LANDS ABOVE THE TREES

(A natural history of the alpine lands of BC)[1]

by Bert Brink

The alpine lands of B.C. are extensive. They are part of the longest mountain chain in the world – the Cordillera of North and South America. They share features with alplands elsewhere but many features are distinctive to BC. To write briefly of their dynamics and their diversity requires a tight organization and omission of much of significance. In a general way it would seem to be useful to address major-features of landscape and then smaller features of rock, soil, plant and animal.

The terms "alpine" and subalpine" may require definition. As widely used by biologists and geographers "alpine" refers to the elevated slopes above treeline and "subalpine" to a distinctive forested zone below the treeline. "Alpine" also may refer archaically to a "sub-race" of "Homo sapiens" or to plants in gardens usually derived from alplands or to mountains in a general sense.

Treeline (Timberline)

More than one quarter of the land of B.C. is alpland – "land above the trees". The high altitude treeline is one of the most conspicuous features on the B.C. landscape. Fly over it on clear day, north or south, east or west for conviction. The treeline separating alpine from forest land is almost continuous. Superficially, it seems to be a relatively simple feature: on close scrutiny it is revealed to be complex. For example it is notable that on the wet west coast of Vancouver Island and the Queen Charlotte Islands treeline may be lower than 900 meters, that it increases as land mass increases to the east so that in the Rocky Mountains near Fernie at may be as high as 2000 meters.

Trimline

The trimline marks the maximum levels reached by mountain glaciers and glacierettes during "the Little Ice Age", a maximum reached about 1850 A.D., 150 years ago. The trimline today, 2001 A.D. is, in our Province, a very conspicuous feature most noticeable in the late summer and autumn after the melting of winter snows (Photo 1). The melting of the continental ice sheets 12000 B.P. (before present) years ago left our Province largely ice free except for some large alpine glaciers such as Bridge River ice cap in the Coast Range and innumerable glacierettes (small areas of ice). About 1400 A.D. ice began again to accumulate on these scattered ice remnants initiating what has been termed "the Little Ice Age". Abruptly accumulation ceased about 1850. Ablation (melting and evaporation of ice) has continued to this day. The vertical and horizontal loss (retreat) of ice since 1850 is very well marked as the trimline.

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Over much of the lower altitudes the trimline is a treeline marking the destruction of forest (Photo 2) as ice advanced until 1850; at higher elevations it is marked by lateral moraines, rocky debris and polished bare rock.

The trim line today delimits an astonishingly large area of land in B.C.. The magnitude can best be appreciated from high peaks or aircraft in late summer or autumn. Reforestation at alpine elevation is very slow so that even after 150 years the ice free areas are readily distinguished. To estimate the area freed, the volume of ice lost and impacts on stream flow in BC would be an interesting task. Although trimlines are to be seen on all mountains of the world the magnitude of the area it marks is large because of the many glaciers in B.C.

A Wavy Treeline: Snowpack and Snow Creep

For all but a few months of the year snow covers the alplands of B.C. The meadows and fellfields (rocky areas) of summer, passionately loved for color, clean air and water and a sense of freedom they convey are snow free briefly. Snow dominates the alplands. Snow accumulates in many ways and places. It changes character with season and depth. It is complex.

Snow interfaces in complex ways with rock, soil, plant, animal and atmosphere. It modifies stream, influences climates, it is used for recreation and indirectly irrigation, it impedes transportation. Snow heavily impacts Canadian life. Yet it may be fairly stated that we as citizens know little of its character and little of its roles in the alplands.

Some things about snow are told by looking at wavy treelines. Where mountains receive lots of snow the treeline is often wavy: forest extends like fingers up into open alpine and meadow reaches down into subalpine forest. Observation shows that trees establish on high ground and not in swales or hollows. The length of time soil is free of snow is a large factor in determining the growing season in the alplands and the ability of tree species to establish. (Photo 3) On high ground snow may blow away and snowpacks slowly <u>flow</u> or creep to deepen in the swales. Deep snow packs put pressure on the interface with soil rock and vegetation. Trees bend and grow with twisted stems. Snowpacks slide over heaths (<u>Phyllodoce</u> spp. and <u>Cassiope</u> spp.) Heaths are slippery underfoot for humans too. Snowpacks in spring, when thinning and melting are transparent and light signals avalanche lilies (<u>Erythronium</u> spp.) and some other plants to initiate growth. Initiation by some of these plants starts a special cyan respiration producing heat and cavities in the snow giving such species a few extra growing days.

Snow Patchs

Visitors to the summer alplands see the glory of the flowers and in autumn coloured foliage. Few see snow patchs as part of the “great alpine dynamic” – their roles in eroding soil and rock or relating to plant and animal life.

Snowpatch erosion of soil and rock is sometimes termed "nivation." Snowpatchs on slopes (Photo 4) can creep and actively sap (pluck) soil and rock at the interface. Some patchs have a steep bank of soil and rock at their upper end and a run-out area at their lower end which is often wet with meltwater. A vertical profile through an ice patch reflects the snowfalls and temperatures of winter. Often at their bottom is a layer of ice. Often soil at the upper end of a snow patch is dry and that at the lower end is saturated, sometimes so wet a touch with an ice axe will cause it to flow (gelification).

The vegetation around many snow patchs is zoned – a response to gradual shortening of growing season as the snow patch melts. Some plants established at the edges of snow patchs may in some years not emerge from the patch (e.g. Lyall's saxfrage).

Some snow patchs are the result of avalanches and land slips. Avalanches commonly devastate forests but some sub-arborescents such as alders (Alnus spp.) are flexible and avalanche slides over them.

Tree Species of the Treeline

The tree species defining treeline in B.C. are native conifers. In many places in the world (e.g. New Zealand) non conifers may be the determinants. Treeline species change with climate and substrate.

Mountain hemlock (Tsuga mertensiana) is a principal treeline species in the high snowfall/high rainfall Garibaldi Provincial Park above Squamish but farther north in the Park as snow and rain decline alpine fir (Abies lasiocarpa) replaces hemlock; both species are important components of the subalpine forests below their respective treelines. Lodgepole pine (Pinus contorta) and Spruce (Picea spp.) are common treeline species. Deciduous species, such as cottonwood and aspen (Populus spp.), alders (Alnus), birch (Betula spp) or willow (Salix spp.) delimit treeline in a few areas in northern B.C.

There are three conifers, "true trees of the timberline", which only occur in the narrow alpine/subalpine transition zone: Lyalls larch (Larix Lyallii) and two look-alike pines, whitebark pine (Pinus albicaulis) and limber pine (Pinus flexilis). True firs and spruces at timberline have spire tops and single leaders; these three have broad tops and tend to multistems with shapes which give visual pleasure to artists and photographers. Lyall's larch is deciduous coloring and shedding its needles in autumn; it occurs as far west as Frosty mountain in Manning provincial park and near Mt. Baker (Mt. Ruth) WA. and east along the International Boundary into the Rocky Mountains of B.C., Alberta and Montana. Who has missed the golden autumn splendor of this alpine tree has missed much.

Whitebark pine occurs mainly on the lee side (eastern) of the Coast Range. Limber pine occurs in the southern Rockies of B.C. and Alberta and south well into the mountainous U.S. states: it is much photographed for its twisty gnarled stems in Waterton (Canada) and Glacier (U.S.) national parks. Both pines have large cones with large edible seeds which Clarke's nutcrackers and chipmunks are notable users. The seeds are tightly held in tough bracts so how do they do pry the cones open?

Elfin Wood (Krumholz)

Trees species can establish on soils above the protection of the forest. When they do they almost always hug soil or rock. Elfin woods are given many names in the mountain lands of the world; Krumholz (German for crooked wood) is common in Europe. Occasionally a leader or main shoot will rise above the snow and will survive abrasion and pruning by snow and ice crystals driven by winter winds. Elfin woods reproduce vegetatively by layering i.e. by rooting from branches appressed to the soil by snow.

Fellfield (fields of stones) Sheer Rock and Ice

Above the alpine meadow and elfin wood are fellfields, steep rock and "permanent" snow and ice. Although ice sheets periodically covered B.C. during the last million years (the Pleistocene era) and advanced and retreated repeatedly; some high peaks and high ridges stood above the ice sheets as "nunataks". Today much land that stood above the ice is fellfield, fields of shattered frost-riven rocks; steep bare rock or catchments for snow and ice.

Fellfields and the zone in which they occur usually receive less snow than the alpine land below them and much of the snow which does fall blows from the peaks and ridges; black lichens often cover the rocks but some vascular plants distinctive to the zone (e.g. Kobresia) may occur sparsely. The zone is a land of violence – avalanche, rockfall and rapidly moving ice; gravity, frost and strong winds.

Alpine Substrates: Bedrock And Soil

Bedrock is frequently exposed in alplands. It is therefore relatively easy for naturalists and geologists and mining engineers to recognize main kinds of rocks – granites, ultrabasics, limestones, recent volcanics, etc. It is easier too to appreciate processes such as weathering or mineralization and to develop an interest in the fascinating world of geology.

Here and there in the alplands soils do occur but, because of the rapidity of erosion, are not mature with developed profiles (classed as regosols). Loessial (aeolian) or wind derived soils are fairly common recognized as free of rocks; it is probable that as ice sheets waned exposing new land that winds carried particulates (dust) some of which settled in alplands. In many places in B.C. volcanic ash fell producing a fine soil.

Life Above the Snowline and Life at the Snow/Soil Interface: Winter

In the dead of winter there is not much life in evidence above the snowline. Occasionally mountain goats may be seen breasting deep snow as they move over the alplands to forage in a new valley or birds such as ravens may fly by. As the snowpack melts however by early summer blown up by winter winds, pollen, twigs, leaves, soil particles and dust begin to accumulate on the snow surface. Cold and sterile as the surface may seem to be it becomes a habitat for some organisms: red, blue and green algae (Sphaerella spp.) "stain" the snow in some places and on sunny days dark coloured ice worms (true annelids) wiggle through the crystals of firn snow ingesting the sparse organic matter.

Under the snow at the interface with rock and snow it may be a different story. Snow is a good insulator and where snowpacks are thick the soil may rarely freeze or freeze deeply. Many plant species slowly grow and change in preparation for summer and rodents live and mate using food stored from summer. Where snowpacks are thin however, the soil below may freeze deeply.

Summer

Summer in the alplands is brief. All life in one way or another is tuned to that fact. On average the temperatures of day are cool and of night cold.

Strategies adopted by plants and animals to survive and reproduce are many. Opportunities for the naturalist/photographer are there to record but are missed. The struggles of animals and plants to establish, survive and reproduce are underfoot. How do plants use rocks for establishment and protection. How do plants and animals contend with unstable moving soils? How do they adapt to high light intensities and ultraviolet radiation? How do they reproduce vegetatively or by seed? Why are there no annuals? How do insects pollinate flowers where wind blows almost constantly?

Concluding Comment

Comparative features of the diverse mountain ranges have been omitted to favour brevity. Sufficient it may be to emphasize the special dynamics of alpland weather and substrate and to note how life tunes to it.