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Plant Formations and Their Bio-Products from Western Banks Island (N.W.T., Canada)

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Summary: This report deals with major plant formations in the southwestern part of Banks Island. They are: aquatic, moss-bog, hummocky moss-bog, mesic, shrubby, herbaceous, steppe, littoral, *Dryas, Rhacomitrium*-lichen, *Saxifraga oppositifolia* tundras, and some indefinite vegetation gradients. Special attention was paid to plant communities that produce organic deposits. Descriptions of communities are based mainly on the following criteria: the floristic composition, the dominance of species, general physiognomic-ecological features, relationships with landforms and substrates, and types of bio-products derived from a community. The general geobotanical character of the area, distribution of plant communities in it, their possible age, and the postglacial migration on the island, are discussed.

Zusammenfassung: Der Bericht gibt die Haupt-Pflanzenformationen auf dem südwestlichen Teil von Banks Island wieder. Es handelt sich um aquatische, moosreiche, moorblütenreiche, feuchte, strauchige, krautige, steppenartige, litorale, *dryas*reiche, *Rhacomitrium*-flechtenreiche, *Saxifraga oppositifolia*-Tundraeinheiten und einige undefinierbare Vegetationsübergänge. Besondere Aufmerksamkeit wurde den Pflanzengesellschaften geschenkt, die organische Ablagerungen fördern. Die Beschreibungen der Gesellschaften basieren auf folgenden Kriterien: floristische Zusammensetzung, Dominanz der Arten, allgemeine physiognomisch-ökologische Merkmale, Beziehung zwischen Landformen und Bodensubstraten und von Gesellschaften stammenden organischen Produktionstypen. Der allgemeine geobotanische Charakter des Gebietes, die Verbreitung der Pflanzengesellschaften, das mögliche Alter und die postglaziale Einwanderung auf die Insel werden diskutiert.

INTRODUCTION

Recent investigations of the Beaufort Formation, interglacial and postglacial deposits of Banks Island yielded many interesting facts shedding light on its Quaternary history (Craig & Fyles 1960, French 1972, Fyles 1969, Hills 1969, Hills & Ogilvie 1970, Hills et al. 1974, Kuc 1970a, 1973a & b, 1974a & b, Kuc & Hills 1971, Meher 1968, 1970, Roy & Hills 1972). Paleoecological interpretation of examined bio-stratigraphic sequences requires a knowledge of bio-products of modern growth types, which hitherto were not studied in detail on Banks Island. For this purpose the author carried out in 1968 and 1969, a geobotanical survey of plant formations in the southwestern part of the island (Fig. 1).

The area is situated between the mountains of southern Banks Island (Fig. 1) and the rolling uplands of the northern part of the island and between the Beaufort Sea and the inland plateau. Wide valleys, covered by various types of lush growth, especially shrubby and wet tundras, and barren boulder and gravel alluvium are oriented, more or less, from the east to the west. Sand and fine gravel occur along the coast and on adjacent minor hills, plains and promontories. Gentle elevations of uplands are coated mainly by dark, heavy clay and morainic deposits strongly eroded by frost and wind on their tops and supporting a xeric lichen-moss and *Dryas* tundra. In the mountains, various types of bedrock are exposed on steep slopes. The slippage from them of weathered and Pleistocene materials form at lower elevations gentle slopes and terrace-like landforms covered by vegetation types which are arranged in a zonal manner related to altitude (Kuc 1973a, 1974a). Inland the area has the shape of the dissected plateau, covered by gravel and bouldery deposits which have been strongly eroded by snow-melt waters, mass movements and wind. In more stable habitats mostly grows primitive *Saxifraga oppositifolia* tundra.

Detailed information about geology, climate, soil, geomorphologic processes, landforms and other data connected with plant environments are in papers by French 1970a, b & c, 1971a & b, 1973a & b, 1974a & b, Fyles 1962, 1963, 1969, Manning 1953, Porsild 1955, Rae 1951, Tedrow & Douglas 1964, Thorsteinsson & Tozer 1962, Vincent 1978.

The sum total of information on earlier floristic investigations of the studied area and some of its plant formations are contained in Porsild's monographs (1955, 1964), Mason et al. (1972), Kuc (1970b, 1974a), Thannheiser & Schweingruber (1974), Thannheiser (1975, 1976), and Steere & Scotter (1979).

Broadly speaking, bio-products of the present day vegetation form thick postglacial deposits, e.g. in the Masik River profile (Kuc 1973a) and at Thesiger Bay and occur in upper sections of pre-Wisconsin sequences (e.g. Worth Point, Kuc 1974b; cliffs west of Sachs Harbour, Hills et al. 1974) but hitherto were not found below Wisconsin strata.

REMARKS ON METHODOLOGY

Descriptions of the plant formations listed below were based on the following criteria: (1) The floristic composition. This is a list of the vascular plants, mosses and in some cases lichens and liverworts. (2) The dominance of species. Dominants are those constituents which occur most abundantly in a given tundra type. Subdominants show lower degrees of participation. Associates are rare or very rare and often are not permanent constituents. (3) General physiognomic-ecological features such as the habit of a community, its compactness, homogeneity, layering and surficial relief (flat, hummocky, irregular), etc. (4) Relationships

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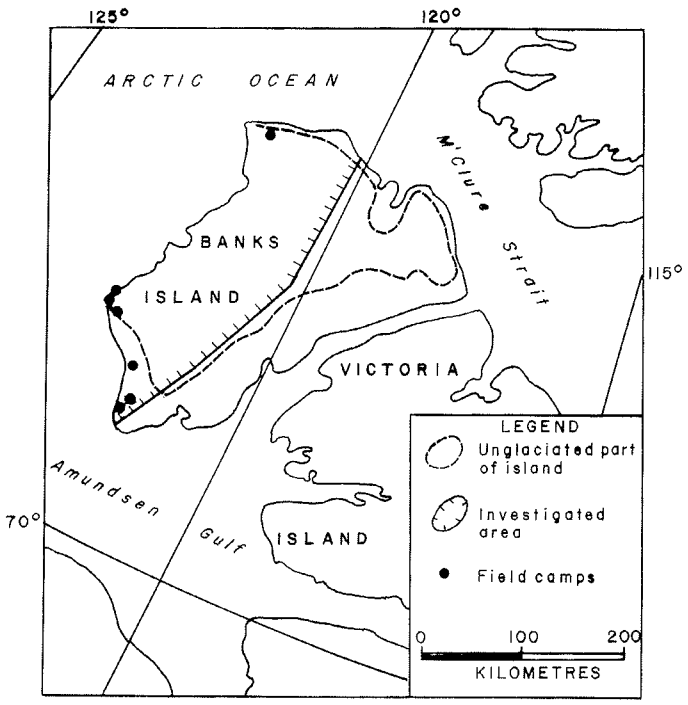

Fig. 1: Location of the investigated area.

Abb. 1: Lage des Untersuchungsgebietes.

with landforms and substrates. (5) Types of bio-products derived from a community.

Communities are not classified into hierarchial units because the present knowledge about arctic communities still is too fragmentary. Special attention was paid to those formations which form deep organic layers.

PLANT FORMATIONS OF THE STUDIED AREA

The review of plant communities begins with aquatic formations and ends with the most xeric ones.

Aquatic tundra

Aquatic tundra (Fig. 2) develops in shallow water bodies (pools, ponds, shallow borders of larger lakes) and consists of vascular plant hydrophytes (*Arctophila fulva, Caltha palustris* var. *arctica, Carex stans, Carex* sp., *Hippuris vulgaris, Pleuropogon sabinei, Ranunculus gmelini, R. hyperboreus*) and mosses (*Calliergon giganteum, C. richardsonii, C. trifarium, Cratoneuron* sp., *Drepanocladus exannulatus, D. fluitans, D. latifolius, D. revolvens, Hygrohypnum luridum, Scorpidium scorpioides* and *S. turgescens*), abundantly associated with zooplankton and phytoplankton.

The selection of dominant and associate species is quite difficult. In young, well-bordered pools and ponds with less trophic water and stony or sandy bottoms, the first invaders are the mosses *Drepanocladus exannulatus* and *Hygrohypnum luridum*, usually unattached to substrates. In older but shallow water bodies invaded from borders by boggy vegetation and with bottoms covered by organic sapropel abundantly grow *Arctophila fulva, Calliergon giganteum, C. trifarium, Carex stans, Drepanocladus latifolius, Hippuris vulgaris*, and *Scorpidium scorpioides*, while other species are always rare.

Bio-products of the community are several variants of sapropel: (1) primary, detrital and silty sapropel with numerous planktonic forms; (2) mossy sapropel with strongly decomposed moss fragments, mainly *Scorpidium* and *Calliergon*; (3) rhizome sapropel and (4) reworked detrital sapropel composed mainly of amorphous lake detritus but usually rich in animal remains accumulated in shallow places by wave action.

Moss-bog tundra

This community (Fig. 3) is common and widespread throughout the area in permanently submerged bog depressions, or on flooded gentle slopes, near streams, or on boggy borders of some water bodies. The surface of the moss-bog is flat or slightly undulated, but not hummocky. Dominant plants are mosses abundantly associated with liverworts, forming thick carpets of gold-green or brown-green colours. Vascular plants rooted in peat are apparently rare, and form the upper, loose and discontinuous stratum. The moss-bog tundra is especially well developed on nonporous, muddy or filne silty ground.

The community has no dominant species. Mosses are subdominants and occur in large, often monospecific patches: *Aulacomnium palustre, Bryum pseudotriquetrum, B. ovatum, Calliergon giganteum, Campylium polygamum, Drepanocladus revolvens, Tomenthypnum nitens*, and in less wet habitats: *Drepanocladus vernicosus, Mnium affine* s.l., *Orthothecium chryseum* and *Philonotis tomentella*. Less frequent components are several *Bryum* species, *Calliergon richardsonii, C. sarmentosum, Campylium stellatum, Catoscopium nigritum, Cinclidium* species, *Cratoneuron curvicaule, Hypnum pratense, Meesia triquetra, M. uliginosa, Mnium hymenophyllum, Scorpidium turgescens*, and *Splachnum vasculosum*. The most obligate vascular plants are: *Arenaria rossii*, several species of *Carex* (e.g. *C. membranacea, C. stans*), *Chrysosplenium tetrandrum, Epilobium arcticum, Eriophorum* species, *Eutrema edwardsii, Saxifraga hirculus* and *Stellaria edwardsii*.

Moss-bog tundra frequently produces uniform, slightly or not decomposed, often compressed, fasciculated moss-peat cryoturbations.

Hummocky moss-bog tundra

This widespread mosaic community (Fig. 4) develops mostly on thicker and drier stands of the previous one or on gentle and seasonally flooded slopes. Its most characteristic feature is the moss-hummock relief composed of mono- or multi-species peat

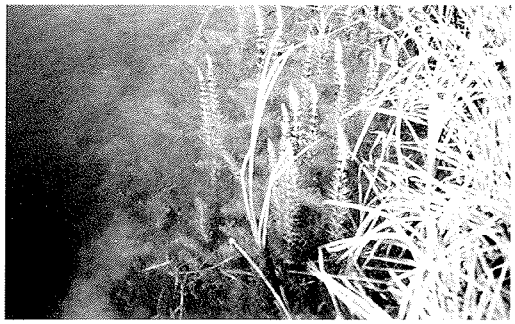

Fig. 2: Aquatic tundra.

Abb. 2: Aquatische Tundra.

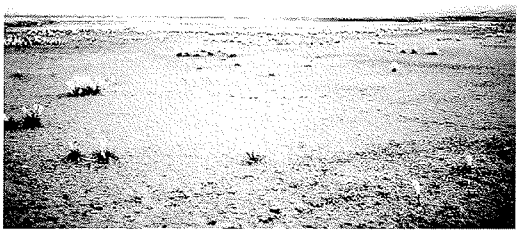

Fig. 3: Moss-bog tundra. A blanket of moss with the first invaders of *Senecio congestus*.

Abb. 3: Moosreiche Niedermoortundra mit Decken von Moosen und ersten Einwanderern von *Senecia acongestus*.

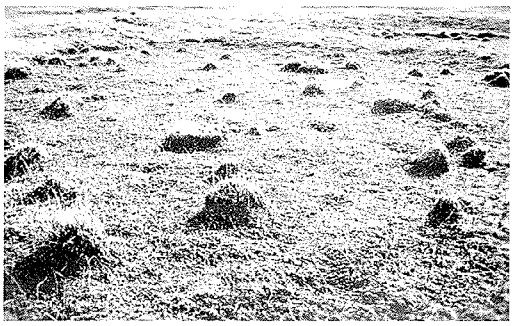

Fig. 4: Hummocky moss-bog tundra.

Abb. 4: Blütenreiche Moostundra.

Fig. 5: Shrubby tundra. Groups of *Salix alaxensis* (up to 1.5 m tall).

Abb. 5: Strauchreiche Tundra mit Gebüsch von *Salix alaxensis* (bis zu 1,5 m hoch).

hummocks. In the vertical projection of the highest and best developed hummocks the following micro-zones can be distinguished: (1) dry and humic tops sometimes with lichens (e.g. species of *Alectoria, Cladonia, Dactylina*), xerophytic mosses (e.g. *Hylocomium splendens, Rhacomitrium lanuginosum, Polytrichum juniperinum, Timmia austriaca*) and vascular plants that require better soil conditions such as *Dryas integrifolia* and dwarf *Salix* species; (2) moist, lower parts of hummocks and drier parts of the depressions between them covered by mesophytes such as *Aulacomnium turgidum, Dicranum elongatum, D. groenlandicum, Drepanocladus uncinatus* and many others, the only lichen, *Peltigera* sp., and the vascular plants such as *Alopecurus alpinus, Arctagrostis latifolia, Ranunculus sulphureus*; (3) permanently wet depressions; (4) minute, temporary tundra pools in places with aquatic and semiaquatic plants.

The community produces heterogeneous brown, compressed, fibrous moss-peat, discontinuously and indistinctly layered in some places with lenses of decomposed humic peat.

Mesic tundra

Mesic tundra is the complex of various communities forming the transition between hydric vegetation types and xeric ones. The best mesic tundra patches grow in shallow, wide depressions on moist slopes, near stream banks and on alluvium, and in frost cracks and on patches of dry peat. The growth is relatively thin but dense and its floristic composition is the mixture of many species belonging to different ecological types. Mosses dominate in this community and vascular plants usually subdominate, while lichens appear rarely but consistently. All these components are also common in other communities.

The bio-products of mesic tundra are thin, discontinuous, strongly decomposed, black peaty strata occurring in the upper parts of thicker moss-tundra sections or are components of organic soil horizons.

Shrubby or bushy tundra

This is a multilayered shrubby growth (Fig. 5) stratified as follows: (1) in the highest stratum, up to 2-6 feet thick, *Salix alaxensis*, with *S. richardsonii* are dominants, (2) the middle layer is composed of herbs and dwarf shrubs such as *Arctostaphylos rubra, Cardamine digitata*, several *Carex* species, *Epilobium arcticum, Equisetum arvense* (frequent), *Petasites frigidus, Pyrola grandiflora* (occurring mainly in this environment), *Stellaria longipes* s.l., *Salix reticulata* and (3) the floor layer is formed by bryophytes growing on humus and on wet twiggy peat and includes *Cratonueron arcticum, Calliergon cordifolium, C. giganteum, Brachythecium* sp. (cf. *rutabulum), Tomenthypnum nitens* var. *nitens*, several *Bryum* and *Dicranum* species, *Isopterygium pulchellum* (frequent), *Mnium affine* s.l. (common), and *Pohlia nutans* (common). Some of these mosses often climb onto *Salix* branches sticking out from the moss floor and are often mixed with *Ceratodon purpureus, Distichium*

sp., *Ditrichum flexicaule*, and on slightly higher parts of branches with the lichens *Caloplaca holocarpa, Caloplaca cerina, Gyalecta foveolaris, Lecanora epibryon, Lecanora verrucosa, Lecidea wulfeniana.* Tall heliophiles such as *Arthemis tilesii, Astragalus* sp., *Calamagrostis* sp., *Eutrema edwardsii, Hedysarum mackenzii, Juncus balticus* ssp. *alaskanum, Senecio congestus* and others, occur in marginal parts of *Salix* stands or among loose, depauperate gradients of the community.

Shrub tundra produces twiggy humic peat composed of stem fragments, branches, moss, duff and a certain amount of amorphic humus (cf. KUC 1973a, 1974a).

Herbaceous tundra

This type (Fig. 6) is quite extensively represented in the area and results in thick, moist, soft, mucky soil on favourably exposed and moderately elevated but sheltered places, mostly between slopes and the flatland, along streams at lower slopes and on dry, flat peaty habitats. Vascular plants are the dominant species, and among them the most characteristic are *Arnica alpina* ssp. *angustifolia, Epilobium latifolium, Equisetum arvense, Melandnium ostenfeldii, Papaver keelei*, some species of *Pedicularis, Petasites frigidus, Polemonium boreale, Senecio atropurpureus, S. hyperborealis*, species of *Taraxacum* and several others. These are mainly mesophytes with large leaves and colourful flowers, deep and well developed roots or creeping stems, associated with mosses of mesic tundra and tolerant inhabitants of swamps such as *Cratoneuron curvicaule, Meesia triquetra*, and *Orthothecium chryseum.*

Strongly decomposed black muck is produced by the community in moist, low situated depressions. In higher elevated and inclined habitats it does not accumulate deeper deposits.

Steppe tundra

This type of tundra (Fig. 7) is physiognomically similar to the previous formation because of its herbaceous appearance, but floristically and ecologically it is quite different. It develops on dry, stony, south-facing substrates that are on moderately elevated, exposed and rather windy places situated between the high inland interior and coastal areas. The community has no dominants. The main components are vascular plants: *Agropyron latiglume* s.l., *Androsace chamaejasme, A. septentrionalis, Anemone parviflora, Antennaria* sp., *Armeria maritima* s.l., *Artemisia* species, *Braya humilis* var. *arctica, Castilleja pallida* ssp. *elegans*, several species of *Draba, Elymus* sp., *Erigeron compostus* s.l., *Erysimum pallasii, Festuca baffinensis, Lesquerella arctica, Melandrium ostenfeldii*, several *Oxytropis* species, *Papaver keelei, Pedicularis sudetica, Plantago septata*, some *Potentilla* species, *Pulsatilla ludoviciana, Saxifraga aizoides, S. tricuspidata, Senecio hyperborealis, Taraxacum hyparcticum, Trisetum spicatum* (luxuriant forms) and others. The majority of these species have characteristic „tunics" (the dense, persisting coats of dry, dead leaves covering stems at ground level)

Fig. 6: Herbaceous tundra.

Abb. 6: Krautreiche Tundra.

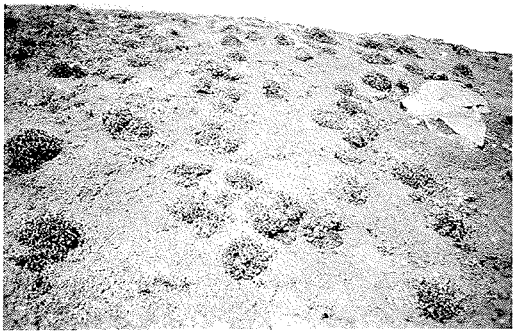

Fig. 7: Steppe tundra.

Abb. 7: Steppenartige Tundra.

which is a feature of many steppe plants. Bryophytes are rare and all are xerophiles and heliophiles. The most permanent components are: *Abietinella abietina, Anoectangium tenuinerve, Anthelia juratzkana, Bryum argenteum, Grimmia* sp., *Gymnomitrium concinnatum, Hypnum vaucheri, Pterigoneurum arcticum, Ptilidium ciliare, Rhacomitrium* species, *Rhytidium rugosum, Tortella fragilis, T. tortuosa, Tortula mucronifolia,* and *T. ruralis*. Crustaceous and foliaceous lichens are abundant on hard rock surfaces or between stones. This community does not produce a large amount of organic matter, as it is generally blown away by the wind, though the resulting duff (mainly decomposed leaf, stems, root fragments and amorphic humus) can be recognized in upper soil horizons.

Littoral tundra

Littoral tundra develops on shelving shores, both on sand and mud. The lower parts of the littoral zone extensively occupy temporary, brackish pools which are usually surrounded by saline swamps; whereas in the more elevated and drier parts (gravel storm ridges, minor dunes, and the gently sloping, levelled sides and raised beaches) it is a loose vegetation. The growth is composed of the following ecological groups: (1) halophiles of hydrophytic or mesophytic habits (*Carex ursina, Puccinallia phryganodes, Stellaria humifusa*); (2) halophiles of mesophytic or xerophytic habits (*Arenaria peploides, Carex maritima, C. subspathacea* and *Mertensia maritima*); (3) psammophiles (*Ely-*

mus arenarius ssp.) and several facultative psammophiles such as *Arenaria rubella, Armeria maritima* ssp., *Festuca* sp., *Papaver radicatum, Cerastium arcticum*, and *Draba subcapitata*; (4) nitrophiles (*Cochlearia officinalis, Braya purpurascens, Phippsia algida, Alopecurus alpinus, Juncus biglumis* and *Oxyria digyna*); and (5) widely ranging arctic species of large ecological amplitudes such as *Saxifraga caespitosa, S. cernua, S. rivularis* and others.

Dryas tundra.

This formation (Fig. 8) develops on various types of inorganic soils. The dominant species is *Dryas integrifolia* and subdominants are: *Androsace chamaejasmae, Salix arctica, Saxifraga caespitosa, S. oppositifolia*, and *Stellaria longipes*, s.l. associated with the mosses *Aulacomnium turgidum, Ditrichum flexicaule, Drepanocladus uncinatus, Hylocomium splendens; Artemisia hyperborea, A. richardsoniana, Chrysanthemum integrifolium, Melandrium affine, Oxyria digyna, Parrya arctica, Polygonum viviparum, Saxifraga cernua*, and *S. tricuspidata* and mosses; *Hypnum procerrimum, H. revolutum, H. vaucheri, Pohlia nutans, P. cruda, Polytrichum alpinum, Timmia austriaca, Tortula ruralis* and lichens of the genera *Alectoria, Cladonia, Cetraria, Ramalina, Stereocaulon, Thamnolia*. The above plants form two layers: the upper one composed of vascular plants and the lower one of mosses and lichens.

Dryas tundra covers large areas in the flat or hilly northern parts of the region but to the south becomes gradually dispersed and restricted to lower elevations.

Dryas tundra produces specific organic debris. Individual fragments of *Dryas integrifolia* (stems with roots, leaves, parts of flowers), *Salix arctica* (branches, leaf remains, bud scales) and *Saxifraga oppositifolia* (top parts of stems, capsules), associated with individual moss stems, appear in muddy or sandy soils.

Rhacomitrium-lichen tundra

This ubiquitous high-arctic community (Fig. 9) grows exclusively on habitats such as old stony scree, rock outcrops, gravel terraces, patches of the Beaufort Formation and boulder fields, etc., at higher elevations. This is a moss-lichen, unilayered, mosaic carpet composed mainly of bryophytes (*Rhacomitrium lanuginosum, Chandonanthus setiformis, Ptilidium ciliare, Sphenolobus minutus, Andreaea papillosa, Dicranum* sp., *Hylocomium splendens*) and lichens (*Alectoria nigricans, A. ochroleuca, Cetraria delisei, C. nivalis, Dactylina ramulosa, D. madreporiformis*, several *Cladonia* species, *Stereocaulon* sp., *Thamnolia vermicularis*). Vascular plants are associating constituents and occur mainly as individual specimens or in small groups (*Saxifraga nivalis, S. oppositifolia, Cerastium arcticum, Luzula nivalis, Cardamine bellidifolia* - all wide-ranging arctic plants) usually submerged in the moss carpet. Hard rocky surfaces are abundantly covered by epilithic lichen growth.

Saxifraga oppositifolia tundra

This formation (Fig. 10) mainly occurs at the highest elevations, on the plateaus and in the mountains, on stony and dry places. It is dominated by *Saxifraga oppositifolia* cushions often associated with *Silene acaulis, Dryas integrifolia, Oxytropis* sp., and *Artemisia borealis*. On eroded habitats between the cushions grow individual, usually depauperate specimens of *Papaver radicatum, Salix arctica, Saxifraga cernua, S. flagellaris, S. tricuspidata, Sagina intermedia* and others. Mosses and lichens (components of the *Rhacomitrium*-lichen tundra) are rare in this community and usually are associated with larger vegetation spots.

Fig. 8: *Dryas* tundra.

Abb. 8: *Dryas*reiche Tundra.

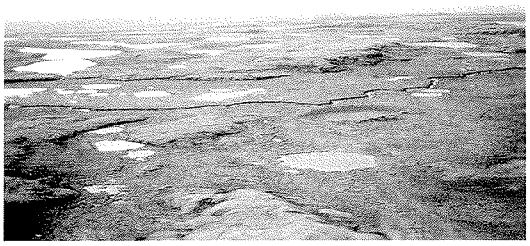

Fig. 9: *Rhacomitrium*-lichen tundra covering surfaces of elevated landforms.

Abb. 9: Flechtenreiche *Rhacomitrium*-Tundra bedeckt die erhöhten Oberflächenformen.

Fig. 10: *Saxifraga oppositifolia* tundra.

Abb. 10: *Saxifraga oppositifolia*-Tundra.

Undefined tundra types

Southwestern Banks Island also includes several types of vegetation which have hitherto been little studied. These are: (1) epilithic lichen tundras developing on hard-rock surfaces (Fig. 11); (2) vegetation of snow beds with such species as *Potentilla hyparctica, Ranunculus pygmaeus, Salix pseudopolaris* and *Saxifraga rivularis*; (3) grass tundra mainly composed of grasses or grass-like plants (Fig. 12); and (4) patches dominated by *Phlox richardsonii*, restricted to coastal areas.

Fig. 11: Epilithic (crustaceous) lichen growth on moraine boulders.

Abb. 11: Epilithisches (Krusten-) Flechtenwachstum auf Moränenblöcken.

Fig. 12: Grass tundra. *Alopeucrus alpinus* and *Equisetum arvense* on vertical peat slopes.

Abb. 12: Grasreiche Tundra mit *Alopecurus alpinus* und *Equisetum arvense* auf torfigen Hängen.

Fig. 13: *Eriophorum* „meadow" (white spots).

Abb. 13: *Eriophorum*-„Wiese" (weiße Flecken).

Vegetation patches of special habitats

Small patches of physiognomically and ecologically distinct growth occur on exclusive substrates and local environments. Examples are: (1) Anthropogenic vegetation in Sachs Harbour village and on places of former Eskimo camps. These are lush stands composed of *Matricaria ambigua, Rumex articus, Halimolobos mollis, Alopecurus alpinus, Draba glabella, Braya humilis, Erigeron unalaschkensis, Artemisia tilesii, Cerastium* sp., *Potentilla rubricaulis, Saxifraga tricuspidata, Cochlearis officinalis, Descurainia sophioides, Melandrium ostenfeldii, Phlox richardsonii, Oxyria digyna, Poa glauca, Parrya arctica*, and many others. (2) The vegetation of older alluvial areas is a mixture of components of various tundra types. Found only on alluvium are *Aster pygmaeus, Gentiana actophila, Calamagrostis purpurascens* and *Juncus balticus* ssp. *alaskanus*. The floristic combination of species varies from very poor to quite rich depending on the age of the alluvium, the amount of fines in the soil, the neighbourhood of plant communities, water supply and other factors. (3) The vegetation of former lake bottoms, which are partly or entirely drained and covered with humic sapropel invaded by terrestrial or amphibious plants, often growing together with semiaquatic, depauperate species such as *Ranunculus gmelini, R. hyperboreus, Hippuris vulgaris, Caltha palustris* var. *arctica, Senecio congestus, Epilobium arcticum, Alopecurus alpinus, Carex* species, *Equisetum arvense, Stellaria edwardsii, Cerastium beringianum, Eutrema edwardsii, Saxifraga hirculus, Epilobium latifolium, Petasites frigidus* and some others, and such mosses as *Drepanocladus latifolius, D. revolvens, Scorpidium scorpioides, Calliergon giganteum*, and *Campylium* sp. (4) In wet ditches and by their borders often appear spots of *Eriophorum angustifolium, E. scheuchzeri, Senecio congestus, Carex stans* and *C. membranacea* (Fig. 13). This community produces *Eriophorum* peat. (5) Nitrophilous growth. These patches develop by borders of water bodies strongly manured by bird droppings. Obligatory nitrophiles are *Cochlearia officinalis, Phippsia algida, Splachnum vasculosum, Tetraplodon mnioides*, and *Voitia nivalis*.

DISCUSSION

Geobotanically, the studied area has a pronounced low arctic character (Porsild 1955, 1964, Polunin 1955, Brown 1972), confirmed by the studied plant formations, their distribution and environmental requirements. The most typical low arctic communities are aquatic, herbaceous, littoral, shrubby and steppe tundras as well as anthropogenic, *Phlox richardsonii*, and alluvial growth types. Shrubby and steppe tundras, and anthropogenic and *Phlox richardsonii* communities do not grow in the High Arctic.

The steppe tundra seems to be a community endemic to southwest Banks Island since it has not been described from other parts of the Canadian Arctic Archipelago and has not been found elsewhere by the author.

The shrubby tundra is much better developed and enriched by boreal species in the subarctic (observed by the author in the Tuktoyaktuk, Inuvik and Norman Wells areas).

Pan-arctic communities include the *Dryas*, moss-bog, mesic, *Rhacomitrium*-lichen, and *Saxifraga oppositifolia* tundras and the epilithic lichen, snowbed and nitrophilous habitats. Among them the *Rhacomitrium*-lichen tundra, and the epilithic lichen and snowbed vegetation types are restricted in the studied area to small but numerous and well bounded places which are often limited to definite landforms such as scree, stone fields, bare rock, rocky outcrops, vicinities of late snow patches, etc., whereas in the High Arctic they cover large areas (cf. e.g. POLUNIN 1948, SAVILE 1961).

The altitudinal distribution of the discussed plant communities between the coast and the inland plateau is also a characteristic feature of the area. In it one can distinguish three largely overlapping vertical zones. (1) The narrow coastal region, up to 50 feet, composed of plains, gentle hills, sea terraces, abrupt minor cliffs and faces of the sea slopes. Littoral tundra and *Phlox richardsonii* growth are restricted to this area. (2) The uplands or the hill land, from 50 up to 500 feet (exceptions are some slopes up to 800 feet a.s.l.), strongly dissected by river valleys, which, on their flat bottoms, are extensively covered by boggy areas, wet and shrubby tundras, and *Eriophorum* „meadows", with drier elevations where occur mainly herbaceous and steppe communities and poorer gradients of shrubby tundra and grass growth. This region is the richest in species and best developed plant formations, producing thicker organic deposits, mainly peats, sapropels and organic debris. Aquatic, *Dryas* and moss-bog tundras and grassy growth, though occurring throughout the studied area, are distinctly better developed in this region than at the coast and at higher elevations. (3) The inland plateau consists of slopes above 500 feet separated by the narrow upper reaches of valleys. Rock outcrops, boulder and gravel fields predominate in this landscape. The dominating community is *Saxifraga oppositifolia* tundra, some patches of *Rhacomitrium*-lichen tundra and extensive epilithic lichen growth on stable hard rock substrates. Minor water bodies have an oligotrophic character and have small primitive fragments of wet tundra developed at their borders. All of these communities are restricted to this region, which is characterized by negative geobotanical features.

From the historical point of view, it is possible to deduce that the oldest among the existing plant communities in the studied area are widespread arctic plant formations, such vegetation types are now common in the High Arctic: *Dryas*, mesic, *Rhacomitrium*-lichen and *Saxifraga oppositifolia* tundras and epilithic lichen, snowbed and nitrophilous growth. These vegetation gradients are best adjusted to severe polar conditions and they could survive the Wisconsin time on unglaciated areas of Banks Island.

The multilayered shrubby tundra possesses features of the highest organized community in the area. It grew on the west coast of the island, producing thick twiggy-moss deposits during the pre-Wisconsin interglacial (KUC 1970a, 1974b) and appeared again on Banks Island in the early Postglacial time around 10,000 years ago in the Masik River area, however, the thickest deposits resulted during the postglacial hypsithermal period (KUC 1973a). At the same time as shrubby tundra, or during the hypsithermal interval, could have also appeared other communities requiring better arctic environments, such as the herbaceous and steppe tundras. Aquatic, moss-bog and littoral tundras and some of the alluvial vegetation gradients had their floristic composition enriched with more southern and boreal species and these peat-forming formations produced at this time thick peat and sapropel deposits. The youngest communities are eutrophic boggy growth on drained lake bottoms and anthropogenic vegetation.

The recent deterioration of the general climate is recorded by a number of features. The most pronounced of these are (1) the retreat of shrubby tundra from its highest stations and uppermost parts of valleys, where it left thin twiggy deposits and dead specimens among drained bogs, (2) the strong drainage of water bodies, (3) strong erosion of thicker organic deposits, dissected by frost ditches, which are drained and eroded on their top surfaces by wind, (4) strong erosion of the inland plateau and slopes at higher elevations, (5) the multiyear accumulation of snow often on quite developed vegetation in deep, narrow, or well sheltered places located at higher elevations.

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