or their evident rarity. In addition, several species favouring settled areas were found, sparcely, in the Hemp Creek valley but are excluded from the keys.

Soredia are usually white, powdery masses produced by many lichen species. Isidia are minute, fingerlike or coralloid outgrowths particularly characteristic of several foliose lichens.

General Key

1 (8) Distinctly fruticose (without definite upper and lower surfaces), much branched, with cylindrical or angular branches.

2 (3) Bright yellow, branches rather coarse, short, and stiff with rough surface; scattered in all the wooded zones. - Letharia vulpina.

3 (2) Blackish, brown, grey or green, more finely branched.

4 (5) Branches with white, tough, central cord (conspicuous when a branch is stretched), green, sorediate, forming tufts rarely exceeding 2 in. in length; scattered valley floor species. - Usnea cfr. glabrata.

5 (4) Branches without any tough central cord, often not green.

6 (7) Forming loose tufts with short (not exceeding one inch), stiff, clearly flattened, ash-grey, and sorediate branches; rare species of valley floors (Helmcken Falls). - Ramalina cfr. farinacea.

7 (6) Branches usually longer, softer and finer, usually more or less cylindrical, often not grey.
- Alectoria (+ Ramalina thrausta), see spec. key 1.

8 (1) Foliose (with definite upper and lower surfaces), usually distinctly flattened.

9 (10) Lobes fairly broad, upper surface almost black, below densely clothed with very short grey hairs; rare species of aspen and poplar trunks. - Leptogium saturninum.

10 (9) Upper surface not black or the species is very narrow-lobed.

11 (12) Light-brown, more or less erect, stiff and resembling fruticose species (upper and lower surfaces poorly differentiated); at bases of subalpine shrubs (especially Rhododendron albiflorum) and common on ground in subalpine meadows. - Cetraria subalpine.

12 (15) Sulphur-yellow, small (less than one inch in diameter).

13 (14) With marginal soredia, apothecia absent. - Cetraria pinastri.

14 (13) Without soredia, conspicuous blackish apothecia always present. - Cetraria canadensis.

15 (12) Not sulphur-yellow.

16 (19) Lobes often one inch broad, clearly ridged, brown, and truncate.

17 (18) Soredia or isidia on prominent ridges on the upper surface; common in rich forests below subalpine zone. - Lobaria pulmonaria.

18 (17) Similar but lacking soredia and isidia; sparsely found at tree bases at Murtle Lake, also on ground in alpine and subalpine zones. - Lobaria linita.

19 (16) Lobes smaller, ridgeless or less ridged, often rounded.

20 (23) Lobes 0.5-1 cm. in breadth, lower surface hairy, light-brown, upper surface dark-brown; less common species.

21 (22) Upper surface covered with numerous black isidia, lower surface clothed with long, light-brown rhizinae, marginal lobes short and indistinct; rare, in rich forests. - Sticta fuliginosa.

22 (21) Upper surface rather smooth with scattered, flattened isidia, lower surface with dark-brown rhizinae in the central parts; less common, in rich forests. - Nephroma helveticum var. sipeanum.

23 (20) Lobes more or less radiated, narrow (usually 0.1 - 0.3 cm. in breadth) and long, lower surface black in most cases, upper surface grey or brown; includes many common species. - Parmelia + Parmeliopsis + Cetraria + Physcia, see spec. key 2.

Special Keys

1. Alectoria (+ Ramalina thrausta)

1 (6) Green to gray

2 (3) Green, extreme tips of the branches black (use hand lens!), main branches often coarse, soredia absent. - Alectoria sarmentosa.

3 (2) Gray or greenish, extreme tips of branches not black, main branches not particularly coarse.

4 (5) Light-gray to greenish, finely branched, main branches clearly angular, extreme tips usually curved and with white soredia;

common in rich lowland forests. - Ramalina thrausta.

5 (4) Ash-gray, delicately branched, branches cylindrical, soft, without soredia; infrequent species of valley floor forests. - Alectoria implexa.

6 (1) Dark-brown to blackish.

7 (8) Stiff and prostrate at basal parts, not very densely branched, branches olive-brown, somewhat shiny, cylindrical, and divergent, white soredia frequent; common. - Alectoria "chalybeiformis".

8 (7) Not clearly prostrate, usually densely branched, branches often angular, dull or lax, soredia infrequent.

9 (10) Reddish-brown, dull, rather stiff, branches angular, apothecia not uncommon, with ciliate margins; abundant in subalpine zone. - Alectoria oregana.

10 (9) Not distinctly reddish, softer, most branches more or less cylindrical, apothecia extremely rare.

11 (12) Blackish-brown, not very shiny, main branches rather thin and little differentiated; common. - Alectoria jubata.

12 (11) Chestnut-brown to blackish-brown, usually very shiny, main branches thick, pitted, and twisted, rarely with yellow soredia. - Alectoria fremontii.

2. Parmelia, Parmeliopsis, Centraria, and Physcia

1 (14) Upper surface brown or black.

2 (3) Lower side with rhizinae; infrequent species of hardwood trees. - Parmelia olivacea.

3 (2) Lower side naked, rhizinae absent.

4 (5) Upper side partly gray or only light-brown, with rather narrow lobes; common in subalpine zone. - Parmelia austerodes.

5 (4) Upper side intensely brown.

6 (7) Margins of lobes with long ciliae, lobes broad; rare. - Cetraria ciliaris.

7 (6) Lobes without ciliae.

8 (9) Margins of lobes with gray granular soredia, lower side pale brown; common. - Cetraria scutata.

9 (8) Soredia absent.

10 (11) Both sides black or black-brown; rare species of lodgepole pine forests. - Cetraria merrillii.

11 (10) Both sides usually light-brown.

12 (13) 0.5 - 2 inches in diameter, lobes broad, wrinkled, not much ascending, apothecia not very numerous; scattered on conifers. - Cetraria platyphylla.

13 (12) Usually less than 0.5 inches in diameter, lobes smooth, narrow, and ascending, with numerous apothecia; rare. - Cetraria sepincola.

14 (1) Upper surface gray to yellowish.

15 (20) Lower side with rhizinae.

16 (17) Lobes somewhat convex, narrow (not exceeding 1 mm.); infrequent, only on aspen or poplar. - Physcia aipolia.

17 (16) Lobes flat or a little concave, broader; common on conifers.

18 (19) Upper side with white cracks, which produce soredia, lobes 1 - 5 mm. broad; common. - Parmelia sulcata.

19 (18) Upper side with short, chiefly marginal, isidia, lobes narrower; on Abies in hemlock zone, fairly common. - Parmelia saxatilis var. divaricata.

20 (15) Lower side without rhizinae.

21 (28) Rather coarse and often loosely attached to the substrate.

22 (23) Lobes flat, broad (0.5 - 1.5 cm.), usually with irregular, marginal, gray soredia and isidia; common. - Cetraria glauca.

23 (22) Lobes somewhat inflated, hollow, and narrow (0.1 - 0.8 cm.).

24 (25) Soredia absent, lobes often 0.5 - 0.8 cm. in breadth; common. - Parmelia enteromorpha.

25 (24) Soredia present in limited patches at the ends of the lobes, lobes narrower.

26 (27) Soredia on the lower sides of inflated spoon-like formations at lobe tips; common. - Parmelia physodes.

27 (26) Soredia on the upper sides of cylindrical lobe tips; infrequent. - Parmelia tubulosa.

28 (21) Small, almost crustose, tightly attached to the bark; forming extensive covers on tree stems, especially in the subalpine zone.

29 (30) Yellowish-gray. - Parmeliopsia ambigua.

30 (29) Ash-gray. - Parmeliopsis hyperopta.

3. Notes on the major macrolichen species

FRUTICOSE LICHENS

Alectoria jubata

Taxonomically this species is a great mess. Recently Motyka (1958) split *A. jubata* into several species, some of which are very poorly defined. In any event, in the present study area the species is probably fairly uniform.

It is commonly found on conifers throughout the park, but it attains the greatest abundance in the upper subalpine zone. Its ecological amplitude is wide. For instance, it seems to be most shade-tolerant *Alectoria* in Wells Gray Park, if the rare *A. implexa* is omitted. In collective sense *A. jubata* is a common, circumpolar, boreal species.

Alectoria "chalybeiformis"

This form, closely related to *A. jubata*, is obviously a distinct species, but the epithet *chalybeiformis* does not seem to be correct, but belongs to a European type, which grows on shore rocks and birch trees. Following Howard (1950), the name *A. chalybeiformis* is tentatively used here. British Columbia speciments of this species and of *A. jubata* have been sent to the Polish specialist, Dr. Jozef Motyka, for identification, but he has not completed this work yet.

A. "chalybeiformis" is very abundant in the subalpine forests, being concentrated to the lower parts of the trees. In the hemlock zone it seems to be less abundant. It does not withstand dense shade.

Alectoria fremontii

This species was reported by Edwards et al. (1960) to occur in all wooded elevations in Wells Gray Park. They stated that it is scarce or absent at those levels on trees which A. sarmentosa frequents, while it is common immediately above this level. Furthermore, A. fremontii was not found by them to invade tree tops as successfully as A. jubata s. lat., which was therefore considered to be more xerophytic. Generally A. fremontii is less abundant than A. sarmentosa and A. jubata in the park according to their observations. Szczawinski (1953) stated that on Vancouver Island the present species is confined to the most open and driest sites, being even found at the bases of tree stems (this was also noted by the present author at the Little Qualicum Falls, V.I.).

Ahlner (1948), who has extensively studied the distribution and ecology of this species in northern Europe, states that it is present in both continental and oceanic areas, but generally avoids districts with long and warm summers. However, in Scandinavia its most typical habitats are continental, open and dry Scots pine forests, which greatly resemble the lodgepole stands in Wells Gray Park, but which are more permanent climax stages in Europe. In spruce forests it is also found, though less abundantly.

A. fremontii is only distributed (cf. Howe, 1911, Ahlner, op. cit.) in northern Europe and western North America (Alaska, B.C., Alta., Wash., Ida., Mont., Ore., Wyo., Calif.). There may be some slight morphological differences between the populations of the two

separate areas, as, for instance, the more sparse occurrence of yellow soredia in North America (Ahlner, op. cit.), but they are ill-defined. The North American population also seems to be more eurytopic in its ecological requirements. So it is sometimes found to be very abundant in fairly dense forests in Wells Gray Park, which would be very strange in Europe.

But even in Wells Gray Park A. fremontii is usually the most abundant species in lodgepole pine forests (in particular in old stands), and probably at all levels on pine trees, although Edwards et al. (1960) for some reason reached a more or less opposite result in their single sample plot in pine forest. Also, A. fremontii is perhaps the most abundant species in upper portions of all kinds of conifers in the park. This is not necessarily always the case, but several tops of fallen or wind-broken trees were examined and all of them proved to be dominated by the present species. Assessments with binoculars also seemed to offer evidence for this statement. The discrepancy between the observations by the writer and by Edwards et al. (op. cit.) might be explained by differences in delimitation of the species. Especially young and dark, finely branched threads of A. fremontii are extremely difficult to distinguish from A. jubata, as has also been pointed out by the certainly reliable Swedish authority on this species, Dr. Ahlner (1948). Extremely plastic phenotypes are typical of many lichen species.

In any event, the writer agrees with Edwards et al. in the fact that in lower elevations A. fremontii is not generally very abundant on lower twigs of trees, being frequently totally absent on them.

Alectoria sarmentosa

The abundance of this conspicuous species in the park has been emphasized by Edwards et al., although it is mainly confined to lower branches of trees in the hemlock zone, being scarce near timberline.

The general distribution of A. sarmentosa is suboceanic in character (cf. Howe, 1911, Ahlner, 1948). In western North America its known range extends from Alaska down to California and westwards to Alberta. In the east it is distributed from Labrador to New England, but is not known with certainty in the interior of the continent. In Europe it is also present, but no reliable reports are available from Asia.

In northwestern Europe the optimal range of A. sarmentosa is situated in districts with comparatively cool summers (mean temperature of July below 15°C) and in habitats with fairly high humidity of air (Ahlner, 1948 p. 114). However, its ecological amplitude is wide.

In Wells Gray Park A. sarmentosa is abundant in the hemlock zone and locally in the lower subalpine zone, while in the upper subalpine zone it is hardly ever abundant though very frequent.

It prefers spruce and fir species all over its range, being particularly characteristic of their dead, thin, lower twigs. It is especially plentiful on entirely dead trees, often forming great masses on their lower branches. On pine trees it is also common and the individuals may grow large, but seldom does it attain any great abundance on them. The same is true with cedar and hemlock, which, however, may

carry heavy loads on upper branches, inaccessible to caribou.

A. sarmentosa is more hygrophilous and shade-tolerant than A. fremontii. However, its most favourable habitats seem to be in rich lakeshore forests, where humidity is constantly high and a lot of light is available at the same time. Thus on Diamond Lake (south-western end of Murtle Lake) this species usually rises up to 55 - 60 feet on trees in a moist forest site type, while on drier sites it only reaches about 25 feet. In the valley floor between Hemp Creek and Dawson Falls 60 feet is attained everywhere on fresh or moist sites. In the best lakeshore habitats of the lower subalpine zone (Stevens Lakes) the upper limit of A. sarmentosa is at 40 ft., while generally in the subalpine forests this lichen is only found up to 20 - 30 ft. In very thick forests it does not thrive on lower branches at all, but in Wells Gray Park it is almost always present in some quantity within the reach of caribou.

As mentioned below under Ramalina thrausta, that species and Alectoria sarmentosa were not separated by Edwards et al. (1960).

Alectoria oregana

Little information is available of this reddish-brown species. Indeed, Howe (1911) compiled a map of its distribution, showing that it is a western North American species ranging from California to B.C. and westwards to Alberta and Montana. It seems to be preferably a subalpine species. In Wells Gray Park it is very abundant in the upper subalpine zone, forming mass vegetation on twigs. Below the sub-

alpine forests it is absent or very rare. Its upper limit on trees was not studied in detail, but scattered observations indicate that it may be confined to comparatively low levels. It is probably a little more photophilous than A. jubata and A. "chalybeiformis", being therefore most abundant at edges of subalpine meadows.

Ramalina thrausta (Alectoria thrausta)

This species resembles Alectoria sarmentosa very much, but is usually readily distinguished by its paler color and presence of soredia. Edwards et al. (1960) included R. thrausta with A. sarmentosa. In their sample plot no. 1 R. thrausta was more abundant, though A. sarmentosa was also present, as confirmed by the writer in the field. In the rest of their plots the greenish lichen was exclusively or mainly A. sarmentosa.

R. thrausta is a more or less circumpolar, boreal species, which prefers continental territories (Ahlner, 1948). In large areas it is not very common and therefore its distribution is rather poorly known.

In Wells Gray Park R. thrausta is common and even abundant in many places in the hemlock zone in both the Clearwater Valley and Murtle Lake areas. It was not found in the subalpine zone. Everywhere, but particularly in the Murtle Lake district, the species is restricted in low levels on trees, lower than A. sarmentosa. In the Murtle Lake area it hardly grows higher than 10 ft. above the ground. It occurs both on branches and trunks, even on cedar stems in very shaded forests, where the Alectoria species are scarce.

Ahlner (1948) states that also in Scandinavia R. thrausta has a narrower ecological amplitude than A. sarmentosa. There R. thrausta is almost always found in fresh, fairly shadowy spruce forest sites. It strictly avoids pine trees as substrate. In suitably damp and dense, old spruce forests it often forms heavy cover on twigs. In more open forests it is weak in competition with A. sarmentosa.

Letharia vulpina (Evernia vulpina)

This conspicuous bright-yellow species occurs in Wells Gray Park from the valley floors up to the timberline forests. However, its optimal habitats seem to be in ponderosa pine forests in more arid districts. Therefore, it is not normally very abundant in Wells Gray Park.

L. vulpina is a clearly photophilous species and in the park it grows most abundantly in lodgepole pine stands, on stumps and snags in burns, and on solitary trees or in small tree stands at the edges of subalpine meadows and at timber-line. In the upper subalpine zone it may attain considerable size (4 - 5 inches in length).

Outside western North America L. vulpina is only found in western Eurasia, being, however, distinctly continental in habitat requirements (Ahlner, 1948).

In Scandinavia this species was once much used for killing wolves and foxes, for the yellow substance, vulpinic acid, is highly poisonous.

FOLIOSE LICHENS

Foliose lichens have generally low palatability for caribou. In Wells Gray Park only Cetraria glauca may be of importance. The other common or conspicuous species listed are apparently utilized to a very limited extent.

Lobaria pulmonaria (Sticta pulmonaria) is restricted in the hemlock zone, being common both around Murtle Lake and in the Hemp Creek area. It prefers old, shaded and damp forests and is confined to the lowest twigs of various conifers. However, its local distribution is spotty, so that it is not found in every suitable looking locality. It often forms pure luxuriant covers on twigs, but does not usually exceed 10 ft. above the ground.

L. pulmonaria is probably a circumpolar, boreal species in general distribution.

Cetraria glauca (Platysma glaucum)

This bluish-gray species is extremely common and usually the most abundant foliose lichen in the coniferous stands of the hemlock zone in Wells Gray Park. In the subalpine zone it is scattered and rarely abundant.

The general distribution of Cetraria glauca shows boreal and oceanic tendencies. It is abundant in the coastal provinces of northeastern and northwestern North America, but rare or absent in the interior (e.g. in Ontario).

C. glauca has a wide ecological amplitude, but it attains greatest abundance in strongly to moderately shaded fresh spruce or fir firests, climbing fairly high up towards the tree crown.

Cetraria scutata (C. chlorophylla)

This brown species is common but scattered on twigs throughout Wells Gray Park. In North America it is only found in the western provinces and states.

C. scutata is present in all kinds of forests, but prefers rather open stands and seems to be most frequent in lodgepole pine forests. However, it is never very abundant, though some individuals attain about two inches in diameter.

Parmelia physodes (Hypogymnia physodes)

A very common circumpolar boreal-temperate species with wide ecological amplitude. In Wells Gray Park it is found on most of the mature individuals of trees, being frequently abundant, but also scarce in many cases. It favours open woods rather than shaded ones.

Parmelia enteromorpha (Hypogymnia enteromorpha)

Another very abundant species, which is usually even more plentiful than P. physodes. However, it is a western species in North America, also occurring on the Asiatic side of the northern Pacific coasts. It is taxonomically somewhat involved (cf. Imshaug, 1957), but there is only one common type in Wells Gray Park.

P. enteromorpha prefers rather open woods, and on fresh sites attains a good size (4 - 5 inches in diameter) being then easily browsed by caribou.

Parmelia austerodes (Hypogymnia austerodes)

A common species in the subalpine forests, though less abundant than P. enteromorpha and P. physodes. It was also found in the Murtle Lake area in the upper hemlock zone. It is a northern circumpolar species with continental tendencies. It is most common in woods with cold winters.

Parmelia sulcata

This is a very common circumpolar boreal-temperate species. However, in Wells Gray Park it is less abundant than in many other coniferous territories, though it is frequent even there. It finds its optimal habitats in moderately damp, rather open woods, being particularly characteristic of forests on riverbanks and lakeshores. In some other districts it is one of the typical species of birch trees.

VI. ABUNDANCE OF EPIDENDRIC LICHENS IN VARIOUS FORESTS

1. Tree species as sites for epidendric lichens

The physical and chemical qualities of the host trees, the phorophytes, of the epiphytic cryptogams are not the same in each tree species.

In Barkman's (1958 p. 139) division all the coniferous trees of Wells Gray Park seem to belong to his Group I, although he did not classify the North American phorophytes. The bark of the trees in this group is characterized by low total electrolyte concentration, low buffer capacity, low phosphate content, low pH, low water capacity and presence of resin and tannin. The type of crown is centrifugal, so that the trunk epiphytes receive only small amounts of precipitation.

The group has three subdivisions (op. cit.). Subdivision a. apparently includes Abies lasiocarpa, Picea engelmannii, P. glauca, and Tsuga heterophylla. Their common properties are obviously fairly smooth bark, its low rate of scaling, its higher pH (dead bark about 4 - 4.5) than in most trees of the Subdivision b, and small amount of light transmitted by the dense evergreen crown, which makes the whole forest site very shady.

The Subdivision b. (op cit.) includes Pinus contorta, P. monticola, Pseudotsuga menziesii, Thuja plicata, and Betula papyrifera. The scaling rate of their bark is higher, pH lower (about 3.5 - 4; in

Thuja probably higher), surface rough, and the crown smaller and less shading than in the preceding subdivision.

In the Subdivision c. (op. cit.) there are alder and oak species, and in the other two Groups remaining hardwood genera, all of which are without interest in this connection.

Below all of the important trees in Wells Gray Park are listed with notes on their facilities to carry fruticose and foliose lichens accessible to caribou in the park.

Subalpine Fir (Abies lasiocarpa)

Living branches usually reach down close to the ground and almost always many dead twigs are present within 10 ft. from the ground. In the subalpine zone the amount and branchiness of the twigs is clearly higher than in the hemlock zone (Murtle Lake).

The Bark does not scale much at all and therefore foliose and sometimes also fruticose species are abundant on stems.

An important fact is the common occurrence of dried-up fir trees. The Murtle Lake and the Hemp Creek areas have many dead fir trees, and they are also frequent in the subalpine zone. On the other hand, young subalpine firs are very abundant in all zones. A comparatively short life span seems to be characteristic of this tree in the park, as elsewhere (Sudworth, 1908, Hartman, 1957). Dead standing trees offer excellent habitats for fruticose lichens.

Subalpine fir is no doubt the best tree for both fruticose and foliose lichens in Wells Gray Park.

Engelmann Spruce (Picea engelmannii)

Often this species has a tall, branchless lower bole, but in the subalpine zone, however, it frequently has a fair number of dead twigs within 10 ft. from the ground. The living twigs are not as near the ground as in the subalpine fir. Even in fairly small trees (20 ft. in height) in the Murtle Lake area dead twigs are common.

Dried-up spruces are not common. Young trees are much less frequent than mature ones in both the hemlock zone and the subalpine zone, especially the latter.

The bark is somewhat faster scaling than in the subalpine fir.

Engelmann spruce is rather abundant both in the subalpine forests and in the hemlock zone.

The local white spruce (Picea glauca), hybridizing with the Engelmann spruce in the valley floor forests, but mainly absent in the upper elevations, does not essentially differ from Engelmann spruce in producing lichens.

Lodgepole Pine (Pinus contorta var. latifolia)

In middle-aged (50 - 70 years old) stands lichens may attain considerable abundance at lower levels thanks to a great number of dead twigs in this period. Old trees have a long, bare, effectively scaling trunk, where few lichens are able to grow.

Lodgepole pine usually grows in almost pure stands, but is not particularly abundant in the park. In the subalpine zone pine stands were seen only at Stevens Lakes.

Western White Pine (Pinus monticola)

This species is not common in Wells Gray Park. A few stands were observed in the Murtle Lake area and on the Fish Lake Hill road. It is a very poor tree for growth of lichens. In mature trees there are usually no twigs at lower parts and the bark is strongly scaling.

Douglas Fir (Pseudotsuga menziesii var. glauca)

A poor tree for lichens, resembling the pine species. The young trees have an extremely smooth bark, unfavourable for the attachment of lichens and the twigs are strongly shading. In old trees the lower trunk has no twigs at all. The tops of tall trees often carry heavy loads of lichen, but they grow very sparsely on lower levels.

Douglas fir is common only at lower elevations in the park. Within the present caribou range it was seen only in the Murtle Lake area.

Western Red Cedar (Thuja plicata)

Red cedar is an abundant tree in the virgin forests surrounding of Murtle Lake, Azure Lake, Clearwater Lake, and Hemp Creek. However, it is a poor tree for lichen growth.

Young cedars often form thick bush in shaded places (also on shorelines), being almost completely devoid of fruticose lichens. Old trees seldom have branches near the base. However, dying young

trees usually possess dead lower twigs supporting some kind of lichen cover that is occasionally abundant.

The physical and chemical properties of cedar bark differ considerably from those of the other trees. A few crustose lichens specific to cedar are common, while the black Alectoria species seem to be less abundant on this tree than on the others.

Western Hemlock (Tsuga heterophylla)

Although the pure hemlock stands are not particularly densely stocked, their foliage is so shading that this factor alone makes such stands poor lichen forests. In addition, old trees are not rich in twigs and lichens except in their upper levels. Even the young trees have very scanty lichen covers.

Hemlock seems to be a rather slowly growing tree in the area, but is dominant in old climax stands on dry or fresh sites. Such forests were observed on the North Arm and the south shore of Murtle Lake, on Azure Lake, and on the Fish Lake Hill road.

Hardwood Trees

The hardwood species present, Betula papyrifera, Populus trichocarpa, P. tremuloides, Acer glabrum, Alnus tenuifolia, A. sinuata, and Salix scouleriana are generally very poor sites for fruticose lichens. In Wells Gray Park even foliose lichens are not very pleniful on these trees.

2. Sample plot analyses

The data collected from the sample plots are presented in

Appendix III. Notes on site type and its fertility are excluded, since the abundance of lichens seems to be essentially dependent upon the density and species of tree cover rather than directly upon the site. The composition of tree stand usually also gives indications of the site type.

Upper Subalpine Zone

The number of trees is rather high, the stem number class being from 2 to 5. Even very high numbers are sometimes reached. Nevertheless, the stands are rather open, since the trees are not equally distributed at all, but are usually growing in almost impenetrable clumps. Crown canopy is thus 20 to 50 per cent in most cases. Solitary trees and tree groups smaller than the sample plot are normally present at the edges of subalpine meadows and at alpine timber-line.

Subalpine fir and Engelmann spruce are the only tree species. The former is less long-lived than the latter and therefore the biggest trees are spruces, while the fir is more numerous and more important as to lichen loads. The fir is also rich in twigs (classes IV - V).

Fruticose lichens are abundant on twigs at both lower levels (cover usually 30 - 70 per cent) and on crowns. Foliose lichens are rather scarce (cover usually 5 - 20 per cent).

Alectoria oregana, A. chalybeiformis, A. jubata, and A. fremontii are constant and abundant species with varying cover degrees. A. sarmentosa is sparse. Letharia vulpina is occasionally abundant.