and by Wiggins and Thomas (1962). Although botanical exploration of the Alaskan arctic has increased markedly since the end of World War II, extensive gaps occur in the distribution records because the area involved is so large.

Comparisons with other arctic areas suggest that the Ogotoruk Creek–Cape Thompson area is one of the richest areas floristically in the entire circumpolar area. Several factors contribute to its richness. It is accessible to plants from the Brooks Range, the Bering Sea coast, the Arctic coastal plain, and, to a certain extent, from the interior highlands. The area has not been glaciated. Although it has been subject to fluctuating sea levels (Hopkins, 1959), it has probably always supported plants during the Quaternary period (Hultén, 1937). Geologically the the mixed parent materials, limestone, dolomite, shale, sandstone, mudstone, etc., support a highly variable flora. There is also considerable local relief from the marine strand through low wet meadows to steep cliffs, rock outcrops, and dry uplands. Such conditions guarantee a diversity of habitats.

Work on arctic vegetation in Alaska has been conducted by Griggs (1934), Hanson (1951, 1953), Hopkins and Sigafoos (1951),Sigafoos (1951, 1952), Wiggins (1951), Benninghoff (1952), Churchill (1955), Bliss (1956), Bliss and Cantlon (1957), Britton (1957), and Spetzman (1959). Most of this work is restricted to the Arctic coastal plain and to the foothills of the Brooks Range. The entire area between Kotzebue and Cape Lisburne along the coast of the Chukchi Sea has been virtually unexplored botanically.

THE VEGETATION

The Ogotoruk Creek–Cape Thompson area lies within the area called Arctic by northern geographers (Hare, 1951; Polunin, 1951). This region lies approximately 100 miles north of the latitudinal tree line along the Chukchi Sea coast and about 50 miles north of the last alder shrubs. According to the subdivisions of the Arctic proposed by Polunin (1951), the Cape Thompson area supports primarily low arctic vegetation. Because of considerable topographical heterogeneity in the area, however, there are patches of vegetation which fit the criteria for all three of Polunin's subdivisions of the Arctic — low, middle, and high. Since this is primarily a geographic problem, there is little profit in drawing precise dividing lines between these areas for a study of the vegetation.

The Quaternary history of the flora of this area is still best understood from Hultén (1937). His theory of progressive equiformal areas to explain plant distribution in the circumpolar area is more generally applicable than any other hypothesis presented thus far. More precise information on sea-level changes relevant to plant migration during the Cenozoic era has recently been summarized by Hopkins (1959).

Britton (1957) discusses the characteristics of the Alaskan arctic vegetation from the Brooks Range to the Arctic Ocean; some of his descriptions are applicable to the Ogotoruk Creek area. In a more recent paper, Spetzman (1959) reports on his lengthy investigations of the vegetation of the arctic slope of the Brooks Range.

Vegetation Classification and Description

Whether one believes that all vegetation is continuous in nature or that it consists of discrete, discontinuous pieces, it is possible to study large homogeneous segments of vegetation and to describe them as separate entities. Since one of the objectives in this study was to describe the vegetational assemblages in Ogotoruk Valley, we chose to follow the philosophy that vegetation consists of discrete, discontinuous pieces. Vegetation types were identified and named when repeating patterns of species association were found in the valley and when these patterns were associated with rather well-defined physiographic units. Each unit was called a stand, and two or more similar stands together constituted a vegetation type. We employed a subjective criterion of homogeneity in choosing stands for study and consistently tried to avoid the complications of ecotonal vegetation. The vegetation of highly heterogeneous habitats, such as gravel bars and snow beds, was examined, but no attempt was made to combine these stands and to refer to them individually as plant communities. This approach emphasizes the abstract and synthetic features of vegetation. A different kind of approach might lead to emphasis on the distributions of individual species rather than communities.

Concepts of Succession and Climax

Many of the problems relating to concepts of succession and climax in Ogotoruk Valley involve frost-induced bare ground and its potential for supporting plants. A substantial part of the botanical program was devoted to an intensive study of frost features and their vegetation, but since some aspects of this program are still in progress, we shall limit our discussion of succession and climax to a few preliminary remarks.

Much has been written in recent years which suggests that the climax concept is not applicable to subarctic and arctic environments (Griggs, 1934; Hopkins and Sigafoos, 1951; Polunin, 1934-1935; Raup, 1941, 1951, 1954; Sigafoos, 1951, 1952; Drury, 1956). These authors doubt the applicability of the climax concept in these areas because of the exigencies of the northern environment, which produces disorder, especially in the substratum.

The problem relating to these concepts is further complicated in the Arctic by the presence of few species, many of which have rather broad tolerances.

Because of this, Griggs (1934) called the arctic vegetation "weedy"; on the other hand, Dahl (1956), working in the Norwegian alpine vegetation, notes, "the vegetational contrasts are due to differences in dominance of some species, while a comparable shift in presence of species is less evident." Those who take a wider view of arctic vegetation believe in the permanence of communities and admit that internal changes may occur; however, they believe that change is characteristic of even steady-state communities (Churchill and Hanson, 1958, p. 180). According to these ideas, also expressed by Watt (1947), plants die and are replaced by individuals of the same or other species, but these replacements are fluctuations around a mean. Churchill and Hanson believe, "such changes as do occur in these communities are regarded as being within the framework of the climax."

In general, there is no tendency for long-term replacement of our major vegetation types by other types. Where frost action is of significance in the valley, changes are occurring in the vegetation, and some successional sequences have been identified. The crux of the problem lies in an understanding of the directional nature of the changes. If the observed changes prove to be cyclic, it may be agreed that the level of operation is within the community pattern; if they be directional changes, i.e., progressive or retrogressive, then it may be concluded that the climax concept is not totally applicable in the Arctic. A final decision on this matter must await the conclusion of our work with patterned-ground phenomena.

Methods

The primary goal of the vegetation study was to describe the primary assemblages of vegetation in an area encompassing approximately 40 square miles. Two summers were devoted to the descriptive aspects of the study. The summer of 1959 was used for reconnaissance and for subjective identification and description of vegetation types and plant communities. In 1960 the vegetation was described quantitatively.

During our first summer in the Ogotoruk Valley, 54 one-acre plots were established in representative stands. The number of plots per vegetation unit is not strictly proportional to the area covered by each type, but it is generally so. A subjective criterion of homogeneity was applied in choosing the plots. We decided on one-acre plots because they are easy to mark and to relocate later and because reasonably homogeneous pieces of vegetation at least one acre in size are abundant in the area. Furthermore, we worked closely with the terrestrial mammalogists, who use the one-acre sized plot as standard in their sampling methods.

Each of the 54 plots was laid out in the same way. Where possible, the plots were oriented so that two sides were parallel to the direction of slope. The four corners were marked with wooden or metal stakes (eventually all wooden stakes were replaced by metal ones). A copper tag bearing the number of the plot was wrapped around one corner stake. The location of each plot was marked by triangulation from existing or especially constructed stations. The physical information recorded included the following: the extent in acres of the vegetation in which the stand was located, the elevation, exposure, slope, substratum, permafrost depth, and snow depth. An estimate was made of the cover of high shrubs, low shrubs, and herbaceous cover; the cover by cryptogamic species; and the extent of bare ground or open water. General characteristics of the vegetation were described in qualitative terms; miscellaneous phenomena, such as frost action, solifluction phenomena, and animal activity, were recorded in special notes. A species list was prepared for each plot, and collections of unknown plants were made. At the time of the initial descriptive work, a tentative classification system was prepared for the vegetation types in the valley. By the end of the 1959 field season, categorization of the vegetation units of Ogotoruk Valley was essentially complete.

The line-intercept method was used in our quantitative work. Two permanent 50-m intercepts were established in the 45 plots investigated during the summer of 1960. The intercepts were established parallel to each other and to a given side of the plot. The beginning and ending points of each intercept were marked by stakes, which were located 6 m inside the boundary of each plot to preclude the possibility of disturbance around the margins of the plot. If the plot was located on a slope, the lines ran parallel to the slope. Each line was divided into five 10-m segments, and the vegetation intercepting the first 2 m of each segment was measured and recorded on data sheets. Each species was recorded separately, and the distance of the line covered was related to the total measured distance in each plot and was expressed as a percentage. When cover is complete and consists of different layers of plants, total cover of all species always exceeds 100%. By utilizing the data obtained through this procedure, we were able to calculate the frequency of each species per plot, the percent of ground it covered, and its relative cover in terms of all species in the plot. We also calculated an importance value for each species by totaling the figures for relative frequency, percent cover, and relative cover. This is the figure that has been consistently used in presenting tabular and graphic quantitative data in this paper. This procedure, modified from Curtis and McIntosh (1951), comes closest to expressing aspects of both pure phytosociology and ecology because it takes into account such features of the vegetation as aggregation. In Fig. 4 and Table A of the Appendix to this chapter, where these data are presented, plot data for mosses and hepatics and for lichens have been summed because of the unevenness of our quantitative data on cryptogams. The total cover for these groups was always recorded; however, field identifications were not always dependable, and extensive collections at the time of the quantitative analyses could not be made. Information on the relation of the terrestrial cryptogams to habitat is presented in Table B of the Appendix.

Vegetation Types

The following major vegetation types were recognized in Ogotoruk Valley: *Eriophorum* tussock, *Dryas* fell-field, *Eriophorum*–*Carex* wet meadow, *Eriophorum*–*Carex* solifluction slope, ericaceous shrub polygon, *Dryas* steps and stripes, *Carex bigelowii* high-center polygon, and a saline meadow type. Vegetation that did not fit into these categories includes frost-scar ecotone communities, gravel-bar and gravel-bench communities, talus slope communities, and snow-bed communities. These are broad categories that could be subdivided *ad extenso* by other methods. The few large subdivisions proposed will be discussed where appropriate.

The vegetation map (Plate 5) shows the extent and distribution of each of these vegetation types and plant communities. Table 1 summarizes the amount of area and the percent cover of the Ogotoruk watershed for each vegetation unit, these figures being derived from planimetric measurements of the final vegetation map.

Table 1—ACREAGE OF VARIOUS VEGETATION TYPES AND PLANT COMMUNITIES OF THE OGOTORUK CREEK DRAINAGE SYSTEM

Vegetation types and communities	Acres	Drainage, %
Eriophorum tussock	9,615	39.2
Dryas fell-field	7,462	30.4
Eriophorum—Carex wet meadow	3,072	12.5
Frost-scar ecotone communities	1,131	4.6
Wet meadow—tussock mixtures*	1,124	4.6
Gravel-bar and gravel-bench communities	802	3.3
Eriophorum—Carex solifluction slope	361	1.5
Talus slope communities	326	1.3
Snow-bed communities	251	1.0
Ericaceous shrub polygon	170	0.7
Dryas steps and stripes	129	0.5
Carex *bigelowii* high-center polygon	68	0.3
Saline meadow	27	0.1
Total (38.3 square miles)	24,538	100.0

*A large area dominated by a mixture of the *Eriophorum—Carex* wet meadow and *Eriophorum* tussock types.

Each vegetation type blends with adjacent types at its margins. The extent of the transition between the types depends on the steepness of the environmental gradients. In a few instances the transitional area may be of sufficient extent to be considered as a distinct entity; the ecotonal frost-scar area on the east side of Ogotoruk Valley is a representative case. The borders between types are arbitrarily placed, but they are based primarily on the distributional limits of the most characteristic species of each type. For example, the boundary between wet-meadow and tussock stands is drawn at the point where the sedges of which the wet meadow is primarily composed are replaced by cottongrass tussocks. Where there is a rapid change in the moisture gradient, this margin may be rather sharp, but, on gentle slopes where soil moisture changes gradually, the margins are blurred by the interdigitation of tussocks and wet-meadow sedges. One very large area of this kind is located on the lower slopes of the east side of Ogotoruk Valley.

Some of these vegetation types have been recognized by other workers in Alaska who have applied different names to these somewhat similar units (Table 2). Because so much of the arctic vegetation is circumpolar in terms of species composition, it is possible to make similar comparisons over long distances (Hanson, 1953). To be consistent within our philosophy of vegetation, however, we believe that there is little to be gained from these pan-boreal comparisons.

In Fig. 1 a general scheme showing the relations of vegetation types to important environmental gradients and to each other is presented. The environmental limits of each vegetation type are shown by arbitrary lines drawn around it. The

Table 2 — VEGETATION TYPES RECOGNIZED IN OGOTORUK VALLEY

Ogotoruk Valley vegetation types	Nomenclature used by other workers
Eriophorum–Carex wet meadow	Lowlands sedge marshes (Palmer and Rouse, 1945) Marsh and wet tundra (Porsild, 1951) Sedge sod (Hopkins and Sigafoos, 1951) Fresh-water marsh herb type (Hanson, 1953) Wet sedge community (Bliss, 1956) *Carex aquatilis* marsh type (Britton, 1957) Wet sedge meadows (Spetzman, 1959)
Eriophorum–Carex solifluction slope	Probably included in above
Eriophorum tussock	Tundra (Palmer and Rouse, 1945) Niggerhead tundra (Porsild, 1951) Tussock–birch–heath vegetation (Hopkins and Sigafoos, 1951) Cottongrass sedge-dwarf heath shrub complex (Hanson, 1953) Heath tussock (Bliss, 1956) Dwarf-shrub heath type (Churchill, 1955; Britton, 1957) Niggerhead tundra (Spetzman, 1959)
Saline meadows	Saline sedge marshes herb type (Hanson, 1953) Lagoon and salt marsh subject to floods (Porsild, 1951)
Dryas fell-fields	Alpine *Dryas* type (Palmer and Rouse, 1945; Hanson, 1953) Dry upland meadows (Spetzman, 1959)
Dryas steps and stripes	Alpine sedge–alpine *Dryas* (?) (Hanson, 1953)
Ericaceous shrub polygon	Dwarf heath–lichen communities (?) (Hanson, 1951) Dwarf birch–heath–lichen type (Hanson, 1953) Frost-scar collective type, in part (Churchill, 1955; Britton, 1957)
Carex bigelowii high-center polygon	Frost-scar collective type, in part (Churchill, 1955; Britton, 1957)
Ecotonal frost scar	Frost-scar collective type, in part (Churchill, 1955; Britton, 1957)

relevant features of this figure will become more apparent in discussions on each of the types.

The discussion of the vegetation types begins with the upper ridges and slopes of the valley and follows the development of soils and vegetation downward along those environmental gradients which lead toward the center of the valley where Ogotoruk Creek removes soil and plants by erosion. All available evidence and theoretical considerations of the downslope movement of arctic soils suggest that there is a continuous flow of materials from higher elevations to lower ones although in most instances it is too slow to be of much importance to plants. Exceptions to this are discussed in later sections.

DRYAS FELL-FIELDS Vegetation dominated by *Dryas octopetala* var. *viscida* occupies the exposed, windswept upland areas bordering Ogotoruk Valley and the dry, low ridges and bedrock exposures within the valley proper (Fig. 2). This is the *Dryas* fell-field type, which occurs on soils derived from limestone and dolomite (limited to the west side of the valley) or on the complex of sandstones and mudstones present at lower altitudes on the west side of the valley and comprising all the ridge systems on the east. *Dryas*-dominated vegetation covers about 7500 acres or 30% of the total watershed area. These habitats are mesic to xeric.

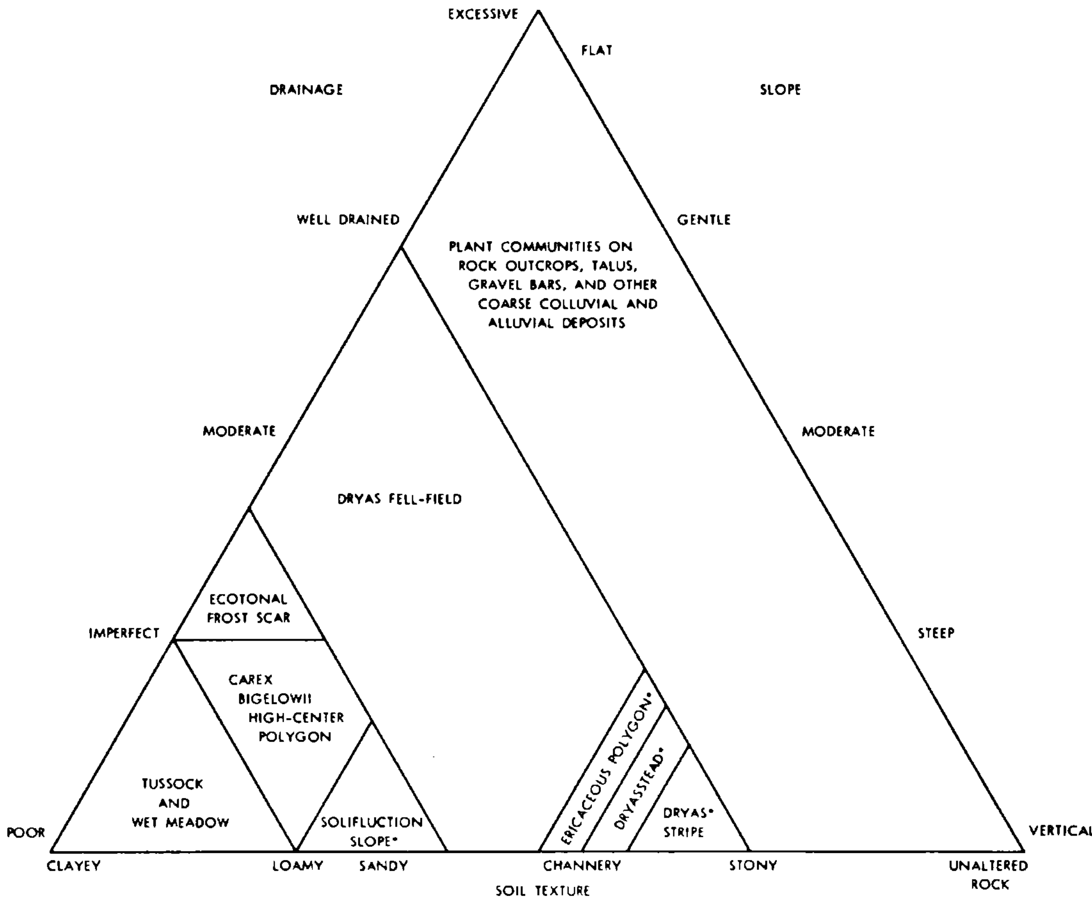

Fig. 1—The relation of the Ogotoruk Valley vegetation mosaic to certain environmental gradients. Vegetation types that occur on soils derived from limestone and dolomite only are marked with an asterisk.

Soils tend to be coarse and well drained, and, during extended dry periods in the summer, shallowly rooted plants may suffer from water shortage. Plant debris does not ordinarily accumulate on the surface except in depressions, fine soil is blown from the surface where it is not held by plant cover, and rock fragments are brought to the surface by frost action. Together, these influences produce a surface that in its extreme expression is reminiscent of desert pavements.

The surface appearance of the fell-fields is somewhat deceptive because well-developed arctic brown soil profiles occur beneath the coarse surface materials. The reader is referred to Chap. 13 for a discussion of soil types. For our purposes the presence of a zonal soil suggests relative habitat stability as opposed to the highly frost-influenced and frost-modified soils on the lower slopes and valley floor. Soil development from the basic parent materials is much superior on the west side of the valley to that on the east side; moreover these calcium-rich soils support species absent from the more acidic soils of the Ogotoruk watershed.

Importance values for *Dryas* and other fell-field species are shown in Fig. 3 and in Table A in the Appendix. The *Dryas* plants grow in prostrate mats to more

Fig. 2—Typical expression of Dryas *fell-field vegetation on exposed slopes and ridgetops.*

than 1 m in diameter; they rarely reach a height of more than 5 to 10 cm. Scattered among and between the *Dryas* mats are cushion plants and other mat-formers, such as *Oxytropis nigrescens, Arenaria arctica, Androsace ochotensis, Silene acaulis, Salix phlebophylla, Salix arctica, Oxytropis pygmaea, Saxifraga eschscholtzii*, and *Arenaria dicranoides.* The latter three grow almost exclusively on calcareous soils. The most common non-clump-forming species are *Carex microchaeta, Hierochloe alpina, Luzula confusa, Lupinus arcticus,* and the calcophile *Kobresia myosuroides.* Fruticose lichens, especially *Alectoria pubescens, A. ochroleuca, Cornicularia divergens, Cetraria hepatizon,* and *Ochrolechia frigida,* are conspicuous. Crustose lichens are also important. A list of lichens and mosses and hepatics is arranged according to habitat in the Appendix, Table B.

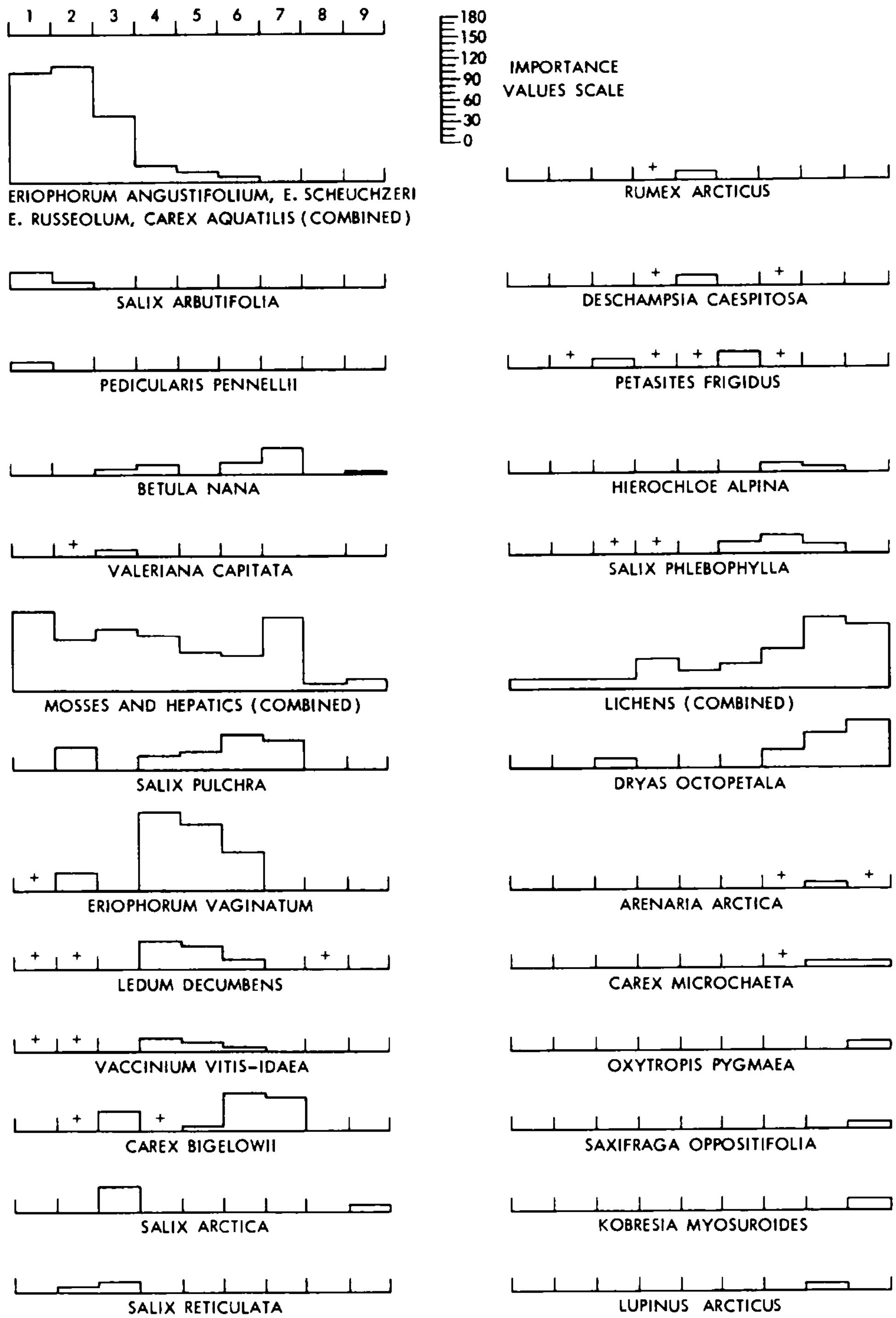

Fig. 3—Importance values for selected vascular plant species, mosses and hepatics (combined), and lichens (combined) according to vegetation types from 1-acre plots in Ogotoruk Valley. Vegetation types are ordinated according to an approximate moisture gradient with types occupying wet habitats on the left (number 1) and those found in dry habitats on the right. (See also Table A of the Appendix.) The plus sign indicates importance values of less than 5.0.

Fig. 4—Dark patches of vegetation in center of picture are ericaceous shrubs indicative of snow beds that melt by early July. Terraces and polygonal ground show in the foreground; talus slope shows in the upper left.

Where snow accumulates in depressions (Fig. 4), ericaceous shrubs, especially *Vaccinium vitis-idaea, V. uliginosum, Ledum decumbens, Arctostaphylos alpina, Empetrum nigrum,* and *Cassiope tetragona,* occur. *Betula nana* sometimes occupies these places. Of the species listed only *Cassiope tetragona* thrives in late-lying snow beds, and in deep depressions essentially pure stands of it are found.

Modern frost action in the fell-fields is limited to the formation of small sorted circles ordinarily not more than 1 to 2 m in diameter. The centers of these circles are active under the current climatic regime and contribute to small-scale vegetation disruption. Most intense activity in these features was noted in areas adjoining snow beds; presumably moisture availability contributes to soil heaving and to sorting processes. The presence of larger "fossil" polygons and nets presumably indicates a more rigorous environment in periglacial time. Permafrost was not detected at depths of 1 m.

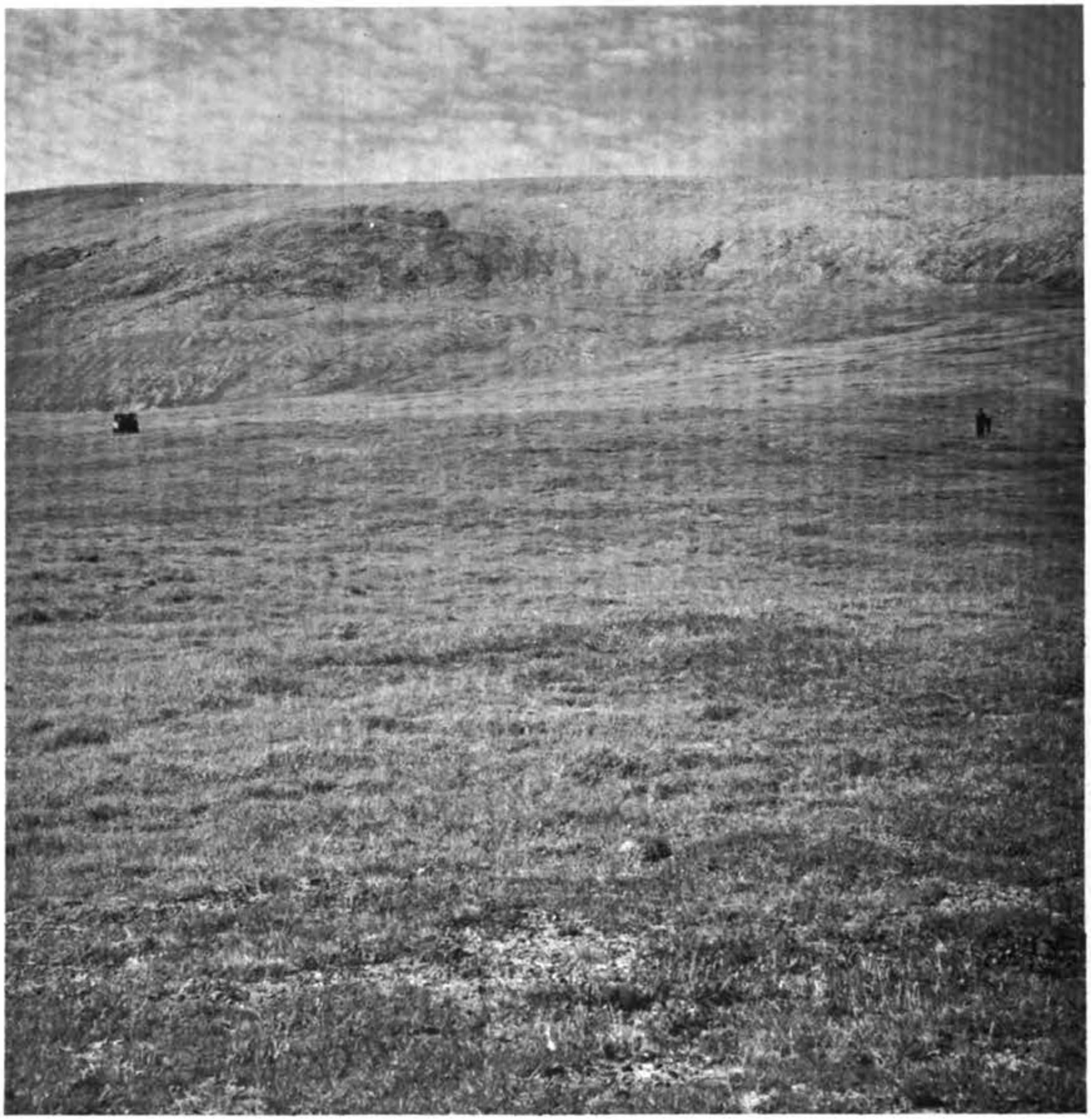

Fig. 5—Talus on the upper steep slopes of Saligvik Ridge. Dryas *stripes are obvious above the vehicle.*

TALUS AND SCREE SLOPES Under the influence of frost action, water, wind, and gravity, the fine soil particles and coarser material from the frost-riven bedrock of the uplands are carried to the less elevated parts of the valley. On the steepest parts of all ridges, the fell-field grades rapidly into talus and scree slopes, which support only isolated plant cover (Fig. 5). The only footholds available for plants on these steep slopes are the small patches of soil between the rocks; even so, many species of plants grow here, but the area covered by all of them combined is very small. A few of the more common species on talus and scree slopes are *Saxifraga tricuspidata, S. bronchialis, S. eschscholtzii, Draba caesia, D. macrocarpa, Cystopteris fragilis, Woodsia ilvensis,* and *Smelowskia calycina.*

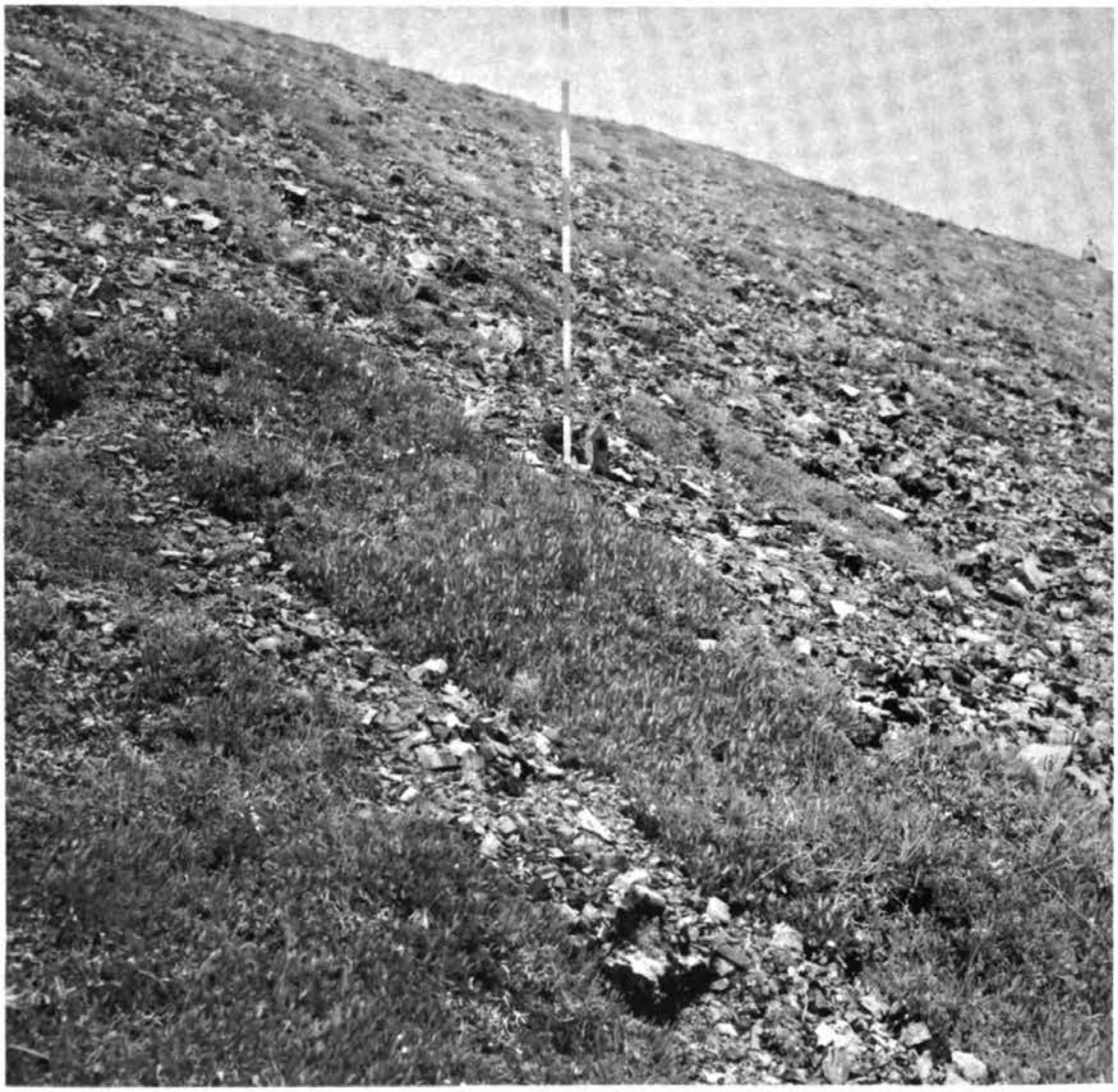

Fig. 6—Stripes of Dryas octopetala *alternate with lichen-covered and bare angular limestone fragments on steep to moderate slopes.*

DRYAS STEPS AND STRIPES On gentler slopes the fell-field merges into other kinds of plant communities whose characteristics are determined primarily by the depth of soil and the amount of moisture present during the growing season. On deep, well-drained slopes from which snow blows in the winter, the *Dryas* mats from the fell-fields continue to dominate the vegetation, but they are contorted into step- and stripe-like patterns by frost action and downslope movement of colluvium. The primary reason for recognizing a different type of vegetation here is that there are very large differences in species composition, apart from *Dryas* itself.

The *Dryas* step and stripe type occurs only on the west side of the valley and occupies less than 1% of the valley. *Dryas* stripes are found on slopes that approach 20°, and the orientation of the alternating stripes of *Dryas* and other plants and bare soil is parallel to the slope (Fig. 6). Sorting processes do not seem to contribute to the pattern; this kind of patterned ground fits the non-sorted stripe category of Washburn (1956). The bare soil between the stripes is subject to downslope movement, and in some places small lobes and tongues of soil are obvious. Within the stripe of vegetation, there is little surface movement. The vegetation of these habitats is much richer in species than the fell-fields. We have no quantitative data for either step or stripe vegetation, but our species list includes *Phlox sibirica*, *Eritrichium chamissonis*, *Castilleja pallida*, *Parnassia palustris*, *Artemisia borealis*, *A. trifurcata*, *Carex nardina*, *Arnica louiseana*, and many others in addition to most of the fell-field species. Mosses and lichens are not abundant on these slopes.

Where slopes are about 10°, the orientation of the stripes of *Dryas* changes to run approximately across the slope. This change in orientation from vertical through diagonal to horizontal patterns is referred to as *Dryas* steps. The flat portions of each step are covered surficially with layers of coarse gravel, which is composed of angular rock fragments averaging about 4 cm in diameter. The width of the bare gravelly portion of the step varies from about 10 cm to 1 m. These steps are not perfectly flat on top but tend to slope slightly downhill (Fig. 7). The front parts of the steps are faced with dense mats of *Dryas octopetala* with a rich flora of other plants interspersed through the mat. These fronts are from 10 to 30 cm high and up to 1 m wide. The vegetative mat prevents most of the downslope movement of the bare soil, but in a few places there are small breaks in the mat where soil is "flowing" through. Some of these breaks are initiated by ground squirrels as they root feed on *Dryas* and other plants.

Soils in the *Dryas* step areas are deep and well drained and have a well-developed arctic-brown profile. Permafrost is absent from at least the upper 1 m. Sorting and frost action are probably of minor importance. The steps are probably produced by the net tendency of the soil mass to move downhill, but it moves so slowly that plants have an opportunity to colonize and subsequently stabilize the frontal margins of small terraces.

Probably more species occur in the *Dryas* step type than in any other vegetation type in the area. More than sixty species were recorded from one 1-acre plot; in addition to *Dryas*, they include *Salix arctica*, *Parrya nudicaulis*, *Polygonum bistorta*, *Carex scirpoidea*, *C. bigelowii*, *Allium schoenoprasum*, *Astragalus alpinus*, *A. umbellatus*, *A. australis*, *Oxytropis maydelliana*, *O. glutinosa*, *O. gracilis*, *Campanula uniflora*, *Hedysarum alpinum*, *Phlox sibirica*, *Pedicularis oederi*, *P. capitata*, and many others. Lichens and bryophytes are relatively unimportant here.

Dryas steps and stripes are not present on the east side of Ogotoruk Valley nor, for that matter, on any nonlimestone substrate in the entire area. Part of the reason for this absence surely lies in the fact that soils derived from limestone rocks are deeper and better developed than are slope soils developed from acidic rocks. The interactions between these soils, their plants, and those physical factors producing the patterns on the slopes are not understood.

Eriophorum-Carex **SOLIFLUCTION SLOPES** *Dryas* steps and stripes occur on slopes that do not accumulate large amounts of snow in the winter. There are, however, a number of valley heads on the west ridge system that accumulate such large

Fig. 7—Dryas *step vegetation on moderate slopes in area west of the Chariot campsite. Note the gravelly upper portions of each step and the* Dryas-*banked fronts.*

snow beds that they persist for much of the summer. These basins also have deep soils, but they are very wet during the growing season. Permafrost is present at all times rarely more than 1 to 2 ft from the surface. These habitats are occupied by a sedge mat consisting of *Eriophorum angustifolium, Carex aquatilis,* and *Carex bigelowii* (Fig. 8). The most conspicuous feature of these cold, wet slopes is a series of large solifluction lobes which are 0.5 to 1 m high at the downslope edge, 6 to 10 m long, and 2 to 4 m wide (Fig. 9). The *Eriophorum–Carex* solifluction slope type covers about 361 acres or about 1.5% of the total area. In many respects the solifluction slope type is merely an upland extension of the wet meadows occurring on the flats below, but because of the hilly topography and

Fig. 8—Eriophorum–Carex *solifluction slope vegetation, aerial view. Drier slopes on upper left and lower right show* Dryas *steps.*

the presence of solifluction lobes, more species occur here than in the wet meadows. Species common in both wet and dry habitats occur in this type, the more mesic and xeric species being confined to the well-drained surfaces of the solifluction lobes.

In addition to *Carex aquatilis* and *Eriophorum angustifolium,* the species comprising most of the vegetation on the nonlobed areas of these slopes are *Salix reticulata, Equisetum arvense,* and a moss mat consisting of several species of which *Rhytidium rugosum, Tomenthypnum nitens,* and *Drepanocladus* spp. are most abundant. *Saxifraga hirculis, Petasites frigidus,* and *Valeriana capitata* are the most important herbaceous plants in these sites. On the drier margins of the solifluction lobes, plants of drier habitats, including *Dryas octopetala, Carex bigelowii,* and *Salix arctica,* are abundant.

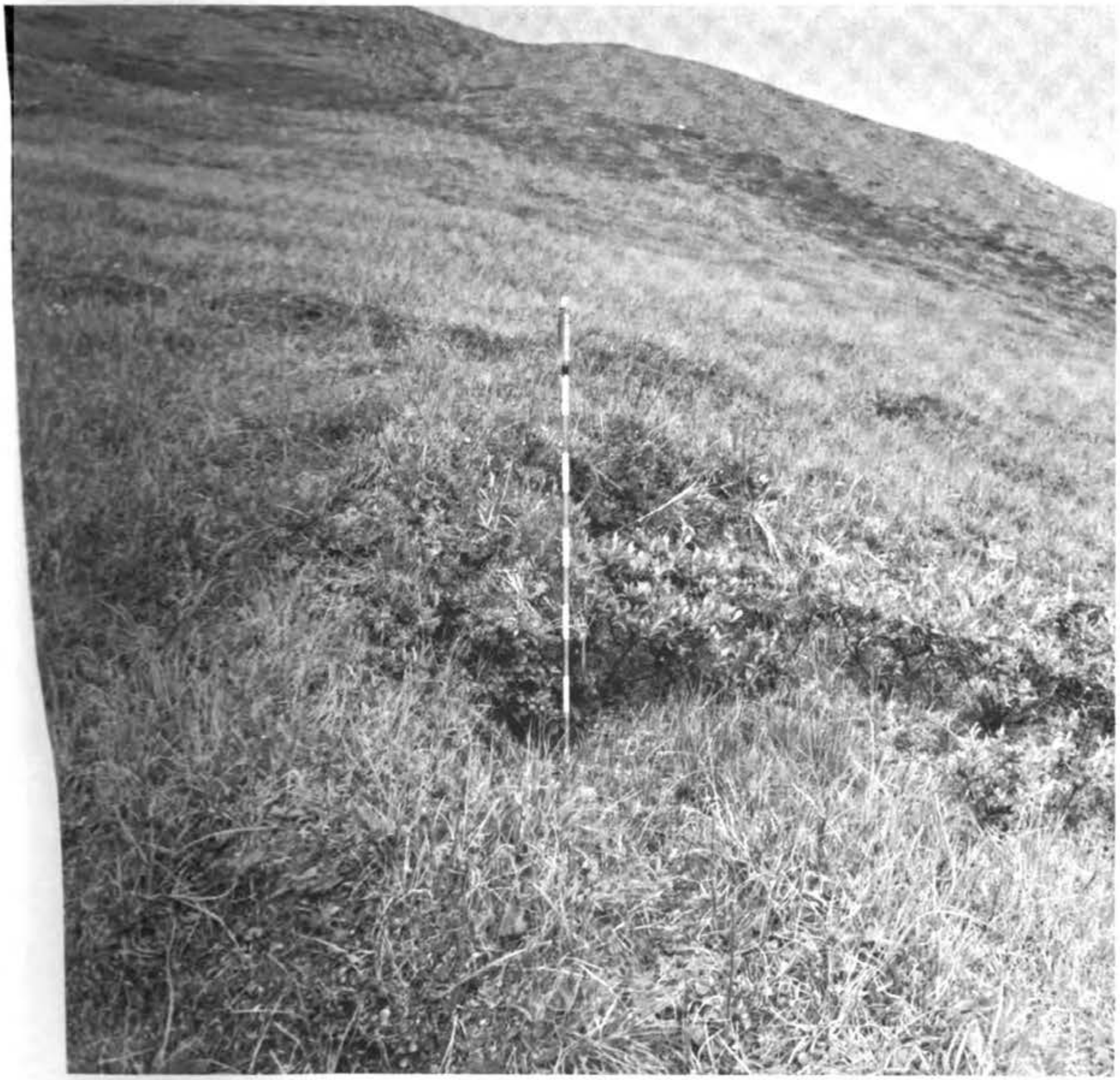

Fig. 9—Clump of Salix glauca *in a depression at the edge of a solifluction lobe, plot 7.*

A large body of literature has been accumulated on the physical and botanical aspects of solifluction lobes and terraces. In a series of recent papers, Williams (1957a, 1957b, 1959) reviews most of the important literature and discusses some of his work on these interesting phenomena.

Briefly, solifluction terraces are lobate masses of soil which occur on gentle-to-moderate slopes and which support vegetation on their upper and frontal surfaces. Terraces smaller than those described here may occur in some environments (Williams, 1957a). The presence of solifluction terraces depends on an abundant water supply, moderate-to-steep slopes, the presence of frost-sensitive soils, freezing—thawing processes, and, perhaps, permafrost. In Ogotoruk Valley the terraces are limited almost exclusively to the west side of the valley where these requirements are better fulfilled. We have already emphasized the presence of deep soils on the west side of the valley. Long-lasting snow beds assure a fairly constant water supply, at least during the early to mid-summer period.

Williams (1957a, p. 51) states "the commonest theory for the cause of solifluction is that the soil is reduced to a plastic consistency by the excess water, from both melting ice and snow, in the soil at thaw." In such cases it has been further suggested by many workers that the soil "flows" downhill under the influence of gravity and is aided by the presence of an impermeable layer, such as bedrock or permafrost. Williams demonstrates, however, that terrace formation occurs on sites that do not meet these criteria (e.g., absence of permafrost or bedrock close to the surface) and suggests other possibilities, such as frost-heave "creep" and the reduction of shear strength in soils which have been disturbed by ice-layer formation. His careful analyses of the work he has conducted on these problems lend credence to his suggestions.

The solifluction terraces in Ogotoruk Valley are moving slowly downhill. There are humus layers under the leading edges of the terraces which extend upslope under the terrace surface; these layers are more or less continuous with the vegetation directly beneath the frontal bank. The detection of movement in solifluction terraces requires elaborate instrumentation, but studies conducted elsewhere suggest that movement is in terms of a few millimeters annually.

ERICACEOUS POLYGONS The *Dryas* fell-field vegetation also grades into another vegetation type on the west ridges of the valley. This is the ericaceous shrub polygon type which occurs on steep slopes of 15 to 20° and comprises less than 1% of the Ogotoruk watershed. Flat-topped polygons 3 to 6 m in diameter and outlined by depressions 15 to 20 cm deep are a characteristic physical feature and are directly related to the distribution of the plants.

Like the other slope-vegetation types occurring on well-drained soils, the ericaceous polygon type is underlain by arctic-brown soils. Permafrost is not found at depths of more than 0.5 m. There is no indication that the physical forces that produced the polygons are still active; no fresh disturbances of the vegetation were noted in the area.

The centers of these polygons have a vegetation similar to the *Dryas* vegetation types. *Dryas octopetala, Arenaria arctica, Kobresia myosuroides, Arenaria macrocarpa, Salix phlebophylla, Saxifraga bronchialis,* and *Hierochloe alpina* are common on the well-drained centers. An almost continuous mat of ericaceous shrubs is found in the depressions surrounding each polygon because of the more favorable moisture regime in the depressions and because of the ameliorating influence of the snow accumulation on the capacity of the shrubs to overwinter. *Ledum decumbens, Vaccinium uliginosum, V. vitis-idaea, Arctostaphylos alpina,* and *Cassiope tetragona* are common in the depressions.

FROST-SCAR ECOTONE COMMUNITIES The kinds of slope vegetation recognized from the west side of the valley and described above are not represented on the east side. Instead, in the latter area the *Dryas* fell-field extends from the tops of the ridges almost to the valley floor except where slopes are too steep to prevent its development. It is probable that the difference in parent materials and differences in exposure inhibit good soil development on the east side of the valley.

Fig. 10—Gravelly surfaced frost scar in Carex bigelowii *vegetation type, plot 13.*

Along most of the lower flank of the east-ridge system, there is a transitional zone between the fell-field vegetation of the slopes and the vegetation types of the valley floor. The most conspicuous feature of this transitional zone is a frost-scar type with gravelly, almost bare convex surfaces with diameters up to 2 to 3 m (Fig. 10). The edges and surfaces of the frost scars support plants of the fell-fields and other dry habitats, and the areas between the scars contain many species of the wetter vegetation types. Although these scars fall into the nonsorted category of Washburn (1956), there appears to be some sorting with depth, if not laterally, because the soils are coarser at the surface than immediately beneath it.

Altogether these transitional communities make up about 4.6% of the valley and cover 1131 acres. The frost scars occupy about 20% of the total area in these communities. The scars are active, especially during spring and fall, and winter observations suggest that these areas are swept almost bare of snow most of the time.

The soils of the ecotonal frost-scar communities have been classified as intergrades between arctic-brown and low-humic gley soils. Permafrost is deeper here than in any of the vegetation types on the valley floor but shallower than beneath the fell-fields on the slopes above. By the end of the summer, the active soil layer is between 0.5 and 1 m thick.

Carex bigelowii is probably the most characteristic plant of these diverse communities. Together with *Salix pulchra*, it grows most abundantly around the margins of the frost scars. A few ericaceous shrubs and *Betula nana* occupy similar sites. The dry surfaces of the scars support such fell-field species as *Dryas octopetala, Salix phlebophylla,* and *Hierochloe alpina.* Mosses and lichens, which are well represented here, are more important in these communities than in any other vegetation unit measured. *Rhytidium rugosum, Hylocomium alaskanum* and *Pleurozium schreberi* are among the most important moss species, and *Cetraria cucullata, C. islandica, Cladonia rangiferina,* and *Sphaerophorus globosus* are characteristic lichens.

The transitions between the vegetation types on the ridges and slopes and those on the gently sloping valley floor are as follows: from fell-field to tussock, from fell-field to wet meadow, from solifluction slope to wet meadow, from *Dryas* steps to tussock, from *Dryas* steps to wet meadow, from ericaceous polygons to wet meadow, and from ericaceous polygons to tussock. In a few cases talus or scree slopes grade directly into wet-meadow vegetation.

Approximately half the total area of the Ogotoruk Creek watershed is occupied by gently sloping and flat areas at altitudes from slightly above sea level to about 300 ft. The soils of these areas have developed on unconsolidated sediments consisting primarily of colluvial materials but also of eolian deposits of sand and silt and other materials. According to Kachadoorian *et al.* (1961), most of these sediments are less than 20 ft thick but may be as much as 60 ft thick locally and are thought to be of Quaternary age. All these soils are very wet and are classified by the soils investigators as tundra soils of the humic gley or low-humic gley type. Permafrost is ubiquitous in these fine-grained deposits. Even at the end of the growing season, at a time when air temperatures have been consistently above freezing for more than 2 months, frozen soil is found within 0.5 m of the surface. It is only slightly deeper here than under bare frost-disturbed ground. Exceptions to this are usually associated with the influence of open or running water or local outcrops of bedrock.

Isolated in this sea of gley soils are small islands of other soil types that are caused by the presence of bedrock at or close to the surface or by locally improved drainage. The presence of bedrock usually produces fell-field situations. The kinds of soils and vegetation in areas of improved drainage are described below.

The uniformity of the valley floor is also modified by small bodies of standing water and by numerous small secondary drainage systems tributary to Ogotoruk Creek. These areas too support vegetation different from the otherwise monotonous valley floor.

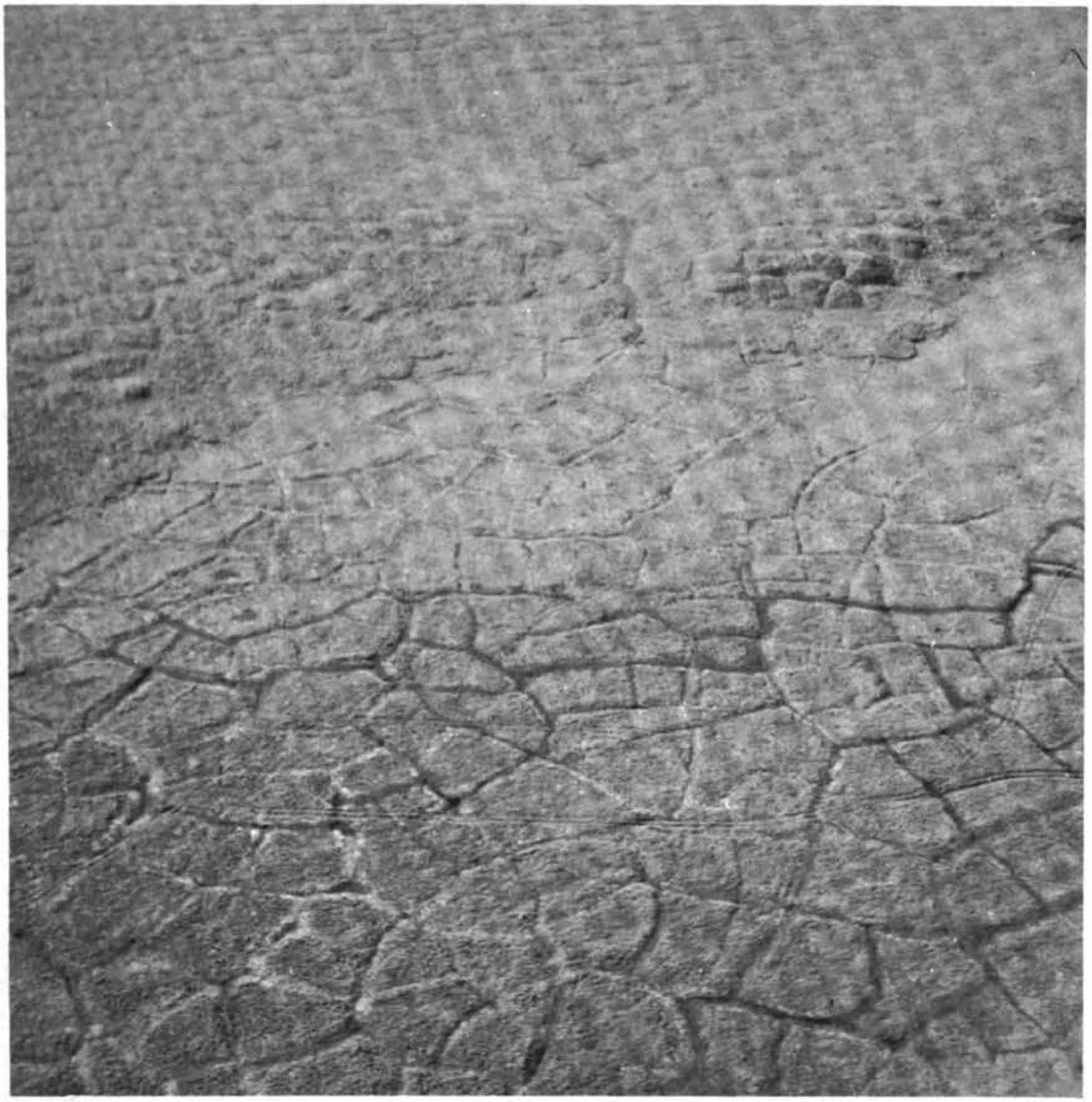

Fig. 11—Aerial view of Eriophorum *tussock vegetation growing in centers of an ice-wedge-polygon field. Trenches between centers support* Eriophorum angustifolium *and* Carex aquatilis. *Vehicle tracks show approximate scale.*

Another general characteristic of the lower slopes and the valley-bottom habitats is large-scale frost action, which is the primary modifying influence on soils and vegetation on these wet fine-grained soils. The surface manifestations of frost action on the valley floor are of two main types. The first of these is the familiar ice-wedge reticulum, which is probably more or less continuous on all these gentle surfaces in Ogotoruk Valley (Fig. 11). In many places the network is visible; in areas where it is not obvious, the remarkable subsidence of "weasel" roads suggests that its presence is masked by the plant cover.

The size of the ice-wedge polygons (10 to 30 m in diameter) compares favorably with similar structures observed in large areas of the north. Although

Fig. 12—A typical frost scar in wet-meadow vegetation showing sparse vegetation, convex surface, and mineral soil. Note the remains of dead plants on surface.

they are commonly polygonal in outline, the individual "meshes" may be almost square or rectangular. The fine-grained centers of the network are in some instances raised and in others depressed relative to the polygon border.

Superimposed on the coarse polygonal network and also occurring in nonpolygonal areas is the second and most active frost feature in the valley, i.e., small nonsorted circles (Washburn, 1956) of bare or partially vegetated mineral soil. We call these features frost scars. Frost scars are usually oval or circular in shape, and, although they vary in size, the average scar is from 1 to 3 m in diameter (Fig. 12). In some vegetation types they are abundant, but in other parts of the same type or in different types, they are scarce. The centers of the scars may be convex, flat, or even depressed. Permafrost is invariably present be-

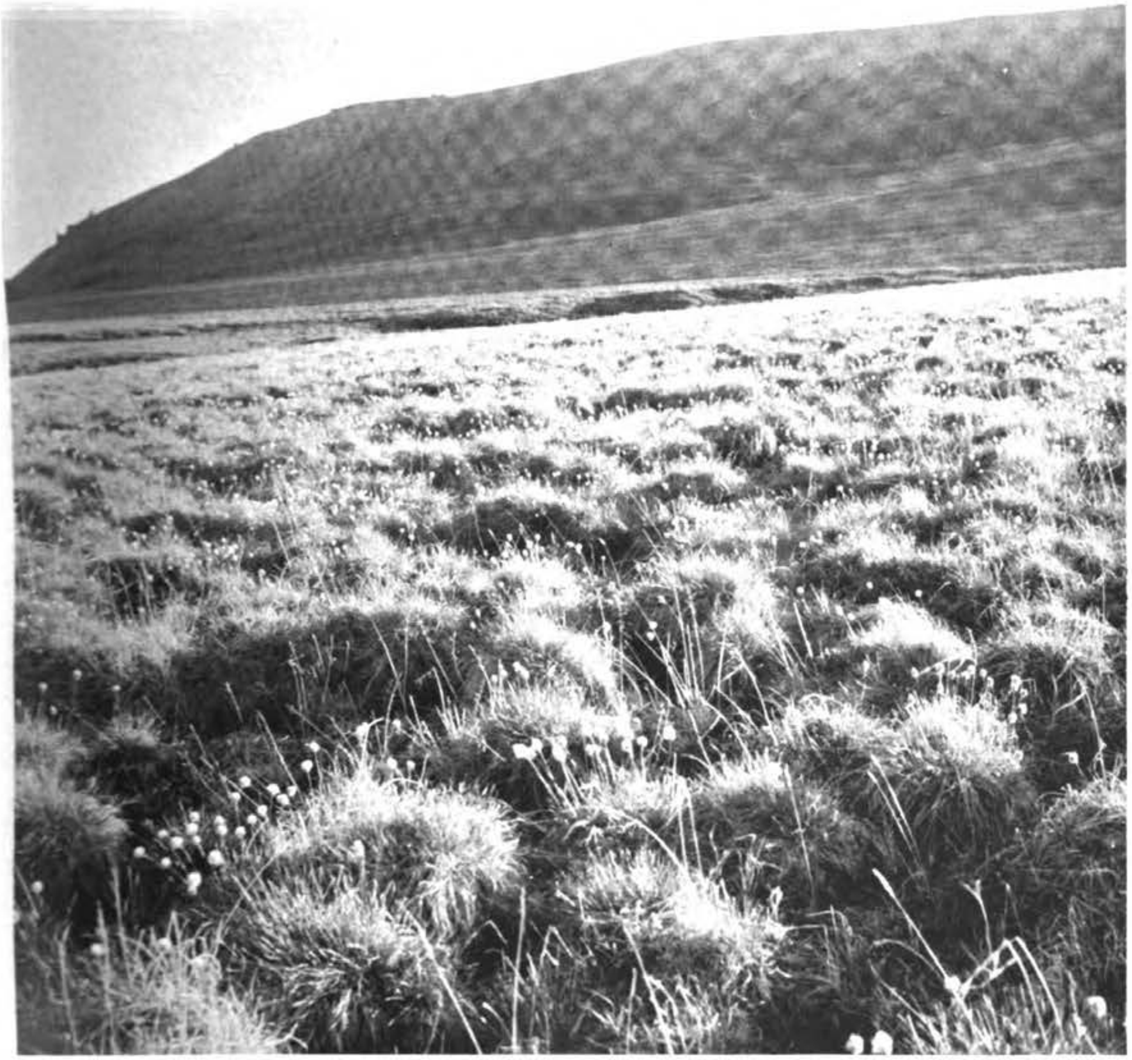

Fig. 13—Eriophorum vaginatum *tussock field.*

neath them, being deepest under the center of the scar and shallowest at its margins. Convex scars are always underlain by lenses of clear ice in the soil. Our intensive work on the interrelations of frost action and vegetation was concentrated particularly on frost scars.

***ERIOPHORUM* TUSSOCK** Nearly 40% of the land surface in the Ogotoruk watershed supports tussocks of *Eriophorum vaginatum* and a few species that grow on and around the tussocks, especially *Ledum decumbens, Betula nana, Salix pulchra,* and *Vaccinium vitis-idaea.* In these areas relief is low, the tundra low-humic gley soils are wet and cold, and the landscape is monotonous (Fig. 13). Closer examination, however, reveals many exceptions to the relatively uniform conditions of this type, particularly where there are frost features.

Tussocks are clones of the species that produce them, and at maturity they appear as more or less columnar masses of tightly interwoven plants that stand above the substrate. Each tussock is separated from adjacent tussocks by a channel of varying width that may be filled with mosses and other plants or may be almost completely devoid of plants. The tussocks discussed here are cottongrass tussocks; however, many graminoid and caricoid plants produce tussocks elsewhere.

Tussock formation begins with seed germination on moist mineral soils. Almost from the outset there is a tendency for large numbers of lateral shoots to be produced; thus a rapid increase in the diameter of the clone results. The maximum size attained by a tussock varies from site to site. Since the largest tussocks do not occur on areas where they are most dense, it may be assumed that competition for space eventually limits size. In areas marginal for tussock growth, both size and density decrease. In one plot where conditions are marginal for *E. vaginatum,* only 2.5 tussocks per square meter were recorded. Their average height and diameter measurements were 15.0 and 19.4 cm, respectively. In another tussock plot, however, there were five tussocks per square meter with their heights averaging 25 cm and their diameters, 27 cm. For a description of tussocks in another part of Alaska, see Hopkins and Sigafoos (1951, pp. 70-76).

Because little is known of the ecology of *E. vaginatum* tussocks, one can only speculate as to which environmental phenomena are of importance in limiting their size and distribution. Competition for minerals may be keen on some sites because the tussock contributes almost nothing to the soil in terms of organic debris as it increases in size. Tussocks are extremely resistant to decay; in other parts of Alaska, almost intact tussocks have been found completely buried by *Sphagnum* mosses. Frost action is also related to tussock density; where tussocks are least dense, frost action has been observed to be most profound. It is not at all clear, however, whether a decrease in tussock density allows more frost action to take place or whether increased frost action due to the physical factors operating in the site has reduced the number of tussocks.

Early in the study of tussock sites, it was proposed that this vegetation type could be subdivided on the basis of presence or absence of ice-wedge polygons. Those tussock stands which lack ice-wedge polygons have considerably more frost scars than those which have the polygons. It is not clear why this difference exists, but it is noteworthy that tussock stands underlain by the polygonal network occupy wetter sites than the nonpolygonal frost-scar stands. This difference is also reflected in the vegetation of the two subtypes; the wet-sedge group of species and mosses favoring wet habitats are much more abundant on the polygon subtype, and those species adapted for colonizing frost scars are more prominent on the nonpolygonal areas.

The ice wedges in the tussock areas are obvious because of depressions that lie directly over them. The depressions are from 30 to 60 cm deep, and they contain species typical of the wet-meadow vegetation, i.e., *Carex aquatilis, Eriophorum angustifolium,* and *Sphagnum* spp. We do not know whether or not the ice wedges are growing in size under the current climatic regime. For our purposes here we consider frost features to be active only if the physical phenomena that produce or maintain them are such that recognizable changes in the

Fig. 14—Vegetation forming tight sod over surface of frost scar in tussock type. Species on scar include Ledum decumbens, Carex bigelowii, Vaccinium vitis-idaea, Petasites frigidus, *and others.*

vegetation associated with them occur. Long-term changes, such as regional climatic changes, which may in time contribute to the growth or degradation of frost features are not considered here. The kind of cyclic processes related to ice-wedge polygons described by Britton (1957) from the Arctic Coastal Plain in Alaska do not occur in Ogotoruk Valley, probably because of its much more irregular terrain.

As indicated above many of the differences in species composition between the tussock subtypes are related to frost action and the production of frost scars. Frost scars may be completely bare of all plants or they may be in various stages of revegetation (Fig. 14). The plants growing on frost scars are often completely different from those of the unbroken vegetation surrounding the scar because the scar is always microclimatically different from the areas surrounding it; it is better insolated, it is usually warmer and drier, and it is subject to more erosion by wind and water.

Species most often growing on scar surfaces include *Luzula nivalis, Juncus biglumis, Deschampsia caespitosa, Festuca brachyphylla, Arenaria macrocarpa, Rumex arcticus, Petasites frigidus,* and many others. None of these occur abundantly, if at all, in undisturbed tussock vegetation, but many occur in drier vegetation types.

These areas and others like them make vegetation classification in the Arctic difficult and cause doubt concerning the applicability of the climax concept in the Arctic. The tussock vegetation type, taken broadly, includes a mosaic of vegetated and unvegetated areas, the former including *E. vaginatum* and a group of species growing on and between tussocks and the latter including mostly frost scars and their characteristic plants. Any consideration of tussock vegetation that omits the frost scars tells only part of the story concerning this vegetation type.

***ERIOPHORUM-CAREX* WET MEADOW** Wet-meadow vegetation occupies the lowest, wettest nonaquatic sites in Ogotoruk Valley. Although it is not so extensive as tussock vegetation, it has stands dominated by *Carex aquatilis* and *Eriophorum angustifolium* which are abundant in areas bordering lakes and streams, on shallow drainage slopes, and on extensive low flats along Ogotoruk Creek. Wet-meadow species grow up to the edge of open water on one extreme and are mixed with tussocks in the transitional areas between these two vegetation types. Approximately 15% of the valley is covered by this kind of vegetation.

The wettest stands of the wet-meadow vegetation type are on half-bog tundra soils around the ponds in the upper part of the valley (Fig. 15). In these areas there is an ice-wedge polygon network that differs from the tussock network in that here the centers of the polygons are depressed and the ridges overlying the ice wedges are elevated. This kind of vegetation is relatively poor in species; apart from the sedges, which grow abundantly, only *Salix arbutifolia, Betula nana,* and *Pedicularis pennellii* are important. This is the only part of the valley in which *Andromeda polifolia* occurs. Mosses and hepatics are more important here than elsewhere in the valley; in many places an almost continuous mat of *Sphagnum imbricatum* and *S. balticum* covers the ground in spongy hummocks. The sedges in these stands are mostly limited to the depressed polygon centers, where water stands 10 to 15 cm deep. The other higher plants are mostly restricted to the raised polygonal ridges. Frost scars do not occur on these nonmineral soils.

The depressed-center-polygon wet-meadow vegetation is regarded as one subtype of a broad category that also includes two other subtypes, only one of which will be discussed here. The latter two subtypes of wet-meadow vegetation that occur on humic or low-humic gley tundra soils are much alike except that one of them is characterized by low ridges running at right angles to the shallow slopes(Fig. 16). The other subtype does not have these ridges. The pattern of ridges in the former is irregular, and the method of ridge formation is unknown. From the air the ridges resemble wrinkled carpets. They may have been produced by pressure exerted from downslope movement of materials from above, or they

Fig. 15—Carex aquatilis *and* Eriophorum angustifolium *meadow with low-center polygons. Note the ridge surrounding the low center in foreground.*

may have been produced in a manner similar to that of the bog ridges in another part of Alaska (Drury, 1956). The ridges, which are from 15 to 25 cm high, are important to the vegetation because of the more mesic habitats they offer. Some of them also function as dams to restrain drainage during the wettest seasons of the year.

Ridged wet meadows also support almost continuous carpets of sedges, which tend to form closed communities where the terrain is featureless. In our quantitative data we have lumped four sedge species, *Carex aquatilis, Eriophorum angustifolium, E. russeolum,* and *E. scheuchzeri,* because they are usually not in flower and the leaves alone are difficult to distinguish rapidly. In general, *C. aquatilis* and *E. scheuchzeri* occupy the wettest sites, and the other two cotton-grasses occupy only slightly drier ones.

Fig. 16—Eriophorum–Carex *wet-meadow vegetation. Note series of low ridges oriented across low-angle slope.*

The major palpable difference between ridged and nonridged wet meadows is that the former are much richer in species because of their microrelief features. *Betula nana, Salix pulchra, S. reticulata, S. ovalifolium, Ledum decumbens, Vaccinium uliginosum, V. vitis-idaea,* and *Rubus chamaemorus* were recorded from the ridges, as well as such herbaceous species as *Aconitum delphinifolium, Corydalis pauciflora, Cardamine microphylla, Eutrema edwardsii, Saxifraga punctata, S. hieracifolia, Polemonium acutiflorum,* and *Valerina capitata.*

Frost scars are abundant in the wet meadows of the latter two subtypes. As in the tussock communities, they are colonized by plants quite different from those found in typical wet-meadow vegetation, and interestingly, the frost-scar plants of tussock and wet-meadow communities are often the same. The general com-

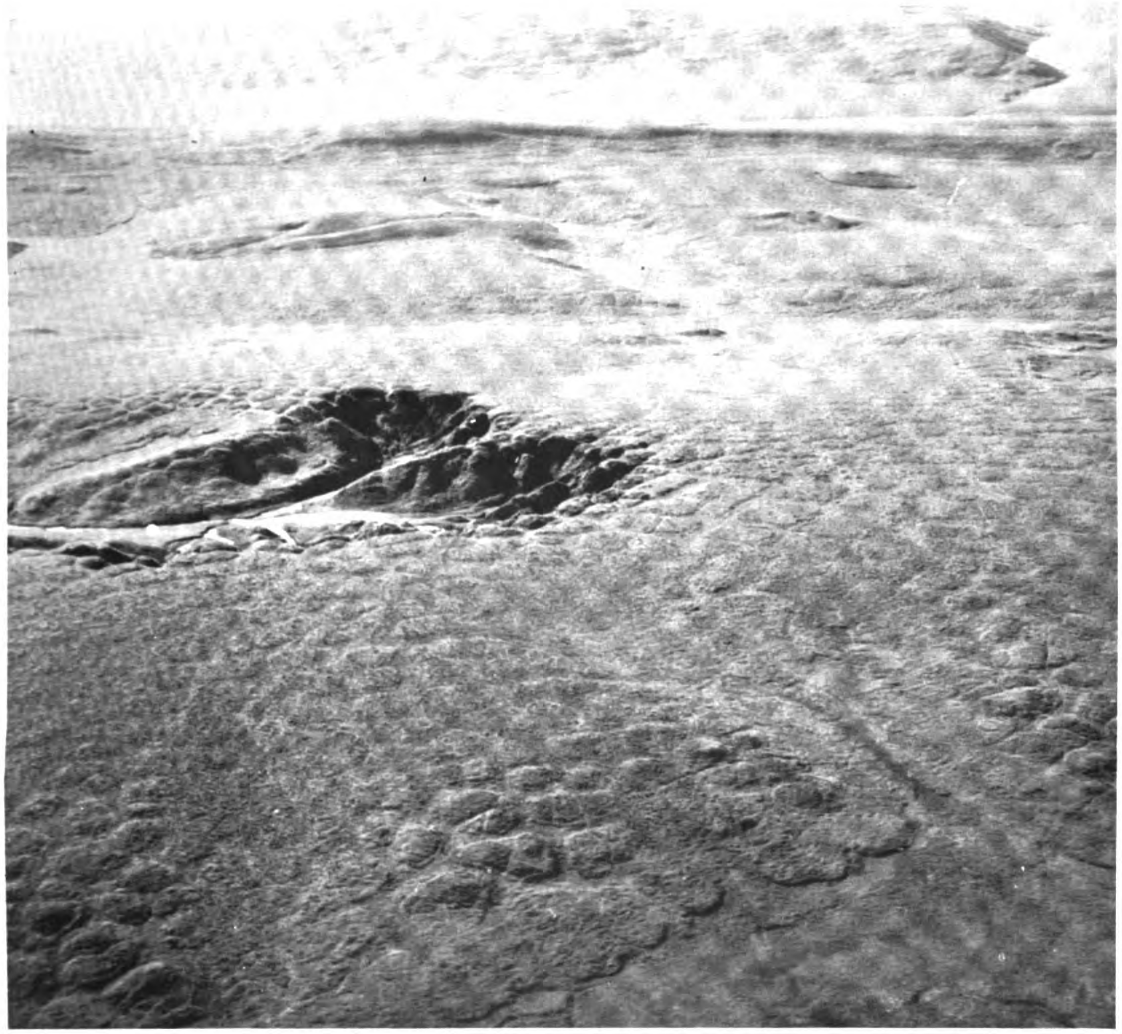

Fig. 17—Headward erosion of stream into polygon field; centers of these well-drained polygons support Carex bigelowii.

ments concerning frost scars appearing in the discussion of tussock vegetation apply here equally well.

Since all other vegetation types and plant communities occupying the valley floor cover very small areas, they will be discussed only briefly.

***CAREX BIGELOWII* HIGH-CENTER POLYGON** On interfluvial ridges of minor extent on fine-grained soils, another vegetation type that is probably a modification of the tussock type was found (Fig. 17). Improved drainage has resulted in the dissection of an ice-wedge-polygon pattern. The tops of the ice wedges have probably been lowered by melting; thus the centers of the polygons have been relatively elevated. Concomitantly, the soils in the polygon centers have dried somewhat and are no longer sufficiently wet to support *Eriophorum* tussocks. *Carex bigelowii* grows in habitats only slightly drier than those colonized by cottongrass; it occupies the centers of the polygons while *E. vaginatum* now grows in the depressions over the ice wedges. Soils tend to be somewhat modified here too, and, in one of the two stands of this type, the soils investigators reported an intergrade between arctic-brown and low-humic gley soils. The other important vascular plants here are *Salix pulchra, S. phlebophylla, Petasites frigidus, Ledum decumbens,* and *Vaccinium vitis-idaea.*

Mosses grow abundantly in the wet channels between polygonal centers, especially *Sphagnum girgensohnii, Aulacomnium palustre,* and *Polytrichum.* Lichens grow best on the drier centers and include *Cetraria islandica, C. cucullata, C. glauca, Cladonia rangiferina,* and *Peltigera scabrosa,* among a number of others.

Permafrost levels in this type are somewhat lower than in the tussock or wet-meadow communities, another reflection of improved drainage and warmer soils.

SALINE MEADOW Another vegetation type of minor extent (less than 1% of the watershed area) is an interesting community on wet alluvium near the mouth of Ogotoruk Creek. During on-shore storms this meadow is flooded by the Chukchi Sea, which deposits driftwood in large quantities. Most of the area is covered by an almost continuous sedge-grass mat, including *Eriophorum angustifolium, Carex glareosa, Deschampsia caespitosa, Dupontia fischeri, Calamagrostis deschampsioides, Arctagrostis latifolia, Puccinellia phryganodes, P. langeana,* and *Arctophila fulva.* The presence of such maritime species as *Chrysanthemum arcticum, Potentilla egedii,* and *Matricaria ambigua* reveals the influence of the sea on the composition of this vegetation type. *Primula borealis* is more common here than elsewhere in the watershed and in a few places along the driftwood zone forms nearly solid pink mats in mid-summer.

The soils of this type were classified as tundra humic gley types. Although permafrost data are lacking, the levels are thought to be deep because of the periodic flooding of the area both by the sea and by Ogotoruk Creek.

MISCELLANEOUS PLANT COMMUNITIES The vegetation types described above account for about 95% of the total Ogotoruk Creek watershed area. The remaining 5% is composed of a miscellany of plant communities that occur on sites influenced by late-lying snow, on the shifting gravelly substrates along Ogotoruk Creek and its tributaries, along the marine strand, in shallow ponds, or under the influence of ground squirrels.

Snow-bed Communities. Because of strong winds and local relief, the final pattern of snow distribution in Ogotoruk Valley bears no resemblance to what has actually fallen on one spot (Fig. 18). Although amount and duration of snow cover vary over a period of several years, there is always a tendency for snow to be deposited in the same place because the prevailing winter winds are more or less constant in direction from year to year. The size of a snow bed is determined by local relief and by the amount of snow that falls. Once a depression is full of snow, it can accumulate no more; however, the largest snow beds are so situated that they accumulate snow all winter. Whenever snow persists long enough to modify the local environment by its presence, the vegetation shows characteristic changes in species composition. Because individual plant species show

Fig. 18—Distribution of snow in Ogotoruk Valley in mid-June, 1959.

characteristic responses to differing amounts of snow and to the time available for completing a truncated life cycle, certain species occur again and again in snow-bed habitats. When a cool summer follows a snowy winter, some of the Ogotoruk Creek snow beds do not completely melt and, obviously, plants do not grow in such places. This is exceptional, however, since most of the snow beds, even the large ones, have disappeared by the middle or end of July. In addition to shortening the growing season, snow depresses soil temperatures during the summer and ameliorates the influence of cold and desiccation during the winter. It is likely, in fact, that the snow bed is one of the kindest of all habitats in this region of environmental extremes, and it is in these places that plants not well-adapted to the rigors of arctic environments manage to survive. The comprehensive work of Gjaerevoll (1956) on the problems associated with snow-bed vegetation provides a framework for all future studies of these phenomena.

Ericaceous snow-bed communities occur on slopes where drainage is rapid and where snow melts fairly early in the season, i.e., by the middle of July. The plants here include *Ledum decumbens*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Cassiope tetragona*, and *Arctostaphylos alpina*, among the ericaceous shrubs, and such herbaceous plants as *Anemone narcissiflora*, *Polygonum bistorta*, *Hierochloe alpina*, and *Luzula nivalis*. Lichen cover is small; *Cladonia alpestris*, *Thamnolia vermicularis*, *Cetraria cucullata*, and *Sphaerophorus fragilis* are most common.

On steeper, rockier slopes a different kind of snow bed may develop. These sites have coarse and highly porous substrates from which all water drains almost at once. Ericaceous shrubs are poorly developed here but may include any of the species listed above. Lichen cover increases relatively; *Cladonia alpestris*, *C. rangiferina*, *Cetraria islandica*, *C. delisei*, and *Stereocaulon* sp. may make up as much as 30 to 40% of the total plant cover. Herbaceous plants are relatively unimportant in these communities.

Some of the largest and longest-lasting snow beds lie in the bottoms of small streams tributary to Ogotoruk Creek (Fig. 19). A few of these beds may last well into August. All shrub growth here is suppressed, and the dominant plants are often mosses and the characteristic snow-bed lichen, *Cetraria delisei*. Mosses found in these extreme conditions most often include species of *Drepanocladus*, *Aulacomnium*, and *Calliergon*. The hepatic *Anthelia juratzkana* is also admirably suited to late snow-bed sites. Herbaceous plants favoring these environments include *Oxyria digyna*, *Carex podocarpa*, *Koenigia islandica*, *Saxifraga rivularis*, and *Cardamine bellidifolia*.

Gravel-bar and -bench Communities. Gravel bars and benches of Ogotoruk Creek and its tributaries support a variety of stands from pioneer species on bare gravel to well-developed *Eriophorum angustifolium* wet meadows on the higher benches. A series of communities similar to those described by Bliss and Cantlon (1957) from the gravel bars and terraces of the Colville River near Umiat on the arctic slope can be identified. They recognized a perennial-herb stage, a young felt-leaf-willow (*Salix alaxensis*) stage, and a decadent felt-leaf-willow stage on the gravel bars. The sequence of development on the terraces, they found, is complicated by drainage, slope, distance above the water table, and thickness of the active-soil layer. They saw a series of stands transitional between the gravel-bar willow stands to cottongrass tussocks and wet-tundra meadows of the surrounding uplands.

Along Ogotoruk Creek the perennial-herb communities on gravel bars are composed of *Epilobium latifolium*, *Artemisia tilesii*, *A. arctica*, *Hedysarum alpinum*, *Lupinus arcticus*, *Elymus mollis*, *Arenaria macrocarpa*, *A. arctica*, *Festuca rubra*, *F. vivipara*, *Luzula confusa*, and many other species.

Willows begin their development directly on the bare gravel, the two most important species being *Salix pulchra* and *Salix alaxensis*. Near the coast the latter is the more common; about 5 miles inland the two species occur in almost even numbers; and about 6 miles upstream from the mouth of the creek, at a point where it leaves the hills on the east side of the valley, *S. pulchra* reaches its maximum development, forming dense stands up to 3 m tall. As the willows

Fig. 19—Snow bed in a tributary of Ogotoruk Creek on June 30, 1959.

invade the gravel bars, they gradually eliminate the pioneer perennial herbs. Where they form continuous, dense stands, the only plants that grow well under them are various mosses, such as *Rhytidium rugosum* and *Rhacomitrium lanuginosum*, and the lichen species *Peltigera aphthosa, P. canina,* and *Stereocaulon* sp. Other shrubby species may also invade the gravel bars with the willows, especially *Ledum decumbens* and *Arctostaphylos alpina.*

Where *Salix pulchra* dominates the gravel-bar community, there are essentially no openings in the willows, and most of the perennial herbs are limited to scattered *Epilobium latifolium, Festuca altaica, Anemone richardsonii, Polemonium acutiflorum, Artemisia tilesii,* and *Amica lessingii.* In this area, however, about 80% of the soil surface is covered by the mosses *Hylocomium splendens, Drepanocladus aduncus, Aulacomnium palustre,* and *Climacium dendroides.*

In the youngest of the plant communities on the gravel bars, drainage is rapid, and soil development is negligible. Permafrost, if present, is deep enough to be of little significance in determining the plant composition of these habitats. As the bars become subject to less and less periodic flooding, fine materials accumulate on the gravel surface, and a layer of organic material contributed by the willows and other plants develops on the surface. Where running water no longer modifies older gravel bars and where the soil surface has an insulating cover, permafrost may be expected to rise to levels where it is of importance in modifying the composition of the gravel-bar vegetation.

The benches or terraces of Ogotoruk Creek are adjacent to the gravel bars, but they are sufficiently high that they are rarely, if ever, flooded by the stream. Their soils are characterized by significantly higher percentages of sand and silt. Drainage is considerably poorer in these situations; consequently, willows of the bench communities are much lower growing than those on the gravel bars. *Salix pulchra* is the common willow on the terraces. The rest of the plants on the benches are mixtures of those species common in widespread tundra stands and the perennial herbs of gravel bars. For example, on very wet terraces *Eriophorum angustifolium, Carex aquatilis, Eriophorum vaginatum,* and *Carex bigelowii* occur in various combinations. These species show the same relation to soil moisture as is found in other tundra stands (Fig. 20).

We did not study the successional series of communities on the stream terraces, but our general observations support the belief that they are transitional between the communities of the gravel bars and wet-meadow and tussock communities.

Strand Communities. The gravelly beaches along this stretch of the Chukchi Sea coast do not favor plant growth. Most of the common strand species prefer somewhat sandy soils, and these are not abundant until one travels north or south along the coastline for some distance. In the few scattered suitable habitats, however, the strand species that are common along most of the northern coastlines of the world occur. *Elymus mollis* is by all odds the most common of the strand species, but *Senecio pseudo arnica, Lathyrus japonicus, Honckenya peploides, Mertensia maritima,* and *Cochlearia officinalis* also grow here and there.

There are two contributing influences to the paucity of strand plants along this coastline. During the winter and spring, the sea ice commonly plows up the gravelly beach surfaces, and, in the summer and fall, severe on-shore storms sweep the entire beach and alternately remove and deposit tons of fine gravel. Consequently the strand plants are most often found on the lee side of barrier beaches, especially at the mouths of small streams that enter the sea at intervals along the coastline. Fine-grained materials are more common in these places.

Aquatic Communities. The small bodies of fresh water in Ogotoruk Valley are surprisingly low in aquatic species. Except for mostly emergent species growing along the edges of ponds, these habitats are almost barren of higher plant life. The most common species growing along pond margins are *Arctophila fulva, Hippuris vulgaris, Ranunculus pallasii, Potentilla palustris,* and *Carex aquatilis* (Fig. 21). *Caltha palustris* sometimes grows in small tundra ponds, and occasionally *Ranunculus hyperboreus, R. gmelinii,* and *R. aquatilis* grow in shallow

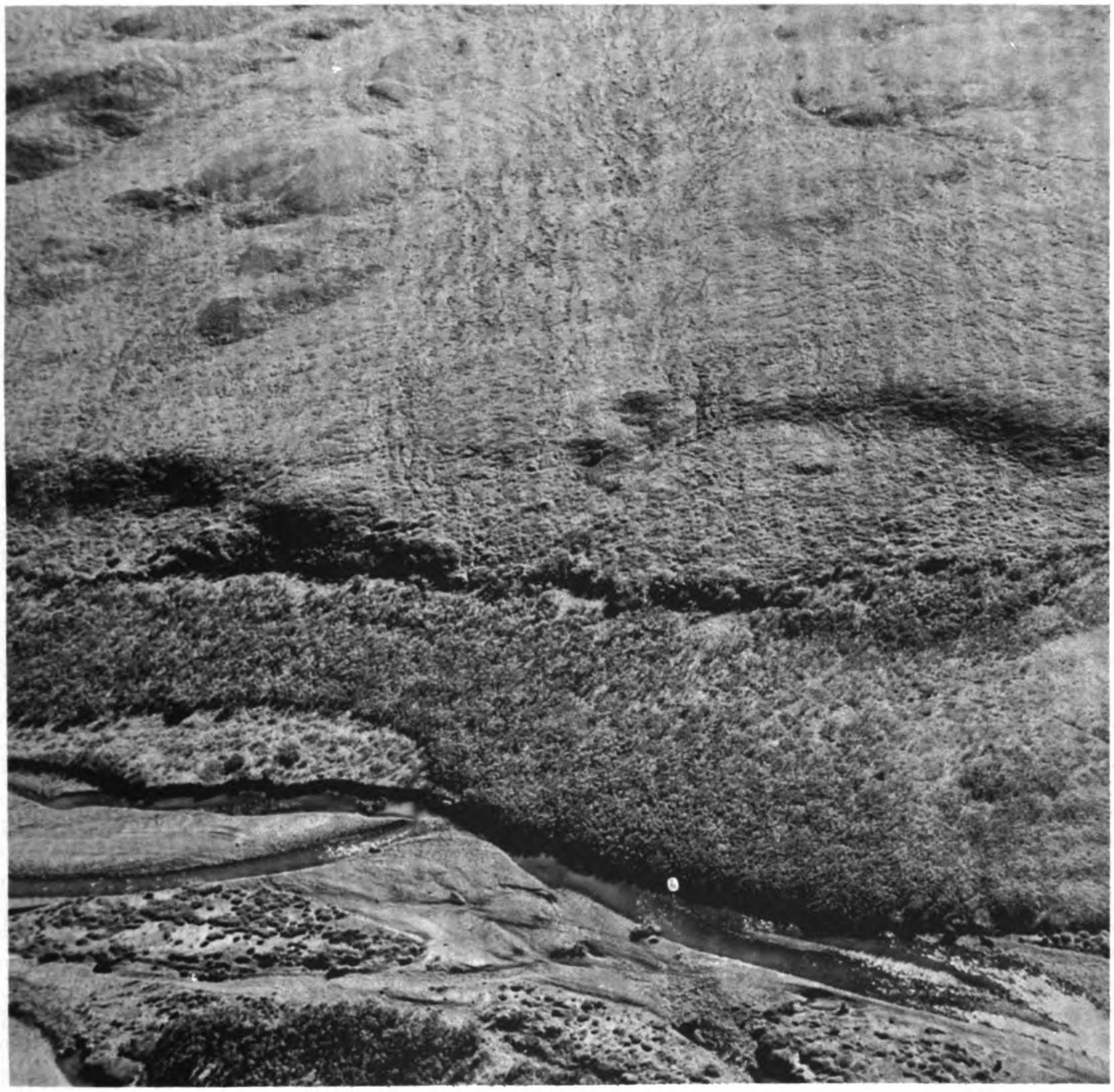

Fig. 20—Gravel bars and benches of Ogotoruk Creek.

water. In the small ponds between the upper Ogotoruk Valley and the Kukpuk River, *Sparganium hyperboreum* is fairly common. *Potamogeton pectinatus* and *P. filiformis* are present in some of these ponds but are rather rare.

Citellus Mound Communities. In the 1959 field season, it became apparent that vegetation distribution is profoundly influenced locally by the activities of certain of the more abundant mammals in the valley. The most noticeable effects are produced by the Arctic ground squirrel, *Citellus parryi.* Ground squirrels are active in a variety of vegetation types and plant communities, but the effects of their activities are most pronounced in the *Dryas* fell-field, *Dryas* step and stripe type, and ecotone communities along stream banks. The squirrels are generally absent from the *Eriophorum* tussock, *Eriophorum*–*Carex* solifluction slope, and *Eriophorum*–*Carex* wet-meadow types.

Fig. 21—Aquatic community in a small pond on a bench of Ogotoruk Creek. Hippuris vulgaris *is the conspicuous emergent plant.* Carex aquatilis *and* Eriophorum angustifolium *border the open water.*

Our studies of the relations between the ground squirrel and plant distribution suggest that vegetation changes result primarily from burrow construction and from feeding activities. The activities of the squirrel associated with the formation and use of the burrow affect plant distribution in the following ways: the soil-deposit piles that result from burrow construction cover existing vegetation, and squirrel excrement mixed with the newly exposed soil provides an ideal situation for germination and growth of many species, especially grasses, sedges, and rushes. Because these plants do not ordinarily occur in the undisturbed vegetation surrounding the burrow, they are highly conspicuous as they grow densely on the burrow-excavation piles. With time and continued use, willows and other shrubs may grow densely on the burrow system, the important species here being *Salix pulchra* and *S. glauca* (Fig. 22). Once established these plants may persist on

Fig. 22—Ground-squirrel burrow system in Dryas *fell-field showing growth of willows where soil is disturbed.*

otherwise rather featureless tundra for long periods of time even if the ground squirrels abandon the site.

Feeding activities of the squirrels are apparently important only in the spring and fall when the vegetation mat is destroyed on a local level by their search for roots of *Dryas octopetala.* These activities also open up the soil to erosion processes that are probably more significant to the plants than the feeding operations. Otherwise, the squirrels use a wide variety of food plants over a fairly large area around the burrow and do not denude any area of plants. Nest materials are gathered from the sedges in the wet meadows, and their removal apparently has little effect on the vegetation.

For additional observations on the behavior and ecology of this mammal, the reader is referred to Chap. 20.

THE FLORA

The majority of the plant collections (nearly 3000 numbers) were made in the Ogotoruk Creek watershed. Also included, however, are collections from several adjacent areas including the Kukpuk River area where it is adjacent to Ogotoruk Valley and the coastline as far west as Cape Thompson and as far east as the mouth of Kisimilok Creek. Extensive collections were also made in the Cape Dyer—Cape Lewis area of the northwestern Alaska coast; Johnson and Viereck (1962) have reported on the most interesting of these collections.

The habitats available to plants in the Ogotoruk Creek—Cape Thompson area have been described in the section under vegetation. The semi-mountainous topography with a variety of parent materials, the broad perifluvial flats dotted with small ponds, the alluvial deposits along the streams, and the marine strand and saline meadows near the sea are broad categories of habitats that are much modified by solifluction, frost heaving, snow accumulation, drainage, animal activity, and ocean storms acting individually or in concert to produce a large array of microhabitats. In the annotated list of species that follows this section, an attempt has been made to summarize the available information on habitat preference for each species and, as accurately as possible, to indicate the relative abundance of each by use of the qualitative designations rare, uncommon, scattered, and common. Our use of the word "rare" means that the plant was found in small numbers in one or two places over the entire area; uncommon plants are those which occur here and there in restricted habitats; plants of scattered occurrence are found in a variety of habitats but are never very abundant; and common plants are those which are locally abundant in at least one habitat type and are often the characteristic species in one or more vegetation type. More precise information on species abundance is presented in the section on vegetation.

For the most part we have followed Hultén(1941-1950) for the nomenclature of these taxa, but in many instances it was necessary to emend his nomenclature in the light of changes or discoveries subsequent to his publication. The appearance of Wiggins and Thomas(1962) while our manuscript was in preparation added a more recent source of names. We have also made extensive use of Porsild's careful work on the Alaskan and Canadian arctic and subarctic floras (1951, 1955); other sources when used are indicated. Differences of opinion among these sources are common, and our general policy has been to follow those workers who have had most experience with the North and with North America. In those instances where there may be some doubt as to the origin of the nomenclature we use, we have listed names used by other workers, but in no case have we presented complete synonymy for these taxa.

The study presented here follows the methods of classical taxonomy; it does not include the useful data that are becoming available from chromosome studies. A cytotaxonomic study of the Ogotoruk Creek—Cape Thompson flora is now in progress, and, when its results are available, some of the taxa recognized in this paper may undergo a change in status. We do not feel justified in using cytological information from similar populations in localities other than the one under consideration here although we are well aware that this procedure is sometimes followed.

A complete set of all of our collections is housed in the University of Alaska Herbarium. Duplicate specimens have been sent to the U. S. National Museum; the University of Colorado Herbarium, Boulder, Colorado; the Botanical Museum, Copenhagen, Denmark; the National History Riksmuseet, Stockholm, Sweden; the Botanical Museum, Oslo, Norway; the Royal Museum, Trondheim, Norway; and the Central Experimental Farm, Ottawa, Canada.

The following collections and collectors are cited in the text:

JVM collections by Albert W. Johnson, Leslie A. Viereck, and Herbert R. Melchior, summer, 1959, in Ogotoruk Valley, the Cape Thompson area, the Kukpuk River area, and at the mouth of Kisimilok Creek.

AJ collections by Albert W. Johnson, summer, 1960, in Ogotoruk Valley.

M collections by Herbert R. Melchior, Hilda Melchior, and Ross E. Johnson, summer, 1960, in Ogotoruk Valley, in the Kukpuk River area, and in the vicinity of Cape Thompson.

RJ collections by Ross E. Johnson, summer, 1960, in Ogotoruk Valley, in the Kukpuk River area, and in the vicinity of Cape Thompson.

VB collections by Leslie A. Viereck and Anore Bucknell, summer, 1960, at Point Hope, in the Cape Dyer—Cape Lewis area, and in Ogotoruk Valley.

JN collections by Ross E. Johnson and Bonita M. Neiland, summer, 1961, in Ogotoruk Valley.

The annotated list of plants that follows does not include lichens, mosses, or hepatics because we do not feel competent to discuss taxonomic problems in these groups. One publication on the bryophytes of the Ogotoruk Creek region has already appeared (Persson, 1962), and papers on the other cryptogams are planned by the specialists who made the bulk of the determinations. We have included a list of all bryophytes and lichens collected by us in the Appendix, and we have correlated these plants with the habitats in which they are most often found. We do not make claims for the completeness of the list in terms of species or in regard to the habitats they occupy, but we feel that it is at least representative of the cryptogams occurring in this part of the Arctic.

DIVISION LYCOPHYTA

Lycopodiaceae

Lycopodium selago L. var. *appressum* Desv.
Uncommon in snow beds and in ericaceous polygon vegetation.
Collection number: JVM 97

Selaginellaceae

Selaginella sibirica (Milde) Hieron.
Scattered on dry, exposed outcrops.
Collection number: JVM 163

DIVISION SPHENOPHYTA

Equisetaceae

Equisetum arvense L.
Common in solifluction slopes and snow beds.
Collection number: JVM 124

Equisetum scirpoides Michx.
Uncommon on gravel bars and on moist slopes.
Collection numbers: JVM 391, 564

Equisetum variegatum Schleich.
Rare in wet-meadow situations.
Collection number: VB 4647

Cystopteris fragilis (L.) Bernh. ssp. *fragilis*

Cystopteris fragilis (L.) Bernh. ssp. *dickieana* (Sim.) Hylander

Cystopteris fragilis is a variable species in Alaska and, according to Wiggins and Thomas (1962) and Wiggins (1954), can be separated into two species, *C. fragilis* s. str. and *C. dickieana*. Individuals with spinose spores are referred to the former and those with rugose spores to the latter. Both types are present in our collections. JVM 702 has rugose spores; VB 4564 has spores that are clearly spinose. Our other collections are too young and have only immature sporangia. Because the two types are so much alike in other respects, however, we prefer to follow Hylander (1945) and Gjaerevoll (1958) and refer those individuals with rugose spores to subspecific status. Whether or not the two subspecies show ecological preferences cannot be stated on the basis of our samples.

Scattered on dry talus slopes; among crevices and large rocks.
Collection numbers: JVM 120, 143, 702; VB 4564

Dryopteris fragrans (L.) Schott.
Rare among rocks on talus slopes.
Collection number: AJ 62255

Woodsia glabella R.Br.
Scattered on calcareous soils among rocks on hillsides and cliffs.
Collection numbers: VB 4593, 4648

Woodsia ilvensis (L.) R.Br.
Scattered on talus slopes and among *Dryas* stripes.
Collection numbers: JVM 173, 273

DIVISION SPERMATOPHYTA

Gramineae

Agropyron latiglume (Scribn. and Merr.) Rydb.
Scattered on talus slopes and rocky ridges and on gravel bars.
Collection numbers: JVM 538; VB 4572, 4654
Melderis (1950) has included this and other species of the genus *Agropyron* in the genus *Roegneria*. Inasmuch as most of the Alaskan material has not been critically examined, we retain the name *Agropyron*.

Alopecurus alpinus J. E. Smith

Common in wet situations throughout the valley.

Collection numbers: JVM 226, 682, 696; JN 71; RJ 121

Arctagrostis latifolia (R.Br.) Griseb.

Arctagrostis latifolia (R.Br.) Griseb. var. *arundinacea* (Trin.) Griseb.

Common in *Dryas* fell-fields and on dry hummocks in other vegetation types.

Hultén (1942), Gjaerevoll (1958), and Wiggins and Thomas (1962) discuss the problems relating to the variability of this species. Wiggins, Thomas, and Hultén regard *arundinacea* as a variety of *A. latifolia* while Porsild (1951) and Gjaerevoll accord it specific status. All these workers agree that, although the extremes in the variation pattern are distinct, there are forms which overlap; furthermore, there seems to be no clearcut geographic separation between the two, the two types sometimes "growing side by side" (Hultén, 1942). For these reasons, we follow Hultén in recognizing var. *arundinacea* of *A. latifolia.*

Collection numbers: typical *A. latifolia*—RJ 115; JVM 668; M 186; and var. *arundinacea*—JVM 578, 638; M 172, 200; RJ 140

Arctophila fulva (Trin.) Rupr.

Common in shallow standing water and wet silt or sand deposits in saline meadows and wet meadows.

Collection numbers: JVM 681; VB 4576; M 236; RJ 119, 126

Bromus pumpellianus Scribn. var. *arcticus* (Shear) Porsild

Common on steep slopes and in sandy and rocky habitats where drainage is good.

Collection numbers: JVM 683; M 184, 203, 206

Calamagrostis canadensis (Michx.) Beauv. var. *langsdorfii* (Link) Inman

Uncommon on drier sites in the wet meadows and on squirrel mounds in *Dryas* fell-fields; also in moist streamside areas.

Collection numbers: VB 4691; M 274, 286c

Calamagrostis deschampsioides Trin.

Common in saline meadows; uncommon on wet solifluction slopes.

Collection number: RJ 127

Calamagrostis inexpansa A. Gray

Common on ground squirrel mounds and on gravel bars.

Collection numbers: JVM 611; M 262; VB 4646

Calamagrostis lapponica (Wahlenb.) Hartm.

Uncommon in dry sites in wet meadows and fell-fields.

Collection number: M 232b

Calamagrostis neglecta (Ehrh.) G. M. and Sch. ssp. *neglecta.*

Common in tussock tundra and wet meadows.

Collection numbers: M 254, 275; VB 4543, 4547

Calamagrostis neglecta (Ehrh.) G. M. and Sch. var. *borealis* (Laest.) Kearney

Scattered in tussock and wet-meadow tundra.

Collection number: JVM 592

Calamagrostis purpurascens R.Br.

Uncommon in *Dryas* step areas.

Collection number: AJ 63360

Deschampsia caespitosa (L.) Beauv. s. lat.

Common on frost scars, especially in tussock vegetation type; also on solifluction slopes and in saline meadows.

Collection numbers: JVM 496, 606, 607, 656, 714; RJ 123, 133; VB 4542

The situation regarding *Deschampsia caespitosa* in Alaska is confused. Hultén (1942) recognized three infraspecific taxa in his *Flora*, namely ssp. *orientalis*, var. *glauca* and the main form. Gjaerevoll (1958) reporting on his collections from interior Alaska concludes that ssp. *orientalis* is the same as *Deschampsia brevifolia* R.Br. Porsild; however, in reporting on the latter in his Canol Road Flora (1951b), he says *D. brevifolia* "... cannot be referred to *D. caespitosa* or to its var. *glauca* or ssp. *orientalis*." Finally, Wiggins and Thomas (1962) recognize both ssp. *orientalis* and var. *glauca* from the arctic portions of Alaska but do not mention *D. brevifolia*. Fortunately, we have had at our disposal several specimens cited by Wiggins and Thomas as ssp. *orientalis*. In comparing our material from the Ogotoruk Creek area with this material and also with presumably typical var. *glauca*, we find that without exception our specimens are closer to the latter. The glumes and lemmas tend to be shorter on the average than the arctic-slope material; all our specimens have involute basal leaves, and the lemma awns are inserted between the middle and the base, some of them being definitely basal. There seems to be little doubt, however, that all the characteristics purportedly separating ssp. *orientalis* and var. *glauca* overlap considerably. For this reason, we prefer to treat all our material in the broad sense until the taxonomic confusion is resolved.

Dupontia fischeri R.Br. ssp. *psilosantha* (Rupr.) Hultén

Common in saline marshes, on moist gravel bars, and occasionally in wet meadows.

Collection numbers: JVM 605, 617, 711, 722; M 252; RJ 125

Elymus mollis Trin.

Common along beaches and dry slopes near the sea.

Collection numbers: JVM 570; RJ 120

Festuca altaica Trin.

Snow beds and other sheltered situations; uncommon.

Collection numbers: JVM 393; RJ 145

Festuca baffinensis Polunin

Moist to well-drained situations on the calcareous soils on the west side of the valley; scattered.

Collection numbers: JVM 567; M 196; RJ 129; VB 4433

Festuca brachyphylla Schultes

Common on *Dryas* stripes, on frost scars in various vegetation types, on gravel bars, talus slopes, and other dry habitats.

Collection numbers: JVM 274, 597, 639; M 237a, 248; RJ 132, 143; JN 44, 144

Festuca rubra L. var. *lanuginosa*, Mert. and Koch

Common on gravel bars, sand dunes, and on solifluction slopes.

Collection numbers: M 188, 234; RJ 131, 135

All our specimens have pilose lemmas characteristic of var. *lanuginosa*. It may be appropriate to note that this variety has been referred to ssp. *richardsonii* by Hultén and to var. *arenaria* (Osbeck) Fr. by Porsild. We follow here the synonymy suggested by Hitchcock (1950, p. 877) for this variety.

Festuca vivipara (L.) Sm.

Uncommon on talus slopes, frost scars, gravel bars, and bench deposits.

Collection numbers: JVM 719; M 235; RJ 149

Hultén (1958) does not include western North America in the range of this species. He mentions Lepage's (1951) report of *F. vivipara* from Nome. Porsild (1939) also reported this species from the Seward Peninsula, and more recently Gjaerevoll (1958) concluded that his material from the White Mountains of interior Alaska compared very favorably with *F. vivipara* from Scandinavia and Spitzbergen. A. W. Johnson had the opportunity to compare the above specimens with *F. vivipara* material from Scandinavia, Spitzbergen, Greenland, and Iceland (in the Oslo Museum) and concludes also that our material cannot reasonably be separated from it. Numbers JVM 719 and RJ 149 had a few "normal" spikelets with anthers over 2 mm long. This precludes the possibility that our specimens are merely viviparous *F. brachyphylla* or *F. baffinensis*.

Hierochloe alpina (Sw.) Roem. and Schult.

Common on gravel bars, in *Dryas* tundra, and in other dry habitats.

Collection numbers: JVM 144; RJ 137; VB 4546

It is interesting to note that collection number VB 4546 has a few viviparous spikelets on each plant. We have found no other reports of vivipary in this species in Alaska.

Hierochloe pauciflora R.Br.

Scattered on solifluction slopes and wet meadows.

Collection number: JVM 342

Koeleria asiatica Domin.

Rare on dry sites.

Collection numbers: JVM 506, 536

This interesting species had been collected only once previously in North America (Wiggins, 1959). It bears a superficial resemblance to *Trisetum* and consequently has probably been overlooked.

Phippsia algida (Soland) R.Br.

Common in snow beds and on gravel bars.

Collection numbers: JVM 149; M 204; RJ 136

Poa alpigena (E. Fr.) Lindman

Scattered in wet-meadow vegetation.

Collection numbers: M 189, 241

Poa alpigena (E. Fr.) var. *vivipara* Hultén
Collected only once (VB 4687) in a snow-bed community.

Poa alpina L.
Scattered on dry slopes, polygonal areas, and on gravel bars.
Collection numbers: JVM 692; VB 4577

Poa arctica R.Br. ssp. *arctica*
Scattered in dry fell-fields and on dry sites in other vegetation types.
Collection numbers: JVM 447, 537; VB 4652; M 108, 109

Poa brachyanthera Hultén
Scattered on dry outcrops.
Collection number: JVM 674

Poa glauca Vahl
Common in snow beds, on talus slopes, fell-fields, gravel bars, and other dry habitats.
Collection numbers: JVM 218; VB 4571, 4652A; M 174; RJ 144

Poa lanata Scribn. and Merr.
Common in most vegetation types but especially in fell-fields, wet meadows, tussocks, gravel bars, and on squirrel mounds, but occurring also in high-center polygons, ericaceous polygons, and saline meadows.
Collection numbers: JVM 367, 403B, 441, 582, 595, 636, 666; M 231, 232a, 233, 241, 247, 261; RJ 124; VB 4544

Poa lanata Scribn. and Merr. var. *vivipara* Hultén
Collection number: JVM 710

Poa paucispicula Scribn. and Merr.
Scattered in snow-bed situations.
Collection numbers: M 205; JVM 667

Puccinellia phryganodes (Trin.) Scribn. and Merr.
Common on mud at the mouth of Ogotoruk Creek and in saline meadows.
Collection numbers: JVM 713; RJ 142

Puccinellia langeana (Berl.) Sørens. ssp. *typica* Sørens.
Collected only in saline meadow at mouth of Ogotoruk Creek.
Collection numbers: RJ 141; AJ 62281
Listed in some manuals as *Puccinellia paupercula* (Holm) Fern. and Weatherby.

Puccinellia vaginata (Lge.) Fern. and Weatherby
Common along the bases of the sea cliffs.
Collection number: JVM 533
According to Dr. Thorv. Sørensen, who identified this specimen, this species was not known to occur west of the Mackenzie region before this collection.

Trisetum sibiricum Rupr.
Scattered in bare gravels, in mounds of earth surrounding ground squirrel burrows, in snow beds, and on solifluction slopes.
Collection numbers: JVM 345, 534, 535, 724; M 79; RJ 130

Trisetum spicatum (L.) Richt.
Common on dry disturbed soils on frost scars, ground squirrel burrows,

in pockets of soil on talus slopes, and in snow beds.
Collection numbers: JVM 558, 655; M 156, 185, 190c, 194; RJ 118

Cyperaceae

Carex aquatilis var. *stans* (Drejer) Boott
Abundant in wet meadows and solifluction slopes and scattered in other wet situations.
Collection number: JVM 490

Carex atrofusca Schkuhr.
Rare in wet meadows.
Collection number: VB 4685

Carex bigelowii Torr. and Schwann.
Common and locally abundant on solifluction slopes, on ridges in wet meadows, in tussock areas, and in other moist habitats.
Collection numbers: JVM 165, 242, 278, 302, 386, 486; JN 117
Hultén includes this species in his *Flora* but has later (1958) accepted the view of Porsild (1957) and Raymond (1951) that in Alaska the species is replaced by *C. lugens* and *C. consimilis*, especially by the latter. Gjaerevoll (1958) also follows Porsild but "with much hesitation" and notes "the character pointed out by Holm, viz. the sharply denticulate margins of the perigynia, does not hold quite good." A. W. Johnson has had an opportunity to compare the material cited above with large collections of *C. bigelowii* from other parts of its circumpolar area and has also seen a fragment of the type of *C. consimilis*. In his opinion, the Ogotoruk Creek material falls within the variation of *C. bigelowii*, and there seems to be little justification for recognizing *C. consimilis* as a separate taxon, at least until experimental studies of the *Carex bigelowii* complex have been made.

Carex capillaris L.
Uncommon on sandy and gravelly soils.
Collection numbers: M 178, 190a

Carex glareosa Wahlenb. var. *amphigena* Fern.
Scattered but locally abundant in saline meadows.
Collection number: JVM 321

Carex lachenalii Schkuhr.
Scattered in wet-meadow situations and along streams.
Collection numbers: JVM 394, 648; M 264

Carex maritima Gunn.
Along sandy shores of the sea and inland on south-facing slopes and in seepage areas on calcareous soils.
Collection numbers: JVM 553, 685, 725; VB 4682; M 177

Carex membranacea Hook.
Scattered in wet meadows, along streams, and in wet depressions in other vegetation types.
Collection numbers: JVM 395, 584, 612, 616, 646; M 255; VB 4679

Carex microchaeta Holm

Scattered in *Dryas* fell-fields, *Dryas* step vegetation, and on ground-squirrel mounds.

Collection numbers: JVM 281C, 362, 493, 583; M 243a, 250

Carex misandra R.Br.

Scattered in *Dryas* fell-fields and in *Dryas* step vegetation, especially on calcareous soils.

Collection numbers: JVM 301, 333, 697

Carex nardina Fries

Scattered on calcareous soils, especially in pockets of soil in talus slopes.

Collection numbers: JVM 211, 549, 704; M 220

Carex physocarpa Presl.

Scattered in sedge meadows.

Collection number: VB 4683

Carex podocarpa R.Br.

Common in snow-bed situations, along streams, and in the drier portions of wet meadows; also on the piles of earth excavated by ground squirrels.

Collection numbers: JVM 392, 491, 579, 623; M 107, 249

Porsild (1951) and Gjaerevoll (1958) point out that the plant called *Carex montanensis* L. H. Bailey in Hultén's *Flora* (and also in Wiggins and Thomas, 1962) is in reality *C. podocarpa* R.Br. and that the plant referred to as *C. podocarpa* by Hultén is *Carex microchaeta* Holm. Furthermore, according to Porsild, *Carex nesophila* Holm may be segregated from *C. microchaeta* in the areas along the Bering coast although the differences between the two are admittedly indistinct. We are following these recommendations except that we are not able to separate *C. microchaeta* and *C. nesophila* and assign all specimens in this complex to the former rather arbitrarily. The situation is confused, and even Porsild's attempts to clarify it are not completely satisfactory because he reports that *C. microchaeta* is aphyllopodic (1951, p. 118), while in fact Holm's original description clearly states that *C. microchaeta* is phyllopodic.

Carex ramenskii Kom.

Seen and collected only once at the edge of a small pond.

Collection number: JVM 420

Carex rariflora (Wahlenb.) Smith

Scattered in wet meadows and in brackish marshes.

Collection numbers: JVM 573, 712

Carex rotundata Wahlenb.

Scattered in wet-meadow and tussock vegetation.

Collection numbers: JVM 414, 584, 646; VB 4588

Carex scirpoidea Michx.

Scattered in *Dryas* step vegetation.

Collection numbers: JVM 277, 279

Carex subspathacea Wormskj.

Scattered in wet portions of the strand.

Collection number: AJ 62249A

Eriophorum angustifolium Honck.

Abundant in all wet meadows, often in standing water; also in wet depressions in other vegetation types and along ponds and streams.

Collection number: JVM 51

Eriophorum russeolum Fries var. *albidum* Nyl.

Scattered in wet-meadow, tussock, and solifluction-slope vegetation.

Collection numbers: JVM 37, 72, 263, 647

Eriophorum scheuchzeri Hoppe

Scattered in wet meadows, adjacent to ponds and streams in sand and silt.

Collection numbers: JVM 235, 635; VB 4597

Eriophorum vaginatum L.

Abundant and comprising great areas of tussock tundra on wet, gently sloping, fine-grained soils.

Collection number: JVM 9

Kobresia hyperborea Porsild

Uncommon in solifluction-slope vegetation, on *Dryas* steps and stripes, and in snow beds.

Collection number: VB 4614

Kobresia myosuroides (Vill.) Fiori and Paol.

Scattered in *Dryas* mats, on moist shale slopes, and on sand dunes; usually restricted to calcareous soils.

Collection numbers: JVM 540, 566; M 183

Kobresia simpliciuscula (Wahlenb.) Mack.

Seen only once in a wet seepage area at the base of a steep hill.

Collection number: JVM 684

Juncaceae

Juncus balticus Willd. ssp. *alaskanus* (Hultén) Porsild

Rare on wet, sandy soil along streams.

Collection numbers: JVM 680, M 253

Juncus biglumis L.

Scattered in open patches of wet soil in wet-meadow, tussock, and other moist tundra habitats.

Collection numbers: JVM 146, 455

Juncus castaneus Smith

Scattered but locally abundant along stream bottoms, in open patches of soil in the tussock tundra, and in seepage areas.

Collection numbers: JVM 571, 628; M 259

Luzula arcuata (Wahlenb.) Wahlenb.

Luzula confusa Lindb.

These two species are difficult to separate, and the characteristics listed by Hultén in *Flora of Alaska and Yukon* as well as those listed by Wiggins and Thomas (1962) for the arctic Alaskan material do not hold up in the Ogotoruk Creek area. All combinations of characters occur, and even those specimens which most closely approach "typical" *L. arcuata* in our specimens seem to be somewhat under the influence of *L. confusa.* Our situation seems to be similar to that reported by Hylander (1945) for Scandinavia; there it is possible to recognize extremes at both ends of the variation pattern, but there is a broad overlap between the two species. There are some differences in ecology of the two species, *L. arcuata* being especially restricted to snow beds and gravelly areas and *L. confusa* to dry fell-fields and other drier habitats. Of the specimens collected by us, the following are considered to be the most typical of *L. arcuata*: JVM 241, 665; JN 118. The following approach *L. confusa* closely: JVM 453; VB 4529. Numbers that are more or less intermediate between the two are JVM 184, 315, 494, 580, 619, 625.

Luzula nivalis (Laest.) Beurl. var. *nivalis.*
Scattered on gravel bars, *Dryas* fell-fields, benches, tussocks, and on frost scars.
Collection numbers: JVM 316, 618

Luzula nivalis (Laest.) Beurl. var. *latifolia* (Kjellm.) Sam.
In same habitats as main form.
Collection numbers: JVM 240, 640, 581

Luzula wahlenbergii Rupr.
Scattered in wet meadows growing in *Sphagnum* moss; also in sandy and gravelly soil and on wet frost scars.
Collection numbers: JVM 374, 589, 626, 629, 637; VB 4643

Liliaceae

Allium schoenoprasum L. var. *sibiricum* (L.) Hartm.
Scattered in wet frost scars, on sea-front banks, on steep, gravelly slopes.
Collection numbers: JVM 416; M 60, 147; JN 160
Apparently the northern limit of this species is reached in the Ogotoruk Creek area since Wiggins and Thomas (1962) do not report it from arctic Alaska.

Lloydia serotina (L.) Rchb.
Scattered in *Dryas* fell-fields, on dry slopes, at margins of frost scars, in snow-bed communities, and in other vegetation types.
Collection numbers: JVM 69, 101; M 43

Melanthaceae

Tofieldia coccinea Richards.
Scattered on steep slopes with ericaceous shrubs and in *Dryas* mats.
Collection numbers: JVM 650C, 375

Tofieldia pusilla (Michx.) Pers.
Scattered in snow beds, especially on calcareous soils.
Collection number: VB 4655

Zygadenus elegans Pursh
On steep south- and west-facing slopes and in snow-bed communities.
Collection numbers: JVM 515, RJ 88

Salicaceae

Salix alaxensis (Anderss.) Colville

Common on gravel bars of Ogotoruk Creek and other drainages in the area.

Collection numbers: JVM 45, 171, 172, 219, 715, 716; M 170, 297

Salix arbutifolia Pall.

Common on hummocks and ridges in wet meadows and growing from the sides of tussocks.

Collection numbers: JVM 98, 153, 236, 451, 585, 587, 648

Salix arctica Pall.

Scattered and locally abundant in a variety of vegetation types and communities, including talus slopes, snow beds, on ridges in wet meadows, in ericaceous vegetation, and on solifluction slopes.

Collection numbers: JVM 213, 615, 650B; JN 35; VB 4621, 4623

Salix brachycarpa Nutt. ssp. *niphoclada* (Rydb.) Argus

Scattered on talus slopes, especially on calcareous soils.

Collection numbers: JVM 148, 215, 215A, 673; VB 4651

Salix chamissonis Anderss.

Scattered in wet meadows, at the margins of snow beds, and along small creeks and seepage areas.

Collection numbers: JVM 99, 162; M 84, 102; AJ 42; JN 75

Salix glauca L. sens. lat.

Common in a variety of vegetation types including gravel bars and benches, *Dryas* steps, ericaceous polygons, and on dry sites in other types.

Collection numbers: JVM 41, 168, 170, 303, 610, 643, 644; M 168, 238, 298

Salix ovalifolia Trautv.

Common along beaches and zone of storm tides; in saline marshes and wet meadows.

Collection numbers: JVM 207, 445, 608, 723

Salix phlebophylla Anderss.

Common in fell-fields, *Dryas* stripes and steps, on dry frost scars, and on talus slopes.

Collection numbers: JVM 3, 6, 43; JN 45

Salix pseudopolaris Flod.

Collected once in a snow bed in the upper Ogotoruk Creek basin.

Collection number: M 105

Salix pulchra Cham.

A common species of gravel bars, wet meadows, tussocks, and other types.

Collection numbers: JVM 4, 188, 189, 400, 438, 439, 720, 721, 726; M 299

Salix reticulata L.

Scattered in *Dryas* steps, ericaceous snow beds, and gravel bars.

Collection numbers: JVM 282; JN 36; M 180

Salix rotundifolia Trautv.

Scattered but locally abundant on gravel bars and benches and other moist habitats.

Collection numbers: JVM 71, 164, 166

Betulaceae

Betula nana L. ssp. *exilis* Sukatch.

Common in depressions in *Dryas* fell-fields, on the sides and tops of tussocks, at the margins of frost scars, on ridges in wet meadows and in snow beds.

Collection number: JVM 46

It is with considerable hesitation that we report this species from the Ogotoruk Creek area. Hultén's *Flora* lists this species from Alaska, and in a more recent discussion of this taxon (1958) he maintains, "subspecies *exilis* predominates (in the *B. nana* complex) in western and southern Alaska." Porsild (1951) points out, "all Alaskan material of *B. glandulosa* var. *sibirica* (*B. nana* ssp. *exilis*) lacks the velutinous pubescence of the young twigs, so characteristic of *B. nana.*" He refers his material to *B. glandulosa* var. *sibirica.* Wiggins and Thomas (1962) follow Porsild in this matter. Our material too lacks pubescent young twigs. On the other hand, the material from Ogotoruk Valley has mature leaves not at all like typical *glandulosa*, the leaf bases being both truncate and toothed, characteristics typical of *B. nana.* Hultén (1958) feels that this mixture of characteristics of both *nana* and *glandulosa* is indicative of introgression between the two in at least some parts of Alaska. The entire *B. nana–B. glandulosa* complex should be thoroughly studied in North America. In the absence of such studies, we arbitrarily follow Hultén in the nomenclature of this taxon because we feel that he has a more complete knowledge of its circumpolar aspects.

Polygonaceae

Koenigia islandica L.

Scattered on gravel bars, snowflush areas, and on wet frost scars.

Collection numbers: JVM 317A, 598, 678; VB 4584

This species was not reported from the Alaskan arctic slope by Wiggins and Thomas (1962). Hultén reports a collection by Anderson from Point Lay, and it seems likely that it occurs in other places on the arctic slope.

Oxyria digyna (L.) Hill

Widespread in snow beds, on gravel bars, and on sea-front banks.

Collection numbers: JVM 126, 717; M 31, 93; JN 173

Polygonum bistorta L. ssp. *plumosum* (Small) Hultén

Scattered and locally abundant in snow beds, on frost scars, and on solifluction slopes.

Collection numbers: JVM 160, 216; M 94; JN 77

Polygonum viviparum L.
Common in snow beds, on sea front banks, stream banks, and other well-drained areas.
Collection numbers: JVM 541; JN 171

Rumex acetosa L. ssp. *alpestris* (Scop.) Löve
Scattered on steep ridges and grassy slopes.
Collection numbers: JVM 183, 552; M 64

Rumex arcticus Trautv.
Scattered in wet places such as benches of Ogotoruk Creek, in saline marshes, wet meadows, tussock and solifluction slope vegetation types.
Collection numbers: JVM 318, 410

Rumex graminifolius Georgi. ex Lambert.
Rare in *Dryas* step vegetation and in fell-fields.
Collection number: JVM 300

Portulacaceae

Claytonia acutifolia Pall. ssp. *graminifolia* Hultén
Scattered in wet-meadow vegetation and at the margins of frost scars.
Collection numbers: JVM 66; AJ 2, 53; JN 60, 97; M 266

Claytonia tuberosa Pall. ex Willd.
Uncommon in wet-meadow vegetation, especially on elevated ridges.
Collection numbers: JVM 432; M 118

Montia lamprosperma Cham.
Scattered in disturbed areas along the beach, especially in wet muddy places.
Collection number: VB 4551

Caryophyllaceae

Arenaria arctica (Stev.) Aschers.
Common on the gravel bars of Ogotoruk Creek, in *Dryas* fell-fields, and scattered in dry habitats within other vegetation types.
Collection numbers: JVM 147, 239; M 67

Arenaria dicranoides (Cham. and Schlecht.) Hultén
Scattered in *Dryas* fell-fields forming low mats.
Collection numbers: JVM 185; M 293

Arenaria rossii R. Br. ssp. *elegans* Maguire
Rare on steep gravelly slopes.
Collection number: JVM 593

Arenaria macrocarpa Pursh
Scattered in a variety of vegetation types including *Dryas* fell-fields, frost scars, ericaceous polygons, *Dryas* steps and stripes, gravel bars, and snow beds.
Collection numbers: JVM 238; M 265; RJ 76

Arenaria rubella (Wahlenb.) Smith
Scattered on talus slopes and frost scars and in *Dryas* step and stripe vegetation.
Collection number: JVM 214

Cerastium beeringianum Cham. and Schlecht.
A common plant of *Dryas* fell-fields, *Dryas* steps and stripes, solifluction slopes, moist creek banks, and saline meadows.
Collection numbers: JVM 281B, 344; VB 4625; JN 125; M 135

Dianthus repens Willd.
Seen only once on a steep slope with *Dryas*.
Collection number: RJ 76

Honckenya peploides (L.) Ehrh.
A common plant of beaches and high tide zones.
Collection numbers: JVM 323; AJ 57

Melandrium affine (J. Vahl.) Hartm.
Scattered in pockets of soil on talus slopes, beach embankments, and moist streamside meadows.
Collection numbers: JVM 204, 517; M 46, 129

Melandrium apetalum (L.) Fenzl.
Scattered in wet meadows, solifluction slopes, and on frost-scar surfaces.
Collection numbers: JVM 295, 427; M 128, 144; JN 100

Sagina intermedia Fenzl.
Scattered on wet gravel bars and other moist open soil.
Collection number: JVM 415

Silene acaulis L. var. *exscapa* (All.) DC.
Common in *Dryas* fell-fields and less abundant in other vegetation types such as solifluction slopes, ericaceous polygons, and *Dryas* steps and stripes.
Collection numbers: JVM 129; JN 34

Stellaria ciliatosepala Trautv. var. *ciliatosepala*
Scattered on solifluction slopes, wet meadows, gravel bars, and benches.
Collection numbers: JVM 353, 411; JN 64, 109; VB 4553

Stellaria crassifolia Ehrh.
Scattered on gravel bars, in saline marshes and at the edges of lagoons, and in snow beds overlying gravel bars.
Collection numbers: JVM 677; VB 4592, 4594

Stellaria humifusa Rottb.
Common, locally abundant, and forming mats in saline marshes and brackish meadows.
Collection numbers: JVM 229, 422; VB 4595

Stellaria longipes Goldie
Scattered in a variety of vegetation types such as *Dryas* fell-fields, wet meadows, frost scars, solifluction slopes, high-center polygons, ericaceous polygons, *Dryas* steps and stripes, and gravel bars.
Collection numbers: M 125; VB 4561

Stellaria monantha Hultén
Common locally on the gravel bars of Ogotoruk Creek.
Collection number: JVM 237

Ranunculaceae

Aconitum delphinifolium DC. ssp. *paradoxum* (Rchb.) Hultén

Scattered in wet meadows, on sea-front banks, and in snow beds and saline meadows.

Collection numbers: JVM 377; JN 170; M 103, 191, 228; RJ 69, 128

Anemone multiceps (Greene) Standley

Scattered on calcareous soils on *Dryas* steps, snow beds, *Dryas* fell-fields, and ericaceous polygons.

Collection numbers: JVM 14; M 3; JN 1, 25, 38

Anemone narcissiflora L. ssp. *sibirica* (L.) Hultén

Scattered on *Dryas* fell-fields, in the drier parts of wet meadows and tussocks, on solifluction slopes, ericaceous polygons, *Dryas* steps and stripes, in snow beds, and on gravel bars.

Collection numbers: JVM 1; JN 9, 13; M 57

Anemone parviflora Michx.

Scattered in snow-bed communities, solifluction slopes, and wet places along streams.

Collection numbers: JVM 47, 663; JN 2, 31, 119

Anemone richardsonii Hook.

Scattered in snow-bed communities and in moist grass and sedge meadows along small streams.

Collection numbers: JVM 123; M 99

Caltha palustris L. var. *arctica* (R.Br.) Huth.

Common in depressions in wet meadows and in other wet places such as the margins of pools or streams.

Collection numbers: JVM 50, 634; JN 16

Delphinium brachycentrum Ledeb.

Scattered in snow-bed communities, in solifluction meadows, and on sea-front banks.

Collection numbers: JVM 675; VB 4591; JN 162; RJ 87

Oxygraphis glacialis (Fisch.) Bunge.

Rare in gravelly areas below snow beds.

Collection number: AJ 6289A

Ranunculus aquatilis L. var. *eradicatus* Laestad.

Collected only once in a small tundra pond.

Collection number: VB 4675

Ranunculus gmelinii DC. var. *gmelinii*

Scattered in small tundra ponds.

Collection numbers: VB 4573, 4629

Ranunculus hyperboreus Rottb.

Scattered in and around small tundra ponds.

Collection numbers: JVM 421; VB 4585, 4615, 4615A, 4627

Ranunculus lapponicus L.

Uncommon along wet streamside habitats.

Collection number: AJ 62223

Ranunculus nivalis L.

A common plant of stream banks, seepage areas below snow beds, in

wet meadows, and occasionally on gravel bars.
Collection numbers: JVM 121; M 1, 14, 50, 71; JN 111

Ranunculus pallasii Schlecht.
Scattered in shallow water and on the edge of small ponds in the tundra.
Collection number: JVM 230

Ranunculus pedatifidus Sm. var. *affinis* (R.Br.) Benson
Scattered in wet meadows, solifluction slopes, and in other wet depressions.
Collection numbers: JVM 275; VB 4624; M 155; AJ 48

Ranunculus pygmaeus Wahlenb.
Scattered on wet gravel bars, in seepage areas below snow beds, and on hummocks in wet meadows.
Collection numbers: JVM 131, 228, 454; M 100

Ranunculus sulphureus Solander
Scattered in wet meadows and in early-melting snow beds.
Collection number: JVM 48

Thalictrum alpinum L.
Scattered on calcareous soils on slopes; *Dryas* step areas, solifluction slopes.
Collection number: JVM 276

Papaveraceae

Papaver macounii Greene
Scattered in grassy meadows along streams and on solifluction slopes.
Collection numbers: JVM 206, 699

Papaver radicatum Rottb.
Scattered on gravel bars, fell-fields, dry-beach ridges, and talus slopes.
Collection numbers: JVM 206, 699

Fumariaceae

Corydalis pauciflora (Steph.) Pers.
Scattered in ridged wet meadows and on the beaches between the beach and the driftwood zone.
Collection numbers: JVM 64, 125; M 45; JN 19

Cruciferae

Arabis lyrata L. ssp. *kamtschatica* (Fisch.) Hultén
Scattered on gravel bars of the streams.
Collection numbers: JVM 233; VB 4653

Braya purpurascens (R.Br.) Bunge
Uncommon on steep slopes with *Dryas*.
Collection numbers: AJ 62302, 62199A

Cardamine bellidifolia L.
Scattered in ridged wet meadows, wet gravel bars, seepage areas below snow beds, and rarely in open places in tussock fields.
Collection numbers: JVM 132, 150, 624; M 6, 38; JN 20

Cardamine microphylla Adams.
Scattered on gravel bars of streams and in wet meadows.
Collection numbers: JVM 243, 401, 679; M 98, 133; RJ 71; JN 68, 112

Cardamine pratensis L. var. *angustifolia* Hook.
Scattered in wet meadows and on gravel bars.
Collection numbers: JVM 244, 346; JN 157; RJ 72

Cardamine purpurea Cham. and Schlecht.
Scattered in wet meadows, on gravel bars, and in snow beds.
Collection numbers: JVM 70, 151; JN 102

Cardamine digitata Richardson
Scattered in wet meadows and on gravel bars of streams.
Collection numbers: JN 68, 112

Cochlearia officinalis L. ssp. *oblongifolia* (DC) Hultén
Scattered plants growing against the steep cliffs.
Collection number: JVM 501

Cochlearia officinalis L. ssp. *arctica* (Schlecht.) Hultén
Scattered on the gravelly sea beaches.
Collection numbers: JVM 222; M 49; AJ 8
The material cited above is highly variable regarding the size and shape of the capsule. We follow Hultén in separating the two subspecies but with some reservations as to their distinctiveness.

Draba alpina L.
Scattered on dry places in wet meadows and on south-facing slopes.
Collection numbers: JVM 119; JN 56, 58, 59

Draba borealis DC.
Scattered on solifluction slopes and gravelly places.
Collection number: JVM 335

Draba caesia Adams.
Scattered in *Dryas* fell-fields and on rocky outcrops.
Collection number: AJ 31

Draba hirta L.
Scattered in wet meadows, snow-bed communities, and on gravel bars.
Collection numbers: JVM 350, 351; AJ 50; JN 21

Draba lanceolata Royle
Uncommon on *Dryas* slopes.
Collection number: AJ 62142

Draba longipes Raup
Seen only once in a wet meadow.
Collection number: RJ 73

Draba macrocarpa Adams.
Scattered on talus slopes and rocky outcrops.
Collection number: JVM 556

Draba nivalis Liljebl.
On gravel bars and dry alpine slopes and ridges.
Collection numbers: JVM 212, 225, 703; AJ 51

Draba pseudopilosa Pohle
On gravel bars and old beach ridges; in dry places in wet meadows.

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Draba pseudopilosa Pohle
On gravel bars and old beach ridges; in dry places in wet meadows.

Collection numbers: AJ 49; JN 23, 24

Eutrema edwardsii R.Br.

Common in wet meadows on ridges and hummocks; also found on solifluction slopes and high-center polygons.

Collection numbers: JVM 152, 260, 348; JN 62

Parrya nudicaulis (L.) Regel.

A common plant of *Dryas* fell-fields, *Dryas* steps and stripes, and occurring less commonly in moist meadows.

Collection numbers: JVM 13, 378; M 12, 29, 269; JN 30

Smelowskia borealis Drury and Rollins var. *jordalii* Drury and Rollins

Uncommon on limestone talus slopes and ridges.

Collection number: JVM 688

Smelowskia calycina (Stephan.) C. A. Mey. var. *integrifolia* (Seem.) Rollins

A common plant of talus slopes, *Dryas* fell-fields, and *Dryas* steps and stripes.

Collection numbers: JVM 17, 366, 555; M 7, 24; JN 43, 88; AJ 30, 46

Parnassiaceae

Parnassia kotzebuei Cham. and Schlecht.

Occasional in snow beds, banks of small streams, stream terraces and gravel bars.

Collection numbers: JVM 591, 691; M 257

Parnassia palustris L.

In snow-bed communities and moist meadows.

Collection numbers: JVM 574, 690; VB 4644, 4676

Saxifragaceae

Chrysosplenium tetrandrum (Lund) Th. Fries

In wet meadows and seepage areas below snow beds.

Collection numbers: JVM 117; AJ 5

Chrysosplenium wrightii Franch. and Sav.

In patches of soil on talus slopes, along stream embankments, and in depressions in limestone fell-fields.

Collection numbers: JVM 591, 691; M 257

Saxifraga bronchialis L. ssp. *funstonii* (Small) Hultén

Locally abundant on talus slopes, *Dryas* fell-fields, on old gravel bars, and on *Dryas* steps and stripes.

Collection numbers: JVM 270; JN 50, 75, 120; M 115; AJ 58

Saxifraga caespitosa L. s. lat.

Scattered in dense clumps and mats in rock crevices, in seepage areas below snow beds, and on wet solifluction slopes.

Collection numbers: JVM 127, 343; JN 131; M 124; AJ 55

The relation of *S. caespitosa* to other taxa has been discussed by most arctic investigators. It is especially closely related to *S. groenlandica* and may simply be a segregate of that polymorphic species. Rather than recognize infraspecific categories within this species at present, we prefer to delay such decisions until more work has been done.

Saxifraga cernua L.

In wet meadows, solifluction slope vegetation, and *Dryas* steps and stripes.

Collection numbers: JVM 586; M 166

Saxifraga davurica Willd. ssp. *grandipetala* (Engl. & Irmscher) Hultén

Common in snow-bed communities; also found in *Dryas* step vegetation and in ericaceous polygons.

Collection numbers: JVM 161, 280, 650A; JN 42; M 271

Saxifraga eschscholtzii Sternb.

Scattered in *Dryas* fell-fields.

Collection numbers: JVM 12; AJ 4

Wiggins and Thomas (1962) report that this species prefers limestone soils. In the Ogotoruk Creek area it is usually limited to these habitats but is sometimes found on sandstone soils.

Saxifraga flagellaris Willd. ssp. *flagellaris*

On *Dryas* fell-fields, ericaceous polygons, and *Dryas* steps and stripes.

Collection numbers: JVM 358; M 132; JN 161

The differences between ssp. *flagellaris* and ssp. *platysepala* are listed by Porsild (1954, 1955) and by Wiggins and Thomas (1962). In the Ogotoruk Valley, these distinctions do not hold up. For example, all the specimens cited above have sepal widths intermediate between those mentioned by Wiggins and Thomas, and M 132 and JVM 358 both have at least some purple-headed glands on the sepals, a characteristic of ssp. *platysepala*. Furthermore, although Porsild (1957, p. 137) calls both races "obligate calcicoles," we have collected and observed ours growing on noncalcareous soils. These differences suggest the need for further studies of Alaskan populations.

Saxifraga foliolosa R.Br.

On ridges in wet meadows, on frost scars in various vegetation types, and in snow-bed communities.

Collection numbers: JVM 388, 450, 588; VB 4545; M 225

Saxifraga hieracifolia Waldst. and Kit.

Occasional on ridges in wet meadows, on solifluction slopes, high-center polygons, and *Dryas* steps and stripes.

Collection numbers: JVM 262, 352; JN 128; M 164

Saxifraga hirculis L.

In wet meadows, solifluction slopes, and seepage areas from snow beds.

Collection numbers: JVM 7; M 10

Saxifraga oppositifolia L.

Occasional in fell-fields, *Dryas* stripe areas, and talus slopes.

Collection numbers: JVM 7; M 10

Saxifraga punctata L. ssp. *nelsoniana* (D. Don) Th. Fries

In wet meadows, moist stream benches, snow-bed communities, tussocks, high-center polygons, solifluction slopes, and other wet places.

Collection numbers: JVM 118; JN 15; M 97; RJ 74

Saxifraga radiata Small
In wet meadows, saline meadows, and gravel bars.
Collection numbers: JVM 187, 487; JN 61

Saxifraga reflexa Hook.
Dryas fell-fields, solifluction slopes, and *Dryas* steps and stripes.
Collection numbers: JVM 181, 369; JN 127

Saxifraga rivularis L.
In a wet seepage area below snow beds; on moist, muddy stream banks; and on wet gravel bars.
Collection numbers: JVM 130, 596; JN 165

Saxifraga serpyllifolia Pursh
Collected only once in a *Dryas* fell-field.
Collection number: JVM 694

Saxifraga tricuspidata Rottb.
Locally abundant on talus slopes and dry ridges and outcrops in other vegetation types.
Collection numbers: JVM 381; M 123

Therofon richardsonii (Hook.) O. Kunze
In snow-bed communities.
Collection numbers: JVM 297; JN 94; M 131

Rosaceae

Dryas integrifolia M. Vahl
Common on solifluction slopes, in the drier parts of wet meadows, and on moist stream banks.
Collection numbers: JVM 499; M 268

Dryas octopetala L. var. *viscida* Hultén
The common and characteristic plant of fell-fields and step and stripe vegetation and occurring also in dry places in other vegetation types.
Collection numbers: JVM 42; JN 3; M 34, 56, 182
The most recent treatment of this genus by Hultén (1959) attempts to clarify the confusion that has surrounded the various species complexes and hybrids in the taxon. Briefly, Hultén rejects his previous ssp. *punctata* and substitutes for it ssp. *octopetala* with many varieties and forms. All the material we have seen of the *D. octopetala* complex from the Cape Thompson area falls rather nicely into var. *viscida*. Wiggins and Thomas (1962) apparently do not follow Hultén here, and they treat *D. octopetala* collectively.

Geum glaciale Adams.
In *Dryas* step and stripe vegetation, on frost scars, in ericaceous polygons, and on solifluction slopes.
Collection numbers: JVM 10; JN 27; M 2; VB 4690

Potentilla biflora Willd. ex Schlecht.
Common, especially on talus slopes and rocky ridges and less frequently with *Dryas*.
Collection number: JVM 433

Potentilla egedii Wormskj. var. *groenlandica* (Tratt.) Polunin
Common in saline meadows along the coastline.
Collection number: JVM 359

Potentilla fruticosa L.
Uncommon, primarily in snow-bed communities.
Collection numbers: JVM 511; RJ 86

Potentilla hookeriana Lehm.
Scattered on dry slopes and rocky outcrops.
Collection number: JVM 529
In our earlier reports this species was listed as *P. nivea* L. ssp. *hookeriana* (Wolf) Porsild.

Potentilla hyparctica Malte
Scattered on ridges with *Carex* in wet meadows, along the shore between the beach and the driftwood zone, in snow beds, and on frost scars.
Collection numbers: JVM 11, 205, 261; M 110; JN 54, 124; VB 4626

Potentilla ledebouriana Porsild
Scattered on *Dryas* fell-fields, *Dryas* stripes, and other well-drained habitats.
Collection numbers: JVM 122, 271; M 28

Potentilla palustris (L.) Scop.
Common in standing water in wet meadows, especially along the margins of tundra ponds.
Collection numbers: JVM 572; VB 4642

Rubus arcticus L.
Collected only once on a gravel bar.
Collection number: JVM 446

Rubus chamaemorus L.
Scattered on *Sphagnum* in wet meadows and growing from the tops and sides of tussocks.
Collection numbers: JVM 145; M 74

Sanguisorba officinalis L.
Scattered in small drainages next to the beach.
Collection numbers: JVM 545; RJ 80

Fabaceae

Astragalus alpinus L.
A common species on gravel bars and dry slopes with *Dryas*.
Collection numbers: JVM 221, 528, 641; JN 103; AJ 54

Astragalus australis (L.) Lam
On gravel bars, shale slopes, and other xeric habitats.
Collection numbers: JVM 512, 546
This plant has been referred to as *Astragalus lepagei* Hultén. According to Polunin (1959) and Welsh (*in. litt.*) *A. lepagei* is an extreme form of *A. australis*.

Astragalus polaris (Seem.) Benth.
On sandy or gravelly soil along the coast and streams.

Collection number: M 127

Astragalus umbellatus Bunge

On *Dryas* fell-field, *Dryas* steps, and other sandy or gravelly, rather open soils.

Collection numbers: JVM 283, 524; M 113, 114

Hedysarum alpinum L. var. *americanum* Michx. ex Pursh

On gravel bars and benches, snow beds, and on sandy and gravelly slopes of the hills.

Collection numbers: JVM 530, 642; JN 101; M 112

Hedysarum mackenzii Rich.

Uncommon on gravel bars and fell-fields.

Collection number: AJ 62295

Lathyrus japonicus Willd. var. *aleuticus* (Greene) Fern.

On sandy beach ridges; not common in our area.

Collection numbers: JVM 417; RJ 84

Wiggins and Thomas (1962) refer the material from the Alaskan coastline between Point Hope and Point Lay to var. *japonicus*. Our material, though not densely pubescent, is sufficiently so that we feel justified in placing it in var. *aleuticus*.

Lupinus arcticus S. Wats.

Locally common in *Dryas* fell-fields, gravel bars and benches, and in frost scars in various vegetation types.

Collection numbers: JVM 96; JN 11; M 51, 221

Oxytropis

The genus *Oxytropis* is very much confused in Alaska and is in need of comprehensive examination. Several taxa include elements that have been segregated for apparently minor reasons, and most species are polymorphic. In general, our treatment of the genus follows Porsild (1951b; 1955), and for clarity we have indicated recent synonymy by Hultén and by Wiggins and Thomas, the latter having followed Barneby's recent (1952) revision of the genus.

Oxytropis glutinosa Porsild

In *Dryas* fell-fields, on rocky ridges, gravel bars, and *Dryas* steps.

Collection numbers: JVM 539; M 141, 157; JN 95

Hultén refers to this plant as *O. leucantha* (Pall.) Bunge, and it is called *O. viscida* var. *subsucculenta* in Wiggins and Thomas' *Flora*.

Oxytropis gracilis (A. Nels.) K. Schum

On *Dryas* fell-fields and talus slopes.

Collection numbers: JVM 217; JN 85

Wiggins and Thomas refer to this plant as *Oxytropis campestris* var. *varians* (Rydb.) Barneby.

Oxytropis maydelliana Trautv.

In *Dryas* fell-fields, on sandy and gravelly hillsides, and on rocky ridges.

Collection numbers: JVM 525; M 141, 157; JN 95

Oxytropis mertensiana Turcz.

Uncommon in *Dryas* fell-fields.

Collection number: AJ 62228

Oxytropis pygmaea (Pall.) Fern.

Limited to calcareous soils on talus slopes and the summits of ridges in *Dryas* fell-fields.

Collection numbers: JVM 128, 334, 557; JN 116

Wiggins and Thomas include this species in *O. nigrescens* (Pall.) Fisch.

Oxytropis nigrescens (Pall.) Fisch.

Occupying the same kinds of habitats as *O. pygmaea* and, in addition, on noncalcareous soils.

Collection numbers: JVM 2, 365; JN 10, 37

Callitrichaceae

Callitriche verna L.

Rare in small tundra ponds; collected only once.

Collection number: JVM 423

Empetraceae

Empetrum nigrum L. var. *hermaphroditum* (Lge.) Sør.

A common plant of areas of shallow snow accumulation in *Dryas* fell-fields, wet meadows and tussocks (on dry sites), ericaceous polygons, *Dryas* steps and stripes, snow beds, and gravel bars. Our populations of this species are invariably predominately hermaphroditic.

Collection number: JVM 268

Violaceae

Viola epipsila Ledeb. ssp. *repens* (Turcz.) Becker

Uncommon; a plant of snow beds.

Collection numbers: JVM 456; M 75; AJ 32

Onagraceae

Epilobium angustifolium L.

Uncommon in our area; collected once on a sod house near Cape Thompson; it has been found in only one locality in the Ogotoruk Valley proper.

Collected by Mr. Lou Schene (no number).

Epilobium latifolium L.

Common on gravel bars of Ogotoruk Creek; scattered on sandy soil elsewhere.

Collection numbers: JVM 379; JN 107; M 148

Epilobium palustre L.

Uncommon; collected only once in a wet meadow below a snow bed.

Collection number: VB 4628

Hippuridaceae

Hippuris vulgaris L.

Common in small ponds and in brackish meadows.

Collection numbers: JVM 317, 609; VB 4586

This includes also the species recognized by Wiggins and Thomas (1962) as *Hippuris tetraphylla* L. In a recent paper, McCully and Dale (1961) demonstrate that *H. vulgaris* is highly polymorphic regarding leaf size and shape and that it is susceptible to environmental stimuli in modifying these characteristics. They show further that under uniform conditions *H. vulgaris* and *H. tetraphylla* are only phenotypically distinct. For these reasons we are combining all our material under *H. vulgaris;* this practice has already been adopted by Polunin (1959).

Umbelliferae

Angelica lucida L.

Uncommon on the edges of saline marshes and on sea-front banks.

Collection number: VB 4593A

Bupleurum americanum Coult. and Rose

In *Dryas* fell-fields, ericaceous polygons, and *Dryas* stripes.

Collection numbers: JVM 269, 531; M 209

Conioselinum cnidiifolium (Turcz.) Porsild

Uncommon on dry shaly and limestone slopes and sandy areas above the beach.

Collection numbers: JVM 505, 548

Pyrolaceae

Pyrola grandiflora Radius

Scattered in our area on wet meadows and other moist places.

Collection numbers: M 142; AJ 56

Ramischia secunda (L.) Garcke

Uncommon in snow beds with *Cassiope.*

Collection number: AJ 62275

Ericaceae

Andromeda polifolia L.

Scattered, especially on *Sphagnum* mats in wet meadows.

Collection numbers: JVM 232; M 121; VB 4590

Arctostaphylos alpina L. ssp. *alpina*

In snow beds, depressions in *Dryas* fell-fields, ericaceous polygons, *Dryas* steps and stripes, and gravel bars.

Collection numbers: JVM 40; M 8, 21, 292

Cassiope tetragona (L.) D. Don

A common plant of snow beds and in depressions in other vegetation types where snow accumulates in the winter.

Collection numbers: JVM 49; M 26, 291; JN 6

Ledum decumbens (Ait.) Lodd ex Steud.

A common plant of depressions in the *Dryas* fell-fields and ericaceous polygons; also growing on ridges in wet meadows, from the sides and tops of tussocks, and scattered in other vegetation types.

Collection number: JVM 292

Rhododendron lapponicum (L.) Wahlenb.

Uncommon in snow-bed communities and moist slopes.

Collection numbers: AJ 52; VB 4688

Vaccinium uliginosum L.
Scattered; growing in the same kinds of situations as, and often together with, *Ledum decumbens.*
Collection numbers: JVM 267; JN 26, 55, 115; M 101; VB 4603

Vaccinium vitis–idaea L. ssp. *minus* (Lodd.) Hultén
A common plant growing in nearly the same habitats as *V. uliginosum* with a tendency to occupy somewhat wetter sites.
Collection numbers: JVM 368; VB 4552, 4579; M 283

Diapensiaceae

Diapensia lapponica L. ssp. *obovata* (Schmidt) Hultén
A common plant in *Dryas* fell-fields; also found occasionally in the drier parts of other habitats.
Collection numbers: JVM 39; JN 12, 51, 78; M 58

Primulaceae

Androsace chamaejasme Host. ssp. *lehmanniana* (Spreng.) Hultén
Scattered on sandy, gravelly, and other dry sites; seen in *Dryas* fell-fields, *Dryas* steps and stripes, high-center polygons, and on frost scars.
Collection numbers: JVM 68, 227; M 32; JN 47, 63

Androsace ochotensis Willd.
Scattered in *Dryas* fell-fields, *Dryas* steps and stripes, and occasionally on dry habitats in other vegetation types.
Collection numbers: JVM 8; M 9

Androsace septentrionalis L.
Rare in our area; collected only once on a steep gravelly slope near the beach.
Collection number: M 63

Dodecatheon frigidum Cham. and Schlecht.
Scattered; growing on moist sites in solifluction slopes, along the margins of streams, and on benches.
Collection numbers: JVM 116; M 73, 95; JN 57

Primula borealis Duby
Scattered in saline meadows and on other moist habitats near the shoreline.
Collection numbers: JVM 67, 186; JN 39, 52

Primula tschuktschorum Kjellm.
Scattered in snow beds and occasionally in wet meadows.
Collection numbers: JVM 65; RJ 70

Plumbaginaceae

Armeria maritima (Mill.) Willd. var. *sibirica* (Turcz.) Lawr.
Collected especially on sandy or gravelly soils near the beach; occasionally on *Dryas* steps and stripes.
Collection numbers: JVM 299; M 48; AJ 6; JN 158

Gentianaceae

Gentiana glauca Pall.
Found especially along streams, especially under the protection of willows.
Collection numbers: JVM 403, 413; VB 4550, 4575

Gentiana propinqua Richards.
On talus slopes and dry habitats with *Dryas*.
Collection numbers: JVM 532, 620

Gentiana prostrata Haenke.
On slumping stream banks, talus slopes, and rock outcrops.
Collection numbers: JVM 569; M 130

Gentiana tenella Rottb.
In saline marshes and along the edge of the driftwood zone.
Collection numbers: JVM 419, 550, 602, 718

Polemoniaceae

Phlox sibirica L.
In *Dryas* fell-fields and on gravelly slopes above the beach, especially on south- and west-facing slopes.
Collection numbers: JVM 209; M 52; JN 40
Wherry (1955) and Grant (1959) consider the Alaskan material of this taxon to be a separate species, *Phlox borealis* Wherry. According to these authors, *P. sibirica* is restricted to central and northeastern Asia.

Polemonium acutiflorum Willd.
On ridges and hummocks in wet meadows; along stream banks and on ground-squirrel mounds.
Collection numbers: JVM 293; JN 66, 104; M 96
Grant (1959) considers this species to be *Polemonium caeruleum* L.

Polemonium boreale Adams.
On talus slopes, sandy ridges and stream banks.
Collection number: JVM 424

Boraginaceae

Eritrichium chamissonis DC.
Scattered in xeric habitats often with *Dryas*.
Collection numbers: JVM 38; M 36, 44

Eritrichium splendens Kearney
Uncommon on slopes with *Dryas*.
Collection number: AJ 62255A

Mertensia maritima (L.) S. F. Gray
A common strand plant growing on beach sand and gravel.
Collection numbers: JVM 223; M 68; JN 69; RJ 81

Myosotis alpestris Schmidt. ssp. *asiatica* Vestegr.
In moist slopes and ridgetops surrounding the valley; locally common.
Collection numbers: JVM 210, 519, 563; JN 172; M 61, 210

Scrophulariaceae

Castilleja pallida (L.) Spreng. ssp. *caudata* Pennell
Scattered on gravel bars and snow-bed communities.
Collection numbers: JVM 349, 523

Castilleja pallida (L.) Spreng. ssp. *elegans* (Ostenfeld) Pennell
Scattered especially on shale slopes with *Dryas* and on *Dryas* stripes.
Collection number: JVM 265

Lagotis glauca Gaertn. var. *stelleri* (Cham. and Schlecht.) Trautv.
Common at the margins of and on wet frost scars; also found on solifluction slopes and *Dryas* steps and stripes.
Collection numbers: JVM 167, 182; AJ 3

Pedicularis capitata Adams.
Scattered in *Dryas* fell-fields, on solifluction slopes, on rocky and gravelly slopes, in snow beds, and on benches along streams.
Collection numbers: JVM 208; JN 33, 81; M 62

Pedicularis labradorica Wirsing.
Scattered at the edges of snow-bed communities and along streams.
Collection number: JVM 440

Pedicularis lanata Cham. and Schlecht.
A common and conspicuous plant of *Dryas* fell-fields and occasionally in snow beds.
Collection numbers: JVM 15; M 5, 59

Pedicularis langsdorfii Fisch. ex Steven.
Scattered in a variety of vegetation types including *Dryas* fell-fields, wet meadows, solifluction slopes, and high-center polygons; also in snow beds and on benches of the streams.
Collection numbers: JVM 100, 180, 403C; JN 18, 79; M 66, 76

Pedicularis oederi Vahl
A common plant of *Dryas* steps; found also on solifluction slopes, and occasionally in the *Dryas* fell-field.
Collection numbers: JVM 281A, 294, 347; M 82; JN 92

Pedicularis pennellii Hultén
Common in wet meadows, saline meadows, and rarely on solifluction slopes.
Collection numbers: JVM 234, 322; JN 155

Pedicularis sudetica Willd. ssp. *albolabiata* Hultén
Scattered in wet meadows and saline meadows; found also on solifluction slopes.
Collection number: JVM 179

Pedicularis sudetica Willd. ssp. *interior* Hultén
On gravel bars and benches and sometimes in snow beds.
Collection numbers: JVM 224, 409

Pedicularis verticillata L.
On steep *Dryas* slopes and on gravel bars.
Collection numbers: JVM 500; JN 154

Rubiaceae

Galium boreale L.
Growing in moist meadows along streams and on moist *Dryas* slopes.
Collection numbers: JVM 518; VB 4578

Adoxaceae

Adoxa moschatellina L.
Collected only in the loose soil at the mouth of a ground-squirrel burrow.
Collection number: AJ 1

Valerianaceae

Valeriana capitata Pall. ex Link.
Common in wet meadows; less abundant on solifluction slopes, high-center polygons, stream benches, and wet frost scars.
Collection numbers: JVM 443; M 138, 272; JN 129

Campanulaceae

Campanula lasiocarpa Cham.
In *Dryas* fell-fields and in pockets of soil in talus slopes.
Collection numbers: JVM 444; M 192, 222

Campanula uniflora L.
Scattered; on limestone outcrops and on embankments near the beach.
Collection numbers: VB 4677; M 111

Compositae

Antennaria alaskana Malte
Common in *Dryas* fell-fields, *Dryas* steps; less frequent in talus slopes and snow beds.
Collection numbers: JVM 284, 495, 561, 577

Antennaria monocephala DC.
Dryas fell-fields, *Dryas* steps and stripes, snow beds, and frost scars.
Collection number: JVM 154

Arnica lessingii Greene
Uncommon on *Dryas* steps and stripes and scattered on gravel bars, especially under willows.
Collection numbers: JVM 654; JN 169

Arnica louiseana Farr. ssp. *frigida* (Meyer) Maguire
Scattered on *Dryas* steps and stripes; also on sea-front banks and sand and gravel along the beach.
Collection numbers: JVM 266, 527; JN 87, 168; RJ 82

Artemisia arctica Less. ssp. *comata* (Rydb.) Hultén
On *Dryas* fell-fields, gravel bars, and other dry habitats, such as frost scars and squirrel mounds.
Collection numbers: JVM 380, 452, 492, 575

Artemisia borealis Pall.
Found only on talus slopes in our area.
Collection numbers: JVM 513, 560

Artemisia globularia Cham. ex Besser
Rather common in *Dryas* fell-fields and *Dryas* steps; also on gravelly frost scars.
Collection numbers: JVM 296, 436, 701

Artemisia glomerata Ledeb.
Scattered on talus slopes, *Dryas* stripes, fell-fields, and gravel bars.
Collection numbers: JVM 272, 514, 562

Artemisia tilesii Ledeb. ssp. *elatior* Torr. and Gray
On gravel bars and sandy soils along drainages.
Collection number: JVM 590

Artemisia trifurcata Steph. ex Sprengel
Found on talus slopes and in fell-fields.
Collection numbers: JVM 437, 559

Aster sibiricus L.
On sandy and silty soils along the streams, on sea-front banks, and occasionally in snow beds.
Collection numbers: JVM 522; M 150, 213; JN 167

Chrysanthemum arcticum L. ssp. *polaris* Hultén
In wet meadows and brackish marshes near the beach; less frequently on sandy and gravelly soils near the high-tide line.
Collection numbers: JVM 361, 425, 489; JN 176; AJ 38; RJ 75

Chrysanthemum integrifolium Richards.
Uncommon in *Dryas* fell-fields and rocky ridges, mostly on limestone.
Collection numbers: JVM 434, 569; M 162, 211

Crepis nana Richards.
Uncommon on sandy and gravelly soils along the beach and major drainages and on talus slopes.
Collection numbers: JVM 435 (collected by F. S. L. Williamson); RJ 78

Erigeron grandiflorus Hook.
Collected only once in sandy soil along the Kukpuk River.
Collection number: M 149
This plant, previously identified by us as *Aster alpinus* ssp. *vierhapperi* was correctly determined by A. E. Porsild. We are grateful to him for pointing out this error.

Erigeron humilis Graham
Especially abundant in protected sites such as snowbeds but occasionally found in wet meadows and other well-watered habitats.
Collection numbers: JVM 502, 695; JN 174, 175; M 136, 212; AJ 45

Erigeron hyperboreus Greene
Scattered on dry slopes and ridges with *Dryas*.
Collection numbers: JVM 504, 516, 604, 687; JN 93; M 151

Matricaria ambigua (Ledeb.) Krylof
Scattered on sand and gravel beaches.

Collection numbers: JVM 603; RJ 79

Petasites frigidus (L.) Fries

Growing in a variety of habitats including wet meadows and tussock vegetation, especially on open frost scars; also on solifluction slopes, high-center polygons, saline meadows, snow beds, and gravel bars and benches.

Collection numbers: JVM 319, 320, 360; JN 14; M 4

Saussurea angustifolia (Willd.) DC.

In snow beds, sea-front banks, ericaceous polygons, *Dryas* fell-fields, and wet meadows.

Collection numbers: JVM 560D, 664, 700; JN 163

Senecio atropurpureus (Ledeb.) Fedtsch. ssp. *atropurpureus*.

Scattered in tussocks and wet meadows; found also on solifluction slopes, high-center polygons, and on *Dryas* steps and stripes.

Collection numbers: JVM 220, 520, 622; JN 110; M 77, 139

Senecio atropurpureus (Ledeb.) Fedtsch. ssp. *frigidus* (Richards.) Hultén

Uncommon; growing in a tussock area.

Collection number: AJ 47

Senecio congestus (R.Br.) DC.

Uncommon on gravel bars and on ridges in wet meadows.

Collection numbers: VB 4587; M 119

Senecio conterminus Greenm.

Scattered on *Dryas* slopes.

Collection numbers: AJ 6259, 62293

Senecio fuscatus (Jord. and Fourr.) Hayek.

Collection number: JVM 390

Senecio lugens Richards.

Scattered at the edges of snow beds, on gravel bars, and on the sandy shores of streams.

Collection numbers: JVM 503, 551, 676; VB 4686; JN 126

Senecio pseudo–arnica Less.

Uncommon in our area on sandy and gravelly beaches.

Collection numbers: JVM 488; RJ 85

Senecio resedifolius Less.

Scattered on *Dryas* steps and stripes, solifluction slopes, and ericaceous polygons; occasionally on frost scars and other well-drained habitats.

Collection numbers: JVM 389, 521, 694; JN 130, 164; M 140; RJ 90

Solidago multiradiata Ait.

Scattered on well-drained slopes and ridges with *Dryas*; also on sea-front banks and on sandy and gravelly soil.

Collection numbers: JVM 526, 621; JN 166; RJ 83

Taraxacum

Inasmuch as the genus *Taraxacum* contains numerous taxa of dubious status, we follow the conservative approach to this genus as has been the case in recent treatments (see Wiggins and Thomas, 1962; Porsild, 1955; Cronquist, 1955).

Taraxacum ceratophorum (Ledeb.) DC.
On gravel bars and other dry habitats.
Collection numbers: JVM 412; AJ 43; M 223

Taraxacum phymatocarpum J. Vahl
On *Dryas* steps and on frost scars.
Collection number: JVM 298

SUMMARY

The vegetation units of the Ogotoruk Creek–Cape Thompson area have been described, and the species of vascular plants, bryophytes, and lichens have been enumerated. Species are discussed in relation to the kinds of vegetation in which they occur; vegetation types are discussed in terms of their relations with environmental gradients.

Fifty-four 1-acre vegetation plots were established in vegetation types and plant communities. The biotic and physical environmental features of each plot were recorded. Vegetation in representative plots was analyzed quantitatively by the line-intercept method. Importance values were calculated for each species of vascular plant, for mosses and hepatics combined, and for lichens combined.

Eight vegetation types, *Dryas* fell-field, *Eriophorum* tussock, *Eriophorum–Carex* wet meadow, *Eriophorum–Carex* solifluction slope, ericaceous shrub polygon, *Dryas* step and stripe, *Carex bigelowii* high-center polygon, and saline meadow, are described. Although some plant communities are not aggregated into vegetation types because of high stand-to-stand diversity, they are described here. These include frost-scar ecotone communities, talus-slope communities, snow-bed communities, gravel-bar and -bench communities, and marine-strand communities.

Vegetation types are characterized by their most common species and by their occurrence on well-defined physiographic units.

Habitats in the Ogotoruk Creek watershed are diverse because of local relief, heterogeneous parent materials, permafrost and frost action, the irregular deposition of snow, the proximity of the Chukchi Sea, drainage patterns, animal activity, and other physical and biotic aspects of the environment.

The presence of transitions between vegetation types confirms the belief that vegetation is continuous in space. Furthermore, differences between vegetation types are often reflected in changes in importance of widespread species rather than in changes in species composition.

In its gross aspects most of the vegetation of the valley appears to be stable and to be in equilibrium with the regional climate. Exceptions to this occur where frost action, wind and water erosion, solifluction, and animal activity engender changes in species composition.

Zonal arctic-brown soils are found on well-drained slopes and uplands, and tundra gley soils are found beneath the wet lowlands. The presence of zonal soils suggests relative habitat stability.

Modern frost action occurs most intensely on gley soils. Temperature conditions are suitable for frost action anywhere in the area; however, coarse soils,

which are often low in soil moisture, are least susceptible to cryopedogenic processes. Patterned-ground features include nonsorted circles, soil steps and stripes, ice-wedge polygons, and small sorted circles and polygons. Large sorted structures apparently were produced at some unspecified previous time under a different climatic regime.

Studies of the vegetation of frost-induced bare ground suggests that plant succession occurs on these sites. Whether these successional sequences are cyclic or directional cannot be stated from short-term observations.

Solifluction occurs most prominently on steep to moderately steep slopes where fine-grained soils are saturated by contributions of water from melting snow. The solifluction terraces seen on these slopes are important in modifying local plant cover and species composition.

Snow cover is highly variable because of its redeposition by strong winds. Plant composition is determined by the length of time required for the snow beds to melt and by the characteristics of the underlying substrate. Snow also ameliorates environmental extremes and contributes moisture to plants during the growing season.

Studies of gravel-bar and -bench communities suggest that there may be a successional sequence that leads from perennial-herb communities to willow-dominated communities on gravel bars to communities on the benches that closely resemble the wet-meadow communities of the surrounding tundra.

Strand vegetation is not extensive because of the coarse nature of the beach and its extreme disturbance by sea ice and on-shore storms.

Aquatic communities are mostly limited to a few emergent species at the edges of small streams and ponds.

The arctic ground squirrel produces important changes in fell-fields and other *Dryas*-dominated vegetation by its burrowing and feeding activities.

An annotated list of the nearly 300 vascular plant species collected in the area demonstrates the richness of the arctic flora in this part of Alaska.

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APPENDIX

Table A—IMPORTANCE VALUES* FOR SELECTED VASCULAR PLANT SPECIES, MOSSES AND HEPATICS COMBINED, AND LICHENS COMBINED ACCORDING TO VEGETATION TYPES† FROM 1-ACRE PLOTS IN OGOTORUK VALLEY

Species	Wet meadows with depressed-center polygons	Wet meadows with ridges	*Eriophorum*–*Carex* solifluction slopes	*Eriophorum* tussocks with ice-wedge polygons	*Eriophorum* tussocks with unsorted circles	*Carex bigelowii* high-center polygons	Ecotonal frost scars	*Dryas* fell-fields on acidic rocks	*Dryas* fell-fields on basic rocks
Carex aquatilis, Eriophorum angustifolium, E. russeolum, E. scheuchzeri (combined)	157.4	163.6	94.6	21.5	10.5	+			
Mosses and hepatics (combined)	117.8	74.3	86.8	78.3	53.5	52.7	104.3	7.9	11.5
Salix arbutifolia	21.1	8.5							
Betula nana	12.5	16.3	‡	16.9	36.2	‡	6.5	‡	‡
Pedicularis pennellii	5.5	‡	‡						
Lichens (combined)	9.6	8.3	8.3	36.0	21.9	29.5	52.2	100.6	92.2
Dupontia fischeri	+								
Saxifraga cernua	+		+						
Andromeda polifolia	+								
Eriophorum vaginatum	+	22.1		112.3	93.6	50.9			
Ledum decumbens	+	+		43.7	38.0	15.0	‡	+	
Vaccinium vitis-idaea	+	+		15.5	10.1	6.4	‡	‡	‡
Salix pulchra		33.4		21.0	26.0	49.6	45.1		
Salix reticulata		6.4	12.6						
Salix chamissonis		+							
Saxifraga hirculis		+	7.8						
Aconitum delphinifolium		+							
Valeriana capitata		+	6.0			‡	‡		
Petasites frigidus		+	6.6	+	+	15.4	+		
Rubus chamaemorus		+							
Saxifraga hieracifolia		+	+			‡	‡		
Caltha palustris		+							
Polemonium acutiflorum		+	+			‡			
Chrysosplenium tetrandrum		+	‡						
Stellaria ciliatosepala		+	+						
Calamagrostis neglecta		+		+	+		+		
Saxifraga punctata		+	+	‡	‡	+	+		
Carex bigelowii		+	31.7	+	5.5	54.7	53.8		
Thalictrum alpinum			7.4						
Salix arctica		‡	36.8	‡	‡			‡	5.9
Equisetum arvense			5.3						
Festuca brachyphylla			‡		+		+		
Arctagrostis latifolia			+		+	8.4	+	‡	‡
Poa arctica			+						
Deschampsia caespitosa		‡		+	9.6		+		
Poa lanata		‡		+	+				
Rumex arcticus		‡	‡	+	9.2		‡		
Luzula confusa		‡		+	+	+	+	+	
Salix phlebophylla			+	+	‡	12.1	22.0	9.7	
Hierochloe alpina		‡			+	‡	11.5	8.0	

Table A (Continued)

Species	Wet meadows with depressed-center polygons	Wet meadows with ridges	*Eriophorum*–*Carex* solifluction slopes	*Eriophorum* tussocks with ice-wedge polygons	*Eriophorum* tussocks with unsorted circles	*Carex bigelowii* high-center polygons	Ecotonal frost scars	*Dryas* fell-fields on acidic rocks	*Dryas* fell-fields on basic rocks
Dryas octopetala			8.8				23.6	47.8	69.1
Arenaria macrocarpa					+	‡	‡	‡	
Artemisia arctica					+	‡	+	‡	
Empetrum nigrum		‡			+			‡	
Juncus biglumis		‡	‡		+	‡	‡		
Luzula nivalis					+	‡	+	+	
Anemone narcissiflora		‡				+	+	‡	
Polygonum bistorta		‡	‡		‡	+	+	‡	‡
Polygonum viviparum	‡		+				+		
Diapensia lapponica					‡		+	+	
Arenaria arctica			‡		‡	‡	+	7.3	+
Arctostaphylos alpina							+	+	‡
Lupinus arcticus					‡	‡	‡	9.0	‡
Oxytropis nigrescens						‡	‡	‡	
Oxytropis pygmaea									5.2
Androsace ochotensis								+	‡
Carex microchaeta						‡	+	6.4	5.7
Saxifraga bronchialis								+	‡
Saxifraga oppositifolia									7.6
Kobresia myosuroides									17.0
Pedicularis lanata									+
Saxifraga eschscholtzii									+

*Importance values of less than 5.0 are indicated by a plus sign (+).

†Vegetation types are ordinated according to an approximate moisture gradient with species occupying wet habitats on the left and those found in dry habitats on the right.

‡Species are known to occur in this vegetation type but were not recorded from line intercepts.

Table B—HEPATICS, MOSSES, AND LICHENS COLLECTED FROM VEGETATION TYPES AND MISCELLANEOUS HABITATS IN THE OGOTORUK CREEK–CAPE THOMPSON AREA

Species	*Eriophorum*–*Carex* wet meadows	Solifluction slopes	*Eriophorum* tussocks	*Carex bigelowii* high-center polygons	Ecotonal frost scar	*Dryas* steps and stripes	*Dryas* fell-field on acidic rocks	*Dryas* fell-field on basic rocks	Rock outcrops and talus slopes	Snow beds	Miscellaneous
Hepatics											
Blepharostoma trichophyllum (L.) Dum.	X										
Odontoschisma elongatum (Lindb.) Evs.	X										
Paludella squarrosa (Hedw.) Brid.	X										
Preissia quadrata (Scop.) N.	X									X	
Ptilidium ciliare (L.) Hampe.	X	X	X							X	
Rhiccardia latifrons Lindb.	X										
Marchantia polymorpha L.		X							X	X	
Anthelia juratzkana (Limpr.) Trev.			X		X					X	
Cephaloziella arctica Bryhn. and Douin			X	X							

Table B (Continued)

Species	*Eriophorum–Carex* wet meadows	Solifluction slopes	*Eriophorum* tussocks	*Carex bigelowii* high-center polygons	Ecotonal frost scar	*Dryas* steps and stripes	*Dryas* fell-field on acidic rocks	*Dryas* fell-field on basic rocks	Rock outcrops and talus slopes	Snow beds	Miscellaneous
Diplophyllum taxifolium (Wahlenb.) Dumort			X								
Lophozia incisa (Schrad.) Dum.			X								
Scapania paludicola Loeske and K. M.			X	X							
Plagiochila arctica Bryn. and Kaal.								X			
Marsupella groenlandica C. Jens.										X	
Mosses											
Aulacomnium turgidum (Wahlenb.) Schwaegr.	X		X	X							
A. palustre (Hedw.) Schwaegr.	X	X	X	X	X	X				X	
Bryum pseudotriquetrum (Hedw.) Schwaegr.	X										
B. salinum Hag.	X										
Calliergon giganteum (Schp.) Kindb.	X	X									
C. stramineum (Brid.) Kindb.	X		X								
Campylium stellatum (Hedw.) Lange and C. Jens.	X										
Ceratodon purpureus (Hedw.) Brid.	X		X								Gravel bar
Climacium dendroides (Hedw.) Web. and Mohr.	X										Gravel bar
Distichum capillaceum B. and S.	X										
Drepanocladus aduncus (Hedw.) Warnst.	X										
D. uncinatus (Hedw.) Warnst.	X	X	X			X				X	
Haplodon wormskjoldii (Hornem.) R.Br.	X										
Hylocomium splendens (Hedw.) Bry. Eur.	X	X	X	X							
Mnium medium Br. and Sch.	X										
Oncophorus wahlenbergii Brid.	X		X		X						
Pleurozium schreberi (Willd.) Mitt.	X	X	X	X	X						
Pohlia cruda (L.) Lindb.	X										
P. nutans Hedw.	X		X								
Psilopilum cavifolium (Wils.) Hag.	X										
P. laevigatum (Wb.) BSG.	X										
Sphagnum balticum Russ.	X		X								
S. compactum DC.	X										
S. fimbriatum Wils.	X		X								
S. girgensohnii Russ.	X		X							X	
S. imbricatum Hornsch.	X										
S. magellanicum Brid.	X										
S. obtusum Warnst.	X										
S. rubellum Wils.	X										
S. squarrosum Crome.	X										
S. subsecundum Nees.	X		X								
Splachnum ovatum Hedw.	X										
Tomenthypnum nitens (Hedw.) Loeske	X	X			X	X		X			
Drepanocladus revolvens (C.M.) Warnst.		X									
Philonotis tomentella Mo.		X								X	
Polytrichum juniperinum Hedw.		X						X			
Rhytidium rugosum (Hedw.) Kindb.		X	X		X	X	X	X			
Abietinella abietina (Hedw.) C.M.			X								
Dicranum elongatum Schleich.			X	X	X	X					
D. majus Turn.			X								
Drepanocladus badius (Hn.) Roth.			X								
D. fluitans (Hedw.) Warnst. v. falcatus Limpr.			X								
D. pseudosarmentosus (Card. J. Ther.) H. Perss.			X								
D. schultzei Limpr.			X								

Table B (Continued)

Species	*Eriophorum–Carex* wet meadows	Solifluction slopes	*Eriophorum* tussocks	*Carex bigelowii* high-center polygons	Ecotonal frost scar	*Dryas* steps and stripes	*Dryas* fell-field on acidic rocks	*Dryas* fell-field on basic rocks	Rock outcrops and talus slopes	Snow beds	Miscellaneous
Sphagnum fuscum (Schp.) Klinggr.			X								
S. lenense H. Lindb.			X								
S. nemoreum Scop.			X								
S. warnstorfianum Russ.			X								
Tetraplodon mnioides Hedw.			X								
Polytrichum strictum Sm.			X								
Rhacomitrium canescens Brid.			X								Gravel bar
Andreaea rupestris Hedw.					X						
Calliergon sarmentosum (Wg.) Kindb.					X					X	
Dicranella subulata (Hedw.) Schp.					X						
Hylocomium alaskanum (Lesq. and James) Kindb.					X			X			
Amblystegiella serpens (L.) B. and S.						X					
A. sprucei (Bruch.) Loeske						X					
Barbula icmadophila Br. and Sch.						X					
Bartramia ithyphylla Brid.						X					
Ctenidium procerrimum (Mol.) Broth.						X					
Encalypta affinis Hedw.						X					
E. rhabdocarpon Schw.						X					
Hypnum bambergeri Schp.						X					
Meesia uliginosa Hedw.						X		X			
Tetraplodon pallidus Hag.						X					
Bryum pallescens Schleich.							X				
Conostomum tetragonum (Brid.) Lindb.							X				
Polytrichum hyperboreum R.Br.							X				
Calliergon turgescens (T. Jens.) Kindb.								X			
Drepanocladus brevifolius (Lindb.) Warnst.								X			
Hypnum vaucheri Lesq.								X			
Orthotrichum killiasii C.M.								X			
Rhacomitrium lanuginosum (Hedw.) Brid.								X	X		
Tetraplodon angustatus (Hedw.) Br. and Sch.								X			
Grimmia ovalis (Hedw.) Lindb.									X		
Leskeela nervosa (Schwaegr.) Loeske									X		
Pohlia albicans (Wg.) Lindb.										X	
Polytrichum jenseni Hag.										X	
Calliergon megalophyllum Mikot.											Aquatic
Drepanocladus exannulatus (R.Br.) Warnst.											Aquatic
Hypnum subplicatile (Lindb.) Limpr.											Gravel bar
Meesia triquetra Hedw.											Sub-aquatic
Pohlia proligera Lindb.											Eroding peat
Polytrichum commune Hedw.											Gravel bar
Scorpidium scorpioides (Hedw.) Limpr.											Aquatic
Lichens											
Cetraria cucullata (Bell.) Ach.	X	X	X	X	X		X				
C. islandica (L.) Ach.	X	X	X	X	X		X	X		X	
Cladonia gracilis (L.) Willd.	X		X								
C. rangiferina (L.) Web.	X		X	X	X		X	X		X	
Cornicularia divergens Ach.	X				X	X	X	X	X		
Peltigera scabrosa Th. Fr.	X		X	X							Gravel bar
P. aphthosa (L.) Willd.	X	X	X	X							Gravel

Table B (Continued)

Species	*Eriophorum—Carex* wet meadows	Solifluction slopes	*Eriophorum* tussocks	*Carex bigelowii* high-center polygons	Ecotonal frost scar	*Dryas* steps and stripes	*Dryas* fell-field on acidic rocks	*Dryas* fell-field on basic rocks	Rock outcrops and talus slopes	Snow beds	Miscellaneous
Thamnolia vermicularis (Sw.) Ach.	X		X				X	X			
Cladonia pyxidata (L.) Fr.		X									
Lobaria linita (Ach.) Rabh.		X		X	X		X	X			
Nephroma expallidum Nyl.		X								X	
Peltigera canina (L.) Willd.		X	X								Gravel bar
Alectoria ochroleuca (Ehrh.) Nyl.			X		X		X	X	X		
Baeomyces roseus Pers.			X								
Cetraria chrysantha Tuck.			X				X				
C. sibirica Magn.			X								
Nephroma arcticum (L.) Torss.			X								
Parmelia omphalodes (L.) Ach.			X		X						*Salix* bark
Peltigera polydactyla (Neck.) Hoffm.			X								
Sphaerophorus globosus (Huds.) Vain.			X	X	X		X	X			
Lecidea aglaea Sft.					X						
L. pantherina Ach.					X						
Ochrolechia frigida (Sw.) Lynge					X		X	X			
Pannaria pezizoides (Web.) Trev.					X						
Pilophoron robustum Th. Fr.					X						
Siphula ceratites (Wahlb.) Fries					X						
Alectoria tenuis E. Dahl						X					
A. pubescens (L.) Howe							X				*Salix* bark
Cetraria hepatizon (Ach.) Vain.							X				
C. nivalis (L.) Ach.							X	X	X		
Lecidea flavocoerulescens (Hornem.) Ach.							X				
L. pilati (Hepp.) Krb.							X		X		
Lobaria verrucosa (Huds.) Hoffm.							X				
Sphaerophorus fragilis (L.) Pers.							X	X			
Umbillicaria proboscidea (L.) Schrad.							X	X	X		
Cetraria tilesii Ach.								X			
Dactylina ramulosa (Hook.) Tayl.								X			
Evernia perfragilis Llano								X			
Lecanora rupicola (L.) Zb.								X			
Pertusaria dactylina (Ach.) Nyl.								X			
Rhizocarpon chioneum (Norm.) Th. Fr.								X	X		
R. geographicum (L.) DC.								X	X		
Solorina crocea (L.) Ach.								X		X	
Acarsopora glaucocarpa (Wahl.) Kbr.									X		
Caloplaca elegans (Link.) Th. Fr.									X		
Cetraria scholanderi Llano									X		
Cladonia alpestris (L.) Rabh.									X	X	
Diploschistes scruposus (Schreb.) Norm.									X		
Evernia esorediosa DuRietz									X		
Dermatocarpon miniatum (L.) Mann. v. complicatum Hellb.									X		
Lecanora behringii Nyl.									X		
L. cinerea (L.) Sommerf.									X		
L. coilocarpa (Ach.) Nyl.									X		
L. crenulata (Dicks.) Ach.									X		
L. muralis (Schreb.) Rabh.									X		
L. pelobotrya (Wg.) Sft.									X		
L. straminea (Wahlb.) Ach.									X		
Mastodia tesselata Hook.									X		
Parmelia separata Th. Fr.									X		
Pertusaria coriacea Th. Fr.									X		
Physcia caesia (Hoffm.) Hampe									X		

Table B (Continued)

Species	*Eriophorum*—*Carex* wet meadows	Solifluction slopes	*Eriophorum* tussocks	*Carex bigelowii* high-center polygons	Ecotonal frost scar	*Dryas* steps and stripes	*Dryas* fell-field on acidic rocks	*Dryas* fell-field on basic rocks	Rock outcrops and talus slopes	Snow beds	Miscellaneous
P. muscigena (Ach.) Nyl.									X		
P. sciastra (Ach.) DR									X		
Protoblastenia rupestris (Scop.) Stein.									X		
Rhizocarpon disporum (Naeg.) Muell. Arg.									X		
R. inarense (Vain.) Vain.									X		
Toninia caeruleonigricans (Lightf.) Th. Fr.									X		
Umbillicaria torrefacta (Lightf.) Schrad.									X		
Xanthoria candelaria (Ach.) Arn.									X		
Cetraria crispa (Ach.) Nyl.										X	
C. delisei (Bory) Th. Fr.										X	
C. richardsonii Hook.										X	
Cladonia amaurocrea (Flk.) Schaer.										X	
C. bellidiflora (Ach.) Schaer.										X	
Dactylina arctica (Hook.) Nyl.										X	
Lecanora allophana Rohl.											*Salix* bark
Nephroma parile Ach.											*Salix* bark
Solorina saccata (L.) Ach.											Eroding peat