THE LICHENS OF

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THE COASTAL DOUGLAS-FIR DRY SUBZONE

OF BRITISH COLUMBIA

by

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Willa Jane Noble, 1982

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ABSTRACT

Lichenological studies in western North America have lagged behind those of eastern North America and Europe. Several manuals, now mainly outdated, are available for the western United States; no descriptions or keys have ever been compiled for the British Columbia lichen flora. This flora of the Coastal Douglas-fir Dry Subzone in British Columbia, Canada, partially fills this void.

The Coastal Douglas-fir Dry Subzone is a small area in the southwestern portion of the province composed of a narrow strip on the eastern side of Vancouver Island and the adjacent Gulf Islands in the Strait of Georgia. It is a unique area in the province with a Mediterranean-type climate. It also has a large and increasing human population. Most of the subzone has been logged once although second growth forests now cover much of the region not utilized by the human population.

The lichen flora is based primarily on 5,500 specimens collected for this study. In addition, some minor herbarium collections, including later collections of John Macoun, are also included. A total of 448 species in 114 genera, including 26 species from adjacent zones are treated. Keys and concise descriptions are provided plus information on substratum preferences, abundance within the subzone, and taxonomic problems. Spore diagrams are supplied for many of the crustose genera, especially those with septate or muriform spores.

One species new to science already has been published, <u>Gyalideopsis</u> <u>alnicola</u> Noble & Vězda, and several others are to be described in future publications. One new combination has already been made, <u>Catillaria</u> <u>columbiana</u> (Merr.) Noble, and two others, <u>Lecanora ochrococca</u> (Nyl.) Noble and <u>Arthothelium macounii</u> (Merr.) Noble, will be published in a forthcoming checklist of the province. <u>Lecanora phaeobaea</u> Tuck. has proved to be synonymous with <u>Lecanora ochroccoca</u>, and <u>Solenospora hassei</u> (Zahlbr.) Zahlbr. with Lecania dudleyi Herre.

Ninety-six species new to British Columbia were encountered, primarily among the microlichens. Ten genera were added to the provincial checklist.

A first assessment of many taxonomic problems was made and others noted. Type specimens of many poorly known California species were examined for confirmation of identification: of the local collections. Some difficult genera require monographic treatment before the local flora can be treated any more than tentatively.

Local distributions within the subzone are discussed. Eight patterns are distinguished reflecting frequency, climate constraints, substratum restrictions, and human influences. Oceanic distributions make up several distinctive patterns including marine oceanic, strictly oceanic (non-marine) and hyperoceanic.

An analysis of the world distributions of the species composing the local flora showed that the majority are very widespread with an essentially continuous range. Twelve different elements are recognized. Important elements include the circumboreal element (31%), the western North American endemic element (18%), the circumtemperate element (12%), the western North America-Europe disjunct element (11%), and the western North Americaeastern North America-Europe disjunct element (8%). Eastern Asia, despite its relative proximity, has only minor affinities with the local flora.

This study is a preliminary flora of the lichens of the Coastal Douglas-fir Dry Subzone. It provides a manual to encourage others to look at these poorly known cryptogams; it also acts as the foundation for future work. iii

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PART III:	DISCUSSION
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PART I:

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INTRODUCTION AND METHODS

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INTRODUCTION

General

Lichenological studies have lagged behind those of many other plant groups in western North America as well as behind lichenological research in Europe and eastern and southwestern United States. Several manuals, now mainly outdated, are available for the western United States, including Alaska. No descriptions or keys have ever been compiled for the British Columbia lichen flora. This study was undertaken to provide a modern treatment for the lichens of a small, unique area of the province. This flora, sadly, is quickly disappearing as a result of human pressures. The study had five principal aims: (1) to make a comprehensive analysis and collection of the lichen flora of the Coastal Douglas-fir Dry Subzone, (2) to prepare keys and descriptions to the species from this area, (3) to discern local distributions of individual species, (4) to analyze the phytogeographic affinities of the species involved, and (5) to elucidate taxonomic problems concerning controversial taxa in the area.

Originally, a larger study area was proposed that included also the San Juan Islands of Washington to the southeast and the Sunshine Coast area of British Columbia to the east. Time limitations, access problems, and most particularly a larger than expected number of species in the initial study area resulted in the exclusion of these regions. Similarly, original plans called for more detailed ecological studies that the large flora also defeated. This investigation is, therefore, essentially taxonomic and floristic.

The present treatment is by no means exhaustive. Many inherent taxonomic problems, rare species, unidentified sterile crustose material, and

additions from the outlying areas mentioned above will make corrections and additions necessary in the future. Only lichenized ascomycetes are treated; lichenized basidiomycetes are not included. In many respects this is a preliminary flora to the lichens of the Coastal Douglas-fir Dry Subzone. It makes a first assessment of those taxonomic problems and endeavours to provide the foundation for their eventual clarification or solution.

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History of Lichenological Studies

The first information concerning the lichen flora of the Coastal Douglas-fir Dry Subzone was acquired almost 200 years ago with the collections of Archibald Menzies, a physician-botanist accompanying Captain George Vancouver in 1792. In the vicinity of what is now Victoria, Menzies collected <u>Cetraria juniperina</u> (L.) Ach. (now <u>C</u>. canadensis (Räs.) Räs.), Cetraria lacunosa Ach. var. stenophylla Ach. (= Platismatia stenophylla (Ach.) Culb. & C. Culb.), Evernia prunastri (L.) Ach., Evernia vulpina (L.) Ach. (= Letharia vulpina (L.) Hue), Parmelia perforata (Jacq.) Ach. (probably P. arnoldii Du Rietz), Peltigera venosa (L.) Hoffm., <u>Pilophorus cereolus</u> Ach. var. acicularis Tuck. (= P. acicularis (Tuck.) Th. Fr.) and Umbilicaria angulata Tuck. (Newcombe & Forsyth, 1923). Later, in conjunction with surveys carried on by the North American Boundary Commission, Dr. David Lyall, surgeon-naturalist, visited the southeast coast of Vancouver Island and the islands in the Gulf of Georgia in the summer of 1858. Ostensibly he must have collected lichens in this area along with other plants, for upon returning to England he secured the services of Mr. William Mitten, A.L.S., for the arrangement and naming of his extensive collections of cryptogams (Lyall, 1864). However, an account of these was never published. Mueller (1889) reported eighteen species of macrolichens from the Victoria area collected by Dr. Julio Roell along with others reported for Oregon and Washington. Cooley (1892) reported Peltigera canina (L.) Hoffm. and Cladonia squamosa Hoffm. from Nanaimo.

The first major contribution concerning the lichen flora did not appear until the 20th Century with the work of John Macoun, explorer-naturalist and later botanist to the Geological and Natural History Survey of Canada. He collected primarily in the Victoria area but also along the east coast of Vancouver Island to Comox, west to Ucluelet, and also on Saltspring Island. These collections, with additional material from the lower mainland, published in the Catalogue of Canadian Plants (Macoun, 1902), long served as the principal basis for the knowledge of lichens in British Columbia. Macoun's list includes both macrolichens and crustose species. He reported over 105 taxa from the Dry Subzone; an additional 25 taxa are reported for nearby Comox in the Wet Subzone. Macoun initially enlisted the aid of Prof. E. Tuckerman for the identifications and subsequently Dr. Eckfeldt and Rev. J. S. Deichmann Branth. Unfortunately the localities of Macoun's early collections are often inaccurate, and must be treated with some caution. His exsiccata, Canadian Lichenes, which includes some numbers from this area, has been more or less disregarded since, in some cases, numerous localities are included on a single label and there is an inconsistency of specimens in the packets (Brodo & Hawksworth, 1978). Among his general collections printed labels are often altered by handwritten notations and paradoxical date-locality combinations are frequent. These same problems have been pointed out concerning his hepatic collections from southwestern British Columbia (Godfrey, 1977a). For a large scale regional flora, most of Macoun's early collections would be acceptable, but for the study of a single subzone it seems more prudent to disregard these specimens.

After his retirement to Sidney on Vancouver Island in the early 1900's John Macoun devoted much of his time to the study of cryptogams, including lichens. These later collections are more interesting and reliable than his early ones. Taxonomically difficult specimens were referred to G. K. Merrill who published four species new to science from these submissions - <u>Lecanora atrosanguinea</u> (= <u>Caloplaca atrosanguinia</u> (Merr.) Lamb), <u>Biatora columbiana</u> (= <u>Catillaria columbiana</u> (Merr.) Noble), <u>Arthonia</u>

<u>macounii</u> (= <u>Arthothelium macounii</u> (Merr.) Noble, ined.), and <u>Xylographa</u> <u>micrographa</u> (status uncertain). Most of his later collections were donated to the British Columbia Provincial Museum in Victoria and eventually were deposited at UBC on extended loan. Some specimens may also be found at CANL and FH (Merrill's types). (For standard abbreviations of herbaria see Holmgren and Keuken, 1974.)

After Macoun's death there was a lapse of over forty years before any additions to the lichen flora of the Coastal Douglas-fir Zone occurred. These were primarily incidental to the ecological investigations of V. J. Krajina and his students (Krajina, 1959, 1965; Krajina & Spilsbury, 1953; McMinn, 1960; Mueller-Dombois, 1959; Szczawinski, 1953). Much of this work was done in the Nanaimo River Valley, primarily in the Wet Subzone. Unfortunately, very few voucher specimens were deposited at UBC in support of these reports.

In more recent times the Thetis Park Nature Sanctuary Association (1974) published a report of 53 taxa, mainly macrolichens, from Thetis Lake Park near Victoria. Roemer (1972) included an appendix of 35 lichen taxa, some named only to genus, with their abundance and fidelity to rock microhabitats in Quercus associations.

Many lichenologists including T. Ahti, I. M. Brodo, A.W. T. C. Herre, I. Kärnefelt, P. M. Jørgensen, and L. Tibell, and other collectors including C. D. Bird, W. F. Savale, Jr., and W. B. Schofield (specimens of the latter two at UBC) have collected in the study area. Only Herre (1957) has published on his collections.

In 1973 the first major lichenological work since Macoun was published from the area, specificially Saltspring Island (Bird & Bird, 1973). This report included 199 taxa including many crustose species. Substratum relationships of the species were also examined. Many authentic new

reports for the province are found in this work although there are many obvious misidentifications among the macrolichens. (Correction of these misidentifications are noted in the main body of the flora). Subsequent examination of their crustose species was not undertaken.

Only one recent report, <u>Lichens of British Columbia - Preliminary</u> <u>Checklist</u> (Otto & Ahti, 1967), has been available as a guide to the lichen flora of the province. This listed 569 species in 99 genera and, although covering all of British Columbia, its emphasis was on the southern part of the province. This checklist, and, to a lesser extent, the list of Bird and Bird (1973), served as the initial base for the present floristic work.

Outside the Coastal Douglas-fir Dry Subzone, but still within the province, Weber and Sushan (1959) reported 79 taxa collected by Dr. H. Persson in the Queen Charlotte Islands. Benton et al. (1977) listed 73 species plus substratum information from Bamfield Marine Station on the west coast of Vancouver Island. Ohlsson (1973) made a major contribution to the flora of the province with his <u>New and interesting macrolichens of</u> <u>British Columbia</u>. Ohlsson's collections came from the coastal region of the province but outside the study area considered here.

Beyond the province, and therefore of limited local application but still useful to various degrees, are other works, studies, and papers from western North America. To the south, important floristic work was conducted in California in the early 1900's by A. W. C. T. Herre and H. E. Hasse. Both men published many papers, but their most comprehensive were <u>Lichens</u> <u>of the Santa Cruz Peninsula</u> (Herre, 1910a) and <u>The lichen flora of southern</u> <u>California</u> (Hasse, 1913). Initially both researchers consulted the European specialists W. Nylander and A. Zahlbruckner, resulting in the publication of many species new to science, especially crustose species. Herre's ability to succinctly describe a simple, crustose lichen was particularly

appreciated during the present study. Recently Tucker and Jordan (1978) published a <u>Catalog of California Lichens</u> (based on literature reports) which is an excellent bibliographic source for Herre's and Hasse's many small papers.

Useful papers from Oregon and Washington have included Merrill (1914), Herre (1917), and Howard (1955) from Washington and Gyelnik (1932, 1934a), Sipe (1939, 1943), and Pike (1973) from Oregon. Pike's paper, <u>Lichens and</u> <u>bryophytes of a Willamette Valley oak forest</u>, has been particularly useful in the current study. Howard (1950) published <u>The lichens of Washington</u> <u>State</u>. It treated 335 species and is now largely outdated. Magnusson (1932, 1935a, 1935b, 1939a, 1944a, 1947a, 1954) concentrated heavily on western North America, especially California, Oregon, and Washington, publishing many new species from these areas.

North of British Columbia two large treatments of the lichens of Alaska have been published by Cummings (1904) and Krog (1968). The former is now outdated, while Krog's work, <u>The macrolichens of Alaska</u>, is very useful, with current distributional and chemical information, although it lacks keys and descriptions. Nylander (1888) also published one large important paper concerning coastal Alaskan lichens; but this requires to re-examination.

DESCRIPTION OF THE STUDY AREA

Location

The study area is located in the southwestern portion of British Columbia, Canada. It lies between 48° 17'N. Latitude and 49° 37'N. Latitude and between 123° 10' W. Longitude and 124° 52' W. Longitude.

It consists of a narrow strip of land on the southeast coast of Vancouver Island from Rocky Point in the south, narrowing as it extends northward almost to Fanny Bay, and includes the adjacent Gulf Islands. Denman Island and Hornby Islands are included in the north. The study area is almost 200 km long but only about 24 km wide at its maximum width between Cowichan Bay and Mayne Island. It encompasses approximately 1700 sq. km with about 25% of that area representing the Gulf Islands and 75% the adjacent strip on Vancouver Island. This is the approximate extent of the Coastal Douglas-fir Dry Subzone in British Columbia. The area is illustrated in the accompanying map (Figure 1) that includes also important geographical and topographical place names.

To provide familiarity with this region the climate, physiography and geology, vegetation, human history and land use, and lichen habitats are discussed briefly.

	Is	lands	Mou	ntains and Hills 🔺
	1	Denman I.	33	Bear Hill
	2	Discovery I.	34	Little Mt.
	3	Gabriola I.	35	Maple Mt.
	4	Galiano I.	36	Nancose Hill
	5	Hornby I.	37	Mt. Benson
	6	James I.	38	Mt. Erskine
	7	Kuper I.	39	Mt. Finlayson
	8	Mayne I.	40	Mt. Douglas
	9	Moresby I.	41	Mt. Galiano
]	0	North Pender I.	42	Mt. Geoffrey
]	1	Prevost I.	43	Mt. Maxwell
1	.2	Saltspring I.	44	Mt. Metchosin
]	.3	Saturna I.	45	Mt. Newton
1	.4	Sidney I.	46	Mt. Parke
1	.5	South Pender I.	47	Mt. Prevost
1	.6	Thetis I.	48	Mt. Sulivan
1	.7	Valdes I.	49	Mt. Taum
			50	Mt. Tzuhalem
2	it:	ies and Towns 🔿	51	Mt. Warburton Pike
1	.8	Chemainus	52	Woodley Range
1	.9	Comox	Riv	ers
2	20	Courtenay	53	Chemainus R.
2	1	Croften	54	Cowichan R.
2	2	Cumberland	55	Englishman R.
2	3	Duncan	56	Goldstream R.
2	4	Fanny Bay	57	Little Qualicum R.
2	5	Ladysmith	58	Nanaimo R.
2	6	Nanaimo	59	Oualicum R.
2	7	Parksville	a .1	~
2	8	Port Renfrew	Oth	<u>er</u>
2	9	Qualicum Beach	60	Rocky Point
3	0	Sidney	61 62	Cowienan Bay
3	1	Sooke	62	Colwood-Metchosin
3	2	Victoria	63	Highlands



Climate

The climate of the study area is classified as Csb according to the Köppen-Geiger system of climate classification. This is a warm, temperate climate with the mean temperature of the coldest month between -3° C and 18° C, the mean of the warmest month under 22° C but with at least four months having means over 10° C, and with a dry summer season (Strahler, 1969). Put simply, this is a mild, wet winter and warm, dry summer climate, a type of Mediterranean climate. In North America the Csb climate is found along the Pacific coast from Monterey, California, north to the Georgia Strait area of British Columbia. Day et al. (1959) stated that this is the farthest poleward advance of a true Mediterranean climate. Outside this continent the cool Mediterranean climate is found in small areas of Port-÷ ugal and Spain in Europe, Chile in South America, and the Cape area of South Africa. The adjacent and more widespread hot Mediterranean climate is found in southern California, southwest and southeast Australia, and extensively in lands bordering the Mediterranean Sea in Europe and Africa.

The temperatures of the study area are related to its latitude and modified by its proximity to the Pacific Ocean and the smaller straits in its vicinity. Therefore, summer temperatures are warm with locations closest to Georgia Strait, Haro Strait, and the Strait of Juan de Fuca, slightly cooler. The mean daily tempertature in July ranges from a low of 14° C at Victoria to a high of 18.6° C at Duncan. In winter the temperatures are cool but average above the freezing point. Locations closest to the Straits are slightly warmer. The mean daily temperature in January ranges from a low of 1.7° C at Denman Island (2.1° C at Duncan) to a high of 4° C at Victoria. Temperatures actually fall below freezing in the Victoria area on the average of 20 days per year (Forward, 1969).

The yearly distribution of rainfall is affected by the middle-latitude

cyclones in the wet months and the subtropical high pressure ridge in the dry months. The Pacific cyclones that move in a westerly direction across the Pacific Ocean are in full force from fall through spring. The moisture-laden air of these periodic storms rises and cools as it hits the British Columbia coastline and produces rain or snow. The Olympic Mountains and Insular Mountains of Vancouver Island receive most of this precipitation, creating a rainshadow to the east over the study area, particularly over the Saanich Peninsula. Rainfall along the unprotected western Vancouver Island coast is more than 250 cm per year, while rainfall in the Victoria area averages below 76 cm. Rainfall is highest from November to January with moderate amounts falling in the autumn and spring months. With some irregularities resulting from topography, the rainfall increases to the west and north (see Figure 2). Although the rainfall is much less than in western portions of Vancouver Island, there is a substantial moisture surplus in these winter months (Forward, 1969).

There are occasional outbreaks of cold polar air from continental North America during winter months that, combined with the cyclonic storms, may produce snow. Snow averages 30 cm per year in the Victoria area, increasing to the north (i.e. Denman Island, 104 cm), and west (i.e. Sooke area, 114 cm). Snow falls mainly in the months of December and January. However, the warmer ocean temperatures modify the cold air and snow never persists on the ground for long periods.

In July and August the subtropical high pressure ridge pushes north into British Columbia and effectively deflects some Pacific cyclones to the north. This reduces rainfall to less than 3 cm in the summer for the Victoria area, increasing to 6 cm in the north and west of the study area. This is the famous summer-dry climate of Georgia Basin (Kerr, 1952). The low rainfall combined with the warm, summer temperatures produces a moisture deficiency that parches the land. The possibility of fires often results in forest closures as well as the closing of public trails in the Capital Region District, especially during August.

Besides being dry the summers are, as might be expected, sunny. Victoria has the Canadian high, if the southern Prairies are excluded, of 2,200 hrs of sunshine per year. The yearly total of sunshine decreases slowly northward and rapidly westward of the Victoria area. Winters, as also might be expected from the amount of rainfall, are mainly cloudy. Fog occurs occasionally, primarily in the late summer or early fall as warm, moist air from Juan de Fuca Strait is cooled by colder water in the channels surrounding the Gulf Islands (Barker, 1974).



Physiography and Geology

Physiographic Outline and Topography

The study area falls within the Canadian Cordillera Region, one of five major physiographic subdivisions of Canada that accounts for almost 90% of the land area of British Columbia (Holland, 1976). Within the region there are three major systems or subdivisions all trending in a northwest direction. The study area falls within the Western System which consists of an insular mountain chain, a coastal mountain chain, and an intervening coastal frough. The Coastal Trough runs for over 800 km from Puget Sound on the British Columbia-Washington border to Dixon Entrance on the British Columbia-Alaska border. The Trough is actually only a northern segment of the Pacific Coast Downfold (Clapp, 1913) which extends from the Gulf of California north into Alaska. In British Columbia the Trough is divided into two sections, the southern one being the Georgia Depression (see inset, Figure 1). It is partially submerged beneath the Strait of Georgia and Puget Sound. The Georgia Depression is divided into the Georgia Lowland on the mainland (eastern) side of Georgia Strait and the Nanaimo Lowland on the western side. This Nanaimo Lowland is a narrow strip along the east coast of Vancouver Island from Sayward in the north to Jordan River in the south. Included are the adjacent small islands from Denman Island south to Saturna Island. It is primarily lowlying country, below 185 m in elevation. The study area falls entirely within the Nanaimo Lowlands.

Although the study area consists of lowland, averaging below 10 m in elevation, the topography is not usually flat, but is quite irregular. Major features of the area include islands, small monadnocks, cuesta-like ridges, and one small fiord, but few lakes and rivers.

The numerous islands all lie less than 2 km from Vancouver Island or the next nearest island; all have a NW-SE trend; and all tend to be elongated along this axis to a greater (Galiano Island), or lesser (Gabriola Island), extent. There are 17 larger islands with areas greater than 2 sq. Saltspring is the largest with an area of 180 sq. km; Denman, Galiano, km. and Gabriola are all about 55 sq. km; Hornby, North Pender, Mayne, Saturna, and Valdes are all between 20 and 30 sq. km; and James, Kuper, Moresby, Portland, Prevost, Thetis, Sidney, and South Pender are all smaller than 10 sq. km but larger than 2 sq. km (British Columbia, Department of the Environment, 1976). There are also 18 smaller islands large enough to be named on maps and innumerable un-named islets just above water at high Denman and Hornby are isolated together off Fanny Bay at the north tide. of the study area. Otherwise most of the islands form an archipelago between Nanaimo and Sidney at the tip of the Saanich Peninsula. These islands form two series, an inner chain next to Vancouver Island (Thetis, Kuper, Saltspring, and Moresby) and an outer chain more exposed to Georgia Strait and progressively further away from Vancouver Island, extending southwards (Gabriola, Valdes Galiano, Mayne, and Saturna).

Another major topographic feature is the Saanich Peninsula in the south of the study area which is about 3-5 km wide and extends almost 22 km northward from Victoria. The peninsula is separated from the major part of Vancouver Island by Saanich Inlet, a fiord that narrows into Finlayson Arm.

On the Saanich Peninsula the lowland relief is interrupted by numerous small monadnocks which rise up to 300 m. These have a smooth rounded outline and include Mt. Douglas (225 m), Bear Hill (213 m), and Mt. Newton (305 m). To the north in the Nanaimo area as well as on the Gulf Islands, the lowland is surmounted by cuesta-like ridges that rise gently on the northeast and end abruptly with vertical faces often 120-200 m high facing southwest, i.e. Mt. Maxwell (589 m) on Saltspring Island, Mt. Parke (262 m) on Mayne Island, Mt. Prevost (600 m) near Duncan, and Little Mountain (260 m) near Parksville.

On the southwestern side of the Saanich Peninsula lie the Highlands, an area which is transitional between the lowland and the upland mountains of Vancouver Island. The terrain is rugged and averages 45-90 m in elevation. Although included by Holland (1976) in the Nanaimo Lowland it was excluded by Day et al. (1959) from the coastal plains. Similar low mountainous relief (to about 185 m in elevation) is found to the west in the Malahat and north on the west side of Saltspring Island and adjacent Vancouver Island between Cowichan Bay and Chemainus.

Freshwater bodies are scarce in the study area. However, there are a few small lakes scattered on the Vancouver Island portion of the Nanaimo Lowlands and adjacent hilly areas. On the adjacent islands only Saltspring Island and North Pender Island possess lakes. Several small rivers drain through the lowlands although the larger part of their drainage areas lie to the west, and outside the study area. These include, progressing from south to north, Goldstream, Cowichan, Chemainus, Nanaimo, Englishman, Little Qualicum, and Qualicum Rivers. The volume of these rivers generally increases proceeding northward. The Cowichan and Nanaimo Rivers have both built up small deltas at their mouths.

The coastline is extensive, produced by the numerous islands and irregularities in the outline of Vancouver Island. The beaches vary from sandy in the Parksville area to steep cliffs and attendant sandspits and coarse boulder beaches around Victoria. Rocky beaches are scattered throughout the area.

Glacial History

More than 150 million years ago, in Mesozoic times, the Coastal Trough, of which the Nanaimo Lowland is but one small part, began forming from a downfolding of the earth's crust along the Pacific margin. As the Trough subsided, thick deposits including marine, non-marine, and volcanic sediments accumulated. The Georgia Depression took on its present form more than one million years ago although it has been modified by bedrock erosion, continued downwarping, and glaciation (Barker, 1974). The glaciation was especially intense (Holland, 1976). Lobes of ice from the Cordilleran ice sheet invaded the depression beginning about one million years ago. A glacier was formed by the coalescing of ice in the Georgia Depression from the adjacent Coastal Mountains and Vancouver Island Mountains which then flowed southeast and south and then west through Juan de Fuca Strait. Glaciation was not continuous here during the Pleistocene; the ice probably advanced and retreated at least four times. In western North America this was nearly the maximum limit of the last glacier with the actual southern limit being near Olympia, Washington (Armstrong et al., 1965). The last glaciation, the Fraser Glaciation (= Wisconsin Glaciation) like the first, also completely covered Vancouver Island according to Muller (1977a). Heusser (1960) suggested that the central mountains of northern Vancouver Island may have escaped this glaciation. Again a continuous ice sheet covered the Georgia Lowland and probably flowed southwestward. At its climax the last ice sheet was at least 1,500 m thick (Halstead, 1966). The final retreat was about 13,500 years ago from Puget Sound and 13,000 years ago from Georgia Strait (Armstrong et al, 1965). As the glacier retreated the ocean entered the Strait of Juan de Fuca and then the Strait of Georgia flooding the greater part of the present lowlands because of the relative depression by the weight of the glacier (Fyles, 1963). Although glacial ice

was absent from the lowlands, shelf ice and icebergs or even sea ice was present in the enlarged Georgia Strait. This ended about 11,000 years ago as the land rebounded and the sea partially retreated (Armstrong et al., 1965). Sometime during this major retreat a minor glacial advance took place. For a short time on Vancouver Island a piedmont glacier advanced out of the Cowichan Valley.

The advancing glaciers smoothed and rounded the monadnocks (Mt. Douglas, etc.) and excavated U-shaped valleys (Saanich Inlet). The retreating glacier deposited unconsolidated materials on much of the lowland, particularly below 150 m in elevation. The wasting glacier sheet and subsequent separate glacier tongues left ground moraines and outwash plains. As the weight of the glacier was removed, the earth's crust gradually rebounded leaving raised beaches, deltas, and glaciomarine deposits 90 m above the current sea level near Victoria, 130 m near Nanaimo, and 160 m near Qualicum (Fyles, 1959). The sizeable deltas built up by the local rivers indicate the present sea level has been maintained for a considerable time (Halstead, 1967).

Geology

The geology of the study area was first extensively reported by Clapp (1912, 1913, 1914) and Clapp and Cooke (1917). Clapp's classification remained unaltered for over half a century. Recently newer studies (Muller, 1977a; Sutherland-Brown, 1966) have reorganized some of the names, ages, and boundaries of the rocks of Vancouver Island. Several different interpretations of the geology of the study area or portions of the study area are available (Forward, 1969; Foster, 1976; Howatson, 1979; Muller, 1967, 1977a). The following account is generalized from Muller (1977a) with Clapp's equivalents given where possible. The generalized geology of the study area

is given in Figure 3. A summary of the rock formations and relative geological age is given in Table I.

The geology of the study area is not homogeneous or as Sutherland-Brown (1966)explained, it has "just enough variety to arouse interest". It consists of nine different rock groups or formations. They include sedimentary, metamorphic, and igneous rocks that span three geological eras. Two of the formations date from the Paleozoic, five from the Mesozoic, and two from the Cenozoic.

The oldest rocks in the study area are the complex of metamorphosed gneisses in the Victoria area called the Wark and Colquitz Gneisses by both Clapp (1912) and Muller (1977a) and the "Basement Complex" by McKee (1972). Clapp (1914) regarded these as intrusive batholiths. On the nearby San Juan Islands the equivalent Turtleback formation, originally regarded as igneous intrusives of the Mesozoic era, are now thought to be at least Devonian (of the Palaeozoic era) as they were metamorphosed prior to the Middle Devonian (McKee, 1972).

The next oldest, dating from the Pennsylvanian and Permian are rocks of the Sicker Group (= Sicker Series of the Vancouver Group of Clapp). They consist of metamorphosed sedimentary and volcanic rocks. The original sedimentary rocks were carbonaceous shales and fine-grained sandstones which were metamorphosed into slaty and cherty rocks. The original igneous rocks were basalts, breccias, and tuffs. The Sicker Group occurs in the study area as two linear outcrops on southern Saltspring Island and the adjacent Maple Bay area of Vancouver Island and north of Nanaimo in the Nanoose area.

The Karmutsen Foration (= Vancouver Volcanic of Clapp) of the Vancouver Group make up the main rocks of Vancouver Island. They formed as a great outpouring of submarine basalt in the late Triassic. In the study area, however, they occur only in a small area near Nanaimo. The rocks are pri-

marily andesites and basalts, over 4,500 m thick in places. Reports of this formation in the Victoria area (Clapp, 1913; Foster, 1976; Muller, 1967) have been referred to the next group.

The Bonanza Volcanics of the Bonanza Group were originally included in the Vancouver Group but are now thought to be quite separate (Muller, 1977a). The Bonanza Volcanics are slightly younger than the Karmutsen formation but are also mainly basalts. They occur as a band across the Saanich Peninsula and adjacent Malahat area.

Intercalated with these volcanics at Tod Inlet and Bamberton plus among other groups in the general vicinity of Saanich Inlet are small, lens-shaped deposits of limestone, the so-called Sutton Formation of Clapp (1912). The crystalline limestones have been metamorphosed and greatly altered (Foster, 1976). They have been mapped by Mathews (1947). The "Sutton formation" is of uncertain age but perhaps belongs to the Triassic (Muller, 1977a).

Occurring on the north half of the Saanich Peninsula and adjacent Malahat area are plutonic, igneous rocks of uncertain age, called the Island Intrusives (= Saanich granodiorite of Clapp). Muller (1977a) tentatively dated them as Jurassic or possibly older. Howatson (1979) stated they are co-magmatic with the Bonanza Volcanics and are therefore definitely Jurassic in age. They are composed of granites, granodiorites, and quartzdiorites.

The most extensive formation in the study area is the Nanaimo Group produced from alternating marine and non-marine sediments in the Cretaceous. These consist of sandstones, shales, conglomerates, and coal, together up to 3,000 m thick in places. The sediments were folded and faulted, presumably in post-Eocene times (along with other formations to the south), in a northwest-trending direction with a northeast dip. This can be seen in the elongated shape of the islands formed of the more resistent sandstones and conglomerates, and the intervening elongate marine channels formed of the
softer shales. The dip is visible on the islands as shallowly inclined beaches on the northeast that rise to sheer cliffs on the southwest side. All major islands, except Saltspring Island which also has the Sicker group, are formed entirely from the Nanaimo group as is a large part of the adjacent Vancouver Island strip from Cowichan Bay northwards. The various formations of the group have been studied by Clapp (1914) and Muller and Jeletzky (1970).

The youngest rocks in the study area belong to two formations, found southwest of Victoria. The Metchosin formation dating from the early Eocene, occurs in the Colwood-Metchosin area. Like the earlier Karmutsen formation, the Metchosin formation is a submarine basalt flow, but which averages only 3,000 m in thickness. The rocks of this area are basaltic lavas, pillow lavas, breccias, and tuffs. This formation has been studied by Muller (1977b).

The Leech River formation just touches the study area in the vicinity of Finlayson Arm, being much more extensive to the west. The rocks are greywacke, argillite, chert, and volcanic rocks which are largely metamorphosed to schist. The age of this formation is uncertain, but it is theorized to be of sediments which accumulated in the Jurassic to Cretaceous and then were metamorphosed in the Eocene (Muller, 1977a).

G

ERA	PERIOD	APPROX. N OF YEARS	IUMBER GAGO	FORMATION, GROUP, OR NAME	DESCRIPTION
	Quaternary Recent Pleistocene (Ice Age)	Last 10,000 10,000-1,000,000			
	Tertiary	(Millions)			
CENOZOIC	Miccene				
	Oligocene	25 -		· · · · · · · · · · · · · · · · · · ·	
CENOZOIC MESOZOIC PALAEOZOIC	Eocene	36 -	58	Metchosin	basaltic flows, basaltic lava, pillow lava, breccia, tuff; marine
				Leech River	phyllite,schist, chert, greywacke, argillite; perhaps older
	Paleocene	58	63		
	Cretaceous	63 -	135	Nanaimo Group	sandstone, shale, coal, conglomerate
MESOZOIC	Jurassic	135 -	181	Bonanza Volcanics (of Bonanza Group)	granodiorite, quartzdiorite, granite andesitic breccias, tuffs; marine
ERA CENOZOIC MESOZOIC PALAEOZOIC PROTEROZOIC ARCHAEAN	Triaggia	101	220	"Sutton" Group	limestone
		101 -	230	Karmutsen (of Vancouver Group)	massive basaltic flows; marine
	Permian	230 -	280	Sicker Group	slaty and cherty rocks, plus basaltic flows, breccias, and tuffs
	Pennsylvanian & Mississippian	280 -	345		
PALAEOZOIC	Devonian	345 -	405	Wark and Colquitz Gneisses	gneisses; perhaps older
	Cilurian	105	125	("Basement Complex")	
	Ordovician	405 -	500	·	
	Cambrian	500 -	600		
PROTEROZOIC		600 -	2,000		
ARCHAEAN		2,000	4,800		

Table I. Stratigraphy of the study area and Geological Time Scale. (After Muller, 1977a and Holland, 1974.)



Vegetation

History

Following the retreat of the last glacier between 10,000 and 13,000 years ago, the land became available for colonization by organisms. Only a small number of studies concern the vegetational sequence within the study area from deglaciation to the present time. Recent and detailed information is available for the adjacent San Juan Islands, Puget Sound area of Washington, and south-coastal British Columbia.

Pollen studies on Orcas Island, 15 km to the east of the study area, indicate that following glacial retreat the forest invaded rapidly (Hansen, In all the above-mentioned areas Pinus contorta was the predominant, 1943). pioneer invader. Fossil cones of this species have been found at Englishman River, southeast of Parksville, where a radiocarbon age of adjacent wood was placed at about 12,000 yrs B.P. Dryas drummondii (yellow mountain-avens) fossils were also found at the same site. There the "composite pollen and spore assemblage clearly indicates that the climate was substantially colder than the present" (Terasmae & Fyles, 1959). In most areas, with climate amelioration and soil maturation, the Pinus was rapidly supplanted by Pseudotsuga menziesii and then Tsuga heterophylla. This is consistent with current natural succession in the surrounding area. Pollen profiles from bogs near Victoria, Qualicum Beach, and Courtenay generally concur with this picture, with the northern-most bog at Courtenay showing the eventual dominance of Tsuga. The bog near Victoria, however, indicates Pseudotsuga maintained its dominance. Pollen of Quercus garryana also occurs both earlier and more abundantly in this southern bog (Hansen, 1950). In south-coastal British Columbia the increase of Pseudotsuga occurred at about 10,500 yrs.

B.P. (Mathewes, 1973). Here also vegetational disturbances indicated by the continuing high presence of successional species such as <u>Alnus</u>, <u>Pseudotsuga</u>, <u>Salix</u>, <u>Acer</u>, and others were common. These disturbances, as today, could have resulted from forest fires, windstorms, insect infestations, or fungal disease with probable emphasis on the first. Despite these disturbances, the general stability of pollen profiles from all areas indicates continuing biogeoclimatic similarity and continuity with the present.

There are two interpretations of essentially the same evidence concerning the existence of a warmer, drier period than the present between 8,000 and 3,500 years ago, termed the Hypsithermal. Pollen profiles on eastern Vancouver Island (Hansen, 1950), Orcas Island of the San Juan Islands (Hansen, 1943), and south-coastal British Columbia (Mathewes, 1973; Mathewes & Rouse, 1974) have been interpreted as showing no evidence of a Hypsithermal which is postulated for, and better supported in eastern Oregon and Washington, central Oregon (Hansen, 1950), and south-central British Columbia (Hansen, 1955). Mathewes (1973) has suggested that even if there were macroclimate changes since deglaciation they were not of sufficient intensity to overcome the ameliorating influence of a maritime climate combined with the wide tolerance of most tree species. However, Hansen and Easterbrooke (1974) contended, on the basis of similar evidence to the above, that the dominance of Pseudotsuga in the Puget Lowland 7,000 yrs B.P. followed by increased Thuja plicata and Tsuga is evidence of a Hypsithermal followed by a moister, cooler climate.

Current Vegetation

The vegetation of the study area has been classified both in detailed local studies and in less detailed provincial-scale studies. On the provincialscale Hämet-Ahti (1965) provisionally divided the province into five vegeta-

tion zones. Most of Vancouver Island's lower elevations fall in the southern boreal and oroarctic, however, the southeast strip of the island falls in the boreomeridional (= temperate) zone. Two sections of the boreomeridional occur on the island, the humid section and the summer-dry section. The summer-dry section includes the very extreme southeast side of Vancouver Island, and the adjacent islands in Georgia Strait; the humid section is an adjacent matching strip to the west that extends further north. Hämet-Ahti maintained that this zonal-sectional system is universally applicable being linked with the great circumpolar and transcontinental vegetation divisions.

Lacking this universal application but more commonly used in the province are the biogeoclimatic zones of V. Krajina. Edgell (1979a) maintained that this is the "most satisfactory ecological and management classification of British Columbia's vegetation". Krajina (1973) distinguished twelve biogeoclimatic zones in the province, four of which occur on Vancouver Island. Edgell (1979a) has mapped these zones, plus associated subzones, for the island following Packee (1972) (see Figure 4). Klinka et al. (1979) have mapped these subzones for central Vancouver Island.

Occupying the eastern half of Vancouver Island and corresponding to Hämet-Ahti's boreomeridional zone is Krajina's coastal Douglas-fir Zone, part of the Pacific Coast Mesothermal Forest. <u>Pseudotsuga menziesii</u> (Douglas-fir), which gives its name to the zone, is the dominant tree species. Besides <u>P. menziesii</u> the Coastal Douglas-fir Zone's combination plant indicators include <u>Abies grandis</u> (grand fir), <u>Arbutus menziesii</u> (madrona), <u>Cornus nuttallii</u> (Pacific dogwood), <u>Pinus contorta</u> (lodgepole pine), <u>Arctostaphylos</u> <u>columbiana</u> (manzanita), <u>A. uva-ursi</u> (kinnikinnick), <u>Gaultheria shallon</u> (salal), <u>Holodiscus discolor</u> (ocean spray), <u>Berberis aquifolium</u> (tall mahonia), <u>B. nervosa</u> (Oregon grape), <u>Philadelphus gordonianus</u> (mock orange), <u>Ribes sanguineum</u> (red current), <u>Rosa gymnocarpa</u> (dwarf rose), <u>Vaccinium</u> <u>parvifolium</u> (red huckleberry), <u>Calypso bulbosa</u> (false lady's slipper), <u>Chimaphila umbellata</u> (pipsissewa), <u>Goodyera oblongifolia</u> (rattlesnake plantain), <u>Linnaea borealis</u> (twin-flower), <u>Polysticum munitum</u> (sword fern), <u>Pyrola picta</u> (wintergreen), <u>Stokesiella oregana</u>, <u>Hylocomium splendens</u>, and <u>Pilophorus cereolus¹ (Krajina, 1965)</u>.

The zone is divided into two subzones, the Madrone-Douglas-fir Subzone (or Wet Subzone) and the Garry oak-Douglas-fir Subzone (or Dry Subzone). According to Edgell (1979a) the Dry Subzone extends from Rocky Point, Metchosin, in the south to Campbell River in the north. Klinka et al.(1979) present the Dry Subzone as extending only as far north as Mapleguard Point at Deep Bay just south of Fanny Bay on Vancouver Island plus Denman Island and Hornby Island slightly to the north. This is about 75 km short of Edgell's northern limit. Hämet-Ahti's (1965) northern limit at Nanaimo for her equivalent section is 75 km shorter than Klinka et al. (1979) and 150 km shorter than in Edgell (1979). It should be noted that both Edgell and Klinka et al. included parts of the Sunshine Coast plus northern and eastern Georgia Strait islands in the Coastal Douglas-fir Dry Subzone but these are not treated here. Klinka et al. (1979) explained this variation by stating that, except for the Saanich Peninsula and Gulf Islands, the Drier Maritime Subzone was "broadly transitional towards the Wetter Maritime Subzone". Indeed, this is supported by the isopleths of many of the climatic factors in the area, which increase both to the west and north of the Victoria area, but the increases to the west are very sharp, while the increases to the north are much more gradual. Indeed, Day et al. (1959) also noted

 $¹_{Pilophorus}$ cereolus actually is restricted to Europe and a few rare and isolated sites in eastern North America; <u>P. acicularis</u> is the western North American species (Jahns, 1970, 1981).

this pattern by including the Saanich Peninsula and Gulf Islands with their "prairie-like soils " of the oak parklands in a Cool Mediterranean Climate, but the narrow lowland strip north to Comox with its Brown Podzolic and Concretionary Brown soils was separated as a Transitional Climate Type. Thus, while the southwestern boundary of the Coastal Douglas-fir Dry Subzone is comparatively distinct, the northern limit is more indefinite and open to individual interpretation.

For the purposes of this flora, the study area is defined as this drier strip of Vancouver Island and adjacent Gulf Islands, slightly larger than the summer-dry boreomeridional zone of Hämet-Ahti and more or less equivalent to the Drier Maritime Subzone as interpreted by Klinka et al. (1979) but excluding the Sunshine Coast on the east side of Georgia Strait. The exclusion of the Sunshine Coast from the study area is based on practical considerations, rather than floristic or climatic features. For comparison, many sites actually have been taken outside this Dry Subzone in the Wet Subzone of the Coastal Douglas-fir Zone and also in the Western Hemlock Zone up to the Fog-Spruce Subzone (compare Figure 4, Biogeoclimatic Zones, with the map in Appendix B, Major Collection Sites).

Within the Dry Subzone the indicator plants include <u>Quercus garryana</u> Garry oak), <u>Camassia quamash</u> (common camas), <u>C</u>. <u>leichtlini</u> (Leichtlin's camas), <u>Collinsia parviflora</u> (blue-eyed Mary), <u>Plectritis congesta</u> (seablush), <u>Zigademus venenosus</u> (death-camas), and <u>Ramalina menziesii²</u> (Krajina, 1965). Except for the last species all are typical of outcrop areas. Packee (1972)listed typical indicator species as <u>Quercus garryana</u>, <u>Arctostaphylos columbiana</u>, <u>Rhus diversiloba</u> (poison oak), and <u>Opuntia fragilis</u>

 $²_{\rm Ramalina}$ menziesii is not actually an indicator species of the Dry Subzone, since it is found along the west side of Vancouver Island, in the Queen Charlotte Islands and adjacent mainland, and as far north as Juneau, Alaska.

(prickly pear cactus) which, like the taxa listed by Krajina, are all xeric species. Klinka et al. (1979), like Krajina (1965), also included <u>Quercus</u> <u>garryana</u>, <u>Camassia quamash</u>, <u>C. leichtlinii</u>, and <u>Collinsia parviflora</u> sens. lat. as characteristic combination species of the subzone but added <u>Lonicera</u> <u>hispidula</u> (purple honeysuckle), <u>Bromus carinatus</u> (California brome-grass), <u>Claytonia perfoliata</u> (miner's lettuce), <u>Dodecatheon hendersonii</u> (shooting star), <u>Erythronium oreganum</u> (easter lily), <u>Galium aparine</u> (goose-grass), <u>Nemophila parviflora</u> (grove lover), <u>Sanicula crassicaulis</u> (western snake root), <u>Brodiaea coronaria</u> (harvest brodiaea), <u>Carex pensylvanica</u> (Pennsylvanian sedge), <u>Danthonia californica</u>(Californian oatgrass), <u>Lomatium</u> <u>utriculatum</u> (spring gold), <u>Mimulus alsinoides</u> (baby monkey flower), <u>Poa</u> <u>bulbosa</u> (bulbous bluegrass), <u>Sisyrinchium douglasii</u> (blue-eyed grass), and <u>Vulpia microstachya</u> (Nuttall's fescue). The first four and last eight listed occur on non-mesic sites, both hygic and xeric, of the subzone's climax.

Within the subzone a number of different forest communities have developed that reflect local soil, relief, and water patterns. These communities are variously circumscribed.

Edgell (1979a) divided the Dry Subzone into three vegetation groupings, ranging from <u>Abies grandis</u> and <u>Thuja plicata</u> on hygric sites to <u>Pseudotsuga</u> <u>menziesii</u> stands with understory of <u>Berberis nervosa</u> on mesic sites, to open woodlands of <u>Pseudotsuga menziesii</u>, <u>Quercus garryana</u>, <u>Arbutus menziesii</u>, and Pinus contorta on xeric sites.

Hagmeier (1965) classified the vegetation of the Thetis Lake area near Victoria into five communities, including an oak-grass community, a fir-oak community, a fir-salal community, with increasing water availablity through the series. Included in the oak-grass community are three assemblages of rocky knolls, namely grass-lichen-shrub, grass-lichen-moss, and bare rock. These are all assemblages where lichens may be dominant. In much more detail, Roemer (1972) has classified the forest vegetation of the Saanich Peninsula into three complexes and seven associations on the basis of physiognomy. The complexes include an open oak complex on the dry sites, a complex of deciduous and part deciduous stands associated with moist sites, and a coniferous forest complex dominating most of the landscape in intermediate sites.

The oak complex consists of a <u>Quercus-Geranium</u> association, which lacks a shrub layer and a <u>Quercus-Erythronium</u> association, with a well-developed shrub layer. Both associations are found on the driest sites, often on exposed, southwest-facing, steep hillsides. The <u>Quercus-Geranium</u> association is also well-developed on the gently sloping to flat land on the very southeastern extremity of the Saanich Peninsula (the Oak Bay area of Victoria) where the lowest rainfall occurs.

The coniferous forest complex may be divided into two associations, the <u>Arbutus-Pseudotsuga</u> association, and the <u>Pseudotsuga-Berberis</u> association. The first is found on the drier end of the mesic sites, on the lower part of hillsides or extremely well-drained soils. The forests tend not to be very dense and often contain scattered openings. The broad-leaf but evergreen <u>Arbutus</u> in the tree layer and several evergreen shrubs, give this association a resemblance to the sclerophyllous forests of Mediterranean Europe. The <u>Pseudotsuga-Berberis</u> association, which lacks a well-developed herb layer, is actually the most common community on the Saanich Peninsula.

The moist site complex is divided into three associations, the <u>Abies-Alnus</u> association, the <u>Populus-Pyrus</u> association, and the <u>Alnus-Athyrium</u> association. The first two have a mixture of conifers and deciduous trees in the tree layer. The <u>Abies-Alnus</u> association occurs on gently sloping and flat land where the water table is high in the wet season. The Populus-

<u>Pyrus</u> association occurs on bottom land that experiences winter flooding. The <u>Alnus-Athyrium</u> association is typical of creek banks, depressions on slopes with seepage, and the foot of slopes with abundant seepage.

<u>Arbutus menziesii</u> and <u>Quercus garryana</u> are both at the northern extemity of their ranges in southern British Columbia; their centers of distribution occur southward in the United States (Hosie, 1979). As pointed out by Hagmeier (1965) and Roemer (1972) the <u>Pseudotsuga-Arbutus</u> association has southern affinities. A similar Douglas-fir Forest Community is found south to Mendocino County, California, in the North Coast Ranges, with scattered remnants even further southward to Sonoma and Marin counties (Munz & Keck, 1970). The <u>Quercus</u> associations also extend down to California, being scattered through the Puget Sound region of Washington and developing into oak parklands in the Willamette Valley of Oregon. These oak parklands, however, are not climax (Shelford, 1963). An Oregon Oak Forest Community (Barbour & Major, 1977) or a Northern Oak Woodland Community (Munz & Keck, 1970) with <u>Quercus garryana</u> as the dominant is found in northwestern California. A similar Southern Oak Woodland with other <u>Quercus</u> species as dominants occurs in the interior valleys of southern California.



Human History and Land Use

Humans have inhabited the study area for at least several thousand years but up to the 1800's these were native Indian people who apparently caused no major alteration of the natural environment. European immigration abruptly altered this situation. The first permanent settlement was started in 1843 with the arrival of forty men in Victoria, when the Hudson's Bay Company transferred its base of operations north from Fort Vancouver, Washington. Among the first changes was the destruction of the open, park-like woodlands with their rick, black soil, to replace it with company farms to supply the fort. From Victoria, settlement spread northwards on Vancouver Island but was confined primarily to the narrow eastern lowlands. Nanaimo was established in 1851 with the discovery of coal. In the 1860's Duncan and Courtenay-Comox were established as agricultural centers, the settlers being attracted by the open forest and therefore the relative ease of clearing. Chemainus began as a lumber mill in 1862, taking advantage of the abundant timber. In 1886 the establishment of the Esquimalt and Nanaimo Railroad connected many of these settlements, encouraging further growth. By 1900 the population of Vancouver Islnad was 50,000 with nearly 90% concentrated in the Victoria-Nanaimo region. By 1976 the population was 441,500 with the majority still concentrated in the narrow southeast coastal strip (Wood, 1979).

"Today the economy of the area is based on the extraction and initial processing of natural resources with forestry, mining, agriculture, and fishing being the major sources of income" (British Columbia, Department of the Environment, 1976). Forestry is by far the most important.

The major transportation route for Vancouver Island, Highway #1, runs down the eastern side of the island, linking the original settlements now grown to cities, towns, and villages. The first settlement, Victoria, is still the largest, with a regional population of 220,000. It has expanded north and west, covering much of the Saanich Peninsula and Colwood-Metchosin areas with urban sprawl. To the north, Nanaimo has a regional population of 61,000; Duncan a population of 35,000; Sidney, Ladysmith, and Parksville all approximately 12,000; and Qualicum Beach and Chemainus both about 5,000 (British Columbia, Ministry of Tourism, 1981). Eight major centers, therefore, occur within 175 km. With expansion and sprawl along Highway #1 little distance separates these centers (see Figure 5).

The natural vegetation has been madically altered along the lowland strip, usually completely eliminated in the urban areas where landscaping utilizes cultivated plants rather than native species. Quercus garryana, however, is an exception, especially in the Victoria area, although this occurs usually as a residue of selective clearing rather than by planting. All of the fertile land has been claimed for agricultural purposes. As Roemer (1972) pointed out, only relic stands of the native Populus-Pyrus association persist in the bottom lands. The human population has reached such a level that land now limits further increase. Much of the choice agricultural land is adjacent to the population centers and is therefore also under pressure. It is forestry, though, that has most conspicuously altered the natural environment. Because the Esquimalt and Nanaimo Railroad was given a grant of one-quarter of Vancouver Island, including nearly all of the southeast lowlands, no government controls could abate the "forest mining and liquidation" or clear-cut logging at its worst" or "massive overcut" that depleted the superb, old growth Douglas-fir stands in the heyday of the industry (Edgell, 1979b). Up to 1940 most of the provicial timber cut came from the accessible valleys and slopes of eastern Vancouver Island. Today improved foresty management is practiced with less destruction of soil and watersheds. However, the "magnificent stands of large

timber" are "gone forever as a part of the Island's eastern landscapes" (Edgell, 1979b). However, it must be noted that Klinka et al (1979) stated that the subsequent natural second growth of trees is now sufficiently mature that the understory vegatation is well-developed.

The rocky Gulf Islands have not suffered as much from the pressures described in the previous paragraphs. Initially, with restricted transportation and little local industry, the population remained small. Currently the islands are becoming increasingly valued for their retreat and recreational use by the population of the adjacent Vancouver Island and the Lower Mainland. Many of the islands are experiencing seashore subdivision, primarily for summer homes, the density of which is reminiscent of the municipalities surrounding Vancouver and Victoria.

Because of the pressure of the expanding population, the parks in the study area are becoming increasingly important as refugia for the natural vegetation. Although these parks operate primarily to provide human access and use of recreational areas, little actual alteration usually occurs since the emphasis is on preserving a natural environment. There are over 25 provincial parks covering approximately 3,000 hectares in the study area (Pfister, 1979). Most of these are on the Gulf Islands and are often marine parks. Many of them also were originally homesteads that have been bequeathed to the people of the province (i.e. Fillongly on Denman Island, Helliwell on Hornby Island, and Ruckle on Saltspring Island) and are therefore quite disturbed. The Capital Regional District operates several parks on the Saanich Peninsula, three of which are monadnocks and one which is a large area of the Highlands. Also on the Saanich Peninsula are two, seminatural municipal parks, Mount Douglas Park in Saanich and Thetis Lake Park in the Highlands.

Established for the actual preservation of the natural communities and

therefore discouraging human use are ecological reserves set up by the Province of British Columbia. Three terrestrial reserves occur on the Gulf Islands: an undisturbed stand of Garry oak and an Arbutus - Douglas-fir forest both of which are on Saltspring Island, and a Coastal Douglas-fir forest on Saturna Island. Five marine reserves, set up to protect subtidal marine life, also inadvertently offer protection for seashore lichen communities. Two of these, Ten Mile Point and the Oak Bay Islets, are located near Victoria; two, Canoe Islets and Rose Islets, are near Valdes Island; and one, Race Rocks, is off Rocky Point (British Columbia, Ministry of the Environment, 1978; British Columbia, Ministry of Lands, Parks and Housing, 1981).



Lichen Habitats

The Coastal Douglas-fir Dry Subzone is a small, unique region in British Columbia containing many lichen species so far unknown from other places in the province, or, indeed in the rest of Canada. The lichen flora is rich in species numbers. This results from the variety of habitats available in the area as well as the diversity of floristic sources available to the area. The present study is primarily taxonomic and floristic, with little concentration on the ecology. Generalizations are presented to aquaint the reader with lichen habitats in the area. Saxicolous lichen communities are especially well-developed; corticolous communities fairly well-developed; and terricolous communities the least developed.

Lichens are generally photophilous and adapted to xeric environments (Hale, 1967b), thus they thrive on rock surfaces. In the study area a number of different rock habitats are available. Two extremely different habitats for saxicolous species are the rocky seaside beaches and the outcrop areas on the hillsides and hilltops, both habitats where vascular plants are absent or sparsely represented. The beaches, with a less extreme environment, have a large number of species arranged in zones reflecting the salt gradient. The rocky knolls of the outcrop areas, especially the southwest facing hillsides and ridges, produce well-developed lichen communities subjected to a more extreme temperature regime. Here variations of light and moisture (drip surfaces) produce a myriad of niches. A third, less important habitat for saxicolous species includes the shaded, irregular openings in the Pseudotsuga-Arbutus association. Two variables help to create more niches within the described habitats: rock pH and rock hardness. Most of the rocks in the study area are noncalcareous. The few "Sutton" limestone lenses were not available for collection from since they are being com-

mercially utilized. However, the flora of a number of calcareous sandstones and occasionally conglomerates were sampled, usually inadvertently (see Appendix B for a listing of calcareous sites). Rock hardness also seemed to play a role in lichen occurrence, although not as marked as in the pH response. Some species were best developed (thallus size, thallus numbers, fertile condition) on the soft sandstones (i.e. <u>Caloplaca laeta</u>), but others were poorly developed on the friable sandstone and, instead, were better developed on the harder, igneous rocks (i.e. <u>Bacidia alaskensis</u>).

Corticolous lichen communities are well-developed, particularly in the <u>Quercus</u> and <u>Pseudotsuga-Arbutus</u> associations. Variables in light (evergreen/ deciduous) and moisture regimes from base to crown coupled with different species' bark characteristics of pH, texture, etc (see Barkman, 1958) produce quite distinct and often separate communities on the trees and shrubs. The deciduous <u>Quercus garryana</u>, <u>Alnus rubra</u>, and the shrub <u>Holodiscus discolor</u> all support good lichen growth. Among the conifers <u>Pseudotsuga menziesii</u> and secondarily <u>Thuja plicata</u> when exposed along openings in the forest also have well-developed floras. Although epiphyllous communities are known to occur in wetter regions to the west and east of the study area (Vitt et al., 1973), these were lacking on <u>T</u>. <u>plicata</u> in the study area. Even <u>Arbutus</u> <u>menziesii</u>, which has exfoliating bark, often had characteristic species present at the trunk base.

Unfortunately the geography and climate which makes the Coastal Douglasfir Dry Subzone unique is also extremely attractive to man. As a result of his intervention, the natural habitats for the lichens in the study area have been greatly altered. On the negative side, most of the natural vegetation has been obliterated completely in the still expanding urban areas. Additionally, most forested areas have all been logged at least once. Practically no virgin timber remains on the east side of Vancouver Island. Consequently, although lichen communities are well-developed in the subsequent second growth forests, it is probable that some lichen species have been eliminated, especially canopy species. <u>Nephroma occultum</u>, only recently described from western Oregon where it grows high in the canopy of 400-500 year old Douglas-fir (Wetmore, 1980), may have once been present in the study area. Especially susceptible are species with limited dispersal ability and specific habitat demands. For example, in Europe <u>Erioderma pedicellatum</u> may have been exterminated through forestry practices (Jørgensen, 1978). This same species is now extremely rare in eastern North America as a result of logging (Maass, 1980). Similarly <u>Usnea longissima</u>, a species confined in Scandinavia to old spruce forests, is on the decline in Sweden because of the reduction in these forests (Essen et al., 1981). Locally <u>Ramalina menziesii</u> is probably disappearing as the older, larger trees it grows best on become scarcer. This species was abundantly represented in Beacon Hill Park in Victoria in the early 1900's but is no longer there.

Also on the negative side, but not assessed here are the effects of increasing pollution accompanying the increased industrialization and population growth in the study area. Lichens are notoriously sensitive to air pollution and local populations may well be responding to emissions from large pulp mills at Chemainus and Harmac near Nanaimo. The Greater Victoria region has also reached a size where smog is noticeable. A very distinct possibility is that chemical and sewage wastes affect the seashore lichen communities since all cities and towns discharge their liquid wastes, mostly untreated, directly into Georgia Strait and the Strait of Juan de Fuca.

However, man's interference has created some new habitats in cities and towns, that while not replacing in numbers those lost, are rather different. The present study places primary emphasis on the natural vegetation so little attempt was made to investigate the urban environment. Super-

ficially it appears that the human presence makes available certain habitats that some lichen species exploit much more effectively than those available naturally such that monocultures flourish to an extent which is not seen in the wild. For example <u>Thelomma occidentale</u> does especially well, often abundantly so, on unpainted fences, wharfs, and buildings close to the sea, while it was never collected on a natural substratum. <u>Rinodina cfr.</u> <u>columbiana</u> was collected from <u>Quercus</u> in a Victoria playground, and was sufficiently abundant to provide numerous specimens although this same species was collected only once in a limited amount in the wild. <u>Sarcogyne regularis</u> thrives almost exclusively on shaded cement and mortar substrata provided by man, but is sparsely represented on the calcareous sandstones and conglomerates scattered throughout the area. <u>Peltigera venosa</u> also occurred primarily on roadcuts, paths, and other man-made disturbances but rarely in 'natural' habitats.

METHODS

Field Methods

Intensive collecting was carried out in the Gulf Islands portion of the study area during the summer of 1974. In the summer of 1975 collecting was concentrated on Vancouver Island, especially the Dry Subzone but also the Wet Subzone and adjacent Western Hemlock Zone. This resulted in approximately 5,500 specimens from 123 major collection sites. Specifics of the collection sites are available in Appendix B. Limited collections were also made in 1976, 1977, 1978, 1980, and 1981, particularly with revisits to previously collected sites.

Specimens were placed in small individual newspaper packets with a number label and substratum information. Numbers and pertinent field data were recorded in a collector's book.

Laboratory Methods

I personally processed the specimens and prepared them for harbarium deposit. Some small losses occurred from mold damage. The specimens were sorted to genus and then in turn each genus was studied in detail. Descriptions were compiled as the work progressed, and keys were constructed after the species of a genus were understood. Frequent additions were made of overlooked species, and corresponding ammendments of keys were made as needed.

Most species were examined with the aid of a binocular Nikon dissecting microscope (DM). Examination and measurement of spores, ascocarps, perithecia, etc., were carried out utilizing a binocular Nikon light microscope (LM) capable of up to 400X power.

Extensive use was made of the standard lichenolgoical chemical spot

tests using commercial liquid bleach (C), Steiner's stable paraphenylenediame solution or fresh alcoholic paraphenylenediame (PD or P), aqueous potassium hydroxide (K), and iodine in potassium iodide solution (IKI). In specific groups the actual lichenic acids were determined by micro-recrystallization techniques or thin-layer chromatography (TLC). Techniques employed followed Thomson (1967c) and Walker and James (1980). The emphasis of this preliminary flora has not been on the chemical aspects which is one avenue of research open for the future.

Reliably identified comparative material was available for confirmation/ comparison from the University of British Columbia Herbarium for less than 25% of the species studied. It was not uncommon for even the most abundant macrolichens to be unrepresented at UBC. As a result, when it seemed essential, comparative specimens were borrowed from CANL and COLO and occasionally from BM, F, WIS, US and SFSC. Additionally type specimens of western North American endemics were borrowed extensively from FH but also from H, UPS, W, and ORE. (For standard abbreviations to herbaria see Holmgren and Keuken, 1974).

When experts in the various lichen groups were available for consultation, the material was first identified as far as possible with the appropriate literature and then submitted for confirmation or correction. Experts consulted included J. Sheard (<u>Buellia</u> and <u>Rinodina</u>), O. Vitikainen (<u>Peltigera</u>), P. M. Jørgensen (<u>Pannaria</u>), M. Dibben (<u>Pertusaria</u>), T. Ahti (<u>Cladonia</u> and <u>Cladina</u>), and I. M. Brodo (some <u>Bryoria</u>, <u>Lecanora</u>, <u>Ochrolechia</u>). Also consulted on smaller individual problems were A. Henssen, P. Rundel, L. Tibell, R. Egan, T. Esslinger, M. E. Hale, Jr., A. Vězda, J. Poelt, and J. Thomson. Material was made available to G. Degelius, T. Ahti, L. Tibell, and O. Vitikainen for the publication of new species.

Although most of the present flora is based upon personal collections,

specimens of J. Macoun (post-retirement), W. B. Schofield, and J. Savale, Jr. contained at UBC were also used. Some specific specimens from Saltspring Island cited in Bird and Bird (1973) were obtained from CAL for examination.

Specimens collected for this study have been deposited at UBC; first duplicates have been deposited in my private herbarium; and, further duplicates, when available, will be deposited at CANL and/or COLO.

PART II:

.

THE LICHEN FLORA

0F

THE COASTAL DOUGLAS-FIR DRY SUBZONE

0F

BRITISH COLUMBIA

FORMAT

General Presentation

The body of the flora is arranged with keys to the genera first followed by the treatments of individual genera (in alphabetical order). Within a genus treatment is a genus description, references, a key to species (if more than one), and then species descriptions in alphabetical order.

Nomenclature

To a large extent nomenclature follows Hawksworth et al. (1980). In a few cases personal preference has been followed.

Authorities

Author citations, in most cases, follow Hawksworth et al. (1980); however, author abbreviations follow, for the most part, Sayre et al. (1964). In the case of North American endemics, Hale and Culberson (1970) has been followed.

Publication Citations

The citation of publication information following taxa names was taken directly from Zahlbruckner (1921-1940), Lamb (1963), or Commonwealth Mycological Institute (1972) especially for many early names. In the case of recently described species the citation was usually taken directly from the original publication. In a few cases the publication information was not located in the above references and so is absent here.

Besides the currently accepted legitimate name for a species the

basionym and commonly used or recent synonyms are included.

Spot Tests -

Only spot tests necessary for identification or contrast with other species are given in most cases. Abbreviations follow those given under 'Laboratory Methods', p. 45.

The ' \pm ' sign in this section indicates a positive <u>or</u> negative reaction, + or - and not 'more or less'. For example, P \pm red should be read P \pm red or P-.

An ultra-violet lamp (UV) capable of transmitting long-wave radiation (3660 Å) was used to examine thalli.

Abundance

Abundance in the subzone actually refers to the number of times a species was collected.

" <u>Abundance</u> "		No. of Collections
rare	= ·	1 - 2
infrequent	=	3 - 10
occasional	=	11 - 20
frequent	=	21+

Selected Specimens

The specimen numbers cited in this section are the collection numbers of W. J. Noble except for a few specimens from the UBC herbarium. These latter specimens are cited by their UBC accession numbers, e.g. UBC-L5302.

Substrata

The common tree and shrub species that are substrata for corticolous lichens are referred to by only the genus name. Thus <u>Ps</u>eudotsuga =

<u>P. menziesii</u>, <u>Arbutus</u> = <u>A. menziesii</u>, <u>Quercus</u> = <u>Q. garryana</u>, <u>Pinus</u> = <u>P. contorta</u>, <u>Alnus</u> = <u>A. rubra</u>, <u>Acer</u> = <u>A. macrophyllum</u>, and <u>Holodiscus</u> = <u>H. discolor</u>. Rarer substrata are referred to by their complete latin name every time.

Local Distributions

It has not been possible to present collection maps of all the species for two reasons: (1) the very large number of species involved, and (2) the narrow outline of the study area coupled with the density of collection sites made the presentation of 448 maps impractical. Instead a few representative species have been mapped.

World Distribution Information

World distribution information is given for only those species that occur within the Coastal Douglas-fir Dry Subzone since these are necessary for phytogeographic interpretation. World distributions of species occurring solely in the Western Hemlock Zone or Coastal Douglas-fir Wet Subzone are omitted.

World distributions were not exhaustively researched. Where possible, the distributions are taken from monographic treatments. Otherwise distributions were interpolated from various floras (i.e. Ozenda & Clauzade, 1970; Wetmore, 1968; Brodo, 1968; Thomson, 1979; and others).

The distribution of some species is well documented. However, the distributions of many species, especially crustose species, are incompletely known with either few reports or conflicting reports. The species with very little information available on their distributions are described as "uncertain". Many other species have distributions intermediate between well-documented and "uncertain". Species in this group usually are assigned distributions but these are prefixed by "tentatively" to indicate their provisional nature.

References

References are listed under both genera and in the "Remarks" section of individual species.

Additionally the following floras and keys are valuable as general references: Brodo (1968), Dahl and Krog (1973), Duncan (1970), Fletcher (1975a, 1975b), Hale (1979), Harris (1977), Krog (1968), Magnusson (1952), Ozenda and Clauzade (1970), Poelt (1969), Poelt and Vězda (1977, 1981), Smith (1918, 1926), Thomson (1979), and Wetmore (1968). Particularly useful for macrolichens are Dahl and Krog (1973) and Hale (1979). For crustose species the cited publications of Duncan, Poelt, Poelt and Vězda, and Ozenda and Clauzade are most useful. The papers of Fink (1935) and Howard (1950) are now quite outdated. The papers of Herre (1910a) and Hasse (1913) although also outdated, can be particularly helpful with crustose, western North American endemic species.

Recommended glossaries include those found in Duncan (1970), Wetmore (1968), Brodo (1968), and Ainsworth (1971). A short introduction to lichen morphology and anatomy is available in Hale (1967) and Jahns (1973).

KEYS TO THE LICHENS OF THE

COASTAL DOUGLAS-FIR DRY SUBZONE

I. Thallus crustose Key A
I. Thallus squamulose, foliose, or fruticose II
II. Thallus squamulose or foliose (symmetry bilateral) Key B(p. 59)
II. Thallus fruticose (symmetry radial) Key C(p. 64)

KEY A: THALLUS CRUSTOSE
1. Thallus fertile 2
1. Thallus sterile
2. Fruiting structures mazaedia (spores in a loose powdery mass) and/or on a <u>very</u> thin stalk
 Fruiting structures apothecia, perithecia, or lirellae (spores not released); not slenderly stalked
3. Mazaedia on tall, slender stalks or ascocarp on slender stalks 4
3. Mazaedia immersed in thallus or on short, broad-based stalks 7
4. Spores simple 5
4. Spores septate 6
5. Spores hyaline or pale in mass; excipulum absent
5. Spores dark brown to black in mass; excipulum present
6. Spores 1-septate (p. 164)
6. Spores 3- or more septate <u>STENOCYBE</u> (p. 696)
7. Mazaedia immersed in raised areoles <u>THELOMMA</u> (p. 716)
7. Mazaedia on broad-based, short stalks8

	8.	Mazaedia extruded, greenish; spores pale green-brown, simple to 3-septate, cylindrical
	8.	Mazaedia not or hardly extruded, blackish-brown; spores dark brown, ellipsoid, l-septate <u>CYPHELIUM INQUINANS</u> (p.283)
9.	Fruiti	ng structures elongate, narrow lirellae
9.	Fruiti	ng structures roundish ascocarps13
	10.5	Spores simple (p. 780)
	10.	Spores septate
11.	Excipu	loid margin present, carbonaceous
11.	Excipu	loid margin absent (p. 77)
	12.	Spore walls thickened to form lenticular lumina, 7- or more septate <u>GRAPHIS SCRIPTA</u> (p. 295)
	12.	Spore walls not markedly thickened, without cylindrical lumina; 3- to 5-septate <u>OPEGRAPHA</u> (p. 511)
13.	Ascoca	rps forming apothecia, or apothecia-like; disc-shaped
13.	Ascoca shaped	arps forming perithecia, or perithecia-like; black, flask-
	14.	Phycobionts blue-green algae <u>PLACYNTHIUM NIGRUM</u> (p. 597)
	14.	Phycobionts green algae 15
15.	Apothe	cia lacking both proper and thalline margins
15.	Apothe	cia with thalline margin and/or proper margin
	16.	Spores muriform
	16.	Spores simple to 1- or many septate
17a	. Spor	es thick-walled, usually > 20.4um long <u>MYCOBLASTUS</u> (p. 485)
17a	. Spor	es thin-walled, usually < 20 um long17b
	17b.	Spores septate_iwth one cell enlarged; ascocarps <u>+</u> black, often subsessile <u>ARTHONIA</u> (p. 77)
	17b.	Spores simple to septate and then with all cells of equal size; ascocarps pale yellow, bluish, grey to black or mottled

.

18. Apothecia with both thalline and proper margins; thalline margin usually enlarged and overarching a plane or concave disc ("barnacle-like"); spores muriform, coloured
18. Apothecia with either a thalline margin or a proper margin but not both; spores simple, septate, or muriform; hyaline to coloured20
19. Corticolous; spores > 50 μm long <u>THELOTREMA</u> <u>LEPADINUM</u> (p. 716)
<pre>19. Saxicolous or muscicolous; spores < 50 µm long<u>DIPLOSCHISTES</u> (p. 290)</pre>
20. Apothecia with proper margin
20. Apothecia with thalline margin
21. Spores simple 22
21. Spores septate
22. Spores thick-walled MYCOBLASTUS (p. 485)
22. Spores thin-walled 23
23. Spores 8 per ascus 24
23. Spores more than 8 per ascus 28
24. Paraphyses free in water, simple <u>LECIDELLA</u> (p. 415)
24. Paraphyses coherent in water, tips at least branched 25
25. Apothecia often with a thalloid veil; thallus C+ red; spores and thallus often pinkish <u>TRAPELIA INVOLUTA</u> (p. 720)
25. Apothecia without a thalloid veil; thallus C-; spores hyaline; thallus variously coloured but not pinkish
26. Entire exciple dark brown to black throughout; saxicolous <u>HUILIA</u> (p.302)
26. Exciple light coloured or if dark then light- coloured internally; on all substrates
27. Apothecia brightly coloured, K+ red; spores narrowly ellipsoid protection (p. 614)
27. Apothecia usually brown to blackish; spores commonly broadly ellipsoid <u>LECIDEA</u> (p. 382)
28. Corticolous STRANGOSPORA MORIFORMIS (p. 708)
28. Saxicolous

	29.	Apothecia < 0.5 mm; exciple swollen and convoluted, <u>+</u> obscuring disc <u>POLYSPORINA</u> <u>SIMPLEX</u> (p. 609)
	29.	Apothecia ≥ 0.5 mm wide; exciple hardly raised, thin, not covering disc, often excludedSARCOGYNE (p. 684)
		30. Spores brown (or occasionally hyaline but then with halo; thallus saxicolous)
		30. Spores hyaline, lacking haloes; corticolous or saxicolous32
·	31.	Spores 1-septate to submuriform, without haloes; paraphyses <u>+</u> simple, free; saxicolous or corticolous <u>BUELLIA</u> (p.145)
	31.	Spores 1-septate, submuriform to muriform, usually with haloes; paraphyses branched and coherent; saxicolous
		32. Spores polarilocular
		32. Spores thinly 1-septate to muriform (but not polarilocular)33
	33.	Spores 1-septate
	33.	Spores more than 1-septate or muriform35
		34. Apothecia brightly coloured, orange <u>DIMERELLA LUTEA</u> (p. 289)
		34. Apothecia white, tan, to black <u>CATILLARIA</u> (p. 208)
	35.	Spores muriform
	35.	Spores only latitudinally-septate 39
		36. Apothecia with pseudothalline margins; saxicolous
		36. Apothecia with only proper margin; corticolous
	37.	Calcicolous; hymenium IKI+ blueGYALECTA JENENSIS (p. 296)
	37.	Not calcicolous; hymenium IKI- or IKI + orangish
		38. Spores large, > 65 µm long, l/ascus, pale brown; apothecia black, ≥1 mm wideLOPADIUM PEZIZOIDEUM (p. 460)
		38. Spores small, < 20 μm long, 8/ascus, hyaline; apothecia reddish(-black), < 1 mm wide <u>GYALIDEOPSIS</u> <u>ALNICOLA</u> (p. 299)
	39.	Apothecia black, <u>+</u> white pruinose; hypothecium dark coloured LECANACTIS (p. 331)
	39.	Apothecia red, white, cream, not pruinose; hypothecium hyaline to fulvous

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	40.	Spores curled; paraphyses anastomosing; exciple reduced <u>SCOLICIOSPORUM</u> cfr. <u>PERPUSILLUM</u> (p. 688)
	40.	Spores <u>+</u> straight (if curled then paraphyses not anastomosing and exciple well developed) <u>BACIDIA</u> (p. 113)
41.	Spore	s simple
41.	Spore	s polarilocular, l-septate, to muriform
	42.	Spores thick-walled
	42.	Spores thin-walled
43.	Apoth	ecia <u>+</u> immersed or level with upper thallus surface
43.	Apoth	ecia adnate or bulging above thallus surface
	44.	Apothecia black or greenish-black; epithecium HNO ₃ + green <u>ASPICILIA</u> (p. 101)
	44.	Apothecium tan or pinkish; epithecium HNO ₃
45.	Apoth	ecia bright yellow
45.	Apoth	ecia white, tan, green, to black but not bright yellow 46
	46.	Spores large, >30 µm long <u>OCHROLECHIA (p. 499</u>)
	46.	Spores small, <30 µm longLECANORA (p. 349)
47.	Spore	s polarilocular
47.	Spore	s thinly 1-septate or several septate to muriform
	48.	Spores brown; apothecia dark-coloured, KRINODINA (p. 665)
	48.	Spores hyaline; apothecia yellow, orange or red, K+ purple or red
49.	Spore	s fusiform, one to many-septate
49.	Spore	s muriform
	50.	Lignicolous/muscicolous <u>ICMADOPHILA</u> <u>ERICETORUM</u> (p. 325)
	50.	Corticolous or saxicolous 51
51.	Apoth	ecia bright red (p. 300)
51.	Apoth	ecia tan to brownish LECANIA (p. 335)

	52. Corticolous (p. 574)
	52. Saxicolous 53
53.	Calcicolous; hymenium IKI+ blueGYALECTA JENENSIS (p. 296)
53 ⁻ .	Not calcicolous; hymenium IKI- or IKI+ orangish
	54. Spores simple (p. 759)
	▶54. Spores septate to muriform55
55.	Spores latitudinally septate only
55.	Spores muriform STAUROTHELE HAZSLINSKYI (p. 694)
	56. Spores brown, 1-septate <u>LICHENOTHELIA</u> <u>UNKNOWN #1</u> (p.451)
	56. Spores hyaline, 1- or more septate
57.	Spore walls thickened to form diamond-shaped lumina
57.	Spore walls not thickened 58
	58. Spores 1-septate 88)
	58. Spores more than 1-septate
59.	Thallus entirely leprose
59.	Thallus corticate, even when almost entirely sorediate at least some parts corticate61
	60. Thallus bright yellow or green <u>CHRYSOTHRIX</u> (p. 232)
	60. Thallus white or grey
61.	Corticolous, lignicolous, or terricolous
61.	Saxicolous
	62. Pycnidia raised, black, barrel-shaped, with extruding white pycnospores <u>LECANACTIS</u> <u>MEGASPORA</u> (p. 332)
	62. Pycnidia lacking or if present then <u>+</u> immersed63
63.	Thallus of yellow, coralloid granules; esorediate <u>BACIDIA</u> <u>RUBELLA</u> (p. 126)
63.	Thallus sorediate at least in part OR not yellow

	64. Thallus of minute, brown coralloid granules; esorediate; lignicolous or terricolous <u>LECIDEA ULIGINOSA</u> (p. 412))
	64. Thallus sorediate or at least not of brown, coralloid granules 69	ō
65.	Goralia elongate-linear; soredia often blue-grey or speckled; thallus <u>+</u> submerged within substratum; lignicolous <u>XYLOGRAPHA</u> <u>VITILIGO</u> (p. 782)
65.	Soralia <u>+</u> roundish; thallus present; lignicolous or corticolous6	6
	66. Thallus dark grey; soredia C+ red <u>LECIDEA GRANULOSA</u> (p. 397)
	66. Thallus not dark grey or if dark grey then soredia C-; corticolous6	7
67.	Thallus of dark bluish, granular soredia, almost entirely sorediate but usually some subsquamulate lobes remaining; phycobiont blue-green; corticolous(or terricolous)	; .
67.	Soredia white, green, yellow, yellow-brown, or somewhat orange, but not blue6	8
	68. Soredia yellow-brown or brown; thallus dark brownish; soralia almost pustular, sometimes becoming confluent <u>MYCOBLASTUS TORNOENSIS</u> (p. 489	;
	68. Soredia white, green, yellow, or somewhat orange 6	9
69.	Soredia white	0
69.	Soredia yellow, green, or somewhat orange-white	1
	70. Soralia excavated with large, granular soredia, KC+ violet (ephemeral), P <u>PERTUSARIA</u> <u>AMARA</u> (p.562)
	70. Soralia globose; soredia farinose, KC-, P+ red 	;
71.	Thallus yellow or yellow-green7	2
71.	Thallus whitish with large, scattered granular, orangish soredia; K+ red <u>PHLYCTIS</u> <u>ARGENA</u> (p.574)
	72. Thallus almost totally yellow, granular sorediate 	j
,	72. Thallus not entirely sorediate; pale yellow to yellow-green; C+ orange <u>LECANORA</u> <u>EXPALLENS</u> (p.361)
73. Thallus granular-isidiate, green; shaded, maritime habitats BACIDIA SCOPULICOLA (p. 127) 73. Thallus not greenish isidiate; habitats maritime or otherwise74 74. Soredia dark grey; thallus white with 77. Thallus scurfy-isidiate ASPICILIA LEPROSESCENS (p. 107) 77. Thallus entirely papillate, pinkish-grey....LECANIA AIPOSPILA (p. 326) 78. Soredia white, KC+ violet (ephemeral), C- PERTUSARIA AMARA (p. 562) 78. Soredia yellowish, KC-, C+ redOCHROLECHIA ANDROGYNA (p. 501)

KEY B: SQUAMULOSE, PLACOIDAL, OR FOLIOSE

(Squamulose)

1.	Thallus squamulose (not minutely foliose) 2
1.	Thallus placoidal or foliose, including minutely foliose
	2. Thallus ear-shaped with a raised lip at margin; always sterile <u>NORMANDINA PULCHELLA</u> (p. 498)
	2. Thallus variously shaped but without a raised lip at margin; often fertile
3.	Ascocarps forming perithecia; usually fertile; thallus dusty-pruinoseDERMATOCARPON <u>HEPPIOIDES</u> (p. 285)
3.	Ascocarps forming apothecia or if sterile then often sorediate; thallus usually epruinose
	4. Phycobiont blue-green 5
	4. Phycobiont green6

5.	Thallus umbilicate
5.	Thallus not umbilicate (p. 515)
	6. Thallus sorediate and/or corticolous
	6. Thallus usually fertile, esorediate; saxicolous or terricolous8
7.	Squamules often with black, raised pycnidia and/or immature podentia; often P+ red or yellow <u>CLADONIA</u> (p.241)
7.	Squamules lacking pycnidia and/or immature podentia; P
	8. Asci polysporous; spores small, ≤ 5 μm long <u>ACAROSPORA</u> (p. 67)
	8. Asci 8-spored; spores > 5 μm long9
9.	Apothecia with thalline margin10
9.	Apothecia with proper margin11
	10. Terricolous or muscicolous <u>PSOROMA</u> <u>HYPNORUM</u> (p. 629)
	10. Saxicolous
11.	Spores simple
11.	Spores 1- or several septate <u>TONINIA</u> (p. 718)
	12. Thallus pale grey or white above <u>TRAPELIOPSIS</u> <u>WALLROTHII</u> (p. 722)
	12. Thallus brown or brownish green above <u>PSORA</u> (p. 627)
	(Placoidal)
13.	Thallus placoidal or very closely applied to the substratum14
13.	Thallus foliose, with distinct lower surface, separate from substratum
	14. Thallus with central pink(-brown) cephalodia
	14. Thallus without cephalodia15
15.	Thallus and/or apothecia yellow, orange, or red, K+ purple
15.	Thallus and/or apothecia grey, green, or brown, K

	<pre>16. Thallus sorediate, brown; lobes flat, minute, ≤ 2 mm wide</pre> LECANORA DEMISSA (p. 358)
	16. Thallus esorediate, often fertile, white, grey, or yellow-green; lobes thick and arched or plane, \geq 3 mm wide17
17.	Thallus white-grey
17.	Thallus (yellow-)green [LECANORA (p. 349)
	(Foliose) 18. Thallus gelatinous, homoiomerous; phycobiont blue-green
	18. Thallus not gelatinous, heteromerous; phycobiont green, or blue-green21
19.	Upper cortex absent (whole-thallus mount viewed from above through LM); thallus often appearing thick or pulpy <u>COLLEMA</u> (p. 273)
19.	Upper cortex present; thallus often appearing thin and membranous20
	20. Upright hyaline hairs on very margin of thallus
	20. Hairs lacking on upper surface or if present then not confined to very edge <u>LEPTOGIUM</u> (p. 432)
21.	Thallus bright yellow or orange 22
21.	Thallus white, green, yellow-green (especially pale yellow-green) or brown
	22. Thallus K+ purple (p. 774)
	22. Thallus K 23
23.	Pycnidia common along margin; often fertile <u>CETRARIA CANADENSIS</u> (p.220)
23.	Pycnidia usually lacking; usually sterile <u>CANDELARIA</u> <u>CONCOLOR</u> (p. 201)
	24. Thallus umbilicate; saxicolous
	24. Thallus more broadly attached, or if centrally attached then not saxicolous
25.	Phycobiont blue-green; thallus ≤0.5 cm wide DEMANGEONII (p.577)
25.	Phycobiont green; thallus usually >0.5 cm wide

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	26. Ascocarps forming perithecia; thallus dusty- pruinose; rhizines lackingDERMATOCARPON (p. 285)
	26. Ascocarps forming apothecia or if sterile then thallus isidiate or rhizinate; thallus epruinose <u>UMBILICARIA</u> (p. 724)
27.	Thallus with veins on the lower surface; lower cortex absent (p. 541)
27.	Thallus without veins on the lower surface; lower cortex usually present
	<pre>28. Phycobiont blue-green; thallus minutely foliose, ≤ 2 cm wide</pre>
	28. Phycobiont green, or if blue-green then thallus >2 cm wide 31
29.	Muscicolous (p. 462)
29.	Saxicolous
	30. Thallus <u>+</u> black with blue rhizoids (under LM)SPILONEMA <u>REVERTENS</u> (p. 693)
	30. Thallus green-grey; without blue rhizoids
31.	Thallus with pseudocyphellae or cyphellae on the lower surface 32
31.	Thallus without pores on the lower surface
	32. Thallus with pseudocyphellae <u>PSEUDOCYPHELLARIA</u> (p. 622)
	32. Thallus with cyphellae STICTA (p. 704)
33.	Thallus heavily to moderately ridged on the upper surface AND the lower surface with fine tomentum interrupted by naked, white patches
33.	Thallus not heavily ridged or if ridged then <u>not</u> finely tomentose on the lower surface with naked, white patches
	34. Phycobiont blue-green; apothecia on edge of lower surface <u>NEPHROMA</u> (p. 494)
	34. Phycobiont green; apothecia on upper surface
35.	Lobes inflated or partially hollow
35.	Lobes not hollow

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	36. Tunnels (cavernulae) pock-marking the lower surface; thallus minute, < 2 cm <u>CAVERNULARIA</u> (p.216)
	36. Thallus without cavernulae on the lower surface but with occasional perforations into hollow center; thallus small to large, >2 cm
37.	Thallus with perforations in the center of the lobes on the upper surface; thallus closely attached to substratum and flattened to it <u>MENEGAZZIA</u> <u>TEREBRATA</u> (p. 472)
37.	Thallus without perforations in the UPPER surface; thallus loosely attached and/or not flattened to substratum <u>HYPOGYMNIA</u> (p. 317)
	38. Thallus broadly attached to substratum rhizines usually abundant
	38. Thallus loosely or partially attached or <u>+</u> free from substratum; rhizines absent or at least not abundant43
39.	Thallus small, <3 cm; lobes narrow, ≤ 1.5 mm wide40
39.	Thallus medium to large, >3 cm; lobes commonly wide, \geq 1.5 mm wide (exception: X. mougeotii = small, narrow-lobed, yellow- green, sorediate AND saxicolous) = Parmelia sens. lat
	40. Spores simple and hyaline; thallus pale yellow or grey; lobes closely applied to substratum; soralia pustular and laminal; corticolous <u>PARMELIOPSIS</u> (p.536)
	40. Spores brown, polarilocular; thallus white, grey, green or brown; lobes closely or loosely attached; saxicolous or corticolous, if corticolous then esorediate or soralia terminal or marginal
41.	Thallus white or pale grey; cortex K+ yellow <u>PHYSCIA</u> (p. 579)
41.	Thallus brown or green-brown; cortex K 42
	42. Thallus white below, often pruinose above <u>PHYSCONIA</u> (p.589)
	42. Thallus black below, epruinose <u>PHAEOPHYSCIA</u> (p.571)
43.	Thallus with pores on the upper surface (punctae); lobes broadly rounded and the edges sorediate; medulla C+ red
43.	Thallus without punctae on the upper surface; lobes broad to narrow; sorediate, isidiate, or neither;mmedulla C44

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44. Thallus mineral grey or mottled above, usually blackish or browning below <u>PLATISMATIA</u> (p. 600)
44. Thallus yellow or brown or green-brown; same colour or a little darker below <u>CETRARIA</u> (p. 219)
45. Thallus yellow-green
45. Thallus brown or grey 48
46. Rhizines simple; saxicolous; lacking pseudocyphellae
46. Rhizines branched or simple (not abundant if simple); pseudo- cyphellae present or absent; corticolous or saxicolous
47. Lobes elongate-linear; rhizines branched and abundant
47. Lobes obtuse and rounded; rhizines simple, not abundant
48. Thallus with marginal black cilia <u>PARMOTREMA</u> <u>ARNOLDII</u> (p. 539)
48. Thallus eciliate 49
49. Thallus grey with <u>+</u> slightly brown edges <u>PARMELIA</u> (p. 522)
49. Thallus brown, olive-brown to brown-black
50. Cortex HNO ₃ + blue-green; isidiate with globular isidia; saxicolous (p. 491)
50. Cortex HNO ₃ -; thallus not isidiate <u>and</u> saxicolous (or if isidiate and saxicolous then isidia tiny and granular rather than large and globular) <u>MELANELIA</u> (p. 463)

KEY C: THALLUS FRUTICOSE
1. Thallus pale to dark brown or brown-black 2
1. Thallus green, yellow, white, or grey5
2. Corticolous; thallus filamentous <u>BRYORIA</u> (p. 134)
2. Saxicolous or muscicolous; not filamentous
3. Thallus minutely fruticose, ≤ 1 cm; muscicolous; phycobiont blue-green POLYCHIDIUM MUSCICOLA (p. 608)
3. Thallus larger, ≻1 cm; saxicolous; phycobiont green

.

	4. Thallus thin and wiry, much-branched; pseudocyphellae absentPSEUDEPHEBE PUBESCENS (p. 619)
	4. Thallus thicker; unbranched with apothecia OR branched with pseudocyphellae <u>CORNICULARIA</u> (p. 280)
5.	Thallus podetiate
5.	Thallus filamentous or strap-shaped13
	6. Podetia hollow
	6. Podetia solid
7.	Squamules present on or at base of podetia, occasionally absent; podetia corticate (smooth, often shiny) or sorediate <u>CLADONIA</u> (p. 241)
7.	Squamules absent; podetia corticate or ecorticate, esorediate 8
	 Podetia corticate; <u>+</u> simple; lacking pycnidia and apothecia
	 Podetia ecorticate; branching abundant; pycnidia and som sometimes apothecia commonly present <u>CLADINA</u> (p. 236)
9.	Thallus of short, < 2.5 cm, $+$ unbranched podetia topped with brown or black apothecia; primary thallus present at base10
9.	Thallus not of short, unbranched podetia; apothecia often absentlll
	10. Apothecia brown; cephalodia absent; terricolous-saxicolous <u>BAEOMYCES</u> <u>RUFUS</u> (p. 133)
	10. Apothecia black; cephalodia abundant at base or on podetia; saxicolous PILOPHORUS ACICULARIS (p. 592)
11	. Thallus of minute, <1 cmchigh, ecorticate, solid podetia
11	. Thallus moderate to large, >1 cm high; corticate
	12. Ascocarps forming mazaedia; cephallodia and tomentum absent SPHAEROPHORUS GLOBOSUS (p. 689)
	12. Ascocarps forming apothecia; cephallodia and tomentum often present STEREOCAULON (p. 698)

13.	Thallus bright chartreuse (yellow-green) <u>LETHARIA</u> <u>VULPINA</u> (p. 449)
13.	Thallus pale greenish to nearly white14
	14. Thallus strands with a tough central axial strand (gently pull strand apart) USNEA (p. 735)
	14. Thallus with soft medulla or hollow15
15.	Thallus actually flattened with slight colour difference between 'top' and 'bottom'; cortex soft, thallus pliant even when dry
15.	Thallus round or if flattened then no colour difference; cortex stiff; thallus comparatively stiff when dry
	16. Thallus filamentous, not perforated with raised pseudocyphellae; esorediate; not usually fertile (locally)
	16. Thallus of wide, flattened strands; perforated or not; hollow or not; if filamentous then lacking pseudocyphellae; often sorediate or fertile

ACAROSPORA Mass.

Thallus areolate to squamulate. Squamules scattered to clustered and radially arranged; small, < 5 mm wide; corticate. Rhizines, hypothallus, and soredia all lacking. Phycobiont a green alga.

Apothecia immersed in thallus. Thalline margin present or absent but algae always present below hypothecium. Asci polysporous, commonly over 100-spored. Spores typically small, <7 µm long, simple, and hyaline.

Mainly saxicolous, occasionally terricolous.

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Weber (1968), in a revision of the yellow <u>Acarosporae</u>, which are not found locally, reduced over eighty taxa to two species. A critical review of the brown species is also necessary since many of the species are too narrowly delimited (Hawksworth et al., 1980).

References: Magnusson (1924, 1929 - <u>non</u> <u>vidi</u>, 1933, 1956). The last reference contains a key to the North American species.

1. Spores ≥7 µm; asci <100-spored; substratum calcareous (HCl+)..... <u>A. MACROSPORA</u>

1. Spores <7 μm; asci > 100-spored; substratum not calcareous (HCl-)....2

- Thallus C+ red; hymenium <100 μm high; algal layer not dissected by thick hyphal strands <u>A</u>. <u>FUSCATA</u>
- 2. Thallus C-; hymenium >150 µm high; algal layer dissected by hyphal strands<u>A</u>. cfr. <u>ASAHINAE</u>

ACAROSPORA cfr. ASAHINAE H. Magn., Ann. Crypt. Exot. 6:43. 1933.

<u>Thallus</u> squamulate. Squamules flattened, scattered and irregularly lobed, attached only at the center in the larger scales; or angulose when crowded; <u>+</u> shiny; (1.0-)2-4.5 mm wide; pale brown, fawn brown, creamy brown, + black margined. Black below. Algal layer not continuous, instead separated in irregular clumps by dissecting bands of hyphal tissue.

<u>Apothecia</u> common, (1-)2-3 mature on each squamule, upwards of 8 immature; <u>+</u> even with thallus, not depressed; initially 0.1-0.2 mm wide and appearing punctiform, in some cases becoming 0.3-0.7 mm wide. Disc plane, dark brown. Thalline margin not distinguished from rest of thallus but cortex in the immediate region of the disc much darker brown than rest of thallus. Hymenium 200(-250) µm high; paraphyses thin, 1.0 um thick, not noticeably branched but <u>+</u> coherent; epithecium light brown. <u>Spores</u> over 100 per ascus, hyaline, cylindric, 4.0-5.5 X (1.5-)2.0-2.5 µm.

Spot Tests: upper cortex C-; medulla K-.

<u>Substratum/Habitat</u>: saxicolous; collected once on conglomerate on the top of Mt. Maxwell (589 m). The material was particularly abundant on shaded, almost vertical cliffs.

Specimen: 7356.

Local Abundance and Distribution: rare; distribution poorly known, perhaps preferring higher elevations but not associated with other arcticalpine species at the same site; not collected in the adjacent zones.

<u>World Distribution</u>: uncertain; described from Japan but not encountered since in the literature; perhaps amph-Pacific.

<u>Remarks</u>: The local material agrees with the description of <u>A</u>. <u>asahinae</u> in the C- cortex, plane squamules with black lower surface, small and rimless apothecia, and high hymenium. The main difference between the two is the dissection of the algal layer by hyphal strands, a feature which is not mentioned for <u>A</u>. <u>asahinae</u>. This may be just an oversight. Magnusson (1924) considered the dissected algal layer to ba a constant species character as also the dark (or light) lower surface. Two Scandinavian species possess both characters - <u>A</u>. insolata H. Magn. and <u>A. molybdina</u> (Wnbg)Mass. The latter forms well delimited orbicular patches with very distinct marginal lobulae. The former also has contiguous areoles, however, it is similar to the local material in its habitat of steep granitic rocks mostly near the tops of hills, albeit usually sunny exposures. Magnusson placed <u>A</u>. <u>insolata</u> close to <u>A</u>. <u>smaragdula</u> (medulla K+ red). Indeed he was not sure of the separation of several forms of the latter from his new species but he preferred to give a new name for the Swedish material.

<u>A. asahinae</u> is tentatively reported here as new to the province.

ACAROSPORA FUSCATA (Nyl.) Arn., Verhandl. zool.-bot. Gessellsch.

Wien 20:528. 1870.

Lecanora cervina **fuscata Nyl., Lich. Scan.:175. 1861.

<u>Thallus</u> areolate-squamulate. Areoles scattered, irregularly flattened, <u>+</u> slightly lobed; or grouped and irregularly angled by compression, hardly lobed; attached at the center; 0.5-1.4 mm wide, <u>+</u> shiny; dark brown, redbrown, brown-black, or olive-brown; faint black margin apparent in lobed forms or not. Black below. Algal layer <u>+</u> even and continuous, not regularly dissected by hyphal strands.

<u>Apothecia</u> common, sunken, 1 (-3) per squamule, 0.2-0 6(-1.1) mm wide. Disc concave or plane, dark brown to reddish-brown. Thalline margin not apparent. Hymenium 85-95 μ m high; epithecium somewhat orange-brown; paraphyses stout, 2-2.5 μ m thick, apparently simple but coherent. <u>Spores</u> over 100 per ascus, hyaline, cylindric, often narrower at one end, 3-5 X 1.5-2.5 μ m.

Spot Tests: upper cortex C+ rose (see below).

<u>Substratum/Habitat</u>: saxicolous; collected on sandstones and igneous rocks.

Selected Specimens: 2966B, 4158.

Local Abundance and Distribution: occasional; primarily at exposed, higher elevations inland but also at maritime locations; also present in the adjacent zones.

<u>World Distribution</u>: circumarctic to circumtemperate in the Northern Hemisphere. Ozenda and Clauzade (1970) suggested that it might be cosmopolitan, but <u>A</u>. <u>fuscata</u> is absent from south and central Africa (Magnusson, 1933), Antarctica (Dodge, 1973), and northern South America (Hertel, 1971b). Magnusson (1929) stated it was widely distributed in the north temperate zone and, within North America itself, Wetmore (1968) considered it panboreal and Brodo (1968), temperate. However, it has been reported for the north slope of Alaska (Thomson, 1979) and as Thomson pointed out, also Siberia, the Canadian Arctic Islands, and Spitzbergen. In the Southern Hemisphere it has been reported from Australia (Filson & Rogers, 1979), New Zealand (Martin, 1968), and Argentina (Grassi, 1950).

<u>Remarks</u>: The C+ reaction is best seen through the LM in the cortical tissues surrounding the apothecia after the spores have been checked. The rose-red reaction is faint and ephemeral. Alternately a squamule can be placed under the DM on a pieve of filter paper predotted with C. By squashing the squamule and smearing it across the paper the positive reaction may be observed.

ACAROSPORA MACROSPORA (Hepp) Bagl., Enum. lich. Liguria:396. 1856. Myriospora macrospora Hepp, Flecht. Europ. No. 58. 1853.

<u>Thallus +</u> areolate, hardly squamulate. Areoles attached by most of the lower surface, 0.5-1.0 mm wide, \pm contiguous and angles over a 1-2 cm broad area, more elongated near the edges; slightly shiny; fuscous to dark brown, sometimes darker near the margin.

<u>Apothecia</u> common, 1-4 per areole, often becoming confluent in older areoles, + round, 0.4-1.0 mm. Disc plane, immersed but nearly level with top

of areole, darker than the thallus, matt. Hymenium 130-150 μ m high; paraphyses stout, 2.5-3.0 μ m wide, coherent; epithecium somewhat orange-brown. <u>Spores</u> 24-100 per ascus, simple, hyaline, ellipsoid, 9-11 X 5-6 μ m.

Spot Tests: cortex C-.

<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous sandstone at a maritime site.

Selected Specimen: 2979A.

Local Abundance and Distribution: rare; distribution poorly known.

<u>World Distribution</u>: perhaps circumboreal; Magnusson (1936) suggested that <u>A. macrospora</u> was probably circumpolar being known from the Bering Strait area and Greenland plus a heavy concentration in the mountains of central and northern Europe.

Remarks: A. macrospora is reported here as new to the province.

ALECTORIA Ach.

Thallus fruticose; filamentous; erect to pendulous; yellowish-green to yellow. Branches terete, occasionally slightly compressed. Medulla of loosely interwoven hyphae. Pseudocyphellae conspicuous, fusiform, raised, white.

Ascocarp an apothecium, produced laterally on the branches. Margin lecanorine, eciliate. Disc brown to black. Spores 2-4 per ascus, simple, ellipsoid, with distinct epispore, brown at maturity, 20-45 µm long.

Corticolous, occasionally terricolous.

The genus has been recently monographed for North America (Brodo & Hawksworth, 1977) which resulted in the separation of <u>Bryoria</u>, <u>Pseudephebe</u>, and <u>Sulcaria</u> from <u>Alectoria</u>.

References: Howe (1911a), Motyka (1964) - not recommended, Hawksworth (1972), Ahti and Hawksworth (1974), and Brodo and Hawksworth (1977).

1.	Pseudocyphellae absent; ends of branches hooked or curled <u>RAMALINA</u> <u>THRAUSTA</u> (p.640)
 Pseudocyphellae present; ends of branches not hooked or curled 	
	2. Pseudocyphellae yellow, fissural <u>BRYORIA</u> <u>TORTUOSA(p.143</u>)
	2. Pseudocyphellae white, raised3
3.	Medulla C+ red; thallus greyish-green <u>A. VANCOUVERENSIS</u>
3.	Medulla C-; thallus yellowish-greenA. SARMENTOSA

ALECTORIA SARMENTOSA (Ach.) Ach., Lich. Univ.:595. 1910.

Lichen sarmentosus Ach., K. Vet. Acad. Handl. 16:212. 1795.

<u>Thallus</u> fruticose, filamentous, pendent, 10-20 cm long. Branches straight to slightly twisted, <u>+</u> terete although major axils expanded and flattened, dichotomously branched, 0.4-1.0 mm wide narrowing at the apices; short, minor branchlets common towards the apices, developing at right angles to main branches, often <u>+</u> blackened at tips; pseudocyphellae common, linear, raised, white; dull greenish-yellow, chartreuse yellow, pale yellow.

<u>Apothecia</u> occasional, lateral on filaments, 0.5-2.5 mm wide. Thalline margin thick, crenulate, finally excluded. Disc flesh-coloured, darkening, concave, finally plane. Hymenium 125 μ m high; epithecium brownish; paraphyses coherent. <u>Spores</u> 3 per ascus, ellipsoid, hyaline turning brown with a distinct epispore, 35-42 X 20-22 μ m.

<u>Spot Tests</u>: medulla C-.

3

<u>Substratum/Habitat</u>: corticolous; collected on conifers including <u>Pinus</u>, dead <u>Pseudotsuga</u>, and <u>Tsuga</u>.

Selected Specimens: 4718A, 5236.

<u>Local Abundance and Distribution</u>: rare; infringing only at the higher elevations on the western boundary of the CDFD subzone; more common in the adjacent zones to the west (see Figure 6).

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct in the Northern Hemisphere; in the Southern Hemisphere present in Pategonia of South America; primarily boreal but also temperate and arctic (Hawksworth, 1972; Ahti, 1964).

<u>Remarks</u>: The local material is all subsp. <u>sarmentosa</u>; subsp. <u>vexillifera</u>, which is usually considered arctic with high alpine outliers in the Rocky Mountains, has been reported from a coastal rock outcrop in Victoria (Brodo & Hawskworth, 1977). (The specimen on which this report is based has not been seen). Subsp. <u>vexillifera</u> is typically prostrate on rocky or gravelly soils, up to 15 cm long, with main branches rigid, compressed and expanded, foveolate or striate, and little branched.

Subsp. <u>sarmentosa</u> can attain much greater lengths than measured in the few local collections, i.e. 45 cm (Howe, 1911a), 75 cm (Martin & Child, 1972) and 80 cm (Hawksworth, 1972). Additionally the local material was not abundantly fertile so only a few apothecia were available for measurement. The spore size is reported as $23-35(-48) \times (12-)15-20(-25) \mu m$; the spores/ascus from 2-3(-4) (Brodo & Hawksworth, 1977).

<u>A. sarmentosa</u> is not common in the CDFD subzone compared to <u>A</u>. <u>vancouver</u>ensis. See the latter species for comments.

ALECTORIA VANCOUVERENSIS (Gyeln.) Gyeln. ex Brodo & D. Hawksw. Opera Bot.

42:75. 1977.

Bryopogon vancouverensis Gyeln., Feddes Repert. 38:245. 1935.

<u>Alectoria vancouverensis Gyeln.</u>, Feddes Repert. 38:245. 1935 (nom. inval.)



<u>Thallus</u> fruticose, filamentous, pendent, 15-30 cm long. Branches straight to twisted, \pm terete with major axils expanded and flattened, 0.3-0.6 mm wide, narrowing at the apices; short, minor branches, sometimes developing at right angles to the main branches, especially towards the apices, \pm blackened at the tips; pseudocyphellae common to abundant, linear, raised, straight to twisted around the branches, white; deep green to greyish green.

<u>Apothecia</u> occasional, lateral along main branches, 1.5-3.5 mm wide. Thalline margin thick, crenulate, finally excluded. Disc flesh-coloured, often brown spotted, darkening, concave, finally plane to irregularly convex. Hymenium 110 μ m high; epithecium brownish; paraphyses coherent. <u>Spores</u> 3 per ascus, ellipsoid, hyaline turning brown with a distinct epispore, 28-35 X 18-20 μ m.

<u>Pycnidia</u> common on fertile thalli, black; pycnospores hyaline, cylind-rical, $6-8 \times 0.8 \ \mu m$.

Spot Tests: medulla C+ red (usually quickly), persistent.

<u>Substratum/Habitat</u>: corticolous; on trunks and branches of conifers. Selected Specimens: 1819, 2407A.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially at higher elevations inland, also present in the adjacent zones but not as common (see Figure 7).

World Distribution: western North American endemic; known from Cali-

<u>Remarks</u>: Only a few fertile specimens were collected of this species. Although the few apothecia examined consistently had 3 spores per ascus the number typically ranges from 2-4 spores per ascus according to Brodo and Hawksworth (1977).

<u>A. vancouverensis</u> and <u>A. sarmentosa</u> are very similar species, readily separated by the C+ spot test of the former. Brodo and Hawksworth (1977)



pointed out that <u>A</u>. <u>vancouverensis</u> also tends to have branches of uneven diameter that are twisted with a dense and compact medulla and a greyish-green colour while <u>A</u>. <u>sarmentosa</u> tends to have even branches with a lax medulla and a straw-yellow coloration. Unfortunately, intermediates exist.

ARTHONIA Ach.

Thallus crustose, usually very thin and little developed, sometimes immersed in substratum.

Ascocarp a round to irregularly branched pseudothecium, often immersed in thallus. Margin absent. Asci globose to broadly clavate, bitunicate. Spores 8 per ascus, commonly hyaline, fusiform to ovoid, usually 1-, 2-, or 3-septate but sometimes up to 8-septate; often with one cell enlarged.

Mainly corticolous-lignicolous, occasionally saxicolous.

Arthonia is in need of revision.

References: Redinger (1936-38), Willey (1890).

1.	Saxicolous 2
1.	Corticolous or lignicolous 4
	2. Spores 1-septate <u>A</u> . <u>LAPIDICOLA</u>
	2. Spores 2- or more septate3
3.	Spores 3- to 5-septate; apothecia < 0.5 mm; in the marine <u>Verrucaria</u> zone <u>A</u> . <u>PHAEOBAEA</u>
3.	Spores 2-septate; (host)apothecia \ge 0.5 mm; often maritime, but not in the <u>Verrucaria</u> zone <u>A</u> . <u>INTEXTA</u>
	4. Spores 1-septate5
	4. Spores 2- or more septate6

5.	Pseudothe black; sp	cia becoming elongate, sometimes branched, ores 16-21 X 5-8 µm	
5.	Pseudothecia <u>+</u> round, reddy brown to brownish; spores 8-10 X 2.5-3.0 µm		
	6.	Spores 5- to 6-septate ARTHOTHELIUM ILICINUM (p. 96)	
	6.	Spores 2- to 4-septate7	
7.	Pseudothe light-col	cia branched, elongate; hypothecium oured (fulvous to light brown)8	
7.	Pseudothe	cia round to elliptical; hypothecium black <u>A. ASPERSA</u>	
	8.	Pseudothecia <u>+</u> stellate; spores 3-septate, cells <u>+</u> equal length <u>A. RADIATA</u>	
	8.	Pseudothecia elongate, not or only slightly branched; spores (3-)4-septate, one enlarged end cell <u>A</u> . <u>POLYGRAMMA</u>	

<u>ARTHONIA</u> <u>ASPERSA</u> Leight., Ann. & Magaz. Nat. Hist., ser. 2, 18: 322. 1856. Thallus crustose, smooth to scurfy; whitish grey.

<u>Pseudothecia</u> common, <u>+</u> scattered, sessile to somewhat immersed, (0.3-) 0.5-0.7 (0.9) mm wide. Exciple absent. Disc black, matt to shiny, round to slightly irregular. Hymenium 45 µm high, brownish; epithecium black; hypothecium black, 30 µm high; asci ovoid, bitunicate. <u>Spores</u> 8 per ascus, hyaline, ovoid, (2-) 3-septate with enlarged end cell, 12-13 X 4-5 µm (see Figure 8).

<u>Substratum/Habitat</u>: corticolous, collected once on <u>Abies</u> sp. and once by Szczawinski (UBC) from an unnamed conifer.

Selected specimen: 5021A.

Local Abundance and Distribution: absent from the CDFD subzone; two collections (one Szczawinski's) from the CDFW subzone.

<u>Remarks</u>: The hymenium of <u>A</u>. <u>aspersa</u> is usually reported as IKI+ bluegreen (Ridinger, 1936-38; Smith, 1918). <u>A</u>. <u>arthonioides</u> (Ach.) A.L.Sm. is similar, with a black hypothecium and a hymenium which is IDI+ red. That Figure 8. Selected spores of <u>Arthonia</u>, <u>Arthothelium</u>, and <u>Artho</u>pyrenia. Collection numbers of specimens are given in brackets.

- A. <u>Arthonia aspersa</u> (5021)
- B. Arthonia carneorufa (2637E)
- C. Arthonia dispersa (2158B)
- D. <u>Arthonia</u> <u>intexta</u> (5375)
- E. Arthonia lapidicola (2247)
- F. Arthonia phaeobaea (3269)
- G. <u>Arthonia polygramma</u> (119)
- H. Arthonia radiata (1790)
- I. Arthonthelium ilicinum (111)
- J. Arthonthelium macounii (1243C)
- K. Arthothelium cfr. spectabile (1196)
- L. Arthopyrenia antecellans (591)
- M. Arthopyrenia biformis (2896)
- N. Arthopyrenia cfr. <u>carinthiaca</u> (4060)
- 0. Arthopyrenia halodytes (5184)
- P. Arthopyrenia padi (3189B)
- Q. Arthopyrenia plumbaria (1535).



species, however, has a much better developed thallus which is thickish and becomes granular-leprose (Ozenda & Clauzade, 1970; Redinger, 1936-38).

ARTHONIA cfr. CARNEORUFA Will., Int. Stud. Lich. Suppl.:52. 1887.

<u>Thallus</u> crustose; effuse, of scattered, minute granules, almost pulverulent; greenish.

<u>Pseudothecia</u> adnate, scattered, 0.1-0.4 mm wide. Disc round, plane to slightly convex, reddish-brown, almost translucent. Hypothecium light yellowish to light orange-brown; epithecium hyaline to fulvous; paraphyses coherent, branched, and anastomosed; hymenium 40 µm high, hyaline. <u>Spores</u> 8 per ascus, hyaline, 1-septate, ovoid, not to slightly constricted at septum with the cells either equal in size or one slightly wider with the other narrower and elongated, 8-10 X 2.5-3.0 µm (see Figure 8).

Spot Tests: hymenium IKI+ orange-red; epithecium K-.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Thuja</u> twigs. Selected Specimen: 2637E.

Local Abundance and Distribution: rare; distribution poorly known, collected only in the CDFD subzone.

<u>World Distribution</u>: western North American endemic; described from material collected in Washington Territory, actually Oregon (Willey, 1887) and not Washington as reported in Fink (1935); not reported since.

<u>Remarks</u>: The local material seems closest to <u>A</u>. <u>carneorufa</u> for which there are no complete descriptions. Fink (1935) described this species as having equal-celled spores. The local material has both equal and unequalcelled spores mixed together.

Several European species seem very similar. <u>A</u>. <u>spadicea</u> Leight. is close but has a K+ violet epithecium. <u>Allarthonia exilis</u> (Floerke) Sandst. is also close but has black ascocarps and a brown epithecium, which may be just an insolation effect. A. carneorufa is reported tentatively here as new to the province.

<u>ARTHONIA DISPERSA</u> (Schrad.) Nyl., Lich. Scand.:261. 1861. <u>Opegrapha dispersa</u> Schrad., Annal. des Botan., 22. Stuck, 86. 1797.

<u>Thallus</u> crustose; very thin and smooth to slightly cracked around ascocarps; medium grey, greenish-grey.

<u>Pseudothecia</u> common, usually scattered, immersed, even with thallus, round becoming elongated often with short branches, 0.3-0.8 mm long and 0.1-0.2 mm wide. Margins absent. Disc plane, <u>+</u> shiny, black. Hymenium 40-50 μ m high, fulvous to light brown or mottled; epithecium dark reddish brown to brown-black; hypothecium light brown to <u>+</u> absent. Asci ovoid, bitunicate. <u>Spores</u> (6-)8 per ascus, hyaline turning brown, 1-septate, cells usually equal in length but one often broader, (13-)16-21 X 5-8 μ m (see Figure 8).

Spot Tests: hymenium IKI+ blue; epithecium K-.

<u>Substratum/Habitat</u>: corticolous; collected three times, twice on <u>Alnus</u> and once on Pseudotsuga.

Selected Specimens: 2158B, 4049B.

Local Abundance and Distribution: infrequent; inland throughout the subzone; not collected in the adjacent zones.

World Distribution: circumtemperate (Ozenda & Clauzade, 1970).

<u>Remarks</u>: The local material corresponds rather well to var. <u>excipienda</u> (Nyl.) Olivier, which is characterized by larger spores that turn brown (Duncan, 1970). Redinger (1936-38) pointed out that this variety usually has longer (up to 1.5 mm long) and wider (up to 0.5 mm wide) ascocarps but the local pseudothecia were the typical size for the species. The usual spore size of <u>A</u>. <u>dispersa</u> is 10-13 X 4-5 μ m.

A. dispersa is reported here as new to the province.

ARTHONIA INTEXTA Almqu., Kgl. Svensk. Vetenck. Handl. 17(6):60. 1880. Bacidia biseptata Magn., Bot. Not. 1942:6. 1942., <u>nom</u>. <u>illeg</u>.

Bacidia petsamoensis (Vain.) Magn., Ark. Bot., ser. 2, 2(2):143.

1952., <u>nom. illeg</u>.

Diplophragnmia petsamoensis Vain., Lich. Fenn. 4:472. 1934., nom. illeg.

<u>Thallus</u> absent. <u>Host thallus</u> crustose, thin to commonly thick, crackedareolate, areoles usually verruculose; light grey.

Pseudothecia <u>+</u> absent. <u>Host apothecia</u> common, <u>+</u> round, abundant, adnate, constricted, scattered to grouped and then somewhat confluent, 0.5-1.2 mm wide. Proper margin entire, even, <u>+</u> shiny, black, excluded early. Disc plane to slightly convex, black, sometimes almost tuberculate, black. Hypothecium hyaline to fulvous, thick; epithecium brown to sometimes blue-black; excipulary tissue bright blue; hymenium 50 μ m high, hyaline to fulvous; paraphyses simple to slightly branched, coherent in water. <u>Spores</u> 6 (-8) per ascus, hyaline, ellipsoid to ovoid, 2-septate, with cells <u>+</u> equal or one end cell narrower and longer, 12-15 X 4.5-5.0 μ m (see Figure 8).

<u>Spot Tests</u>: thallus C-, P-, K<u>+</u> slight yellow, epithecium C-; hymenium IKI+ yellow; upper hypothecium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous sandstone in the suprahaline zone.

Selected Specimen: 5375.

<u>Local Abundance and Distribution</u>: rare; not collected in the CDFD subzone, collected only the CH zone.

<u>Remarks</u>: <u>A</u>. <u>intexta</u> is a very reduced, parasitic ascomycete lacking ascocarps of its own. It is parasitic on the apothecia of lichens, specifically on <u>Lecidella</u> species (Hertel, 1969a). The thallus description above belongs to that of the host Lecidella sp., the spore description belongs to the <u>Arthonia</u>. The parasitized thallus and apothecia are remarkably consistent; the holotypes of <u>Bacidia biseptata</u> and <u>Diplophragmnia petsamoensis</u> were both examined and are essentially identical with each other as well as with the local material. The parasite <u>Arthonia</u> causes no obvious external disruption of the host and blends very well with the hymenial tissues of the host. The apparent resulting lichen strongly resembles a <u>Bacidia</u> (thallus crustose; ascocarps lecideine, black; spores several septate) albeit with a very unusual spore septation for that genus. Indeed the "hybrid" <u>Lecidella-Arthonia</u> has been described twice as a <u>Bacidia</u> by very competent lichenologists as well as placed in its own genus. If emphasis is given to the unequal-celled spores and IKI+ yellow hymenium then one is confronted by the apparent paradox of an Arthonia with a well-developed exciple.

Additional collections of this <u>Arthonia</u> have been made in British Columbia since the original collection connected with this study. They are also from maritime sites in the Spruce/Fog subzone of the Coastal Hemlock zone. In Europe the species is known from arctic-alpine situations.

A. intexta is reported here as new to the province.

<u>ARTHONIA LAPIDICOLA</u> (Tayl.) Branth & Rostr., Bot. Tidssk. 3:245. 1869. <u>Lecidea lapidicola</u> (Tayl.) Zahlbr., Naturl. Pflanzenfamil., l.

Teil Abt. 1, 91. 1903.

<u>Thallus</u> crustose; irregular, very thin, conforming to the substratum being \pm continuous on shale but of separate granules on sandstone; dark grey, brown-grey.

Pseudothecia abundant, scattered to clustered and then <u>+</u> confluent, adnate, 0.3-0.7 mm wide. Disc round and convex to oval or irregular and only slightly convex; smooth to slightly tuberculate; black to dark red-brown; epruinose. Hypothecium orange-brown to medium brown; epithecium brown-black to medium brown; paraphyses coherent, branched and anastomosed; hymenium 50-60 μ m high, hyaline to more commonly fulvous with or without brownish patches. <u>Spores</u> 8 per ascus, hyaline, 1-septate, ovoid, <u>+</u> constricted at septum with one cell usually distinctly wider, and narrow cell occasionally also elongated, 12-18 X 4.5-6.0 μ m (see Figure 8).

Spot Tests: thallus C-, KC-, K-, P-; hymenium IKI+ orange-red.

<u>Substratum/Habitat</u>: saxicolous; collected twice on sandstone and once on shale; all collections from the supralittoral zone of ocean sites.

Selected Specimens: 2247B, 2906C.

Local Abundance and Distribution: infrequent; apparently at ocean sites only within the CDFD subzone but this may be an artifact of the few collections.

<u>World Distributions</u>: circumtemperate and also perhaps circumboreal in the Northern Hemisphere.

Remarks: A. lapidicola is reported here as new to the province.

ARTHONIA PHAEOBAEA (Norm.) Norm., Flora 52:525. 1869.

Segestrella phaeobaea Norm., Kgl. Norske Vidensk.-Selsk. Skrift. 5:367. 1868.

<u>Thallus</u> crustose, irregular, up to 7 cm broad, usually very thin, smooth, and shiny, occasionally thicker and rimose; deep grey, brownish-grey sometimes with purple tints.

<u>Pseudothecia</u> usually scarce, sometimes absent; scattered, sessile, 0.1-0.3 mm wide. Margin absent. Disc round, plane, black or brown-black, occasionally roughened. Epithecium brown-black; asci clavate, bitunicate. <u>Spores</u> 8 per ascus, hyaline, gelatinous halo present, (1-)3- to 5-septate, ellipsoid-oblong but often the end one or two cells broader, 16-25 X 5-8 µm (see Figure 8).

Pycnidia often present, sometimes abundant, immersed, appearing as a

"pucker" on the surface of the thallus. Pycnospores hyaline, cylindrical, 5 X 1.5-2 µm.

Spot Tests: hymenium IKI+ red, K-.

<u>Substratum/Habitat</u>: saxicolous; on igneous rocks in the lower part of the supralittoral zone, both with Verrucaria maura and above.

Selected Specimens: 2590B, 3269.

Local Abundance and Distribution: infrequent; maritime at the very south and north of the CDFD subzone, which is probably a reflection of the lack of igneous rocks throughout most of the Gulf Islands and adjacent Vancouver Island portion; known also from the Spruce/Fog subzone of the CH zone.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; very likely to eventually be reported from eastern Asia in the future.

<u>Remarks</u>: <u>A</u>. <u>phaeobaea</u> was reported as new to the province in Noble (1978) as a result of this study and other collections.

ARTHONIA POLYGRAMMA Nyl., Acta Soc. Scient. Fennic. 7:480. 1863.

OR Annal. Science. Nat., Botan., ser. 4, 20:230. 1863.

<u>Thallus</u> crustose, thin but slightly cracked, approaching scurfy; pale greenish grey, medium grey, or brownish.

<u>Pseudothecia</u> common, <u>+</u> scattered, immersed, level with the substratum, irregularly elongate often with short to medium branches to nearly stellate, 0.5-1.2 mm long and 0.1-0.2 mm wide. Margins absent, but thallus often cracked around edge of ascocarps and giving the appearance of a possible margin. Disc immersed, plane, brown to reddish brown to blackening. Hymenium 70 µm high, hyaline-fulvous; epithecium light brown to indistinct; hypothecium reduced, coloured like hymenium; asci ovoid, bitunicate. <u>Spores</u> 8 per ascus, hyaline, narrow obovoid, (3-)4-septate with one large cell at the widest end, $(17-)19-22 \times 6-7 \mu m$ (see Figure 8).

<u>Spot Tests</u>: hymenium IKI+ blue; epithecium K-; thallus K+ yellow-orange, C-.

<u>Substratum/Habitat</u>: corticolous; collected once on Alnus.

Selected Specimen: 119.

Local Abundance and Distribution: rare; distribution poorly known.

<u>World Distribution</u>: probably western North American endemic; described from California, not reported since except for Fink (1935) who also lists it from Florida. This seems unlikely.

<u>Remarks</u>: The ascocarp shape is reminiscent of <u>A</u>. <u>radiata</u> var. <u>opegraphia</u> (var. <u>angustata</u> in Hasse, 1913) but the spores are distinctly clavate with one large end cell and the hymenium is IKI+ blue.

<u>A. polygramma</u> seems very similar to the European species, <u>A. fuliginosa</u> (Turn. & Borr.) Flot. which, however, has an IKI+ orange hymenium. Both these species are whitish-grey pruinose on the thallus and ascocarps. The type of <u>A. polygramma</u> was examined and although the spores were the same and the pseudothecia very similar to the local collection the thallus of the type was distinctly 'chalky-pruinose' and the ascocarps also lightly pruinose. Although pruinosity is often a constant species character in lichens, the expression of the character is variable. In this case it is felt that the fertile characters outweigh the vegetative character. It should also be noted that Zahlbruckner (1921-40) lists a var. <u>denudata</u> Ny1. The problem requires further study supplemented with the collection of more local material; an examination of <u>A. fuliginosa</u> is also necessary.

<u>ARTHONIA RADIATA</u> (Pers.) Ach., Kg. Svenska Vetensk.-Akad. Nya Hadl.:131.1808. <u>Opegrapha radiata</u> Pers., Neue Annal. Botanik, 1. Stuck, 29, Tab. 2, fig. 33.

1794.

. . . . *. .*

Thallus crustose, thin, shiny; medium grey.

<u>Pseudothecia</u> common, <u>+</u> scattered, 0.6-1.3 mm wide. Margin absent. Disc plane, subsessile to sessile, irregularly round to commonly <u>+</u> stellate with numerous, radiate, short branches. Hymenium 55-65 μ m high, fulvous; epithecium indistinct to grey-brown or dark brown; hypothecium narrow, light brown; asci ovoid, bitunicate. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to slightly ovoid, 3-septate with four cells of equal length with two often slightly wider, (13-)15-17 X 5-6 μ m (see Figure 8).

<u>Spot Tests</u>: thallus K+ yellow; hymenium IKI+ blue, or + red in one specimen; epithecium K-.

Selected Specimen: 1790.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Alnus</u> although several very small thalli present as admixtures in other collections.

Local Abundance and Distribution: infrequent; distribution poorly known, not collected in the adjacent zones.

<u>World Distribution</u>: circumtemperate; reported from Europe, North America, China (Redinger (1936-38), and India (Schubert & Klement, 1966) in the Northern Hemisphere; reported from New Zealand (Martin, 1966) and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

ARTHOPYRENIA Mass.

Thallus crustose, often \pm immersed within the substratum. Phycobiont present or absent.

Ascocarp a pseudothecium or a perithecium, immersed or sessile, black. Asci bitunicate. Pseudoparaphyses persistent or gelatinizing. Spores uniseriate or massed in an ascus, usually hyaline, 1- to septate with one cell often larger.

Usually corticolous on smooth bark.

<u>Arthopyrenia</u> is a large, polymorphous genus which is currently being divided into several, smaller, more natural genera, i.e. <u>Anisomeridium</u>, <u>Acrocordia</u>, etc. Poelt (1973) classified these segregate genera in a completely different order than that of <u>Arthopyrenia</u>. The fundamental work primarily responsible for the segration, Harris (1975), has not been published in its entirety. Since this work is not readily available for study, the local species have been retained in <u>Arthopyrenia</u> sens. lat. although mention is made of recent, or possible future transfers.

References: Swinscow (1965, 1970), Harris (1973, 1975).

#³

1.	Littoral zone, on barnacles <u>A</u> . <u>HALODYTES</u>
1.	Corticolous or saxicolous, but not in the littoral zone
	2. Sàxicolous <u>A</u> . <u>CARINTHIACA</u>
	2. Corticolous 3
3.	Spores > 25 µm long <u>A</u> . <u>ANTECELLANS</u>
3.	Spores < 25 µm long 4
	 Spores almost 3-septate, 1-septate spores with mid-lumina constrictions or wall-thickenings <u>A</u>. <u>PLUMBARIA</u>
	 Spores only 1-septate, lacking med-lumina constrictions or thickenings
5.	Asci cylindrical; paraphyses persistent; spores unconstricted at septum, widest cell also longest cell, uniseriateA. BIFORMIS
5.	Asci pyriform; pseudoparaphyses persistent or gelatinizing; spores constricted, widest cell not the longest cell, massed in ascus <u>A</u> . <u>PADI</u>

ARTHOPYRENIA ANTECELLANS (Nyl.) Arn., Flora 53: 485. 1870.

Verrucaria antecellans Nyl., Flora 49:86. 1866.

<u>Thallus</u> crustose; exophloedial, very thin, \pm smooth; pale grey-brown.

<u>Pseudothecia</u> abundant, scattered to clustered, subsessile, 0.1-0.25 mm wide, with a shiny involucrellum, part of which remains as a black ring on the thallus after the rest of the ascocarp disintegrates. Pseudoparaphyses gelatinizing. Asci pyriform, bitunicate. <u>Spores</u> 8 per ascus, massed, hyaline (but browning when overmature), 1-septate, slightly constricted at septum, cells unequal with a pointed, short but wide apical cell and an elongated and narrower, blunt end cell, 27-35 X 7.5-10.5 µm (see Figure 8).

<u>Pycnidia</u> slightly larger than perithecia, 0.2-0.3 mm, partially covered by fragments of the thallus, shiny, black; pycnospores hyaline, ellipsoid, $3-4 \times 2.0-2.5 \mu m$.

Spot Tests: thallus not tested.

<u>Substratum/Habitat</u>: corticolous; collected once on twigs of <u>Holodiscus</u>. Selected Specimen: 591B.

Local Abundance and Distribution: rare; distribution poorly known, collected only on the southern Gulf Islands, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; oceanic-temperate (Harris, 1975).

<u>Remarks</u>: The pycnidia described above were found on similarly coloured thalli which were near but not intermixed with the ascocarps. Harris (1975) described the pycnospores as rod-shaped, only 1 μ m wide, so there is a possibility the above belong to another species.

Other differences with Harris' description of <u>A</u>. <u>antecellans</u>, probably result from the small amount of the local material. These differences include paraphyses which are usually persistent and spores that become 3-septate with age.

<u>ARTHOPYRENIA</u> <u>BIFORMIS</u> (Borr.) Mass., Framm. Lich.:26. 1855. Verrucaria biformis Borr., Suppl. Engl. Bot. 1:pl. 2617, f. 1. 1831. Anisomeridium biforme (Borr.) R. C. Harris, publication information not available.

Thallus crustose; thin, smooth, partly endophloedial; pale grey.

<u>Perithecia</u> abundant, scattered, sessile to partially subsessile, 0.3-0.5 mm wide with a \pm steep-sided shiny, black involucrellum, part of which remains as a black ring on the thallus after the rest of the ascocarp disintegrates. Paraphyses simple to slightly branched, persistent. Asci \pm cylindrical, bitunicate. <u>Spores</u> 8 per ascus, \pm uniseriate, hyaline, 1-septate, not constricted at septum, cells equal to slightly unequal or, if unequal, then wider cell also the longest cell, ends \pm pointed, 12-13 X 5-6 µm (see Figure 8).

Spot Tests: thallus K+ faint yellow.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Quercus</u> and once on <u>Pseudotsuga</u>.

Selected Specimens: 289G, 6463B.

Local Abundance and Distribution: rare; distribution poorly known, concentrated in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: probably circumtemperate but very widely distributed; in the Northern Hemisphere known from Europe, North America, China, India, Bermuda and the West Indies; in North America probably absent from the Rocky Mountains but widely distributed in temperate latitudes otherwise; also known from the Southern Hemisphere in New Zealand and South America (Harris, 1975).

<u>Remarks</u>: Recently transferred to <u>Anisomeridium</u>.

<u>ARTHOPYRENIA</u> cfr. <u>CARINTHIACA</u> J. Stein, Oesterr. Botan. Zeitschft. 63:335. 1913.

Anisomeridium cfr. carinthiacum (J. Stein) R.C. Harris, ined.

<u>Thal'lus</u> crustose; very thin, varying from very finely rimose-cracked to almost farinose; medium grey to dark grey. Alga: <u>Trentepohlia</u> (?).

<u>Perithecia</u> adnate, scattered, minute, less than 0.1 mm wide, black. Paraphyses gelatinizing. <u>Spores</u> 8 per ascis, massed, hyaline to light brownish, 1-septate with one cell slightly longer and narrower than the other, sometimes constricted at the septum, 16-18 X 6-7 µm (see Figure 8).

Spot Tests: thallus not tested.

<u>Substratum/Habitat</u>: saxicolous; collected once on a loose cobble (HCl-), but of very soft material.

Selected Specimen: 4060.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the Highlands in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct.

<u>Remarks</u>: This species was first tentatively referred to <u>A</u>. <u>saxicola</u> Mass., however, the perithecia of that species have been described as immersed and the spores as a little larger, 21-23 X 8-11 µm (Duncan, 1970). Furthermore, Hawksworth et al. (1980) stated that it may be referred in the future to <u>Pyrenocollema</u> indicating it contains blue-green algae. The local material definitely contains a eucaryotic alga although the exact genus is not certain. <u>A</u>. <u>inconspicua</u> Lahm, another European species, has smaller spores, 12-16 X 4-6 µm, but is a strict calcicole (Ozenda & Clauzade, 1970). <u>A</u>. <u>carinthiaca</u> is sometimes described as a calcicole although Harris (1975) stated otherwise. The local material differs in a number of respects from <u>A</u>. <u>carinthiaca</u> which often has a distinct black hypothallus, perithecia 0.3-0.3 mm wide, and persistent paraphyses (Harris, 1975).

All previous records of <u>A</u>. <u>carinthiaca</u> in North America have been in the eastern United States. It is reported tentatively here as new to the province.

ARTHOPYRENIA HALODYTES (Nyl.) Arn., Bericht. Bayer. Bot. Gesellsch.

1:Supplement, 121. 1891.

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Verrucaria halodytes Nyl., Memoir. Soc. Scienc. Nat. Cherbourg 5:142. 1857.

<u>Arthopyrenia</u> <u>sublitoralis</u> (Leight.) Arn., Bericht. Bayr. Bot. Gesellsch. 1, Anhang:121. 1891.

Paraphysothele halodytes (Nyl.) Keissl., Rabh. Krypt.-Fl. 9, Abt.I,

Teil 2:149. 1936.

Pyrenocollema halodytes (Nyl.) R. C. Harris, ined.

Thallus crustose; immersed in substratum.

Perithecia abundant, scattered to clustered, sessile to immersed, 0.1-0.3 mm wide, usually with a shiny, black, carbonized, rounded to irregular involucrellum which is sometimes absent or reduced in immersed pseudothecia. Ostiole occasionally visible as a single apical depression. Paraphyses present, irregularly entangled. <u>Spores</u> 8 per ascus, hyaline, oblongellipsoid, 1-septate with one cell broader, thin-walled, often difficult to observe outside ascus, 14-21 X (5-)6-8 µm (see Figure 8).

Spot Tests: thallus not tested.

<u>Substratum/Habitat</u>: primarily on <u>Balanus</u> sp. (barnacles), in the littoral zone at beaches.

Selected Specimens: 5812, 5815.

Local Abundance and Distribution: occasional; (This species was overlooked in the initial collections but subsequent checking showed it to be present at most beach sites in the subzone - abundance should probably be frequent); restricted to maritime sites.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia disjunct in the Northern Hemisphere (see Figure 70), also widespread in the Southern Hemisphere (Santesson, 1939); often described as cosmopolitan but absent from tropical and arctic shores; marine.

<u>Remarks</u>: According to Santesson (1939), <u>A</u>. <u>halodytes</u> is a truly calcicolous species found in the littoral zone on limestones or shells. He identified 61 species of molluscs and cirripeds as substrata, including snails, limpets, and barnacles. Swinscow (1965a) and Harris (1975) noted that <u>A</u>. <u>halodytes</u> is also epilithic on acidic rocks. The thallus is smooth, sometimes shiny, thin, yellow-brown to black-brown. On calcareous substrata the thallus is mainly endolithic. Hawksworth et al. (1980) stated that <u>A</u>. <u>sublitoralis</u>, which has often been included recently in <u>A</u>. <u>halodytes</u>, "may be distinct".

This species may be referred to Pyrenocollema in the future.

ARTHOPYRENIA PADI Rabenh., Lich. Eur., fasc. 14. No. 390. 1858.

Thallus crustose; thin, mainly endophloedal; greyish-brown.

<u>Pseudothecia</u> perithecia-like, abundant, scattered, subsessile, 0.1-0.2 mm wide, covered by a partially visible, shiny, black involucrellum, Ostiole occasionally visible as a single, apical depression. Pseudoparaphyses irregular, many-septate, gelatinizing or persistent. Asci pyriform, bitunicate. <u>Spores</u> 8 per ascus, massed, hyaline, oblong-ellipsoid, 1-septate, eventually constricted at the septum, one cell broader than the other, ends <u>+</u> rounded, 14-21 X 4-6 µm (see Figure 8).

Spot Tests: thallus not tested.

<u>Substratum/Habitat</u>: corticolous; collected on <u>Alnus</u>, <u>Holodiscus</u>, and <u>Acer macrophyllum</u>.

Selected Specimens: 1731, 3189B.

Local Abundance and Distribution: infrequent; scattered throughout the subzone, not collected in the adjacent zones.

<u>World Distribution</u>: perhaps circumtemperate in the Northern Hemisphere; according to Harris (1975), it is uniformly distributed from coast to coast
in the northern states; also present in the Southern Hemisphere.

<u>Remarks</u>: This species is commonly called <u>A</u>. <u>punctiformis</u> Mass. To avoid nomenclatural problems Harris (1975) suggested using <u>A</u>. <u>padi</u> instead.

ARTHOPYRENIA PLUMBARIA (Stizenb.) R. C. Harris, ined.

Verrucaria plumbaria Stizenb., Erythrea 3:44. 1895.

Porina plumbaria (Stizenb.) Hasse, Contr. U.S. Natl. Herb. 17:12. 1913.

Thallus crustose; endophloedal. Algae present.

<u>Pseudothecia</u> perithecia-like, abundant, scattered, with shiny, black involucrellum, 0.2-0.4 mm wide. Apical pore usually distinct. Asci cylindrical to narrowly ovate or obovate, bitunicate. Paraphyses <u>+</u> simple, slender, free, persistent. <u>Spores</u> (4-)8 per ascus, uniseriate to biseriate, hyaline, <u>+</u> oblong-ellipsoid, l-septate, constricted at central septum, also spore wall constricted mid-lumina of both cells or wall thickened mid-lumina, $15-20 \times 4-6.5 \mu m$ (see Figure 8).

Spot Tests: thallus not tested.

<u>Substratum/Habitat</u>: corticolous; collected twice on <u>Pseudotsuga</u>; also one collection of J. Macoun (UBC) on 'wild cherry'.

Selected Specimens: 1535, 2417.

Local Abundance and Distribution: infrequent; distribution poorly known; rather an inconspicuous species, probably more common than the few collections indicate.

<u>World Distribution</u>: western North American endemic (see Figure 55); from southern California to the Queen Charlotte Islands, British Columbia; never very far inland according to Harris (1975) but reported as widespread on "interior" Pseudotsuga (Funk, 1980). <u>Remarks</u>: Reported as very common on the bark of healthy, young <u>Pseudotsuga</u> (Funk, 1980).

ARTHOTHELIUM (Nyl.) Zahlbr.

Thallus and ascocarps as in <u>Arthonia</u>. Spores submuriform to muriform, generally larger than in Arthonia.

The North American species are in need of review since Willey (1890) is the most recent treatment. Several species have been described from California by Nylander and these need to be re-evaluated; this may well affect the understanding of the local flora.

References: Redinger (1936-38), Willey (1890), Coppins and James (1979).

1.	Apotheci K+ purpl	a reddish-brown to black; epithecium e-red <u>A</u> . <u>MACOUNII</u>
1.	Apotheci	a black; epithecium K2
	2.	Spores not usually muriform, 5- to 6- septate with a large end cell; epithecium reddish-brown; hymenium IKI+ blue <u>A</u> . <u>ILICINUM</u>
	2.	Spores muriform; septa evenly spaced, no enlarged end cell; epithecium black; hymenium IKI+ orange-red <u>A</u> . cfr. <u>SPECTABILE</u>

<u>ARTHOTHELIUM</u> ILICINUM (Tayl.) P. James, Lichenologist 3:97. 1965. <u>Arthonia ilicina Tayl., Flora Hibernica 2:105. 1836</u>.

<u>Thallus</u> crustose; thin, smooth, nearly transparent and glossy; green to greenish-grey.

Pseudothecia abundant, + scattered, immersed, level with substratum,

0.6-1.1 mm wide. Margins absent, although thin shreds of thallus sometimes present on young ascocarps. Disc \pm round, plane, black or brown-black. Hymenium 75 µm high, hyaline to fulvous-brown; epithecium reddish brown; hypothecium reduced, coloured like hymenium. Asci ovoid, bitunicate. <u>Spores</u> 8 per ascus, hyaline, later browning, ovoid, often curved, only observed as (1-)5- to 6-septate, with one cell at the larger end accounting for up to 1/3 of the length of the spores, 25-36 X 9-13 µm (see Figure 8).

<u>Spot Tests</u>: thallus K+ yellow to light orange; hymenium IKI+ bluish with spores and asci turning yellow-orange; epithecium K-.

Substratum/Habitat: corticolous; collected only on Alnus.

Local Abundance and Distribution: rare; distribution poorly known.

<u>World Distribution</u>: western North America-Europe disjunct; in Europe reported from Britain, Ireland, and the Azores (Coppins & James, 1979) and in western North America only from coastal British Columbia (Brodo, 1971; Benton et al., 1977).

<u>Remarks</u>: This species has been treated traditionally as an <u>Arthonia</u> but the large size of the spores plus their clavate shape suggested a transfer to <u>Arthothelium</u> despite the lack of longitudinal septa (Richardson & Morgan-Jones, 1964). Poelt (1969) retained it in <u>Arthonia</u>. Two recently described varieties that possess longitudinal septa in the tail portion would appear to support the genus transfer. However, at least one variety may be a species in its own right and is, in fact, very close to A. macounii.

The spores of the local material start out simple with the first septum cutting off the large end cell, then the other septa form in the narrower tail, progressing towards the tip until six or more septa have been formed. Most spores are at least 4- to 5-septate before they can be forced out of the ascus. No (sub-) muriform spores were observed.

ARTHOTHELIUM MACOUNII (Merr.) Noble, ined.

....**:**

Arthonia macounii Merr., Ottawa Naturalist 28:35. 1914.

<u>Thallus</u> curstose; thin, smooth, matt or slightly shiny; pale greenishgrey, smoke grey, or medium grey.

<u>Pseudothecia</u> common, scattered to clustered, subsessile to nearly sessile, 0.5-0.7 (-1.3) mm wide. Margins absent. Disc <u>+</u> round, plane to occasionally slightly convex, matt, roughened, black or reddish-brown. Hymenium 75-80 μ m high, light to dark reddish brown with some hyaline areas; epithecium dark reddish-brown with uppermost part black, subgranular; hypothecium reddish-brown or red. Asci ovate, bitunicate. <u>Spores</u> 8 per ascus, hyaline, eventually brown, ellipsoid-clavate, often curved, muriform with 5to 7- longitudinal septa and (0-)1- to 2-transverse septa in some cells, the end cell always enlarged and non-septate, accounting for up to 1/3 of the spore's length, (25-)28-32(-38) X (8-)10-13 μ m (see Figure 8).

<u>Spot Tests</u>: Epithecium K+ purple-red; hymenium IKI+ red; thallus K-, C-.

<u>Substratum/Habitat</u>: corticolous; collected twice, once on <u>Quercus</u> and once on <u>Taxus</u> <u>brevifolia</u>.

Selected Specimens: 1100, 1243C.

Local Abundance and Distribution: rare; distribution poorly known, so far known from only the northern tip of the Saanich Peninsula and nearby Prevost Island; several attempts to recollect this species from the type locality, Sidney, have failed; not collected outside the CDFD subzone.

<u>World Distribution</u>: western North American endemic (but see below); described from Vancouver Island, British Columbia, and not reported since.

<u>Remarks</u>: <u>Arthonia macounii</u> was described by Merrill (1914) from material collected by J. Macoun at Sidney, Vancouver Island. The type collection has been examined and actually consists of three bark patches glued to one

piece of cardboard. One patch is primarily Opegrapha herbarum. The other two parches are both Arthothelium species but two different species. One is A. spectabile. It has ellipsoid spores, 30-35 X 12-14 µm with 7-8 longitude inal septa and 1-2 latitudinal septa, epithecium K-, and ascocarps black, up to 0.5 mm wide. The second Arthothelium species has similar-sized spores but they are clavate with the end cell enlarged and accounting for up to 1/3 of the spore length; very few latitudinal septa are present and then only in the tail portion; the epithecium is K+ purple, and; the ascocarps are reddish brown, 0.5-1.3 mm wide. This is A. macounii. However, the type description was notably inaccurate on several characters. The spores were reported as 40-47 X 13-14 µm. None of the spores examined in the type specimen even approached this length. The large end cell of the spores is noted "at times irregularly divided" but this was never observed either and perhaps was based on the spores of the specimen of A. spectabile. Finally, the ascocarps were described as 0.1-0.5 mm wide. This would definitely appear to be based also on A. spectabile.

<u>Arthothelium ilicinum</u> var. <u>reagens</u> was recently described from Great Britain (Coppins & James, 1979). The spores and epithecial reaction in K are essentially the same as in the local <u>A. macounii</u>. The two types need to be compared.

<u>ARTHOTHELIUM</u> cfr. <u>SPECTABILE</u> (Flot.) Mass., Ricerch. Auton. Lich.:54. 1852. <u>Arthonia spectabilis</u> Flot., Lichenogr. Europ. Reform.:371. 1831.

Thallus crustose; very thin, smooth; pale olive grey to greyish-olive.

<u>Pseudothecia</u> common, <u>+</u> scattered, immersed, becoming sessile or subsessile, 0.3-1.0 mm wide. Margins absent, but with shreds of thallus sometimes adhering to surface of young ascocarps. Disc plane to slightly convex, round to slightly irregular, black. Hymenium fulvous to mottled brown, up to

120 μm high; epithecium black, thick, up to 25 μm high; hypothecium coloured like hymenium, almost absent. Asci ovoid, bitunicate. <u>Spores</u> 8 per ascus, hyaline turning brown, ellipsoid-ovoid, muriform with 6-9 longitudinal septa and 1-3 latitudinal septa, 26-42 X 10-15 μm (see Figure 8).

<u>Spot Tests</u>: thallus K+ yellow-orange; hymenium IKI+ yellow-red; epithecium K-.

<u>Substratum/Habitat</u>: corticolous; collected three times on <u>Alnus</u> and once on <u>Taxus</u> <u>brevifolia</u> with Arthothelium macounii.

Selected Specimens: 1196, 3750B.

Local Abundance and Distribution: infrequent; appears concentrated in the southern Gulf Islands and adjacent tip of the Saanich Peninsula; collected only in the CDFD subzone.

<u>World Distribution</u>: circumtemperate in the Northern Hemisphere (Ozenda & Clauzade, 1970).

<u>Remarks</u>: <u>A</u>. <u>spectabile</u> is noted for its thick, black epithecium up to 100 μ m thick (Ozenda & Clauzade, 1970). The local material does, indeed, have a black epithecium which is often thickened but not as markedly as described. The spores of <u>A</u>. <u>spectabile</u> (as illustrated in Ozenda & Clauzade, 1970; Redinger, 1936-38) are <u>+</u> perfectly ellipsoid while the spores of the shape of the latter closely approaches those of <u>A</u>. <u>ilicinum</u> although they are not as noticeably clavate. The spores are always completely muriform, lacking any septate stages, which seems to preclude the possibility of the material actually being <u>A</u>. <u>ilicinum</u>. Additionally, the black epithecium and IKI+ orange hymenium support the separation.

ASPICILIA Mass.

Thallus typically cracked-areolate crustose, but some taxa also foliose or fruticose; effuse to radiately lobed or margined; hypothallus absent to present marginally.

Ascocarp an apothecium, initially immersed in the thallus and sometimes remaining immersed. Thalline margin present, indistinct to distinctly raised and thickened. Disc typically black, often white pruinose, often concave becoming plane. Epithecium usually sordid green (HNO₃+ green = '<u>Aspicilia</u> green'); paraphyses typically unbranched, often moniliform at the apices. Spores 4-8 per ascus, hyaline, simple, ellipsoid.

Usually saxicolous, occasionally terricolous.

<u>Aspicilia</u> was formerly regarded as a section of <u>Lecanora</u>. It is in serious need of monographic treatment. There are many taxa with few absolute, qualitative characters combined with a wide morpological amplitude produced by environmental variations. Complete descriptions are lacking for most species.

The present treatment of local <u>Aspicilia</u> is by necessity incomplete. The apparently more or less continous variation and the currently poor understanding of <u>Aspicilia</u> make separation of all but the most distinctive species purely tentative. Most of the undetermined material lies close to <u>A. caesiocinerea</u> with a K-, cracked-areolate thallus, usually immersed apothecia with (sub-) moniliform paraphyses.

References: Magnusson (1939b).

1.	Thallus	placoidal <u>A. MELANASPIS</u>
1.	Thallus	crustose, lacking convex marginal lobes 2
	2.	Thallus scurfy-isidiate <u>A</u> . <u>LEPROSESCENS</u>
	2.	Thallus non-isidiate
3.	Areoles	distinctly separate and scattered 4
3.	Areoles or if se	not distinctly separate (cracked-areolate) eparate then contiguous and not scattered
	4.	Areoles white pruinose; medulla K-; substratum calcariousA. <u>A</u> . <u>CONTORTA</u>
	4.	Areoles epruinose although sometimes scabrid; medulla K+ red (crystals under LM); substratum non-calcareousA. cfr. SIPEANA
5.	Thallus	K+ red <u>A</u> . <u>CINEREA</u>
5.	Thallus	K <u>A</u> . <u>CAESIOCINEREA</u>

ASPICILIA CAESIOCINEREA (Nyl. ex Malbr.) Arn., Verhandl. zool. -bot.

Gesellsch. Wien, 36:67. 1886.

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Lecanora caesiocinerea Nyl. ex Malbr., Bull. Soc. Amis Asi. Nat. Rouen 4:320. 1869.

<u>Thallus</u> crustose; cracked-areolate, continuous. Areoles irregularly angular, \pm abruptly steep-sided, contiguous, 0.4-0.9 mm wide; moderate to thick, plane to often slightly uneven; light to medium grey or bluish-grey, often scabrid.

Apothecia common, scattered, 1(-4) per areole, initially immersed, becoming level with areoles or sometimes slightly adnate, 0.5-0.9 mm wide. Thalline margin initially obscure when apothecia subsessile but becoming more obvious with age, often distinguished by a paler (scabrid or sometimes a light pruinia, especially when young) or a darker (with age, especially when slightly raised) coloration than the thallus. Disc initially concave becoming plane, black, Hymenium (100-) 135-150 µm high; epithecium (green-) black and sordid greenish below, fading down the hymenium; paraphyses becoming branched and moniliform towards the apices. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 20-23 X 10-12 µm.

Spot Tests: thallus K-, C-, KC-, P-, IKI-.

<u>Substratum/Habitat</u>: saxicolous; collected primarily on sandstone but also on conglomerate and igneous rocks.

Selected Specimens: 864, 2473.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both inland and maritime sites; also collected in the adjacent zones.

<u>World Distribution</u>: probably circumboreal; described as circumarcticalpine by Thomson (1979), however, in Europe Magnusson (1939b) described it as widely distributed but absent along the Arctic Ocean and probably also absent along the Mediterranean and also with a maximum elevation of 1100 m.

<u>Remarks</u>: there are some specimens among the local material that identify to <u>A</u>. <u>caesiocinerea</u> sens. str. There are also a considerable number of specimens that come closest to <u>A</u>. <u>caesiocinerea</u>, however, their inclusion within this species is not completely satisfactory. There appear to be intermediates of all characters involved and specimens that extend over substratum discontinuities often display two extremes of the same character. For example, one thallus on hard conglomerate pebbles is thin, little- and incompletely cracked but on the adjoining cementing sandstone becomes abruptly thickly cracked-areolate or even verruculose-areolate.

According to Magnusson (1939b) <u>A</u>. <u>caesiocinerea</u>, "like most common lichen species" is "liable to great variability both as to morphology and anatomy" and is therefore "difficult to characterize". He went on to say the

main characters of this species are "its bluish-grey colour, its prominent wall round the young apothecia, a transparent cortex with large, often elongated, thin-walled cells where the uppermost, coloured stratum assumes a rosebrown colour in KOH, often extending to most parts of the cortex, a high hymenium, 120-150 μ m, large spores, broadly ellipsoid cells of the paraphyses and short conidia". However, he admitted that "its colour varies from dark brown over plumbeous gray to grayish white, the shape and the size of the areolae from very thick, verrucose, uneven, or even squamulose ones to very thin and smooth ones, separated by wide and deep or very narrow cracks, the apothecia from deeply immersed with a distinct, prominent, even flexuose margin to almost sessile with a hardly noticeable one, the disc is scabrid or smooth".

Older floras for western North America reported A. gibbosa (Ach.) Koerb. as among the most common species. Duncan (1970) characterized this latter species as very variable and often hard to separate from A. caesiocinerea but typically a darker grey(-brown) with the edges of the areoles more rounded than steep-sided. A. gibbosa is often distinguished by its K+ red cortex (Ozenda & Clauzade, 1970; Magnusson, 1939b) although Magnusson (op. cit.) stated that, although the reaction is "typically positive", it may escape attention in thin sections or on a too rapid examination, but admitted that sometimes the reaction "is not always reliable or obtainable only in parts of the thallus. Magunsson also admitted that "the limitation of L. gibbosula" (= A. gibbosa) "against the nearest related species, cupreogrisea" (= A. cupreogrisea (Th. Fr.) Hue) "and caesioceinerea has not been established without some difficulties. And there is still a possibility that L. gibbosula is an extreme form of cupreogrisea grown under unfavourable conditions. The structure of the thallus and the apothecia, as also the size of the pycnoconidia is on the whole very similar in the three species".

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ASPICILIA CINEREA (L.) Koerb., Syst. Lich. Germ.:164. 1855. Lichen <u>cinereus</u> L., Mantissa 1:132. 1767.

Lecanora cinerea (L.) Somm., Suppl. Fl. Lapp.:99.1826.

<u>Thallus</u> crustose; areolate; continuous. Areoles completely crackedseparate, distinct, angular, straight-edged, continuous, moderately thick, <u>+</u> flat, smooth, almost shiny; brownish grey and white, whiter around apothecia and slightly whiter around edge of some areoles. Hypothallus absent.

Apothecia immersed, remaining so, 1 (-3) per areole, 0.3-0.5 mm wide. Proper margin not observed; thalline margin initially only slightly discernible from remainder of areole but becoming slightly raised, moderately thick, and lighter grey than rest of thallus, persistent. Disc concave to almost plane, black, epruinose. Hypothecium hyaline; epithecium sordid golden(-green) brown; hymenium hyaline below, pale green above, 120 µm high; paraphyses slender becoming slightly branched above, very top cells moniliform (3 or more globose cells in a row). <u>Spores</u> 8 per ascus, simple, globose-ellipsoid, hyaline, 30-23 X 12-16 µm.

<u>Spot Tests</u>: (medulla) K+ red crystals under LM, KC-, C-, P-, IKI-; epithecium HNO3+ green.

<u>Substratum/Habitat</u>: saxicolous; collected once on sandstone (HC1-). <u>Selected Specimen</u>: 1904B.

Local Abundance and Distribution: rare; distribution poorly known, collected once at a higher elevation inland on Mayne Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

World Distribution: circumboreal-circumtemperate (Thomson, 1979).

<u>Remarks</u>: The spores of the local material are slightly larger than those usually given for <u>A</u>. <u>cinerea</u>, i.e., 12-20 X 8-10 µm (Ozenda & Clauzade, 1970),

14-21 X 8-12 μ m (Thomson, 1979), but just within that given by Duncan (1970) of 15-23 X 8-14 μ m. Ozenda and Clauzade (op. cit.) recognized <u>A. intermutans</u> (Nyl.) Arn. as more or less identical to <u>A. cinerea</u> except for larger spores (22-28 X 12-14 μ m) and smaller conidia (7-9 X 1 μ m) compared with 12-16 X 1 μ m for conidia of A cinerea. Conidia were not observed in the local collection.

Descriptions of <u>A</u>. <u>cinerea</u> vary in a number of respects. Duncan (1970) stated the K+ red reaction is confined to the cortex although Ozenda and Clauzade (1970) stated that the medulla is also positive. The latter also stated that a positive cortical reaction but negative medulla reaction is found in <u>A</u>. <u>gibbosa</u> (Ach.) Koerb. and <u>A</u>. <u>cupreogrisea</u> (Th. Fr.) Hue. Both Ozenda and Clauzade (op. cit.) and Thomson (1979) stated the hypothallus was typically well-developed but this character was not observed in the single, small local collection.

ASPICILIA CONTORTA (Hoffm.) Kremp., Denkschrift. Kgl. Bayer. Botan. Gesellsch. 6(2):175. 1861.

Verrucaria contorta Hoffm., Descr. Pl. Crypt. 1:97, pl. 22, f. 3,4. 1790. Lecanora contorta (Hoffm.) J. Stein., Verhandl. zool. -bot. Gesellsch. Wien

65:199. 1915.

<u>Thallus</u> crustose; areolate; effuse. Areoles usually dispersed or somewhat contiguous, roughly circular or occasionally subcrenulate, plane to slightly convex, or raised in the middle, 0.5-1.2 mm wide; light (green-) grey to dark grey-black, typically completely white pruinose. Hypothallus absent.

<u>Apothecia</u> common, 1(-2) per areole, initially immersed, sometimes becoming more elevated and then the entire areole resembling a small volcano. Thalline margin thin becoming thick, raised, <u>+</u> radially cracked, persistent, white pruinose or occasionally the sides epruinose and then grey-black.

although top of margin still pruinose. Disc plane, round to a little elongated, black and epruinose or thickly white pruinose. Paraphyses coherent, thin; epithecium pale sordid green; hymenium 140-170 µm high, hyaline below. Spores 6 per ascus, simple, hyaline, sub-globose, 19-27 X 15-21 µm.

<u>Spot Tests</u>: thallus K-, C-, KC-, P-, IKI-; hymenium IKI+ blue (or yellow-green).

<u>Substratum/Habitat</u>: saxicolous; collected twice on calcareous sandstone and observed once,but not collected (Butchart Gardens), on limestone; the latter a very sunny, exposed situation and accompanied by <u>Placynthium nigrum</u>.

Selected Specimens: 1901, 2103.

Local Abundance and Distribution: infrequent; scattered throughout the southern part of the CDFD subzone at both maritime and inland sites, not collected in the adjacent zones.

<u>World Distribution</u>: perhaps circumtemperate; Ozenda and Clauzade (1970) describedits distribution as "Northern Hemisphere"; Fink (1935) stated it is found throughout the United States; also reported from "Israel (Galun, 1970) and temperate regions of Asia.

ASPICILIA LEPROSESCENS (Sandst.) Hav., Bergens Mus. Aarbog, Hefte 1,

Naturvid. raekke, 2:29. 1918.

Lecanora <u>leprosescens</u> Sandst., Verhandl. Botan. Verein. Provinz Brandenburg 45:131. 1903.

<u>Thallus</u> crustose; cracked areolate; continuous. Areoles plane or occasionally somewhat convex, usually with the upper surface minutely cracked to give a scurfy appearance, the edges of the areoles often becoming isidiate; isidia few to abundant, minute and papillate or larger, flattened-coralloid, constricted variously along their length, becoming bent over, \pm hollow or opening along one side, concolorous with thallus or often blackening; white-

grey to medium grey. Hypothallus absent or visible only at margin, narrow, shiny, black.

<u>Apothecia</u> common, scattered, immersed or subsessile initially becoming subsessile or almost adnate, 1(-2) per areole, 0.2-0.5 (-1.0) mm wide; isidia often reduced in vicinity. Thalline margin thin to thick, smooth to occasionally papillate, <u>+</u> radially cracked, often circularly cracked around the base with age, sometimes becoming partially excluded to expose proper margin. Proper margin occasionally observed between disc and thalline margin; black, thick, white pruinose. Disc concave becoming plane or plane from start; round to often a little irregular, black, <u>+</u> light white pruinose Hypothecium hyaline, 35-60 µm high; epithecium green or sordid green; paraphyses branched and coherent especially towards apices; hymenium 80-130 µm high, hyaline below. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid or ellipsoidoblong, 17-23 X 11-13 µm.

<u>Spot Tests</u>: thallus K<u>+</u> yellow, C-, KC-, P+ yellow (<u>+</u> turning orange); IKI-; hymenium IKI+ blue; some thallus sections K<u>+</u> red needle-shaped crystals under LM.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone and conglomerate especially in the supralittoral zone.

Selected Specimens: 503, 1466.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone, especially but not exclusively at maritime sites; not collected in the adjacent zones.

World Distribution: western North America-Europe disjunct.

<u>Remarks</u>: The local material was initially identified as <u>A</u>. <u>mastrucata</u> (Ach.) Th. Fr. Ozenda and Clazade (1970)described <u>A</u>. <u>mastrucata</u> as typically lobed on the margins, dark grey to olive grey, with a conspicuous, delimiting, black hypothallus, verrucose with papillate, branched or simple isidia, and usually, collected at higher elevations, over 2,000 m. Wetmore (1968) reported <u>A. mastrucata</u> as new to North America from South Dakota and Wyoming. The thallus is described as sorediate and containing norstictic acid. Ozenda and Clauzade (op. cit.) agreed that most forms are K+ yellow turning red.

In two of the local collections the thallus did produce red, needleshaped crystals with KOH but the reaction was very slow with few crystals produced. No colour change was visible under the DM. The P+ yellow (\pm turning orange) was much more reliable.

There are no reports of <u>A</u>. <u>leproscescens</u> containing norstictic acid; however, the slow reaction might quite possibly go unnoticed. Indeed, there were only two, very short, abbreviated descriptions available for this species. Duncan (1970) described the thallus as scurfy, composed of <u>+</u> papillose or flattened granules with a conspicuous green-grey hypothallus, and small urceolate apothecia with pseudothalline, crenulate, and often granular margin and spores subglobose to ellipsoid, 17-28 X 16-20 μ m. Fletcher (1975a) described the thallus as pale grey, scabrid-tartareous, centrally granular-squamulose with dark hypothallus and urceolate, black apothecia, and typically on nutrient-rich rocks in the xeric-supralittoral zone.

The local material requires comparison with European specimens since both the spore size and shape and chemistry require checking.

A. leprosescens is tentatively reported as new to the province.

<u>ASPICILIA MELANASPIS</u> (Ach.) Poelt & Leuckert, Willdenowia 7:25. 1973. <u>Parmelia melanaspis</u> Ach., Meth. Lich.: 196. 1803. Lecanora melanaspis Ach., Lich. Univ.: 427. 1810.

<u>Thallus</u> foliose-placoidal; orbicular, up to 3 cm broad. Centrally areolate, becoming lobed marginally. Lobes closely adnate, 0.5-1.0 mm wide, palmately branched, contiguous to imbricate, flat to slightly arched, smooth

shiny to dull, often transversely cracked; centrally pearl grey or medium grey, marginally whiter; below pale coloured, ecorticate.

Apothecia common towards center, adnate to subsessile, 0.8-1.6 mm wide. Thalline margin thick, often slightly blackened near disc. Disc plane, black, lightly white pruinose. Hymenium 75-80 μm high; paraphyses coherent; epithecium black; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid-oblong, 11-13 X 7-9 μm.

<u>Spot Tests</u>: thallus K+ orange (slow), C-, KC-, P+ yellow turning orangered; hymenium IKI+ yellow or orange-red in part; hypothecium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected once on a vertical, exposed sandstone surface.

Selected Specimen: 1614.

Local Abundance and Distribution: rare; distribution poorly known; collected once from a higher elevation inland on Saturna Island in the southern part of the CDFD subzone; not collected in the adjacent zones.

World Distribution: circumarctic-circumtemperate (Thomson, 1979).

<u>Remarks:</u> <u>A. melanaspis</u> belongs to the <u>A. radiosa-A. alphoplaca-A. thamnoplaca</u> group (Poelt, 1958) that was formerly commonly referred to section <u>Placodium</u> in <u>Lecanora</u> because of the placoidal thallus. The <u>A. radiosa</u> group is often separated in keys according to spot tests reactions with K and P. However, Hermann et al. (1973) showed that all the species of the group tested in their study, namely <u>A. alphoplaca</u> (Wahlenb. ex Ach.) Poelt & Leuck., <u>A. melanaspis, A. praeradiosa</u> (Nyl.) Poelt & Leuck., and <u>A. radiosa</u> (Hoffm.) Poelt & Leuck., had the ability, at least occasionally, to produce norstictic acid in varying concentrations. The spot tests for the group are therefore not reliable species characters as the spot tests would vary from K- to K+ yellow turning red, and P- to P+ yellow. Hermann et al. (1973) also reported that A. parasitica B. de Lesd. produced stictic acid occasionally, which would cause a K+ yellow, P+ orange reaction. This may explain the report of A. <u>melanaspis</u> as K+ yellow and P+ red in Poelt (1969).

<u>A. melanaspis</u> is reported here as new to the province.

[LECANORA cfr. SIPEANA H. MAGN.], Meddel. Göteborgs Bot. Trad. 13:243. 1939.

<u>Thallus</u> crustose; scattered verrucose-areolate. Areoles typically smoothly rounded with larger ones becoming more irregular and verruculose, usually scattered and separate or occasionally slightly contiguous, adnate becoming short-stalked, 0.4-0.9 mm wide; medium grey with a slightly scabridpruinose appearance. Hypothallus not observed.

<u>Apothecia</u> scarce, 1 per verruca, clustered, initially sub-sessile becoming adnate on sides or tops of verrucae, 0.4-0.8 mm wide. Thalline margin thick, raised, <u>+</u> smooth or occasionally slightly irregular, initially white pruinose but quickly epruinose and concolorous with thallus, persistent. Proper margin occasionally visible inside the thalline margin; black, thin. Disc initially concave becoming plane, smooth becoming roughened, black, epruinose. Hypothecium hyaline, often conical, especially in young apothecia; hymenium 125-150 µm high; epithecium (green-) black fading sordid green immediately below; paraphyses tightly coherent and branched towards apices, septate, becoming moniliform towards apices. <u>Spores</u> scarce in specimen examined, ellipsoid, hyaline, simple, 20-23 X 10-11 µm.

<u>Spot Tests</u>: medulla and perhaps also cortex K+ yellow turning red (red, needle-shaped crystals under LM), C-, KC-, P-, IKI-.

<u>Substratum/Habitat</u>: saxicolous; collected once on noncalcareous sandstone.

Selected Specimen: 1615.

Local Abundance and Distribution: rare; distribution poorly known; collected once at a higher elevation inland on Saturna Island in the southern

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part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; described from Oregon.

<u>Remarks</u>: The single local specimen agrees very closely with the published description of <u>L</u>. <u>sipeana</u> not differing in any major respects. However, the local specimen is not abundantly fertile and additional material would be desirable so additional spores can be examined. Comparison with the type specimen is also necessary in this little known species.

There are, additionally, two European species that are K+ red and have a verruculose thallus which, although not as closely matched to the local material, warrant further comparison. <u>A</u>. <u>mauritii</u> Hue is described by Ozenda & Clauzade (1970) as irregularly glebulose-verruculose although the thallus colour is very dark, almost black, and the apothecia are immersed and the spores 12-18 X 8-10 µm. <u>Lecanora (Aspicilia) lecideoides</u> Hue is described as pale grey with convex, subdiscrete areoles and a black prominent margin al-though the hymenium is only 90 µm high (Magnusson, 1952).

According to Magnusson (1939b) <u>L</u>. <u>sipeana</u> partly resembles <u>A</u>. <u>arctica</u> but the former has more scattered verrucae, shorter conidia (5-7 μ m long, instead of 15-20 μ m in <u>A</u>. <u>arctica</u>), and higher hymenium. The conidia were not observed in the local material.

There is also some similarity of <u>L</u>. <u>sipeana</u> to <u>A</u>. <u>gibbosa</u> which has forms with rounded, scattered verrucae but the K reaction in the latter species is confined to the cortex and algal layer and lacking in the medulla. It sould be mentioned that although the local material has a K+ red reaction of the medulla that some of the verrucae were very slow to react, if at all, and that adjacent sections, especially thin sections, of the same verrucae would be negative while the adjacent thick sections reacted positive quickly.

The new combination in Aspicilia is not proposed here since the type has

not been examined and the local material is only tentatively referred to this species.

L. sipeana has not been previously reported from the province.

BACIDIA de Not.

P

Thallus crustose. Ascocarp an apothecium. Proper margin present. Disc variously coloured. Paraphyses simple to sparsely branched. Spores 8 per ascus, hyaline, acicular or oblong-fusiform, 3- to many septate.

All substrates.

Several ascolocular species formerly considered part of <u>Bacidia</u> have been transferred recently to Micarea and Scoliciosporum.

A review of this genus, especially for North American species, is needed.

References: Vainio (1922), Vézda (1961).

1.	Spores acicular, <3 µm wide 2
1.	Spores fusiform, >3 µm wide14
	2. Spores curled 3
	2. Spores <u>+</u> straight 4
3.	Spores 60-85 X 2.5 µm
3.	Spores 20-35(-45) X 2-2.5 µm <u>SCOLICIOSPORUM</u> cfr. <u>PERPUSILLUM</u> (p.688)
	 Hypothecium dark brown to black; paraphyses branched but free; hymenium IKI <u>LECANACTIS</u> (p.331)
•	 Hypothecium hyaline, fulvous to light brown; paraphyses simple, coherent; hymenium IKI+ blue

5.	Saxicolou	s 6
5.	Corticolo	us 11
	6.	Thallus granulose-isidiate; shaded, maritime rocks; often sterile <u>B</u> . <u>SCOPULICOLA</u>
	6.	Thallus not isidiate; maritime or not; commonly fertile
7.	Apothecia	black; spores <25 µm long; maritime8
7.	Apothecia not marit	light brown to tan; spores >25 µm long; ime
	8.	Thallus thick and continuous; spores truly acicular; <u>Verrucaria</u> zone
	8.	Thallus thin or scattered/grouped areoles; spores actually narrowly fusiform; <u>Xanthoria</u> - <u>Caloplaca</u> zone
9.	Thallus s	cant, dark grey-brown #1
9.	Thallus well-developed, grouped to rosette areoles, light brown to pinkish-brown	
	10.	Calciphobe; near freshwater <u>B</u> . <u>INUNDATA</u>
	10.	Calcicole <u>B</u> . <u>UNKNOWN</u> <u>#2</u>
11.	Apothecia	a red, K+ purple <u>B. HERREI</u>
11.	Apothecia	a orange-brown, tan, or black; K 12
	12.	Thallus isidiate-granulose, yellow; apothecia orange-brown
	12.	Thallus thin or indistinct, variously coloured but not yellow; apothecia tan-brown or black
13.	Apothecia epithecia	a black; spores 3-septate, 17-23 X 2.5 µm; µm green <u>B</u> . <u>IGNIARII</u>
13.	Apothecia 40-55 X 2	a tan to yellow-brown; spores 5- to 7-septate, 2 μm <u>B</u> . <u>ARCEUTINA</u>
	14.	Hypothecium red-brown above <u>MICAREA</u> <u>MELAENA</u> (p. 481)
	14.	Hypothecium hyaline to fulvous15
15.	Spores 2	-septate; maritime rocks <u>ARTHONIA</u> <u>INTEXTA</u> (p. 83)
15.	Spores 3	- or more septate

	16. Apothecia orange-brown; spores 14-19 X 5-8 μm; epithecium yellowish-brown <u>B</u> . <u>SPHAEROIDES</u>
	16. Apothecia tan to blackish17
17.	Paraphyses simple; thallus greyish or indistinct; epithecium C
17.	Paraphyses branched; thallus somewhat thickened, green, verruculose; epithecium C+ red <u>MICAREA</u> <u>PELIOCARPA</u> (p.480)
	18. Spores 13-17 X 4-5 µm; apothecia mottled; margin lighter coloured <u>B. NAEGELII</u>
	18. Spores 17-23 X 2.5 μ m; apothecia and margin black
19.	orticolous <u>B</u> . <u>IGNIARII</u>
19.	axicolous
	20. Thallus very poorly developed, almost absent; dark grey-brown <u>B. UNKNOWN #1</u>
	20. Thallus well-developed, of clustered to rosette areoles, light brown to pinkish-brown <u>B</u> . <u>UNKNOWN</u> <u>#3</u>

BACIDIA ALASKENSIS (Nyl.) Zahlbr., Cat. Lich. Univ. 4:171. 1927. Lecidea alaskensis Nyl., Bull. Soc. Linn. Normand., ser. 4, 1:283. 1887.

<u>Thallus</u> crustose; determinate, up to 8 cm broad or larger, thick (0.5-2 mm thick), deeply areolate-cracked but not cracked completely through thallus; light grey, light purplish-grey but more commonly mottled with tints of grey, tan, black, and/or purple.

<u>Apothecia</u> common, <u>+</u> scattered, adnate, 0.6-1.0(-1.5) mm wide. Proper margin even and entire, usually very inconspicuous and excluded early; black. Disc plane to slightly convex, round, matt, black, epruinose. Hypothecium hyaline; epithecium medium to dark brown or almost red-brown; hymenium 55-70 μ m high; paraphyses simple, coherent at tips. <u>Spores</u> 8 per ascus, hyaline, acicular, 3-septate, 23-25 (-30) X 2.5-3 μ m (see Figure 9).

<u>Pycnidia</u> common, tan to black, immersed; pycnospores arcuate, hyaline, 12-19 X 0.5 μ m.

Figure 9. Selected spores of <u>Bacidia</u> and <u>Scoliciosporum</u>. Collection numbers of specimens are given in brackets.

- A. <u>Bacidia</u> <u>alaskensis</u> (5174)
- B. <u>Bacidia arceutina</u> (4133A)
- C. <u>Bacidia herrei</u> (5488)
- D. <u>Bacidia igniarii</u> (3008)
- E. <u>Bacidia inundata</u> (6395)
- F. <u>Bacidia laurocerasi</u> (1221B)
- G. <u>Bacidia naegelii</u> (2733E)
- H. Bacidia <u>rubella</u> (882B)
- I. <u>Bacidia</u> <u>scopulicola</u> (179B)
- J. <u>Bacidia</u> <u>sphaeroides</u> auct. (3996)
- K. <u>Bacidia unknown #1</u> (1752B)
- L. <u>Bacidia</u> <u>unknown</u> <u>#2</u> (7286)
- M. <u>Bacidia</u> <u>unknown</u> <u>#3</u> (1355)
- N. <u>Scoliciosporum</u> cfr. <u>perpusillum</u> (3678B)



<u>Spot Tests</u>: epithecium K-, C-; hymenium IKI+ blue; thallus K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: saxicolous; collected mainly on igneous seashore rocks just at the upper edge of the <u>Verrucaria</u> zone; collected once on sandstone in sterile condition.

Selected Specimens: 4171, 5174.

Local Abundance and Distribution: infrequent; maritime sites at the very south and north of the subzone, common at maritime sites in zones to the west (see Figure 10).

<u>World Distribution</u>: western North American endemic; known from Alaska to Washington, strictly maritime.

<u>Remarks</u>: the type has been examined and, although quite small, it corresponds exactly with the local collections. Although considered to be a rare species (Thomson, pers. comm.), it is quite common on the western side of Van-couver Island.

The apparent restriction to the north and south of the CDFD subzone probably reflects the preference for igneous substrata, which are not common in the Gulf Islands or adjacent Vancouver Island.

<u>B. alaskensis</u> was reported new to the province in Noble (1978) as a result of the present study.

BACIDIA ARCEUTINA (Ach.) Rehm & Arn., Verh. Gesell. Wien 29:624. 1869. Lecidea luteola var. arceutina Ach., Method. Lich.:61. 1803.

<u>Thallus</u> crustose; effuse and <u>+</u> disappearing to determinate and orbicular, thin, rimose to cracked-areolate; light greyish.

<u>Apothecia</u> common, usually scattered, adnate, 0.3-0.7 mm wide. Proper margin at first very thick, entire, shiny, usually distinctively 'clincheddown' around the disc at the top with the middle of the exciple bulging out,



becoming less prominent and finally <u>+</u> excluded; often darker coloured than the disc. Disc plane or becoming slightly convex, waxy-looking, tan-brown to medium brown or mottled. Hypothecium fulvous, occasionally almost hyaline; epithecium yellow-brown to light brown; hymenium 50 μ m high; paraphyses simple, slightly coherent. <u>Spores</u> 8 per ascus, twisted in ascus, hyaline, acicular, straight to slightly cirved, (3-)5- to 7-septate, 35-57 X 2 μ m (see Figure 9).

Spot Tests: thallus K-, C-, P-; epithecium K-, C-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; collected on twigs and bark of a variety of deciduous trees plus once each on Thuja and Arbutus.

Selected Specimens: 175B 4133A.

Local Abundance and Distribution: infrequent; scattered throughout the subzone with perhaps a slight tendency towards the western border or wetter sites.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; in North America reported for Oregon and Massachussets (Fink, 1935).

<u>Remarks</u>: The local material is identified as <u>B</u>. <u>arceutina</u> <u>sensu</u> Duncan (1970) which includes material with piebald light and dark brown apothecia. Often the name <u>B</u>. <u>arceutina</u> is limited to specimens with dark brown-black apothecia while the lighter coloured specimens which are often shorter spored are referred to <u>B</u>. <u>intermedia</u> and <u>B</u>. <u>effusa</u> (both <u>B</u>. <u>assulata</u> (Koerb.) Vézda) or <u>B</u>. <u>albescens</u>. See Brodo (1968) for a discussion of these taxa.

BACIDIA HERREI Zahlbr., Annal. Mycolog. 6:130. 1908.

Haematomma californicum Sigal & Toren, Bryologist 78:71. 1975.

<u>Thallus</u> crustose; effuse, up to 8 cm broad; composed entirely of \pm shiny, spherical to occasionally \pm coralloid granules which are abundant and heaped and so appearing powdery, sometimes scarce and solitary, esorediate; pale

vellowish green, greenish yellow. Hypothallus white, inconspicuous.

Apothecia common, solitary or clustered, round to irregular, sometimes confluent, sessile, 0.5-1.2 mm wide. Disc plane, becoming slightly convex, surface dull, uneven, dark blood red. Thalline margin absent. Proper margin thick, smooth to crenulate, concolorous to lighter than the disc. Hymenium 60-80 µm high; paraphyses coherent, inspersed; epithecium bright red, rest of hymenium hyaline to tinged with orange. <u>Spores</u> 8 per ascus, hyaline, 3- to 7-septate, acicular with one end narrower, sometimes one or more middle cells enlarged, straight to curved, 30-42 X 2.5=3.0 µm, often difficult to dislodge from ascus (see Figure 9).

Spot Tests: thallus K-, C-, P-.

<u>Substratum/Habitat</u>: corticolous, lignicolous, and saxicolous; collected twice on the base of <u>Pseudotsuga</u> (one living, one dead), and also once, although poorly developed, on vertical conglomerate.

Selected Specimens: 4876, 5488.

Local Abundance and Distribution: infrequent, scattered along the western border of the CDFD subzone at inland, higher elevations and often on dry microhabitats which may or may not be exposed to the elements; also present in the adjacent CDFD subzone at drier sites.

<u>World Distribution</u>: western North American endemic; described from California.

<u>Remarks</u>: This species was described recently as a <u>Haematomma</u> (Sigal & Toren, 1975) due to the presence of a thalline margin which was reported as disappearing early. No distinct thalline margin was seen in the local material nor in comparative material from California obtained on loan. Even very young ascocarps lacked a distinct thalline margin; cross-sections showed no algae present even in the region of the stalk. However, most <u>Bacidia</u> lack secondary products, the lichenic acids (Huneck & Follman, 1972) while <u>B. herrei</u> contains usnic acid, divaricatic acid, plus the acetone-soluble red hymenial pigment (Sigal & Toren, op. cit.) which are found also in one chemical strain of <u>Haematomma lapponicum</u> (Thomson, 1968). The disposition of this species is therefore uncertain and awaits further study. It is included here in the genus <u>Bacidia</u> because of the apparent lack of a thalline margin and because it was first described from this genus.

There is also a problem with the corticolous/lignicolous collections of <u>B. herrei</u> perhaps differing from the saxicolous forms (Sigal & Toren, pers. comm.). The species is typically found on bark, fence posts, or lignum with the type collection being from <u>Arctostaphylos</u> sp. and not <u>Adenostoma panicu-latum</u> as was reported by Zahlbruckner (1908). The saxicolous form is very uncommon despite Herre's (1910) statement to the contrary. The saxicolous form also contains an additional unknown chemical compound not found in the corticolous/lignicolous forms. This requires further study.

<u>B. herrei</u> was reported new to the province in Noble (1978) due to this study.

BACIDIA IGNIARII (Nyl.) Oxn., Flora lischainikiv Ukraini (Kiev) 2(1):166. 1968.

Lecidea igniarii Nyl., Flora 50:328. 1867.

Bacidia abbrevians (Nyl.) Th. Fr., Lich. Scand. 1:362. 1864.

<u>Thallus</u> crustose; disappearing or of thin, small, scattered verrucae; greenish-grey.

<u>Apothecia</u> abundant, scattered to clustered, adnate to slightly stipitate, constricted, 0.3-0.8 mm wide. Proper margin at first thick, entire, raised, shiny, becoming thinner, less prominent, sometimes almost excluded. Disc plane, occasionally convex, black. Hypothecium fulvous to light brown; epithecium sordid green-black, fading greenish part way down the hymenium; hymenium 50 μ m high; paraphyses simple, coherent; excipular tissue brown to brownish black. <u>Spores</u> 8 per ascus, hyaline, fusiform to almost cylindric, 3-septate, occasionally slightly constricted at mid-septum, 17-23(-30) X 2.5 μ m (see Figure 9).

<u>Spot Tests</u>: epithecium K-, C-; hymenium IKI+ yellow (-orange), top of ascus IKI+ blüe.

Substratum/Habitat: corticolous; on Quercus.

Selected Specimens: 3008, 4594B.

Local Abundance and Distribution: rare; distribution poorly known; collected only in the CDFD subzone.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; reported first for North America from Michigan by Harris (1977).

BACIDIA INUNDATA (Fr.) Koerb., Lich. Germ.: 187. 1855.

Biatora inundata Fr., Kg. Vetensk.-Akad. Nya Handl.,:270. 1822.

Thallus crustose; effuse, scurfy to scattered, minute, thin verrucae; pale gray-olive, olive-buff.

<u>Apothecia</u> adnate, constricted, scattered, 0.3-0.6 mm wide. Proper margin thin, entire, lighter coloured than the disc, excluded early or late. Disc round, plane to occasionally convex, light tan to light brownish. Hypothecium hyaline to sometimes light brownish; epithecium hyaline to sometimes light brownish; hymenium 25-50 μ m high, hyaline; paraphyses simple but coherent. <u>Spores</u> 8 per ascus, hyaline; acicular, straight to slightly curved, (1-)3-(-5) spetate, 27-35 X 1.5-2 μ m (see Figure 9).

Spot Tests: epithecium K-, C+; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected once on noncalcareous, <u>+</u> vertical metamorphic rock beside a waterfall. The collection was made during a summer of exceptionally low water levels and the normal habitat of this material may be under the waterfall or at least within its spray.

Selected Specimen: 6395.

Local Abundance and Distribution: rare; distribution poorly known; collected once near Victoria on the CDFD-CDFW border.

World Distribution: circumtemperate.

<u>BACIDIA LAUROCERASI</u> (Del. ex Duby) Zahlbr., Cat. Lich. Univ. 4:213. 1926. <u>Patellaria laurocerasi</u> Del. ex Duby, Bot. Gall. II:653. 1830. <u>Bacidia atrogrisea</u> (Del. ex Hepp) Koerb., Parweg. Lich.:133. 1860. <u>Bacidia acerina</u> auct.

<u>Thallus</u> crustose; effuse, irregular from scattered granules to \pm continuous, minutely verruculose, \pm shiny; greenish-white.

<u>Apothecia</u> scattered, adnate, constricted, 0.3-1.0 mm wide. Proper margin at first thick, smooth, shiny, raised, often with striations (minute creases) down to disc, light to dark reddish-brown and often slightly darker on raised portion; becoming thin but never entirely excluded. Disc plane to slightly convex, black, matt to slightly shiny, epruinose. Hypothecium light fulvous to dark yellow; epithecium orange-brown to almost reddish-black; hymenium hyaline to fulvous, 60-75 µm high; paraphyses simple but coherent at tips. <u>Spores</u> 8 per ascus, spirally arranged, hyaline, acicular, 11- to 21septate, straight to more commonly curled, 60-85 X 2.5(-3) µm (length measured end to end, not along the curl) (see Figure 9).

<u>Spot Tests</u>: epithecium C-, K+ more intensely purple, not really a colour change but rather an intensifying of the natural colour; hymenium IKI+ blue; hypothecium K+ yellow.

<u>Substratum/Habitat</u>: corticolous; collected once each on <u>Cornus</u> <u>nutallii</u>, <u>Pseudotsuga</u>, and <u>Salix</u> sp.

Selected Specimens: 1221B, 4399.

<u>Local Abundance and Distribution</u>: infrequent; distribution uncertain, perhaps tending towards the western edge of the subzone, not collected outside the CDFD subzone.

World Distribution: tentatively circumtemperate(-circumboreal); Ozenda & Clauzade (1970) suggested it is perhaps cosmopolitan.

<u>Remarks</u>: This material was first identified as <u>B</u>. <u>acerina</u> a species it keys to quickly in Ozenda & Clauzade (1970) because of the curled spores. One European collection of this species was borrowed for comparison and closely matched the local material, except for slight differences in apothecial reaction with K. In the European material the epithecium fades rapidly to pale bluish with K, the hypothecium yellowing slightly, and the exciple (in one section) browning. In contrast the local material had the epithecium brighten slightly to a more purplish colour, the hypothecium and part of the surrounding excipular tissue turning bright yellow. Despite these slight differences it seemed best to accommodate the local material in B. acerina.

Hawksworth et al. (1980), however, listed <u>B</u>. <u>acerina</u> auct., along with <u>B</u>. <u>atrogrisea</u> (Del. ex Hepp) Koerb., as synonyms of <u>B</u>. <u>laurocerasi</u>. All of these are treated as independent species by Ozenda & Clauzade (1970).

Magnusson (1954) described <u>B</u>. <u>idahoensis</u> in the <u>endoleuca-acerina</u> group. Like the local material, the spores of this species are long and curled although slightly wider (3-3.5 μ m) and it has a hyaline hypothecium. The exciple is also described as K+ yellow. However, its thallus is olive-brown and epithecium sky blue to sordid green-brown. No material of this species has been seen for comparison.

BACIDIA NAEGELII (Hepp) Zahlbr., Oesterr. Botan. Zeitschrift. 59:439. 1909. Biatora naegelii Hepp, Spor. Flecht. Eur. pl. 4, f. 1:19. 1853.

Thallus crustose; effuse, disappearing or thin, scattered, scurfy gran-

ules; light grey.

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Apothecia few to abundant, adnate, 0.3-0.6 mm wide. Proper margin thin, entire, lighter coloured than the disc, often white, finally \pm excluded. Disc plane to slightly convex, tan to brown-grey to dark grey-black, often mottled. Hypothecium hyaline; epithecium hyaline, light brownish to often sordid green (in dark apothecia); hymenium 40-55 µm thick; paraphyses simple, coherent. <u>Spores</u> 8 per ascus, hyaline, fusiform, (1-)3-septate, 13-17(-20) X 4-5 µm (see Figure 9).

<u>Spot Tests</u>: epithecium K-, C-; hymenium IKI+ blue.

Substratum/Habitat: corticolous, only on Quercus.

Selected Specimens: 2733E, 3014B.

Local Abundance and Distribution: infrequent; scattered throughout the subzone, not collected in other zones.

<u>World Distribution</u>: circumtemperate (Ozenda & Clauzade, 1970).

<u>Remarks</u>: <u>B</u>. <u>naegelii</u> is superficially similar to <u>Micarea</u> <u>peliocarpa</u>. See that species for comments.

<u>BACIDIA</u> <u>RUBELLA</u> (Hoffm.) Mass., Ricerch. Auton. Lich.:118. 1852. <u>Verrucaria</u> <u>rubella</u> Hoffm., Deutschl. Flora:174. 1796. Bacidia luteola (Ach.) Mudd, Manual Brit. Lich.:183. 1861.

Thallus crustose; effuse, of scattered or grouped isidiate granules, almost pulverulent; light greyish, pale green-grey, olive-buff, greyishyellow.

<u>Apothecia</u> adnate, constricted or not, scattered or often clustered, 0.5-1.3 mm wide. Proper margin even and thin, somewhat raised, <u>+</u> shiny, lighter coloured than the disc; often excluded early or sometimes excluded late. Disc plane or becoming convex, round to flexuous, often somewhat tuberculate; light orange-brown. Hypothecium fulvous to light brownish-yellow

just below hymenium; epithecium fulvous to golden, not distinctly restricted to epithecium but colouring whole upper section of hymenium; hymenium 50-75 μ m high; paraphyses simple but coherent. <u>Spores</u> 8 per ascus, hyaline, acicular, straight, 5- to 9-septate, (40-)50-65 X 2.5-3.0 μ m (see Figure 9).

<u>Spot Tests</u>: epithecium K-, C-; hymenium IKI+ blue; thallus K+ faint yellow, C-, P-.

Substratum/Habitat: corticolous; collected twice on Quercus.

Selected Specimens: 882B, 6451.

Local Abundance and Distribution: rare; probably much more common than the two collections indicate, since sterile granules on <u>Quercus</u> bark have been seen in many other collections which correspond well with the thallus of the fertile collections; distribution poorly known, not collected outside the CDFD subzone.

<u>World Distribution</u>: probably circumtemperate in the Northern Hemisphere; also reported from Australia in the Southern Hemisphere (Filson & Rogers, 1979).

BACIDIA SCOPULICOLA (Nyl.) A. L. Sm., Monogr. Brit. Lich. 2:156. 1911. Lecidea scopulicola Nyl., Flora 57:312. 1874.

<u>Thallus</u> crustose; effuse, moderately thick, cracked-areolate becoming sorediate-isidiate to granulose or entirely granulose-isidiate; green, olivebuff, buff.

<u>Apothecia</u> few, often absent, adnate, 0.3-0.8 mm wide. Proper margin moderately thick, entire, even, <u>+</u> shiny, lighter coloured than the disc, becoming excluded. Disc plane, becoming convex, light brown to dark reddish brown. Hypothecium and epithecium <u>+</u> hyaline; hymenium 50-55 μ m high, hyaline or with fulvous-brown sections. <u>Spores</u> 8 per ascus, hyaline, acicular, straight, 3- to 5-septate, 32-48 X 1.5-2.0 µm (see Figure 9).

<u>Spot Tests</u>: epithecium K-, C-; hypothecium K+ yellowish; hymenium IKI+ blue; thallus K-, C-, P-.

<u>Substratum/Habitat</u>: saxicolous; in the suprahaline zone on shale and once on shaded sandstone with Verrucaria maura.

Selected Specimens: 179B, 7284.

Local Abundance and Distribution: rare, probably more common than the two collections indicate but usually in the sterile state; distribution poorly known; also known to be present in the adjacent zones.

World Distribution: western North America-Europe disjunct.

Remarks: B. scopulicola is reported here as new to the province.

BACIDIA SPHAEROIDES auct.

Thallus crustose; inconspicuous, thin; light-grey.

<u>Apothecia</u> scattered to clustered and then \pm confluent, closely adnate, 0.4-1.3 mm wide. Proper margin thin, shiny, lighter than the disc, often becoming \pm excluded. Disc plane or eventually slightly to strongly convex, round to flexuous; yellowish-brown to light orange-brown. Hypothecium hyaline to fulvous; epithecium fulvous to golden(-brown); hymenium 50-55 µm high, fulvous; paraphyses simple but \pm strongly coherent. <u>Spores</u> 8 per ascus, hyaline, ellipsoid-fusiform, 3-septate, 14-19 X (5-) 6-7(-8) µm (see Figure 9).

Spot Tests: epithecium K-, C-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; collected mainly on <u>Pseudotsuga</u> but also once on <u>Pinus contorta</u>. Usually growing with <u>Mycoblastus</u> tornoensis.

Selected Specimens: 3996, 4730C.

Local Abundance and Distribution: infrequent; primarily on the southwestern border of the CDFD subzone and adjacent CDFW subzone, not collected on any of the Gulf Islands. <u>World Distribution</u>: circumarctic-circumtemperate (Thomson, 1979); also reported from New Zealand (Martin, 1966) and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks</u>: <u>Bacidia sphaeroides</u> (Dicks.) Zahlbr. and <u>Bilimbia sphaeroides</u> (Dicks.) de Not., both names which are commonly applied to this species, are treated as synonyms of <u>Catillaria sphaeroides</u> (Dicks.) Schuler in Hawksworth et al. (1980).

BACIDIA UNKNOWN #1

<u>Thallus</u> crustose; effuse, thin, slightly verruculose, very scant, sometimes only in the vicinity of the apothecia; brown-grey, darkened on the tops of the verrucae. Hypothallus absent.

<u>Apothecia</u> few, scattered, 0.3-0.6 mm wide. Proper margin initially thin, smooth, a little raised, \pm shiny, becoming excluded, concolorous with the disc. Disc moderately constricted, plane, finally convex, minutely roughened but still a little shiny, black, epruinose. Hypothecium pale yellow, 50 µm thick; exciple black on the upper edge, becoming orange-brown below on the side, both of large thin-walled cells, becoming abruptly hyaline on the lower sides and below hypothecium 25-75 µm thick, thickest at the base, of thickwalled gelatinized cells; epithecium sordid green-black; paraphyses stout, coherent, terminal cell enlarged and globose, often branching at apices; hymenium 50-60 µm high, \pm hyaline. <u>Spores</u> 8 per ascus, hyaline, cylindricfusiform, straight, 3-septate, one end sometimes narrower after the last septum, ends both usually rounded, 19-26(-32) X 2-2.5 µm (see Figure 9).

<u>Spot Tests</u>: hymenium C-, K-, IKI+ blue; epithecium K+ brighter green.

<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous sandstone at an ocean site, above the littoral zone.

Selected Specimen: 1752B.

Local Abundance and Distribution: rare; distribution poorly known, collected once on the Gulf Islands in the southern part of the CDFD subzone, not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: the single collection consists of only a few apothecia with very little thallus scattered among separate, larger sterile verrucae of presumably a <u>Lecania</u> sp.

This unknown <u>Bacidia</u> is similar to <u>B</u>. <u>igniarii</u>. Both have a green-black epithecium and narrow, fusiform spores. But in <u>B</u>. <u>igniarii</u> the spores are slightly smaller, the outer exciple blackened even below the hypothecium, the hymenium IKI+ yellow-orange, and the habit corticolous. The light-coloured exciple below the hypothecium in the unknown <u>Bacidia</u> perhaps indicates a paler ascocarp initially that has darkened with age. The species may or may not have a maritime preference. The solution of the problem requires the collection of additional material.

BACIDIA UNKNOWN #2

Thallus crustose; effuse, finely granulose; green or grey-green.

Apothecia abundant, \pm scattered, 0.4-0.6 mm wide. Proper margin initially rather thick, smooth, a little raised and 'cinched in' on the top of the disc so that the sides of the exciple form the widest part of the ascocarp, paler than the disc or concolorous, or with the very top edge a little darker, finally excluded, or occasionally excluded early. Disc plan becoming convex, moderately constricted, \pm round; tan to pale brown. Hypothecium hyaline or pale yellow on outer edge; paraphyses coherent but \pm simple; epithecium hyaline or pale yellow; hymenium 55-65 µm high, hyaline. Spores 8 per ascus, hyaline, acicular, 3- to 7-septate, straight to a little curved, 30-52 X 2-2.5 µm (see Figure 9).
Spot Tests: thallus K-, C-, KC-, P-; hymenium IKI+ orange-red.

<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous sandstone in a shaded site.

Selected Specimen: 7286.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Mayne Island at an inland site, also known from separate collections from the adjacent zones (see below).

World Distribution: unknown.

<u>Remarks:</u> <u>B.</u> <u>cuprea</u> (Mass.) Lett. (=<u>B</u>. <u>prasinoides</u> (Ny1.)Arn:), a calcareous, saxicolous species known from Europe, is almost identical to the local material but its spores are much smaller, 12-21 X 2-4 μ m (Duncan, 1970; Ozenda & Clauzade, 1970).

Among the local species there are two acicular-spored, saxicolous species with pale apothecia to which this species is similar. <u>B</u>. <u>inundata</u> also has a greenish thallus but the spores tend to be a little shorter, the hymenium IKI+ blue, and the exciple not 'cinched in'. It is known to prefer wet, often inundated habitats on noncalcareous rocks. <u>B</u>. <u>scopulicola</u>, a martime species with isidiate-sorediate green thallus, also has shorter spores, lack the 'cinched in' exciple and grows on HCl- rocks, albeit shaded. Add-itionally B. scopulicola has much smaller apothecia.

Material very similar to <u>Bacidia unknown #2</u> has been collected from outside the study area at Ucluelet, Vancouver Island. This collection was on a cement curb. The thallus was well-developed and away from the apothecia was becoming sorediate.

BACIDIA UNKNOWN #3

<u>Thallus</u> crustose; verruculose granules scattered or more commonly grouped into an irregular or rosette-shaped mass of thickly cracked areoles; indivi-

dual granules a little scabrid, matt; tan-brown to almost a pinkish-tan. Hypothallus absent.

<u>Apothecia</u> scarce, <u>+</u> scattered, adnate, 0.2-0.5 mm wide. Proper margin thin, smooth, <u>+</u> even, epruinose, concolorous with thallus, or the top edge a little darkened like the disc, sometimes persistent even after the disc has disintegrated. Disc <u>+</u> plane, moderately constricted, <u>+</u> round; red-black to black, epruinose. Hypothecium hyaline to pale yellow; exciple hyaline or reddish at top edge (adjacent to hymenium); paraphyses unbranched, <u>+</u> free, tips distinctly globose; epithecium blackish; hymenium 40 µm high, <u>+</u> hyaline. <u>Spores</u> 8 per ascus, hyaline, narrow fusiform, (1-)3-septate, (18-)20-23 X 2-2.5 µm (see Figure 9).

<u>Spot Tests</u>: thallus K-, C-, KC-, P-; hymenium IKI+ blue; exciple (when reddish) K+ purplish; epithecium K-.

<u>Substratum/Habitat</u>: saxicolous; collected once on HCl-sandstone at a maritime site above the littoral zone.

Selected Specimen: 1355.

Local Abundance and Distribution: rare; distribution poorly known, collected once on the Gulf Islands in the southern part of the CDFD subzone, not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This <u>Bacidia</u> is distinguished by the thick, light coloured, verruculose thallus, pale tan exciple (<u>+</u> persistent) with plane, black disc, and narrow, fusiform, 3-septate spores. It most closely resembles the local material of <u>Bacidia unknown #1</u> which also has narrow, fusiform, 3-septate spores and black disc as well as a maritime habitat. However, in <u>Bacidia unknown #3</u> the paraphyses are noticeable free and globose, black-tipped, the margin lighter than the disc and persistent even after the disc is gone, and the thallus much better developed.

<u>B...rioessa</u> Herre, described from California, has small, black apothecia, often with paler margin, blackish epithecium, free paraphyses with sub-globose tips, hypothecium colourless to pale brown, and a thin to thick granular or crumb-like squamuliform thallus. It is also maritime. However, <u>B. ioessa</u> has a thick, prominent hypothallus, wider spores (14.5-20 X 2.5-6 μ m), excluded margin, an epithecium which reacts K+ purplish or rosy violet, and a dark thallus (black with a greenish or greyish cast).

BAEOMYCES Pers.

Thallus crustose to squamulose. Corticate.

Ascocarp an apothecium. Lecideine, globose, often multiparted, on short stipes. Stipes containing algae or not. Hypothecium and exciple not distinct from stipe interior. Spores 8 per ascus, fusiform to ellipsoid, hyaline, simple to 3-septate.

Terricolous, on acidic soils or humus; sometimes saxicolous.

References: Thomson (1967a).

There is one local species.

BAEOMYCES <u>RUFUS</u> (Huds.) Rebent., Prodr. Flor. Neomarch.:315. 1804. Lichen rufus Huds., Flora Anglica 443:1762.

<u>Thallus</u> crustose; up to 9 cm wide, orbicular becoming confluent or following the substratum surface, \pm irregular, scurfy to granulose, sometimes nearly areolate-squamulate towards the margins, sometimes \pm sorediate; yellowish-green, dark green, to buff.

Apothecia common, scattered, stipitate. Disc 9.6-3.0 mm wide. Convex to

convolute, smooth, cream, reddish-brown to brown. Proper margin indistinct. Podentia 0.25-2.0 (-3) mm high, corrugated, white-cream, usually unbranched but sometimes forked with two or more terminal apothecia. Hymenium 80(-125)µm high; paraphyses simple, coherent at the tips; epithecium brown. Asci narrowly cylindrical. <u>Spores</u> 8 per ascus, uniseriate, ellipsoid, hyaline, simple to sometimes 1-septate, 8-10(-13) X 3-4 µm.

Spot Tests: thallus K+ yellow.

<u>Substratum/Habitat</u>: saxicolous and terricolous; sometimes also muscicolous; the substrata often sloping and shaded or north-facing.

Selected Specimens: 3857, 5293.

Local Abundance and Distribution: infrequent; scattered primarily along the border of the CDFD subzone and CDFW subzone, much more common to the west of the study area.

<u>World Distribution</u>: circumboreal-circumtemperate in the Northern Hemisphere (Thomson, 1979; Ozenda & Clauzade, 1970).

BRYORIA Brodo & D. Hawksw.

Thallus fruticose; erect to pendulous (all local species caespitose to pendulous). Branches <u>+</u> terete, filamentous; light to dark brown or black. Spinules, soredia, and pseudocyphellae absent to abundant.

Ascocarp an apothecium, lateral. Thalline margin even to ciliate, often excluded. Spores 8 per ascus, simple, hyaline, ellipsoid, without a distinct epispore, 4-15 X 2-7 μ m.

Primarily corticolous, but also terricolous and saxicolous.

Bryoria was recently removed from <u>Alectoria</u> on the basis of the small, hyaline spores which are 8 per ascus, other morphological and anatomical diff-

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erences, and chemistry. See Brodo and Hawksworth (1977) for details.

There has been considerable difficulty in the taxonomy of the 45+ species known from North America. Only Brodo and Hawksworth (1977) present a modern, comprehensive treatment of the group although difficulties still exist. Older references, except Hawksworth (1972), mentioned uncer <u>Alectoria</u> are of interest, but are incomplete or faulty in species concepts.

It should be noted that the spot tests for this genus are best carried out on small squares of filter paper with any colour reaction being more easily observed as it spread out on the white paper. The C test is very fleeting and requires a miniscule amount of reagent. See Brodo and Hawksworth (1977) for precise directions.

The report of <u>Bryoria nadvornikiana</u> (Gyeln.) Brodo & Hawksw. from Saltspring Island (Brodo & Hawksworth, 1977) is based on an error: a misnumbered specimen from Ontario (Brodo, pers. comm.).

Locally most <u>Bryoria</u> species produce poor growth in the CDFD subzone; this makes identification difficult. They grow considerably better in the adjacent zones to the west.

References: Brodo & Hawksworth (1977) see also references under Alectoria.

1.	Pseudocyphellae yellow; thallus usually with at least a weak yellowish tinge <u>B</u> . <u>TORTUOSA</u>
1.	Pseudocyphellae white or absent; thallus reddish-, greenish-, or greyish-brown 2
	2. Thallus reddish-brown 3
	2. Thallus greenish- or greyish-brown 4
3.	Thallus very shiny; cortical cells elongate-linear; soredia yellow when present <u>B</u> . <u>FREMONTII</u>
3.	Thallus dull; cortical cells "jig-saw" (puzzle-like); esorediate <u>B</u> . <u>OREGANA</u>
	4. Thallus esorediate 5
	4. Thallus sorediate

5.	Thallus	light coloured, pale greyish-brown 6
5.	Thallus	greenish or darker brown 7
	6.	Filaments brittle, C+ red, K-, P <u>B</u> . <u>FRIABILIS</u>
	6.	Filaments not brittle, C <u>+</u> red, K+ yellow, P+ yellow, KC+ redB. <u>CAPILLARIS</u>
7.	Thallus absent;	very glossy green (-brown); pseudocyphellae branching angles obtuse <u>B</u> . <u>GLABRA</u>
7.	Thallus pseudocy	not glossy or greenish or if greenish then vphellae present; branching angles acute to obtuse <u>B</u> . <u>PIKEI</u>
	8.	Filaments glossy greenish; major branching angles obtuse <u>B</u> . <u>GLABRA</u>
	8.	Filaments not strongly greenish or shiny; major angles usually acute

BRYORIA CAPILLARIS (Ach.) Brodo & D. Hawksw., Opera Bot. 42:115. 1977. Parmelia jubata β. capillaris Ach., Meth. Lich.:273. 1803. Alectoria capillaris (Ach.) Cromb., J. Bot., Lond. 9:177. 1871.

<u>Thallus</u> fruticose; filamentous, pendent, (4-)7-12 cm long. Branches dull to slightly shiny, flaccid, not friable, uneven or occasionally even, (0.1-)0.2-0.4 mm wide, somewhat foveolate, branching sometimes isotomically dichotomous but <u>+</u> always ending in anisotomic dichotomies; pseudocyphellae present, fusiform, white, 0.3-0.8 mm long, often scarce; deep olive-buff, greyish-olive, mouse grey, under the DM very light tan-brown.

<u>Apothecia</u> not observed. According to Brodo & Hawksworth (1977) apothecia very rare, up to 1.7 mm wide, becoming strongly convex, epruinose; <u>spores</u> 8 per ascus, hyaline, ellipsoid to sub-globose, simple, 4.3-6.8 X 4.0-4.5 µm.

<u>Spot Tests</u>: thallus K+ yellow (often faint), C<u>+</u> red (ephemeral), P+ yellow, KC+ red.

<u>Substratum/Habitat</u>: corticolous; primarily on <u>Pseudotsuga</u> but occasional on a wide variety of trees including Quercus, Tsuga, and dead branches of <u>Arbutus</u>.

Selected Specimens: 2441, 3141.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Hawksworth, 1972).

<u>Remarks</u>: <u>B. capillaris</u> is esorediate in North America but frequently sorediate in Europe (Brodo & Hawksworth, 1977).

BRYORIA FREMONTII (Tuck.) Brodo & D. Hawksw., Opera Bot. 42:136. 1977. Alectoria fremontii Tuck., Am. J. Arts. Sci., ser. 2, 25:422. 1858.

<u>Thallus</u> fruticose; subpendent, up to 8 cm long. Branches filamentous, extremely shiny, \pm even, 0.2-0.3 mm wide, anisotomically branched; pseudocyphellae absent; bone brown, brown, but under DM distinctly reddish-brown or sometimes yellowish brown. Soredia absent or present, yellow; soralia elongated and reflexed. Cortical cells elongate-linear under LM.

<u>Apothecia</u> not observed. According to Brodo & Hawksworth (1977) the apothecia are lateral, convex, 1-2(-4) mm wide, yellow pruinose; <u>spores</u> 8 per ascus, hyaline, simple, 5-8 X 4-5 µm.

Spot Tests: thallus K-, C-, P-, KC-.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Pseudotsuga</u>. Selected Specimen: 5461B.

Local Abundance and Distribution: rare; collected only in the adjacent CDFW subzone although one specimen examined from the Parksville area (UBC) which is within the CDFD subzone.

<u>World Distribution</u>: western North America-Europe disjunct; also unconfirmed reports from eastern Asia, Ellesmereland, and Ecuador (Brodo & Hawksworth, 1977). <u>Remarks</u>: According to Brodo & Hawksworth (1977) <u>B</u>. <u>fremontii</u> may be much larger in both length and diameter than the specimens described here. The thallus can be up to 45 cm long and the filaments (0.2)0.4-1.5(-4.0) mm wide. Furthermore, the filaments may become uneven in width, twisted, and foveolate. Pseudocyphellae may be present as elongate, fusiform, white to pale brown cracks that are perhaps produced by torsion as the filaments twist.

<u>B. fremontii</u> is very distinctive when the yellow soralia are present. In their absence, the reddish, shiny filaments with elongate-linear cortical cells should separate it from the similar B. oregana.

BRYORIA FRIABILIS Brodo & D. Hawksw., Opera Bot. 42:118. 1977.

Thallus fruticose; subpendent to pendent, up to 19 cm long. Branches filamentous, \pm dull, friable, 0.2-0.4 mm wide, uneven in diameter towards the apices where they can appear 'knobby', also often twisted to foveolate; pseudocyphellae present, fusiform, white, usually partially twisted around branches, inconspicuous; soredia absent; buff-brown, drab brown, light greyish olive to dark olive.

<u>Apothecia</u> not observed. According to Brodo & Hawksworth (1977) the apothecia are very rare, being observed only once on a specimen from northern Vancouver Island. The apothecia are described as 0.35-0.5 (-0.8) mm wide, lateral, often elongated, strongly reflexed light coloured, epruinose; the <u>spores</u> as 8 per ascus, hyaline, ellipsoid, 4.2-5.0 X 2.4-3.0 µm.

<u>Spot Tests</u>: thallus K-, P-, C+ pink, flash, fading quickly or sometimes slowly.

<u>Substratum/Habitat</u>: corticolous; collected from the trunk and and twigs of <u>Pseudotsuga</u>.

Selected Specimens: 768, 892.

Local Abundance and Distribution: infrequent; collected only on the southern Gulf Islands, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America disjunct (see Figure 64); temperate; in western western North America known from California to Prince Rupert, British Columbia, in eastern North America known from Quebec, Nova Scotia, and New England (Brodo & Hawksworth, 1977).

BRYORIA FUSCESCENS (Gyeln.) Brodo & D. Hawksw., Opera Bot. 42:83. 1977. <u>Alectoria fuscescens</u> Gyeln., Nyt Magn. Naturvid. 70:55. 1932.

<u>Thallus</u> fruticose; pendent, up to 15 cm long. Branches filamentous, even to uneven, usually straight, branching angles acute to obtuse, sometimes with lateral spinulose branches; pseudocyphellae absent; soralia abundant to sparse, tuberculate or fissural, sometimes becoming spinulose; pale fuscous to brown to blackish, the basal parts often paler.

Apothecia not known in North America (Brodo & Hawksworth, 1977).

Spot Tests: thallus K-, C-, KC-, P+ red; soralia K-, C-, KC-, P+ red.

Substratum/Habitat: corticolous; primarily on conifers.

Selected Specimens: 1605B, 4848.

Local Abundance and Distribution: infrequent; scattered along the western boundary of the CDFD subzone, also present in the adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere; one variety also known from the mountains of East Africa in the Southern Hemisphere.

Remarks:

"There is no species group in which there are more problems in delimiting taxa than those species of the section <u>Bryoria</u> which generally have PD+ red soralia. 'Intermediate' specimens can be demonstrated from almost any pair within the group, although the distinctness of the taxa is unquestioned in most cases. Few characters of any of the taxa are constant for all specimens and variability is exceptionally broad. Environmental modifications may be the cause of at least some of this variability" (Brodo & Hawksworth, 1977). Species within section <u>Bryoria</u> that have P+ red soralia include <u>B. chalybeiformis</u> (L.) Brodo & D. Hawksw., <u>B. glabra</u> (Mot.) Brodo & D. Hawksw., <u>B. lanestris</u> (Ach.) Brodo & D. Hawksw., <u>B. subcana</u> (Nyl. ex Stiz.) Brodo & D. Hawksw., <u>B. trichodes</u> (Michx.) Brodo & D. Hawksw., and <u>B. fuscescens</u>.

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B. chalybeiformis has been collected on Mt. Benson, west of Nanaimo. It is a prostrate arctic-alpine species over rocks and soil. The main branches usually become twisted, foveolate, and sometimes channeled, averaging 0.5-1.0 mm in diameter, and are shiny dark brown to black. B. glabra is known from the CDFD subzone. It is typically shiny and olivaceous with the branches very even, broadly angled, strictly dichotomously branched, and the soralia are small, oval, and fissural. B. fuscescens and B. glabra intergrade to some extent in southern British Columbia and Alberta. B. lanestris is not known from Vancouver Island although it has been collected on the adjacent mainland. It has very slender (0.1-0.25 mm wide), very brittle, usually very uneven, dark brown-black or black branches. B. subcana is known from coastal California to Alaska but not yet from Vancouver Island. It has branches that are even, straight, brittle, slender (0.15-0.3 mm), basally pale fuscous brown and apically very pale fuscous to greenish white; pseudocyphellae often present; soralia tuberculate, sometimes becoming spinulose; all parts reacting P+ red. B. trichodes is known from Vancouver Island outside the CDFD subzone. It has two subspecies. Subsp. trichodes has terete, uneven, pale cervine brown or dark brown, consistently shiny branches that are abundantly pseudocyphellate (white, oval, and raised). Subsp. americana has even, darker brown branches with sparse, pseudocyphellae that are fusiform, brownish, and depressed (Brodo & Hawksworth, 1977).

BRYORIA GLABRA (Mot.) Brodo & D. Hawksw., Opera Bot. 42:86. 1977. Alectoria glabra Mot., Fragm. Florist. Geobot. 6:448. 1960.

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<u>Thallus</u> fruticose; pendent, up to 13 cm long. Branches filamentous, even, smooth, very glossy, sometimes \pm transparent, isotomically dichotomously branched with obtuse angles between major filaments (actually \pm 90°), 0.3-0.5 mm wide; deep olive, greyish-olive, olivaceous black, but always olivaceous(-brown) under the DM. Soralia common to absent, especially in small thalli, fissural; soredia white, \pm granular. Pseudocyphellae absent.

<u>Apothecia</u> not observed. According to Brodo & Hawksworth (1977) the apothecia are rare, lateral, 0.65-1.15 mm wide with mature spores unknown.

Spot Tests: thallus K-, C-, KC-, P-; soralia P+ orange-red.

Substratum/Habitat: corticolous; predominantly on Pseudotsuga.

Local Abundance and Distribution: infrequent; scattered throughout the adjacent zones, present only at a few sites on the western edge of the CDFD subzone.

<u>World Distribution</u>: western North America-eastern North America disjunct; temperate montane (Brodo & Hawksworth, 1977).

<u>Remarks</u>: Although typically a sorediate species, collections of nonsorediate <u>B</u>. <u>glabra</u> $\overline{\sigma}$ re fairly common on Vancouver Island. They must be carefully distinguished from <u>B</u>. <u>pikei</u> which is greenish, sometimes shiny, obtuse to acute angled at branching points, but has pseudocyphellae and a different chemistry.

<u>B</u>. <u>glabra</u> intergrades with <u>B</u>. <u>fuscescens</u> in southern Alberta-British Columbia. See that species for comments.

<u>BRYORIA</u> <u>OREGANA</u> (Tuck. ex Nyl.) Brodo & D. Hawksw., Opera Bot. 42:134. 1977. Alectoria oregana Tuck. ex Nyl., Lich. Jap.:104. 1890. <u>Thallus</u> fruticose; subpendent to pendent, 3.5-8 cm long. Branches filamentous, <u>+</u> terete to irregular, older branches foveolate to slightly twisted, up to 2 mm wide, rigid, anisotomically branched, matt to slightly shiny but not glistening; soredia and pseudocyphellae absent; chestnut brown, burnt umber, under the DM definitely reddish-brown. Cortial cells knobby, jig-sawshaped under LM.

<u>Apothecia</u> not observed. According to Brodo & Hawksworth (1977) the apothecia are uncommon, lateral, margin even or ciliate, up to 2 mm wide; the spores are 8 per ascus, broadly ellipsoid, 6.5 X 4.5 µm.

Spot Tests: thallus K-, C-, KC-, P-.

Substratum/Habitat: corticolous, collected on Pseudotsuga.

Selected Specimens: 4717, 5538.

Local Abundance and Distribution: rare; collected only at two higher elevations near the western border of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; temperate-montane (Brodo & Hawksworth, 1977).

<u>Remarks</u>: Like <u>B</u>. <u>oregana</u>, <u>B</u>. <u>fremontii</u> can be reddish in colour, however, the latter species can be distinguished by its isotomic branching, conspicuously twisted branches, linear cortical cells, yellow pruinose apothecia, and yellow soredia (when present).

BRYORIA PIKEI Brodo & D. Hawksw., Opera Bot. 42:125. 1977.

<u>Thallus</u> fruticose; pendulous, 7-17 cm long. Branches filamentous, 0.25-0.4 mm wide, shiny to dull, even at base, uneven towards apices, isotomibranched, angles obtuse or acute; soredia absent; pseudocyphellae common, white, fusiform; olivaceous, grey-olive, or browning.

<u>Apothecia</u> not observed. According to Brodo & Hawksworth (1977) the apothecia are unknown.

Spot Tests: thallus K+ light yellow, C+ red; medulla P+ yellow.

<u>Substratum/Habitat</u>: corticolous, collected once on <u>Pseudotsuga</u> (Brodo, 13839 CANL) and once on <u>Pinus contorta</u>.

Selected Specimen: 4335.

Local Abundance and Distribution: rare; collected once at a higher elevation in the CDFD subzone and once at a higher elevation in an adjacent zone.

<u>World Distribution</u>: western North America-eastern North America disjunct; coastal-oceanic from Oregon to the Queen Charlotte Islands in British Columbia on the west coast, one collection from Cape Breton, Nova Scotia on the east coast.

<u>Remarks</u>: Without chemical tests <u>B</u>. <u>pikei</u> can be confused with non-sorediate <u>B</u>. <u>glabra</u> except that <u>B</u>. <u>pikei</u> has abundant white pseudocyphellae. It is also very similar to <u>B</u>. <u>pseudofuscescens</u> (Gyeln.) Brodo & D. Hawksw. Both are greenish, shiny, and pseudocyphellate. <u>B</u>. <u>pseudofuscescens</u> is, however, C-. It has been reported from Victoria on the basis of an early Macoun collection. This record has been excluded from the present flora until a confirmatory collection is made; <u>B</u>. <u>pseudofuscescens</u> has not been reported for Vancouver Island other than from Macoun's specimen, although it is present on the adjacent mainland.

BRYORIA TORTUOSA (Merr.) Brodo & D. Hawksw., Opera Bot. 42:138. 1977. Alectoria tortuosa Merr., Bryologist 12:1. 1909.

<u>Thallus</u> fruticose; pendent, 7-20 cm long. Branches filamentous, <u>+</u> terete, shiny, smooth, sometimes twisted, infrequently dichotomously branched,

0.2-0.3 mm wide but some major branches up to 0.7 mm wide and these usually very twisted and foveolate; flattened and expanded in the axils; esorediate; pseudocyphellae common, fusiform, yellow, often twisted around the filaments; colour ranging from deep olive to medal bronze to brown but usually partially to strongly yellowish-olive or pale greenish yellow in places.

<u>Apothecia</u> uncommon, lateral, 0.6-1.4 mm (2-3 mm in Brodo & Hawksworth, 1977). Thalline margin thin, entire, becoming excluded. Disc variously shiny or yellow pruinose in parts, very irregularly convex. <u>Spores</u> 8 per ascus, biseriate, hyaline, ovoid to subglobose, 5-7 X 4-5 µm.

Spot Tests: thallus K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: corticolous; collected on both <u>Pseudosuga</u> and <u>Quercus</u>.

Selected Specimens: 1032A, 5056C.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone and adjacent zones especially the CDFW subzone.

<u>World Distribution</u>: western North American endemic; also a single report from Europe in the Carpathian Mountains which is not yet confirmed (Brodo & Hawksworth, 1977).

<u>Remarks</u>: Merrill (1909) described this species from a specimen collected near New Westminster. Both Merrill (op. cit.) and Motyka (1964) described the pseudocyphellae as white but all the local specimens checked have distinctly yellow pseudocyphellae. Howe (1911) and Fink (1935) initially included <u>A. tortuosa</u> as a synonym of <u>A. virens</u> Tayl., which is a southeast Asian species (Hawksworth, 1971). Du Rietz (1926) and Gyelnik (1935) both pointed out differences in the two species. Howe (1921) considered it as falling within the variation of <u>A. fremontii</u>.

Brodo & Hawksworth (1977) mentioned an unusual collection of <u>B</u>. tortuosa from Vancouver Island which is sorediate.

BUELLIA de Not.

Thallus crustose; rimose to areolate. Hypothallus often present.

Ascocarp an apothecium, black. Margin lecideine. Spurious thalline margin sometimes present. Hypothecium brown, continuous with exciple. Paraphyses simple to slightly branched, \pm free. Spores usually 8 per ascus, brown, l-septate to submuriform, not halonate.

All substrates.

There are several lichenicolous fungi genera with similar spores and ascocarps to <u>Buellia</u>. Locally a <u>Leciographa</u> sp. may be found growing on a corticolous Pertusaria (?) sp.

The genus <u>Buellia</u> of North America was monographed by Imshaug (1951) in an unpublished Ph.D. thesis. Several new species were discussed in this work which Imshaug intended to validly publish later. Some of these illegitimate names have crept into the literature.

Several segregate genera have been removed recently from <u>Buellia</u>, i.e. <u>Diplotomma</u>, <u>Catolechia</u>, and <u>Epilichen</u> (Hafellner, 1978). Only <u>Buellia</u> is recognized here, although recent name changes are mentioned.

References: Imshaug (1951), Sheard (1964, 1969), Schauer (1965), Weber (1971).

1.	Corticolous or lignicolous	2
1.	Saxicolous or lichenicolous/muscicolous	9
	2. Spores submuriform or muriform	3
	2. Spores 1- to 3-septate	4

3.	Black hypothallus present; spores muriform (at least more than 1 longitudinal septum); pseudothalline margin absent <u>B</u> . <u>PENICHRA</u>
3.	Hypothallus absent; spores submuriform; (O to l longitu- dinal septum); pseudothalline margin often present <u>B</u> . <u>ALBOATRA</u>
	 Spores 3-septate 4. Spores 3-septate (not handled)
	4. Spores 1-septate 5
5.	Spores 12 per ascus B. UNKNOWN #1
5.	Spores 8 per ascus
	6. Spores <16 µm long; hymenium not inspersed <u>B. PUNCTATA</u>
	6. Spores >16 µm long; hymenium inspersed
7.	Discs <u>+</u> pruinose; proper margin lighter than disc; hypothallus often visible <u>RINODINA HALLII</u> (p. 677)
7.	Discs not pruinose; proper margin concolorous with disc; hypothallus visible or not8
	8. Corticolous; K+ red <u>B</u> . cfr. <u>DISCIFORMIS</u>
	8. Lignicolous on driftwood; K <u>+</u> yellow <u>B</u> . <u>FOSTERI</u>
9.	Spores muriform or submuriform 10
9.	Spores 1-septate
	10. Thallus K+ yellow turning red (often slow) <u>B</u> . <u>CHLOROPHAEA</u>
	10. Thallus K <u>B</u> . <u>ALBOATRA</u>
11.	Thallus yellow-green, C+ redB. <u>VERRUCULOSA</u>
11.	Thallus white to dark grey, or brown12
	12. Hymenium inspersed
	12. Hymenium not inspersed13
13.	Hypothallus conspicuous, black; thallus areolate, white-grey, K <u>B</u> . <u>STELLULATA</u>
13.	Hypothallus absent or inconspicuous; thallus brown, not distinctly areolate, K
	14. Thallus of <u>+</u> terete brown lobes or digitate squamules; often lichenicolous/muscicolous, or saxicolous <u>B</u> . <u>BADIA</u>
	14. Thallus crustose; saxicolous15

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- 15. Thallus usually dark greyish, sometimes brownish; thin, scattered granules to thinnly cracked-areolate.....<u>B</u>. <u>PUNCTATA</u>
- 15. Thallus brown to olive-brown; continuous, verruculose, cracking into large areoles<u>B</u>. <u>TURGESCENS</u>

<u>BUELLIA</u> <u>ALBOATRA</u> (Hoffm.) Branth & Rostr., Botan. Tidsskrift 4:239. 1869. <u>Lichen</u> <u>alboatra</u> Hoffm., Enum. Lich.:30. 1784.

<u>Diplotomma</u> <u>alboatrum</u> (Hoffm.) Flot., 27 Jaresber. Schlesisch. Gesellsch. fur veterl. Kultur:130. 1849.

<u>Thallus</u> crustose, smooth to more other irregularly cracked, dull to chalky pruinose; white to grey-white. Hypothallus absent.

<u>Apothecia</u> common, abundant, scattered to crowded, sessile, 0.4-0.7 mm wide. Margin at first spuriously thalline, finally often blackening, thin, excluded in convex ascocarps. Disc plane, black, matt or usually pruinose, becoming slightly or strongly convex. Hymenium 75-85 µm high, not inspersed; epithecium dark brown; hypothecium light reddish brown to dark brown. <u>Spores</u> 8 per ascus, brown, submuriform, 3-(5-) septate latitudinally, 0- to 1septate longitudinally, 14-17 X 6-8 µm (see Figure 11).

Spot Tests: thallus IKI-, C-, P-, K+ sordid yellow.

<u>Substratum/Habitat</u>: corticolous; collected twice on <u>Quercus</u> and once on <u>Juniperus</u> <u>scopulorum</u>.

Selected Specimens: 3805, 6511.

Local Abundance and Distribution: infrequent; all collections from the Saanich Peninsula in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumtemperate(-circumboreal) in the Northern Hemisphere. Ozenda and Clauzade (1970) described its distribution as circumtemperate but they considered the species as only corticolous. Thomson (1979), on the other hand, noted only saxicolous collections from the north Figure 11. Selected spores of <u>Buellia</u>. Collection numbers of specimens are given in brackets.

- A. Buellia alboatra (6511)
- B. Buellia badia (4203A)
- C. <u>Buellia</u> chlorophaea (2459)
- D. <u>Buellia</u> cfr. <u>disciformis</u> (2290)
- E. Buellia fosteri (6553)
- F. Buellia lepidastroidea (3785)
- G. Buellia punctata (653)
- H. Buellia penichra (848)
- I. Buellia stellulata (2966)
- J. Buellia turgescens (1298)
- K. Buellia verruculosa (2747)
- L. Buellia unknown <u>#1</u> (3655B)

























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slope of Alaska and described its distribution as circumarctic-circumtemperate; also reported from Australia (Weber & Wetmore, 1972) and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: <u>B</u>. <u>alboatra</u> is usually considered saxicolous as well as corticolous (Duncan, 1970; Harris, 1977; Sheard, 1964; Imshaug, 1951). The saxicolous substratum is usually calcareous.

All available local saxicolous collections which are similar to <u>B</u>. <u>al-boatra</u> are actually <u>B</u>. <u>chlorophaea</u>. The two species are very similar differing chiefly in their chemistry. <u>B</u>. <u>chlorophaea</u> is K+ yellow turning red and <u>B</u>. <u>alboatra</u> is K-. In the local collections the K positive reaction of <u>B</u>. <u>chlorophaea</u> was often slow or incomplete, approaching orange, while the Kreaction of <u>B</u>. <u>alboatra</u> may be positive sordid or faint yellow, especially in corticolous specimens. See <u>B</u>. <u>chlorophaea</u> for further comments.

BUELLIA BADIA (Fr.) Mass., Memor. Lichenogr.:124. 1853.

Lecidea badia Fr., Syst. Orb. Veget., pars 1, 287. 1825.

<u>Thallus</u> minutely squamulate-foliose; irregular over substratum, of digitate squamules to narrowly, nearly terete lobes, \pm shiny at ends, moderately branched, loosely adnate, up to 1.5 mm long, imbricate; dark brown. Hypothallus absent.

<u>Apothecia</u> common, crowded, 0.4-0.9 mm wide. Proper margin thin, entire, finally excluded. Disc black, matt, plane, becoming convex. Hymenium 75 µm high, not inspersed, light brownish; epithecium dark brown; hypothecium medium to dark brown. <u>Spores</u> 8 per ascus, brown, 1-septate, constricted (or not) at septum, 12-15 X 6-8 µm (see Figure 11).

<u>Spot Tests</u>: thallus IKI-, K-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: lichenicolous and saxicolous; collected once on <u>Neofuscelia verruculifera</u>, twice on igneous rock, and once on conglomerate,

all collections at higher elevations inland on exposed, sunny slopes.

Selected Specimens: 4303A, 4745B.

Local Abundance and Distribution: infrequent; scattered throughout the subzone, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-Europe disjunct; in North America Fink (1935) described its distribution as "from South Carolina and Tennessee westward to California and Washington", however a later monograph (Imshaug, 1951) noted only collections from California and Washington. According to Imshaug (1951), Zahlbruckner (1921 40) reported the species "from the cold and temperate regions of the Northern Hemisphere" which is how Ozenda & Clauzade (1970) also described its distribution despite the fact that it is restricted in France to localities above 1,000 m.

BUELLIA CHLOROPHAEA (Hepp ex Muell. Arg.) Lett., Hedwigia 52:244. 1912.

Lecidea chlorophaea Hepp ex Muell. Arg., Lich. Flora Great Brit., ed. 1:328.

1871.

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<u>Diplotomma</u> <u>chlorophaeum</u> (Hepp ex Muell. Arg.) Szat., publication information not available.

<u>Thallus</u> crustose; irregular to orbicular, up to 4 cm broad, continuous, thin to more often thick, rimose-cracked, or evenly areolate, areoles 0.2-0.5 mm wide, often additionally cracking, becoming thinner and slightly larger towards margin, smooth, \pm shiny or appearing chalky-pruinose; pale grey, whitish grey.

<u>Apothecia</u> common, abundant, \pm scattered to somewhat crowded, subsessile becoming sessile, (0.2-)0.4-0.8 mm wide. Margin thin, at first spuriously thalline, finally blackening, entire, excluded in convex apothecia. Disc lane, matt, round, black. Hymenium 60-75 µm high, not inspersed; epithecium medium to dark brown; hypothecium yellowish to light brown or reddish-brown. <u>Spores</u> 8 per ascus, brown, submuriform, 3-septate latitudinally, (0-)1-(-2) septate longitudinally, 14-19 X 7-9 µm (see Figure 11).

<u>Spot Tests</u>: thallus IKI-, C-, K+ yellow, turning red (crystals under LM); hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; often but not exclusively on seashore rocks.

Selected Specimens: 182, 2961.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, also present in adjacent zones, more common at maritime sites.

<u>World Distribution</u>: tentatively western North America-Europe disjunct; in Europe reported only from Great Britain and Ireland (Poelt, 1969).

<u>Remarks</u>: In many collections of <u>B</u>. <u>chlorophaea</u> the positive K reaction is rather slow or incomplete as viewed under the DM. However, under the LM a rose colour usually appears quickly and in most cases the narrow, red crystals are eventually produced. The reaction is particularly slow in the chalky, pruinose specimens. If the K reaction is overlooked, then the specimens will key to <u>B</u>. <u>alboatra</u>. This species is indeed present locally but all collections so far have been corticolous. When <u>B</u>. <u>alboatra</u> is saxicolous the substratum is usually calcareous (Thomson, 1979; Sheard, 1964).

Utilizing the treatment of Imshaug (1951) the local material would key to <u>B</u>. <u>ambigua</u> (Ach.) Malme which is present in California, and is described as producing a K+ yellow-turning-red reaction. However, European floras(Poelt, 1969; Ozenda & Clauzade, 1970) stated that <u>B</u>. <u>ambigua</u> has a K- reaction. Sheard (pers. comm.) suspected that what Imshaug treated as <u>B</u>. <u>ambigua</u> is actually <u>B</u>. <u>chlorophaea</u> since the thallus of the former is described as ochraceous, a coloration that herbarium specimens of the latter from the British Isles often assume (Sheard, 1964.)

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<u>BUELLIA</u> cfr. <u>DISCIFORMIS</u> (Fr.) Mudd, Man. Brit. Lich.:216. 1861. <u>Lecidea parasema</u> var. <u>disciformis</u> Fr., Nov. Sched. Crit.:9. 1826. Lecidea disciformis (Fr.) Nyl., Bot. Not. 1852:175, t. 1, f. 1. 1852.

<u>Thallus</u> crustose; irregularly orbicular, up to 2 cm broad, thin, crackedrimose, often scurfy; greenish grey, olive-grey. Hypothallus visible at margin and often between thallus granules, black.

<u>Apothecia</u> common, sessile, scattered, 0.2-0.8 mm wide. Proper margin thin, entire, finally excluded. Disc plane, black. Hymenium 100 μ m high, greenish, inspersed with oil droplets, epithecium pale orange-brown; hypothecium brown-black. <u>Spores</u> 8 per ascus, brown, 1-septate, not constricted at septum, thickened at the septum, isthmus <u>+</u> present, thin-walled and whitened at the cell apices, (20-)22-25 (-27)X 9-11 μ m (see Figure 11).

<u>Spot Tests</u>: thallus K+ yellow, slowly turning orange or red, C-; hymenium IKI+ blue.

Substratum/Habitat: corticolous; collected twice on Alnus.

Selected Specimens: 109, 2290.

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Local Abundance and Distribution: rare; distribution poorly known, collected only on the southern Gulf Islands, not collected in the adjacent zones.

<u>World Distribution</u>: perhaps circumboreal; Thomson (1979) stated it is a very widespread species, perhaps circumarctic to circumtemperate.

<u>Remarks</u>: After a preliminary examination Dr. Sheard identified a specimen of the local material as <u>B</u>. <u>curtisii</u> (Tuck.) Imsh., an eastern North American endemic. Dr. Sheard (pers. comm.) stated that "despite the massive range extension, the P+ yellow, K+ red thallus reactions indicate the identification is correct". Besides the positive spot tests, the local material exhibits the thickened septa and isthmus of spores of <u>B</u>. <u>curtisii</u>, however, the local material has an inspersed hymenium. According to Imshaug (1951) one reason that <u>B</u>. <u>curtisii</u> was separated from <u>B</u>. <u>disciformis</u> was the noninspersed hymenium of the former and the inspersed hymenium of the latter as well as the dark exciple and uniform-walled spores of <u>B</u>. <u>disciformis</u>. <u>B</u>. <u>disciformis</u> is a widespread circumboreal species known in western North America from Washington to California and Arizona. The nature of the spores and the chemistry place the local material closest to <u>B</u>. <u>curtisii</u> perhaps, but the inspersed hymenium is an important character that cannot be overlooked. The local material may represent an undescribed species.

<u>B. disciformis</u> has been reported from British Columbia on a number of occasions; the specimens on which these reports are based should be checked to ensure that they are indeed <u>B. disciformis</u>. The two specimens at UBC collected by Macoun in Sidney were checked and proved to be <u>Buellia punctata</u> and a <u>Catillaria sp</u>.

BUELLIA FOSTERI Imsh., Lichen-forming sp. of the genus Buellia in U.S. and

Canada: 92. 1951. (The University of Michigan, Ph.D.), nom. nud.

<u>Thallus</u> crustose; up to 8 cm broad, verruculose to nearly continuous granules, <u>+</u> tartareous; pale greyish.

<u>Apothecia</u> common, abundant, crowded, sessile, 0.7-1.7 mm wide. Proper margin thin, black, finally excluded. Disc black, matt to shiny, usually plane and round to flexous, sometimes slightly convex. Hymenium 90-100 μ m high, inspersed with oil droplets; epithecium reddish brown; hypothecium reddish-brown. <u>Spores</u> 8 per ascus, brown, ellipsoid, often flattened on one side, 1-septate with each lumen often narrowed near the apex to almost delimit another cell (almost 3-septate), 20-32 X 8-11 μ m (see Figure 11).

<u>Spot Tests</u>: thallus K+ yellow, C-, P-, IKI-; hymenium IKI+ blue. Substratum/Habitat: lignicolous; collected twice on driftwood with

Lecanora grantii at maritime sites.

Selected Specimens: 2915A, 5335A.

Local Abundance and Distribution: rare; distribution poorly known, present in the CDFD subzone, also collected recently at maritime sites outside the CDFD subzone.

<u>World Distribution</u>: western North American endemic; 'described' from Washington, now also known from British Columbia; maritime.

<u>Remarks</u>: According to Imshaug (1951) all previous collections of <u>B</u>. <u>fosteri</u> are from Washington and on driftwood, old boats, and logs on the beach. They are contained in the herbarium of G.K. Merrill and were designated by him as a new species, but never published. Imshaug regarded it as a good species but also never validly published it. <u>B</u>. <u>fosteri</u> was placed into synonymy, along with <u>B</u>. <u>rinodinospora</u> Riddle, under <u>B</u>. <u>callispora</u> Knight in Hale and Culberson (1970). However, as Imshaug pointed out <u>B</u>. <u>fosteri</u> lacks the thickened septum present in <u>B</u>. <u>callispora</u> and also has spores in the smaller size range only. Furthermore, the seashore habitat of <u>B</u>. <u>fosteri</u> is distinctive. <u>B</u>. <u>callispora</u> is a strictly corticolous species; its distribution is pantropical with extensions into temperate regions.

BUELLIA cfr. LEPIDASTROIDEA Imsh., Lichen-forming sp. of the genus

Buellia in U.S. and Canada:165. 1951. (The University of Michigan, Ph.D.), nom. nud.

<u>Thallus</u> crustose; irregular, scattered areoles, often turgid, cracking, tartareous, light grey, showy white. Hypothallus absent.

<u>Apothecia</u> common, scattered to clustered, sessile, 0.4-0.7(-0.9) mm wide, often persistent in various stages of decomposition. Proper margin thick, entire, smooth, <u>+</u> shiny. Disc black, plane, matt. Hymenium 75-80 µm high, densely inspersed with oil droplets; epithecium brown; hypothecium brown. <u>Spores</u> 8^{*} per ascus, brown, 1-septate, not constricted at septum, 12-17(-19) X 5-6 µm (see Figure 11).

<u>Spot Tests</u>: thallus K+ yellow(cortex), P-, C-, IKI-; hymenium IKI+blue. <u>Substratum/Habitat</u>: saxicolous; collected once on 'rotten' granite. Selected Specimen: 3785.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the southern CDFD subzone on the Saanich Peninsula, not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; previously known only from California.

<u>Remarks</u>: <u>B</u>. <u>lepidastroidea</u> is distinguished from other saxicolous <u>Buellia</u> species by the inspersed hymenium (Imshaug, 1951). However, despite the inspersed hymenium, the thallus morphology and chemistry of the local collection do not accord with <u>B</u>. <u>lepidastroidea</u>. The unusual substratum may have produced these differences. Until additional material is collected locally the collection is provisionally assigned to this species.

B. lepidastroidea is reported here tentatively as new to the province.

BUELLIA PENICHRA (Tuck.) Hasse, Contrib. U.S. National Herb. 17:122. 1913. Buellia oidalea var. penichra Tuck., Synops. N.A. Lich. 2:99. 1888.

<u>Thallus</u> crustose; thick rimose to cracked-areolate, matt with marginal black hypothallus to thin, \pm shiny, dissected by a black hypothallus; grey-white, light greyish olive, pale purplish grey.

<u>Apothecia</u> common, sessile, scattered, 0.5-1.0 mm wide. Proper margin thin, coloured like the disc, \pm shiny, finally excluded. Disc concave, becoming plane, sometimes convex, matt to occasionally shiny, black. Hymenium 95-110 µm high, inspersed with oil droplets; epithecium medium to dark brown; hypothecium brown. <u>Spores</u> 8 (sometimes less) per ascus, brown, muri-

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с. 1. кнеform, usually (3-)5-9 latitudinal septa and 3 longitudinal septa, straight to often curved, 22-33 X 11-15 (-18) μ m (see Figure 11).

Spot Tests: K-, P+ yellow; hymenium KIK+ blue.

<u>Substratum/Habitat</u>: corticolous; collected on most coniferous and deciduous trees and shrubs, especially <u>Pseudotsuga</u> and <u>Alnus</u>. Not collected on <u>Quercus</u>.

Selected Specimens: 848, 2421.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone, also present outside the CDFD subzone but not as common.

<u>World Distribution</u>: western North American endemic (see Figure 59); reported from British Columbia, Washington, Montana, and Oregon; possibly amphi-Pacific as it has been reported from Japan by Nylander (1890).

<u>Remarks</u>: Imshaug (1951) used the P+ yellow spot test of the thallus (which he believed constant) along with thallus colour, to separate <u>B. penichra from B. oidalea</u> (Tuck.) Tuck. <u>B. oidalea</u> is also a western North American endemic but it has slightly larger spores ($32-55 \times 14-21 \mu m$) with correspondingly more septa, a higher hymenium ($140-230 \mu m$ high), and an ochraceous, P- thallus. Although spore size had been used previously to separate the species, Imshaug pointed out that there was some overlap, although the mode size of <u>B. penichra</u> ($28-13 \mu m$) was the minimum size for <u>B. oidalea</u>. He suggested that specimens with spores overlapping in size be "distinguished by the white, usually areolate thallus (PD-plus, yellow) of <u>B. penichra</u> as contrasted with the ochraceous, frequently rugose or verrucose thallus (PD-minus) of <u>B. oidalea</u>". In the local material the P test was not consistent although the spores never reached the larger size range nor was the thallus ever ochraceous, as in <u>B</u>. <u>oidalea</u>.

Fink (1935) reported the distributions of both species to range from California north to Washington and inland to Montana. Imshaug (1951) also

reported this general distribution for <u>B</u>. <u>penichra</u> extending it north into southern British Columbia. However, he reported <u>B</u>. <u>oidalea</u> as restricted to California. Imshaug maintained that in California the ranges of the two species did not overlap, with <u>B</u>. <u>penichra</u> being confined to the higher elevations in the coast ranges and the Sierra Nevada while <u>B</u>. <u>oidalea</u> was restricted to the low elevations along the coast from San Francisco Bay south to Baja California.

<u>B. oidalea</u> has been reported from British Columbia (Otto & Ahti, 1967). Specimens available for checking at UBC, collected by Macoun from Mayne Island and Saanichton, Vancouver Island, all proved to be B. penichra.

Despite their similarities, the two species appear quite distinct. The foregoing comparison was presented because <u>B</u>. <u>oidalea</u> has been reported from the province and because Tucker and Jordan (1978) included <u>B</u>. <u>penichra</u> as a synonym of <u>B</u>. <u>oidalea</u> in the <u>Catalog of</u> California Lichens.

<u>BUELLIA PUNCTATA</u> (Hoffm.) Mass., Ricerch. Aunton. Lich.:81. 1852. <u>Verrucaria punctata</u> Hoffm., Deutschl. Flora:192.1796.

Thallus crustose; thin, shiny and scurfy to thick, cracked-areolate; greenish, greyish-olive. Hypothallus absent.

Apothecia common, scattered, sessile, 0.2-0.5 mm wide. Proper margin thin, <u>+</u> raised, black, finally excluded. Disc plane, occasionally slightly convex, black. Hymenium 45-60 µm high, not inspersed with oil droplets; epithecium dark brown to black, the coloration confined to dark caps of globose tips of the paraphyses; hypothecium medium brown. <u>Spores</u> 8 per ascus, brown, 1-septate, ellipsoid, occasionally slightly constricted at septum, walls + evenly thickened, 10-14(-16 X 5-7 µm (see Figure 11).

Spot Tests: thallus K-, P-; hymenium IKI+ blue.

Substratum/Habitat: corticolous, lignicolous, and saxicolous; collected

on both conifers and deciduous trees and shrubs as well as on driftwood; also sandstone, conglomerates, and igneous rocks.

Selected Specimens: 2703, 5322.

Local Abundance and Distribution: occasional (often as small thalli and hence probably much more common than the number of collections indicate); scattered throughout the CDFD subzone but heavily concentrated on the Gulf Islands, not collected in the adjacent zones but known from other locations in the province.

<u>World Distribution</u>: circumboreal-circumtemperate in the Northern Hemishpere; often referred to as cosmopolitan; also present in New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemishpere.

<u>BUELLIA STELLULATA</u> (Tayl.) Mudd, Man. Brit. Lich.:216. 1861. Lecidea stellulata Tayl., Flora Hibernica 2:118. 1836.

Thallus crustose; continuous, finely and evenly areolate; areoles 0.2-0.4 mm wide, steep-sided; pale grey, or appearing medium grey when ascocarps abundant. Hypothallus conspicuous as fimbriate margin, sometimes also visible between areoles, very occasionally absent or reduced; black.

<u>Apothecia</u> common, abundant, subsessile, finally even with areoles, placed within the areoles or separate between the areoles, 0.1-0.4 mm wide. Margin at first spuriously thalline, slow to quickly blackening, thin, entire. Disc plane, matt, black. Hymenium 40-50 μ m high, not inspersed; epithecium black, somewhat dark sordid green; hypothecium reddish-brown. <u>Spores</u> 8 per ascus, brown, ellipsoid, 1-septate, not constricted at septum, 8-12 X 4-6 μ m (see Figure 11).

<u>Spot Tests</u>: thallus K+ yellow, C-, P-, IKI-; hymenium IKI+.

Substratum/Habitat: saxicolous; only on seashore rocks in the supra-

Selected Specimens: 2744, 3277.

Local Abundance and Distribution: infrequent; at maritime sites scattered throughout the CDFD subzone, not collected at maritime sites in the adjacent zones.

<u>World Distribution</u>: uncertain; perhaps western North America-Europe disjunct since according to Imshaug (1951) in North America it is found only along the Pacific Coast from California to Puget Sound. However, there are many scattered reports of this species. Fink (1935) also reported it from Massachesetts, New Jersey, Tennessee, and Alabama in eastern North America. Other reports include Douglas & Vitt (1976), Singh (1964), and Grassi (1950). The latter is from Argentina in the Southern Hemisphere.

<u>Remarks</u>: There is some disagreement regarding the P reaction of the thallus. Sheard (1964) reported that the British material is P+ yellow but the local material is definitely P-. Imshaug (1951) also found the western North American material to be P-. A very similar European species, <u>B. aethalea</u> (Ach.) Th. Fr., has a negative P spot test; however, its K spot test is + yellow turning red and the IKI is + blue-mauve.

BUELLIA TURGESCENS Tuck., Gen. Lich.: 185. 1872.

Thallus crustose; <u>+</u> verruculose cracked-areolate with cracks in the large areoles, when thicker appearing faintly lobed at margin; brown, fuscous, dark greyish -olive, olive brown. Hypothallus usually absent, sometimes present, marginal, brown.

<u>Apothecia</u> common, scattered to crowded, sessile, 0.4-0.6 (-1.0) mm wide. Proper margin initially thin, entire, shiny, becoming <u>+</u> excluded. Disc plane becoming convex, matt, black. Hymenium 60-80 μ m high, not inspersed; epithecium dark brown; hypothecium dark brown-black. Spores 8 per ascus, brown, 1-septate, often bent, not constricted at septum, 13-17 X 6-7 μ m (see Figure 11).

Spot Tests: thallus K-, IKI-; hymenium IKI+ blue.

Substratum/Habitat: saxicolous; in the supralittoral zone.

Selected Speciments: 1298, 3156A.

Local Abundance and Distribution: infrequent; only collected at maritime locations in the southern Gulf Islands, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively North American endemic; pan-temperate; reported from New England, Iowa, Kansas, California, Washington, Ontario (Imshaug, 1951; Brodo, 1981).

<u>Remarks</u>: <u>B</u>. <u>turgescens</u> is sometimes regarded as only very well developed <u>B</u>. <u>punctata</u> (Sheard, pers. comm.). Imshaug (1951), however, stated that the three species, <u>B</u>. <u>punctata</u>, <u>B</u>. <u>turgescens</u>, and <u>B</u>. <u>badia</u>, exhibit a series of steps of increasing thallus development which are quite separate, lacking gradations.

BUELLIA VERRUCULOSA (Sm.) Mudd, Man. Brit. Lich.:215. 1861. Lichen verruculosus Sm., Engl. Botan. 33:tab. 2317. 1812.

<u>Thallus</u> crustose; usually quite small, but up to 1.5 cm broad; of <u>+</u> scattered to slightly clustered areoles; areoles flat, dull, tending to become lobed; pale green, yellow-green, yellow. Hypothallus black, conspicuous between areoles and at margin.

<u>Apothecia</u> common, scattered, <u>+</u> immersed, 0.2-0.5 mm wide. Proper margin entire, thin to thick, partially to entirely covered by a spurious thalline margin. Disc plane, matt, black. Hymenium 75 µm high, not inspersed; epithecium dark brown; hypothecium light to medium brown. <u>Spores</u> 8 per ascus, brown, 1-septate, not constricted at septum, 13-16 X 6-8 µm (see Figure 11).

<u>Spot Tests</u>: thallus K+ yellow, C+ orange-red, P-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous, collected once on conglomerate pebbles in the supralittoral zone at a maritime site.

Selected Specimen: 2747.

Local Abundance and Distribution: rare; distribution poorly known; collected once on Denman Island in the northern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; widely distributed in Europe, known in eastern North America from Massachusetts and in western North America from California and British Columbia.

<u>Remarks</u>: Superficially <u>B</u>. <u>verruculosa</u> resembles some of the yellow <u>Rhizocarpon</u> species. In the local flora this especially includes <u>R</u>. <u>viridia</u>trum which, however, lacks a spurious thalline margin.

There are several yellow-green, areolate <u>Buellia</u> species which appear to be concentrated in western North America. <u>B</u>. <u>saurina</u> W. Web., known from Utah, is C- (Weber, 1971). <u>B</u>. <u>semitensis</u> Tuck. has a C+ reaction and is known from California, however, it has finally sessile apothecia and lacks both a spurious thalline margin and a hypothallus. <u>B</u>. <u>halonia</u> (Ach.) Tuck., also known from California, has similar apothecia and possesses a black hypothallus, but according to Ozenda & Clauzade (1970) has a C- reaction. Furthermore Imshaug (1951) described the epithecium as green and the apothecia as larger (0.4-1.2 mm), soon convex, and frequently aeruginous-pruinose.

Sheard (1969) pointed out that <u>B</u>. <u>verruculosa</u> also has been confused with <u>Rinodina chrysomelaena</u> Tuck as a result of the former's cryptolecanorine apothecia.

<u>B. verruculosa</u> was reported as new to the province in Noble (1978) as a result of this study.

BUELLIA UNKNOWN #1

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<u>Thallus</u> crustose; thin and scurfy to thicker and rimose-cracked; pale grey, medium grey. Hypothallus visible when thallus thin, brownish.

Apothecia common, scattered to grouped, immersed (in one collection) to sessile, 0.3-0.6(-0.7) mm wide. Margin at first spuriously thalline, quickly becoming proper; at first markedly raised, becoming slightly raised later. Disc at first concave, quickly becoming plane, black, epruinose. Hymenium 70-75 μ m high, not inspersed with oil droplets; epithecium light to medium brown; hypothecium light reddish-brown. <u>Spores</u> 12 per ascus, brown 1-septate, ellipsoid, not constricted at septum, often slightly bent, <u>+</u> equally thinwalled or slightly thinner at the ends, 15-19 X (5-)6-8 μ m (see Figure 11).

<u>Spot Tests</u>: thallus K+ yellow turning red, P+ yellow.

<u>Substratum/Habitat</u>: corticolous; collected twice on <u>Quercus</u> and once on <u>Alnus</u>.

Selected Specimens: 881C, 3655B.

Local Abundance and Distribution: infrequent; scattered throughout the subzone, not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This species is characterized by the 12-spored asci, moderatesized spores, uninspersed hymenium, and thallus chemistry.

Initially this local material was identified as <u>B</u>. <u>polyspora</u>, a species known from temperate, eastern North America, which differs from the above in having an internally hyaline exciple and smaller spores (9-12 X 4-6 μ m) which range from 12-24 per ascus (Brodo, 1968, 1981; Harris, 1977).

Poelt (1969) mentioned two polysporous <u>Buellia</u> species, <u>B</u>. <u>dives</u> Th. Fr. and <u>B</u>. <u>polysporella</u> (Nyl.) Arn. Both are described as having quickly convex and rimless apothecia, 0.3-0.4 mm broad with spores $i2-16 \times 6-8 \ \mu$ m. They are separated on the basis of the first having a dark hypothecium and the second a light-coloured hypothecium Schauer (1965) stated that the primary difference between <u>B</u>. <u>dives</u> and <u>B</u>. <u>disciformis</u> are the former's 16-spored asci implying that the former also has an inspersed hymenium.

The <u>B</u>. <u>unknown</u> <u>#1</u> is similar to <u>B</u>. <u>punctata</u> in some respects but besides differing in the polysporous condition, the spores of the unknown species are constantly larger despite being more numerous. Additionally the chemistry of the two species is different. <u>B</u>. <u>unknown </u><u>#1</u> would appear to be an undescribed species.

CALICIUM Pers.

Thallus crustose, of well developed verrucae to immersed in substratum. Ascocarp an apothecium. Spores released along with fragments of the asci and paraphyses in a powdery mass, the mazaedium. Apothecia stipitate, on slender, tall stalks. Excipulum well-developed. Spores brown, ellipsoid, 1-septate, septum distinct, minutely ornamented.

Corticolous, lignicolous, and occasionally saxicolous. Preferring especially the shaded, dry sides of trees.

References: Tibell (1975).

 Thallus bright green, well-developed <u>C. VIRIDE</u>
 Thallus greyish (sometimes yellowish in <u>C. subquercinum</u>), often poorly developed or immersed in substratum 2
 Outer hyaline envelope of stalk IKI+ blue; stalk white to tan or reddish-black, sometimes black 3

2. Outer envelope IKI-; stalk usually black, occasionally brown..4

3.	Stalk white to buff <u>C</u> . <u>ADAEQUATUM</u>		
3.	Stalk reddish-black, sometimes black <u>C</u> . <u>SUBQUERCINUM</u>		
	 Thallus P+ yellow; yellow pruina often present on capitulum 		
	4. Thallus P-; yellow pruina absent 5		
5.	Excipulum with faint whitish pruin a ; spores 11-12 X 4-5 µm <u>C</u> . <u>GLAUCELLUM</u>		
5.	Excipulum without pruina; spores 11-15 X 5-8 µm C. ABIETINUM		

CALICIUM ABIETINUM Pers., Tentam. Dispos. Math. Fungor.:59. 1797.

<u>Thallus</u> crustose; effuse, scant, white-grey layer on substratum, Phycobiont present.

<u>Apothecia</u> stipitate. Stalks 0.4-0.7 high, slender to thickened, shiny, and black with an other hyaline layer (LM). Excipulum urceolate, shiny, epruinose, black. <u>Spores</u> 8 per ascus, uniseriate in 8 cylindrical ascus, brown, 1-septate, not or slightly constricted at the septum, surface roughened, 11-15 X 5-8 µm, released from the asci to form a mazaedium which is extruded.

Spot Tests: hyaline layer of stalk IKI-.

<u>Substratum/Habitat</u>: lignicolous; collected once on the dead branch of a live <u>Salix</u> sp.

Selected Specimen: 5487.

Local Abundance and Distribution: rare; distribution poorly known; collected once at a higher elevation inland on Saltspring Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: (circumboreal-) circumtemperate in the Northern Hemisphere (Tibell, 1975, 1981); also reported from the Southern Hemisphere including New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), South America (Tibell, 1981), and Kenya (Tibell, 1981). <u>Remarks</u>: Tibell (1975) stated that the stalks often have an olivaceous tinge; this was not observed in the local collections.

CALICIUM ADAEQUATUM Nyl., Flora 52:409. 1869.

Calicium hemisphaericum Howard, Bryologist 58:34. 1955.

Thallus crustose; + immersed, not observed.

<u>Apothecia</u> stipitate. Stalks up to 0.5 mm high, moderately stout, <u>+</u> hyaline at the base darkening slightly to pale tan up the stalk, slightly constricted below the excipulum. Excipulum pale tan to dark brown, often from darkened spores showing through the <u>+</u> transparent excipulum, <u>+</u> shiny. <u>Spores</u> 8 per ascus, brown, ellipsoid, constricted at septum, with spiral striations, 7-9 X 3.5-5.0 μ m, released early to form a black, powdery mazaedium which is not extruded.

Spot Tests: stalk IKI+ blue-purple.

<u>Substratum/Habitat</u>:corticolous; collected once on <u>Acer</u> twigs with Xanthoria polycarpa.

Selected Specimen: 5504.

Local Abundance and Distribution: rare; distribution poorly known, not collected in the CDFD subzone, collected once in the adjacent CDFW subzone.

<u>Remarks</u>: <u>C</u>. <u>adaequatum</u> is found commonly on twigs and branches of <u>Alnus</u>. It is probably much more common than the single collection would indicate, as the species is very inconspicuous.

The very pale stalks are the striking characteristic of this species. Tibell (1975) described the stalks as light olive brown. Howard (1955), in her description of <u>C</u>. <u>hemisphericum</u>, describes the stalks as white, which is closer to that seen in the local material. However, older stalks that lack capitula are much darker.
CALICIUM ADSPERSUM Pers., Icon. Descript. Fungor. Minus Cognit., fasc. 1,

Tab. 14, fig. 7. 1798.

Thallus crustose; effuse, thin; grey.

<u>Apothecia</u> stipitate. Stalks short, 0.3-0.5 mm high, stout, shiny black; with an outer hyaline covering (viewed under LM). Excipulum urceolate, black. <u>Spores</u> 8 per clavate ascus, brown, 1-septate, irregularly shaped, roughened, 10-11 X 4-5 µm, released to form a large, powdery, black mazaedium which is extruded.

Spot Tests: thallus P+ yellow; hyaline envelope IKI-.

Substratum/Habitat: corticolous; collected once on Thuja.

Selected Specimen: 3724.

Local Abundance and Distribution: rare; distribution poorly known; collected once in the CH zone, not collected in the CDFD subzone.

<u>World Distribution</u>: western North America-Europe-eastern Asia; in North America reported from British Columbia (Tibell,1975) in Asia reported from Japan (Asahina, 1932); a different form has also been reported from Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks</u>: According to Tibell (1975) <u>C</u>. <u>adspersum</u> has a yellow pruin**a** on the mazaedium which is most evident in the young fruiting structure. In addition he described the spores as obviously striated. Two varieties are known from Europe. One, found on deciduous tree, has a thick thallus with short-stalked apothecia and dense, yellow proing on the mazaedium and exciple. The other, found on conifers, has a thin thallus, with long, slenderstalked apothecia and a faint yellow pruing on the mazaedium. Only the latter has been found in North America. CALICIUM GLAUCELLUM Ach., Meth. Lich.: 97. 1803.

Thallus immersed.

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<u>Apothecia</u> stipitate. Stalks 0.6-1.0 mm high, shiny, black; with a hyaline-brownish outer covering (viewed under LM). Excipulum urceolate, black, in part faintly white pruinose on the edge. <u>Spores</u> 8 per cylindrical ascus, brown, 1-septate, not constricted at septum, with one cell sometimes longer than the other, faintly patterned, $11-12(-13) \times 4.5-5 \mu m$.

Spot Tests: hyaline layer IKI-.

Substratum/Habitat: corticolous; collected once on Pseudotsuga.

Selected Specimens: 756, 6409.

Local Abundance and Distribution: rare; distribution poorly known; collected twice in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; known from British Columbia in western North America and Ontario and Michigan in eastern North America.

CALICIUM SUBQUERCINUM Asah., J. Jap. Bot. 8:2. 1932.

<u>Thallus</u> crustose; thin, of scattered granules; grey to yellowish grey. <u>Apothecia</u> stipitate. Stalks 0.6-1.0 mm high, stout, shiny, black becoming reddish-brown towards the top. Excipulum slightly flared with a faint white pruinose ring. <u>Spores</u> 8 per ascus, brown, 1-septate, ellipsoid, not constricted, 10-15 X 5-7 µm, released to form a mazaedium but not extruded.

Spot Tests: stalk IKI+ blue.

Substratum/Habitat: corticolous; collected once on Thuja.

Selected Specimen: 5429B.

Local Abundance and Distribution: rare; collected only in the CH zone, not collected in the CDFD subzone.

<u>Remarks</u>: According to Tibell (1975), the pruina may be dense or absent, the asci clavate to subcylindric, the spores minutely pustulate to cracked, and the stalk completely to only partially blackened.

<u>CALICIUM VIRIDE</u> Pers., Neue Annal. Bot. 1 Stuck, 20. 1794. Calicium hyperellum Ach., Meth. Lich.:93. 1803.

<u>Thallus</u> crustose; of scattered to grouped, thick to thin, leprose granules; bright green, yellow-green.

<u>Apothecia</u> stipitate. Stalks 0.6-1.5 mm high, shiny, black. Excipulum brown to black, initially constricted at the top. <u>Spores</u> 8 per ascus, brown, 1-septate, constricted at the septum, minutely ornamented, cells sometimes irregularly flattened, 9-12 X 4-5 µm.

Spot Tests: none.

Substratum/Habitat: corticolous, collected on Pseudotsuga.

Selected Specimens: 6328, 7366.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, not collected in adjacent zones or subzones.

World Distribution: circumboreal (Tibell, 1975).

<u>Remarks</u>: Tibell (1975) stated that <u>C</u>. <u>viride</u> can be similar to <u>C</u>. <u>salicinum</u> Pers. which is known from Cameron Lake on Vancouver Island. The latter species has a greyish, immersed thallus and cylindrical asci compared with the former's green, well developed thallus and narrowly clavate asci.

CALOPLACA Th. Fr.

Thallus crustose to placoidal; disappearing to granulose, areolate, or effigurate-lobate. White to grey (lacking parietin) or yellow to orange, K+ purple (containing parietin). Hypothallus present or absent.

Ascocarp an apothecium. Lecideine to commonly lecanorine. Disc yellow, orange, red, or black; epithecium K+ purple (parietin). Spores 8 per ascus, hyaline, polarilocular.

All substrata; locally very common on seashore rocks.

The North American species are in need of revision.

References: Magnusson (1944a, 1944b, 1950, 1953), Poelt (1954), Rudolf (1955), Wade (1965), Nordin (1972).

1.	Sacicolous	
1.	Corticol	ous or lignicolous
	2.	Thallus effigurate, usually obviously orbicular even if lobes not formed
	2.	Thallus effuse, not effigurate; or of separate, scattered areoles or squamules
3.	Marginal	lobes distinct, well formed 4
3.	Marginal	lobes indistinct, of elongated areoles
	4.	Lobes not contiguous, corticate below, dark orange to red <u>XANTHORIA ELEGANS</u> (p.775)
	4.	Lobes contiguous, ecorticate below, yellow
5.	Thallus sorediate	
5.	Thallus is	sidiate C. VERRUCULIFERA

	6 Thallus vellow to orange-vellow	7
	6 Thallus blue-grev	ΥΤΑ
7	Thallus consists	
/.	marius sorediate	<u> </u>
7.	Thallus esorediate	8
	<pre>8. Thallus cracked-areolate, <u>+</u> continuous; <u>+</u> yellow-orange hypothallus</pre>	INA
	8. Thallus separate areoles or squamules, <u>+</u> discontinuous; <u>+</u> black hypothallus <u>C. IRRUBESC</u>	ENS
9.	Thallus yellow or orange	.10
9.	Thallus white or grey or <u>+</u> disappearing	.12
	10. Thallus <u>+</u> absent; on calcareous substrata <u>C</u> . <u>FERACISS</u>	IMA
	10. Thallus distinctly developed; on noncalcareous substrata	.11
11.	Black hypothallus often present; areoles flat, <u>+</u> smooth, yellow-orange to orange; disc < 1 mm <u>C</u> . <u>IRRUBESC</u>	ENS
11.	Hypothallus absent; areoles <u>+</u> convex, often cracking, cartilaginous, tawny-yellow; disc > 1 mm	INA
	12. Thallus sorediate, of dark blue-grey <u>+</u> discontinuous areoles on a black hypothallus; lobed at margin or not <u>C. TEICHOL</u>	 .YTA
	12. Thallus esorediate, white to dark grey, <u>+</u> continuous, cracked areolate to thin and disappearing, not lobed; with or without a hypothallus	.13
13.	Margin completely black <u>C</u> . <u>LITORIC</u>)LA
Ì3.	Margin yellow or orange, concolorous with disc	.14
	14. Thallus cracked-areolate, well-developed, almost lobed at margin; black hypothallus often presentC. ATROFI	<u>.AVA</u>
	14. Thallus thin to absent; hypothallus absent or white	.15
15.	Apothecia bright, 'fluorescent' orange	<u>AETA</u>
15.	Apothecia ferrugineous (brownish-orange, brownish-red) <u>C</u> . <u>AREN</u>	ARIA
	16. Thallus yellow	17
	16. Thallus grey or whitish	20

17.	Thallus sorediate18	
17.	Thallus esorediate	
	18. Thallus entirely sorediate	
	<pre>18. Thallus verruculose (greyish), breaking down in places into yellow soredia</pre>	
19.	Thallus thick, of scattered, turgid verrucae; thalline margin conspicuous, cracking; on driftwood <u>C</u> . <u>BOLACINA</u>	
19.	Thallus thin, continuous, slightly verrucose to smooth; thalline margin inconspicuous, not cracking <u>C</u> . <u>FLAVORUBESCENS</u>	
	20. Thallus sorediate	
	20. Thallus esorediate21	
21.	Hypothecium reddish; algae absent in apothecium <u>C</u> . <u>ATROSANGUINEA</u>	
21.	Hypothecium hyaline to fulvous; algae present as a thick continuous layer, or as scattered clumps of cells, or occasionally absent	
	22. Disc yellow-orange to bright orange; algal layer thick, continuous below hypothecium	
	22. Disc ferrugineous (dirty brown-orange, brown-red) sometimes blackening; algal layer discontinuous, of scattered clumps of cells, or absent	
23.	Thalline margin persistent; proper margin not visible <u>C</u> . <u>CERINA</u>	
23.	Thalline margin partially or totally excluded; proper margin visible24	
	24. Spores > 16 µm long; partially excluded thalline margin often blackened on sides of apothecia <u>C</u> . <u>OREGONA</u>	
	24. Spores < 16 μm long; if excluded thalline margin partially visible, then not blackened <u>C</u> . <u>HOLOCARPA</u>	
25.	Proper margin thin, not prominent or flexuous; disc dirty orange (not reddish or blackening), very roughened-granular; pycnidia absent	
25.	Proper margin thick, raised, often flexuous; disc dirty orange to red-orange to red-black, <u>+</u> smooth; pycnidia present, red	

CALOPLACA ARENARIA (Pers.) Muell. Arg., non auct., Mém. Soc. Physc. Hist. Natur. Geneve 16:387. 1862.

Lichen arenarius Pers., Neue Annal. Botan. 1:27. 1792.

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Caloplaca lamprocheila (DC.) Flag., Revue Mycol. 10:120. 1888.

<u>Thallus</u> crustose; seemingly absent or obscure, thin, discontinuous around sand grains of substratum; dirty light grey.

<u>Apothecia</u> common, adnate, scattered to clustered, 0.3-0.6(-0.7) mm wide. Thalline margin absent but algae present below hypothecium. Proper margin lighter coloured than the disc, thick becoming thinner with age, entire, raised. Disc dark rust-orange (liver brown, chestnut-brown, mahogany red, burnt sienna), matt, round to slightly irregular, \pm plane. Hymenium 60-65 µm high; epithecium granular, dark orange-brown; hypothecium hyaline to tan. <u>Spores</u> 8 per ascus, hyaline, oblong, 1-septate to polarilocular, septum 1-2.5 µm thick (sometimes indistinct or incomplete), isthmus distinct (sometimes indented), (14-)15-17 X (4-)5(-6) µm (see Figure 13).

<u>Spot Tests</u>: epithecium K+ dark red, granules dissolving, C+ rose-red, granules dissolving; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous, collected primarily on sandstone (HC1-). <u>Selected Specimens</u>: 707, 6441.

Local Abundance and Distribution: infrequent; mainly in the southern Gulf Islands at both maritime sites and higher elevations inland; exposed sites; not collected in the adjacent zones.

<u>World Distribution</u>: (circumboreal-) circumtemperate in the Northern Hemisphere; known from Europe, Asia, North Africa (Ozenda & Clazade, 1970) and Siberia and Japan (Magnusson, 1944b).

Remarks: The local material agreed well with comparative material

borrowed from COLO.

<u>C. arenaria</u> has been confused with <u>C. fraudans</u>. The latter species is the one described in Rudol**ph** (1955) in what appears to be a mixed description of both species. Magnusson (1944b) is the only paper with descriptions of both species. According to him <u>C. fraudans</u> has larger apothecia (0.7-1.0 mm wide), thicker hymenium (85-100 μ m high), a thicker, dark grey hypothecium (60-100 μ m thick), and when present, a pale yellowish thallus.

<u>CALOPLACA ATROFLAVA</u> (Turn.) Mong., Bull. Géogr. Bot. 23 ann.:192. 1914. <u>Lecidea atroflava</u> Turn., Trans. Linn. Soc. Lond. 9:142. 1808.

<u>Thallus</u> crustose; <u>+</u> continuous, moderately thick, cracked-areolate; surface slightly verruculose or uneven, edges of 'areoles' occasionally a little raised especially at the margin; dark grey, brownish-grey. Hypothallus often present at margin, shiny, blue-black.

Apothecia common, \pm abundant, scattered or clustered, adnate, constricted, 0.5-0.8 mm wide. Thalline margin excluded early or partially visible at sides of ascocarps, concolorous with thallus. Proper margin present, thick, raised, smooth and shiny, initially yellow-orange becoming and staying bright orange (often 'cleaner' orange than the disc), persistent. Disc round to irregular by compression, initially concave becoming plane, sometimes slightly convex, matt, bright orange often becoming brown-orange. Hypothecium hyaline to fulvous; algae present below hypothecium; epithecium orange granular; hymenium 75 μ m high, \pm hyaline; paraphyses slightly branched, septate, often submoniliform near the top. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum distinct (ca. 5 μ m), (13-)15-17 X (6-)7-8 μ m.

<u>Spot Tests</u>: thallus K-; epithecium C+ bright orange-red, granules not dissolving, K+ rose-red, granules dissolving.

Substratum/Habitat: saxicolous; collected once each on sandstone, conglom-

erate cobbles, and granitic igneous rock; all HC1-.

Selected Specimens: 836, 4179.

Local Abundance and Distribution: infrequent; scattered in the southern part of the CDFD subzone at both maritime sites and exposed higher elevations inland; not collected in the adjacent zones.

World Distribution: western North America-Europe disjunct.

<u>Remarks</u>: The local material was originally determined as a saxicolous form of <u>C</u>. <u>holocarpa</u> which is known to be present locally in its corticolous form. However, the thallus was too well-developed with a fringing hypothallus, darkening disc, slightly larger spores, and on noncalcareous substrata to be <u>C</u>. <u>holocarpa</u>. Saxicolous <u>C</u>. <u>holocarpa</u> is reported to be a caloicole (Duncan, 1970).

C. atroflava is reported here as new to the province.

<u>CALOPLACA</u> <u>ATROSANGUINEA</u> (Merr.) Lamb, Canada Nat. Mus. Bull. 132. 305. 1954. <u>Lecanora</u> <u>atrosanguinea</u> Merr., Ottawa Naturalist 27:117. 1913.

Blastenia herrei Hasse, Bryologist 17:92. 1914.

<u>Thallus</u> crustose; very thin, smooth, and slightly shiny to thicker and rimose; light grey to green-grey. No hypothallus observed.

Apothecia common, usually scattered, adnate, 0.4-0.8(-1.1) μ m wide. Thalline margin totally absent, no algae below hypothecium. Proper margin thin, raised, <u>+</u> shiny, concolorous or darker than the disc, usually persistent. Disc plane to slightly convex, round to flexuous, matt and velvety; black (dark red-brown or red-black under DM). Hymenium 65-75 μ m high, hyaline to reddish; epithecium black to dark granular red; hypothecium light to dark, bright magenta. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum c. 4-5 μ m, isthmus distinct, (12-)14-17 X 7-9 μ m (see Figure 13).

Spot Tests: thallus K-; epithecium K+ purple-magenta; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous, on a variety of deciduous or coniferous trees, most frequently on <u>Quercus</u>, although thalli are best developed on <u>Pseudotsuga</u>.

Selected Specimens: 1430, 4065.

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Local Abundance and Distribution: occasional; scattered throughout the study area; also collected in adjacent zones.

<u>World Distribution</u>: western North American endemic; described from Sidney on Vancouver Island, so far known from only southern coastal British Columbia and adjacent Washington (Hasse, 1914).

<u>Remarks</u>: Rudolph(1955) stated that the hypothecium is hyaline but this was not true of any of the local collections which were all brightly coloured. The type has been examined and now has faded to an apricot coloured hypothecium in the one dissected, although it originally had a reddish colour (Merrill, 1913). The description of <u>Blastenia herrei</u> also noted the coloured hypothecium (Hasse, 1914).

<u>CALOPLACA</u> <u>BOLACINA</u> (Tuck.) Herre, Proc. Wash. Acad. Sci. 12:233. 1910. <u>Placodium</u> <u>bolacinum</u> Tuck., Lich. Calif.:18. 1866.

<u>Thallus</u> crustose-squamulose; of scattered or sometimes clustered turgid verrucae, initially <u>+</u> round and flattened but becoming convex and irregular and then sometimes lobate to subsquamulate; occasionally almost absent and present only at base of apothecium; areoles smooth and shiny or cartilaginous becoming slightly cracked, tartareous, but not sorediate; citron yellow, tawny yellow, greenish-yellow. Hypothallus absent.

The verrucae in cross-section show thick-walled hyphae occurring in vertical bundles that break the algae into clumps instead of an uninterrupted algal layer. The hyphae become shorter and irregularly oriented in the upper

cortex (45-60 um thick) with only the upper 25 μ m being pigmented yellow.

<u>Apothecia</u> common, scattered to crowded, sessile, sometimes subsessile if the verrucae are abundant and swollen, 1.0-1.7(-2.6) mm wide. Thalline margin thick, cracked, tartareous, sometimes becoming excluded or reduced. Proper margin thin, visible between disc and thalline margin or <u>+</u> prominent if thalline margin reduced, paler orange than the disc. Disc plane, concave when crowded, matt, orange. Hymenium 65-75 µm high; epithecium sordid yellow-brown; hypothecium hyaline, 125 µm high; algae in clusters in thick, thalline rim (up to 300 µm thick). <u>Spores</u> 8 per ascus, hyaline, polarilocular, isthmus distinct or not, (11-)13-18 X (4-)6-7(-8) µm.

Spot Tests: thallus and epithecium K+ red-purple; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous, often along fissures and crevices at exposed sites along the seashore; occasionally lignicolous on driftwood.

Selected Specimens: 1552, 7351.

Local Abundance and Distribution: infrequent; scattered at maritime sites throughout the subzone, not collected in the adjacent zones.

<u>World Distribution</u>: Rudol**ph** (1955) described this species as orange chrome coloured and areolate giving a completely different impression than Magnusson's description (1944a) of it as dark citrine and <u>+</u> squamulose. The type has been examined and although slightly molded the thallus may still be seen to be poorly developed while the apothecia are abundant and large. The colour is primarily a dark orange with lighter yellow-orange evident in some places. The verrucae in cross-section are the same as in the local material. The type represents one end of the spectrum of the variation possible in this species. It probably came from a very exposed habitat since lighter-coloured thalli from California have been noted to be associated with maritime <u>Lecania</u> loan material. It should be noted that the type is on calcareous sandstone although the local material is all on HCl- rock. <u>C</u>. <u>bolacina</u> is reported here as new to the province.

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CALOPLACA CERINA (Ehrh. ex Hedw.) Th. Fr., Nova Acta Soc. Sci. Upsal. ser. 3, 3:218. 1861.

Lichen cerinus Ehrh. ex Hedw., Pl. Crypt. exc. 22:216. 1787.

<u>Thallus</u> crustose; thin to thick, rimose to almost cracked-areolate; dirty grey. Hypothallus not seen.

Apothecia common, scattered to crowded, subsessile becoming sessile, 0.5-0.8 mm wide. Thalline margin light grey, persistent. Proper margin not observed. Disc plane to slightly convex, 'velvety' matt, dark orange. Hymenium 60-75 µm high; paraphyses slightly branched; epithecium granular, dark orange; hypothecium hyaline; algae forming a thick, continuous band below hypothecium. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum 4-5 µm thick, isthmus usually distinct, (12-)14-15 X 6-7 µm.

<u>Spot Tests</u>: epithecium K+ rose-red; hymenium IKI+ blue. <u>Substratum/Habitat</u>: corticolous; collected once on cultivated <u>Pyrus</u>. <u>Selected Specimen</u>: 1238.

Local Abundance and Distribution: rare; distribution poorly known; collected once in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal(-circumtemperate) (Thomson, 1979); described as almost cosmopolitan by Ozenda & Clauzade (1970); also known from New Zealand (Martin, 1966) and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks:</u> <u>C. cerina</u> is typically yellow coloured on the disc with the thalline margin a dark grey. The local material had an orange disc with light grey margin. In many respects it is similar to <u>C. holocarpa</u> and <u>C. oregona</u>.

The thalline margin, however, is not excluded even partially, and the proper margin is not visible at all.

CALOPLACA CHRYSOPHTHALMA Degel., Svensk Bot. Tidskr. 38:56, 1944.

<u>Thallus</u> crustose; scattered to clustered, verruculose granules; light grey, greenish grey to pale yellowish grey in places (possibly pre-sorediate regions); sorediate, soredia finely granular, yellow, usually edges of verrucae crumbling to form the soralia, however, sometimes becoming extensive and soralia + confluent. Hypothallus not observed.

Apothecia abundant in specimen observed, adnate, moderately constricted, 0.5-0.8(-1.3) mm wide. Thalline margin usually initially distinct, thick, raised, uneven to almost verruculose, occasionally sorediate, pale grey to yellowish grey. Proper margin sometimes observed between thalline margin and disc, concolorous with or slightly paler than the disc, smooth, shiny, slightly raised, persistent. Disc round to often rather irregular, concave becoming plane, surface 'velvety', orange, Hypothecium hyaline; algal layer present below hypothecium, often dissected by bands of hyphae; hymenium 65-70 µm high; epithecium orange, granular; paraphyses simple to slightly branched at apices, apical cells globose. <u>Spores</u> 8 per ascus, hyaline, polarilocular, often somewhat swollen towards the middle, septum thick (ca. 3.5-5 µm long), isthmus distinct or not, 12-15 X 5-6 µm.

Spot Tests: soredia and epithecium K+ rose-red.

<u>Substratum/Habitat</u>: corticolous; collected once at the base of an old, roadside <u>Quercus</u>, partially covered by adjacent grass.

Selected Specimen: 7408.

Local Abundance and Distribution: rare; distribution poorly known, collected once near Victoria in the southern part of the CDFD subzone, not collected in the adjacent zones; (with future work it may prove to be more

common an urban areas).

<u>World Distribution</u>: uncertain; Europe and North America; in North America reported from Michigan (Harris, 1975), California (Tucker & Jordan, 1978) and New Mexico (Egan, 1972).

Remarks: C. chrysophthalma is reported here as new to the province.

CALOPLACA CITRINA (Hoffm.) Th. Fr., Nova Acta Soc. Sci. Upsal., ser. 3, 3:218. 1861.

Verrucaria citrina Hoffm., Deutschl. Flora:198. 1796.

<u>Thallus</u> crustose; pulverulent-sorediate, effuse, thin to thick, sometimes of scattered sorediate granules; pale yellow-green, light yellowish olive, yellowish citrine.

Apothecia common, often crowded, adnate, 0.5-1.2 mm wide. Thalline margin thick to thin, smooth becoming crenate or sorediate, slightly to entirely excluded. Proper margin not to slightly visible as thalline margin is excluded; raised, concolorous with disc. Disc plane, round to irregular when crowded, matt, yellow to yellow-orange. Hymenium 60 µm high; epithecium granular, orange, paraphyses not apically branched; hypothecium hyaline to fulvous. <u>Spores</u> 8 per ascus, hyaline, oblong-ellipsoid, polarilocular, septum 2-3 µm thick, isthmus distinct to indistinct, 11-13 X 5-6 µm.

<u>Spot Tests</u>: thallus and epithecium K+ purple-red; hymenium IKI+ blue. <u>Substratum/Habitat</u>: lignicolous; collected twice on driftwood. Selected Specimens: 448, 2916B.

Local Abundance and Distribution: infrequent; distribution poorly known; scattered throughout the subzone, not collected in the adjacent zones.

World Distribution: circumtemperate (Ozenda & Clauzade, 1970).

<u>Remarks</u>: <u>C</u>. <u>citrina</u> is sometimes regarded as only a saxicolous species with the corticolous form known as <u>C</u>. <u>phlogina</u> (Ach.) Flag. Wade (1965) pointed out that the size of the granules of the corticole were about half the average size of those of the saxicole but, more importantly, there were no apothecial differences.

CALOPLACA FERACISSIMA H. Magn., Bot. Not. 1953:189. 1953.

<u>Thallus</u> crustose; <u>+</u> immersed in substratum; several small, poorly developed granules, in vicinity of larger ascocarps, bright yellow; hypothallus absent.

<u>Apothecia</u> abundant, clustered, adnate, moderately constricted, (0.3-)0.4-0.6(-0.8) mm wide. Thalline margin poorly developed, usually initially present, irregular, often cracked, bright yellow, becoming partially or occasionally totally excluded. Proper margin often present, paler or concolorous with disc (more orange than the thalline margin), on the inside of the thalline margin, raised, persistent. Disc concave becoming plane, round to slightly irregular but not usually angled even from pressure, surface 'velvety', yellow-orange to sordid yellow-orange. Hypothecium hyaline; hymenium 70 μ m high; algal layer present below hypothecium; paraphyses <u>+</u> simple, or only slightly branched towards the apices, cells at apices slightly globose; epithecium granular and orange. <u>Spores</u> 8 per ascus, hyaline, polarilocular, septum thin (1-2.5 μ m thick), isthmus often indistinct, 17-20 X 6-8 μ m (see Figure 13).

Spot Tests: epithecium K+ pink-rose, persistent.

<u>Substratum/Habitat</u>: saxicolous; collected once on an old cement foundation (HCl+).

Selected Specimen: 7399.

Local Abundance and Distribution: rare; distribution poorly known; collected once near Victoria in the southern part of the CDFD subzone, not collected in the adjacent zones; (it may prove to be common at urban locations with future work).

<u>World Distribution</u>: uncertain; reported only for North America; described from Wisconsin in 1953 and since reported from New York (Brodo, 1968), South Dakota (Wetmore, 1968), Michigan (Harris, 1977), and Ontario (Brodo, 1981).

<u>Remarks</u>: The thallus of <u>C</u>. <u>feracissima</u> was originally described as completely absent (Magnusson, 1953). Rudolph (1955) stated that the thallus is "ochraceous buff, with black hypothallus, often disappearing". Brodo (1968) and Harris (1977) both mentioned a reduced yellow thallus. Brodo (1981) stated that "the thallus is often seen as a blackish crust around apothecia".

<u>C. feracissima</u> appears to be very similar to the European <u>C. lactea</u>, (Mass.) Zahlbr. which is also known from North America (New Mexico, North Dakota). <u>C. lactea</u> also has relatively small apothecia, similar-sized spores with a narrow septum, and a reduced to absent thallus on calcareous stustrata. However, the thallus of <u>C. lactea</u>, when present, is described as chalk white (K-) and presumeably the same applies to its thalline margin.

C. feracissima is reported here as new to the province.

CALOPLACA FERRUGINEA (Huds.) Th. Fr., Nova Acta Reg. Soc. Sci. Uppsala III. 3:223. 1861.

Lichen ferrugineus Huds., F. Angl.:444. 1762.

<u>Thallus</u> crustose; thin, smooth and \pm shiny or thicker and rimose; offwhite to light grey. Hypothallus absent or visible at margin, blue-black.

<u>Apothecia</u> common, scattered, occasionally crowded, adnate, 0.5-1.1 mm wide. Thalline margin absent but some clumps of algae often present below hypothecium. Proper margin thick, remaining thick or sometimes becoming thin; raised, \pm shiny, concolorous, not usually darkening as fast as the

disc. Disc plane, sometimes becoming convex, round becoming flexuous, matt, orange-red, sometimes blackening. Hymenium 65-75 μ m high, usually hyaline; epithecium granular, light or dark orange-brown; hypothecium hyaline to fulvous. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum 5-7 μ m thick, isthmus distinct, 13-17 X 7-8(-10) μ m (see Figure 13).

<u>Pycnidia</u> usually present, dark red, sessile to subsessile; pycnospores hyaline, cylindrical, 2.5-3 X 0.8 µm.

Spot Tests: thallus K-; epithecium K+ rose-red; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; collected on <u>Juniperus</u> <u>scopulorm</u>, Quercus, and Thuja.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic to circumboreal (Thomson, 1979).

CALOPLACA FLAVORUBESCENS (Huds.) Laund., Lichenologist 8:147. 1976.

Lichen flavorubescens Huds., Fl. Angl.:433. 1762.

Caloplaca aurantiaca auct. p.p., non (Lightf.) Th. Fr.

<u>Thallus</u> crustose; continuous, smooth to irregularly cracked but not distinctly areolate; creamy, pale yellow. Hypothallus absent.

<u>Apothecia</u> common, scattered, adnate, 0.4-0.8 mm wide. Thalline margin absent but algae present below hypothecium. Proper margin thick, slightly raised, entire, shiny, concolorous with disc. Disc concave becoming plane, round, matt to shiny, dark orange. Hymenium 75 μ m high; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum 5-6 μ m thick, isthmus distinct, 13-17 X 6-8 μ m.

<u>Spot Tests</u>: thallus K+ purple-red; epithecium K+ rose-red. <u>Substratum/Habitat</u>: corticolous; collected once on <u>Acer</u>. Selected Specimen: 4480. Local Abundance and Distribution: rare; distribution poorly known, collected near Ladysmith, not collected in the adjacent zones.

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World Distribution: circumtemperate (Ozenda & Clauzade, 1970).

<u>CALOPLACA HOLOCARPA</u> (Hoffm.) Wade, Lichenologist 3:11. 1965. <u>Verrucaria oblitterata</u> var. <u>holocarpa</u> Hoffm., Deutsch. Flora:179. 1796. <u>Caloplaca pyracea</u> (Ach.) Th. Fr., K. Svensk. Vet.-Adad. Handl. 7(2):25. 1867.

<u>Thallus</u> crustose; thin, smooth to rimose, to immersed; pale grey, whitish-grey.

<u>Apothecia</u> abundant, usually scattered, adnate, moderately constricted, 0.3-0.6(-0.7) mm wide. Thalline margin absent or as a thin to thickish remnant around sides of apothecia, concolorous with thallus. Proper margin thick, raised, smooth, shiny, concolorous with disc, persistent. Disc <u>+</u> round, plane, occasionally slightly convex, <u>+</u> smooth and shiny, initially yellow, quickly becoming light orange. Hypothecium hyaline, inspersed; hymenium 55-80 μ m high, hyaline; epithecium granular orange-brown; paraphyses simple to moderately branched. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum 3-4 μ m, isthmus distinct, 10-13(-14) X 5-7 μ m (see Figure 13).

<u>Spot Tests</u>: thallus K-; epithecium K+ rose-red, granules dissolving C+ dark red, granules not dissolving.

<u>Substratum/Habitat</u>: corticolous, collected on <u>Quercus</u>, <u>Juniperus</u> <u>scopu</u>lorum, and <u>Holodiscus</u> <u>discolor</u>.

Selected Specimens: 2734, 3805.

Local Abundance and Distribution: infrequent; scattered throughout the subzone, not collected in adjacent zones.

<u>World Distribution</u>: circumboreal(-circumtemperate) (Thomson, 1979); also known from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: Of the local <u>Caloplaca</u> species, <u>C</u>. <u>holocarpa</u>, <u>C</u>. <u>oregona</u>, and <u>C</u>. <u>flavorubescens</u> are all very similar. All three have a bright orange disc with proper margin showing and a partially to totally excluded thalline margin. <u>C</u>. <u>flavorubescens</u> has a yellow, K+ purple thallus but the only local collection had an almost immersed thallus with scattered yellow verrucae showing through in places which were quite distinct from the apothecial initials also present. The yellow thallus is quite easy to overlook. <u>C</u>. <u>oregona</u> has an often blackened, partially excluded thalline margin and large spores while <u>C</u>. <u>holocarpa</u> has a light grey, partially excluded margin and small spores.

CALOPLACA IRRUBESCENS (Nyl.) Zahlbr., Verhandl. zool.-bot. Gesellsch. Wien 48:365. 1898.

Lecanora irrubescens Nyl., Flora, Regensberg 57:318. 1874.

<u>Thallus</u> minutely squamulose or crustose-areolate; areoles scattered, not continuous even when clustered, unoriented, 0.2-0.9 mm wide, initially slightly irregular with irregularities developing slightly until sublobate and then the margins appearing almost free from substratum; <u>+</u> flat, smooth, shiny; yellow-orange or orange. Hypothallus often visible beyond areoles, sometimes very extensive on igneous rocks; black.

<u>Apothecia</u> common, scattered, adnate on areoles, constricted, 0.3-0.7 mm wide. Thalline margin partially excluded early, visible as scattered remnants below proper margin, concolorous with thallus. Proper margin thin to moderate, even, smooth, paler than the disc. Disc round to a little irregular, plane, deep orange. <u>Spores</u> 8 per ascus; hyaline, ellipsoid, polarilocular, septum distinct, 10-13 X 5-6 µm.

Spot Tests: thallus and epithecium K+ purple-red.

<u>Substratum/Habitat</u>: saxicolous; on HCl- rocks, often with <u>Lecanora</u> incussa, a shade loving species.

Selected Specimens: 641, 4217A.

Local Abundance and Distribution: occasional; inland, scattered throughout the subzone, not collected in the adjacent zones.

<u>World Distribution</u>: probably circumtemperate; known from mediterranean Europe and Asia (Ozenda & Clauzade, 1970); '<u>C</u>. <u>lobulata</u>' has been reported from Washington (Howard, 1950), Arizonea, Rhode Island, Maryland, New Mexico (Rudolf, 1955), and North Dakota (Wetmore, 1968) in North America.

<u>Remarks</u>: The separation of the two species <u>C</u>. <u>irrubescens</u> and <u>C</u>. <u>sipeana</u> H. Magn. is not clear. The latter species is described from Oregon (Magnusson, 1944a). Rudolph (1955) described its colour as salmon orange. Otherwise <u>C</u>. <u>sipeana</u> appears indistinguishable from <u>C</u>. <u>irrubescens</u> on the basis of descriptions available. The types require comparison.

The local material agrees well with descriptions of <u>C</u>. <u>lobulata sensu</u> Rudolph(1955) and Wetmore (1968), a name which is now rejected as a synonym of <u>C</u>. <u>marina</u>, leaving the correct name of this species, according to Ozenda & Clauzade (1970), as <u>C</u>. <u>irrubescens</u>.

Locally the separation of <u>C</u>. <u>irrubescens</u> from <u>C</u>. <u>bolacina</u> requires further study. At first glance <u>C</u>. <u>bolacina</u> is easily distinguished as a maritime species preferring sunny crevices; its thallus is often a tawny-orange colour with convex areoles that develop into distinct squamules with no hypothallus; thalline margin and thallus are often cracked; apothecia are large. <u>C</u>. <u>irrubescens</u>, on the other hand, appears to be primarily an inland species, often on flat, sloped and shaded surfaces; a black hypothallus is often well developed beyond the flat, uncracked, sublobate areoles; apothecia are small. However, intermediate specimens were collected, usually poorly developed specimens from maritime sites which may be meager <u>C</u>. <u>bolacina</u> but that would

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be using the habitat as the distinguishing character.

C. irrubescens is reported here as new to the province.

CALOPLACA LAETA H. Magn., Bot. Not. 1944:77. 1944.

<u>Thallus</u> crustose; effuse, usually thin, \pm shiny, smooth or almost absent to occasionally thick, matt, and rimose-areolate; light greyish-white or when apothecial initials abundant, then with a slight orange tinge. Hypothallus absent.

<u>Apothecia</u> common, abundant and crowded to scattered, adnate, 0.6-1.0 (-1.3) mm wide. Thalline margin excluded early, present at base of apothecia with algae present below hypothecium. Proper margin thick, smooth, and shiny, raised, entire, slightly lighter or concolorous with disc; often persisting as a hyaline cup after disc is gone. Disc plane, matt, bright (almost fluorescent) orange (Orange Chrome, Cadmium Orange, Mars Orange in Ridgway, 1912); occasionally flexuous, also occasionally new apothecia proliferating within the old, with the margins of the new apothecia appearing as light ridges across the disc face. Hymenium 80-90(-100) µm high; epithecium granular, sordid orange to dark brown-orange; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to oblong-ellipsoid, septum thin (1.5-2.5 µm wide), (13-)14-18 X 5-9 µm (see Figure 13).

<u>Spot Tests</u>: thallus K-; epithecium K+ purple-red; hymenium KIK+ blue. <u>Substratum/Habitat</u>: saxicolous; on both igneous and sedimentary rocks (HCl-) above the high tide mark with <u>Rinodina gennarii</u> in the supralittoral zone.

Selected Specimens: 1670, 2590.

Local Abundance and Distribution: frequent; present at most maritime sites throughout the subzone; not collected as often in the adjacent zones (see Figure 12).

<u>World Distribution</u>: western North American endemic; described from California.

<u>Remarks</u>: The type of <u>C</u>. <u>laeta</u> has been examined. It is on HC1- sandstone; the thallus is \pm absent,or the small, scattered grey granules unnoticeable among the quartz grains of the substratum.

The local material agrees perfectly with the type. It usually has a very poorly developed thallus on sandstone although it often grows on this substratum. The thallus can appear much better developed on igneous rocks or the cobbles of conglomerate rocks.

Although the thallus is light greyish it can cometimes appear to be orange as a result of the large numbers of 'pin-prick' apothecial initials. In this state it can be confusable with specimens of <u>C</u>. <u>marina</u>.

C. laeta is reported here as new to the province.

<u>CALOPLACA MARINA</u> (Wedd.) Zahlbr., Methodologischen Grundlage Modernen Pflanzensociologi, Uppsala:170. 1921.

Lecanora marina Wedd., Mem, Soc. Nat. Sc. Cherb. 19:275. 1875.

<u>Thallus</u> crustose, effigurate; orbicular, 0.8-2.5 cm broad, often coalescing to cover larger areas; centrally cracked-areolate; areoles 0.5-0.8 mm wide, marginally areoles not distinct, fusing or lacking transverse cracks, thin, not always distinct to forming a solid rim with some longitudinal cracks; yellow-ocher, ochraceous-orange, sienna, sometimes lighter in crevices of areoles. Hypothallus not usually visible, yellow to light orange.

<u>Apothecia</u> usually absent to occasionally present and then abundant, sessile, 0.4-0.8 mm wide. Thalline margin slightly to totally excluded. Proper margin paler than disc, entire, prominent or visible as a rim between disc and thalline margin. Disc plane or slightly convex, matt, orange (even when thallus yellowish). Hymenium 60-70 µm high; epithecium granular, sordid



brown-orange; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to oblong-ellipsoid, polarilocular, septum 3-4.5 µm thick, isthmus thin to absent, 11-14 X 5-6 µm.

<u>Spot Tests</u>: thallus and epithecium K+ purple-red; hymenium IKI+ blue. <u>Substratum/Habitat</u>: saxicolous; on all types of rocks at maritime sites; also in the adjacent zones at maritime sites.

Selected Specimens: 2811, 5320.

Local Abundance and Distribution: frequent; scattered throughout the subzone at maritime sites; also in the adjacent zones at maritime sites.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct.

<u>Remarks</u>: European <u>C</u>. <u>marina</u> is described as peripherally lobed (Duncan, 1970; Poelt, 1969; Ozenda & Clauzade, 1970). The local material is never lobed distinctly although occasionally collections on smooth igneous rocks approach lobation with a solid, radially cracked margin. The areoles typically appear to be just elongate at the margin. Lamb (1954a) mentioned that this thallus reduction is also known for eastern North American material.

A specimen from Victoria in H has been annotated by I. Nordin, who reviewed the effigurate Scandinavian <u>Caloplaca</u> species, as <u>C</u>. aff. <u>marina</u> (Ahti, pers. comm.). Nordin also pointed out that the western North American specimen was growing higher up the beach with <u>Xanthoria</u> <u>candelaria</u> instead of in the <u>Verrucaria</u> zone as <u>C</u>. <u>marina</u> does in Scandinavia. The precise position of the local specimens on the seashore was not noted but in general this does seem to be the case.

An illustration of spores of <u>C</u>. <u>marina</u> in Ozenda & Clauzade (1970) shows a rather wide, distinct isthmus. Local material either lacks an isthmus entirely or has a rather vague, thin isthmus.

CALOPLACA cfr. OBLITERANS (Nyl.) Blomb. & Forss., Points-Fortechning 69. 1880.

Placodium obliterans Nyl., Flora 57:7. 1874.

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<u>Thallus</u> crustose, effigurate; 0.8-1.5 cm broad; composed of areoles on a thin hypothallus. Areoles contiguous or sometimes dispersed, convex, rounded to slightly elongated, smallest near margin, centrally more developed, often almost unoriented, not forming distinct lobes; \pm smooth, epruinose; soredia present, beginning on edges of areoles, often becoming heavy towards the center, granular, concolorous with thallus. Hypothallus especially notice-able at thallus margin, often extending as a fringe about 1 mm beyond areoles, longitudinally cracked, \pm shiny; sometimes absent. Areoles, soredia, and hypothallus all yellow to pale orange-yellow.

<u>Apothecia</u> not abundant, adnate, often among soredia, 0.5-0.8 (-1.5) mm wide. Thalline margin crenate, <u>+</u> persistent. Proper margin just visible between disc and thalline margin. Disc plane, orange to yellow-orange. Hymenium 55-60 µm high; epithecium dark orange-brown granular; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum thin to thick, isthmus distinct and thin to indistinct, 12-16 X 4-6 µm.

<u>Spot Tests</u>: thallus and epithecium K+ light purple-red; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected on igneous rock and sandstones at seashore sites, mainly HCl- but one sandstone HCl+.

Selected Specimens: 1343, 4446.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, also collected in the adjacent zones.

World Distribution: uncertain; perhaps circumboreal.

Remarks: There are several effigurate Caloplaca species that are

sorediate. <u>C</u>. <u>decipiens</u> (Arn.) Jatta and <u>C</u>. <u>cirrochroa</u> (Ach.) Th. Fr. are the most widespread two. Both are described as distinctly lobed at the margin with the lobes between 3 and 5 mm long. Additionally both grow on calcareous rocks. <u>C</u>. <u>decipiens</u> is commonly pruinose. <u>C</u>. <u>obliterans</u>, on the other hand, is not distinctly lobed and is collected on noncalcareous rocks. It is described as an upland species in Britain (Wade, 1965). Most of the local material was collected from noncalcareous rocks but one collection was on HCl+ sandstone. It was unlobed and composed of unoriented areoles just like the HCl- specimens.

CALOPLACA LITORICOLA Brodo, ined.

<u>Thallus</u> crustose; determinent, often roughly orbicular, 2-4 broad, sometimes thalli coalescing to irregularly cover large areas; crackedareolate, sometimes rimose, dull, to thin and smooth, somewhat shiny; dirty greyish-white. Hypothallus visible at margin, especially noticeable among coalescing thalli, black.

<u>Apothecia</u> common, scattered to clustered and angular by compression, moderately constricted, adnate, 0.6-1.0 mm wide. Proper margin resembling a thalline margin because of its coloration, black (darker than the thallus), thick, <u>+</u> shiny, raised sometimes becoming level, often flexuous, persistent. Disc plane, matt, roughened-granular; cinnamon orange, ochraceous orange, tawny-ochraceous, to orange-yellow. Hymenium 75-80 µm high, hyaline; epithecium granular, light to dark sordid orange-brown; hypothecium inspersed, fulvous to light apricot or pinkish; exciple blue-black on outer edge, hyaline internally, up to 80 µm thick; paraphyses slender, not or slightly branched above the asci, without globose end cells; algae completely absent below hypothecium. <u>Spores</u> 8 per ascus, hyaline, broadly ellipsoid, polarilocular, septum thick (ca. 5-6 µm), isthmus thin but usually distinct, 14-18 X

8-11 µm. (see Figure 13).

<u>Spot Tests</u>: thallus K-; epithecium K+ rose-red, granules partially dissolved but colaration not bleaching out, suffusing down hymenium and remaining, C-, granules darker red but not dissolving; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; on igneous and sandstone rocks (HCl-) at shaded maritime sites, particularly in the <u>Verrucaria</u> zone or slightly above.

Selected Specimens: 1834, 4561.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites but more common in the adjacent zones at maritime sites.

<u>World Distribution</u>: western North American endemic; known from the Queen Charlott**e**Islands (Brodo, pers. comm.) to Vancouver Island, but probably more widespread.

<u>Remarks: C. litoricola</u> has the general appearance of <u>C. chlorina</u> (Flot.) Sandst. (=<u>C. cerina</u> var. chlorina (Flot.) Muell. Arg.) with a yellow-orange disc surrounded by a dark margin and a habitat preference for shaded rocks near water. The margin of <u>C. chlorina</u>, is thalline with an algal layer present below the hypothecium while that of <u>C. litoricola</u>, despite its dark colour, entirely lacks any algae in the margin.

CALOPLACA OREGONA H. Magn., Medd. Goteborgs Bot. Tradg. 13:242. 1939.

<u>Thallus</u> crustose; thin, <u>+</u> smooth to rimose-cracked; light grey to whitish. Hypothallus + present at margin, blue-black.

<u>Apothecia</u> common, scattered, sessile, 0.5-0.7(-1.0) mm wide. Thalline margin partially excluded early, concolorous with thallus, but dark greyblack fragments often present dotting or ringing the proper margin. Proper margin thick, shiny, raised, concolourous with disc. Disc plane, round, slightly roughened, matt, yellow-orange to deep orange. Hymenium 80-100 µm

high; epithecium granular, sordid brown-orange; hypothecium hyaline, not inspersed; paraphyses apically branched. <u>Spores</u> 8 per ascus, hyaline, oblong-ellipsoid, polarilocular, septum 5.0-7.5 µm thick isthmus distinct, (16-)17-19 X 9-11 µm (see Figure 13).

<u>Spot Tests</u>: thallus K-; epithecium K+ purple-red; hymenium IKI+ blue. <u>Substratum/Habitat</u>: corticolous; on deciduous trees and shrubs. <u>Selected Specimens</u>: 4005, 4096.

Local Abundance and Distribution: infrequent; at inland sites especially at mid- to higher elevations which, combined with a Macoun specimen from Comox (U), suggests a preference for the western edge of the CDFD subzone.

<u>World Distribution</u>: western North American endemic; described from Oregon, also known from Comox, Vancouver Island (Magnusson, 1944a).

<u>Remarks</u>: <u>C</u>. <u>oregona</u> requires further study. Locally it has been collected only in scanty amounts. It is quite similar to the local <u>C</u>. <u>holo-</u> <u>carpa</u>, but differing in the larger spores, correspondingly thicker septum, and often the dark grey thalline margin fragments clinging to the proper margin.

While Magnusson (1939a) described the spores as $17-22 \times 9-12(-13) \mu m$, Rudolph(1955), who examined the holotype and paratype, listed them as 15.6-20.9 X 7-10.4 μm . Rudolph's lowest measurements just overlap the largest spores known for <u>C</u>. <u>holocarpa</u> (Wade, 1965; Duncan, 1970) although the spore size range of the local <u>C</u>. <u>holocarpa</u> is not yet known to overlap. The hypothecium of <u>C</u>. <u>holocarpa</u> is usually described as inspersed and its spore septum as quite short compared with <u>C</u>. <u>oregona</u> which has an uninspersed hypothecium and a rather thick septum. Additionally the septum/spore-length ratio of <u>C</u>. <u>holocarpa</u> averages around 1/4 while <u>C</u>. <u>oregona</u> averages about 1/3, or up to 1/2 according to Magnusson and Rudolph. <u>CALOPLACA</u> <u>TEICHOLYTA</u> (Ach.) J. Stein., Sitzungsber. K. Akado Wiss. Wien., Math. Naturw. Cl.104(1):388. 1895.

Lecanora teicholyta Ach., Lich. Univ.:425. 1810.

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Caloplaca arenaria auct., non (Pers.) Muell. Arg.

<u>Thallus</u> crustose; of <u>+</u> dispersed areoles or scales; areoles slightly convex to flattened, often becoming papillose-sorediate, occasionally slightly lobed at the margin; deep grey, blue-grey, slate grey. Hypothallus present or absent, very thin, black.

<u>Apothecia</u> few, scattered, adnate, constricted, 0.6-0.8(-1.3) mm wide. Thalline margin thin, concolorous with thallus, persistent. Proper margin \pm absent. Disc concave to plane, flexuous, brownish to rust-orange. Hymenium 50 um high; epithecium granular, sordid orange; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, septum 3 µm or less, isthmus \pm distinct, 11-14 X 6-7 µm.

<u>Spot Tests</u>: thallus K+ darkening, apparently purplish (cortex K+ light purple under LM); disc K+ purple; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected once on HCl+ conglomerate seashore rock.

Selected Specimen: 2454.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Denman Island in the northern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumtemperate in the Northern Hemisphere (Ozenda & Clauzade, 1970); in North America reported from California (Rudolph, 1955).

<u>CALOPLACA</u> <u>VERRUCULIFERA</u> (Vain.) Zahlbr., Cat. Lich. 7:272. 1931. <u>Placodium</u> <u>verruculiferum</u> Vain., Medd. Gronl. 30:131. 1905. Caloplaca granulosa auct. p.p.

<u>Thallus</u> effigurate; orbicular, 1-2(-3.6) cm broad, at least outer 3-7 mm distinctly lobed, center of thallus often absent; lobes high and steeply arched, linear, 0.5-0.8 mm wide, dichotomously branched, closely contiguous, occasionally young lobes overlapping old; centrally becoming transversely cracked-areolate and isidiate; isidia large, granular; lobes and isidia mustard yellow, primuline yellow, olive ocher, yellow ocher. Hypothallus absent.

<u>Apothecia</u> occasionally present, adnate, 0.5-0.9 mm wide. Thalline margin crenate-granular, irregular, often partially excluded. Proper margin visible between disc and thalline margin. Disc plane, orange, often darker than the thallus. Hymenium 60-70 μ m high; epithecium granular, sordid yellow-brown; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum ca. 3 μ m thick, isthmus thin to absent, (9-)11-14 X 4-6 μ m.

<u>Spot Tests</u>: thallus K+ purple; epithecium K+ rose-red; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; among <u>Verrucaria</u> <u>maura</u> and <u>Arthopyrenia</u> phaeobaea on seashore rocks.

Selected Specimens: 1376. 4312.

Local Abundance and Distribution: infrequent, scattered at maritime sites throughout the subzone, also known from the adjacent zones at maritime sites.

<u>World Distribution</u>: circumarctic with boreal oceanic extensions; reported from Siberia, Bering Strait, Europe, Spitzbergen, and Novaya Zemlya (Moberg; 1972) but not yet known from Arctic Canada or eastern North America although (Taylor, 1974) noted <u>C</u>. <u>granulosa</u> from maritime sites of the northeastern United States.

<u>Remarks</u>: When only the outer fringing lobes of the thallus remain, the globular isidia may be absent.

<u>C</u>. <u>verruculifera</u> was reported as new to the province as <u>C</u>. <u>granulosa</u> (auct.) in Noble (1978) based in part on collections from this study.

CALOPLACA VICARIA H. Magn., Bot. Not. 1944: 70. 1944.

<u>Thallus</u> crustose; thin, scant, <u>+</u> smooth, sometimes rimose, often containing hyaline, irregularly squarish crystals; whitish grey. Hypothallus commonly present, marginal; also often visible scattered through thallus; black.

Apothecia abundant, <u>+</u> scattered, adnate, moderately constricted, 0.4-0.7 (-0.8) mm wide. Proper margin initially thick and raised but quickly thin, smooth, even, <u>+</u> shiny, persistent, usually concolorous with disc, sometimes initially partially blackened like the hypothallus but algae totally absent. Disc <u>+</u> round, plane to slightly convex, surace matt, quite roughened, appearing granular orange pruinose; dirty orange, brown-orange, ferrugineous. Hypothecium hyaline to pale fulvous, inspersed with oil droplets; epithecium orange-brown, granular; paraphyses branched towards apices; hymenium hyaline, 70-80 µm high; algae absent or a few clumps present near base. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, septum 4-6 µm thick, isthmus distinct, 12-17 X 5.5-7.5 µm.

<u>Spot Tests</u>: thallus K-; epithecium K+ rose-red, C+ darker red but granules not dissolving.

<u>Substratum/Habitat</u>: corticolous, on most deciduous trees and shrubs, especially common on <u>Alnus</u>.

Selected Specimens: 2167A, 4262.

1

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: amphi-Pacific; either continuous or disjunct; described from Comox, Vancouver Island, and so far only known from British Columbia in North America; one specimen also seen from Japan (UBC) under C. ferruginea.

<u>Remarks</u>: The holotype has been examined. It consists of five bark pieces collected by J. Macoun at Comox in 1887. There are three <u>Caloplaca</u> species in the packet - <u>C</u>. <u>vicaria</u>, <u>C</u>. <u>oregona</u>, and <u>C</u>. <u>ferruginea</u>. Magnusson clearly numbered and named the first two so there is no problem with the identity of <u>C</u>. <u>vicaria</u>, although that bark piece contains also a small amount of <u>C</u>. <u>ferruginea</u> (which Magnusson does not note as being present).

<u>C. vicaria</u> and <u>C. ferruginea</u> are indeed very similar. Magnusson (1944a) stated that although <u>C. vicaria</u> closely resembled <u>C. ferruginea</u> it possessed smaller apothecia with narrower margin, broader spores (16-18 X 9-10 μ m) with <u>thicker</u> wall (septum6-7.5 μ m), higher hymenium (90-100 μ m), and thin paraphyses (1-1.5 μ m) intricate at the apices. Rudol**ph**(1955) while agreeing with the spores being wider, described them as slightly shorter (13.1-14.8 X 7.8-9.6 μ m) and placed <u>emphasis</u> on the algae being absent from the disc and the spore isthmus being <u>narrower</u> (ca. 4 μ m) in separating <u>C. vicaria</u> from <u>C ferruginea</u>. In contradiction to Magnusson he described the margin as thick and the paraphyses as 2 μ m in diameter although in agreement concerning the high hymenium (125 μ m).

A composite of the local material produces a description of <u>C</u>. vicaria closest to that of Magnusson, agreeing in the smaller apothecia with thin margin. Furthermore, compared to the local material of <u>C</u>. ferruginea, the disc of C. vicaria never blackens and is very roughened-granular. The epi-

Figure 13. Selected spores of <u>Caloplaca</u>. Collection numbers of specimens are given in brackets.

- A. <u>Caloplaca</u> atrosanguinea (4841A)
- B. <u>Caloplaca</u> arenaria (1423)
- C. <u>Caloplaca ferruginea</u> (4842)
- D. <u>Caloplaca holocarpa</u> (3264)
- E. <u>Caloplaca</u> <u>laeta</u> (2477)
- F. <u>Caloplaca litoricola</u> (1834)
- G. <u>Caloplaca</u> oregona (4005)
- H. <u>Caloplaca vicaria</u> (1070)
- I. <u>Caloplaca</u> feracissima (7399)











200





. 10μm





thecium of <u>C</u>. vicaria is C-, granules darker red but not dissolving; <u>C</u>. <u>ferr-uginea</u> is C+ red, granules dissolving quickly. Additionally the local <u>C</u>. <u>ferruginea</u> always possesses pycnidia; pycnidia are absent in <u>C</u>. <u>vicaria</u>. Contrary to the reports of Rudolph or Magnusson, who both reported algae absent from the apothecia, algae are, indeed, sometimes present as scattered clumps near the base of the apothecium. Furthermore, the spore width is never as wide as the other reported measurements and the hymenium is never as high, although it is higher after treatment with either K or C.

Rudolph's description is based on an isotype (M) which may explain the disparity between his, and Magnusson's description. Macoun's early collections are renowned for the inconsistency of the duplicates. Three <u>Caloplaca</u> species were present in the holotype packet Rudolph's "isotype" was probably a duplicate of one of these three species; which one is not known.

CANDELARIA Mass.

Thallus foliose, or fruticose; small rosettes or ratherloosely organized, upper and lower cortex present, attached by rhizines; yellow (K-), paler below.

Ascocarp an apothecium, sessile. Thalline margin present. Disc concave to plane, yellow to brownish. Spores more than 8 (16-32) per ascus, hyaline, ellipsoid, simple to appearing 1-septate.

Corticolous and saxicolous.

There is one local species.

<u>CANDELARIA</u> <u>CONCOLOR</u> (Dicks.) B. Stein, Kryptog.-F1. Schlesien 2(2):84. 1879. Lichen <u>concolor</u> Dicks., Fasc. Plant. Cryptog. Brit. 3:18, tab. 9, fig. 8. 1793.

Thallus foliose; small, orbicular rosettes, up to 0.5 cm broad. Lobes finely divided, up to 0.2 mm wide, often very finely notched in almost sored-

iate condition; upper surface smooth to minutely roughened, sorediate; soredia usually abundant, large, granular, initially at lobe ends and then the entire lobe and often nearly whole thallus dissolving into soredia; rhizines common, simple, long, white; thallus light greenish yellow to yellow above, white below.

<u>Apothecia</u> not observed. According to Ozenda & Clauzade (1970) the apothecia are 0.3-1.5 mm broad, plane, with an entire to sorediate thalline margin; spores hyaline, approx. 32 per ascus, simple, 8-10 X 4-6 µm.

Spot Tests: thallus K-.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Pseudotsuga</u> in a rural area, and several times on <u>Quercus</u> in urban areas, all collections accompanied by Xanthoria ssp.

Selected Specimens: 2642, 7406B.

Local Abundance and Distribution: rare in nonurban environments, frequent in urban areas in the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumtemperate in the Northern Hemisphere; also reported from Argentina (Grassi, 1950), New Zealand (Martin, 1966), and Australia (Filson & Rogers, 1979) in the Southern Hemisphere.

<u>Remarks</u>: Although primarily corticolous, <u>C</u>. <u>concolor</u> is also known from rocks (Poelt, 1969; Duncan, 1970; Howard, 1950).

<u>C</u>. concolor, <u>Xanthoria</u> candelaria, and <u>X</u>. <u>fallax</u> are all yellow, sorediate species and, although the first has smaller, more greenish-yellow lobes, the K-spot test is often the quickest method for separating them initially.

<u>Candelaria concolor</u> is quite inconspicuous in the nonurban environment and it may be much more common than the single collection indicates. In urban areas it can form broad bands on the trunks of roadside trees.
CANDELARIELLA Muell. Arg.

Thallus crustose; granulose, areolate, to marginally lobed; brightly yellow coloured (K-). Hypothallus present or absent.

Ascocarp an apothecium. Margin lecanorine. Spores 8 or more per ascus, simple, or spuriously 1-septate, hyaline, oblong.

Saxicolous and corticolous.

1

References: Hakulinen (1954).

1.	Thallus sorediate; corticolous <u>C</u> . cfr. <u>EFFLORESCENS</u>
1.	Thallus esorediate; saxicolous(-corticolous)
	2. Spores 12 or more per ascus <u>C</u> . <u>VITELLINA</u>
	2. Spores 8 per ascus 3
3.	Thallus well-developed, marginally lobulate areoles; noncalcareous rock
3 .	Thallus scant, few, scattered granules; on calcareous rock <u>C</u> . <u>AURELLA</u>

<u>CANDELARIELLA</u> AURELLA (Hoffm.) Zahlbr., Cat. Lich. Univ. 5:790. 1928. Verrucaria aurella Hoffm., Deutch. Fl. 2:197. 1796.

<u>Thallus</u> crustose; scattered to occasionally clustered granules; granules 0.1-0.3 mm wide, <u>+</u> round to slightly indented, slightly convex, smooth and shiny to scurfy and matt; bright yellow to greenish yellow. Hypothallus absent.

<u>Apothecia</u> common, scattered or clustered, adjacent to or apparently isolated from granules, constricted, 0.3-0.7 mm wide. Thalline margin persistent, <u>+</u> even, entire becoming crenulate, smooth becoming cracked-decorticate, concolorous with thallus. Disc <u>+</u> round, plane to slightly convex, shiny or matt and almost faintly pruinose, concolorous with thallus or pale brownish yellow. Hypothecium hyaline; paraphyses simple or occasionally branched at apices, coherent only at the apices; epithecium granular, orange-brown; hymenium 55-65 μ m high, hyaline. <u>Spores</u> 8 per ascus, simple, hyaline, oblong, straight to curved, 13-17 X 4-5 μ m.

Spot Tests: thallus K-; epithecium K-.

<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous sandstone in the suprahaline zone with Lecanora albescens.

Selected Specimen: 1059.

Local Abundance and Distribution: rare (see below); distribution poorly known, collected once on the Gulf Islands in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumboreal in the Northern Hemisphere (Thomson, 1979); also reported from Argentina (Grassi, 1950) and New Zealand (Martin, 1966) in the Southern Hemisphere.

<u>Remarks</u>: <u>C</u>. <u>aurella</u> is inconspicuous due to the small size of the granules and apothecia, despite the bright colour. It is probably more common locally than the single collection indicates, possibly very common on foundations (HCl+) in the urban areas which have not been investigated thoroughly.

CANDELARIELLA cfr. EFFLORESCENS Harris & Buck, Michigan Botanist

17:155. 1978.

<u>Thallus</u> crustose; of rounded to slightly lobed, separate granules, 0.1-0.5 mm, that become finely sorediate on the edges (often appearing somewhat crenulate at this stage) and then totally dissolved in soredia; granules usually scattered but sometimes clustered especially when dissolved in soredia; pale yellow or greenish-yellow.

Apothecia not observed; according to Harris & Buck (1978) apothecia are

uncommon, the margin occasionally sorediate, spores simple or 1-septate with up to 32/ascus, $12-15(-19) \times 4-5(-6) \mu m$.

Spot Tests: thallus K-.

Substratum/Habitat: corticolous; collected once on Acer.

Selected Specimen: 7327.

Local Abundance and Distribution: rare (see below); distribution poorly known, collected near Victoria in the southern part of the CDFD subzone and once near Parksville in the northern part; not collected in the adjacent zones.

<u>World Distribution</u>: North America-Europe disjunct; definitely eastern and central, temperate North America (Harris & Buck, 1978), tentatively reported for the Queen Charlotte Islands, British Columbia (Brodo, 1980); reported for Britain by Hawksworth et al. (1980).

<u>Remarks</u>: This species is very small, inconspicuous, and sterile, and, therefore, probably often overlooked. It may be much more common locally than the two collection would indicate.

The material is only tentatively referred to <u>C</u>. <u>efflorescens</u> because of its sterile condition. <u>C</u>. <u>reflexa</u> (Nyl.) Lett., known from Europe, is also composed of granules that break down into soredia but it is 8-spored. Harris and Buck (1978) also suggested that western North American material could be an undescribed, 8-spored species. The solution to this problem awaits the collection of fertile material.

Local <u>C</u>. cfr. <u>efflorescens</u> superficially resembles <u>Caloplaca citrina</u> which is K+ purple and often fertile with polarilocular spores.

CANDELARIELLA ROSULANS (Muell. Arg.) Zahlbr., Cat. Lich. Univ. 5:802. 1928. Candelaria vitellina var. rosulans Muell. Arg., Bull Herb. Boiss 3:200. 1895.

<u>Thallus</u> crustose; of <u>+</u> grouped, usually plentiful granules which become lobed and almost small orbicular rosettes; chrome yellow, wax yellow, amber yellow.

Apothecia abundant, often crowded, sometimes scattered, adnate, moderately constricted, 0.5-0.9 mm wide. Thalline margin initially entire becoming cracked and powdery, finally crenulate or partially excluded. Disc plane to slightly convex, concolorous with thallus to slightly darker. Hymenium 50-70 um high; epithecium granular orange; paraphyses simple often becoming distinctly septate apically, somewhat thaickened towards the apices; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, oblong, straight to often curved, $14-17(-19) \times 5-6 \mu$ m.

Spot Tests: thallus K-.

<u>Substratum/Habitat</u>: saxicolous; all collections on seashore sandstone. Selected <u>Specimens</u>: 532, 2026.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, not collected in adjacent zones.

<u>World Distribution</u>: western, temperate, North American endemic. Egan (1971) stated that <u>C</u>. <u>rosulans</u> is rather common at lower elevations in Colorado and New Mexico. It has also been reported from South Dakota, Wyoming (Wetmore, 1968), and California (Tucker & Jordan, 1978); it is known from the interior of British Columbia (Brodo, pers. comm.).

<u>C. aurella</u> is the more well-known, 8-spored <u>Candelariella</u> species. Its thallus is not as well- developed, being composed of scattered, unlobed granules. Egan (1971) described the thalline margin as thin in this species and thick in <u>C. rosulans. C. aurella</u> is also commonly found on calcareous sub-

CANDELARIELLA VITELLINA (Hoffm.) Muell. Arg., Bullet. Herb. Boiss. 2, append. 1:47. 1894.

Patellaria vitellina Hoffm., Descript. et Adumbrat. Plant. Lich. 2:5. 1794.

<u>Thallus</u> crustose; dispersed, up to 3 cm broad, of small scattered granules, sometimes almost becoming lobed; mustard yellow, wax yellow.

<u>Apothecia</u> common, usually clustered, adnate, 0.2-0.7(-1.0) mm wide. Thalline margin thick, raised, <u>+</u> shiny, smooth becoming crenulate. Disc pruinose yellow or epruinose, occasionally browning, plane, round, irregular when crowded. Hymenium 60-75 μ m high; epithecium granular, dark orange; paraphyses simple, stout; hypothecium hyaline. <u>Spores</u> 12+ per ascus, hyaline, oblong to oblong-fusiform, straight to slightly curved, 10-14 X 4-5 μ m.

<u>Spot Tests</u>: thallus and disc K<u>+</u> faint orange-red; epithecium K-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; on sandstones, conglomerate, and igneous rocks; also occasionally corticolous on deciduous trees near the urban centers.

Selected Specimens: 292, 1718.

Local Abundance and Distribution: occasional; scattered, especially towards the southern end of the CDFD subzone at both maritime and inland sites; present, but not as common, in the adjacent zones.

<u>World Distribution</u>: (circumarctic-)circumboreal(-circumtemperate); a very widespread species, often described as cosmopolitan; also reported from Argentina (Grassi, 1950) and Venezuela (Hertel, 1971b) in South America and New Zealand (Martin, 1966) and Australia (Filson & Rogers, 1979) in the Southern Hemisphere.

<u>Remarks</u>: <u>C</u>. <u>vitellina</u> is also typically corticolous, but this form was only common near the urban areas in the CDFD subzone.

CATILLARIA (Ach.) Th. Fr.

Thallus crustose. Ascocarp a lecideine apothecium. Paraphyses unbranched and capitate. Asci unitunicate. Spores 8 per ascus, hyaline, (simple) 1-septate, fusiform-ellipsoid to oblong-ellipsoid.

Saxicolous and corticolous.

There is no modern monographic treatment of this genus.

References: Vainio (1922), Kilias (1981).

1.	Corticolous 2
1.	Saxicolous
	2. Disc black, or white (piebald) and darkening
	2. Disc yellow or red 4
3.	Hypothecium blue; excipulary tissue red; apothecia black becoming convex, epruinose <u>C</u> . <u>COLUMBIANA</u>
3.	Hypothecium hyaline-fulvous; excipulary tissue hyaline to darkening but not red; apothecia white, blackening; <u>+</u> plane, often pruinose
	4. Disc red; apothecia rimless; spores with one cell wider than the other <u>ARTHONIA</u> (p. 77)
	4. Disc yellow 5
5.	Proper margin present <u>C</u> . <u>GRANIFORMIS</u>
5.	Proper margin absent
	6. Disc without proper margin even when young <u>ARTHONIA</u> (p. 77)
	6. Disc with proper margin at least when young; spores with equal cells
7.	Thallus continuous to evenly cracked-areolate; hypothecium brownish; spores 7-13 X 2.5-3 µm <u>C</u> . <u>CHALYBEIA</u>
7.	Thallus verruculose, from thick, cracked-areolate to scattered turgid granules; hypothecium blackish; spores (12-)15-19 X 4-5 μm

<u>CATILLARIA CHALYBEIA</u> (Borr.) Mass., Ricerch. Auton. Lich.: 79. 1852. <u>Lecidea chalybeia</u> Borr., Suppl. Engl. Botan. 1:tab. 2687, fig. 2. 1831.

Thallus crustose; irregular patches up to 4 cm broad, varying from thin, smooth with occasional cracks, shiny, and dark-coloured to moderately thick, cracked-aerolate, matt to slightly shiny, and light coloured; deep olive grey, dusky green-grey, dark grey, to mouse grey.

<u>Apothecia</u> scattered, adnate, constricted, 0.2-0.5 mm wide. Proper margin entire, even, \pm thick, raised, becoming thinner and less prominent but usually not excluded, concolorous with disc. Disc plane to slightly convex, black. Hypothecium light to medium brown; epithecium dark brownblack to bluish black; hymenium 30-50 µm high, hyaline to occasionally bluish; paraphyses simple, free to slightly coherent, black-capped. <u>Spores</u> 8 per ascus, hyaline, fusiform to ovoid, distinctly 1-septate, 7-13 X 2.5-3 µm (see Figure 14).

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; on both sandstones and igneous rocks, usually but not exclusively at maritime sites.

Selected Specimens: 3949, 4173.

Local Abundance and Distribution: occasional; scattered at maritime sites in the southern part of the CDFD subzone, not collected in adjacent zones.

<u>World Distribution</u>: tentatively circumboreal; Kilias (1981) reported it from Europe, Turkey, Japan, South Africa and Uruguary; in North America it has been reported from Greenland (Lynge, 1940), Maine, Ohio, California (Fink, 1935), South Dakota (Wetmore, 1968), and Saskatchewan (Looman, 1962).

- Figure 14. Selected spores of <u>Catillaria</u>, <u>Dimerella</u>, <u>Diploschistes</u>, <u>Graphis</u>, <u>Gyalidea</u>, <u>Gyalecta</u>, and <u>Gyalideopsis</u>. Collection numbers of specimens are given in brackets.
- A. <u>Catillaria</u> griffithii (3083)
- B. <u>Catillaria</u> graniformis (4049)
- C. <u>Catillaria</u> unknown <u>#1</u> (2835)
- D. <u>Catillaria</u> <u>chalybeia</u> (2969)
- E. Catillaria columbiana (3685)
- F. <u>Dimerella</u> <u>lutea</u> (7282)
- G. <u>Diploschistes</u> scruposus (3052)
- H. <u>Diploschistes</u> bisporus (2111B)
- I. <u>Graphis scripta</u> (110)
- J. <u>Gyalidea</u> <u>hyalinescens</u> (5818)
- K. <u>Gyalecta jenensis</u> (5082)
- L. <u>Gyalideopsis alnicola</u> (5811)



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<u>Remarks</u>: The thallus thickness and colour are so variable in the local specimens that it was first believed that two species were present. However, it was decided that the differences – thin to moderately thick thallus with an accompanying development toward areolation, and medium to dark colouration - were explained better perhaps by differences in substratum and insolation.

<u>CATILLARIA</u> <u>COLUMBIANA</u> (Merr.) Noble, Bryologist 83:71. 1980. <u>Biatora columbiana</u> Merr., Ottawa Naturalist 27:119. 1913.

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<u>Thallus</u> crustose, 1.4-4.4 cm broad; continuous-granular to minutely granular areolate; greyish to greenish-white, herbarium specimens yellowing. Hypothallus white, fimbriate, obvious at margin, sometimes absent.

<u>Apothecia</u> abundant, \pm scattered, adnate, 0.3-0.9 mm wide. Proper margin entire, even, inconspicuous becoming excluded, concolorous with disc or darker (when disc lightened). Disc plane, becoming slightly to strongly conves, \pm round although one unusual specimen observed with lobulate to almost tuberculate disc, black or occasionally brown-black, dull, epruinose. Exciple and tissue beneath hypothecium bright blue; epithecium brown to reddish-brown; hymenium 75 µm high, hyaline or suffused with red to a slight extent. <u>Spores</u> 8 per ascus, hyaline, fusiform, 1-septate, (12-)15-18(-19) X 5-6(-7) µm (see Figure 14).

Spot Tests: thallus K+ sordid yellow, C-, KC-, P-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Holodiscus</u> branches; several early collections by Macoun from a variety of trees including <u>Alnus</u>, Acer, and Pseudotsuga.

Selected Specimen: 3685.

Local Abundance and Distribution: infrequent; collected only on the Saanich Peninsula in the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North America endemic, oceanic; known from California to southern British Columbia with the study area representing the current northern range limit of this species.

<u>Remarks: C. columbiana</u> has usually been identified as <u>C. laureri</u> Hepp ex Th. Fr. See Noble (1980) for comments. This latter species is now often included in <u>Catinaria</u>; the generic placement of <u>C. columbiana</u> requires further study.

<u>CATILLARIA GRANIFORMIS</u> (Hag.) Vain., publication information not available. <u>Lichen graniformis</u> Hag., Ten. Hist. Lich.:xlvii., t. 1, f. 2. 1782. Cliostomum graniforme (Hag.) Coppins, Lichenologist 12:106. 1980.

<u>Thallus</u> crustose; of scattered, smooth, becoming pulverulent, granules, up to 0.2 mm wide; pale yellowish, yellow-green. Hypothallus absent.

<u>Apothecia</u> scattered, adnate, hardly constricted to moderately constricted, 0.3-0.7 mm wide. Proper margin present, entire, level with disc, thick, white or paler yellow than the disc, becoming excluded with age. Disc plane becoming \pm strongly convex, round to often a little flexuous, matt, roughened, or very slightly whitish pruinose, smooth but often becoming tuberculate in convex apothecia; light tan-yellow, occasionally partially greyed. Hypothecium hyaline; hymenium 30-35 µm high; epithecium granular, light yellowbrown; paraphyses moderately branched, coherent, looser in KOH; exciple well developed, of thin-walled radiating hyphae. <u>Spores</u> 8 per ascus, hyaline, fusiform, straight to bent, l-septate, 10-14 X 2.5-3.0 µm (see Figure 14).

<u>Pycnidia</u> abundant, immersed in center of a single granule that is uniformly thickened and hence appearing like a dark, sunken apothecium; blackened, ostiole large; pycnospores hyaline, clavate, 4-5 X 2 µm.

<u>Spot Tests</u>: K+ faint yellow, C-, KC-, P+ orange-red; epithecium and hymenium K+ yellow; pycnidia K+ blue, possibly only as a bleaching of the

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black colour.

<u>Substratum/Habitat</u>: corticolous; collected once on the trunk of <u>Pseudotsuga</u>.

Selected Specimen: 4049.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the Highlands on the western border of the CDFD subzone at an inland, forested site; not collected in the adjacent zones.

<u>World Distribution</u>: circumtemperate (Ozenda & Clauzade, 1970); however, not reported from North America in Hale & Culberson (1970).

<u>Remarks</u>: This single specimen of <u>C</u>. <u>graniformis</u> was initially identified as a <u>Micarea</u> species because of the branching of the paraphyses. However, the proper margin is very prominent and excluded only in the end as the ascocarps become very convex.

The P+ spot test is not noted in the other descriptions available for this species.

<u>C. graniformis</u> is reported here as new to the province.

<u>CATILLARIA GRIFFITHII</u> (Sm.) Malme, Lich. Suec. Exc. 18, No. 440. 1914. <u>Lichen griffithii</u> Sm., Engl. Bot. 25: tab. 1735. 1807. <u>Catillaria tricolor</u> (With.) Th. Fr., Lich. Scand. 1:574. 1874. <u>Cliostomum griffithii</u> (Sm.) Coppins, Lichenologist 12:106. 1980.

<u>Thallus</u> crustose; from smooth to more commonly chinky-areolate; greywhite. Limiting black hypothallus often present.

<u>Apothecia</u> common, abundant, scattered to occasionally crowded, adnate, constricted, 0.4-0.9 mm wide. Proper margin at first thick, entire, prominent, raised; becoming thin, less prominent but persistent; lighter coloured than the disc or top edge darkening although still light-coloured on sides and below; shiny to dull. Disc + plane, white-tan, light grey or brown,

blackening or coloration mixed; often pruinose. Hymenium 35-50 μ m high; epithecium light to dark brown, often granular; paraphyses simple although <u>+</u> coherent; hypothecium hyaline to fulvous. <u>Spores</u> (6-) 8 per ascus, hyaline fusiform, 1-septate, straight to slightly bent, 10-15(-18) X 3-4(-5) μ m (see Figure 14).

<u>Spot Tests</u>: thallus K+ yellow, C-, KC-, P-; light-coloured disc K+ yellow(-orange); hymenium K+ yellowish.

<u>Substratum/Habitat</u>: corticolous; collected on many species of both deciduous and coniferous trees and shrubs, but especially common on <u>Alnus</u>.

Selected Specimens: 2723A, 3656.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe disjunct.

<u>Remarks</u>: Colour of the disc and proper margin vary widely in <u>C. griffithii</u>. Sometimes this appears to result from age, with the small apothecia white and the large ones black. At other times insolation may affect the coloration, with much lighter coloured apothecia occurring on the ventral surfaces of twigs. Often the colour variation from thallus to thallus, or indeed on the same thallus, has no discernible cause. The common condition is for the proper margin to be lighter in colour than the tan, grey, or black disc. However, the upper rim of the margin often darkens too, sometimes even before the disc. Furthermore, when the disc is pruinose, it may appear lighter in colour than the margin. It is not uncommon for both the disc and margin to be piebald.

Howard (1950) described the spores as indistinctly 1-septate although all local collections were distinctly septate. Both Hasse (1913) and Herre (1910a)mentioned var.atlantica from California which is reported to have

almost simple spores. In contrast, it was not unusual to see indistinctly 3-septate spores in the local material.

Ozenda & Clauzade (1970)described the epithecium as K+ purple but this was not the case with the local material. The granular epithecium would dissolve in K leaving a faint yellowish wash. Only in the occasionally very dark apothecia, where the K would not entirely 'bleach' the epithecium, but leave an off-coloured purple-brown, would anything approaching a positive reaction occur.

Finally, European descriptions of <u>C</u>. <u>griffithii</u> do not mention pruinose discs, which is a common condition in local material. Herre (1910a) did mention this character in his work on Californian specimens. This appears to be a common character of var. <u>pacifica</u>, besides the distinctly septate spores and blue-black hypothallus.

CATILLARIA UNKNOWN #1

<u>Thallus</u> crustose (approaching squamulose); verruculose, of thick cracked-areolate to turgid, swollen granules which become nearly lobate; matt; off-white to pale fuscous or grey.

Apothecia few to abundant, scattered, adnate, not constricted, 0.4-0.5 mm wide. Proper margin at first thick, shiny, prominent, quickly excluded. Disc plane becoming convex, matt, roughened, black. Hypothecium black; epi-thecium bluish-black; hymenium 50 μ m high, hyaline with top suffused with bright blue or blackish tints; paraphyses simple, stout, septate, with a globose end cell, strongly coherent. <u>Spores</u> 8 per ascus, hyaline, fusiform to ovoid, l-septate or occasionally simple, (12-)15-19 X 4-5 μ m (see Figure 14).

<u>Spot Tests</u>: thallus K-, C-, KC-, P-. <u>Substratum/Habitat</u>: saxicolous; primarily on sandstone in the supra-

littoral zone.

Selected Specimens: 2835, 3000.

Local Abundance and Distribution: infrequent; scattered at maritime sites in the CDFD subzone, not collected in adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: The verruculose thallus, which may be almost white in colour, the black hypothecium, and the larger spores, separate this species from <u>C. chalybeia</u>. Additionally, the apothecia of the local <u>C</u>. <u>chalybeia</u> remain plane, although some European floras describe them as becoming convex; those of this unknown species quickly become convex.

This species seems very close to <u>Toninia</u>. Since the thallus is more crustose than squamulose it has been included in <u>Catillaria</u>. It should also be mentioned that some two-septate spores were occasionally seen.

<u>Addendum</u>: After working with the genus <u>Lecania</u> the similarity of the thallus of this unknown <u>Catillaria</u> to <u>Lecania</u> fructigena was noticed. Occasionally some immature <u>Catillaria</u> apothecia were found on remote sections of the <u>Lecania</u> species thallus. Therefore, this <u>Catillaria</u> may be a parasite. The problem requires further study.

CAVERNULARIA Degel.

Thallus foliose; small, generally less than 2(-4) cm wide. Characterized by involutions of the lower cortex (cavernulae) resulting in a perforated appearance of the lower surface. Rhizines absent. White above, black below.

Ascocarp an apothecium, stipitate. Thalline margin present. Disc brown. Spores 8 per ascus, hyaline, simple, globose. Pycnidia immersed.

Corticolous.

The genus Cavernularia contains only two species.

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References: Degelius (1937).

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CAVERNULARIA HULTENII Degel., Medd. Göteborgs Bot. Trädgard 12:120. 1937.

<u>Thallus</u> foliose; 1-2(-3) cm broad, minute, rosette-shaped. Lobes small, up to 1 mm wide, dichotomously branched, separate to imbricate. Upper surface dull to shiny, faintly reticulately ridged; mineral grey, whiter towards the center, lower cortex visible as a black line along the margins. Soredia present, granular, white to greenish, present at the tips of most lobes. Lower surface shiny, black, browning at the lobe tips, pockmarked with numerous small tunnels. Rhizines absent.

<u>Apothecia</u> rare, laminal, stipitate, with thalline margin. Disc shiny, concave. Asci and spores not mature in single specimen observed. According to Ahlner (1948), the <u>spores</u> are 8 per ascus, globose, 3-4 µm.

<u>Pycnidia</u> sometimes present but never numerous, towards the lobe tips. Pycnospores not observed. Degelius (1937) observed pycnidia-like structure, but also failed to find pycnospores.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; collected only on <u>Picea</u> <u>sitchensis</u>. <u>Selected Specimens</u>: 4468B, 5400.

Local Abundance and Distribution: infrequent; not collected in the CDFD subzone, fairly common at maritime sites in the adjacent CH zone especially the Spruce/Fog subzone. One small collection is known from Burn's Bog near Vancouver (Goward, pers. comm.) which suggests that it could occur also in edaphically suitable sites within the CDFD subzone.

CAVERNULARIA LOPHYREA (Ach.) Degel., Medd. Göteborgs Bot. Trädgard 12:132. 1937.

Parmelia lophyrea Ach., Meth. Lich.: 198. 1803.

<u>Thallus</u> foliose; small, rosette-shaped, 2-3 cm broad. Lobes 0.3-1.0 mm wide, dichotomously branched, <u>+</u> imbricate. Upper surface shiny, slightly reticulately ridged; mineral grey, browning at the lobe tips, the lower cortex visible as a thin black line at the margins. Lower surface shiny, black, browning towards the ends, pockmarked with numerous small tunnels. Rhizines absent.

<u>Apothecia</u> common, laminal, stipitate, 1-5(-8) mm wide, margin concolorous with the thallus; disc brown, concave becoming plane. Hymenium 30 µm high, hyaline; paraphyses coherent; epithecium light brown. <u>Spores</u> 8 per ascus, hyaline, globose, 2-4 µm.

<u>Pycnidia</u> immersed, abundant at lobe tips; pycnospores not observed. <u>Spot Tests</u>: none.

<u>Substratum/Habitat</u>: corticolous; collected only on <u>Picea sitchensis</u>, accompanied by <u>C</u>. <u>hultenii</u>.

Selected Specimens: 4468A, 5403.

Local Abundance and Distribution: rare; not collected in the CDFD subzone, fairly common at maritime sites in the adjacent CH zone, especially the Fog/Spruce subzone.

<u>Remarks</u>: Both <u>C</u>. <u>lophyrea</u> and <u>C</u>. <u>hultenii</u> resemble <u>Physcia</u> in their minute foliose appearance, however, the cavernulae are very distinctive.

CETRARIA Ach.

Thallus foliose to almost fruticose. Yellow to brown, usually with very little colour difference between top and bottom. Rhizines few to absent.

Ascocarp an apothecium, marginal. Thalline margin present; discs usually red-brown to brown. Spores 8 per ascus, simple, hyaline, ellipsoid or globose.

Pycnidia marginal, immersed in papillae or spinules and appearing raised, brown to black.

Corticolous, terricolous, or saxicolous. The local species are predominantly small, foliose, and corticolous.

<u>Cetraria</u> has been considered a heterogeneous assemblage on the basis of both chemistry and anatomy (Dahl, 1952). Several segregate genera have been recently segregated. These include <u>Platismatia</u> and <u>Cetrelia</u> (Culberson & Culberson, 1968), both common locally, and <u>Asahinae</u> (Culberson and Culberson, 1965).

The brown 'fruticose' species of <u>Cetraria</u> have been recently monographed (Kärnefelt, 1979). They are known on Vancouver Island only from higher elevations.

References: Esslinger (1973b).

1.	Saxicolous <u>C</u> . <u>HEPATIZON</u>
1.	Corticolous2
	2. Thallus bright yellow
	2. Thallus green, green-brown, or brown to black
3.	Thallus white sorediate (sometimes brown sorediate) along the margins <u>C</u> . <u>CHLOROPHYLLA</u>
3.	Thallus esorediate

	2.	••		a - 1	•		
	4.	Lobes finely brown to nea	branched; rly black	thallus 	dark olive-	<u>c</u> .	MERRILLI
	4.	Lobes broad;	thallus g	reen-brow	n to brown		5
5.	Thallus	with laminal	papillae;	pycnidia	not numerous	s <u>C</u> . <u>PL</u>	ATYPHYLLA
5.	Thallus abundan	without lami t, black, mar	nal papilla ginal, barr	ae; pycni rel-shape	dia d		<u>C. ORBATA</u>

CETRARIA CANADENSIS (Räs.) Räs., Kuopion Luonnon Ystäväin Yhdistyksen Julkaisuja Ser. B., 2(6):25,36. 1952.

Cetraria juniperina var. canadensis Räs., Ann. Missouri Bot. Gar. 20:12. 1933.

Thallus foliose; 1.5-2.5 cm broad, centrally attached with free and ascending lobes. Lobes narrow, 2-3 mm wide and much-branched, to wider lobed, 5-6 mm with fringed or spiculate margins. Upper surface shiny, foveolate to ridged; occasionally light yellow green, usually bright yellow. Lower surface similar to upper surface, slightly lighter in colour. Rhizines white, few, only at place of attachment.

Apothecia common, marginal to submarginal, 1-3(-5) mm wide. Thalline margin present, smooth to usually crenulate, sometimes thickly papillose. Disc plane, shiny, chestnut brown. Hymenium 30-35 µm high; paraphyses coherent; epithecium reddish-brown. Spores 8 per ascus, hyaline, ellipsoid, epispore evident, 7-8 X 4-5 µm.

Pycnidia common, black, marginal, immersed to slightly raised. Pycnospores measured once, hyaline, 2.5-3.0 X 1.0 µm.

Spot Tests: none.

Substratum/Habitat: corticolous; on conifers, mainly Pinus contorta. Selected Specimens: 4343, 4849.

Local Abundance and Distribution: infrequent, at higher elevations,

exposed sites within the CDFD subzone; common in the adjacent CDFW subzone where Pinus contorta is more abundant on gravelly soils.

<u>World Distribution</u>: western North American endemic; known from northern California, Oregon, Washington, Montana, Alberta and British Columbia (Esslinger, 1973b; Hale, 1979).

<u>CETRARIA CHLOROPHYLLA</u> (Willd.) Vain., Act. Soc. Fauna Flora Fenn. 13:7. 1896. <u>Lichen chlorophyllus</u> Willd., Flor. Friburg. Specim.:30. 1793. Cetraria scutata auct., non (Wulf.) Poetsch., System. Aufzahl. samenlos.

Pflanzen:262. 1872.

<u>Thallus</u> foliose; 1.5-3.5(-6) cm wide. Lobes 1-2 cm broad, linear, occasionally dichotomously branched, ascending. Upper surface shiny, variously ridged and pitted; olive-brown, auburn, to medal bronze. Sorediate, sometimes appearing finely brown isidiate, usually the length of the margins; soredia white. Lower surface lighter coloured, sometimes whitish towards the center. Rhizines common only at place of attachment, occasionally unattached ones scattered along lower surface; long, simple, light brown.

Apothecia and pycnidia not observed. According to Howard (1950), "apothecia rare, marginal or submarginal, small, 0.5-1.5 mm in diameter, adnate to sessile, disc chestnut brown, concave to convex; thalline margin entire or crenulate; spores hyaline, ellipsoid, non-septate, 7.0-9.0 X 3.5-6.0 μ m". Hillmann (1936) stated the apothecia are marginal or terminal and sorediate, the pycnidia rare, pycnospores constricted in the middle, 4-5.5 X 1 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous and lignicolous; mainly on conifer twigs and bark.

Selected Specimens: 4337, 5117A.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones; often found at, but not restricted to, inland sites.

<u>World Distribution</u>: tentatively western North America-eastern North America(Greenland)-Europe-eastern Asia disjunct; however, apparently fairly continuous from Europe to Siberia (reported from Europe east to the Urals, also in western Siberia and Kamchatka) and often described as circumpolar (e.g. Krog, 1968) but in North America concentrated in western North America from California to Alaska and eastward to the Black Hills and lacking in most of eastern North America except for Greenland (Alstrup, 1982).

<u>Remarks</u>: Besides the normal form described above, a form from exposed sites was also found in this area. It has a more compact, orbicular thallus with rounded lobes and brown isidia-soredia on the lobes and margins. It was confirmed as <u>C</u>. <u>chlorophylla</u> by T. Esslinger.

<u>CETRARIA HEPATIZON</u> (Ach.) Vain., Termeszetr. Fuzetek 22:278. 1899. <u>Parmelia fahlunensis</u> var. <u>hepatizon</u> Ach., Method. Lich.: 203. 1803.

<u>Thallus</u> foliose; orbicular, 4-6 cm broad. Lobes 0.5-1.0 mm wide, linear, separate to imbricate, much branched, appressed to substratum over entire length. Older lobes about 1.0 mm wide, dull, surface roughened; younger lobes about 0.5 mm wide, shiny, distinctly raised margin-lip with vaguely elongated pseudocyphellae, both young and old lobes blackish-brown or young lobes somewhat lighter. Lower surface black. Rhizines black, simple, not abundant.

<u>Apothecia</u> occasional, marginal, 3-5 mm wide. Thalline margin dentate, pseudocyphellate. Disc concolorous with thallus, plane becoming contorted, irregularly convex. <u>Spores</u> 8 per ascus, ellipsoid to oblong-ellipsoid, hyaline, 8-10 X 5-6 µm. <u>Pycnidia</u> commonly present, marginal, barrel-shaped,with a gaping ostiole in older pycnidia; pycnospores hyaline, straight with a mid-constriction, $3-6 \times 1-1.5 \mu m$.

Spot Tests: medulla P+ orange.

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<u>Substratum/Habitat</u>: saxicolous; collected on conglomerate and igneous rock at inland sites, especially exposed, high elevations (ca. 600 m),but also once at 100-140 m near Nanaimo.

Selected Specimens: 4693, 5164.

Local Abundance and Distribution: infrequent; scattered primarily at high elevations in the CDFD subzone and adjacent zone.

<u>World Distribution</u>: (circumarctic-)circumboreal in the Northern Hemisphere (Ahti, 1964).

<u>Remarks: C. hepatizon and C. commixta</u> (Nyl.) Th. Fr. are very similar, with the latter differing in the lighter coloured lower surface and P- spot test. The <u>C. commixta</u> specimen reported from Saltspring Island (Bird & Bird, 1973) has been examined and is actually <u>C. hepatizon</u>.

CETRARIA MERRILLI Du Rietz, Arkiv Bot. 20A. No. 11:42. 1926.

<u>Thallus</u> foliose to almost fruticose; 1-2 cm broad, tufted. Composed of several major lobes, 0.5-1.0 mm wide at widest points, finely dissected, flattened to somewhat terete at the tips, smooth to foveolate, shiny; upper surface dark olive or olive-brown, below paler olive brown to clove brown.

<u>Apothecia</u> common even on small specimens, laminal or terminal. Thalline margin dentate. Disc 1-4 cm wide, concave becoming plane. Hymenium 40-50 µm high; epithecium dark green-brown; paraphyses coherent. <u>Spores</u> 8 per ascus, hyaline, irregularly ellipsoid, epispore evident in some, 6-8 X 5-5 µm.

<u>Pycnidia</u> scattered on main lobes, immersed to slightly raised; pycnospores observed once, hyaline, straight with mid-constriction, 4 X 1 µm.

Spot Tests: none.

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<u>Substratum/Habitat</u>: corticolous; collected twice, both times on <u>Pinus</u> contorta.

Local Abundance and Distribution: rare; at exposed inland sites on the CDFD-CDFW subzone border where Pinus contorta is fairly common.

<u>World Distribution</u>: western North America-Europe disjunct; in North America fairly common from Alberta-British Columbia south to California; in Europe only recently reported from one location in Spain (Kärnefelt, 1980).

<u>Remarks:</u> <u>C</u>. <u>merrilli</u> has been confused with <u>Cornicularia californica</u> (Tuck.) Du Rietz which, although not collected locally, is known from California north to the Queen Charlotte Islands. <u>C</u>. <u>californica</u> has terete (never flattened) lobes that are tan to brown or darkening on all surfaces (no colour difference between top and bottom). See Esslinger (1973b).

CETRARIA ORBATA (Nyl.) Fink, Mycologia 11:298. 1918.

Platysma orbatum Nyl., Flora 52:442. 1869.

<u>Thallus</u> foliose; orbicular, 2-5(-8) cm broad. Lobes 1.5-4(-5) mm wide, narrow and pinnately branched to rounded and infrequently branched, free and ascending. Upper surface smooth to pitted and ridged, shiny especially at the margins; greyish-olive, olive-brown, to brown. Spinules frequent both laminally to more commonly marginally, producing a frilled effect. Lower surface white to tan, shiny, pitted and ridged. Rhizines simple, tan, at center for attachment and some scattered on lower surface.

<u>Apothecia</u> common, marginal to submarginal, 1-6(-9) mm wide. Thalline margin crenulate to occasionally papillate; spinules on back, also pseudocyphellate. Disc shiny, round plane becoming plane and irregular, tan to chestnut brown. Hymenium 40 μ m high; paraphyses coherent; epithecium brown. <u>Spores</u> 8 per ascus, globose to subglobose, hyaline, commonly with distinct epispores, 5-6 X 5 µm.

<u>Pycnidia</u> very abundant, marginal, black, raised, barrel-shaped with gaping ostiole. Pycnospores hyaline, straight with mid-constriction, 4-5 X l µm.

Spot Tests: medulla C-, KC-.

<u>Substratum/Habitat</u>: corticolous; on both evergreen and deciduous trees and shrubs but especially common on <u>Pseudotsuga</u>.

Selected Specimens: 3731, 4941.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone, especially at inland sites; present, but not common or abundant, in adjacent zones.

<u>World Distribution</u>: western and eastern North America; temperate; in the west known from British Columbia and Idaho south to California (Esslinger, 1973b) (see Figure 65).

<u>Remarks</u>: <u>Cetraria orbata</u> belongs to the <u>C</u>. <u>ciliaris</u> group which differ in chemistry and slight morphological characters (Hale, 1963; Culberson & Culberson, 1967). <u>C</u>. <u>halei</u> Culberson & C. Culberson (=<u>C</u>. <u>ciliaris</u> Ach. var. <u>halei</u> (Culberson & C. Culberson.) Ahti, ined), a circumboreal species known from the interior of the province, possesses marginal cilia instead of spinules and is KC+ pink-red.

CETRARIA PLATYPHYLLA Tuck., Syn. N. Am. Lich. 1:34. 1882.

Nephromopsis platyphylla (Tuck.) Herr, Proc. Wash. Acad. Scienc. 12:210. 1910.

<u>Thallus</u> foliose; 3-4.5 cm broad. Lobes few, (4-)6-12 mm wide, rounded, free, ascending, margins slightly lacerate, with edges variously curled. Upper surface shiny, strongly to slightly tuberculate; the tubercles pseudocyphellate and arranged so the thallus appears finely wrinkled-ridged to the eye; dark olive, clove brown, fuscous. Below ridged, <u>+</u> lighter coloured. Rhizines, few, simple, tan coloured.

<u>Apothecia</u> common, marginal to submarginal. Thalline margin crenulate. Disc shiny, concave, 1 mm wide. <u>Spores</u> not mature in specimen examined. According to Tuckerman (1882), Herre (1910), and Howard (1950), the apothecia are 1-7 mm wide with tuberculate margin; spores, hyaline, spherical to subspherical, 4-9 µm wide.

Pycnidia not observed.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; collected once on dead branches of Arctostaphylos columbiana at an exposed high elevation.

Selected Specimen: 5511A.

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Local Abundance and Distribution: rare; distribution poorly known, collected once at 589 m at an exposed site in the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; known from British Columbia and Alberta south to California.

<u>Remarks</u>: <u>C</u>. <u>platyphylla</u> is superficially similar to the round-lobed form of <u>C</u>. <u>chlorophylla</u> but lacks the marginal soredia present in the latter species. Esslinger (1937b) stated that small specimens may be confused with <u>C</u>. <u>orbata</u> but black, marginal, barrel-shaped pycnidia are present even in the smallest specimens of the latter.

Both Herre (1910a) and Esslinger (1973b)referred to yellow spots present in the medulla of <u>C</u>. <u>platyphylla</u> which the latter author stated were K+ yellow and CD+ yellowish-orange. These were not observed in the single, local collection.

The tubercles are sometimes referred to as papillae and isidia and,depending on their development, may become foliate.

Howard (1950) stated that C. platyphylla has not been collected below

CETRELIA Culb. & C. Club.

Thallus foliose; medium sized to large sized, 7-24 cm broad. Upper surface pseudocyphellate, often isidiate or sorediate; white or tan. Lower surface black, often punctate; rhizinate.

Ascocarp an apothecium, submarginal, usually perforate. Thalline margin present. Spores 8 per ascus, ellipsoid, hyaline, simple.

Pycnidia marginal; pycnospores cylindrical with slightly inflated ends. Corticolous, saxicolous, and also terricolous. The genus <u>Cetrelia</u> is concentrated mainly in <u>Asia</u>. There is one local species.

References: Culberson and Culberson (1968).

CETRELIA CETRARIODIDES (Del. ex Duby) Culb. & C. Culb., Contrib. U.S. Natl. Herb. 37(7):498. 1968.

<u>Parmelia perlata</u> *A* <u>cetrarioides</u> Del. ex Duby, Bot. Gall., ed. 2:601. 1830. <u>Thallus</u> foliose; 4-7 cm broad, centrally attached with margins free and <u>+</u> ascending. Lobes 7-15 mm wide, rounded. Upper surface shiny, slightly wrinkled with small, 0.3 mm wide pseudocyphellae; off-white to pale olive grey or pale olive-buff, margins often browned. Soredia present, marginal. Lower surface rugulose, shiny black with a wide brown margin; with small punctae (pseudocyphella-like) especially noticeable at the black-brown interphase. Rhizines black, simple, scarce, primarily toward the center.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Culberson & Culberson (1968) the apothecia are extremely rare and the pycnidia are unknown.

Spot Tests: medulla C-.

<u>Substratum/Habitat</u>:saxicolous and corticolous; collected twice on conglomerate and once on Alnus.

Selected Specimens: 1670A, 2062.

Local Abundance and Distribution: infrequent; collected only on the southern Gulf Island of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia (Nepal & China) disjunct. In western North America <u>C</u>. <u>cetrarioides</u> is known from Alaska (Krog, 1968) and Washington (Culberson & Culberson, 1968) as well as the Queen Charlotte Islands (Brodo, 1980) and Bella Coola (Ohlsson, 1973) in British Columbia. It has also been reported for California, but those records have been excluded by Tucker and Jordan (1978) as probable misidentifications.

<u>Remarks</u>: There are four chemically distinct members of the <u>C</u>. <u>cetrario-</u> <u>ides</u> complex: <u>C</u>. <u>chicitae</u> (Culb.) Culb. & C. Culb. (alectoronic acid and α --collatolic acid), <u>C</u>. <u>olivetorum</u> (Nyl.) Culb. & C. Culb. (olivetoric acid), <u>C</u>. <u>cetrarioides</u> (perlatolic acid), and <u>C</u>. <u>monochorum</u> (Zahlbr.) Culb. & C. Culb. (imbricaric acid). Culberson & Culberson (1968) originally did not recognize the last species as distinct from <u>C</u>. <u>cetrarioides</u>. Only the perlatolic acid strain, <u>C</u>. <u>cetrarioides</u> sens. str., is known from western North America. Although admitting that <u>C</u>. <u>chicitae</u> was essentially a chemical species, and retaining <u>C</u>. <u>monochorum</u> in <u>C</u>. <u>cetrarioides</u>, Culberson & Culberson maintained that <u>C</u>. <u>olivetorum</u>, besides possessing chemical differences, also was morphologically distinct from <u>C</u>. <u>cetrarioides</u> (both perlatolic and imbricaric acid strains). According to them C. olivetorum

"...can almost invariably be distinguished...by the experienced eye. The sum total of its small, difficult-to describe yet distinctive traits--the slightly convex lobes, the abundant but extremely minute pseudocyphellae, the extremely fine but abundant marginal soredia, and the total lack of laminal soredia-makes it possible to name most specimens at sight."

However, Jørgensen & Ryvarden (1970), after studying Norwegian specimens, maintained that there were no morphological differences. Dahl & Krog (1973) and Hawksworth et al. (1980) have accepted this conclusion and recognize only the one species, <u>C</u>. <u>olivetorum</u>; Hale (1979) has followed the other extreme and recognizes all four species in the complex.

In the local material the punctae are usually easily seen because they contrast with the black-brown lower surface. The pseudocyphellae, however, are not as easily observed and normally require a DM to be seen.

Several of the medium-sized foliose lichens found locally are superficially similar to <u>C</u>. <u>cetrarioides</u>. <u>Parmelia subrudecta</u> is perhaps the closest, but it has larger, obvious pseudocyphellae on the upper surface and its lower surface is coloured a light tan.

CHAENOTHECA (Th. Fr.) Th. Fr.

Thallus crustose; occasionally almost lobed; sometimes immersed in substratum. Phycobiont present.

Ascocarp an apothecium, stipitate. Excipulum present, often pruinose. Spores 8 per ascus, light brown to dark brown, simple, globose to ellipsoid. Spores, asci, and hymenial fragments released to form a powdery mass, the mazaedium.

Commonly corticolous or lignicolous.

References: Tibell (1975, 1980).

1.	Thallus bright yellow-green; excipulum yellow pruinose <u>C</u> .	CHRYSOCEPHALA
1.	Thallus not bright yellow-green; excipulum epruinose	2

- 2. Capitulum globose; excipulum reduced; thallus immersed to thin and grey, K- <u>C</u>. <u>BRUNNEOLA</u>
 - Capitulum elongate-oval; excipulum welldeveloped; thallus thin to slightly verruculose with yellow-orange granules, K+ red ... C. FERRUGINEA

CHAENOTHECA BRUNNEOLA (Ach.) Muell. Arg., Mém. Soc. Phys. Hist. Genève 16(2):360. 1862.

Calicium brunneolum Ach., K. Vetensk. Akad. Handl. 1816:279. 1816.

<u>Thallus</u> crustose; very thin, grey, effuse, <u>+</u> immersed. Phycobiont present, chlorococcoid.

<u>Apothecia</u> stipitate. Stalks slender, shiny, black, simple or occasionally bi- or trifuricate, 0.5-1.2 mm high. Capitulum globose; excipulum black, reduced to almost absent in most cases. <u>Spores</u> 8 per ascus, light brown, spherical, 2.5-3.0 µm, released to form a brown, powdery mazaedium.

Spot Tests: thallus K-.

Substratum/Habitat: corticolous; collected once on a Thuja trunk.

Selected Specimen: 5429A.

Local Abundance and Distribution: rare; not collected in the CDFD subzone; collected once in the Fog/Spruce subzone of the CH zone.

<u>Remarks</u>: <u>C</u>. <u>brunneola</u> is similar to <u>C</u>. <u>hygrophila</u> Tibell, a species also known from the west coast of Vancouver Island (Tibell, 1980). The latter species is distinguished by (1) the dull, dark brown stalk, (2) the lenticular-shaped capitulum with well-developed excipulum, (3) a much better developed, usually <u>+</u> continuous thallus, and, (4) the absence of baeomycesic acid. Additionally <u>C</u>. <u>hygrophila</u> has asci produced singly from ascogenous hyphae while those of <u>C</u>. <u>brunneola</u> are produced in chains. CHAENOTHECA CHRYSOCEPHALA (Turn. ex Ach.) Th. Fr., Nova Acta Reg. Soc.

Scient. Upsal., ser. 3, 3:350. 1861.

Calicium chrysocephalum Turn. ex Ach., Meth. Lich., Suppl. :15. 1803.

<u>Thallus</u> crustose; thin to thick, of heaped granules, often breaking down to become sorediate; citron green, bright yellow-green.

<u>Apothecia</u> stipitate. Stalk thin, black, shiny to dull, 0.5-1.0 mm high. Capitulum narrowly to widely ovate. Excipulum slightly to widely expanded, yellow pruinose. Spores uniseriate, 8 per ascus, simple, subglobose to slightly elongate, irregularly roughened or ornamented, becoming light borwn, 4-7 X 3-5 µm, extruded to form a brown powdery mazaedium.

Spot Tests: none.

Substratum/Habitat: corticolous; collected on Pseudotsuga trunks.

Selected Specimen: 6403.

Local Abundance and Distribution: rare; not collected in the CDFD subzone but collected in the adjacent CDFW subzone; also one report by Tibell (1975) from Little Qualicum Falls Prov. Park west of Parksville.

CHAENOTHECA FERRUGINEA (Turn. ex Sm.) Migula, Flora Deutschl. Abt. II.

11(2):479, 480. 1930.

Calicium ferrugineum Turn. ex Sm., English Botany:2473. 1813.

<u>Thallus</u> crustose; thin to slightly verruculose; grey-white with scattered yellow-orange granules or 'watermarks'. Algae present, chlorococcoid.

<u>Apothecia</u> stipitate. Stalks slender to stout, dark brown to black, dull to slightly shiny, 0.3-1.0 mm high. Capitulum elongate-oval with black-brown excipulum. <u>Spores</u> 8 per ascus, light brownish, slightly roughened, spherical, 5 µm, released to form a light brown occasionally almost yellow pruinose, extruded mazaedum. <u>Spot Tests</u>: yellow-orange granules of thallus K+ dark, but bright red, fading.

<u>Substratum/Habitat</u>: corticolous; collected on trunks of <u>Thuja</u> and Pseudotsuga.

Selected Specimens: 3724A, 6320.

Local Abundance and Distribution: rare; collected only in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe-Siberia; possibly circumboreal (Tibell, 1975); in North America known from British Columbia, Oregon, Ontario, Massachusetts, Michigan, Minnesota, New Jersey, and New York (Tibell, 1980).

<u>Remarks</u>: According to Duncan (1970) the spores can be 3-8 μ m in diameter; Tibell (1975) stated that mature spores are 5-6.5 μ m in diameter.

CHRYSOTHRIX Mont.

Thallus crustose; leprose; entirely non-corticate and unstratified; yellow to green, containing pulvinic acid derivatives.

Ascocarp an apothecium, rare (unknown in one species), with thin, non-corticate margin or margin absent; disc green, yellow, orange, or brownish, <u>+</u> yellow pruinose. Spores narrowly obovoid to narrowly ellipsoid, 3-septate, cells often unequal and/or constricted at mid-septum.

Corticolous and saxicolous.

The local species were formerly included in <u>Lepraria</u>. References: Laundon (1981), Wade (1959).

 Thallus deep yellow; granules very small, < 0.1 mm.....C. <u>CANDELARIS</u>
Thallus bright, 'fluorescent' green or greenishyellow; granules ≥ 0.1 mmC. <u>CHLORINA</u> <u>CHRYSOTHRIX</u> <u>CANDELARIS</u> (L.) Laundon, Lichenologist 13:110. 1981. <u>Byssus</u> <u>candelaris</u> L., Sp. Pl. 2:1169. 1753.

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Lepraria candelaris (L.) Fr., Sched. Crit. Lich. Exc. Sueciae 1824:16. 1824.

<u>Thallus</u> crustose; entirely leprose, of scattered and also clustered, very fine, < 0.1 mm, noncorticate granules; deep yellow or occasionally a slight orange-yellow.

<u>Apothecia</u> not observed. According to Laundon (1981) the apothecia are rare, up to 0.5 mm, orbicular, bright yellow ith a very thin, non-corticate margin; spores narrowly ellipsoid or obovoid, hyaline, 3-septate, often constricted at mid-septum, 9-14 X 3 μ m.

<u>Spot Tests</u>: thallus K+ orange, C-, KC-, P+ orange.

<u>Michrochemical Tests</u>: in G.E. either calycin (Small, thin, narrow, pointed, orange-red needles) or pinastric acid (pale yellow, narrow, blunt rectangles); of the 8 specimens tested, 4 contained calycin and 4 contained pinastric acid. The crystals were usually quite distinct after only treatment with the acetone extraction.

<u>Substratum/Habitat</u>: corticolous; on a variety of trees especially <u>Pseudotsuga</u> but also <u>Alnus</u>, <u>Quercus</u>, <u>Pinus</u> <u>contorta</u>, <u>Thuja</u>, and <u>Abies</u>. (Note: elsewhere this species has been reported also as saxicolous).

Selected Specimens: 1370, 5357.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: circumtropic-circumtemperate, with the temperate sites mainly in western oceanic regions; also present in the Southern Hemisphere; absent from arctic and desert regions (Laudon, 1981).

Remarks: See C. chlorina for comments.

<u>CHRYSOTHRIX CHLORINA</u> (Ach.) Laundon, Lichenologist 13:106. 1981. <u>Lichen chlorinus</u> Ach., Lich. Suec. Prodr.:6. 1778. Lepraria chlorina (Ach.) Ach. ex Sm., Engl. Bot. 29:tab. 2038. 1809.

<u>Thallus</u> crustose; entirely leprose; of scattered to usually clustered small, ≥ 0.1 mm granules; sometimes becoming quire thick; bright fluor-escent green or yellow-green.

<u>Apothecia</u> not observed. According to Laundon (1981) the apothecia are unknown.

Spot Tests: thallus K-, C-, KC-, P-.

Microchemical Tests: Of 4 specimens examined in G.E. all contained vulpinic acid (large, pale yellow squares or nearly square rectangles, often overlying each other), and the only saxicolous specimen also contained calycin.

<u>Substratum/Habitat</u>: corticolous and saxicolous; collected three times on Pseudotsuga and once on shaded, igneous rock.

Selected Specimens: 3856, 5277.

Local Abundance and Distribution: infrequent; not collected on any of the Gulf Islands but at higher elevations inland in the western part of the CDFD subzone on Vancouver Island; also in the adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Laundon, 1981); the map in the above cited monograph included only examined specimens and as a result showed only two non-European collections, one from India and one from Minnesota, U.S.A.

Remarks: C. chlorina is separated from <u>C. candelaris</u> by the bright green

or greenish-yellow thallus of slightly larger granules. For specimens of intermediate colour <u>C</u>. <u>chlorina</u> always contains vulpinic acid <u>+</u> calycin while C. candelaris contains pinastric acid and/or calycin.

Concerning the chemical variability of the two species involved, Laundon (1981) stated that <u>C</u>. <u>chlorina</u> consists of only one chemical strain (vulpinic acid plus calycin) while <u>C</u>. <u>candelaris</u> consists of three strains (a pinastric acid plus calycin strain). His specimens of <u>C</u>. <u>chlorina</u> were primarily from Europe while those of <u>C</u>. <u>candelaris</u> were more evenly distributed around the world. It is not surprising, therefore, that three of the local <u>C</u>. <u>chlorina</u> ina collections lack calycin, indicating a second chemical strain exists. The existence of this second strain, however, suggests the possibility of a third strain (calycin only) which would make the separation of <u>C</u>. <u>chlorina</u> and <u>C</u>. <u>candelaris</u>, theoretically, not so clear cut.

CLADINA (Nyl.) Harm.

Primary thallus crustose; evanescent. Secondary thallus fruticose. Podetia radial, cylindrical and hollow, branched with open axils, slender, ecorticate; squamules absent, escyphus.

Ascocarp an apothecium, small, < 0.7 mm wide, pale to dark brown, terminal in clusters, plane becoming strongly convex, often absent. Proper margin present, excluded early. Spores 8 per ascus, hyaline, simple, ovoid, small 4-7 X 2 µm.

Pycnidia common, globose, ovoid, or cylindrical, terminal in clusters, blackish to brown, often empty. Pycnidial jelly red or hyaline. Pycnospores hyaline, cylindrical.

Terricolous.

Cladina is often treated as a subgenus of Cladonia.

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References: Ahti (1960, 1961); Thomson (1967c).

1.	Podetia	white, pale grey; P+ red 2			
1.	Podetia branches	greenish-yellow, greenish grey (compare ultimate against white paper for hint of yellow/green); P+ red 3			
	2.	Main branches slender (0.5-0.7 mm wide); K <u>C. CILIATA</u> var. <u>CILIATA</u> (see under var. <u>tenuis</u>)			
	2.	Main branches stouter (0.6-1.0 mm wide); K+ yellow <u>C</u> . <u>RANGIFERINA</u>			
3.	P+ red .	4			
3.	P				
	4.	Branching dichotomous; apices reflexed in <u>+</u> one direction; main stems slender, < 0.9 mm wide <u>C. CILIATA</u> var. <u>TENUIS</u>			
	4.	Branching tri- to polychotomous; apices reflexed but not consistently in one direction; main stems stouter, > 0.9 mm wide			
5.	Branching mainly trichotomous; older stems pellucid (losing outer cottony medulla layer to expose shiny inner medulla layer); UV+				
5.	Branchin stems no medu	g trichotomous and tetrachotomous; t usually becoming pellucid (outer lla layer not lost with age); UV			
CLAD	INA ARBUS	CULA (Wallr.) Hale & Culb., Bryologist 73:510. 1970.			
D+					

Patellaria foliacea var. m. arbuscula Wallr., Naturgeschichte der Saulchen-

Flect.:169. 1829.

Cladonia arbuscula (Wallr.) Rabh., Krypt.-Flora 2(1):110. 1845.

<u>Cladonia</u> sylvatica sens.str. auct.

<u>Thallus</u> fruticose; consisting of esquamulate podetia . Podetia hollow, open at axils, branching anisotomic trichotomous to polychotomous, ecorticate, not distinctly cottony, algae in large areoles or not, slightly swollen at

nodes, apices reflexed in various directions, 1.0-1.4(-1.8) mm wide, up to 7 cm high; yellowish glaucous, pale turtle green, greenish-yellow, with apices browned.

<u>Apothecia</u> not observed. <u>Pycnidia</u> common, terminal, ovoid, black; pycnospores not seen.

Spot Tests: thallus P+ yellow turning (slowly) red; K-.

<u>Substratum/Habitat</u>: terricolous; among moss mats over shallow bedrock. Selected Specimens: 4635, 5289.

Local Abundance and Distribution: rare; at exposed sites on the border of the CDFD subzone and adjacent CDFW subzone.

<u>World Distribution</u>: circumboreal-circumartic (<u>C</u>. <u>arbuscula</u> sens. lat.) in the Northern Hemisphere (Ahti, 1961).

<u>Remarks</u>: The local material falls within subsp. <u>beringiana</u> Ahti, which is an eastern Eurasia-western North America taxon (the eastern North American and Greenland localities shown in Ahti, 1961, are eliminated in Ahti, 1964).

<u>CLADINA CILIATA</u> (Stirt.) Trass var. <u>TENUIS</u> (Floerke) Ahti & Lai, Ann. Bot. Fennici 16:234. 1979.

<u>Cladonia rangiferina</u> Y. <u>tenuis</u> Floerke, Clad. Comm.:164. 1828. Cladonia tenuis (Floerke) Harm., Lich. France III:228. 1907.

<u>Thallus</u> fruticose; consisting of esquamulate podentia. Podetia hollow, open or closed at axils, branching predominantly anisotomic dichotomous, apices deflexed \pm in same direction, 0.5-0.7(-1.0) mm wide, 5-10 cm tall; pale olive-grey, yellowish glaucous, pale olive-buff, with apices slightly browned. Podetial surface cottony, \pm smooth to slightly verruculose; not becoming pellucid.

Apothecia not observed. Pycnidia common, terminal, red-brown to black.
Spot Tests: thallus P+ red, K-.

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<u>Substratum/Habitat</u>: terricolous; among moss in open or rocky places. Selected Specimen: 3821.

Local Abundance and Distribution: rare; at inland sites in the CDFD subzone and adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia (Japan and China) disjunct; oceanic to suboceanic (Ahti, 1961; Ahti &Lai, 1979).

<u>Remarks</u>: The slender branches with the greenish tinge separates <u>C</u>. <u>ciliata</u> var. <u>tenuis</u> from <u>C</u>. <u>rangiferina</u>. The slender habit with the unidirectional deflexed apices and dichotomous branching separate it from <u>C</u>. arbuscula.

<u>C. ciliata</u> var. <u>ciliata</u> (=<u>Cladina leucophaea</u> des Abb.) has been reported from Gonzales Point, Victoria (Ahti, 1960). It is the usnic acid deficient strain with a distinctly bluish-grey colour. It is known from Western North America and Europe.

<u>CLADINA MITIS</u> (Sandst.) Hale & Culb., Bryologist 73:510. 1970. <u>Cladonia mitis</u> Sandst., Abh. Nat. Ver. Bremen 25:105. 1922.

<u>Thallus</u> fruticose; consisting of esquamulate podetia . Podetia hollow, open at axils, branching anisotomic trichotomous and tetrachotomous or occasionally polychotomous, ecorticate; medullary layer <u>+</u> continuous and smooth; not distinctly areolate-verruculose, <u>+</u> persisting in older sections or occasionally somewhat excluded to slightly expose shiny, cartilaginous layer below; apices not or only slightly browned, variously reflexed, not unilaterally reflexed; up to 6 cm high; branches 0.6-1.3 mm wide; pale yellow to pale yellowish grey.

Apothecia and pycnidia not observed. According to Thomson (1967c) the

apothecia and pycnidia are both terminal with the brown apothecia being small and borne singly or in corymbs and the pycnidia containing a colorless jelly.

Spot Tests: thallus K-, P-; UV-.

<u>Michrochemical Tests</u>: containing usnic acid and "substance A" crystals in G.E. (see Thomson, 1967c).

<u>Substratum/Habitat</u>: terricolous; among moss mats or grass over shallow bedrock at exposed locations, both maritime and inland, often with <u>Cladonia</u> uncialis.

Selected Specimens: 5172, 5313.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Discovery Island in the southern part of the CDFD subzone and once at a higher elevation, inland site near Nanaimo in the northern part of the CDFD subzone.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Ahti, 1961); also reported from New Zealand, Chile and Argentina in South America, and Antarctica, in the Southern Hemisphere (Ahti, 1961).

<u>Remarks</u>: <u>C</u>. <u>mitis</u> is not common in the CDFD subzone compared to the very similar <u>C</u>. <u>portentosa</u>. The two collections of <u>C</u>. <u>mitis</u> were both in poor condition with the medullary layer being reduced in older sections of the podentia to expose slightly the shiny cartilaginous layer below, a characteristic more typical of <u>C</u>. portentosa.

<u>CLADINA PORTENTOSA</u> (Duf.) Follm., publication information not available. <u>Cenomyce portentosa</u> Duf., Ann. génér. sci. phys. 8:29. 1817.

<u>Cladonia portentosa</u> (Duf.) Coem., Bull. Acad. r. Belg. ser. 2, 19:48,49. 1865. Cladonia impexa Harm., Lich. France 3:232. 1907.

Cladina impexa (Harm.) B. de Lesd., Rech. lich. Dunkerque:79. 1910.

Cladonia pacifica Ahti, Annal. Bot. Soc. Zool. Bot. "Vanamo"32:25. 1961.

Thallus fruticose; consisting of esquamulate podetion . Podetia hollow,

<u>Thallus</u> fruticose; consisting of esquamulate podetia . Podetia hollow, branching mainly anisotomic trichotomous (but dichotomous and polychotomous also present), main axils open, apices \pm reflexed or divergent, 0.4-0.9(-1.4) mm wide, 3.5-7(-10) cm high; yellowish glaucous, yellow, occasionally olive grey, apices slightly or not browned. Podetia surface cottony with algae usually in distinct areoles, sometimes becoming verruculose; in older portions inner cartilaginous layer commonly becoming visible, + shiny.

Apothecia not observed. Pycnidia occasional, terminal, black.

Spot Tests: thallus P-, K-; UV+ white.

<u>Substratum/Habitat</u>: terricolous; often among moss mats in open locations especially seashore cliffs.

Selected Specimens: 254, 3151.

Local Abundance and Distribution: frequent; at maritime sites throughout the CDFD subzone, present but not as common in the adjacent zones.

World Distribution: western North America-Europe disjunct.

<u>Remarks:</u> <u>C</u>. <u>portentosa</u> is very similar to <u>C</u>. <u>mitis</u> in colour and overall appearance. However, branching in <u>C</u>. <u>mitis</u> is predominently in 4's, the thallus is UV-, and the inner cartilaginous medullary layer does not become exposed as a shiny layer as in <u>C</u>. <u>portentosa</u>. However, the few local collections of <u>C</u>. <u>mitis</u> are not sharply separated from <u>C</u>. portentosa.

CLADINA RANGIFERINA (L.) Nyl., Bull. Soc. Science. Nancy, sér. 2, 14:387. 1896.

Lichen rangiferinus L., Sp. Pl.:1153. 1753.

Cladonia rangiferina (L.) Wigg., Prim. Fl. Holsat.:90. 1780.

<u>Thallus</u> fruticose; consisting of esquamulate podetia . Podetia hollow, dichotomously or trichotomously anisotomically branched; axils + open, ulti-

mate tips \pm deflexed, 0.6-1.0(-1.3) mm wide, 5-9 cm tall; pale purplish grey, pale neutral grey, whitish grey. Podential surface cottony, matt, smooth to verruculose.

<u>Apothecia</u> rare, observed in one collection, terminal in clusters, light brown to dark brown, convex, 0.4-0.6 mm wide. Hymenium 42 μ m high; epithecium orange-brown; spores not observed.

<u>Pycnidia</u> common, abundant, terminal, brown to black; pycnidial jelly hyaline, often absent.

Spot Tests: thallus K+ yellow, P+ yellow turning red.

<u>Substratum/Habitat</u>: terricolous; among mosses often in exposed locations. Selected Specimens: 1288, 3820.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at both maritime and inland, higher elevation sites; also in the adjacent zones.

<u>World Distribution</u>: circumboreal (Ahti, 1977) in the Northern Hemisphere; also reported from Antarctica (Lindsay, 1977) in the Southern Hemisphere (see Figure 50).

<u>Remarks</u>: Ahti (1961) described the branching as mainly "tetrachotomous with trichotomies and dichotomies not uncommon".

CLADONIA Hill ex Wigg

Primary thallus basal, crustose and disappearing or squamulate and persistent to disappearing. Squamules with upper cortex; sometimes sorediate. Secondary thallus erect, fruticose, pode tiate. Podetia subulate or scyphiferous; with or without squamules; corticate and/or sorediate.

Ascocarp an apothecium, borne apically on the podetia or sometimes directly on the squamules. Proper margin present. Disc brown, yellow, or

red; soon convex. Spores 8 per ascus, fusiform, oblong, or ovoid, simple. Pycnidia apical on the podentia or on the squamules, black.

Primarily terricolous; also lignicolous, or corticolous but only at the trunk bases.

References: Thomson (1967c), Ahti (1965, 1966a, 1968, 1973, 1976, 1978, 1980a, 1980b), Ahti & Lai (1979), Bowler (1972), Bird & Marsh (1972), Culberson (1969), Yoshimura (1968a).

1.	Apothec	ia red
1.	Apothec	ia brown or absent
	2.	Esorediate 3
	2.	Sorediate 4
3.	Podetia small .	densely squamulate; cups, when present,
3.	Podetia	<u>+</u> esquamulate; cups distinct, short <u>C</u> . <u>COCCIFERA</u>
	4.	Soredia farinose; podetia⇒subulate, esquamulate, <u>+</u> greenish-grey <u>C. MACILENTA</u>
	4.	Soredia granular or farinose; podetia scyphus with small cups that proliferate marginally; with or without squamules; yellowish-green <u>C</u> . <u>TRANSCENDENS</u>
5.	Podetia almost	a absent to poorly formed; apothecia borne directly on the squamules
5.	Podetia	a present, well-formed; scyphiferous or subulate
	6.	Podetia scyphiferous, forming <u>+</u> distinct cups
	6.	Podetia subulate, not forming distinct cups
7.	Soredia	te
7.	Esoredi	ate 10
	8.	Podetia distinctly yellowish; soredia farinose <u>C</u> . <u>CARNEOLA</u>
	8.	Podetia greenish-grey, mineral grey, brownish-grey, if yellowish then soredia granular

9.	Soredia	coarse, <u>+</u> peltate areoles <u>C</u> . <u>ASAHINAE</u>
9.	Soredia	farinose; schizidia absent
	10.	Podetia short, < 2 cm11
	10.	Podetia taller, > 2 cm12
11.	Podetia	covered in verruculose areoles
11.	Podetia	+ smooth <u>C. UNKNOWN #1</u> (see <u>C. gracilis</u>)
	12.	Cups perforated or open13
	12.	Cups closed14
13.	Podetia	squamulate <u>C.</u> <u>SQUAMOSA</u>
13.	Podeția	esquamulate
	14.	Surface of podetia very smooth, <u>+</u> shiny15
	14.	Surface of podetia cottony, not shiny16
15.	Cortex K	-, greenish-brown; tops epruinose; bases not yellow, K <u>C</u> . <u>GRACILIS</u>
15.	Cortex K white pr	+ yellow, bluish-grey, bluish-green; tips often uinose; old bases often yellow, K+ purple <u>C</u> . <u>ECMOCYNA</u>
	16.	Cups consistently proliferating from center
	16.	Proliferations from the margins of the cups <u>C</u> . <u>PHYLLOPHORA</u>
17.	Podetia	esorediate18
17.	Podetia.	sorediate20
	18.	Podetia short, < 2 cm, with longitudinal creases and tears; usually fertile <u>C</u> . <u>CARIOSA</u>
	18.	Podetia taller, > 2 cm, branched; lacking creases and tears; fertile or sterile19
19.	Podetia	yellow; esquamulate <u>C. UNCIALIS</u>
19.	Podetia	greenish-grey to brownish-grey; squamulate <u>C. HERREI</u>
	20.	Podetia short, < 1.5 cm, unbranched; esquamulate; soredia farinose, totally covering podetia
	20.	Podetia taller, > 1.5 cm; branched or unbranched; with or without squamules; soredia various, totally or incompletely covering podetia

.

21. Podetia P+ red, K-; apothecia brown C. CONIOCRAEA 21. Podetia P+ yellow, K+ yellow; apothecia red (if present)..C. MACILENTA 22. Podetia subulate or narrowly cupped, often proliferating both marginally and centrally; midpodetia branches common too; squamules abundant or occasional from base to inside of cups.....C. VERRUCULOSA 22. Podetia esquamulate; subulate or irregularly cupped; cups not proliferating centrally, not branching mid-podetia23 23. Podetia totally sorediateC. SUBULATA Podetia esorediate at base or at scattered places above24 23. 24. Podetia subulate becoming sorediate at tips; brownish.....C. CORNUTA 24. Podetia often minutely cupped; esorediate in the cup as well as elsewhere on the podentia; greenishC. CONIOCRAEA

CLADONIA ASAHINAE Thoms., Journ. Jap. Bot. 51(2):361. 1976.

<u>Primary thallus</u> squamulose; squamules abundant, spreading horizontally to ascending, thick, crenulate, and imbricate, esorediate to sorediate on the edges; sometimes disappearing; pale greenish-grey, yellowish-green, to brown.

<u>Secondary thallus</u> scyphiferous podetia . Podetia 6-16 mm high, <u>+</u> abruptly flaring 3/4 way up into a broad cup, 3-6(-8) mm wide; not usually proliferating or occasionally proliferating from the margins of the cups; lower part of podetia verruculose-areolate, occasionally squamulate, becoming granular sorediate towards cups, on outside of cup, and inside cup; soredia granular, 0.1-0.3 mm; peltate areoles (schizidia) often interspersed among the soredia or sometimes absent; outside and inside of cups often becoming decorticate, sometimes with minute tears, often only with larger soredia and/or schizidia remaining inside cups; greenish-grey or sometimes almost yellowish green, browning especially after a lot of the soredia is lost.

<u>Apothecia</u> occasional, commonly on marginal projections, several usually developed on each podetia _ 1-3.5 mm wide. Disc medium brown, plane becom-

ing convex, often radially torn. Hymenium 75 μm high; upper part light (orange-)brown; paraphyses coherent. <u>Spores</u> 8 per ascus, hyaline, oblongellipsoid, simple, 7-12 X 2.5-3 μm.

Pycnidia common, marginal on cups, black or dark brown.

Spot Tests: thallus P+ red (quick K-; C-.

<u>TLC</u>: fumarprotocetraric acid and protolichesterinic acid confirmed, <u>+</u> two unknowns (26 specimens examined).

<u>Substratum/Habitat</u>: terricolous; commonly among moss over thin soil mantling rock in exposed situations; occasionally at tree bases.

Selected Specimens: 4084, 5346.

Local Abundance and Distribution: frequent; at exposed locations from seashore to hilltops, scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: western North American endemic; coastal, from California north to Alaska with one known outlier in Idaho (Thomson, 1976).

<u>Remarks: C. asahinae</u> is a strain of the <u>C. chlorophaea</u> complex, a group with granular soredia falling between the trombone-shaped scyphi of <u>C. fimbriata</u>, with farinose soredia, and the stout goblet-shaped schphi of <u>C. pyxidata</u> lacking soredia but with verruculose areoles. The <u>C. chlorophaea</u> complex is typically separated into individual species on the basis of chemistry rather than several chemical strains within a single species, because there are also distinct morphological differences, although they are very subtle and difficult to describe (Ahti, 1960; Bowler, 1972; Kristinsson, 1971). Thomson (1976) pointed out that the local <u>C. asahinae</u> "does have a characteristic appearance which makes one suspect in the field that it may be defferent from the other members of the <u>C. chlorophaea</u> group. <u>C. asahinae</u> is typically taller stalked (before the cups flare) than other members of the group and schizidia are often present along with the granular soredia.

By TLC only the protolichesterinic acid strain of the C. chlorophaea

complex was found to be present locally. However, the material was not chemically homogeneous; many of the collections contained one or two unknown acids or other substances (but not the acids found in the other strains) as well as both fumarprotocetraric acid and protolichesterinic acid. More testing is required to identify these compounds.

<u>CLADONIA BELLIDIFLORA</u> (Ach.) Schaer., Lich. Helv. Spic.:21.1823. <u>Lichen bellidiflorus</u> Ach., Lich. Suec. Prod.:194. 1798.

<u>Primary thallus</u> squamulose. Squamules often abundant, compacted in mats; slightly yellowish-green.

<u>Secondary thallus</u> fruticose, podetiate. Podetia 1.5-4.5 cm tall, 0.8-2.0 mm wide, forming small, nonperforate cups, moderately to abundantly covered in squamules; surface corticate at base and often at apex if apothecia present, remainder quickly becoming decorticate (although not obviously so if thickly squamulate), with minute vertical striations; light green, deep olive buff, sea-foam yellow, with bases often yellower.

<u>Apothecia</u> occasional, terminal on subulate proliferations from cup or apparently replacing cup, 1.0-3.5(-6.0) mm wide. Disc red, initially plane becoming strongly convex. Spores not observed.

Pycnidia occasional, on rim of cup, red and then blackening.

<u>Spot Tests</u>: K-, P- (occasionally + faint sordid yellow); C-.

<u>Substratum/Habitat</u>: terricolous, among moss on thin soil over bedrock at exposed locations.

Selected Specimens: 3661, 5344.

Local Abundance and Distribution: infrequent; scattered along the western border of the CDFD subzone and adjacent zones especially at higher, exposed, inland sites.

World Distribution: tentatively circumarctic-alpine with oceanic boreal

extensions; typically reported as circumarctic-circumtemperate (Krog, 1968) or circumarctic-circumboreal (Thomson, 1979); Ahti (1977) described it as oceanic-boreal in three out of four regions in the Northern Hemisphere (presumably absent in eastern North America), however, it has been reported from Greenland (Lynge & Scholander, 1932); also reported from Argentina in the Southern Hemisphere (Grassi, 1950).

CLADONIA CARASSENSIS Vain., Acta Soc. F. Fl. Fenn. 4:313. 1887.

Cladonia japonica Vain., Nouv. Arch. Mus. Hist. Nat. 3(10):265. 1898.

Primary thallus squamulose. Squamules inconspicuous, scattered.

<u>Secondary thallus</u> oc tiate. Pode 16-26 mm high, 0.4-0.8 mm wide, commonly dilating to form cups or occasionally dichotomously branched and subulate; cups 1.5-2.5 mm wide, open, with margin inrolled to form a thick lip, the rim dentate or with stubby proliferations that grow either at a horizontal slant or \pm upright, occasionally forming another series of cups; squamules absent or occasional; surface continuously corticate, smooth to verruculose to areoles separate with darkening interstices, \pm shiny, appearing rather thick and \pm leathery; brown, pale olive-buff towards base in one collection.

<u>Apothecia</u> occasional, numerous on rim of cup or on short proliferations, up to 0.6 mm wide. Disc plane, not observed to become convex; flexuous, dark brown to almost black. <u>Spores</u> 8 per ascus, narrowly ellipsoid, 10 X 2.5-3.0 μ m.

Pycnidia on rim of cup, or terminal on subulate podentia; black.

Spot Tests: thallus P+ red, K+ yellow.

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<u>Substratum/Habitat</u>: terricolous; collected twice on thin soil over rock. Selected Specimens: 5315, 5386.

Local Abundance and Distribution: rare; collected once on an exposed

island off Victoria (Discovery Island) in the southern part of the CDFD subzone, and, also once in an adjacent zone.

<u>World Distribution</u>: uncertain; tentatively western North America-eastern North America-Europe-eastern Asia; Thomson (1968)suggested it is pantemperate in both the Northern and Southern Hemispheres, however, for North America mention is made of only east coast and west coast locations; Brodo (1968) classed it as part of the "Tropical, oceanic element"; it has been reported from the High Tatras of Europe (Poelt, 1969) and subsp. <u>japonica</u> has been reported from Japan (Yoshimura, 1974); in the Southern Hemisphere it has been reported from South America and New Zealand (Martin & Child, 1972).

<u>Remarks</u>: There has been some discussion as to whether the North American material referred to <u>C</u>. <u>carassensis</u> is actually the same species as Vainio described from Brazil. Evans (1950) stated he was "inclined to accept the views of Vainio and Sandstede that the specimens from Massachusetts...belong to the same species as the plants from Brazil". He did place, however, the eastern North American collections in a separate variety and the California material in another. Krog (1968) expressed the opinion that the North American material was different from <u>C</u>. <u>carassensis</u>, resurrecting <u>C</u>. <u>japonica</u>, which Asahina had reduced to synonymy, to accommodate western North American material which she suggested was probably also different from eastern North American collections. Thomson (1967c) followed Evans, maintaining the North American material as different varieties from the South American material but within C. carassensis.

<u>CLADONIA</u> <u>CARIOSA</u> (Ach.) Spreng., Syst. Veg. ed. 16., 4:272. 1827. <u>Lichen</u> <u>cariosus</u> Ach., Lich. Suec. Prodr.:198. 1798.

<u>Primary thallus</u> squamulose. Squamules persistent.

Secondary thallus podetiate. Podetia 0.6-1.8 cm high, 0.8-1.8 mm wide,

simple to several-branched, usually somewhat flattened, often contorted; surface usually striate from both the areoles cracking in a vertical direction to actual vertical cracks into the hollow center which often exposes vertical medually strands; usually terminating in apothecia; olive-grey, glaucous-green

<u>Apothecia</u> common and abundant, terminal on podetia , 0.6-3.4 mm wide. Disc highly convex, light to dark brown. <u>Spores</u> not observed.

Pycnidia observed only once on primary squamules, black.

Spot Tests: thallus P+ orange; K+ yellow.

Substratum/Habitat: terricolous; collected directly on soil.

Selected Specimens: 2546, 4646.

Local Abundance and Distribution: infrequent; concentrated toward the western boundary of the CDFD subzone; not collected on the southern Gulf. Islands; also present in the adjacent zones.

<u>World Distribution</u>: (circumarctic-)circumboreal in the Northern Hemisphere (Thomson, 1967c; Ahti, 1964); also present in New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks: C. cariosa</u> sens. str. contains only atranorin which is responsible for the K+ yellow spot test. The P spot test is variously described as P- (Thomson, 1967c; Ahti, in Poelt & Vézda, 1977) and P+ yellow (Duncan, 1970; Hale, 1979). Ahti also reported a P+ yellow turning orange population from Europe that contains fumarprotocetraric acid. Other species in the complex, known primarily from the eastern half of the continent in North America, have been reported on by Culberson (1969).

CLADONIA CARNEOLA (Fr.) Fr., Lich. Eur. Ref.: 223. 1831.

Cenomyce carneola Fr., Sched. Crit.:23. 1824.

Primary_thallus_squamulose. Squamules few, persistent on not; concolor-

ous with the podentia.

<u>Secondary thallus</u> podetiate. Podetia 6-10 mm high, 0.7-1.7 mm wide, scyphiferous, either quickly and gradually flaring into cups, or later and abruptly flaring into cups; cups 2-4 mm wide, closed, margin even or dentate, often sloping or slightly irregular; corticate at the base, otherwise entirely farinose sorediate; decorticate areas white fibrous or becoming clear and almost transparent; esquamulate; yellow, pale yellow, or olive-buff.

<u>Apothecia</u> not observed. According to Thomson (1967c) the apothecia are pale yellowish or pale brown, borne directly on the margin of the cup or on short proliferations from the cup center or margin, up to 6 mm wide.

<u>Pycnidia</u> black, on rim of cups or on slight proliferations from margin of cups.

Spot Tests: thallus K-, C-; P-.

Substratum/Habitat: terricolous; collected among mosses.

Local Abundance and Distribution: infrequent; collected only in the northern part of the CDFD subzone and adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Thomson, 1967c); however, Yoshimura (1968a, 1974) stated it is absent from Japan and adjacent areas; reported from New Zealand (Martin, 1966) and Argentina (Grassi, 1959) in the Southern Hemisphere.

<u>CLADONIA CERVICORNIS</u> subsp. <u>VERTICILLATA</u> (Hoffm.) Ahti , Lichenologist 12:126. 1980.

<u>Cladonia pyxidata</u> (tax. vag.) <u>C</u>. <u>verticillata</u> Hoffm., Deutschl. Fl. 2:122. 1796.

<u>Cladonia verticillata</u> (Hoffm.) Schaer., Lich. Helv. Spicil.:31. 1823. <u>Primary thallus</u> squamulose. Squamules few, persistent or not. <u>Secondary thallus</u> podetiate. Podetia 2-4(-11) cm high, 0.7-1.2 mm

wide, forming closed cups, 3-5 mm wide, proliferating centrally one or more times to form additional series of cups; squamules absent or a few borne basally and also occasional at the base of subsequent proliferations; surface corticate, <u>+</u> smooth with slightly dispersed areoles but dull, not shiny, almost arachnoid in some cases; light olive-grey, glaucous-green.

<u>Apothecia</u> common, on the rim of the cups, up to 0.6 mm wide. Disc light brown, becoming convex. <u>Spores</u> (6-) 8 per ascus, hyaline, 10 X 2.5 µm.

Pycnidia not observed.

Spot Tests: thallus P+ red, K-.

<u>Substratum/Habitat</u>: terricolous; collected on soil among moss. Selected Specimen: 2774.

Local Abundance and Distribution: rare; collected only in the northern part of the CDFD subzone and adjacent zones, primarily at inland locations.

<u>World Distribution</u>: (circumarctic-)circumboreal in the Northern Hemisphere; also reported from Australia (Weber & Wetmore, 1972), New Zealand (Martin, 1966), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: <u>C</u>. <u>cervicornis</u> subsp. <u>verticillata</u> is commonly distinguished by the single character of central proliferations rather than marginal proliferations. It should be noted that one local specimen of <u>C</u>. <u>gracilis</u> was unusual in possessing mainly central proliferations as well as occasional marginal and podetial, proliferations. On the basis of the robust podetia, smooth and shiny cortex, with lacerations in the outside of the cups, T. Ahti determined the specimen as C. gracilis.

Ahti (1980b) stated that, although after observing <u>C</u>. <u>cervicornis</u> and <u>C</u>. <u>verticillata</u> in the field and believing them to be genetically distinct, more study is necessary to determine if the two taxa are indeed distinct. Since it is entirely possible that the taxa are not sharply delimited from each other, and, since the identification of herbarium material remains a current problem hesuggested temporarily regarding them as subspecies of the same species.

<u>CLADONIA COCCIFERA</u> (L.) Willd., Fl. Berolin.:361. 1787. Lichen cocciferus L., Sp. Pl.:1151. 1753.

Primary thallus squamulose. Squamules small to medium-sized, compact.

<u>Secondary</u> thallus podetiate. Podetia 6-10(-14) mm high, 1.0-1.5(-3.0) mm wide, expanding early into <u>+</u> stout cups, 2.5-7.0(-11.0) mm wide; cups closed, <u>+</u> even rimmed although one side sometimes lower, causing cups to appear slanted; covered with areoles which are smooth and continuous to more commonly dispersed and slightly bulging or even loose, leaving large areas decorticate; <u>+</u> basal squamules; olive-buff, yellow glaucous, yellow.

<u>Apothecia</u> common, although often inconspicuous on the rim of the cup or on short marginal projections, 0.6-4.0 mm wide. Disc bright red and blackening in some collections, becoming convex. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, 8-10 X 2.0-2.5 µm.

Pycnidia not observed.

Spot Tests: thallus K-, C-, P-.

Substratum/Habitat: terricolous; on thin soil over bedrock.

Selected Specimens: 1607, 4163.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone and adjacent zones, especially at inland sites.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>CLADONIA</u> <u>CONIOCRAEA</u> (Floerke) Spreng. s. lat.,Syst. Veget., ed. 16,4:272. 1827. <u>Cenomyce coniocraea</u> Floerke, Deutsche Lich. 7:14. 1821 Cladonia ochrochlora Floerke, Clad. Comment 1:75. 1828.

<u>Primary thallus</u> squamulose. Squamules moderate to abundant, <u>+</u> marginally sorediate, usually persistent.

Secondary thallus podetiate. Podetia 6-26 mm high, 0.6-1.2(-2.0) mm wide, subulate or occasionally forming small, shallow cups, 1.2-1.5 mm wide, not or only slightly wider than the podentia, \pm entirely covered with farinose soredia, only the base corticate; squamles absent to occasionally basal; greenish-grey, yellowish-green, pale olive buff.

Apothecia not observed (see below).

Pycnidia occasionally present, terminal, brown.

Spot Tests: thallus P+ red, K- or + sordid yellow.

<u>Substratum/Habitat</u>: terricolous or lignicolous; often directly on soil or on very rotten wood, or among moss.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones, but more common towards the western boundary, especially at inland sites.

<u>World</u> <u>Distribution</u>: circumboreal-circumtemperate in the Northern Hemisphere (Ahti, 1964).

<u>Remarks</u>: <u>C. coniocraea</u> auct. and <u>C. ochrochlora</u> Floerke are very similar taxa whose exact limits and distinctiveness is unclear (Ahti, in Poelt & Vézda, 1977). <u>C. coniocraea</u> is described as completely sorediate except at the very base, mostly 1-3 cm high, the tips <u>+</u> pointed or with very small, sorediate cups. <u>C. ochrochlora</u> is very similar but stouter and taller up to 7 cm tall, with scattered sorediate and corticate areas, normally terminating in a single cup that is corticate on the inside. Most of the local material (description above) seems intermediate, being entirely sorediate, usually even inside the cups, but too stout (although not too tall) and ending too often in blunt tips (rather than pointed ends) or cups to be considered as <u>C</u>. <u>coniocraea</u> auct. This material is, therefore, closer to <u>C</u>. <u>ochrochlora</u> and was so identified by T. Ahti. There was also a small number of specimens (not described above) which were clearly <u>C</u>. <u>ochrochlora</u>, being up to 6 cm tall, 2 mm wide, forming irregular cups with marginal, subulate projections and the farinose sorediate areas interspersed with corticate areas. These two extremes are illustrated in Ozenda & Clauzade (1970, p. 459). There are thus two forms of <u>C</u>. <u>ochrochlora</u> present commonly in the study area; <u>C</u>. <u>coniocraea</u> auct. has not yet been found locally.

Because of the difficulty with the local material, and also because of uncertainty of the distinctiveness of the taxa they have been united here following the nomenclature suggested by Ahti (1980b). Ahti (op. cit.) also noted that <u>C</u>. <u>coniocraea</u> (Floerke) Spreng. s. str. was the correct name for <u>C</u>. <u>ochrochlora</u> although this could be set aside under Article 69 in the Leningrad Code, as it would cause too much confusion. Pending the typification of some of the older species epithets no name was readily available for C. coniocraea auct.

A single specimen collected on rotting wood in the Victoria area (UBC-#1877) was originally determined as <u>C</u>. <u>caespiticia</u> (Pers.) Floerke, rather reluctantly by T. Ahti, since the collection was very limited in amount and since <u>C</u>. <u>caespiticia</u> is usually considered restricted to eastern North America. Very similar but abundant material from the wetter interior areas of the province was recently identified by T. Ahti as very reduced <u>C</u>. <u>coniocraea</u>. The local Victoria specimen has also been referred to C. coniocraea now.

CLADONIA CORNUTA (L.) Hoffm., Plant. Lich. 1:pl. 25. 1791.

Lichen cornutus L., Sp. Pl.:1152. 1753.

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Primary thallus squamulose. Squamules few, + disappearing.

<u>Secondary thallus</u> podetiate. Podetia 2-5 cm high, 0.75-1.5 mm wide, simple or branched once or twice near base with one branch remaining small; <u>+</u> tapering straight to a point, occasionally bent or distorted slightly; surface smoothly corticate near base, scattered punctate soralia occurring mid-podentia, increasing in size with the final one-quarter of mature podentia entirely dissolved in farinose soredia; <u>+</u> occasional vertical cracks through medulla into hollow center; drab, greenish-brown, buffy-brown, the sorediate areas often browning.

Apothecia and pycnidia not observed.

<u>Spot Tests</u>: thallus P+ red, K<u>+</u> yellow (caused by large amounts of fumarprotecetraric acid, according to Thomson, 1968).

Substratum/Habitat: terricolous; collected among moss.

Selected Specimen: 4996.

Local Abundance and Distribution: rare; collected once in the northern part of the CDFD subzone at a maritime site, not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Ahti, 1977); also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1952) in the Southern Hemisphere.

<u>Remarks</u>: There were two very slight cup-like structures produced in the lone collection which were perforate. Axils near the basal branches were not perforate. However, this condition of the perforate cups, combined with the more noticeable vertical podential cracks, would key the local material to C. farinacea, which is known from Alaska (Krog, 1968), if it were not for the lack of jursolic acid. A collection of <u>C</u>. <u>cornuta</u> from Tsawassen, near Vancouver, which was identified by T. Ahti, also possessed several cups, the older of which were perforate.

CLADONIA ECMOCYNA Leight., Ann. Mag. Nat. Hist., ser. 3, 18:406. 1866.

Primary thallus squamulose. Squamules scarce, + disappearing.

<u>Secondary thallus</u> podetiate. Podetia: 2-5 cm high, 0.9-1.5 mm wide, \pm unbranched, squamules absent or scattered on lower and mid-parts of podentia; tapering to \pm sharp points, cupless in the local collections (see below); podentia surface smooth, \pm shiny, below with algae often clustered, in some cases becoming dispersed-areolate, especially near apices, and here the exposed medullary tissue \pm lightly pruinose; olive-brown, olive-grey, bluish-grey, purplish grey.

Apothecia and pycnidia not observed.

Spot Tests: thallus P+ orange-red, K+ yellow.

<u>Substratum/Habitat</u>: terricolous; collected among moss at exposed, inland locations.

Selected Specimens: 4671, 5509.

Local Abundance and Distribution: infrequent; collected at inland, higher elevations (above 260 m) at exposed locations both inside the CDFD subzone and in the adjacent zones.

<u>World Distribution</u>: <u>C</u>. <u>ecmocyna</u> sens. lat. is probably circumarcticalpine in the Northern Hemisphere plus present in the Andes and Patagonia in South America and Australia in the Southern Hemisphere (Ahti, 1980a). Ahti has expressed some reservation about it being continuously circumpolar suggesting that it may be oceanic and absent from continental areas, except from alpine localities.

Remarks: Ahti (1980a) divided C. ecmocyna into two subspecies, subsp.

intermedia (Robbins) Ahti and subsp. <u>ecmocyna</u>. The latter is characterized by 6-10 cm tall podetta that are not regularly scyphiferous and with squamules lacking or scarce. It is essentially an arctic-alpine soil taxon found in northern Europe, North America, and Australia. It is not known with certainty from British Columbia although its presence is predicted in the northernmost parts. Subsp. <u>intermedia</u> has 3-6 cm tall podetta that are both richly scyphiferous and squamulose. It is more common on soil and decaying wood in forest and alpine areas of western North America. Despite the lack of cups, this is the subspecies into which the local material falls.

<u>C. ecmocyna</u> can be separated from the local <u>C. gracilis</u> by the presence of atranorin (K+ instantly clear yellow) as well as the "pruinose and dull (never glossy) surface, the mineral-grey colour of the living part, and the ochraceous yellow colour of the dead part" (Ahti, 1980a) which in fresh material is K+ purplish.

Author citation follows Ahti (1978, 1980a).

CLADONIA FIMBRIATA (L.) Fr., Lich. Eur. Ref.:222. 1831. Lichen fimbriatus L., Sp. Pl.:1152. 1753.

<u>Primary thallus</u> squamulose. Squamules abundant to scarce, small, usually crowded, + sorediate on the margins.

<u>Secondary thallus</u> podetiate. Podetia unbranched, 0.8-2.0 cm tall, 0.5-1.5(-2.0) mm wide, flaring moderately to rapidly near the apex to form a cup; cups 2-4(-6) mm wide, closed with even margin or sometimes dentate, occasionally proliferating from the margin; squamules absent, or small ones occasional near base; entire podetia fincluding interior of cup covered in farinose soredia, becoming decorticate after soredia are lost; green, greyish olive, or olive grey.

Apothecia uncommon, terminal on subulate proliferations from rim of cup

or sessile on rim, 2-3 mm wide. Disc light brown. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, 8-10 X 2-2.5 µm.

Pycnidia not common, black, on rim of cup.

Spot Tests: thallus P+ red, K- (or + sordid yellow).

<u>Substratum/Habitat</u>: terricolous and lignicolous; on soil or among moss, also among moss at the base of trees and over stumps.

Selected Specimens: 209, 514.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones, at both maritime and inland sites.

<u>World Distribution</u>: (circumboreal-)circumtemperate in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere previously considered cosmopolitan based on a broader definition of the species (Thomson, 1967c).

<u>Remarks</u>: <u>C</u>. <u>fimbriata</u> is similar to <u>C</u>. <u>coniocraea</u> sens. lat., but the former has a distinctly flared cup and is entirely covered in soredia.

CLADONIA GRACILIS (L.) Willd., Fl. Berol.: 363. 1787.

Lichen gracilis L., Spec. Pl.:1152. 1753.

<u>Primary thallus</u> squamulose. Squamules disappearing or persistent only around the podentia.

Secondary thallus podetiate. Podetia 2-4(-7) cm tall, 1-1.5 mm wide, flaring abruptly near the top to form cups or occasionally without cups; cups 2-5(-9) mm wide, not perforate although the external surface of the cups is often minutely cracked; frequently proliferating from the margin of the cups; squamules scarce to abundant on podetia: and cups, sometimes absent; surface commonly smooth or the algae clustered to form slight areoles, \pm glossy; green, greyish olive, olive brown, with the interior of the cups often darker, basal areas completely blackened or not blackened at all.

<u>Apothecia</u> common, borne on proliferation from the margins of the cups or replacing or greatly distorting cups, 0.8-6.0 mm wide. Disc light to dark brown, usually convex. <u>Spores</u> 8 per ascus, hyaline, narrowly ellipsoid, 8-9 X 2-2.5 µm.

<u>Pycnidia</u> usually present, abundant, sessile on rim of cup or on short, stubby projections; black.

Spot Tests: thallus P+ red, K- (or + sordid yellow).

<u>Substratum/Habitat</u>: terricolous; on soil usually among moss, occasionally on rotting logs.

Local Abundance and Distribution: frequent; especially concentrated on the western boundary and in the northern part of the CDFD subzone, commonly at inland or exposed sites; more common in the adjacent zones.

<u>World Distribution</u>: circumboreal (-circumtemperate) in the Northern Hemisphere (Ahti, 1980a).

<u>Remarks</u>: The local material falls within subsp. <u>turbinata</u> (Ach.) Ahti which is the most widespread of the subspecies. In subsp. <u>turbinata</u> most of the podetia become fairly large cupped and are shorter, stouter, and often squamulose compared to the other subspecies.

<u>C. gracilis</u> is morphologically similar to <u>C. ecmocyna</u>. See that species for comments. Ahti (1980a)pointed out that it can be confused with <u>C. cervicornis</u> subsp. <u>verticillata</u> and <u>C. phyllophora</u> although both of the last two species lack the smoother, glossy surface of <u>C. gracilis</u>. Indeed, two of the local collections of <u>C. gracilis</u> had central proliferations, which in most keys would result in their identification as <u>C. cervicornis</u> subsp. <u>verticill</u>-ata.

Two collections from exposed hilltop sites were unusual in their smallness (< 2 cm) as well as a slightly atypical colouration compared to the usual

<u>C. gracilis</u> collections. It may represent an undescribed taxon (Ahti, pers. comm.) The problem requires further study.

CLADONIA HERREI Fink ex Hedrick, Mycologia 26:157. 1934.

<u>Primary thallus</u> squamulose. Squamules up to 8 mm long, digitate, a few scattered around the podetia or disappearing.

Secondary thallus podetiate. Podetia up to 10 cm tall, 1-1.5 mm wide. terete at base; cupless; ramifying towards the apices, in sterile condition. (unusual) branching isotomic dichotomous with few branches, in fertile condition (usual) then branching tending towards anisotomic dichotomous with branching then usually abundant, with pycnidia the branching ranging from isotomic dichotomous to more often in whorls; axils usually open with edges inrolled; upper parts of fertile podetia lacerate along the adaxial side of the major and minor branches with branches becoming flattened, lacerations + increasing towards the apices; surface of the podetia varying from + smooth with fine cracks that become separated into thin areoles leaving the interstices initially white pruinose or webby (see following) or, especially if the areoles are thicker or verruculose, then the edges raising up and minutely squamulose throughout the entire podetion ; squamules usually present, few towards the apices increasing towards the base, in some forms very abundant and large; in light coloured forms the exposed white interstices clear towards the base, becoming the + shiny, transparent cartilaginous inner medullary layer, which is also visible through the lacerations; in darker coloured forms the exposed inner medulla usually browns faster towards the base than the surrounding areoles and in the few dying basal portions observed turns black first, creating a spotted effect; pale greenish, greenish-brown, to brown in exposed forms, sometimes variegated.

Apothecia common, abundant, in groups at the apices, usually one per

branchlet, 0.2-0.7(-1.5) mm wide. Disc light brown, sometimes medium (reddish-)brown, occasionally blackened; very convex, <u>+</u> translucent, usually smooth, sometimes conglomerate or tuberculate, not perforate. <u>Spores</u> 8 per ascus, 12-13 X 2.5-3 μ m.

<u>Pycnidia</u> not uncommon, on lower branches of fertile podetia or more commonly apical on podetia lacking apothecia; one per branchlet, in whorls or grouped branchelets; obovoid; black.

Spot Tests: thallus P+ red, K+ sordid yellow.

<u>Substratum/Habitat</u>: terricolous; on the ground among mosses or over rotting logs especially in shaded or partially shaded locations.

Selected Specimens: 206, 2676.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: western North American endemic; described from California.

<u>Remarks</u>: The exact status of <u>C</u>. <u>herrei</u> is uncertain. It falls between <u>C</u>. <u>furcata</u> and <u>C</u>. <u>multiformis</u> with some forms coming close to <u>C</u>. <u>scabriuscula</u>. The <u>C</u>. <u>furcata</u> group is in need of revision and the final placement of <u>C</u>. <u>herrei</u> must await such a study.

The local material seems closest to, yet decidedly sep rate from, <u>C. multiformis</u>. The latter initially produces well-formed cups that may secondarily proliferate to form more cups or ramifying subcylindrical branches (Merrill, 1909). It is the secondarily produced branches of <u>C. multiformis</u> that <u>C. herrei</u> resembles, especially the fertile forms. The local material never produces cups, only slight dilations of the axils which are not at all cup-like. Thomson (1967c) stated that the most characteristic feature of <u>C. multiformis</u> is the sieve-like perforation membranes formed inside the cups. The lacerations of the podentia in <u>C. herrei</u>, occurring primarily on the fertile podentia, are not sieve-like although when frequent with thin cortical and/or medullary connections they can appear ladder-like but these occur only at the internodes. Evans (1909) emphasized that the apothecia are often perforate in <u>C</u>. <u>multiformis</u>, a condition not observed in <u>C</u>. <u>herrei</u>. He also described the cortex as continuous or areolate. Yoshimura (1968a) also described the cortex as continuous. The cortex of <u>C</u>. <u>herrei</u>, on the other hand, was described as "subcontinuous to chinky or rough and subareolate" (Hedrick, 1934). Indeed the local material never has a continuous cortex and the sterile podentia even have a decidedly rougher surface, and combined with the tendency towards isotomic dichotomies, strongly resemble <u>C</u>. <u>scabriuscula</u>. However, the cortical roughness occurs throughout the podetia _and, an isidiate-sorediate condition never develops in the apical portions as is characteristic of <u>C</u>. <u>scabriuscula</u>. In the local <u>C</u>. <u>herrei</u> even the 'sterile' podetia typically have abundant pycnidia and a few apothecia are also often present.

<u>C. furcata</u> is usually described as having a smooth cortex so it is also unlike the local material in that character. <u>C. herrei</u> has a strong resemblance to <u>C. furcata</u> var. <u>furcata</u> f. <u>fissa</u> (<u>sensu</u> Thomson, 1967c) which has branches strongly split lengthwise and typically in fertile condition. Most of the local <u>C. herrei</u> was abundantly fertile, a condition in which both <u>C. furcata</u> and <u>C. scabriuscula</u> are rarely found.

It should be noted that Yoshimura (1968a) reduced <u>C</u>. <u>herrei</u> to synonymy with <u>C</u>. <u>multiformis</u>. (This suggests that <u>C</u>. <u>herrei</u> could be amphi-Pacific.) Tucker and Jordan (1978) followed this synonymy in their <u>Catalog of California</u> <u>Lichens</u>. However, the local material seems distinct from <u>C</u>. <u>multiformis</u> as well as <u>C</u>. <u>scabriuscula</u> and <u>C</u>. <u>furcata</u> and so has been kept separate as <u>C</u>. <u>herrei</u>. Its final disposition, however, awaits revision of the <u>C</u>. <u>furcata</u> group. <u>C. herrei</u> is reported here as new to the province. Earlier reports of <u>C. multiformis</u> and <u>C. furcata</u> from coastal British Columbia are actually this species. <u>C. furcata</u> is not known with certainty from the province; <u>C. multiformis</u> is known to occur in the interior.

CLADONIA MACILENTA Hoffm., Deutschl. Fl. 2:126. 1796.

<u>Primary thallus</u> squamulose. Squamules occasionally few but usually abundant, often sorediate.

<u>Secondary thallus</u> podetiate. Podetia. 7-20 mm high, 0.5-1.0(-2.0) mm wide, subulate, without cups; corticate at base with remainder of podetia covered in farinose soredia; occasionally with basal squamules; medium grey, yellowish glaucous grey.

<u>Apothecia</u> common, usually present, terminal, single or several, 0.6-2.6 mm wide. Disc red, usually convex, often cracked or contorted. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, 10-11 X 3 μ m.

<u>Pycnidia</u> common, often present; on primary squamules or occasionally terminal on podetia; black with a red ostiole.

Spot Tests: thallus P+ orange, K+ yellow.

<u>Substratum/Habitat</u>: corticolous and lignicolous; confined to the base of living trees when corticolous, more abundant on rotting wood, especially conifer stumps and logs.

Selected Specimens: 382, 2882.

Local Abundance and Distribution: (circumboreal-)circumtemperate in the Northern Hemisphere (Ahti, 1964); also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks: C. theiophila</u> Asah. has been reported from Saltspring Island (Bird & Bird, 1973). It contains usnic acid while <u>C. macilenta</u> s. str. does not. <u>C. theiophila</u> has been treated as a subspecies of <u>C</u>. macilenta (Thomson, 1967c; Evans, 1955), included in <u>C</u>. <u>flabelliformis</u> (Floerke) Vain. (=<u>C</u>. <u>polydactyla</u>) (Asahina, 1970, 1971), and separated as its own species (Yoshimura, 1968a; Ahti, 1974). Ahti (1974) pointed out <u>C</u>. <u>theiophila</u> and <u>C</u>. <u>vulcani</u> were the same species, with the latter being the earlier, and therefore correct, name. In eastern Asia, from which both species were described, the habitat is almost exclusively in the immediate vicinity of hot springs while the habitat of the <u>C</u>. <u>theiophila</u> reported from Washington and British Columbia is lignicolous or corticolous at the base of trees. The identity of the local taxon included in C. vulcani requires further study.

Besides its possession of usnic acid, <u>C</u>. <u>vulcani</u> differs from <u>C</u>. <u>macilenta</u> in its frequent fertility and in the taller, more branched podentia.

<u>CLADONIA PHYLLOPHORA</u> Ehrh. ex Hoffm., Deutschl. Fl. 2:123. 1796. Cladonia degenerans (Floerke) Spreng., Syst. Veg. 4:273. 1827.

Primary thallus squamulose. Squamules few, disappearing.

<u>Secondary thallus</u> podetiate. Podetia 3.5-8 cm high, 0.5-1.75 mm wide, forming cups; cups 1-2 mm wide or larger and very irregular, the sides occasionally irregularly split with the occasional break inside the cup but otherwise imperforate; several to many proliferations arising from the cup margins, forming new cups or not; cortex of grouped to scattered areoles which are <u>+</u> dull, sometimes appearing arachnoid with exposed medulla white and fibrous, darkening slightly to blackening before the areoles especially at the base; squamules scattered along the podentia; pale grey, pale olive-grey.

<u>Apothecia</u> occasional, terminal or on projections from rim of cup, up to 2 mm wide. Disc light to medium brown, convex. <u>Spores</u> not observed.

Pycnidia on subulate projections from cup rim or directly on rim of cup;

brown to black.

Spot Tests: thallus P+ red, K-.

<u>Substratum/Habitat</u>: terricolous; collected among moss and <u>Selaginella</u> over exposed rock.

Selected Specimens: 3923, UBC-L 3130.

Local Abundance and Distribution: rare; collected only in the southern part of the CDFD subzone, once inland at higher elevation and once at a maritime location; not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Ahti, 1977); also reported as <u>C</u>. <u>degenerans</u> from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972) and Argentina (Grassi, 1950) in the Southern Hemishpere.

<u>Remarks</u>: The appearance of the podentia surface is best described as 'chalky'.

CLADONIA PYXIDATA (L.) Hoffm., Deutschl. Fl. 2:121. 1796.

Lichen pyxidatus L., Sp. Pl. 2:1151. 1753.

<u>Primary thallus</u> squamulose. Squamules small and compact, up to 8 mm long, irregularly lobed, quite thick, esorediate, persistent.

<u>Secondary thallus</u> podetiate. Podetia 0.8-1.6 cm high, 0.75-1.0 mm wide, flaring into cups; cups 3-4 mm wide, the margins even or more commonly with stubby marginal proliferations; covered with contiguous to dispersed verruculose areoles; \pm a few basal squamules; olive grey, pale greyish-olive, green, to yellowish glaucous.

<u>Apothecia</u> common, numerous on short subulate proliferations from margin of cup, 0.5-2.2 mm wide. Disc light to medium brown, becoming very convex and split. Spores 8 per ascus, hyaline, ellipsoid, 10-13 X 2.5-3 µm.

Pycnidia not observed.

Spot Tests: thallus K-, P+ red.

<u>Substratum/Habitat</u>: terricolous and lignicolous; collected <u>+</u> directly on soil and also on wood lying on the ground.

Selected Specimens: 360, 1105.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: (circumarctic-)circumboreal(-circumtemperate) in the Northern Hemisphere; also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>CLADONIA SQUAMOSA</u> (Scop.) Hoffm., Deutschl.Fl. 2:125. 1796. <u>Lichen squamosus</u> Scop., Fl. Carn. ed. 2., 2:368. 1772. Cladonia subsquamosa (Nyl.) Vain., Acta Soc. F. Fl. Fenn. 4:445. 1887.

<u>Primary thallus</u> squamulose. Squamules digitately lobed, incised and elongated, up to 6 mm, \pm ascending, esorediate; presistent or disappearing.

<u>Secondary thallus</u> podetiate. Podetia 1.5-5 cm high, 0.9-2.0 mm wide, subulate or forming cups; cups narrow, shallow, open, with one or more proliferations from margin, proliferations often short and rimming cup; squamules abundant, incised, small to large, covering most of podentia or \pm restricted to one side; surface occasionally with dispersed, often verruculose areoles, more often becoming ecorticate over large areas with commonly white, sometimes browning, medullary tissue showing; white, pale grey, pale olive buff.

<u>Apothecia</u> common, terminal in groups, on short proliferations from rim of cup or directly on cup, 0.4-1.3 mm wide. Disc light to dark brown, finally convex. <u>Spores</u> 8 per ascus, hyaline, 10-12 X 2.5 µm.

Pycnidia terminal; on rim of cup, brown or black.

Spot Tests: thallus P-, C-, UV+ white (2 specimens); thallus P+ orange,

K+ yellow, UV- (41 specimens).

<u>Substratum/Habitat</u>: terricolous and lignicolous; collected among moss and <u>Selaginella</u> on thin soil over bedrock, also on stumps, logs, and fence posts.

Selected Specimens: 351, 5526.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both inland and maritime sites; also in adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere; also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: There are two varieties of <u>C</u>. <u>squamosa</u> present among the local material, var. <u>squamosa</u> containing squamatic acid (P-, K-, UV+) and var. <u>subsquamosa</u> containing thamnolic acid (P+, K+, UV-). Practically all the material collected was var. <u>subsquamosa</u>; var. <u>squamosa</u> was collected in the adjacent CDFW subzone but not in the CDFD subzone. <u>C</u>. <u>squamosa</u> var. <u>subsquamosa</u> has often been treated at the species level but since morphological differences are lacking, Ahti (1978) believed that the chemical difference may be of little taxonomic or evolutionary significance and, therefore, it is better treated as a chemical strain of <u>C</u>. <u>squamosa</u>. Ahti (op. cit.) stated that the nomenclature and taxonomy of var. <u>subsquamosa</u> is extremely complicated and an epithet change probably will be needed in the future.

In the local material the uneven proliferation from the small cup causes distortion until the cup resembles more of a gaping hole in the podetia . Again, when apothecia are abundant, the podetia appear distorted so that cups are not easily identified although perforations of the 'axils' still exist.

<u>CLADONIA SUBULATA</u> (L.) Wigg, Prim. Fl. Holsat.:90.1780. <u>Lichen subulatus</u> L., Sp. Pl.:1153. 1753.

Primary thallus squamulose. Squamules few or disappearing.

<u>Secondary thallus</u> podetiate. Podetia 2-4(-5) cm high, 1.0-1.8 mm wide, subulate or more commonly cup forming; cups closed, 1.5-6.0 mm wide, often sloped or irregular, dentate with several marginal proliferations which in some cases form small cups; entire surface including interior of cups farinose sorediate becoming decorticate; squamules basal or absent; sorediate areas buff to yellow-grey, ecorticate areas white-grey.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Thomson (1967c) the apothecia are rare, brown or reddish-brown, sessile on the margins of cups or stipitate on the margins or terminal on the subulate podetial; pycnidia also on the margins of the cups or topping the podetial.

Spot Tests: thallus P+ red, K-.

<u>Substratum/Habitat</u>: terricolous; collected once on soil among mosses. <u>Selected Specimen</u>: 1590.

Local Abundance and Distribution: rare; collected once inland at a higher elevation (300 m) in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: (circumarctic-)circumboreal in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972) in the Southern Hemisphere.

<u>Remarks</u>: The single local collection was at first reluctantly referred to <u>C</u>. <u>fimbriata</u> because of its distinct cups and the farinose soredia. However, the large size plus abundant marginal proliferations finally led to ______ <u>C</u>. <u>subulata</u>. Because of the cups, it will not key out as this species in Thomson (1967c), a problem already pointed out by Ahti (1968).

This specimen also is similar to some forms of <u>C</u>. <u>coniocraea</u> s. lat., namely the <u>C</u>. <u>ochrochlora</u> forms, but the cups are not corticate as in that species.

<u>C</u>. <u>subulata</u> can grow much larger than the single local collection, up to 10 cm according to Thomson (1967c). He described the coloration as "white to ashy or pale glaucescent or with brownish variegation", and it is on the larger size and colour that he separated <u>C</u>. <u>subulata</u> from the <u>C</u>. <u>coniocraea</u> s. lat. group.

CLADONIA TRANSCENDENS (Vain.) Vain., Nouv. Arch. Mus. Hist. Nat. III. 10:262. 1898.

<u>Cladonia corallifera</u> var. <u>transcendens</u> Vain., Acta Soc. F. Fl. Fenn. 4:179. 1887.

Primary thallus squamulose. Squamules few to abundant, elongate, digitate, up to 9 mm long; usually persistent.

<u>Secondary thallus</u> podetiate. Podetia 1-2(-4) cm high, 1.0-1.5(-2.0) mm wide, generally forming irregular cups; cups small, many times not well formed, closed, proliferating marginally; completely or partially covered in farinose soredia which may become slightly granular, the inside of cups sometimes remaining corticate; squamules absent or basal or occasionally small and scattered along podetia ; pale green, olive buff, yellowish glaucous, yellow, with the base of podetia and the bases of the primary squamules often more golden yellow.

<u>Apothecia</u> abundant, usually present, single to more commonly several sessile on cup margin or on short marginal proliferations, 1.0-3.5 mm wide. Disc plane to convex, red. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, 10-12 X 3 µm.

<u>Pycnidia</u> not observed. According to Thomson (1968) the pycnidia are terminal on subulate podetia and proliferations or on the margins of the cups.

Spot Tests: thallus P+ yellow-orange, K+ yellow.

<u>Substratum/Habitat</u>: terricolous or lignicolous, among moss on rotting wood or soil/wood combinations.

Selected Specimens: 210, 5032.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, not collected in the adjacent zones during the present study but reported as present in these zones by Evans (1951).

<u>World Distribution</u>: western North American endemic; from California to Alaska, essentially coastal; reports of this species from eastern Asia referto another species.

<u>Remarks</u>: The local material has soredia that can be quite farinose while <u>C. transcendens</u> is described as typically having granulose soredia that grade into isidioid structures. However, as Evans (1951) pointed out, there is quite a wide variation displayed in this species, with large areas of the podentia sometimes being corticate or not, cups present or podetia only subulate, and squamules absent to very large and abundant.

<u>C. transcendens</u>, therefore, can resemble <u>C. polydactyla</u> (Floerke) Spreng. as the latter also has granulose soredia and thamnolic acid (P+ yellow-orange, K+ yellow) although it lacks the usnic acid and bellidiflorin reported as accessory in the former (Krog, 1968). <u>C. polydactyla</u> has been reported from Goldstream in the study area (Evans, 1951) on the basis of literature reports which may well be references to <u>C. transcendens</u> or the following species, since <u>C. polydactyla</u> s. str. is now thought to be restricted to Europe (Tønsberg & Ahti, 1980). <u>C. umbricola</u> Tønsb. & Ahti is a red fruited <u>Cladonia</u> with short, narrowly-scyphous podetia that are farinose sorediate and contain squamatic acid (P-, K-, UV+). This species has been collected in the adjacent CDFW subzone, near Campbell River on Vancouver Island.

<u>CLADONIA UNCIALIS</u> (L.) Wigg, Prim. Fl. Holsat.:90. 1780. Lichen uncialis L., Sp. Pl.:1153. 1753.

Primary thallus not observed.

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<u>Secondary thallus</u> fruticose, podetiate. Podetia fragmenting readily, 1.5-4.0(-6) cm high, (0.6-)0.8-2.4 mm wide, wider at nodes which tend to be inflated, branching isotomic dichotomous to polychotomous, internodes short, forming quite dense, entangled tufts or mats; axils occasionally perforate; apices abruptly pointed, wide spreading; esquamulate; surface corticate, matt to slightly shiny, smooth to irregularly verruculose with algae grouped in greenish areoles; olive buff, pale yellow-green, yellowish glaucous, yellow, with the apices often browning.

<u>Apothecia</u> rare, observed once, terminal in groups, 0.3-0.8 mm wide. Disc round and light brown at first, then becoming flexuous, slightly concave and dark brown. Hymenium 25-30 µm high; epithecium orange-brown; spores simple, narrowly ellipsoid, 8-10 X 2.5-3 µm.

Pycnidia common, abundant, terminal, dark brown.

Spot Tests: thallus K-, P-.

<u>Substratum/Habitat</u>: terricolous; collected in exposed locations among moss over thin soil or apparently + directly on rock.

Selected Specimens: 2148, 4961.

Local Abundance and Distribution: occasional; at inland, exposed locations, especially at higher elevations, although also occasionally at maritime locations in both the CDFD subzone and adjacent zones, however, not collected on most of the Gulf Islands.

<u>World Distribution</u>: (circumarctic-)circumboreal (Ahti, 1964, 1977) in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972) and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere. CLADONIA VERRUCULOSA (Vain.) Ahti, Bryologist 81:336. 1978.

<u>Cladonia pityrea</u> var. <u>verruculosa</u> Vain., Acta Soc. Fauna Fl. Fenn. 10:355. 1894.

<u>Primary thallus</u> squamulose. Squamules few and scattered to <u>+</u> disappearing.

Secondary thallus fruticose, podetiate. Podetia 2.2-7.0(-8.0) cm high, 0.7-1.4 mm wide, subulate or forming narrow cups which may proliferate marginally or sometimes even centrally, with both forms also often branching mid-podetia causing the old podetia to be deflected nearly parallel to the ground, and sometimes continuing to branch; cups 2.0-3.5 mm wide, closed; surface mainly decorticate with scattered to abundant, continuous granular soredia, becoming farinose sorediate apically in some subulate podetia , the interior and outside of the cups often corticate and covered in crowded, granular areoles; squamules absent, or a few basally, or scattered up the length of the podetia , often in or around the cups; pale olive buff, olive brown, clove brown, yellowish glaucous, light olive grey, often whitish in young podetia , the decorticate areas of the podetia browning with the newly exposed areas being whitish.

<u>Apothecia</u> occasional, on rim of cups, 0.5-2.5 mm wide. Disc light to medium brown. Spores not observed.

Pycnidia not observed.

Spot Tests: thallus P+ red, K-.

<u>Substratum/Habitat</u>: terricolous; directly on soil or among mosses, often in disturbed areas or exposed locations.

Selected Specimens: 2566, 5433.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both inland and maritime sites, present but not as common in

the adjacent zones.

World Distribution: western North American endemic (Ahti, 1978).

<u>Remarks: C. verruculosa</u> is similar in appearance to <u>C. rei</u> Shaer. (= <u>C. nemoxyna</u> (Ach.) Arn.) differing in a number of small morphological characters as well as the absence of homosekkaic acid which is present in the latter. There is also some similarity to <u>C. decorticata</u> (Floerke) Spreng., which, however, does form cups and lacks fumarprotocetraric acid (P-). An illustration of <u>C. decorticata</u> in Thomson (1967c, plate 8, No. 42) of a Macoun collection from Vancouver Island is undoubtedly <u>C. verruculosa</u>. It is almost identical with the photograph in Ahti (1978) which very clearly illustrates the rather wide morphological variation present in the species.

COLLEMA Wigg.

Thallus usually foliose; homoiomerous, ecorticate, gelatinous. Lobes narrow to broad, variously developed, often wrinkled, with or without isidia or lobules, containing the blue-green alga <u>Nostoc</u>; dark olive-brown to black.

Ascocarp an apothecium, laminal or marginal. Thalline margin present, occasionally excluded in very old ascocarps. Disc plane, red or reddishbrown. Spores (4-)8 per ascus, septate or muriform, ellipsoid to acicular, hyaline.

Corticolous, terricolous, and saxicolous (often calcicolous).

References: Degelius (1954, 1974).

1.	Thallus isidiate	2
1.	Thallus not isidiate	4
	2. Isidia cylindrical-coralloid <u>C</u> . <u>FURFURACEU</u>	M
	2. Isidia globular	3
3. Thallus pustulate or ridged; corticolous <u>C</u>. <u>NIGRESCENS</u>
3. Thallus <u>+</u> plane, not pustulate or ridged; saxicolous <u>C</u>. <u>TUNIFORME</u>
4. Thallus ridged and pustulate; usually corticolous; spores septate <u>C</u>. <u>NIGRESCENS</u>
4. Thallus <u>+</u> plane; saxicolous at maritime sites; spores submuriform C. FECUNDUM

COLLEMA FECUNDUM Degel., Bot. Not. 132:569. 1979.

<u>Thallus</u> foliose, 1.5-2 cm broad. Lobes moderately to deeply indented, 1-2(-3) mm wide, \pm appressed at center with margins entire and ascending, often imbricate; 60-95 μ m thick; black, dark grey, lighter below.

Apothecia common, abundant, usually crowded, 0.3-0.5 mm wide. Thalline margin present, entire, becoming slightly excluded with are; proper margin often slightly visible between disc and thalline margin, light coloured. Disc reddish-brown, concave to plane, epruinose. Hymenium 120-130 µm high; epi-thecium light orange. Spores 8 per ascus, hyaline, ellipsoid with distinctly pointed ends, 3-(-5) septate latitudinally, 0-1 septate longitudinally with central cells always septate, 18-30 X 8-13 µm.

Pycnidia not observed.

Spot Tests: none.

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<u>Substratum/Habitat</u>: saxicolous; on noncalcareous sandstones and conglomerates, also once on igneous rock, in the supralittoral zone, often shaded.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at maritime sites; not collected in the adjacent zones (see Figure 15).

<u>World Distribution</u>: western North American endemic; coastal; currently known from Washington to the Queen Charlotte Islands, British Columbia (Degelius, 1979).



<u>Remarks</u>: The type was selected from material collected during the present study. The <u>locus classicus</u> is Narvaez Bay on Saturna Island. Collections of <u>C. fecundum</u> from the Queen Charlotte Islands were mentioned under <u>C</u>. <u>novoze-</u> <u>landicum</u> Degel. in Degelius (1974). The latter is an isidiate species from the Southern Hemisphere.

<u>C</u>. <u>fecundum</u> has a very thin thallus compared with most <u>Collema</u> species. This gives it a membranous appearance; in the field it is more reminiscent of a <u>Leptogium</u> species.

<u>COLLEMA</u> <u>FURFURACEUM</u> (Arn.) Du Rietz, Ark. Bot. 22A(13):3. 1929. Synechoblastus <u>nigrescens</u> a) <u>furfuraceum</u> Arn., Flora 64:115. 1881.

<u>Thallus</u> foliose, 1-4 cm broad. Lobes <u>+</u> undulate and appressed except margins which are ascending, shallowly rounded, slightly indented to form lobes 3-8 mm wide, or lobes narrower, crowded, and not appressed; appressed thalli distinctly radially ridged and pustulate; isidia abundant, largest towards the center with margins usually free, cylindrical to coralloid, concentrated on ridges and pustules, occasionally on margins and also ventral surface; (50-)80-100(-130) µm thick; below correspondingly ridged and pustulate, attached at numerous points directly to substratum; olive black, black, dark green-grey, lighter below.

<u>Apothecia</u> observed once, sessile, scattered on the upper surface, 0.6-1.1 mm wide; isidia reduced in number. Thalline margin present, entire. Disc plane, reddish-brown. <u>Spores</u> 8 per ascus, intertwined (difficult to expel from ascus), hyaline, acicular, 5-septate, 50-60 X 2.5-4 µm.

Pycnidia not observed.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous and corticolous; on both igneous rocks and noncalcareous sandstones; when corticolous, primarily on <u>Quercus</u> but one collection also from Acer.

Selected Specimens: 2135, 5317.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at inland and maritime sites, not collected in adjacent zones.

<u>World Distribution</u>: tentatively circumtropical with oceanic extensions into the temperate zones; primarily oceanic in Europe (Deglius, 1954), in North America known from coastal Alaska southwards in the west and in the east from Ontario and Newfoundland southwards to Mexico; also in Ecuador and Brazil in South America, Ivory Coast, Ethiopia, Kenya, Tanzania, Angola, and South Africa in Africa, and Turkey, India, Japan, and the Philippines in Asia.

<u>COLLEMA NIGRESCENS</u> (Huds.) DC., Flore Franç., ed. 3, 2:384. 1805. Lichen nigrescens Huds., Flora Anglica, ed. 1:450. 1762.

<u>Thallus</u> foliose, 1.0-4.5 cm broad. Lobes rounded, slight to moderately indented, 2.5-6 mm wide; <u>+</u> appressed except at the margins, which are up-turned; radially pustulate and slightly ridged; below thinly ridged; non-isidiate; 100-130 μ m thick; dark grey, olive black, paler below on ridges.

<u>Apothecia</u> abundant, sessile, base constricted, 0.5-1.0 mm wide. Thalline margin present, thin, persistent. Disc plane, reddish-brown. Hymenium 80 μ m thick; epithecium yellowish-orange. <u>Spores</u> 8 per ascus, hyaline, acicular, 5-(-9) septate, 45-55 X 3-5 μ m.

Pycnidia not observed.

Spot Tests: none.

Substratum/Habitat: corticolous, collected only on Quercus.

Selected Specimens: 2133, 3090A.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at inland sites, not collected in adjacent zones.

World Distribution: circumtemperate in the Northern Hemisphere.

<u>Remarks</u>: Degelius (1954) stated that <u>C</u>. <u>nigrescens</u> is occasionally saxicolous.

COLLEMA TUNIFORME (Ach.) Ach., Lich. Univ.:649. 1810.

Lichen tuniforme Ach., K. Vet.-acad. Nya Handl.:17. 1795.

<u>Thallus</u> foliose, 5-10 mm broad. Lobes irregular, moderately indented with base narrower than ends, 2-4 mm wide or sometimes narrower and elongate, <u>+</u> concave to almost plane, not ridged or pustulate; 175 µm thick; isidia abundant, globular, covering most of lobes except margins; black, lighter below.

<u>Apothecia</u> and <u>pycnidia</u> not seen. According to Degelius (1954) the spores are submuriform, 3-5 latitudinal septa and 1 longitudinal septum, 15-24 X 6.5-13 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous, collected twice on sandstone, both noncalcareous, although one site known to possess calcareous portions.

Selected Specimens: 2697, 3056.

Local Abundance and Distribution: rare; collected twice at maritime sites in the supralittoral zone within the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate in the Northern Hemisphere; also reported from New Zealand (Martin, 1966) and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks</u>: The local material consisted of only very small thalli. <u>C. tuniforme</u> is known to grow up to 10 cm broad. It is usually a calcicole.

CONIOCYBE Ach.

Thallus crustose. Ascocarp an apothecium, stipitate. Stalks long and slender. Capitulum globose; excipulum absent. Spores simple, globose, pale coloured; released along with paraphyses and other hymenial fragments to form a powdery mazaedium.

Saxicolous, terricolous, corticolous, and lignicolous.

References: Tibell (1975).

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There is one local species.

<u>CONIOCYBE</u> <u>FURFURACEA</u> (L.) Ach., K. Sv. Vet.-akad. Nya Handl.:288. 1816. Mucor furfuraceus L., Spec. Plant.:1185. 1753.

<u>Thallus</u> curstose; granulose, powdery, effuse; bright green to dull greenish-yellow.

<u>Apothecia</u> stipitate. Stalk dark, but white to yellowish pruinose, slender, 1-2 mm high. Excipulum absent; capitulum globose to oval; brown. <u>Spores</u> 8 per ascus, hyaline or pale yellow, smooth, spherical to subglobose, 2.5-3.5(-4) µm in diameter, released to form a powdery mazaedium.

Spot Tests: none.

<u>Substratum/Habitat</u>: lignicolous and saxicolous; most abundant on unearthed rootlets and adjacent soil in shaded locations.

Selected Specimens: 4300, 5237.

<u>Abundance and Local Distribution</u>: infrequent; collected by Macoun on the Saanich Peninsula in the southern part of the CDFD subzone (UBC-L3583); during the present study collected only in the adjacent CDFW subzone. <u>World Distribution</u>: (circumboreal-)circumtemperate in the Northern Hemisphere.

CORNICULARIA (Schreb.) Ach.

Thallus fruticose; wiry to strap-shaped, erect branches which are often shiny, rigid, dark coloured, with or without pseudocyphellae.

Ascocarp an apothecium. Thalline margin present, entire, dentate to ciliate. Spores 8 per ascus, simple, ellipsoid.

Saxicolous, terricolous, and corticolous.

The taxonomic position of the genus <u>Cornicularia</u> has always been disputed. It has been included in <u>Cetraria</u> in the Parmeliacaeae, e.g. Fink (1935), but other authors have transferred it to the Usneaceae because of its radial structure (Duncan, 1970). Du Rietz (1926) regarded it as a bridge between the two families. Krog (1968) stated that, on the basis of morphological and chemical characters, <u>Cornicularia</u> was much more closely allied to Cetraria.

Other authors have pointed out that <u>Cornicularia</u> is not a homogeneous group. Hawksworth et al. (1980) placed the pseudocyphellate,terete species in a different genus, <u>Coelocaulon</u>, separating them from the strap-shaped, nonpseudocyphellate members of <u>Cornicularia</u>. Since the genus is currently under review (Kärnefelt, pers. comm.) the more conservative approach of a single genus has been followed here.

References: Asahina (1939), Du Rietz (1926).

- 1. Thallus little branched; branches + smoothly flattened; nonpseudocyphellate; fertile; saxicolous C. NORMOERICA
- Thallus richly, divaricately branched; branches terete to irregularly flattened or twisted; commonly sterile; among moss over thin soil <u>C. ACULEATA</u>

<u>CORNICULARIA</u> <u>ACULEATA</u> (Schreb.) Ach., Meth. Lich.:302. 1803. <u>Lichen aculeatus</u> Schreb., Spicil. Flor. Lipsiens.:125. 1771. Coelocaulon aculeatum (Schreb.) Link, publication information not available.

<u>Thallus</u> fruticose; tufted, 1-3.5(-6) cm high. Branches terete to <u>+</u> irregularly flattened or twisted, smooth to foveolate, shiny, 0.3-0.7(-1.0) mm ide; pseudocyphellae common, white, concave, scattered along branches; richly branched with branches divergent, ending in spinulose tips; cinnamon brown, reddish brown, fuscous-black, darker towards apices, paler below.

<u>Apothecia</u> uncommon, observed once, subterminal, 0.9-1-6 mm wide. Thalline margin thin, dentate, pseudocyphellate on bottom. Disc plane, dark brown. Spores not observed.

Spot Tests: medulla C-.

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<u>Substratum/Habitat</u>: terricolous; commonly among mosses and/or <u>Selaginella</u> on thin soil layer over igneous rock in exposed locations.

Selected Specimens: 4611, 4746.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at maritime (supralittoral zone) and higher elevation, exposed sites; not as common but also present in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumboreal(-circumtemperate) in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), Argentina (Grassi, 1950), and mountains of Ethiopia and Kenya in the Southern Hemisphere.

<u>Remarks: C. pseudosatoana</u> Asah. is similar to <u>C</u>. <u>aculeata</u>, but it is corticolous (primarily on <u>Tsuga</u>) and has a C+ red medulla. It is known from the adjacent Fog/Spruce subzone of the CH zone but it has not been collected in conjunction with this study.

<u>CORNICULARIA NORMOERICA</u> (Gunn.) Du Rietz, Ark. Bot. 20(11):32, 39. 1926. <u>Lichen normoericus</u> Gunn., Flor. Norveg. 2:123, tab. 2, fig. 1. 1776. <u>Cornicularia tristis</u> (Wigg.) Hoffm., Descript. Adumb. Plant. Lich.2: 36, tab.

36, fig. 1. 1794.

<u>Thallus</u> fruticose; tufted, centrally flattened against substratum. Branches few, 0.6-1.2 mm long, 0.3-0.8 mm wide, flattened, rigid, usually unbranched or sometimes dichotomously branched, smooth, shiny, nonpseudocyphellate; blackish brown, fuscous black, lighter below.

<u>Apothecia</u> common, subapical, appearing apical in mature apothecia, 1.0-3.0(-5.0) mm wide. Thalline margin entire with numerous fibrils attached mainly on the back, becoming excluded. Disc plane <u>+</u> becoming irregularly convex, shiny, brown-black. Hymenium 40-45 μ m high; paraphyses coherent; epithecium brown. <u>Spores</u> 8 per ascus, <u>+</u> uniseriate, hyaline, ellipsoid to subglobose, simple, epispore evident, 7-10 X 4-6 μ m.

<u>Pycnidia</u> common, marginal towards the apices, making the branches appear notched or knobby; pycnospores hyaline, irregularly constricted in the middle, 5-8 X 1-1.5 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; collected once on sloping conglomerate (610 m) at a sunny, exposed location with <u>Pseudephebe</u> <u>pubescens</u> and Thamnolia vermicularis.

Selected Specimen: 2207B.

Local Abundance and Distribution: rare; collected once at a high elevation on Saltspring Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-Europe-eastern Asia disjunct (Krog, 1968).

<u>Remarks: C. normoerica</u> is also known from Mt. Constitution on Orcas Island of the adjacent San Juan Islands in a habitat very similar to that of Mt. Maxwell on Saltspring Island (Otto, pers. comm.) In western North America it has been reported from alpine locations in Washington and Montana (Imshaug, 1957), Oregon (Fink, 1935), and California (Sigal & Toren, 1974). Macoun (1902) has reported <u>C. normoerica</u> from Alaska which Krog (1968) cite**d**; however, that report should be verified.

CYPHELIUM Ach.

Thallus crustose; verrucose to subareolate.

Ascocarp an apothecium, sessile, on a broad base. Excipulum well developed, sometimes pruinose. Spores 8 per ascus, usually 1-septate, slightly or distinctly constricted at the septum, oblong to elliptical, brown, variously striated or cracked; released early along with paraphyses and other hymenial fragments to form a dark, powdery mazaedium.

Corticolous, lignicolous, saxicolous.

References: Weber(1967), Tibell (1969, 1971, 1975).

There is one local species.

CYPHELIUM INQUINANS (Sm.) Trev., Flora 45:4. 1862.

Lichen inquinans Sm., Engl. Botan. 12:tab. 810. 1801.

<u>Thallus</u> crustose; effuse, covering large areas; thin to thick granules, nearly verruculose, scabrid to <u>+</u> pruinose; grey-white.

<u>Apothecia</u> plentiful, sessile to short-stalked, 0.2-0.4 mm high, 0.5-1.1 mm wide, black, with a faint white pruine around the top of the excipulum.

<u>Spores</u> 8st per ascus, brown, faintly striated, ellipsoid, 1-septate, constricted at the septum, 13-20 X 8-11 µm; released early to form a black (sometimes white pruinose) powdery, flat mazaedium, sometimes extruded.

<u>Spot Tests</u>: thallus P+ faint yellow, K+ brownish-yellow (on filter paper).

<u>Substratum/Habitat</u>: corticolous; on conifers, primarily <u>Pseudotsuga</u>. Selected Specimens: 3808, 3882.

Local Abundance and Distribution: infrequent; scattered along the western boundary of the CDFD subzone; not collected from the adjacent zones during the present study but reported by others (Tibell, 1975).

<u>World Distribution</u>: western North America-Europe disjunct; in North America reported from British Columbia to California and inland to Colorado, Idaho, Alberta, and the Northwest Territories (Tibell, 1975; Weber, 1967; Ahti et al., 1973).

<u>Remarks</u>: The diameters of the apothecia of the local material were much smaller than the diameters cited by Tibell (1969, 1971, 1975). Tibell described European and North American material as exactly the same :1.5-2.5 mm wide. Other general floras describe European material as smaller :0.5-2.0 mm (Duncan, 1970) and 0.3-0.8 mm (Ozenda & Clauzade, 1970), but they may be including other species.

<u>C. karelicum</u> (Vain.) Räs., has been reported from Cameron Lake which is adjacent to the study area (Tibell, 1975). It is very similar to <u>C. inquinans</u>, but with smaller apothecia (0.4-0.7 mm), deeply fissured spores, and greenish grey to brownish-grey thallus. The apothecial size overlaps that of the local C. inquinans.

DERMATOCARPON Eschw.

Thallus squamulose to foliose; attached by rhizinae or a central holdfast.

Ascocarp an perithecium; simple, immersed, black. Paraphyses commonly gelatinizing. Spores 8 per ascus, simple, ellipsoid, hyaline.

Saxicolous, terricolous, infrequently corticolous.

Dermatocarpon is in need of revision.

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DERMATOCARPON HEPPIOIDES Zahlbr., Ann. Mycol. 10:359. 1912.

<u>Thallus</u> areolate-squamulose; up to 4 cm borad. Composed of central areoles which are \pm marginally lobed, as well as squamules which are closely adnate, \pm imbricate, often appearing fused, 0.5-2.0(-4) mm wide. Upper surface smooth to minutely cracked, often 'puckered' with perithecia and pycnidia; lower surface shiny, smooth, not umbilicate but attached along edge of squamule; \pm roughened with white pruinia; pale grey.

Perithecia common, scattered, immersed. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, long-ellipsoid, (16-)17-20(-23) X 5-7 µm.

<u>Pycnidia</u> common, scattered, immersed; pycnospores hyaline, cylindrical, 4-5 X l µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; on sloping, non-calcareous sandstone, often in exposed locations.

Selected Specimens: 835, 1519A.

Local Abundance and Distribution: infrequent; collected on the southern Gulf Islands of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; described from California.

<u>Remarks</u>: Small thalli of <u>D</u>. <u>miniatum</u> resemble <u>D</u>. <u>heppioides</u>. Both have a smooth, shiny, lower surface. However, the former lacks the larger spores, areoles, and adnate squamules found in <u>D</u>. <u>heppioides</u>.

<u>Dermatocarpon</u> species with small thalli, especially the areolatesquamulate forms, are poorly understood. Many floras neglect them entirely. Of those species treated by Ozenda & Clauzade (1970), nearly all are calcicoles on rocks or soil.

The type specimen of <u>D</u>. <u>heppioides</u> has been examined. It is not contained in Zahlbruckner's collection at W, but in Hasses's at FH. There are two specimens with handwritten labels that are almost identical, bearing the same collection number and on the same pink sandstone (HCl-) but one year is marked as 1910, the other as 1911. As noted above, the collector of the type was Hasse, not Hesse as stated in Zahlbruckner (1912).

D. heppioides is reported here as new to the province.

DERMATOCARPON MINIATUM (L.) Mann, Lich. Bohem. Observ. Disp.:66. 1825. Lichen miniatus L., Spec. Plant.:1149. 1753.

<u>Thallus</u> foliose; umbilicate, cartilaginous, <u>+</u> orbicular, 1-2 cm broad, <u>+</u> monophyllous with margins cleft to indented. Upper surface <u>+</u> coated with white pruinia; pale grey, pale lilac grey. Lower surface <u>+</u> slightly veined to reticulate, otherwise shiny and smooth with central umbilicus; brownish.

<u>Perithecia</u> not observed. According to Duncan (1970) the perithecia are small, immersed with only the black ostiole showing; spores ellipsoid,

10-16 X 6-9 um.

<u>Pycnidia</u> common, abundant, immersed, ostiole visible as a dark brown spot, often 'puckered in'. Pycnospores hyaline, cylindrical, 4-5 X l µm. Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous, on both igneous and sandstone rocks. <u>Selected Specimens</u>: 889B, 1528.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at both maritime and inland sites, not collected in adjacent zones.

World Distribution: circumarctic-circumtemperate (Krog, 1968).

<u>Remarks</u>: The local collections are all small and simple morphotypes of <u>D</u>. <u>miniatum</u>. The species can reach 5 cm in diameter and be polyphyllous. <u>D</u>. <u>reticulatum</u>, which is much more common locally, differs in its lack of the shiny, smooth underside as seen in <u>D</u>. <u>miniatum</u>. See <u>D</u>. <u>reticulatum</u> for . additional comments.

DERMATOCARPON RETICULATUM H. Magn., Ann. Crypto. Exot. 5:18-19. 1932.

<u>Thallus</u> foliose; umbilicate, cartilaginous, \pm orbicular, 2-4(-6) cm broad, monophyllous with margins tattered or deeply cleft or appearing polyphyllous by plicate folds. Upper surface smooth to usually roughened with white pruinia; pale grey, pale brownish grey, often mottled. Lower surface dull, \pm slightly veined or reticulate or not, roughened with papillae; the papillae short, continuous, pyramid-shaped when well developed; umbilicus central, short, stout; brownish.

<u>Perithecia</u> common, abundant, scattered, immersed, often very deeply set, ostiole not distinct but surrounding area darkened, often shiny. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 12-15 X 5-7 µm.

Pycnidia usually present, immersed, ostiole darkened, not distinguishable

from perithecia. Pycnospores hyaline, cylindrical, 4-5 X 0.75-1 µm.

Spot Tests: hymenium "IKI+blue turning sordid yellow-orange.

<u>Substratum/Habititat</u>: saxicolous, on sandstones, conglomerates and igneous rocks; commonly along vertical crevices or on slanted drip surfaces.

Selected Specimens: 2472, 4816.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both inland and, more commonly, maritime sites; not collected in adjacent zones.

<u>World Distribution</u>: western North American endemic; according to Krog (1968) restricted to mountain areas; originally described from Washington, it has also been reported from Alaska, British Columbia, Oregon, Montana, New Mexico (Krog, 1968), California (Tucker & Jordan, 1978), Colorado, Alberta (Imshaug, 1957), and South Dakota (Wetmore, 1968).

<u>Remarks</u>: Despite the emphasis placed on the reticulations by its epithet, <u>D</u>. <u>reticulatum</u> is actually characterized by the minute papillae. In describing the species, Magnusson (1932) placed equal emphasis on both the reticulations and the furfuraceous nature of the undersurface. As Imshaug (1957) pointed out, the papillose character would appear to bring this species close to <u>D</u>. <u>miniatum</u> var. <u>papillosum</u>, but his examination of several European exsiccati "showed that it was distinct, and the 'papillose' undersurface of var. <u>papillosum</u> is in reality a condition of extreme rugosity". Magnusson (1932) mentioned that the texture of <u>D</u>. <u>reticulatum</u> is much softer than in <u>D</u>. <u>miniatum</u>: Krog (1968) acknowledged that the type is thin and fragile but this is not standard for the species. She, too, stated the most important character is the papillose undersurface.

DIMERELLA Trev.

Thallus crustose. Phycobiont Trentepohlia.

Ascocarp an apothecium. Lecideine margin present, consisting of interwoven rather than radiating hyphae. Disc often brightly coloured. Spores 8 per ascus, ellipsoid to fusiform, hyaline, uniseriate, 1-septate.

Folicolous, corticolous, lignicolous, muscicolous, and saxicolous; primarily a tropical genus.

References: Santesson (1952).

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<u>DIMERELLA LUTEA</u> (Dicks.) Trev., Rendic. Istit. Lombardo 13:65. 188. Lichen luteus Dicks., Fasc. Plant. Cryptog. Brit. 1:11. 1785.

<u>Thallus</u> crustose; continuous, smooth to verruculose, irregularly cracked, <u>+</u> dull; green, greyish olive, and grey in the single saxicolous collection.

Apothecia common, usually abundant, sessile with constricted base, (0.6-) 0.8-1.4(-2.0) mm wide. Proper margin whitish, thin. Disc concave becoming plane, buff to yellowish-orange. Hymenium hyaline to fulvous, 75 μm high; epithecium fulvous; hypothecium hyaline; paraphyses simple, coherent at apices. <u>Spores</u> 8 per ascus, uniseriate, oblong-ellipsoid, hyaline, 1-septate, 8-12 X 2-3 μm (see Figure 14).

Spot Tests: none.

<u>Substratum/Habitat</u>: primarily muscicolous, but also corticolous once on <u>Thuja</u> bark and saxicolous once on igneous rock; all substrata very shaded.

Selected Specimens: 471, 1570B.

<u>Abundance and Local Distribution</u>: rare; scattered throughout the CDFD subzone only at maritime sites; present and perhaps more common in adjacent

zones.

World Distribution: circumtemperate-circumtropical in both Hemispheres; authenticated reports from Madeira and Brazil (Santesson, 1952).

DIPLOSCHISTES Norm.

Thallus crustose. Ascocarp an apothecium, immersed to sessile. Usually both proper and thalline margins present. Proper margin of interwoven rather than radiating hyphae, often radiately striate; thalline margin commonly welldeveloped and overarching the proper margin. Disc concave to flat, \pm white pruinose. Hypothecium brown(-ish); paraphyses simple or little branched. Spores 2, 4, or 8 per ascus; hyaline, turning brown with age, muriform, large.

Saxicolous, muscicolous, lichenicolous, and terricolous.

- 1. Spores 2 per ascus; thalline margin very reduced; thallus C-..D. BISPORUS
- Spores 4 per ascus; thalline margin well-developed, overarching the disc when young; thallus C+ red<u>D</u>. <u>SCRUPOSUS</u>

DIPLOSCHISTES BISPORUS (Bagl.) J. Stein., Sitzungsber. K. Akad. Wiss. Wien, math, -naturw. Classe 102:155. 1893.

Urceolaria bispora Bagl., Nuov. Giorn. Botan. Ital. 3:246. 1871.

<u>Diploschistes</u> ochraceus (Anzi.) J. Stein., Sitzungsber. K. Akad. Wiss. Wien, math,-naturw. Classe 102:155. 1893.

<u>Thallus</u> crustose; continuous, thick, irregularly and deeply crackedareolate; areoles angular, <u>+</u> plane, but minutely uneven, almost tartareous; dirty medium grey to brownish grey.

<u>Apothecia</u> common, scattered to central in small thalli, immersed, one to occasionally two per areole but then small, 0.3-0.6(-0.8) mm wide. Thalline margin very reduced, practically absent. Proper margin black, thin to thick. Disc deeply concave, brown-black in middle becoming blacker toward margin, <u>+</u>

light white pruinose. Hypothecium brown; epithecium brown; hymenium 100 μ m high, hyaline; paraphyses slender, branched at apices and there coherent. <u>Spores</u> 2 per ascus, hyaline becoming brown at maturity, oblong-ellipsoid, muriform, (7- to 11-latitudinal septa; 4- to 6-longitudinal septa), 30-32(-40) X 15-18(-20) μ m (see Figure 14).

<u>Spot Tests</u>: thallus K-, C-, KC-, P-; hymenium IKI+ yellow-orange, sometimes initially green-blue; exciple K+ faint orange wash.

<u>Substratum/Habitat</u>: saxicolous, collected once on HCl- sandstone. Selected Specimen: 2111B.

Local Abundance and Distribution: rare, collected at a maritime site on Saltspring Island (southern Gulf Islands); not collected in adjacent zones.

<u>World Distribution</u>: western North America-Europe-eastern Asia disjunct (Ozenda & Clauzade, 1970).

<u>Remarks</u>: In European descriptions of <u>D</u>. <u>bisporus</u>, the apothecia size is greater, up to 1.2-1.5 mm (Poelt, 1969; Ozenda & Clauzade, 1970), than that seen in the single local collection. Additionally, both of the above authors noted a reddish-brown thallus varying to grey-brown.

<u>D</u>. <u>bisporus</u> is reported here as new to the province. No additional records were found for North America.

<u>DIPLOSCHISTES</u> <u>SCRUPOSUS</u> (Schreb.) Norm., Nyt Magazin Naturv. 7:323. 1853. Lichen scruposus Schreb., Spicil. Flor. Lipsiens:133. 1771.

<u>Thallus</u> crustose; up to 11 cm broad, or irregular, verrucose often cracking into areoles, up to 3 mm thick, shiny to pruinose; white-grey, pale yellowish grey.

<u>Apothecia</u> common, often abundant and crowded, 0.7-1.5(-2.0) mm wide, at first immersed, opening by a widening pore until urceolate and sessile. Thalline margin at first thick, becoming thin; proper margin blackish, striate,

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pruinose. Disc black, <u>+</u> white pruinose, concave becoming plane. Hymenium 110-140 μ m high; paraphyses simple, coherent; epithecium black; hypothecium dark brown to black. <u>Spores</u> 4 per ascus, at first hyaline, soon darkening to brown or blackish, pointed ellipsoid to rounded-oblong, muriform (5- to 7-latitudinal septa; 1- to 3-longitudinal septa), 27-40 X 10-15 μ m (see Figure 14).

Spot Tests: thallus C+ red, K-.

Substratum/Habitat: saxicolous, on all rock types (HCl-).

Selected Specimens: 854, 1508.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially at inland, exposed sites; present but not as abundant in adjacent zones.

World Distribution: circumarctic-circumboreal.

<u>Remarks</u>: <u>D</u>. <u>canadensis</u> Ras., which was described from the interior of the province, was sought, but not found in the CDFD subzone. It is K+ violet.

A small collection of <u>Diploschistes</u> on <u>Cladonia</u> squamules was made from an inland, exposed hilltop. Possibly it should be treated as an independent species, <u>D</u>. <u>muscorum</u> (Scop.) R. Sant. (=<u>D</u>. <u>bryophilus</u> (Ehrh. ex Ach.) Zahlbr., <u>C</u>. <u>lichenicola</u> (Mont.) Vain.) although others have included it with . D. scruposus s. lat.

EVERNIA Ach.

Thallus fruticose to almost foliose. Branches terete to broadly flattened, strap-shaped; branching irregular to dichotomous; medulla lacking cartilaginous strands; with or without soredia and isidia; basal holdfast sometimes present; grey-green to yellowish green.

Ascocarp an apothecium. Thalline margin present. Disc brown. Spores 8

per ascus, hyaline, ellipsoid, simple.

Corticolous, saxicolous, terricolous.

References: Howe (1911b), Bird (1974).

There is one local species.

EVERNIA PRUNASTRI (L.) Ach., Lich. Univ.:442. 1810.

Lichen prunastri L., Spec. Plant.:1147. 1753.

Thallus fruticose; tufted, 4-7(-10) cm long, composed of several branches. Branches flattened, 1-3(-5) mm wide, moderately to infrequently dichotomously branched, the new branchlets divergent, surface smooth to often transversely cracked, <u>+</u> dull, with algae often grouped, thin branches often slightly grooved, broader branches slightly foveolate; sorediate, with soredia farinose, sometimes nearly granular, concentrated towards the margins; medulla cottony; upper surface pale green, dull green-yellow, to yellow; lower surface paler, whitish green with margins <u>+</u> slightly raised.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Howe (1911b) the apothecia are lateral, subpedicellate, up to 6 mm wide with a chestnut coloured, emarginate disc; spores 5-7 X 3.5-4.5 µm. According to Howard (1950) the apothecia are rare with inflexed thalline margin; spores hyaline, short ellipsoid, 5-8 X 3.3-6 µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: primarily corticolous but occasionally saxicolous; collected on a wide variety of conifers and deciduous trees and shrubs, but especially common on <u>Pseudotsuga</u> and <u>Quercus</u>.

Selected Specimens: 1170, 2446.

Local Abundance and Distribution: western North America-eastern North



America-Europe-eastern Asia disjunct; boreal temperate (Krog, 1968).

<u>Remarks</u>: Although superficially similar to <u>Ramalina farinacea</u> and <u>R. subleptocarpha</u> even the stubbiest specimens of <u>E</u>. <u>prunastri</u> can be separated by the latter's softer and flabbier thallus, dull surface, with lobes that are distinctly lighter coloured on one side.

GRAPHIS Adans.

Thallus crustose. Ascocarp a lirelliform apothecium, immersed, becoming sessile. Proper margin present, of interwoven rather than radiating hyphae, frequently carbonized. Spores 8 per ascus, elongate-cylindrical, multiseptate with lens-shaped lumina.

Corticolous.

There is one local species.

<u>GRAPHIS SCRIPTA</u> (L.) Ach., Kg. Vet.-Akad. Nya Handl.:145. 1809. Lichen scriptus L., Sp., Pl.:1140. 1753.

<u>Thallus</u> crustose; often roughly orbicular, 2-4.5 cm broad, thin, smooth, sometimes becoming slightly pulverulent; pale grey, whitish grey, olive-buff.

<u>Apothecia</u> common, abundant, lirelliform, erupting through the thallus, straight to curved or angled, simple to occasionally branched, 1.0-4.2(-6.0)mm long, 0.2-0.3 mm wide. Proper margin black, carbonaceous, thick, opening slit-like to expose the disc. Disc black, sometimes faintly white pruinose. Hymenium 75-100 µm high; paraphyses simple, <u>+</u> free; epithecium brownish, granular; hypothecium fulvous. <u>Spores</u> 8 per ascus, hyaline, fusiform, 7- to 13-septate, lumina lenticular, 37-55(-70) X 7-11 µm (see Figure 14).

Spot Tests: none.

Substratum/Habitat: corticolous, nearly exclusively on Alnus.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia (Japan) disjunct; although described as cosmopolitan (Ozenda & Clauzade, 1970) and "throughout the United States"(Fink, 1935) it is apparently absent in mountainous and central North America; also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

GYALECTA Ach.

Thallus crustose. Phycobiont Trentepohlia.

Ascocarp an apothecium, subsessile to sessile. Proper margin and a pseudothalline margin often present. Disc concave, pale. Paraphyses simple, not anastomosing. Hymenium IKI+ blue. Spores 8 per ascus, hyaline, ellipsoid to fusiform, 3-septate to muriform.

Saxicolous, corticolous, muscicolous, and terricolous; often calcicolous. There is one local species.

<u>GYALECTA JENENSIS</u> (Batsch.) Zahlbr., Cat. Lich. Univ. 2:720. 1924. <u>Peziza jenensis</u> Batsch., Elench. Fung. Contin. prima:219. 1786. <u>Gyalecta cupularis</u> (Hedw.) Schaer., Lich. Helvet. Spicil., sect. 2:70. 1826.

<u>Thallus</u>: crustose; in irregular patches up to 2 cm broad, thin and only filling in the crevices around the quartz grains of the sandstone substratum or slightly thicker and nearly continuous, smooth; dirty white, pale grey, tan.

<u>Apothecia</u> common, sessile, scattered to occasionally crowded and fusing, 0.4-0.6 mm wide. Pseudothalline margin prominent, thick, raised, entire to somewhat creased, concolorous with the thallus. Disc tan to orange-pink, concave. Hymenium 120-150 μ m thick; paraphyses slender, not anastomosing, separate; epithecium and hypothecium hyaline to slightly fulvous. Spores 8 per ascus, <u>+</u> uniseriate, hyaline, submuriform to muriform (3-4 latitudinal septa; 0-2 longitudinal septa), 12-20 X 7-9 μ m (see Figure 14).

<u>Spot Tests</u>: hymenium IKI+blue (at first blue only at the base and yellow towards the apices but the yellow gradually turning blue).

<u>Substratum/Habitat</u>: saxicolous, collected once on calcareous sandstone at a river's edge with, and overgrowing, a <u>Verrucaria</u> sp.

Selected Specimen: 5082.

Local Abundance and Distribution: rare, collected once in the CDFW subzone, not collected in the CDFD subzone.

<u>Remarks</u>: According to European descriptions, the apothecia may be up to 1.2 mm wide and the spores larger, 13-40 X 7-16 μ m (Poelt, 1969; Ozenda & Clauzade, 1970).

This species has also been collected at several other locations in the province (Kennedy Lake on Vancouver Island, Bridal Veil Falls near Hope, Jackass Mountain in the Fraser Canyon) with all substrata being shaded, sloping, wet, and calcareous.

G. jenensis is reported here as new to the province.

GYALIDEA Lett.

Thallus crustose. Phycobiont Cystococcus.

Ascocarp an apothecium, very similar to <u>Gyalecta</u> but asci with distinct apical apparatus, spores slime-covered, and hymenium IKI+ yellow to red.

Mainly saxicolous but some species humicolous, muscicolous, terricolous, and foliicolous; often hydrophilic.

References: Vézda (1966, 1979).

There is one local species.

<u>GYALIDIA HYALINESCENS</u> (Nyl.) Vézda, Folia Geobot. Phytotax. 1:321. 1966. Lecidea hyalinescens Nyl., Acta Soc. Linn. Bordeaux 21:355. 1856.

Thallus crustose; thin, continuous, granular; light greyish.

<u>Apothecia</u> abundant, scattered, 0.2-0.5(-0.9) mm wide with a prominent pseudothalline margin concolorous with the thallus. Proper margin yellowish, darkening to black. Disc concave becoming plane, pale tan to yellowish. Hymenium 85-110 μ m high; paraphyses simple, separate; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, submuriform (3-4 latitudinal septa; occasionally with one of the middle cells divided), 12-18 X 5-6 μ m (see Figure 14).

Spot Tests: asci IKI+ red with hymenium and hymenial gelatin shrinking.

<u>Substratum/Habitat</u>: saxicolous; collected once on vertical, shaded phyllite with <u>Placopsis gelida</u> and <u>Pilophorus acicularis</u>; abundant at this one location.

<u>Selected Specimen</u>: 5815 (distributed in Lichenes Selecti Exsiccati, Fasc. LVIII, No. 1427).

Local Abundance and Distribution: rare; collected once in the CH zone, not collected in the CDFD subzone.

<u>Remarks</u>: Vézda's description (1966) of the species, based on more specimens, differs slightly as follows: thallus thick, apothecia 0.8-1.2 mm wide, proper margin becoming yellow-brown, spores 16-24 X 5-6 µm. In Europe it is found exclusively on silicate rocks in the spray zone of mountain brooks.

As a result of this study <u>G</u>. <u>hyalinescens</u> was reported new to the province and to North America in Noble (1978).

GYALIDEOPSIS Vezda

Thallus crustose; hyphophores sometimes present. Phycobiont <u>Trebouxia</u>like.

Ascocarp an apothecium. Proper margin present, of loosely anastomosing hyphae, persistent. Thalline margin and pseudothalline margin absent. Disc red-brown to black, <u>+</u> transparent when wet. Paraphyses slender and anastomosing. Asci thickened apically, IKI+ red. Spores 2-8 per ascus, hyaline, transversely septate to muriform.

Corticolous, terricolous, muscicolous, foliicolous, and saxicolous.

References: Vézda (1972, 1979), Vézda and Poelt (1973), James (1975).

There is one local species.

GYALIDEOPSIS ALNICOLA Noble & Vézda, Folia Geobot. Phytotax. 14:62. 1979.

<u>Thallus</u> crustose; thin, smooth, \pm shiny, forming small orbicular patches, 1-3 cm broad; hyphophores present, more abundant in areas where ascocarps few: white, slender, recurved at the top, often forking towards the top into two or more branches, 0.2-0.3 mm high, 0.04-0.1 mm wide; whitish with distinctly green areas.

<u>Apothecia</u> abundant, scattered, constricted, 0.2-0.6(-0.9) mm wide. Proper margin present, thick and smooth in young ascocarps, slightly reduced with age, concolorous with the disc. Disc initially concave becoming <u>+</u> plane, <u>+</u> round to sometimes a little irregular, slightly roughened or granular, redblack to black when dry, lighter coloured, semi-translucent, and swelling when wet. Hymenium 40-50 μ m high; paraphyses very slender, anastomosing, hyaline, tips coherent and brownish. <u>Spores</u> 6-8 per ascus, hyaline, flattened ellipsoid, submuriform, with (4-)4(-6) latitudinal septa and the central 1 or 2 cells <u>+</u> longitudinally septate, 12-17 X 3-5 µm (see Figure 14).

<u>Spot Tests</u>: asci IKI+ orange-red, the hymenium usually shrinking violently with the IKI.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Alnus</u> in an <u>Alnus</u> thicket.

<u>Selected Specimens</u>: 2221B, 5811 (isotypes-UBC, CANL, Herb. Noble; holotype-Herb. Vézda).

Local Abundance and Distribution: rare; collected only from the type location (part way along the access road to Mount Maxwell on Saltspring Island) in the southern CDFD subzone; not collected in the adjacent zones.

World Distribution: western North American endemic.

<u>Remarks</u>: <u>G</u>. <u>anastomosans</u> Vězda & James, known from Europe, is closely related to <u>G</u>. <u>alnicola</u>, but the former has much larger spores (20-30 X 6-13 μ m), higher hymenium (up to 100 μ m), and pseudoisidia.

The hyphophores present in <u>G</u>. <u>alnicola</u> are quite unusual, being found in only <u>Gyalideopsis</u> and a few other genera. Illustrations of the hyphophores, spores, and hymenium of this species may be found in Vezda (1979).

<u>G. alnicola</u> is known only from the type location which is an <u>Alnus</u> thicket dissected by a narrow, dirt access road to (but not within) Mount Maxwell Provincial Park. If the road is ever widened and/or paved to standard road specifications then the type site undoubtedly will be obliterated.

HAEMATOMMA Mass.

Thallus crustose; granulose to areolate, with or without soredia. Ascocarp an apothecium. Thalline margin present, sometimes but not usually disappearing. Disc pale brown to red, then K+ purple. Spores 8 per ascus, hyaline, acicular, 3- to 7-septate.

Saxicolous, corticolous.

References: Culberson (1963a), Asahina (1964).

There is one local species.

HAEMATOMMA LAPPONICUM Ras., Die Flecht. Estl. 1:67. 1931.

Thallus crustose; of scattered to grouped, shiny areoles; pale greenish yellow, deep yellowish green. Hypothallus white, absent or poorly developed.

<u>Apothecia</u> common, scattered, sessile, 0.7-1.7 mm wide. Disc \pm round, plane, dull and roughened, deep blood red. Thalline margin narrow, concolorous with the thallus or whitish. Hymenium 100-125 µm high; paraphyses coherent, studded with minute particles; hypothecium hyaline; epithecium redbrown. <u>Spores</u> 8 per ascus, hyaline, 3- to 7-septate, acicular, attenuated at one end or central cells enlarged slightly, stongly curved, 38-50 X 3-5 µm

Spot Tests: thallus K-, P-.

Substratum/Habitat: saxicolous; collected once on conglomerate.

Selected Specimens: 4674.

Local Abundance and Distribution: rare; collected once at an inland, exposed site (630 m) in the CDFW subzone; also reported from a similar habitat within the CDFD subzone on Saltspring Island (Bird & Bird, 1973).

<u>World Distribution</u>: circumarctic-alpine in the Northern Hemisphere (Thomson, 1968, 1979); in North America primarily north of 60° N. latitude, occurring southward in the mountains to New England in the east and in the west reported from Alberta, Washington, Oregon, British Columbia, and California (see Figure 48). It is not known from alpine areas of Colorado and New Mexico (Egan, 1972) (see Figure 48).

<u>Remarks</u>: The local collections are from 609 m and 630 m which are considerably below the usual elevation of this species.

HUILIA Zahlbr.

Thallus crustose; smooth to areolate, with or without soredia, sometimes ochraceous, often with a blue hypothallus; often quite reduced.

Ascocarp an apothecium. Proper margin present, composed of a black outer edge and internally of radiating, dark brown-black cells. Disc black. Hypothecium <u>+</u> dark brown. Spores 8 per ascus, hyaline, simple, ellipsoid or pointed ellipsoid, + halonate.

Saxicolous.

References: Hertel (1973, 1975a, 1977).

1.	Thallus	sorediate 2
1.	Thallus	esorediate 3
	2.	Thallus IKI <u>H</u> . <u>SOREDIZODES</u>
	2.	Thallus IKI+ blue <u>H</u> . <u>TUBERCULOSA</u>
3.	Exciple apothec	K+ blood red (viewed under LM) ia >1 mm
3.	Exciple	K-; apothecia ≤1 mm

HUILIA CRUSTULATA (Ach.) Hertel, Herzogia 3:373. 1975.
Lecidea parasema L. crustulata Ach., Lich. Univ.:176. 1810.
Lecidea crustulata (Ach.) Spreng., Syst. Veget. 14:(pars.1)258. 1827.

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<u>Thallus</u> crustose; thin, occasionally continuous and slightly cracked but more often of scattered areoles; white to often blue-grey. Hypothallus black, thin; at margin if thallus continuous, otherwise more noticeable between scattered areoles.

<u>Apothecia</u> common, abundant, usually scattered, not to slightly constricted, 0.6-1.0 mm wide. Proper margin thick or occasionally thin, smooth, slightly to distinctly raised, occasionally flexuous, black, epruinose. Disc <u>+</u> plane, round to irregularly lobed or angular by compression if ascocarps are crowded, epruinose, black. Hypothecium dark brown-black with top 25 μ m pale brown or hyaline, inspersed with oil droplets; epithecium brown, sordid green-brown or brown above and green below; exciple thick, outer edge dark brown or dark sordid green, internally usually concolorous or paler brown, composed of large cells; hymenium 75-85(-100) μ m, hyaline or pale green; paraphyses coherent, branched slightly at top with occasional anastomoses below, thin. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to pointed ellipsoid at one or both ends, often halonate and sticking together, 12-17(-20) X 5-7.5 μ m.

<u>Spot Tests</u>: thallus IKI-, K-, C-, KC-, P-; hymenium IKI+ blue; exciple K- or + pale yellow wash.

<u>Substratum/Habitat</u>: saxicolous; common on all rock types and loose cobbles partially embedded in the ground.

Selected Specimens: 1753, 4909.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones, especially at inland sites.

<u>World Distribution</u>: circumarctic to circumtemperate in the Northern Hemisphere (Thomson, 1979).

<u>Remarks: L. crustulata</u> is similar to <u>L</u>. <u>nigrocruenta</u>. See the latter species for comments.

The local material, for the most part, falls readily into H. crustulata rather than H. macrocarpa (DC.) Hertel, which is usually characterized by larger apothecia (1-3 mm), larger spores (15-30 X 7-11 µm), higher hymenium ($>100 \ \mu\text{m}$), and often a thicker cracked-areolate thallus which on occasion may be ochraceous. Although there were several local collections with slightly larger spores, all but two of these had the smaller spores present as well. Even the two collections with spores averaging 27 X 10 μ m had only a slightly higher hymenium and no other distinguishing characters. The apothecial diameters were consistently at or below 1.0 mm, despite the variation in spores and hymenium. In the limited material examined, the variation appeared more like that of a continum rather than a clear-cut discontinuity and although the material seems rather polymorphic in other respects no solution to the problem can be offered at this time. Anderson (1964) included L. curstulata in L. macrocarpa "because no satisfactory way has been found to distinguish it consistently from the latter". Harris (1977) stated that although most authors recognize L. crustulata as a distinct species, that the group was so variable and overlapping with L. macrocarpa that it was not worth the time to try to distinguish between the two. Wetmore (1968) felt that his specimens from the Black Hills (South Dakota and Wyoming) fell closer to L. crustulata and included all material under that species. Until more work is done on the problem this seems the most satisfactory, temporary solution and the same has been done here.

<u>HUILIA NIGROCRUENTA</u> (Anzi) Hertel, Herzogia 3:374. 1975. <u>Lecidea nigrocruenta</u> Anzi, Comment. Soc. Crittog. Ital. 2(1):18. 186. Lecidea phylliscina Nyl., Flora 56:21. 1873.

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<u>Thallus</u> crustose; thin, varying from continuous and slightly cracked to scattered cracked-areolate, matt; light grey to bluish-grey <u>+</u> orange areas. Hypothallus thin, blue black, at margin, inconspicuous to absent.

<u>Apothecia</u> common, scattered, 0.9-1.5(-1.9) mm wide. Proper margin thin to thick, slightly raised, <u>+</u> persistent, epruinose, black. Disc adnate, hardly constricted, plane to slightly convex or undulate, round to a little irregular, becoming cracked in large apothecia, also occasionally very flexuous, matt, epruinose, black. Hypothecium dark brown-black below, hyaline immediately next to the hymenium for 10-15 μ m, lightly inspersed with oil droplets; exciple entirely dark brown or with only outer edge dark brown (to blue-black in one specimen) becoming a little paler brown internally, composed of large cells, continuing thick below the hypothecium; epithecium sordid green-brown or brown above and green below; paraphyses thin, coherent, branched at top, occasionally anastomosed below; hymenium hyaline or pale green, 90-125 μ m high. <u>Spores</u> 8 per ascus, hyaline, simple, halonate, ellipsoid with one end pointed to almost tear-drop shaped, 18-25 X 7-10 μ m.

<u>Spot Tests</u>: thallus IKI-, K-, C-, KC-, P-; hymenium IKI+ blue, exciple K+ blood red (inner exciple turns red, and when strong a red wash occurs away from the exciple).

<u>Substratum/Habitat</u>: saxicolous, collected twice on sandstone and once on igneous rock.

Selected Specimens: 2126A, 4885.

Local Abundance and Distribution: infrequent; scattered in the southern part of the CDFD subzone at both maritime and inland sites; also present in the adjacent*zones in the southern part of the island.

<u>World Distribution</u>: uncertain; known from Europe, eastern Asia and America (Hertel, 1973), including western Russia in Europe, in North America reported from New York (Lowe, 1939) and South Dakota (Wetmore, 1968) and in Asia reported from China (Hertel & Zhao, 1982).

* <u>Remarks</u>: Hertel (1973) stated that the exciple is lighter gold-brown than <u>H</u>. <u>macrocarpa</u> but this was not seen in the local material.

<u>H. crustulata</u> is the only similar local species but it lacks the positive K reaction of the exciple. The combination of larger apothecia, slightly larger spores, and slightly higher hymenium, also distinguishes <u>H. nigrocruenta</u> Additionally the hypothallus seems much more inconspicuous in H. nigrocruenta.

<u>H. nigrocruenta</u> is reported here as new to the province.

HUILIA SOREDIZODES (Lamy) Hertel, Lichenologist 12:106. 1980.

Lecidea crustulata var. soredizodes Lamy, Bull. Soc. Bot. France 30:410. 1883. Lecidea soredizodes (Lamy) Sandst. non (Nyl.) Vain., publication information

not available.

Haplocarpon soredizodes (Lamy) V. Wirth, publication information not available.

<u>Thallus</u> crustose; thin, discontinuous with scattered areoles to moderately thick, continuous (interrupted by occasional crystal grains projecting from substratum), smooth with a few cracks to cracked-areolate; light to medium grey sometimes greenish grey; usually with abundant, but inconspicuous, crateriform soralia; soredia usually blue or black sometimes finely white granular. Hypothallus black, at margin of thallus, continuous, otherwise also between areoles.

<u>Apothecia</u> often present, usually scattered, constricted, adnate, 0.6-1.3 mm wide. Proper margin at first thick, becoming thinner, raised, <u>+</u> shiny, persistent epruinose, black (brownish in one collection). Disc plane to slightly convex, round to occasionally slightly irregular, <u>+</u> light white

pruinose; black (brownish in one collection). Hypothecium dark brown-black below, 10-25 µm thick hyaline layer next to hymenium, inspersed; exciple dark brown-black throughout,or internally lighter brown in young apothecia; paraphyses coherent, branched above, some anastomosing below; epithecium sordid green-brown or yellow-brown, occasionally black at very tips, becoming beautifully greenish below; hymenium 75(-90) µm high, hyaline below. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid or ellipsoid-pointed, halonate when young, 12-18 X 5-7 µm.

<u>Spot Tests</u>: thallus IKI-, K-, C-, KC-, P-; hymenium IKI+ blue; exciple K-. <u>Substratum/Habitat</u>: saxicolous; especially common on sandstone but also occasionally on conglomerate, shale, and igneous rocks.

Selected Specimens: 1351, 3236.

<u>Abundance and Local Distribution</u>: occasional; scattered in the southern part of the CDFD subzone; not collected in the northern part of the CDFD subzone nor in the adjacent zones.

World Distribution: western North America-Europe.

<u>Remarks</u>: <u>H</u>. <u>tuberculosa</u>, also found locally, is similar with crateriform soralia, but its thallus is IKI+. Additionally, it is so far known locally in the sterile state only, while <u>H</u>. <u>soredizodes</u> is commonly fertile.

<u>H. glaucophaea</u> (Koerb.) Hertel which, according to Hale & Culberson (1970) is a synonym of <u>Lecidea soredizodes</u> (Nyl.) Vain., is also very similar, but with a thick thallus and usually larger spores (17-28 X 9-12 μ m). It is known from Alaska (Thomson, 1979).

H. soredizodes (Lamy) Hertel is reported here as new to the province.

HUILIA TUBERCULOSA (Sm.) P. James, Lichenologist 12:107. 1980. Spiloma tuberculosa Sm., Engl. Bot. 36:tab.2556. 1814. Lecidea tumida Mass., Ricerch. Auton. Lich. 68:fig. 127. 1852. Lecidea sorediza Hyl., Bull. Soc. Linn. Normand., sér.2., 6:291. 187. Lecidea tuberculosa Sm., publication information not available.

<u>Thallus</u> crustose; of almost smooth to more commonly cracked areoles, occasionally dispersed-areolate; areoles <u>+</u> flat, smooth, slightly shiny; light whitish grey. Soralia concave, usually punctiform, concentrated towards the center of the thallus if obviously radial, often coalescing to cover large areas; soredia greenish-grey to usually dark grey-black, granular. Hypothallus obvious, sometimes very conspicuous at margin of thallus, between separated areoles, and over any raised portions of substratum; black.

<u>Apothecia</u> not observed. According to Ozenda & Clauzade (1970) the apothecia are black, 1-3 µm wide, sometimes pruinose with spores 12-21 X 7-13 µm.

Spot Tests: thallus IKI+ purplish, K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone, conglomerate, granitics and other igneous rocks.

Selected Specimens: 2110, 3175.

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Local <u>Abundance</u> and <u>Distribution</u>: infrequent; scattered in the southern part of the CDFD subzone; not collected in the northern part of the CDFD subzone or in the adjacent zones.

<u>World Distribution</u>: circumtemperate in the North Hemisphere (Ozenda & Clauzade, 1970).

<u>Remarks: H. tuberculosa</u> is very close to <u>H. soredizodes</u> which differs in having an IKI- thallus. In <u>H. tuberculosa</u> there is some variation of the iodine reaction in both speed and colour, such that the negative reaction in <u>H. soredizodes</u> may be just one end of a continuum. Even though the local <u>H. tuberculosa</u> differs in having much heavier soredia production than the local <u>H. soredizodes</u>, this could be considered consistent with the phenomenon of soredia suppression in fertile thalli noticed in many lichen species. Most local <u>H. soredizodes</u> are, indeed, fertile. Perhaps also in support of the two local taxa being the same, are their local distributions, which are both similar, and unusual in being confined to the Saanich Peninsula and southern Gulf Islands. This requires further study.

H. tuberculosa is reported here as new to the province.

HYPOCENOMYCE Choisy

Thallus squamulose; squamules < 1.5 mm; upper cortex plectenchymatous, lower cortex absent; with or without soredia; greenish to yellowish brown.

Ascocarp an apothecium, laminal, < 0.7 mm wide. Proper margin present, sometimes excluded. Disc plane at least when young, brown to black. Spores 8 per ascus, hyaline, ellipsoid to fusiform, simple to 3-septate.

Corticolous, occasionally lignicolous.

Hypocenomyce is often included in Lecidea or Psora.

References: Schneider (1980), James (in Poelt & Vézda, 1981).

1.	Thallus	esorediate, often fertile <u>H</u> . <u>FRIESII</u>
1.	Thallus	sorediate, usually sterile 2
	2.	Soralia inflated <u>H</u> . <u>UNKNOWN</u> <u>#1</u>
	2.	Soralia not inflated 3
3.	Thallus	C+ red, \pm shiny, tan to tan-green <u>H</u> . <u>SCALARIS</u>
3.	Thallus	C-, very glossy brown <u>H</u> . <u>ANTHRACOPHILA</u>

<u>HYPOCENOMYCE ANTHRACOPHILA</u> (Nyl.) P. James & G. Schneider, Biblthca lich., Lehre 13:81. 1980.

Lecidea anthracophila Nyl., Flora 48:603. 1865.

Psora anthracophila (Nyl.) Arn., Flora 53:471. 1870.
- Figure 17. Selected spores of <u>Hypocenomyce</u>, <u>Lecanactis</u>, <u>Lecania</u>, <u>Lecanora</u>, <u>Lecidea</u>, and <u>Lopadium</u>. Collection numbers of specimens are given in brackets.
- A. Hypocenomyce unknown <u>#1</u> (873)
- B. Lecanactis megaspora (6414)
- C. Lecanactis patellarioides (4465)
- D. Lecania erysibe (2458)
- E. <u>Lecania aipospila</u> (6441)
- F. Lecania unknown <u>#1</u> (2606)
- G. <u>Lecania nylanderi</u> (1892)
- H. Lecania dudleyi (903)
- I. <u>Lecania toniniodes</u> (1561)
- J. Lecania cyrtella (Macoun specimen, UBC-L4350)
- K. <u>Lecanora phaeobola</u> (1016)
- L. Lecanora <u>badia</u> (5549)
- M. Lecidea albofuscescens (5405)
- N. Lopadium pezizoideum (3231)



<u>Thallus</u> squamulose; of separate, flat to convex, appressed scales, becoming slightly lobed or not, grouped and imbricate to free and ascending; always very glossy; the margins occasionally with a very light white pruinia or almost scabrous, in one instance becoming sorediate on the lower surface with the scale involute exposing the dark grey soredia; dark brown above, whitish below.

<u>Apothecia</u> not observed. According to Poelt (1969), the apothecia are convex, red-brown, 0.3-0.4 mm wide with spores 7-13 X 2-4 μ m.

Spot Tests: thallus and soredia K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: lignicolous-corticolous; collected once on a burnt log and on burnt Pseudotsuga bark.

Selected Specimens: 3852A, 4893.

Local Abundance and Distribution: rare; distribution poorly known, one collection in the CDFD subzone on the Saanich Peninsula in the south, plus one collection in the adjacent zone also in the south.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; in North America it has been reported from Ontario (Brodo, 1981), New York (Brodo, 1968), Michigan (Harris, 1977), Vermont, Massachusetts, New Jersey, North Carolina (Fink, 1935), and South Dakota (Wetmore, 1968).

<u>Remarks</u>: <u>H</u>. <u>scalaris</u> is very similar, but has a duller thallus which is C+ red.

Harris (1977) has reported the soredia as P+ orange; Brodo (1968, 1981) reported it is P+ red, and; Schneider (1980) stated it is P-.

<u>H. anthracophila</u> is reported here as new to the province.

<u>HYPOCENOMYCE</u> <u>FRIESII</u> (Ach.) P. James & G. Schneider, Biblthca. lich., Lehre 13:84. 1980.

Lecidea friesii Ach., Utl. Svensk. Fl. 3:610. 1816.

<u>Thallus</u> minutely squamulose; of slightly convex, thin, appressed granules which become lobed, then linear lobed and often branched, then usually free and ascending, 0.4-0.7(-1.0) mm long, the tips <u>+</u> lightly pruinose; esorediate; greenish-grey, tawny-olivaceous to light brownish; below ecorticate, white.

<u>Apothecia</u> common, scattered between the squamules, adnate, 0.4-0.8 mm wide. Proper margin raised, thin to usually thick, persistent, often flexuous, brown-black to black. Disc <u>+</u> plane, roughened, round to <u>+</u> irregular and appearing almost gyrose because of the flexuous margin, black. Hypothecium not well developed, black, <u>+</u> carbonized; exciple black, <u>+</u> carbonized; hymenium hyaline to yellow or yellowish patches, 75 μ m high, appearing inspersed in ψ some cases; paraphyses indistinct in water, tightly coherent even in K. <u>Spores</u> 8 per ascus, hyaline, fusiform-ellipsoid, simple, 5-8 X 2.5-3 μ m.

Spot Tests: K-, C+ rose (very fleeting), P-.

Substratum/Habitat: corticolous; collected once on the trunk of Thuja.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CDFD subzone on the Saanigh Peninsula; not collected in adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct; in North America it has been reported from Vermont, Massachusetts (Fink, 1935), Ontario (Brodo, 1981), Michigan (Harris, 1977), South Dakota, Wyoming (Wetmore, 1968), California (Lowe, 1939), Arizona (Weber, 1963), and Colorado (Anderson, 1964).

<u>Remarks</u>: <u>H</u>. <u>friesii</u> is usually reported to be C-. There is, indeed, a very fleeting reaction which may have gone unnoticed, or the species may posess some chemical variability. Anderson (1964) reported it as being either K-, P- or K+ yellow, P+ yellow(-orange). The C reaction is often used to separate <u>H</u>. <u>friesii</u> from <u>H</u>. <u>scalaris</u> which has a strong, persistent red reaction with C. Schneider (1980) also reported a feeble red C reaction in the thallus of <u>H. friesii</u>.

<u>H. friesii</u> is also similar to <u>H. caradocensis</u> (Leight.) James &
G. Schneider; both species lack soredia. According to Duncan (1979) the latter (sub. nom. <u>Lecidea acutula</u> Nyl.), also has a fleeting C+ reaction.
However, it has larger, septate spores, 12-15 X 204 µm (Ozenda & Clauzade, 1970). Duncan stated that <u>H. caradocensis</u> resembles <u>H. scalaris</u> while Ozenda & Clauzade notedthat it is similar to H. friesii.

<u>H.</u> <u>friesii</u> was reported as new to the province in Noble (1978) on the basis of material from the present study and a specimen from the interior of the province.

<u>HYPOCENOMYCE</u> <u>SCALARIS</u> (Ach. ex Liljebl.) Choisy, Bull. Mens. Soc. Linn. Lyon 22:103. 1953.

Lichen scalaris Ach. ex Liljebl., Utkast. Svensk. Fl.:422. 1792. Lecidea scalaris (Ach. ex Liljebl.) Ach., Meth. Lich.:78. 1803. Psora scalaris (Ach. ex Liljebl.) Hook., Engl. Pl. 5:196. 1844.

<u>Thallus</u> squamulose; of scattered to grouped and imbricate, small, plane to convex, round to oval scales, attached at one end, the other edges becoming free, lobed and undulate, smooth, matt to slightly shiny, epruinose, 0.6-1.0 (-2.0) mm wide, eventually becoming sorediate on the edge of the lower surface with the margin involute exposing the soredia; tan, olive-tan, light brown.

<u>Apothecia</u> not observed. According to Anderson (1964) the apothecia are black, sometimes pruinose, up to 2 mm wide; the proper margin raised, persistent, entire, flexuous to lobate, whitish or greyish; spores rarely observed, 9-12 X 2-3.5 μ m.

<u>Spot Tests</u>: cortex and soredia C+ red (persistent), K-, P-. <u>Substratum/Habitat</u>: corticolous, lignicolous, collected once on living <u>Pseudotswga</u> barks, both charred and uncharred, and once on the bark of a rotting log.

Selected Specimens: 727B, 6327.

Local Abundance and Distribution: infrequent; scattered in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumtemperate; reported from Europe, Asia, North America; also reported from Tasmania in the Southern Hemisphere (Ozenda & Clauzade, 1970).

HYPOCENOMYCE UNKNOWN #1

<u>Thallus</u> squamulose; of small appressed scales which quickly become separate, \pm loose, linear squamules, 0.5-1.2 mm long, sometimes branched and several lobes per scale, \pm flat and smooth, the tips becoming inflated and then cracking open at the edge (or below or occasionally even above) to become soralia; soredia farinose; rhizines absent; yellowish-green to bluish-green.

<u>Apothecia</u> uncommon, laminal, 0.6-1.0 mm wide. Disc <u>+</u> plane to slightly flexuous, constricted, epruinose, <u>+</u> round, concolorous with thallus to greying or piebald, slightly shiny. Proper margin thin, even, hardly visible in apothecia observed, slightly darker and shinier than disc. Hypothecium hyaline, of very thick-walled hyphae, up to 125 μ m thick; exciple also of thickened, radiating hyphae, <u>+</u> hyaline; epithecium <u>+</u> hyaline; paraphyses tightly coherent, hymenium hyaline, 75 μ m high; algae present in base, spreading out below hypothecium for about 1/3 width of disc, not extending to margin edge. <u>Spores</u> 8 per ascus, hyaline, fusiform with one end narrower, 3-septate, 15-21 X 2.5-3 μ m (see Figure 14).

Pycnidia not observed.

Spot Tests: thallus K-, C-, KC-, P-.

Substratum/Habitat: corticolous, collected only on the trunks of Quercus

where it seems to prefer the edges rather than the top of the bark scales.

Selected Specimens: 873B, 1741B.

Local Abundance and Distribution: infrequent; collected only in the southern part of the CDFD subzone on the Gulf Islands; not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This unknown species is distinguished by the tiny squamulose growth form, helmet-shaped soralia, and corticolous habit. It is very distinctive with the soralia reminiscent of those in <u>Physcia adscendens</u> and apothecia similar to those of <u>Catillaria griffithii</u>. It was not determinable utilizing all available floras and monographs. Some difficulty was encountered in even assigning it to genus. The presence of algae in the base of the apothecium, which spread out below the hypothecium in the immediate area of the base, but never penetrating as far as the margin edge, cannot be overlooked and would classify the margin perhaps as a reduced thalline margin.

From all appearances though, the margin is lecideine rather than lecanorine. Furthermore, none of the genera in the Lecanoraceae seem appropriate – Lecania is typically crustose; <u>Solenospora</u> has a strong rosette growth form with well developed thalline margin and 1-septate spores. Neither of these are commonly sorediate nor corticolous. Since other species in the Lecideaceae have been known to contain some algae around the stalk (Lamb, 1954 b) the unknown local species is assigned here despite the anomaly. Within the Lecideaceae, <u>Toninia</u> initially seemed the obvious choice, since it is squamulose and 1- to 3-septate; <u>Hypocenomyce</u> has been treated as containing only simple-spored species (Schneider, 1980). Furthermore, <u>Toninia</u> is almost exclusively a saxicolous-terricolous genus often with a pruinose, rarely sorediate thallus and bearing apothecia often with a dark hypothecium.

T. opuntioides (Vill.) Baumg. appears to have a similar growth form but it is

saxicolous and esorediate (Ozenda & Clauzade, 1970). <u>T. caradocensis</u> (Leight. ex Nyl.) Lahm, was the only corticolous-lignicolous species but it was also esorediate. Hawksworth et al. (1980) transferred this species to <u>Hypocenomyce</u>, which, therefore, now includes one species with 3-septate spores. Afer some consideration it was felt that the unknown species was best accommodated in Hypocenomyce despite the anomalous algae in the margin.

HYPOGYMNIA (Nyl.) Nyl.

Thallus foliose. Branches corticate above and below, solid to often hollow and inflated; with or without ventral perforations near the axils, soredia, lobules; rhizines absent; pale grey to grownish grey above, black below.

Ascocarp an apothecium, laminal, sessile or substipitate. Thalline margin present. Disc brown, often large. Asci with IKI+ blue apical apparatus. Spores 8 per ascus, hyaline, simple, ellipsoid, small.

Pycnidia often abundant, black; pycnospores hyaline, cylindrical, straight with mid-constriction.

Mainly corticolous, also saxicolous, muscicolous.

Dr. L. Pike has recently reviewed <u>Hypogymnia</u>, uncovering many new species and changing many of the species concepts in the older taxa. The new treatment is as yet unpublished; however, many changes are already appearing in the literature, e.g. Hale (1979). Dr. Pike's treatment is expected to be published soon (Mycotaxon, in press).

<u>Hypogymnia</u> has been retained in <u>Parmelia</u> in a number of recent floras (Duncan, 1970; Ozenda & Clauzade, 1970) but this treatment is becoming unusual.

References: Ohlsson (1973-key, slightly dated), Krog (1974; in Poelt &

Vézda, 1977), Brodo (1979-key).

1.	Sorediate 2		
1.	sorediate		
	2. Soralia terminal, labriform, P+ orange <u>H</u> . <u>PHYSODES</u>		
	2. Soralia terminal, capitate, P <u>H</u> . <u>TUBULOSA</u>		
3.	Lobes 2-5 mm wide, commonly appressed over most of the thallus; branches <u>+</u> contiguous, not divergent		
3.	<pre>1-2 mm wide, centrally attached, marginally radiating horizontally; branches divergent</pre>		
	 Medulla white; perforations uncommon on lower surface; P+ orange 		
	 Medulla with black-brown layer (older lobes); perforations common on lower surface; P <u>H</u>. <u>INACTIVA</u> 		

HYPOGYMNIA IMSHAUGII Krog, Norsk Polarinst. Skr. 144:96. 1968.

<u>Thallus</u> foliose; 2-9 cm broad. Lobes 1-2 mm wide, linear, hollow, attached at the center, otherwise free and horizontally radiating; dichotomously branched with branchlets divergent at \pm right angles; upper surface shiny, smooth, esorediate, grey-white to pale glaucous or yellowish-glaucous; medullary hyphae white; lower surface dull to shiny, rugose, black, sometimes browning towards the lobe tips; ventral perforations \pm absent; rhizines absent.

<u>Apothecia</u> common, laminal, pedicellate, 2-7(-11) mm broad. Thalline margin present. Disc brown, concave becoming plane. Hymenium 40 μ m high; paraphyses coherent; epithecium brown. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to globose with a distinct epispore, 5-8 X 3-5 μ m.

<u>Pycnidia</u> common, usually clustered on the dorsal surface, black; pycnospores hyaline, cylindrical, 4-6 X l µm.

<u>Spot Tests</u>: medulla P+ orange-red, K+ faint fulvous. Krog (1968) stated the medulla was K+ yellow; Ohlsson (1973) said it was K-. <u>Substratum/Habitat</u>: corticolous, primarily on branches and twigs of Pseudotsuga.

Selected Specimens: 103, 802.

Local Abundance and Distribution: occasional; primarily in the eastern part, especially southeastern (Gulf Islands) part, of the CDFD subzone at inland sites; present but not common in adjacent zones.

<u>World Distribution</u>: western North American endemic; known from California to Alaska and also inland to Alberta, Montana and Idaho (Ohlsson, 1973).

HYPOGYMNIA INACTIVA (Krog) Ohlsson, Bryologist 76:374. 1973.

Hypogymnia imshaugii Krog var. inactiva Krog, Norsk Polarinst. Skr. 144:98.

1968.

<u>Thallus</u> foliose; orbicular, becoming elongated in direction of twig, 5-9 (-14) cm broad. Lobes 1-2 mm wide, linear, hollow, dichotomously branched with branchlets divergent at <u>+</u> right angles; centrally attached with lobes free but radiating mainly in the horizontal plane; upper surface smooth, shiny, esorediate, whitish grey, pale glaucous green to pale olive green; lower surface dull to shiny, rugose, black to rarely tan, becoming brown at lobe tips; perforations into medullary cavity occasional, ventral, mainly at branching points; hyphae lining medullary cavity brown to black; rhizines absent.

<u>Apothecia</u> common, laminal, pedicellate, 2-7(-17) mm wide. Thalline margin present. Disc brown, concave becoming plane. Hymenium 40 µm high; paraphyses coherent; epithecium brown. <u>Spores</u> 8 per ascus, ellipsoid to subglobose, hyaline, with a distinct epispore, 6-8 X 4-5 µm.

<u>Pycnidia</u> abundant, black, clustered to scattered on the dorsal surface; pycnospores hyaline, cylindrical, 5-6 X l μ m.

Spot Tests: medulla P-, K-.

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<u>Substratum/Habitat</u>: corticolous; nearly exclusively on conifer twigs and branches, especially <u>Pseudotsuga</u> and Pinus.

Selected Specimens: 2415, 3816.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones, especially common at inland sites.

<u>World Distribution</u>: western North American endemic; known from California Oregon, Washington, British Columbia (Ohlsson, 1973) and Alaska (Krog, 1968); <u>+</u> oceanic except for eastern Washington localities.

<u>Remarks</u>: According to Ohlsson (1973) <u>H</u>. <u>inactiva</u> is somewhat. more restricted and rare than <u>H</u>. <u>imshaugii</u>, but locally <u>H</u>. <u>inactiva</u> was collected twice as often as the latter and was much more widely distributed. The two species were collected only occasionally at the same site.

HYPOGYMNIA PHYSODES (L.) Nyl., Lich. Envir. Paris 1896:39. 1896.

Lichen physodes L., Sp. P1.:1144. 1753.

Parmelia physodes (L.) Ach., Meth. Lich.: 250. 1803.

<u>Thallus</u> foliose, orbicular, becoming elongated in the direction of some twig substrata, 2-6 cm broad. Lobes 1-2 mm wide, hollow, much-branched, contiguous and imbricate, <u>+</u> appressed except for the lobe ends, tips of nonsorediate lobes tending to dilate; upper surface smooth and shiny, off-white to yellowish glaucous; sorediate, soralia terminal, labriform, infrequent in small thalli, formed by the lobe ends breaking open with the upper part remaining convex or becoming reflexed and ragged, the soredia granular, on the upturned inner surface; lower surface black, becoming brown at lobe tips, often visible from above as a black margin, rugose; rhizines absent.

<u>Apothecia</u> rare, observed once, laminal, up to 6 mm broad. Thalline margin present. Disc brown, concave becoming plane. Hymenium 40 µm high; paraphyses coherent; epithecium brown. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to subglobose with a thick epispore, 6-10 X 4-6 um.

<u>Pycnidia</u> often present but small and inconspicuous, tan becoming black; pycnospores hyaline, cylindrical, 5-6 X 0.75-1 um.

Spot Tests: medulla P+ orange-red.

<u>Substratum/Habitat</u>: corticolous; on a wide variety of trees and shrubs, primarily Pseudotsuga and Holodiscus; occasionally also saxicolous.

Selected Specimens: 1357, 3675.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone; present but not as common in the adjacent zones.

World Distribution: circumarctic to circumtemperate (Krog, 1968).

HYPOGYMNIA TUBULOSA (Schaer.) Hav., Bergens Mus. Arbok. Naturvid. Raekke 1917-18(2):31. 1918.

Parmelia ceratophylla var. tubulosa Schaer.,Lich. Helvet. Spicil. 10:459. 1840.

<u>Thallus</u> foliose; orbicular, 2-4 cm broad, attached only at the center, with branches <u>+</u> ascending or divergent. Lobes 1-2 mm wide, hollow, elongatelinear, infrequently dichotomously branched; upper surface smooth, shiny, white-grey to glaucous green or deep green with lobe tips blackened when not sorediate; soralia terminal capitate, on most lobe ends; soredia granular, abundant, encircling lobe tips; lower surface rugulose, dull to mainly shiny, black, lightening towards lobe tips where small circular patches of black occur where lobe is coming in contact with substratum; rhizines absent.

<u>Apothecia</u> not observed. According to Lynge (1921), the apothecia are very rare, apical to subapical, shortly stipitate, 1.5-3.5 mm wide with brown disc and spores arranged in rows, oval to sub-globose with a narrow epispore, 5.2-714 X 3.705.3 um.

Pycnidia observed once, at the end of a nonsorediate lobe, red-brown;

pynospores not observed. According to Lynge (1921) and Hillman (1936) the pycnidia are unknown.

Spot Tests: medulla P-.

<u>Substratum/Habitat</u>: corticolous; on twigs of evergreen and deciduous trees and shrubs, plus one lignicolous collection (see below).

Selected Specimens: 3677, 3887.

Local Abundance and Distribution: infrequent; scattered towards the western boundary of the CDFD zone, especially at higher elevations inland, also present in adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate in the Northern Hemisphere (Krog, 1968).

<u>Remarks</u>: One unusual specimen of <u>H</u>. <u>tubulosa</u> was collected from a wharf. It was more branched than usual, appressed, with many of the lobe tips esorediate and browned. While not very typical, it agrees with the description of an anomalous collection of Lynge (1921).

HYPOGYMNIA TUMIDULA Pike, ined.

Hypogymnia enteromorpha auct., non(Ach.) Nyl.

<u>Thallus</u> foliose; 5-11 cm broad. Lobes 2-5 mm wide, hollow, linear, irregularly to dichotomously branched, usually appressed and crowded or more rarely free, imbricate, and attached only centrally; convex, usually uneven, slight constrictions at intervals and branching points; upper surface smooth, shiny to dull and rugulose in some older sections, esorediate, whitish grey to pale glaucous green, often browned at lobe tips; lower surface black to brown at the tips, often visible as a black margin from above, rugulose, shiny; rhizines absent.

<u>Apothecia</u> occasionally present, laminal, on an urceolate, tumid stipe, 2-13(-20) mm wide. Thalline margin present. Disc brown, concave becoming plane. "Hymenium 40-55 µm high; paraphyses coherent; epithecium brown. <u>Spores</u> 8 per ascus, ellipsoid to subglobose, hyaline, epispore distinct, 5-8 X 4-5 µm.

Pycnidia black, abundant; pycnospores not seen.

Spot Tests: medulla P+ orange turning red or P-.

<u>Substratum/Habitat</u>: corticolous, the P+ strain is found primarily on <u>Pseudotsuga</u> and, infrequently, on other conifers, deciduous trees and shrubs and rotting logs; also once saxicolous; the P- strain was also found primarily on <u>Pseudotsuga</u> but was more frequent than the positive strain, on deciduous trees as a secondary substratum.

Selected Specimens: 2662, 3044 (P+ strain); 1539, 3888 (P- strain).

Local Abundance and Distribution: both strains frequent, with the P+ strain slightly more common; the P+ strain scattered throughout the CDFD subzone and adjacent zones primarily at inland sites; the P- strain much more common in the eastern part of the CDFD subzone (Gulf Islands and Saanich Peninsula) but also present in adjacent zones.

World Distribution: amphi-Pacific (Krog, 1968).

<u>Remarks</u>: <u>H</u>. <u>enteromorpha</u> (Ach.) Nyl. was described from material collected in California. The type is actually a rare species and does not correspond to the widespread species typically called by this name (Brodo, pers. comm.) However, even recently published treatments (Hale, 1979) continue to use this epithet pending publication of <u>H</u>. tumidula.

<u>H.</u> <u>tumidula</u> is chemically diverse according to literature reports (Krog, 1968; Nuno, 1964; Ohlsson, 1973). Specimens containing physodalic acid (P+ orange-red) <u>+</u> other acids are considered the typical variety. Specimens lacking physodalic acid (P- or P+ yellow) <u>+</u> other acids has been named <u>Parmelia</u> <u>enteromorpha</u> f. <u>inactiva</u> by Asahina (1952) and <u>Hypogymnia enteromorpha</u> var. <u>inactiva</u> (Asah.) by Bird & Marsh (1973a). Lacking morphological differences, the inactive strain does not merit species recognition. Locally the two strains are not morphologically separable although, interestingly, the Pvariety appears more fertile than the P+ variety. Out of 29 collections, 21 (72%) of the inactive strain were fertile compared to 18 out of 47 (38%) for the 'active' strain.

HYPOTRACHYNA (Vain.) Hale

Thallus foliose; lobes elongate-linear and truncate; corticate above and below, above cortex paraplentenchymatous with a pored epicortex; with or without soredia. Below black and rhizinate; rhizines dichotomously branched.

Ascocarp an apothecium, laminal, usually adnate. Thalline margin present. Spores 8 per ascus, ovoid, simple, hyaline.

Primarily corticolous; especially common at high elevations in the tropics.

<u>Hypotrachnya</u> was formerly part of <u>Parmelia</u>, subgenus <u>Parmelia</u>. There is one local species.

References: Hale (1974b, 1975).

HYPOTRACHYNA SINUOSA (Sm.) Hale, Smith. Contrib. Bot. 25:63. 1975.

Lichen sinuosus Sm., Engl. Botan., 29:tab.2050. 1809.

Parmelia sinuousa (Sm.) Ach., Synops. Lich.:207. 1814.

<u>Thallus</u> foliose; up to 3 cm broad. Lobes 0.5-1.5 mm wide, elongatelinear, centrally attached with rest of lobe \pm free. Upper surface smooth, shiny; sorediate, soredia farinose, present in terminal soralia, concolorous with thallus; sulphur yellow, pale yellow-green. Lower surface shiny black, browning at lobe tips; rhizines abundant, dichotomously branched, projecting beyond the margins.

<u>Apothecia</u> not observed. According to Hale (1975), "apothecia very rare", adnate, 1-4 mm in diameter; spores 10-14 X 7-9 µm.

Spot Tests: medulla K+ yellow turning red, P+ yellow-orange.

<u>Substratum/Habitat</u>: corticolous; very occasionally saxicolous; collected once each on <u>Holodiscus</u> and <u>Picea sitchensis</u>; the single saxicolous collection was on very shaded sandstone in the supralittoral zone with a <u>Frullania</u> sp.

Selected Specimens: 1952, 4041.

Local Abundance and Distribution: infrequent; two collections from the CDFD subzone both in the southern part of the subzone, one near the western boundary; present and much more abundant in the adjacent zones, especially the Fog/Spruce subzone of the CH zone.

<u>World Distribution</u>: tentatively circumtropical with extensions in oceanic-temperate regions; in the western Hemisphere it is known from Alaska to Oregon, the southeastern United States, Mexico, West Indies, the Andean region from Venezuela to Chile; in the Eastern Hemisphere it is reported from Europe, southeast Asia from southern Japan to Java; additionally it is reported from New Zealand (Martin 1966); Hale (1975) described the foregoing distribution as "pan-tropical-montane, pantemperate".

ICMADOPHILA Trev.

Thallus crustose. Ascocarp a sessile to shortly stipitate apothecium. The stipes secondarily covered with assimilative tissue. Thalline margin present, sometimes excluded to expose a hyaline proper margin. Disc pale flesh-coloured. Paraphyses simple or slightly branched. Asci slightly apically thickened, IKI-. Spores 8 per ascus, hyaline, fusiform, 1- to 3-septate. Pycnidia stipitate, lateral; fulcra endobasidial; pycnospores cylindri-

cal with somewhat thickened ends.

Lignicolous, muscicolous.

There is one local species.

ICMADOPHILA ERICETORUM (L.) Zahlbr., Wiss. Mitteilung Bosnien & Hercegov. 3:605. 1895.

Lichen ericetorum L., Spec. Plant.:1141. 1753.

<u>Thallus</u> crustose; irregular, covering extensive areas, 9 cm wide or greater; shiny, smooth to verruculose; deep glaucous green to greyish green.

<u>Apothecia</u> abundant, scattered, round to irregular, 1.4-2.0(-3.2) mm wide, sessile to shortly stipitate. Thalline margin irregular, becoming excluded except under the apothecium. Proper margin thin, smooth to crenulate, whitish, persistent. Disc plane becoming concave, sometimes convex, irregularly roughened surface, flesh-coloured. Hymenium 100 µm high; paraphyses single, coherent at tips; epithecium brown; hypothecium hyaline. Asci narrowly cylindrical. <u>Spores</u> 8 per ascus, hyaline, fusiform, 1-, 2-, or 3-septate, 22-28 X 4-5 µm.

Pycnidia not observed.

Spot Tests: none.

<u>Substratum/Habitat</u>: lignicolous, on rotten logs and stumps in shaded locations.

Selected Specimens: 2406, 4697.

Local Abundance and Distribution: infrequent; in the CDFD subzone present only in the northern part on Denman Island (three collections); present and more common in the zones to the west (see Figure 18).

<u>World Distribution</u>: circumboreal-(northern)circumtemperate in the Northern Hemisphere (Thomson, 1979).



IONASPIS Th. Fr.

Thallus crustose, thin and discontinuous to thicker and cracked-areolate, sometimes endolithic; homomerous. Phycobiont a green algae (Trentepohlia).

Ascocarp an apothecium, immersed, concave to plane, small [0.5 mm], pale to blackened. Proper margin typically present; thalline margin occasionally also present in some species. Paraphyses simple to slightly branched. Spores 8 per ascus, hyaline, simple, thin-walled, ellipsoid to ovoid.

Saxicolous.

References: Magnusson (1933).

There is only one local species.

IONASPIS ODORA (Ach.) Th. Fr., Lich. Scand. 1:273. 1871.

Gyalecta odora Ach., Lich. Helv. Spicil.:80. 1826/

<u>Thallus</u> crustose; thin and discontinuous, growing among sandgrains or thin and continuous to thicker and slightly cracked-areolate; smooth, <u>+</u> shiny, mottled pale yellow-grey to pale reddish-grey. Hypothallus absent.

<u>Apothecia</u> abundant, scattered to sometimes grouped and partially confluent, innate, 0.1-0.5 mm wide. Thalline margin usually not very obvious, occasionally visible as a slightly raised ring around sunken disc; also not readily visible in cross-section although some algae always present below hypothecium. Proper margin often visible as a pale white, very thin ring. Disc round to somewhat irregular, concave to plane, hyaline, flesh to pale orange. Hypothallus hyaline, fulvous to pale orange; paraphyses coherent; epithecium usually hyaline; hymenium 90-12- µm high. <u>Spores</u> 8 per ascus, simple, ellipsoid, hyaline, (10-)12-15 X 5-8 µm. Spot Tests: thallus K-, C-, KC-, P-; hymenium K-, C-.

<u>Substratum/Habitat</u>: saxicolous; on noncalcareous sandstone at both maritime and inland sites, probably in seepage microhabitats.

Selected Specimens: 2829, 2858.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone.

<u>World Distribution</u>: uncertain; reported from Europe, Asia, and western North America; described by Magnusson (1933b) as boreal-alpine.

<u>Remarks</u>: <u>I</u>. <u>odora</u> is a very polymorphic species. As Magnusson (1933b) pointed out, it "varies considerably in thickness and colour. It may be very thin and almost without cracks, especially near the edge of the specimens, or rather thick, cracked-areolate. Its colour is usually some shade of olive, pale greyish-olive to dark olive but there are also almost plumbeous thalli or almost whitish yellow ones". The local material, besides the paler coloration than is <u>typical</u> of the species, has a higher hymenium and slightly larger spores than is usual. Furthermore <u>I</u>. <u>odora</u> typically grows on granitic rock in or near brooks and lakes, being wetted by water at least part of the year!. The local material does not occur in such hatitats. However, although the local material is not aquatic it was typically encrusted with blue-green algae and in one instance a long, filamentous green algae, indicating a rather wet habitat.

KOERBERIA Mass.

Thallus foliose; of stellate, radiating, linear, appressed to raised lobes; with or without isidia or lobules; rhizines present, tufted; olivegreen above, pale below. Phycobiont blue-green.

Ascocarp an apothecium with a thalline margin or a pseudoexcipulum formed

from ordinary thallus tissue, appearing biatorine. Spores 8 per ascus, rarely mature, hyaline, simple or l-septate.

Saxicolous and corticolous.

References: Henssen (1963b).

There is once local species.

<u>KOERBERIA SONOMENSIS</u> (Tuck.) Henss., Can. J. Bot. 41:1351. 1963. Pannaria sonomensis Tuck., Proceed. Amer. Acad. Arts Sc. 12:169. 1877.

<u>Thallus</u> foliose; orbicular, 0.5-1.0 cm broad, or coalescing irregularly to cover larger areas. Lobes long, linear, 0.1-0.2 mm wide, increasing in width towards the margin, shiny, smooth to longitudinally striate, separate to contiguous, adnate or with short side lobes sometimes ascendant; rhizines inconspicuous, short, scattered, pale; deep greyish olive, olive, lighter below.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Henssen (1963b) the apothecia are 0.4-0.6 mm wide with either a thalline margin or a "proper margin formed by a false excipulum"; disc flat or slightly convex, red-brown; spores hyaline, initially ellipsoid and simple, becoming fusiform and l-septate with maturity, 10-17 X $3.5-4 \mu m$.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; on both sandstone and granite, more common in the supralittoral zone at maritime sites but also present inland.

Selected Specimens: 997A, 2010B.

<u>Local Abundance and Distribution</u>: infrequent; collected only in the southeastern part of the CDFD subzone (Gulf Islands); not collected in the adjacent zones.

World Distribution: western North America-Europe disjunct; in western

North America reported only from California, both coastal and inland (Henssen, 1963b); herbarium material (COLO) has been seen also from Oregon.

<u>Remarks</u>: According to Henssen (1963c) sterile material of <u>K</u>. <u>sonomensis</u> and <u>Vestergrenopsis isidiata</u> are virtually identical, although the latter species usually has laminal isidia and the former eventually forms marginal lobules. Since <u>K</u>. <u>sonomensis</u> was known only from California in North America and <u>V</u>. <u>isidiata</u> had an arctic distribution (Thomson, 1972) this geographical difference was used to distinguish sterile material. Recently, however, <u>V</u>. <u>isidiata</u> has been collected at several locations in southwestern British Columbia, namely Forbidden Plateau on Vancouver Island, Black Tusk area of Garibaldi Provincial Park, Tweedsmuire Provincial Park (Ohlsson, 1973), and Whistler Mountain (UBC). Although currently <u>K</u>. <u>sonomensis</u> is known locally from only lower elevations, it is primarily montane (up to 2,000 m in California and hence the distributions of the two species may overlap.

<u>K</u>. <u>sonomensis</u> was reported as new to the province in Noble (1978) based on the present study.

LECANACTIS Eschw.

Thallus crustose. Phycobiont Trentepholia.

Ascocarp a pseudothecium, sessile, with distinct receptacle, appearing lecideine. Disc \pm round, usually pruinose. Hypothecium dark brown to black. Asci bitunicate, \pm clavate. Spores 8 per ascus, hyaline, fusiform to acicular, sometimes curved, 3- to 7-septate.

Corticolous and saxicolous; best developed in warm climates.

1. Ascocarps pruinose; spores < 40 µm long L. MEGASPORA

1. Ascocarps not pruinose; spores > 50 µm long L. PATELLARIOIDES

<u>LECANACTIS MEGASPORA</u> (Merr.) Brodo, Lich. Can. Exs. 110. 1975. Lecanactis illecebrosa var. megaspora Merrill, Bryologist 16:59. 1913.

<u>Thallus</u> crustose; usually thin, farinose, occasionally almost smooth and continuous; light grey to greenish grey.

<u>Apothecia</u> common, sometimes abundant but usually only a few scattered among pycnidia; adnate, sometimes appearing almost stalked when apothecia flexuous; round to more commonly irregular, 0.4-1.1 mm wide. Proper margin entire, thick, raised, persistent, black. Disc plane often becoming flexuous, covered in thick white or yellowish pruinia (occasionally even brownish). Hypothecium black; epithecium darkened by pruinia granules; hymenium 65-75 μm high, hyaline to more commonly fulvous; paraphyses coherent; asci bitunicate. <u>Spores</u> 8 per ascus (only up to 6 counted because of septation), hyaline or greenish, fusiform with one end drawn-out or attenuated, 3-septate, (25-)28-33 X (3-)4-5 μm (see Figure 17).

<u>Pycnidia</u> usually present, abundant, stalked, black, 0.1-0.3 mm high and 0.1-0.3 mm wide. Pycnospores hyaline to greenish, 'banana-shaped' or cylindric with one or both ends apiculate, 12-15 X 2.5-3 μ m, being extruded as a white powdery mass.

Spot Tests: none.

Substratum/Habitat: corticolous; on conifers, especially Thuja.

Selected Specimens: 3211, 3711.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone although absent on most of the Gulf Islands; present and more common in the adjacent zones.

World Distribution: western North American endemic; probably a coastal

species; known from Washington and British Columbia.

<u>Remarks</u>: The pycnidia, which resemble small, black barrels with a dab of whipped cream on top, are often more abundant than the apothecia, with the latter often absent. In the field the abundant pycnidia vaguely resemble a species in the Caliciales, although a white mazaedium has not been encountered in any of the local species.

<u>L. megaspora</u> is similar to two European species, <u>L. amylacea</u> and <u>L. abietina</u>. Like the latter species, the pycnidia of <u>L. megaspora</u> are stalked and the apothecia are sessile rather than subsessile. However, the spores of <u>L. abietina</u> are larger (35-45 X 3-6 μ m), the ascocarps larger (0.8-2.0 mm), and the proper margin pruinose. <u>L. amylacea</u> has similar-sized ascocarps (0.2-0.6 mm) and an epruinose rim, however, the ascocarps are partially embedded in the thallus, the spores small (15-25 X 3-4 μ m), and the pycnidia are not stalked. Merrill (1913) considered <u>L. megaspora</u> to be a variety of <u>L. illecebrosa</u> (= <u>L. amylacea</u>), differing only in the larger spores and larger ascocarps. Brodo (1976) considered the two to differ also in degree of thallus development (thinner and scurfy in <u>L. megaspora</u>), adnation (see above), and shape of the apothecia. Although Brodo described the ascocarps of <u>L. megaspora</u> as always round, in local material these tend to be rather irregular, as in <u>L. amylacea</u>. (Note: the measurements for European species are taken from Ozenda & Clauzade, 1970).

LECANACTIS PATELLARIOIDES (Nyl.) Vain., Annal. Acad. Sc. Fenn., ser. A, 6(7) :143. 1915.

Lecidea patellarioides Nyl., Memoir. Soc. Science. Nat. Cherbourg 2:333. 1854.

<u>Thallus</u> crustose; thin to thick, farinose scattered patches; whitish to yellowish grey.

Pseudothecia common, adnate, round to usually slightly irregular, con-

stricted slightly at the base, 0.2-0.5 mm wide. Proper margin entire, thin, even, excluded early. Disc plane, becoming convex, epruinose, but surface uneven and appearing pebbly, black. Hypothecium medium brown, exciple black; epithecium brownish; hymenium hyaline, 80 µm high; paraphyses slightly branched but distinctly free; asci bitunicate. <u>Spores</u> difficult to dislodge from ascus, apparently 8 per ascus but not easily counted; hyaline, usually straight but occasionally curled in ascus, acicular, 12-26 septate, 57-85 X 2.5 µm (see Figure 17).

<u>Pycnidia</u> common, partially immersed to adnate, black, 0.05 mm wide; pycnospores cylindrical, 8-10 X 1 μ m.

Spot Tests: hymenium IKI-, ascal jelly IKI+ yellow-orange.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Picea sitchensis</u>. Selected Specimen: 4465.

<u>Abundance and Local Distribution</u>: rare; not collected in the CDFD subzone; collected once in the CH zone at a maritime site.

<u>Remarks</u>: <u>L. patellarioides</u> is distinguished from the other local <u>Lecan</u>actis species, <u>L. megaspora</u>, by the small black epruinose ascocarps and the large, acicular spores. Additionally, the pycnidia of the two species are markedly different; in <u>L. megaspora</u> they are comparatively large, and stalked, and extrude pycnospores while in <u>L. patellarioides</u> they are small, adnate, and do not extrude pycnospores.

This <u>Lecanactis</u> is perhaps more easily confused with <u>Bacidia</u> species and, indeed, <u>L</u>. <u>patellarioides</u> may have been described as such in western North America (see later discussion). The free paraphyses, the bitunicate asci, and IKI- reaction in the hymenium separate it from Bacidia.

<u>Bacidia clementis</u> Hasse, described from California, differs only in its possession of slightly wider spores than the local material, 60-80 X 4-5 μ m (Hasse, 1913), otherwise it matches <u>Lecanactis</u> patellarioides completely.

Mention is made of a yellowish grey to brown hypothecium,paraphyses not being coherent, and the hymenium not reacting with IKI except for the asci which turn yellow. This strongly suggests that <u>Bacidia clementis</u> may well be a species of Lecanactis. The type requires examination.

LECANIA Mass.

Thallus crustose, occasionally marginally lobed or squamulose.

Ascocarp an apothecium. Thalline margin present, well-developed, persistent or excluded. Proper margin sometimes exposed. Spores 8(-32) per ascus, hyaline, fusiform, 1-(3-)septate.

Pycnidia immersed; fulcrum exobasidial; pycnospores cylindrical to arcuate.

Saxicolous, often on calcareous substrata, or corticolous.

There is no modern treatment of this genus. Considering the relatively modest number of European species of Lecania, a disproportionately large number of species have been described from California. These include <u>L</u> brunonis (Tuck.) Herre, <u>L</u>. californica (Zahlbr.) Fink, <u>L</u>. dudleyi Herre, <u>L. fructigena</u> Zahlbr., <u>L</u>. subdispersa (Nyl.) Hasse, and <u>L</u>. toninioides Zahlbr. In similar circumstances are two species of <u>Solenospora</u>, <u>S</u>. crenata (Herre) Zahlbr. and <u>S</u>. hassei (Zahlbr.) Zahlbr. For all these species there are few descriptions and those available are usually abbreviated and often conflicting. They badly need to be re-evaluated. For purposes of the present study an attempt was made to sort out the problems, especially those that apply to the local species. However, not all the type specimens were located or were available for loan. Among the types examined considerable damage has occurred over the years to the friable sandstone substrata, which makes assessment difficult. L. brunonis also was heavily damaged by mold. Some problems concerning these

species have been sorted out, but time limitations excluded an exhaustive study. Additional review of this interesting group is needed.

1.	Cortico	lous <u>L</u> . <u>CYRTELLA</u>
1.	Saxicolo	bus
	2.	Spores mainly 3-septate <u>L</u> . <u>NYLANDERI</u>
	2.	Spores mainly 1-septate 3
3.	Thallus up to 2	of congested papillae; apothecia mm wide <u>L</u> . cfr. <u>AIPOSPILA</u>
3.	Thallus verrucos	not papillose although sometimes se; apothecia ≤1.5 mm, most < 1.0 mm
	4.	Thallus squamulose, ascendant (occasionally only warts); red-brown (paler in crevices), shiny <u>L</u> . <u>DUDLEYI</u>
	4.	Thallus crustose; grey, green, or brownish
5 .	Thallus yellow (of loose, small granules; apothecia flesh or coloured, often becoming tuberculate <u>L</u> . <u>ERYSIBE</u>
5.	Thallus blacken	areolate, apothecia (red-) brown to ing, not tuberculate6
	6.	Thallus verruculose-areolate, verrucae sometimes separated, P-; apothecia usually becoming crenulate, often pruinose when young; spores oblong, some curved <u>L</u> . <u>FRUCTIGENA</u>
	6.	Thallus evenly cracked-areolate, continuous, P+ red; apothecia with smooth margin, epruinose; spores fusiform-ellipsoid (at least one end pointed), straight <u>L</u> . <u>UNKNOWN</u> <u>#1</u>

LECANIA cfr. AIPOSPILA Th. Fr., Kg. Svensk. Vetensk.-Akad. Handl. 7:20. 1867.

<u>Thallus</u> crustose to minutely fruticose, consisting of tightly packed, upright papillae, 0.2-0.4 mm wide and up to 2 mm tall, becoming tightly congested in groups and appearing cracked-areolate (the cracks often wide and through to the substratum), at the margin often only low papillose-verrucae which may be slightly lobed; the individual papillae with gently rounded tips, \pm very finely cracked, often becoming darkened in the cracks; matt; tan, (pinkish-)

brown, darkening to brown-grey or blue-grey.

<u>Apothecia</u> scarce, terminal on the top of a papilla (although this is not often distinct), 0.9-2.0 mm wide. Thalline margin regularly crenate, level to raised becoming flexuous with age, concolorous with the thallus, matt, persistent. Proper margin never exposed. Disc round, often becoming lobate, plane to slightly convex or undulate, very constricted (=stipitate on a papilla) minutely roughened, matt; red-brown, brown, to blackening, epruinose. Hypothecium thick, inspersed with oil droplets, <u>+</u> hyaline below slightly yellowish towards the hymenium, of tightly packed, thick-walled but small elongated cells; epithecium dark brown, pale orange-brown below into the hymenium; paparphyses coherent, branched above, hymenium 60 μ m high; hyaline below. Spores 8 per ascus, hyaline, 1-septate, oblong-ellipsoid with equal cells, to tear-drop shaped with unequal cells, usually straight, 14-16(-18) 5-6.5 μ m (see Figure 17).

<u>Spot Tests</u>: thallus K<u>+</u> pale, sordid orange, C-, KC-, P-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous, on sandstone (HCl-) and igneous rocks in the supralittoral zone.

Selected Specimens: 1751, 6441A.

Local Abundance and Distribution: infrequent (see below); scattered in the southern part of the CDFD subzone at maritime sites, not collected in adjacent zones.

<u>World Distribution</u>: western North America-Europe disjunct; maritime; in Europe known from Great Britain (Duncan, 1970) north to Spitzbergen (Kopaczevskaja et al., 1971); in western North America known from British Columbia and Washington (Ryan, pers. comm.)

<u>Remarks</u>: This species was collected only once in a well-developed, fertile condition. Several sterile, poorly developed collections have been placed here

because sthey seem closest to this species. <u>L</u>. cfr. <u>aipospila</u> is probably much more common than the few collections indicate, but not collected often because of the sterile condition.

An apparently parasitic <u>Catillaria</u> sp. is often associated with this and other <u>Lecania</u> species. See <u>Catillaria</u> unknown #1 for additional comments.

The descriptions of European <u>L</u>. <u>aipospila</u> all lack measurements of the ascocarps (Fletcher, 1975a; Duncan, 1970) although Smith (1918) does describe them as "small". For this reason, until the local material can be compared with European specimens, it is only tentatively referred to this species.

L. <u>aipospila</u> is reported here tentatively as new to the province.

LECANIA CYRTELLA (Ach.) Th. Fr., s. lat., Lich. Scand. 1:294. 1871. Lecidea cyrtella Ach., Meth. Lich.:67. 1803.

<u>Thallus</u> crustose; effuse to almost determinate, thinnish, varying from continuous but finely cracked to effuse; granules flattened although still a little convex, corticate, <u>+</u> shiny; greenish tan to yellow-grey. (Note; yellowish tint may be an artifact of age). Hypothallus not observed.

Apothecia abundant, adnate, constricted, \pm scattered, 0.5-0.8 mm wide. Thalline margin initially thick, raised, \pm smooth, epruinose, sometimes a little shiny, concolorous with thallus, containing algae up to the edge of the rim; excluded only at the very end or occasionally early. Proper margin not observed. Disc \pm plane, finally convex, \pm round, flesh-tan to yellow-tan, lightly white pruinose. Hypothecium hyaline or pale yellow; paraphyses simple and free below, branched and more coherent above; epithecium yellow or pale yellow-brown; hymenium \pm hyaline, 35-50 µm high. Spores 8 per ascus, hyaline, 1-septate with cells equal or just as often cells unequal and the longer cell narrower than the shorter cell, the septum often the widest part of the spores; straight; 12-15(-17) X (3-)3.5-4 µm (see Figure 17). Spot Tests: thallus K+ yellow, C-, KC-, P-; hymenium IKI+ blue.

Substratum/Habitat: corticolous; collected once from "young fir".

<u>Selected Specimen</u>: not collected during the present study, one specimen examined, a collection made by J. Macoun (UVC-L4350).

Local Abundance and Distribution: rare; one specimen from the Saanich Peninsula in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: perhaps circumtemperate in the Northern Hemisphere; in North America reported from Ontario (Brodo, 1981), Michigan (Harris, 1977), South Dakota (Wetmore, 1968), California (Hasse, 1913) and Washington (Howard, 1950); also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

Remarks: There is some vagueness even in European descriptions concerning the species limits of L. cyrtella. The spores are described as straight or curved, the ascocarps apparently can be light pink-fawn to dark brown or black, spore width (depending how many splinter species are included) varies from 2 to 5 µm, and the asci can be 8- to 16-spored. Poelt (1969), who recognized the most corticolous Lecania species, regarded L. cyrtella as having 8 spores per ascus, the spores straight and 10-12 X 4.5-5.5 µm, and the apothecia 0.2-0.4 mm wide and yellowish- to blackish-brown with a lighter coloured rim. Several North American accounts are even more confused including material with 3-septate spores in L. cyrtella (Fink, 1935; Howard, 1950) The local material differs from L cyrtella, especially Poelt's description, in the pale yellowish, rather well-developed thallus, the slightly larger apothecia, which are of a constant pale colour and not darkening, but pruinose, and the slightly larger spores that are both bent and striaght. (Many Lecania species are indeed pruinose but no mention is made of this for L. cyrtella) Furthermore Macoun's specimen is from "young fir", presumable Pseudotsuga but could be Abies grandis, which is

known agound Sydney. European accounts cited only deciduous trees as substrata, including elm, elder, sycamore, and ash. Using Poelt's key the local material comes out closest to <u>L</u>. <u>prasinoides</u> Elenk. but only a skeletal description is available for that species -- spores 8 per ascus, straight, 8-12 X 2-4.5 µm -- differing from <u>L</u>. <u>cyrtella</u> only in the narrower width of spores. While the local collection differs from some accounts of <u>L</u>. <u>cyrtella</u>, and, indeed, seems rather distinctive, it seems best to include it under that species until more material of the local species can be collected, and the species limits of <u>L</u>. <u>cyrtella</u> are better understood.

<u>L</u>. <u>shastensis</u> Herre (Herre, 1912), a corticolous species described from California, has yellow apothecia but its spores are 3-septate.

<u>LECANIA</u> <u>DUDLEYI</u> Herre, Proc. Wash. Acad. Sci. 12:188. 1910. <u>Placolencania</u> <u>hassei</u> Zahlbr., Bryologist 17:62. 1914. Solenospora hassei (Zahlbr.) Zahlbr., Cat. Lich. Univ. 5:755. 1928.

<u>Thallus</u> crustose to squamulose; varying from thick, flattened or slightly convex, dispersed areoles, to scattered, thick, lone, ascendant squamules, 0.4-0.6 mm wide which are usually bent or contorted back towards the substratum; or squamules more developed, massed into rosettes up to 8 mm wide with individual lobes flat and imbricate or more often variously contorted and bent; all forms glossy cartilaginous; brown, red-brown, edges <u>+</u> a little lighter or whole thallus tan in protected crevices; whitish below. No hypothallus observed.

<u>Apothecia</u> occasional, arising from the center of areoles, initially very wide based, and subsessile, finally adnate and at length slightly constricted, 0.4-0.9 mm wide. Proper margin thick initially, \pm smooth and a little glossy, concolorous with thallus or partially tinged with red like the disc, even to slightly raised, \pm persistent but thinner with age. Disc \pm plane, sometimes

becoming orange, red-brown, brown, or piebald, \pm very slight white pruinose especially near the margin when young, not as common in older discs. Hypothecium hyaline, of very closely packed, small but thick-walled hyphae; paraphyses coherent; epithecium pale orange-brown to light brown diffusing up to half way down hymenium; hymenium 50-65 µm high, hyaline below. <u>Spores</u> 8 per ascus, hyaline, 1-septate, oblong-fusiform, usually straight or occasionally slightly bent, 12-16(-20) X 4-5 µm. Pycnidia immersed; fulcrum exobasidial; pycnospores arcuate or straight, 7.5-15 X 0.75-1.0 µm (see Figure 17).

Spot Tests: thallus K-, C-, KC-, P-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected on both calcareous and noncalcareous sandstones in the supralittoral zone, especially favouring shaded crevices; often accompanying <u>Lecania</u> cfr. <u>aipospila</u> and <u>Catillaria</u> <u>unknown #1</u>.

Selected Specimens: 1833, 3155B.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD zone at maritime sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; described from California.

<u>Remarks</u>: <u>L</u>. <u>dudleyi</u> is probably much more common than the few collection sites would indicate. Since it is commonly sterile and often grows in crevices, it is an inconspicuous species.

The growth form is intermediate between <u>Solenospora</u> and <u>Lecania</u>, and is usually better developed than the typical crustose <u>Lecania</u> thallus (although occasionally it is reduced to an areolate condition), but not really as developed as the organized squamulate, to placoidal, thallus of the typical <u>Solenospora</u>. Indeed, on a much reduced scale, there is a close similarity to the thallus of <u>S</u>. <u>holophaea</u> (Mont.) Samp., a European species growing in rock crevices also at maritime locations. In <u>L</u>. <u>dudleyi</u>, however, arcuate pycnospores are produced by exobasidial fulcra which, following Zahlbruckner (1926), definitely places it in the genus <u>Lecania</u>. Zahlbruckner was aware of this character as shown by notes and drawings that accompany the type of <u>Placolecania hassei (=Solenopsora hassei</u>); this suggests that he actually placed more importance on the thallus than on the pycnospores in separating the two genera.

The type of <u>P</u>. <u>hassei</u> has been examined and it is a direct match for the local material. The type of <u>L</u>. <u>dudleyi</u> was difficult to locate and, therefore, obtained on loan at a different time, so direct comparison to the other types was not possible. It would appear to be the same species (see below).

The thallus of L. dudleyi has been described in various ways. Fink (1935) described it as "tough, semiglobular, somewhat clustered, light to reddishbrown warts". Hasse (1913) stated it is "cartilaginous, coarse, semiglobular warts, grouped or dispersed, light brown to red-brown", while Herre (1910a) described the thallus as "effuse, of thick, irregular, closely appressed scales, which vary in shape from flattened squamules to rounded or subglobose warts...". The major difficulty reconciling the local material with the written descriptions of L. dudleyi was the wider spores which all authors agreed were 6-7.5 µm in width. The type of L. dudleyi, in fact, does have wide spores which, however, are very scarce and poorly produced. This invites the speculation that the spores of the type are anomalous or at least atypical enough to permit this slight difference to be accommodated within the limits of a single species. One other possible difference of the L. dudleyi type specimen from the rest of the material was the distinctly punctate, subsessile apothecial initials. This was not noted in the P. hassei type, but the specimen was returned before the L. dudleyi was received; the character remains unchecked.

The local material is definitely the same as <u>P</u>. <u>hassei</u>, which actually belongs in Lecania, and probably the same as <u>L</u>. <u>dudleyi</u>. Because the vegeta-

tive thallus is the same in both cases and the differences in the fruiting characters are rather minor, it seems best to accommodate all the material within the one species pending further study.

L. <u>dudleyi</u> is reported here as new to the province.

<u>LECANIA ERYSIBE</u> (Ach.) Mudd, Man. Brit. Lich.:141. 1861. Lichen erysibe Ach., Lich. Suec. Prod.:50. 1798.

<u>Thallus</u> crustose; granulate; granules <u>+</u> scattered, convex, corticate, 0.1-0.4 mm wide; the smaller granules loosely attached and easily dislodged; light greenish-grey. Hypothallus absent.

Apothecia abundant; <u>+</u> scattered, constricted, adnate, 0.6-1.2 mm wide. Thalline margin finely crenulate, initially raised, persistent, although occasionally excluded enough to expose the proper margin; concolorous with thallus. Proper margin thin, white or lighter yellow than the disc, exposed occasionally, usually not observed. Disc <u>+</u> round, plane becoming slightly convex or undulate to strongly convex, often tuberculate; light yellow to flesh coloured with some portions of tuberculate ascocarps brownish; almost transparent, epruinose or very lightly white pruinose, especially when young. Hypothecium hyaline; epithecium <u>+</u> hyaline to pale yellow; paraphyses branched and coherent; hymenium 70-75 μ m high. <u>Spores</u> 8 per ascus, hyaline, oblong to oblong-ellipsoid, straight, 1-septate or occasionally simple, the cells equal or unequal, the septum often a little irregular, 12-13(-15) X 5-6 μ m (see Figure 17).

Spot Tests: K-, C-, KC-, P-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected once on the cementing substance of conglomerate, HCl- to HCl+ (slowly) in places.

Selected Specimen: 2458.

Local Abundance and Distribution: rare; distribution poorly known,

collected once in the northern part of the CDFD subzone; not collected in adjacent zones.

<u>World Distribution</u>: tentatively circumtemperate in the Northern Hemisphere; in North America reported from Illinois, Iowa, Minnesota (Fink, 1935), Quebec (Lepage, 1972), the Smoky Mountains (Degelius, 1941), South Dakota (Wetmore, 1968), Colorado (Anderson, 1962), Arizona (Weber, 1963), and California (Herr, 1910a); also reported from New Zealand (Martin, 1968) and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: The single local collection was initially not identified as <u>L</u>. <u>erysibe</u>. However, the primary differences were the former's light coloured apothecia and perhaps their tuberculate nature. Hasse(1913) described California material as occasionally tuberculate but European descriptions do not mention this point. However, <u>L</u>. <u>erysibe</u> is a very polymorphic species and although the ascocarps are usually described as reddish brown to black, some descriptions also include "buff" (Dobson, 1979).

The local <u>L</u>. <u>erysibe</u> is similar to <u>L</u>. <u>californica</u> (Zahlbr.) Fink primarily in the granular thallus but also in the apothecia colour which ranges from "flesh-brown to darker" (Fink, 1935). <u>L</u>. <u>californica</u>, however, has much smaller apothecia, 0.15-0.4 mm. The type specimen was not available for study.

L. erysibe is reported here as new to the province.

LECANIA FRUCTIGENA Zahlbr., Bryologist 17:61. 1914.

<u>Thallus</u> crustose; when well-developed \pm determinate, thick, crackedareolate with each areole composed of several rounded verrucae; but often somewhat poorly developed and then thin, effuse, of \pm scattered, verrucose granules; \pm shiny; light to medium grey with the top of verrucae sometimes a little darker. Hypothallus absent.

Apothecia abundant, scattered to grouped, adnate, constricted, 0.7-1.4 mm

Thalline margin initially very thick, smooth, top edge + shiny and wide. blackened like disc, rest concolorous with thallus; eventually somewhat thinner, + crenulate, matt, becoming partially excluded to just expose proper margin but still remaining conspicuous, never completely excluded. Proper margin but still remaining conspicuous, never completely excluded. Proper margin thin, raised, black like disc. Disc initially + concave becoming plane, round to often a little irregular, minutely roughened but often still shiny, black or brown-black, + faint grey pruinia especially when young. Hypothecium hyaline, of small close-packed cells that merge into hymenium, underlain by a thicker hyaline tissue which is part of the proper exciple; proper exciple packed with small and numerous to large and few, rounded grey globules; epithecium dark brown to black, below orange-brown which diffuses down the top half of the hymenium; paraphyses coherent in water, appearing simple but very tightly held together; hymenium 50-75 µm high, hyaline in lower half. Spores 8 per ascus, hyaline, oblong, primarily 1-septate, with 2-septate not uncommon, and occasionally even 8-septate present, straight or curved, (14-)16-20(-24) X 3-4.5 µm (see Figure 17).

<u>Spot Tests</u>: thallus K+ sordid yellow, C-, KC-, P-; hymenium and hypothecium KIK+ blue; proper exciple IKI-.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone (HCl- and HCl+), conglomerate (HCl-) and limestone)HCl+) in the supralittoral zone; often accompanied by <u>Caloplaca laeta</u>.

Selected Specimens: 2311, 2692.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; described from California.

Remarks: L. fructigena is distinguished by the verruculose thallus which
is often well-developed and the crenulate thalline margin (in older ascocarps) that is excluded just enough to expose the proper margin. Well-developed <u>L. fructigena</u> approaches <u>L. cfr. aipospila</u> in appearance but the latter never has the proper margin exposed nor the grey globules in the exciple below the hypothecium. Furthermore, the young apothecia of <u>L. fructigena</u> are quite distinctive, being shiny, smooth, and darkened on the top margin giving the appearance of almost a Lecidea.

The collections from HCl- substrata were better developed than those on HCl+ substrata. Besides being poorly developed, the collections on HCl+ substrata were often lighter coloured with the apothecia somewhat piebald and lighter brown in colour, but they were not sufficiently different to be referred to another species.

The type specimen from South Catalina Island, California, is on HClrock. It is rather abundant and ranges from scattered verruculose granules to cracked-areolate and <u>+</u> determinate. The colour is a dark brownish, blackened on any high points and lighter near the edges or crevices. The apothecia are on the small side, 0.6-0.8(-1.0) mm wide and usually completely blackened. The spores are 13-18 X 4-5 µm with slightly more pointed ends than the local material and are always 1-septate. These differences are small and may be related to immature or stunted thalli, perhaps an insolation effect. The "crenate to lobulate squamules" mentioned by Fink (1935) and "flat-concave, rugose concave squamules with coarsely crenate to lobulate borders" mentioned by Hasse (1913) in all likelihood refer to the old apothecia, where only the thalline tissue remains in roughly cup-shaped structures, which are abundantly present on the type.

L. fructigena is reported here as new to the province.

LECANIA NYLANDERIANA Mass., Sched. Crit. Lich. 8:152. 1856.

<u>Thallus</u> crustose; of scattered, thin, scurfy granules; light grey. Hypothallus absent.

<u>Apothecia</u> abundant, scattered to grouped, adnate, constricted, 0.3-0.7 mm wide. Thalline margin smooth, shiny, even, concolorous with the thallus or a little browner. Disc <u>+</u> round or slightly irregular, as related to the substratum, plane to very slightly convex, pale brown, (red-)brown, or blackening to piebald, with a light white pruinia. Hypothecium hyaline or a little yellowish; epithecium dark brown, below orange-brown suffused down into the hymenium; paraphyses coherent, branched at apices; hymenium 50 μ m high, hyaline below. Spores 8 per ascus, hyaline, 3-septate (occasionally 1-septate intermixed), oblong-ellipsoid, straight to often bent, 11-15(-17) X 4.5-5 μ m (see Figure 17).

Spot Tests: none.

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<u>Substratum/Habitat</u>: saxicolous, collected once on HCl+ sandstone. Selected Specimen: 1892B.

Local Abundance and Distribution: rare; distribution poorly known, collected once at an inland site on the Gulf Islands in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumtemperate; in North America reported from Iowa (Fink, 1935) and South Dakota (Wetmore, 1968).

<u>Remarks</u>: <u>L</u>. <u>nylanderiana</u> was the only saxicolous <u>Lecania</u> species collected at a non-maritime site.

LECANIA UNKNOWN #1

<u>Thallus</u> crustose; continuous, areolate; centrally smooth, incompletely cracked-areolate, marginally not as cracked although <u>+</u> slightly verrucose; almost shiny; dark olive-brown, olive-grey. Hypothallus absent or inconspicuous, finely dendric, shiny dark brown.

<u>Apothecia</u> common, scattered to grouped, constricted but very closely adnate, 0.4-0.9 mm wide. Thalline margin thick, smooth, raised, persistent, concolorous with thallus on the sides with the top of the margin <u>+</u> partially darkened like the disc. Disc round, <u>+</u> plane or slightly convex; shiny; sordid brown or sordid (red-)black; epruinose. Hypothecium hyaline; proper exciple below hypothecium with yellowish patches otherwise hyaline; paraphyses coherent; epithecium (reddish-)brown, suffused partially down hymenium; hymenium 55 µm high, hyaline below. <u>Spores</u> 8 per ascus, hyaline, straight, fusiformellipsoid, 1-septate, with cells equal or unequal, one or both ends pointed, septum thicker than outer wall, 13-18 X 3.5-4.5 µm (see Figure 17).

Spot Tests: thallus K-, C-, KC-, P+ orange-red; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected once on a large cobble of conglomerate (HCl-, but cementing rock HCl+).

Selected Specimen: 2606.

Local Abundance and Distribution: rare; distribution poorly known, collected once at a maritime site in the northern part of the CDFD subzone, not collected in adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This <u>Lecania</u> is characterized by the continuous, <u>+</u> smooth, areolate thallus which is P+ red, and the smooth, persistent margin of the apothecia.

<u>L</u>. <u>pepogospora</u> H. Magn., as described from Connecticut, has a P+ orangered thallus. Hale (1950), however, stated that it is "characterized by the greenish or \pm brownish, continuous thallus, red-brown, convex apothecia, the low thecium (50 µm high), the thin paraphyses (1-1.5 µm), the small spores (8-10 X 4-5 µm) with gelatinous wall ... and the very small conidia (1.5 X 0.5 µm)".

LECANORA Ach.

Thallus crustose or placoidal.

Ascocarp an apothecium adnate. Thalline margin present, persistent or finally excluded. Paraphyses unbranched, coherent or free. Spores 8(-16) per ascus, hyaline, simple, <u>+</u> ellipsoid, usually small (< 20 um in length).

Saxicolous, corticolous, or lignicolous.

There has not been a recent monograph of all species of this large genus. Some sections, however, are being reviewed currently and some recent checklists have recognized segregate genera, including <u>Aspicilia</u>, <u>Hymenelia</u>, and Rhizoplaca (Hawksworth et al., 1980).

Several local species of <u>Lecanora</u> lack an obvious thalline margin, especially at maturity. Algae, however, may be found below the hypothecium either in isolated clumps or as a well-developed layer, indicating that the margin is actually lecanorine.

References: Brodo (1977, 1979b, 1979c), Follman & Huneck (1968b), Imshaug & Brodo (1966), Magnusson (1931), Poelt (1952, 1958), Poelt & Vězda (1977, 1981).

1.	Corticolous or lignicolous 2
1.	Saxicolous 12
	2. Thallus glossy, brown, turgid granules <u>L.</u> <u>OCHROCOCCA</u>
	2. Thallus pale, grey to greenish; + flattened areoles or thallus + absent

3.	Hypothe	cium brown <u>L</u> . <u>ATRA</u>
3.	Hypothe	cium <u>+</u> hyaline
	4.	Disc densely white pruinose, C+ yellow <u>L</u> . <u>CARPINEA</u>
	4.	Disc epruinose or not densely pruinose 5
5.	Thallus	pale greenish or yellow-green, C+ orange
5.	Thallus	greyish, C-; or thallus \pm absent
	6.	Thallus esorediate <u>L. SYMMICTA</u>
	6.	Thallus sorediate <u>L</u> . <u>EXPALLENS</u>
7.	Lignico well-de	lous on driftwood; apothecia > 1 mm, with veloped margin and red-brown disc
7.	Cortico 1 m	lous; or if lignicolous on driftwood then n and margin becoming excluded8
	8.	Thallus <u>+</u> continuous and smooth; apothecia plane, yellow or pale green and browning; thalline margin well-developed with large crystalsL. <u>PACIFICA</u>
	8.	Thallus reduced, often <u>+</u> absent; apothecia margin thin or excluded if well-developed then white pruinose, lacking crystals entirely or only small crystals present9
9.	Lignico sometimo	lous on driftwood; margin concolorous with disc, es white pruinose; disc glossy red-brown <u>L. UNKNOWN</u> #4
9.	Cortico red-bro	lous or if lignicolous, then disc not glossy wn, thalline margin concolorous with thallus
	10.	Disc green to pale brown; margin white pruinose; apothecia constricted, 0.4-0.8 mm wide; thallus <u>+</u> absent, apothecia scattered <u>L. HAGENI</u>
	10.	Disc (red-)brown; margin not heavily white pruinose, apothecia up to 0.5 mm wide; thallus moderately developed to <u>+</u> absent; apothecia grouped to scattered 11
11.	Apothec thallin	ia broadly adnate, often clustered e margin P <u>L</u> . <u>UNKNOWN</u> #3
11.	Apothec thallin	ia moderately constricted, scattered, e margin P+ orange <u>L</u> . <u>UNKNOWN</u> <u>#2</u>
	12.	Thallus placoidal 13
	12.	Thallus entirely crustose, lobes not developed

	0°	
13.	Thallus	sorediate <u>L. DEMISSA</u>
13.	Thallus	esorediate
	14.	Thallus greenish or yellow-green
	14.	Thallus whitish MELANASPIS
15.	Lobes <u>+</u>	flattened; C 16
15.	Lobes ar	rched, C+ red <u>L</u> . <u>STRAMINEA</u>
	16.	Disc yellow to browning; thallus with <u>+</u> well- developed lobes, edged in white and/or black <u>L</u> . <u>MURALIS</u>
	16.	Disc yellow becoming green-black; thallus only slightly lobed at periphery; occurring at higher elevationsL. <u>INTRICATA</u>
17.	Thallus	dark brown
17.	Thallus	white, grey, green, or yellow 19
	18.	Thallus crustose; spores citriform; disc brown <u>L</u> . <u>BADIA</u>
	18.	Thallus stalked, peltate areoles; spores ellipsoid; disc black <u>L</u> . <u>SCOTOPHOLI</u> S
19.	Disc hea	avily white pruinose, C+ yellow <u>L</u> . <u>RUPICOLA</u>
19.	Disc ep	ruinose
	- 20.	Thallus green or yellow-green 21
	20.	Thallus white, grey, or blue-grey 22
21.	Thallus disc be	well-developed, marginally <u>+</u> lobate; coming green-black, margin persistent <u>L</u> . <u>INTRICATA</u>
21.	Thallus yellowi	usually reduced, often <u>+</u> absent; disc pale sh, usually convex, margin often excluded <u>L</u> . <u>POLYTROPA</u>
	22.	Margin \pm white pruinose; thallus reduced, often \pm absent 23
	22.	Margin epruinose; thallus usually well-developed
23.	Disc sh highly	iny red-brown, becoming very flexous; apothecium constricted, \geq 0.8 mm; epithecium pigmented <u>L</u> . <u>UNKNOWN #1</u>
23.	Disc pa not fle 0.8 mm;	le greenish to browning, <u>+</u> round or compressed, xuous; apothecium not highly constricted, ≤ epithecium granular

.

	24. Hypothecium black <u>L</u> . <u>ATRA</u>
	24. Hypothecium <u>+</u> hyaline 25
25.	Disc pale to piebald, brown/green, often tuberculate with age; K-, P-; round to often irregular <u>L</u> . <u>ALBESCENS</u>
25.	Disc red-brown, <u>+</u> plane, <u>+</u> round; K+ yellow, P+ yellow
	26. Apothecia > 1 mm; supralittoral zone <u>L</u> . <u>GRANTII</u>
	26. Apothecia \leq 1 mm; not at maritime sites <u>L</u> . <u>CAMPESTRIS</u>

<u>LECANORA ALBESCENS</u> (Hoffm.) Branth & Rostr., Bot. Tidsskrift. 3:196. 1869. Psora albescens Hoffm., Deutschl. Flora:165. 1796.

<u>Thallus</u> crustose; cracked-areolate, often orbicular, well-developed, 1.5-4.5 cm broad. Areoles thin to thick, often verruculose, surface smooth and a little cartilaginous to often furfuraceous and dull; showy white, creamy white, yellowish white.

<u>Apothecia</u> abundant, usually crowded, subsessile becoming sessile and only slightly constricted, 0.4-0.9 mm wide. Thalline margin thin to moderate, initially raised and often with a bluish black tinge, becoming even with disc and concolorous with thallus, occasionally partially excluded to expose hyaline proper margin. Disc round, usually becoming irregular, often flexuous, concave to plane or occasionally finally convex, epruinose, white, becoming unevenly darkened in colour (piebald to tan-brown or brownish. Hymenium 50-65 μ m high, paraphyses simple or slightly branched, coherent; epithecium granular, pale brownish; hypothecium <u>+</u> hyaline or a little fulvous. <u>Spores</u> 8 per ascus, hyaline, (elongate-) ellipsoid, simple to occasionally spuriously 1-septate, 10-13(-15) X 5-6 μ m.

Spot Tests: thallus K-, C-, KC-, P-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous, on sandstone, conglomerate and igneous rocks, often HCl+, in the supralittoral zone.

Selected Specimens: 950, 4170.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: circumtemperate (Ozenda & Clauzade, 1970) in the Northern Hemisphere; also reported from New Zealand (Martin, 1966) and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: In the study area this species is restricted to the supralittoral zone, while in Europe it is not restricted to maritime sites. Ozenda & Clauzade described <u>L</u> <u>albescens</u> as preferring calcareous, nitrogenous substrata and often quite toxitolerant. Fletcher (1975a, 1975b), did not include it in the <u>Key for the identification of British marine and</u> <u>maritime lichens</u> although he may have included it under <u>L</u>. <u>dispersa</u>. <u>L</u>. <u>albescens</u> "(Hoffm.) Floerke" was reported to occur in Alaska, on Umnak Island in the Aleutian Islands, where it grew with <u>Xanthoria candelaria</u> (Degelius, 1937), although the material was described to be scanty and perhaps was referable to <u>L</u>. <u>caesioalba</u> Koerb. The local material seems very close to the European <u>L</u>. <u>albescens</u> but appears to have a slightly different habitat locally. The differences warrant further study of this common species.

LECANORA ATRA (Huds.) Ach., Lich. Univ.:407. 1810. Lichen ater Huds., Flora Anglica 1:445. 1762.

<u>Thallus</u> crustose; rimose-areolate, commonly continuous and <u>+</u> orbicular, 4-6 cm broad, or less commonly of scattered corticate granules; areoles verruculose, dull to slightly shiny; white to greyish olive (shaded locations).

<u>Apothecia</u> common, scattered to sometimes grouped, subsessile quickly becoming adnate, moderately constricted, 0.7-1.6(-3.2) mm wide. Thalline margin thick, entire, becoming thin and sometimes crenulate, occasionally almost excluded, sometimes blackish-blue tinged, usually concolorous with thallus. Disc plane, sometimes concave, round to irregular, black, smooth and shiny, often uneven with age and then often matt. Hymenium 60-75 μ m high, pale red-black or brownish; paraphyses coherent; epithecium black; hypothecium brown to brownish-black. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid to broad-ellipsoid, epispore distinct, 10-13 X (6-)7-8(-10) μ m.

<u>Pycnidia</u> infrequent, blueish-black, immersed; pycnospores hyaline, cylindrical, usually straight, $11-16(-20) \times 1 \mu m$.

<u>Spot Tests</u>: cortex K+ yellow; medulla K-, KC-, C-, P-; hymenium K+ pinkish (indistinct when hymenium brownish-black), IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous and corticolous; when corticolous often on Pseudotsuga.

Selected Specimens: 1255, 3953.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone, not collected in the adjacent zones; corticolous collections only from higher elevations inland, saxicolous collections primarily, but not exclusively, from maritime sites.

<u>World Distribution</u>: circumboreal (-circumtemperate) in the Northern Hemisphere; also reported from Australia (Weber & Wetmore, 1972), Argentina (Grassi, 1950), and Venezuela (Hertel, 1971) in the Southern Hemisphere; Hertel (op. cit.) also cited reports from South Africa, Brazil, Chile, Juan Fernandez, Falkland Islands, and Antarctica.

LECANORA BADIA (Hoffm.) Ach., Lich. Univ.:407. 1810. Verrucaria badia Hoffm., Flecht. Deutschl.:182. 1796.

<u>Thallus</u> crustose; areolate, effuse; areoles continuous to \pm scattered, irregular, swollen, shiny; buff brown to olive brown.

Apothecia abundant, usually crowded, adnate and moderately constricted

to sessile and hardly constricted, (0.5-)0.7-0.7(-1.0) mm wide. Thalline margin thin, concolorous with thallus, shiny. Disc plane, shiny, <u>+</u> round, olive-black. Hymenium 40 µm high; paraphyses simple, coherent; epithecium brownish; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, fusiform to ellipsoid with ends acute (citriform), 10-12 X 3-4(-5) µm.

<u>Spot Tests</u>: thallus K-, C-, KC+ purplish (fading), P-; hymenium IKI+ blue.

Substratum/Habitat: saxicolous; collected once on igneous rocks.

Selected Specimen: 5449.

Local Abundance and Distribution: rare; collected once at an inland, exposed site (500 m) on Saltspring Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-alpine in the Northern Hemisphere (Thomson, 1979); also reported from Australia (Weber & Wetmore, 1972), Argentina (Grassi, 1950), and Venezuela (Hertel, 1971); Hertel (op. cit.) also cited reports from South Africa and the Falkland Islands.

<u>Remarks</u>: The local collections are rather limited; other descriptions of <u>L</u>. <u>badia</u> report the apothecia to be larger, up to 1.5 mm wide (Duncan, 1970) or 1-2 mm wide (Ozenda & Clauzade, 1970).

<u>L</u>. <u>badia</u> was reported as new to the province in Noble (1978) as a result of the present study and additional specimens from Revelstoke National Park and Garibaldi Provincial Park on the mainland.

LECANORA cfr. CAMPESTRIS (Schaer.) Hue., Bull. Soc. Bot. France. 35:47. 1888. Lecanora subfusca var. campestris Schaer., Enum.:75. 1850.

<u>Thallus</u> crustose; covering up to 11 cm wide, generally inconspicuous, of scattered granules or verruculose cracked-areoles, usually thin, dull, scurfy; pale grey. Hypothallus white, occasionally visible at margin.

<u>Apothecia</u> abundant, scattered, occasionally grouped, adnate, moderately to highly constricted, 0.4-1.0 mm wide. Thalline margin entire, to slightly crenulate, <u>+</u> shiny, slightly raised, concolorous with thallus or occasionally with a bluish tinge; containing numerous, small (< 1.5 μ m wide), greyish granules in the ampithecium. Disc shiny at least when young, sometimes matt with age, chestnut to dark brown or nearly black, plane to slightly convex, <u>+</u> round. Hymenium 60-70 μ m high; paraphyses simple, coherent; epithecium light orange-brown, pigmented, not granular; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, subglobose to <u>+</u> ellipsoid, simple, uniseriate, epispore distinct, 11-13(-14) X 6-7(-8) μ m.

<u>Spot Tests</u>: cortex K+ yellow; medulla P<u>+</u> yellow (-orange), C-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; on sandstone, especially HCl+.

Selected Specimens: 894, 1890.

Local Abundance and Distribution: occasional; scattered throughout the CDFD zone, but more common on the Gulf Islands, at both maritime (above the supralittoral zone) and inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia: disjunct; also reported from Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks</u>: <u>L</u>. <u>campestris</u> is similar to <u>L</u>. <u>grantii</u> which is found locally on both rock and driftwood. <u>L</u>. <u>grantii</u> has larger apothecia (up to 3.5 mm broad), usually a 'cleaner' white, better developed thallus, and is restricted to the lower supralittoral zone at beach sites.

Brodo (1977) stated that in North America <u>L</u>. <u>campestris</u> is made up of two separate, possibly different populations, one in Nova Scotia and the other in California. He suggested that European <u>L</u>. <u>campestris</u> may be different from both North American populations because it possesses a smooth, grey thallus while the thallus of the latter is usually rough to verruculose. However, all descriptions of European <u>L</u>. <u>campestris</u> available (Smith, 1918; Ozenda & Clauzade, 1970; Duncan, 1970; Dobson, 1979)mentioned warted-granulate or granular-areolate to finely granulose thallus. The illustration in Dobson (1979, p. 113) shows it as distinctly granulose-warted. The type specimen has not been seen.

L. campestris is reported tentatively here as new to the province.

LECANORA CARPINEA(L.) Vain., Meddel. Soc. Faun. Fl. Fenn.14:23. 1888. Lichen carpineus L., Sp. Pl.:1141. 1753.

<u>Thallus</u> crustose; smooth, thin, nearly endophloedal to moderately thick, rimose-cracked; whitish-grey. Hypothallus white, occasionally visible at the margin; thin.

<u>Apothecia</u> common, scattered to often grouped and crowded, adnate, moderately constricted, 0.5-0.8 mm wide. Thalline margin usually moderate to thick, prominent, raised or even with disc, persistent in all but the most convex discs, when it is still usually just visible as a thin basal rim; concolorous with thallus; lacking clumps of large crystals in the ampithecium. Disc plane to sometimes finally convex, <u>+</u> round or often angular by compression, yellow to yellow-brown or red-brown but usually appearing white because of the heavy white, granular to farinose pruinia, with pruinia often reduced in older, convex discs. Hypothecium hyaline; hymenium 60-75 μ m high, hyaline; epithecium yellow to brownish(-red) from granular deposits on top of paraphyses. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 9-12 X 5-7 μ m.

<u>Spot Tests</u>: thalline margin K+ faint yellow, C-, KC-, P-: pruinia on disc C+ yellow(-orange).

Substratum/Habitat: corticolous; collected only on deciduous trees

(especially the branches) and shrubs, including <u>Acer</u>, <u>Quercus</u>, and <u>Holodis</u>-<u>cus</u>.

Selected Specimens: 793, 1731.

Local Abundance and Distribution: infrequent; scattered in the southern part of the CDFD subzone at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; there is also one report of this species from India (Schubert & Klement, 1966); in eastern North America it is quite rare and restricted to the Lake Superior region; in western North America it is more widespread being found from California north to British Columbia and eastward to Idaho and Colorado (Imshaug & Brodo, 1966).

LECANORA DEMISSA (Flot.) Zahlbr., Verh. Zool. Bot. Ges. Wien 48:368. 1898. Imbricaria demissa Flot., 28.Jahresber. Schleisisch. Gesellsch. fur

vaterland. Kultur:133. 1850.

Lecanora incusa (Flot.) Vain., Termeszetr. Fuzetek 22. 1899.

<u>Thallus</u> placoidal; orbicular, 0.5-1.0 cm broad, occasionally coalescing to cover large areas. Lobes linear, closely adnate, <u>+</u> plane, contiguous to sometimes imbricate, 0.2-1.3 mm wide, shiny, smooth, transversely cracked, almost areolate towards the center; olive brown, buff brown, with the lobe tips or occasionally the entire thallus white pruinose, sometimes pruinia absent. Sorediate; soralia laminal, globose, concentrated towards the center of thallus; soredia granular, brown to whitish. Hypothallus absent.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Ozenda & Clauzade (1970) the apothecia are rare, brown, and small; the spores 9-12 X 4-5 μ m.

Spot Tests: none.

Substratum/Habitat: saxicolous; on sandstone, conglomerates and igneous

rocks, preferring sloping, often shaded or partially shaded surfaces.

Selected Specimens: 294, 4764.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, but concentrated at inland sites in the southern part, not collected in adjacent zones (see Figure 19).

<u>World Distribution</u>: western North America (California)-Europe (central to Mediterranean area) disjunct (Poelt, 1958).

<u>Remarks: L. demissa</u> was reported as new to the province in Noble (1978) as a result of the present study.

LECANORA DISPERSA (Pers.) Somm., Suppl. Fl. Lapp.:96. 1826.

Lichen dispersus Pers., Neue Ann. Bot. 1:27. 1794.

<u>Thallus</u> crustose; scurfy-areolate, or more commonly very reduced, \pm absent except in immediate vicinity of ascocarps, occasionally of scattered verrucose granules; pale grey.

Apothecia abundant, scattered to crowded, 0.3-0.9 mm wide. Thalline margin thin to thick, usually roughened, cracked, or pruinose-granular, occasionally partially smooth and entire. Disc epruinose, flesh-coloured to light brownish, concave, sometimes plane or convex, round to somewhat flexuous. Hymenium 45-55 µm high; paraphyses coherent; epithecium (orange-)brown, granular; hypothecium hyaline. Spores 8 per ascus, hyaline, ellipsoid, episore thin or indistinct, 9-12 X 5-6 µm.

Spot Tests: thallus K-, C-, KC-, P-; hymenium IKI+ blue.

Substratum/Habitat: saxicolous; on all rock types.

Selected Specimens: 153, 2547.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones at both inland and maritime sites.

World Distribution: circumarctic to circumtemperate (Thomson, 1979).



<u>Remarks</u>: <u>L. dispersa</u> is similar to <u>L. unknown #1</u>. See that species for comments.

LECANORA EXPALLENS Ach., Lich. Univ.: 374. 1810.

<u>Thallus</u> crustose; thin, chinky and well delimited to leprose and effuse, occasionally partially disappearing within the substratum, sorediate; soralia globose, separate, sometimes becoming confluent; soredia farinose, concolorous with thallus or greying; pale greenish-yellow to yellowish-grey.

<u>Apothecia</u> few or absent; adnate, 0.4-0.9 mm wide. Thalline margin thin, sometimes excluded, crenulate to almost sorediate. Disc concave becoming plane to slightly convex, yellow to pale brown, epruinose to faintly white pruinose. Epithecium yellowish; hypothecium hyaline; hymenium fulvous, $60-75 \ \mu m$ high. <u>Spores</u> 8 per ascus, simple, hyaline, narrowly ellipsoid to ellipsoid, 9-15(-17) X 5-7 μm .

Spot Tests: thallus K+ yellow, C+ orange(-reddish).

<u>Substratum/Habitat</u>: lignicolous and corticolous; common on driftwood at maritime sites, also found at inland sites on fences and various tree species especially Pseudotsuga.

Selected Specimens: 1142, 3217.

Local Abundance and Distribution: infrequent (see below); scattered throughout the CDFD subzone and also present in the adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Thomson, 1979).

<u>Remarks: L. expallens</u> is undoubtedly more common than the small number of collections indicate since the sterile form, which is abundant, does not encourage collection.

LECANORA GRANTII H. Magn., Ann. Crypto. Exot. 5:21. 1932.

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<u>Thallus</u> crustose; orbicular, 2.5-7 cm broad or irregular, cracked-areolate; areoles \pm thick, dull, usually continuous, verrucose, occasionally of scattered granules; white. Hypothallus white, usually indistinct.

<u>Apothecia</u> abundant, initially subsessile, quickly becoming adnate and quite constricted, 0.9-2.1(-3.5) mm wide. Thalline margin initially thick and entire becoming thin and often crenulate; containing numerous, small, grey granules in the ampithecium. Disc plane becoming irregularly convex, round sometimes becoming flexuous, shiny, light to dark reddish brown. Hymenium 80-95 μm high; paraphyses simple, coherent; epithecium orange to light brown; hypothecium thick and hyaline. <u>Spores</u> 8 per ascus, hyaline, (elongate-)ellipsoid, epispore distinct, 13-18 X 6-7 μm.

<u>Spot Tests</u>: cortex K+ yellow; thallus P+ yellowish or sometimes P-, C-, KC-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous and lignicolous only on driftwood, always in the supralittoral zone.

Selected Specimens: 1469A, 5173.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at maritime sites; also present in the adjacent zones.

<u>World Distribution</u>: tentatively eastern North America-western North America endemic; maritime (Brodo, 1977).

<u>Remarks</u>: <u>L. grantii</u> is similar to <u>L. campestris</u>. See the latter species for comments.

LECANORA HAGENI (Ach.) Ach., Lich. Univ.:367. 1810.

Lichen hageni Ach., Lich. Suec. Prod.: 57. 1798.

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<u>Thallus</u> crustose; thin, continuous or often scattered flattened areoles, usually scant to almost absent; greenish-grey to green. Hypothallus blueblack, often inconspicuous.

Apothecia abundant, usually scattered to occasionally grouped, adnate, highly constricted (beginning as a small convex bump that breaks open apically and so becoming white "pruinose" at the apex, the bump elongating as the disc expands and appearing narrowly urceolate for much of the early stage), 0.4-0.8 mm wide. Thalline margin thick, raised, persistent, even, heavily white "pruinose" (actually decorticate) on the top edge with the lower sides concolorous with thallus; internally lacking crystals or greyish granules in Disc round, occasionally angular from compression, concave, the ampithecium. sometimes becoming + plane; pale greenish to tan, or browning, usually epruinose but sometimes with a faint white pruinia in the young ascocarps. Hypothecium hyaline, 25-35 µm thick; epithecium granular (orange-)brown; paraphyses simple, slightly coherent; hymenium 70-75 µm high, hyaline; amphithecium with thick cortex (50-80µm) of radiating, thick-walled hyphae which thins towards the upper margin until decomposed at the very top. Spores 8 per ascus, hyaline, simple, broadly ellipsoid, 10-13 X 6-7 μm.

<u>Spot Tests</u>: thallus K-, C-, KC-, P-; hymenium IKI+ blue, K-; epithecium granules dissolving in K.

<u>Substratum/Habitat</u>: corticolous; collected once abundantly on the trunk of young <u>Acer</u> with <u>Catillaria</u> grithiffii and <u>Caloplaca</u> <u>flavorubescens</u>.

Selected Specimens: 7389B.

Local Abundance and Distribution: rare (see below); collected once on the Saanich Peninsula in the southern part of the CDFD subzone, not collected

in the adjacent zones.

<u>World Distribution</u>: circum(sub)artic-circumtemperate in the Northern Hemisphere (Thomson, 1979); also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: <u>L</u>. <u>hagenii</u>, without an apparent thallus and visible in the field only as a few, small, scattered ascocarps, is undoubtedly more common and widespread in the study area than the single collection indicates.

<u>L. hagenii</u> has some similarity to <u>L</u>. <u>pacifica</u> which has a greenish disc and white margin, however, the latter species has a conspicuous showy white thallus and the thalline margin contains large, angular, hyaline crystals.

LECANORA INTRICATA (Ach.) Ach., Lich. Univ.: 380. 1810.

Parmelia intricata Ach., Method. Lich.: 178. 1803.

Lecanora mutabilis Somm., non auct. nec (Ach.) Nyl., Suppl. Fl. Lapp.:82. 1826.

<u>Thallus</u> crustose; cracked-areolate; areoles varying from thick, \pm continuous with deep cracks between areoles, with marginal areoles sublobate, \pm forming small, tight rosettes, or thin and not well organized, slightly dispersed with interconnecting black hypothallus; matt to shiny, smooth; yellow to yellowish-white.

<u>Apothecia</u> abundant, clustered closely together, subsessile to closely adnate, hardly constricted, 0.4-0.8 mm wide. Thalline margin thin, shiny, raised, persistent, concolorous with thallus, sometimes blackening or blueblackening with age; algae only abundant as a continuous layer in the margin when young, with age the algae restricted to scattered clumps in the base or occasionally towards the outer margin. Disc round or oval, <u>+</u> flexuous with age, <u>+</u> plane, initially pale yellow, quickly becoming mottled yellow-black and finally <u>+</u> completely (blue-)black. Hypothecium hyaline, of thick-walled,

closely packed cells; paraphyses simple and/or apically branched epithecium bright green or golden, granular; hymenium 40-55 μ m high, hyaline below. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 9-11 X 4-5 μ m (spores difficult to expel from ascus).

<u>Spot Tests</u>: thallus K-, C-, KC-, P-, IKI-; hymenium IKI+ blue. <u>Substratum/Habitat</u>: saxicolous; collected once on conglomerate. <u>Selected Specimen</u>: 4661.

Local Abundance and Distribution: rare; collected once in the CDFW subzone at an exposed, high elevation (660 m) inland site; not collected in the CDFD subzone.

<u>Remarks</u>: <u>L</u>. <u>intricata</u> resembles both <u>L</u>. <u>polytropa</u> and <u>Lecidea</u> <u>sulphurea</u>. <u>L</u>. <u>polytropa</u> usually has a poorly developed thallus with pale apothecia which do not darken but become convex. <u>Lecidea</u> <u>sulphurea</u> has black apothecia from the start which do not contain algae, even initially.

L. intricata is reported here as new to the province.

LECANORA MURALIS (Schreb.) Rabenb., Deutschl., Krypt. Fl. 2:42. 1845. Lichen muralis Schreb., Spicil. Fl. Lipsiens:130. 1771.

<u>Thallus</u> crustose-placoidal; orbicular, 2.5-7 cm broad, or often irregular. Centrally <u>+</u> areolate, commonly crowded with apothecia; marginally placoidal. Marginal lobes adnate, contiguous to imbricate, usually concave, sometimes plane to almost convex, transversely cracked, smooth, shiny, dichotomously branched, marginally white pruinose or roughened; also often <u>+</u> black edged; yellowish green, pale green; below pale tan coloured.

Apothecia common, usually crowded, sessile to adnate, constricted, 0.9-1.6(-3.5) mm wide. Thalline margin entire to roughened or cracked, almost excluded in very convex apothecia, often black edged. Disc tan to red-brown, concave, becoming plane or convex, often distorted by crowding. Hymenium 55-60 µm high; paraphyses coherent; epithecium brown, pigmented. <u>Spores</u> 8 per ascus, uniseriate, hyaline, simple, ellipsoid, epispore distinct but thin, 8-12 X 5-6 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; especially on sandstone but also found on conglomerate, granitic and other igneous rocks.

Selected Specimens: 935, 5324.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both maritime and inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: (circumboreal-)circumtemperate (Thomson, 1979) in the Northern Hemisphere; in the Southern Hemisphere known from Chile in South America and Ethiopia in Africa (Seaward, 1976).

<u>Remarks</u>: Some forms of <u>L</u>. <u>muralis</u> are similar to <u>L</u>. <u>straminea</u>. See the latter species for comments.

LECANORA OCHROCOCCA (Nyl.) Noble, ined.

Lecidea ochrococca Nyl., Oefvers. Vet. Ak. Forh.: 297 1860; Lich. Scand.: 206. 1860.

<u>Thallus</u> crustose; of loose, scattered to clustered, glossy, convex granules, 0.1-0.5 mm wide, becoming fistulose with increasing size; olivebrown (shady locations), reddish brown, or tawny. Hypothallus not obvious, often indicated by a darkish stain on the substratum.

<u>Apothecia</u> common, grouped to usually scattered, adnate to substipitate, 0.6-1.0(-1.3) mm wide. Thalline margin thin, smooth or minutely scalloped, even with disc, usually quickly excluded, shiny, concolorous with the thallus. Disc round, initially plane, usually quickly convex or remaining plane with edges reflexed, occasionally somewhat tuberculate; very glossy, reddishbrown. Hypothecium hyaline, of horizontally arranged, swollen and conglutinated hyphae that contain the algal layer or clumps of algae; epithecium brownish-orange; hymenium 50 μ m high, light yellowish-orange to hyaline, simple, fusiform, 7-10 X 2.5-3 μ m (see Figure 17).

<u>Spot Tests</u>: thallus K-, C-, KC-, P-; hymenium IKI+ blue; hypothecium IKI+ purplish (slow).

<u>Substratum/Habitat</u>: corticolous; collected primarily on <u>Pseudotsuga</u> but also collected once each on <u>Pinus contorta</u> and <u>Alnus</u>.

Selected Specimens: 2276, 4206.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone, especially at inland sites, present but not as common in the adjacent CDFW subzone.

World Distribution: western North America-Europe disjunct.

<u>Remarks</u>: The local material was initially identified as <u>Lecidea ochroc-occa</u> based on Duncan (1970). Comparisons with Scottish specimens loaned from BM were a direct match. However, upon more careful examination the algal clumps (or layer in young ascocarps) were noticed. Upon request T. Ahti and T. Goward kindly checked Nylander's specimens of <u>L. ochrococca</u> at H. Although the type was absent, the available collections and those identified by Nylander were the same as the local material and, indeed, did contain algae in the margin.

The algal layer (or clumps) is always present although perhaps easily overlooked since the dark thallus colour is more reminiscent of a <u>Lecidea</u>, and thus the algal layer is not expected. In fact, the local material superficially closely resembles <u>Lecanora badia</u>. Both have a dark brown, shiny thallus of convex granules or areoles with shiny disc and narrow spores.

Because of the presence of a thalline margin, the local material was rekeyed utilizing North American keys of <u>Lecanora</u>. This produced the name <u>L. phaeobola</u> Tuck., a species known from California and Washington. Avail-

able descriptions correspond fairly closely to the local material. Fink (1935) described <u>L</u>. <u>phaeobola</u> as "wrinkled and papillate-granulose, the granules minute and polished". Hasse (1913) described the thallus "of small, light brown to brown papillae, rounded or crenulate". Both of the above authors gave a greater range in spore size that that observed in the local material, 9-13 X 3-5 μ m (Fink, 1935) and 10-18 X 4-5 μ m (Hasse, 1913).

Although it seems apparent that <u>Lecidea ochrococca</u> and <u>Lecanora</u> <u>phaeobola</u> are the same species, the types require checking. Nylander's name has priority but needs to be transferred to <u>Lecanora</u> because of the presence of algae in the margin.

<u>Lecanora ochrococca</u> is confirmed here as present in the province Earlier reports of <u>L</u>. <u>phaeobola</u> (Otto & Ahti, 1967; Otto, 1968) were based on misidentified specimens (UBC).

LECANORA PACIFICA Tuck., Syn. N.A. Lich. 1:191. 1882.

<u>Thallus</u> crustose; thin and smooth to slightly verrucose with the verrucae low, usually continuous, occasionally scattered, sometimes crackedareolate; white to pale whitish grey. Hypothallus black, occasionally visible at margin; usually absent

<u>Apothecia</u> common, scattered to occasionally crowded, moderately constricted, adnate, (0.6)0.8-1.2 mm wide. Thalline margin conspicuous, moderately thick, smooth and even to very slightly crenulate, raised, persistent, concolorous with thallus; containing clumps of large, angular, hyaline crystals in the amphithecium. Disc round, slightly concave to usually becoming plane, yellow-tan or pale greenish tan, occasionally browning, or often mottled with a blackish green, epruinose or very lightly white pruinose. Hypothecium hyaline; hymenium 50-65(-75) μ m high, <u>+</u> hyaline; epithecium hyaline or yellow(-brown), granular. <u>Spores</u> (6-)8 per ascus, biseriate to uniseriate, hyaline, simple, ellipsoid, epispore distinct, 11-15 X 6-8 µm.

<u>Spot Tests</u>: thalline margin and thallus K+ yellow (often faint), C-, KC-, P-.

<u>Substratum/Habitat</u>: corticolous; most common and best developed on Alnus but also occurring on most other trees especially deciduous trees.

Selected Specimens: 507, 4268.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: western North American endemic; along the Pacific coast from Alaska to California (Brodo, 1977).

<u>Remarks: L. pacifica</u> is superficially similar to <u>L. hageni</u>. See the latter species for comments.

LECANORA POLYTROPA (Ehrh.) Rabenh., Deutschl. Kryptog.-Flora 2:37. 1845. Verrucaria polytropa Ehrh. Deutschl. Flora:196. 1796.

<u>Thallus</u> crustose; usually scarce, consisting of scattered, irregular granules, sometimes almost absent, very occasionally forming a continuous areolate crust, 1.5-3 cm broad, surface scurfy, dull; pale green, pale greenish yellow, to pale yellow. Hypothallus not observed.

<u>Apothecia</u> abundant, scattered to crowded, adnate, 0.4-0.8(-1.0) mm wide. Thalline margin whitish-yellow, entire, shiny, sometimes becoming thin and nearly excluded. Disc plane to convex, sometimes round but usually irregularly shaped and often with a flexuous margin, tan-flesh, yellow, to pale brownish. Hymenium 45-55 μ m high; paraphyses simple, apically coherent; epithecium light brown; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, epispore distinct, 10-12(-13) X 5-6(-7) μ m.

Spot Tests: cortex K+ yellow; hymenium IKI+ blue.

Substratum/Habitat: saxicolous; on all rock types.

Selected Specimens: 631, 3047.

Local Abundance and Distribution: frequent; scattered throughout the southern part of the CDFD subzone primarily at exposed, inland sites, present but not as common in adjacent zones.

<u>World Distribution</u>: circumarctic-alpine and circumboreal in the Northern Hemisphere (Thomson, 1979); also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), Argentina (Grassi, 1950) and Venezuela (Hertel, 1971); Hertel (op. cit.) also cited reports from South Africa, Juan Fernandez, the Falkland Islands, and Antarctica.

LECANORA RUPICOLA (L.) Zahlbr., Cat. Lich. Univ. 5:525. 1928.

Lichen rupicola L., Mantissa 1:132. 1767.

Lecanora sordida (Pers.) Th. Fr., Nova Acta Reg. Soc. Scient. Upsal., ser. 3., 3:215. 1861.

<u>Thallus</u> crustose; cracked-areolate, orbicular or irregular covering up to 10 cm, areoles contiguous, roughened, dull, sometimes elongated marginally; white to occasionally creamy white or pale greenish white. Hypothallus not observed.

<u>Apothecia</u> usually abundant, innate quickly becoming sessile to adnate, (0.4-)0.7-1.6 mm wide. Thalline margin thin, flexuous, entire and shiny, or dull and crumbling, persistent, concolorous with thallus. Disc plane, sometimes convex, round to angular by compression, commonly black or sometimes paler, very heavily white pruinose. Hymenium 50-65 μ m high; paraphyses simple, coherent; epithecium brown to black; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to oblong-ellipsoid, epispore distinct, 10-13 X 6-7 μ m.

Spot Tests: thallus K+ yellow, C+ pale orange; pruinia of disc C+ bright

yellow; whymenium KIK+ blue.

<u>Substratum/Habitat</u>: saxicolous, collected primarily on sandstone but occasionally also on granitic rock.

Selected Specimens: 1684, 2107.

Local Abundance and Distribution: infrequent; collected in the southern part of the CDFD subzone at both inland and maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal-alpine in the Northern Hemisphere (Thomson, 1979); also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

[Biatora scotopholis Tuck.] Lich. Calif.:24. 1866.
Lecidea scotopholis (Tuck.) Herre, Proc. Wash. Acad. Sci. 12:80. 1910.
Psora scotopholis (Tuck.) Fink, Lich. Flora. U.S. :213. 1935.
Psorula scotopholis (Tuck.) G. Schneider, Biblioth. Lich. 13:141. 1979.

<u>Thallus</u> squamulose; areoles initially round, \pm plane, becoming lobed and varying from plane to convex and undulate or variously contorted, imbricate or scattered, 0:3-0.7 mm wide; \pm smooth, shiny; reddish brown with raised, thin, white margin, sometimes the surface variously marked with grey. Hypothallus black, usually conspicuous, especially at the margin where it may be thick and fimbriate.

<u>Apothecia</u> common, substipitate, highly constricted, seeming to originate by overgrowing the squamules, 0.5-1.5 mm wide. Thalline margin thick, slightly raised, a little uneven especially in older ascocarps, initially black, whitening with age. Disc round, becoming <u>+</u> flexuous, sometimes cracked by distortions, plane, becoming convex; black <u>+</u> pale, white pruinia. Hypothecium white; hymenium hyaline, 40 μ m high; epithecium pale to dark brown; paraphyses coherent. <u>Spores</u> not observed. According to Herre (1910a) the spores are ovoid-ellipsoid, 8-11 X 3-5 µm.

<u>Spot Tests</u>: thallus K-, C-, KC-, P-, IKI-; hymenium and hypothecium IKI+ blue, C-, K-.

<u>Substratum/Habitat</u>: saxicolous; collected once on igneous rock with Rhizocarpon bolanderi.

Selected Specimen: 3281B.

Local Abundance and Distribution: rare; collected once at an exposed headland above the supralittoral zone on the Saanich Peninsula in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from California (Herre, 1910a; Hasse, 1913) and Oregon (Fink, 1935).

Remarks: The local collection is a rather unusual specimen. The overall appearance strongly simulates Rhizocarpon bolanderi. As Herre (1910a) stated, "Often intermingles with the thallus Rhizocarpon bolanderi (Tuck.) to which it bears a curious resemblance". In other keys this species comes out close to Lecanora atriseda (Fr.) Nyl. (=L. nephaea Sommf.) which is crackedareolate but, more significantly, always parasitic on Rhizocarpon geographi-The local collection has an 'aggressive' hypothallus that overgrows all cum. adjacent lichens, including the tiny foliose species, Xanthoparmelia Furthermore, the apothecia appear to be produced by a 'takemouqeotii. over' of squamules although more material is needed to confirm this point. Undoubtedly it is a lichen parasite, probably of R. bolanderi, but where one species stops and the other begins, requires further study. The terms thalline margin, hypothecium, etc. in the above description, therefore, are applied loosely.

Algae are present below the hypothecium, although their exact origin is unknown. The ascocarp, therefore, appears to have a thalline margin and the

species may need to be transferred to <u>Lecanora</u>. Since further study is required of this interesting and peculiar species the combination is not formally proposed here. The algal layer may have been overlooked as a result of the <u>Lecidea atrobrunnea-L</u>. <u>fuscoatra</u> appearance of the thallus. Other than the algal layer in the ascocarp, the local material matches perfectly the description of <u>Lecidea scotopholis</u> in Herre (1910a). The type specimen requires checking. Schneider (1980) stated that the type could not be found at FH. (This is rather surprising since all Tuckerman specimens requested in conjunction with the present study were located at FH without difficulty. It invites the suggestion that the specimen has been filed in some other genus -- perhaps Lecanora.)

"Lecanora" scotopholis is reported here as new to the province.

<u>LECANORA STRAMINEA</u> (Wahlenb.) Ach., Lich. Univ.:432. 1810. Parmelia straminea Wahlenb., Meth. Lich., Suppl.:47. 1803.

<u>Thallus</u> placoidal; usually orbicular, 1-3.5 cm broad, sometimes dying off in the center, leaving a peripheral ring, or occasionally irregularly coalescing to cover large areas. Center sub-areolate, lobes distinct marginally. Lobes convex, 0.5-1.0(-1.5) mm wide, dichotomous to palmately branching, contiguous to imbricate, often slightly transversely cracked, dull with minute elevated white spots on the cortex, like <u>Physcia aipolia</u>; yellow, deep yellowish green, with apices <u>+</u> browned; below pale coloured; rhizines absent.

<u>Apothecia</u> common, abundant and often crowded, adnate, 1.0-1.9(-2.6) mm wide. Thalline margin thick, becoming thin and flexuous, with minute elevated white spots, persistent. Disc concave, becoming plane, red-brown or light brown, <u>+</u> round. Hymenium 50-60 μ m high; paraphyses coherent; epithecium orange-brown. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, epispore distinct, 0-12 X 5-6 um.

Spot Tests: thallus C+ orange-red, K-, P-, IKI-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected twice on igneous rocks in the supralittoral zone, one collection definitely from bird-perching rocks.

Selected Specimens: 266, 5342.

Local Abundance and Distribution: rare; distribution poorly known; collected twice at maritime sites on islands in the southern part of the CDFD subzone; not collected in the adjacent zones although reported from the Queen Charlotte Islands (Brodo, 1971).

World Distribution: circumarctic with oceanic-boreal extensions.

LECANORA SYMMICTA (Ach.) Ach., Syn. Lich.: 340. 1814.

Lecanora varia ∂ L. symmicta Ach., Lich. Univ.:379. 1810.

<u>Thallus</u> crustose; smooth, thin, to almost absent but more commonly thinly rimose to occasionally thickly cracked-areolate; areole edges often becoming slightly granular but not distinctly sorediate; green, pale yellowgreen, greyish yellow. Hypothallus absent.

<u>Apothecia</u> abundant, scattered to often grouped and crowded, adnate to initially almost subsessile, slightly constricted, 0.4-0.8(-1.0) mm wide. Thalline margin initially usually thick, raised and tattered becoming thin, level with disc and subcrenulate, and often finally <u>+</u> excluded; concolorous with thallus. Disc round to a little irregular from compression, at first plane and smooth, becoming slightly convex to very convex and sometimes slightly tuberculate; pale yellow to yellowish-tan, <u>+</u> faint white pruinose, especially when young. Hypothecium not sharply separated from hymenium, hyphae gelatinous; epithecium covered with yellow(-brown) granules; hymenium 35-60 µm high, <u>+</u> hyaline; algae abundant below hymenium. <u>Spores</u> 8 per ascus, hyaline, oblong-ellipsoid or one end pointed, epispore distinct or not, 9-12 X 3.5-5 μm.

<u>Spot Tests</u>: thallus and apothecial rim (\pm disc) K+ yellow, C+ orange, KC+ deeper orange, P-.

<u>Substratum/Habitat</u>: corticolous; common on <u>Alnus</u> and <u>Pseudotsuga</u> but occurring on all other trees and shrubs; collected once on pine cones.

Selected Specimens: 108, 3915.

Local Abundance and Distribution: frequent; present throughout the CDFD subzone and adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate (Thomson, 1979) in the Northern Hemisphere; also reported from New Zealand (Martin, 1966) in the Southern Hemisphere.

<u>Remarks</u>: This species is sometimes included in the genus <u>Lecidea</u> (Duncan, 1970; Thomson, 1979). The local material, however, always has abundant algae in ther margin. See <u>Lecanora expallens</u> for additional comments.

LECANORA UNKNOWN #1 (Affin. L. dispersa?)

<u>Thallus</u> crustose; <u>+</u> absent or reduced to verruculose granules in vicinity of ascocarp, sometimes forming a continuous although limited crust; verrucae small, < 0.1 mm wide; sordid brownish-grey to dark cream coloured. Hypothallus absent.

<u>Apothecia</u> few to abundant, scattered to often grouped, adnate, highly constricted, (0.6-)0.8-1.5 mm wide. Thalline margin moderately thick, distinctly raised, smooth to slightly crenulate, corticate and concolorous with thallus, with the top edge often becoming decorticate and appearing white pruinose. Disc <u>+</u> round when young, often becoming highly flexuous and irregular with age, concave to almost plane, shiny; light to usually dark reddish brown, epruinose. Hypothecium 40 μ m thick, hyaline to greyish, irregularly arranged cells; proper exciple tissue below hypothecium distinctly

separate, \pm fulvous, 25 µm thick, of thick-walled, regular cells; thalline margin distinctly corticate towards the base, composed of thick walled radiating hyphae, 25-35 µm thick; becoming decorticate towards the top of margin with the algae present right up to the outer edge, region between cortex and decorticate edge filled with granular greyish matter; hymenium 55-65 µm high, hyaline below; paraphyses tightly coherent, branched; epithecium (red-) brown, pigmented, not granular; paraphyses appearing brown-capped after K. Spores 8 per ascus, hyaline, simple, ellipsoid, 0-13 X 4.5-6 µm.

Spot Tests: thallus K-, C-, KC-, P-, IKI-; hymenium K-, IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; commonly on HCl+ sandstone although occasionally on HCl- igneous rocks; in the supralittoral zone with <u>Lecanora</u> albescens and Lecania sp.

Selected Specimens: 1765B, 2594.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites; not collected in adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This unidentified <u>Lecanora</u> species is characterized by the highly constricted ascocarps with margins becoming decorticate and, therefore, very showy white "pruinose", a pigmented rather than a granular epithecium, and the shiny reddish brown disc.

It appears to fall close to the very polymorphic species <u>L</u>. <u>dispersa</u>, for which only partial descriptions are available. A composite drawn from several sources suggests that this species has a granular epithecium, a pruinose rather than ecorticate margin, yellow-green to pale brown (occasionally reddish) disc, and slightly smaller apothecia (up to 0.8 mm wide). The impression of <u>L</u>. <u>dispersa</u> is of the disc<u>+</u> round to compressed by pressure rather than flexuous with age. No comments regarding degree of ascocarp constriction nor shininess of disc were found, implying that these characters are not notable in <u>L</u>. <u>dispersa</u>.

<u>L. congesta</u> Lynge (<u>sensu</u> Magnusson, 1952) appears close to this unidentified <u>Lecanora</u>, however, only a skeletal description was available for comparison. <u>L. congesta</u> has been reported from the Queen Charlotte Islands (Brodo, 1980).

LECANORA UNKNOWN #2

<u>Thallus</u> crustose; thin, rimose, to cracked-areolate, sometimes very reduced; dirty pale grey. Hypothallus absent.

<u>Apothecia</u> abundant, usually somewhat crowded, initially subsessile becoming broadly adnate, hardly constricted, 0.2-0.5 mm wide. Thalline margin present, thin; usually initially obvious, appearing tattered-white pruinose on the top edge and sometimes very thin with age and appearing concolorous with disc (looking like a proper margin) although both cortex of amphithecium and abundant algae still present on lower edge of margin. Disc plane, never convex, \pm round, shiny, (red-)brown, sometimes faintly white pruinose. Hypothecium hyaline, thin, 25 µm thick, proper exciple not distinct from hypothecium; amphithecium lacking crystals but with distinct cortex of thick-walled, radiating hyphae, 25 µm thick near the base becoming thinner towards upper edge and here often absent; hymenium 30-45 µm high; epithecium orange-brown, pigmented; paraphyses coherent. <u>Spores</u> 8 per ascus, hyaline simple, subglobose to widely ellipsoid, (7-)9-11 X 5.5-6(-7) µm.

Spot Tests: thallus K-, KC-, C-, P-.

<u>Substratum/Habitat</u>: corticolous, on branches and trunks of deciduous trees, especially Acer.

Selected Specimens: 2827, 4039B.

Local Abundance and Distribution: infrequent (see below); scattered throughout the CDFD subzone, not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This unknown <u>Lecanora</u> is characterized by the usually crowded, small, broadly adnate apothecia with shiny, plane disc, and very thin, \pm excluded margin.

The local material keys out near <u>L</u>. <u>effusa</u> (Pers.) Ach. in Fink (1935), but more recent descriptions of this species (under the name <u>L</u>. <u>saligna</u> (Schrad.) Zahlbr.) note the thallus to be KC+ yellow, P+ reddish, the apothecia up to 0.8 mm wide (Ozenda & Clauzade, 1970), and the cortex thin on the apothecial margin (Brodo, 1981).

<u>Lecanora unknown #2</u> is probably much more common than the few collections indicate, since the small ascocarps and reduced thalli are not very obvious in the field.

LECANORA UNKNOWN #3

<u>Thallus</u> crustose <u>+</u> absent or scant, thin, inconspicuous; medium to dark (brown-) grey. Hypothallus absent.

<u>Apothecia</u> abundant, <u>+</u> scattered, moderately constricted, 0.3-0.7 mm wide. Thalline margin thin, raised, shiny, smooth to crenulate, dirty white (palest coloured part of thallus) or <u>+</u> partially tinged with black, epruinose, persistent. Disc plane or commonly concave, round to often irregularly flexuous or partially flexuous, glossy, brown or red-brown to blackening, epruinose. Hypothecium <u>+</u> hyaline or slightly fulvous; epithecium pigmented (orange-) brown to bluish-black, pigment restricted to caps of globose paraphyses; amphithecium containing abundant algae, crystals absent, cortex 30-45 µm thick, of very thick-walled, hardly branched hyphae (gelatinous?); hymenium 40-45 µm high; paraphyses coherent. <u>Spores</u> 8 per ascus, simple, hyaline, subglobose to broadly ellipsoid, 7-8 X 5-7 µm.

Spot Tests: thallus and amphithecium K+ yellow (faint), KC-, C-, P+

yellow turning orange.

<u>Substratum/Habitat</u>: corticolous and lignicolous, collected once each of the smooth bark of young <u>Pseudotsuga</u> and the dead branch of <u>Arctostaphylos</u> columbiana.

Selected Specimens: 1708, 6422.

Local Abundance and Distribution: rare; distribution poorly known, collected on the Gulf Islands at higher elevations inland in the southern part of the CDFD subzone; not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: <u>L</u>. <u>unknown</u> #3 is distinguished by the small, concave, irregular-flexuous apothecia with thin, shiny, epruinose, raised margin (K+y, P+o), and glossy (red-)brown disc.

The K reaction was difficult to assess because of the darker thallus colour but it would appear to be positive. This would place the unknown in the <u>L</u>. <u>subfusca</u> group, however, it did not readily key out to any of the known species in Poelt & Vézda (1979) or Brodo (1977). The pigment in the epithecium appears restricted to the tops of the paraphyses; epithecial granules are lacking, and small or large crystals are also absent from the amphithecium. Utilizing more generalized European floras, this local unknown keys out to <u>L</u>. <u>chlorona</u> (Ach.) Nyl. (=<u>L</u>. <u>pulicaris</u> (Pers.) Ach.) which has similar-sized ascocarps, thin margin, and P+ thallus, but the spores are larger (12-15 X 7-8 µm) and the epithecium possesses granules.

Another member of the <u>L</u>. <u>subfusca</u> group, <u>L</u>. <u>impudens</u> Degel., has been reported from Saltspring Island (Bird & Bird, 1973) although Brodo (1977) reported it as occurring only as far west as Alberta. It is P+ yellow but commonly sorediate with the soralia conspicuous, capitate, the thalline margin often sorediate and the amphithecium containing masses of small, insoluble granules.

LECANORA UNKNOWN #4

<u>Thallus</u> crustose; <u>+</u> disappearing within substratum. Hypothallus sometimes visible through wood, blue-black.

Apothecia abundant, + scattered, subsessile becoming broadly adnate, becoming slightly constricted, 0.2-0.6 mm wide. Thalline margin initially + moderately thick, distinctly raised, usually becoming reduced to level of disc, + concolorous with disc and therefore appearing like a proper margin, often partially and irregularly dotted with clumps of white pruinia. Disc round to slightly irregular, concave, becoming plane, very glossy, reddishbrown, epruinose or occasionally very slightly pruinose. Hypothecium hyaline, 50 µm thick, of thick-walled, tightly packed hyphae; amphithecium with distinct algae layer, crystals lacking (moderate-sized, irregular, hyaline crystals present in one apothecium only), with distinct cortex (30-50 µm thick) that thins towards the top of margin, composed of thick-walled, linearly arranged cells that towards the top edge often terminate in a larger (purple-)brown globose cell; epithecium orange-brown, pigmented, not granulose, although occasionally small, hyaline, rectangular crystals present when disc pruinose; paraphyses coherent, with slightly globose terminal cells that are capped with pigment (although pigment may not be restricted to caps), appearing embedded in a layer of gelatin; hymenium 45-55 µm high, hyaline or the upper half suffused with orange-brown. Spores 8 per ascus, simple, oblong or oblong-ellipsoid, hyaline, 10-13(-16) X 4-5(-6) μm.

Selected Specimens: 918, 6324.

Local Abundance and Distribution: infrequent; collected only on the Gulf Islands in the southern part of the CDFD subzone; not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: <u>Lecanora unknown #4</u> is characterized by the small, glossy, plane, red-brown ascocarps with concolorous margin that are often pruinose, a pigmented rather than granulose epithecium, and oblong spores. The habitat also appears distinctive.

This species is similar to <u>Lecanora unknown #2</u> and <u>#3</u>. All three species have a <u>+</u> reduced thallus, and small, (red-)brown ascocarps. <u>L</u>. <u>unknown #2</u> is especially similar, with initially subsessile apothecia that become broadly adnate and the thalline margin appearing white pruinose (actually decorticate) in some cases. However, <u>L</u>. <u>unknown #4</u> has a persistent cortex of the amphithecium with the outer cortical cells becoming pigmented towards the top of the margin and,therefore, having the appearance of a proper margin. Even early in its development the thalline margin of <u>L</u>. <u>unknown #4</u> is concolorous with the disc and distinctly raised. Furthermore, the spores of the latter are oblong to oblong-ellipsoid and larger than in L. <u>unknown #2</u>.

As with <u>Lecanora unknown #2</u> and <u>#3</u>, <u>L</u>. <u>unknown #4</u> appears close to several species in the keys but since complete descriptions are not available and abbreviated descriptions are often conflicting, the conservative procedure is to put no "definite" name on the material. <u>Lecanora hypoptoides</u> Nyl. appears very close to the unidentified local material in apothecia size, spores, and scant thallus although its disc colour is usually described as black(ening). Ozenda & Clauzade (1970) described the disc as remaining plane with a distinct proper margin. Brodo (1977) described the ascocarps as usually convex and deformed. Utilizing Magnusson (1952) the local material keys out to <u>L</u>. <u>paroptoides</u> Nyl., which Ozenda & Clauzade (op. cit.) included in <u>L</u>. <u>hypoptoides</u>. <u>L</u>. <u>scarcopisiodes</u> (Mass.) A. L. Sm. <u>sensu</u> Smith (1918) also appears close, although not as similar as the above two species. Smith (1918) described it as "easily mistaken for a Lecidea".
LECIDEA Ach.

Thallus crustose; granulose, areolate, to subsquamulate; with or without soredia. Hypothallus sometimes present, commonly black.

Ascocarp an apothecium. Thalline margin absent. Proper margin present, concolorous with disc. Disc commonly black or blackening. Hypothecium usually hyaline or fulvous, sometimes darkening. Paraphyses simple or branched toward the top but more commonly branched and anastomosing and very coherent. Spores usually 8 per ascus, simple, ellipsoid, globose, or oblong, and thin-walled.

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Commonly saxicolous, sometimes corticolous, lignicolous, and terri-

Until recently <u>Lecidea</u> was a very large genus containing many diverse elements. Many segregate genera have recently been removed. These include <u>Psora, Trapelia, Trapeliopsis, Hypocenomyce, Lecidella</u>, and <u>Huilia</u> among others. However, <u>Lecidea</u> is still a heterogeneous assemblage of species, and undoubtedly other genera will be segregated from it in the future.

Several <u>Lecanora</u> species possess a very dark coloured thallus that can be mistaken for <u>Lecidea</u> species. A cross-section of the apothecia will show a layer or clumps of algae below the hypothecium, illustrating that the margin is actually lecanorine rather than lecideine.

References: Anderson (1964), Hertel (1968, 1968b, 1970, 1971a, 1973, 1975a, 1975b, 1977), Lowe (1939), Magnusson (1935a). Hertel (1975b) contains a key to the cryptothalline Lecidea which is very useful.

3.	Thallus dark brown, minutely coralloid, esorediate (if granules large and glossy see <u>Lecanora ochrococca</u>) <u>L. ULIGINOSA</u>
3.	Thallus grey, green, etc., but not brown; sorediate or esorediate; smooth to verruculose4
	4. Thallus sorediate5
	4. Thallus esorediate6
5.	Thallus and apothecia C+ red (under LM) L. GRANULOSA
5.	Thallus and apothecia C <u>L</u> . <u>BOTRYOSA</u>
	 Corticolous; apothecia black (if lignicolous on driftwood with small, red-brown apothecia, see <u>Lecanora unknown #4</u>)7
	<pre>6. Terricolous or muscicolous; apothecia pink-brown to brown(-black)10</pre>
7.	Spores thick-walled
7.	Spores thin-walled
	8. Hypothecium <u>+</u> hyaline9
	8. Hypothecium yellow-brown to brown-black <u>L</u> . <u>ALBOFUSCESCENS</u>
9.	Paraphyses <u>+</u> free, simple <u>LECIDELLA</u> <u>ELAEOCHROMA</u> (p. 416)
9.	Paraphyses coherent, branched <u>L</u> . cfr. <u>ELABENS</u>
	10. Thallus white, C+ red; of tightly appressed, almost lobed areoles or marginally lobed (almost squamulate); terricolous, usually on very thin soil over rock)
	10. Thallus greenish-grey, C-; granulose to continuous; not areolate or subareolate; muscicolous-terricolous
11.	Thallus granulose; apothecia with the dark inner exciple forming a distinct contrasting layer against the pale lower hypothecium; with or without black granules in the hypothecium <u>L</u> . <u>BERENGERIANA</u>
11.	Thallus smooth; apothecia without a distinct dark inner exciple region; with or without black granules in the hymenium but not in the hypothecium

	12. Thallus squamulate, edges completely free and ascending; brown to green above, white below; medulla C+ red PSORA NIPPONICA (p. 627)
	12. Thallus crustose, smooth and continuous to areolate with areoles somewhat lobed but not completely free or ascending
13.	Paraphyses <u>+</u> simple and free OR hymenium densely inspersed; apothecia shiny black <u>LECIDELLA</u> (p. 424)
13.	Paraphyses branched at least at top; hymenium not inspersed; apothecia shiny or matt14
	14. Apothecia 'aspicilioid' (innate) <u>L</u> . <u>PHAEOPS</u>
	14. Apothecia adnate, sessile, sometimes level with surrounding areoles but quite separate and not immersed in them15
15.	Paraphyses very anastomosed; exciple excluded very early (or not observed at all); apothecia <<0.5 mm <u>MICAREA</u> (p. 473)
15.	Paraphyses slightly to not anastomosed (although coherent at apices from entangled branches); exciple usually present and often persistent; apothecia > 0.5 mm wide16
	16. Thallus yellow to yellowish-grey <u>L</u> . <u>SULPHUREA</u>
	16. Thallus white, grey, blue-grey, pinkish, red-brown or brown (but not yellow)
17.	Apothecia pink to brown, often with remnants of a pseudothallineveil (no algae); thallus grey to pink-grey, C+ red <u>TRAPELIA</u> INVOLUTA (p. 720)
17.	Apothecia red-brown to usually black, without a pseudothalline veil; thallus never pinkish, C+ red
	18. Apothecia dark red-brown; substratum HC1+ <u>L</u> . <u>MONTICOLA</u>
	18. Apothecia black; substratum usually HCl
19.	Thallus (sub-)areolate, of thick, slightly lobed, separate areoles; yellow-brown to red-brown, often with white/black edging; C <u>+</u> red20
19.	Thallus <u>+</u> absent to cracked-areolate (continuous); white to blue-grey, C23

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	20.	Areoles or squamules red-brown with black and/or white edging; <u>+</u> plane; hypothallus conspicuous		
	20.	Areoles buff to copper-brown, not clearly black, white edged; some <u>+</u> slightly convex; hypothallus inconspicuous		
21.	Areoles	plane, C+ red <u>L</u> . <u>FUSCOATRA</u>		
21.	Squamule	s concave, C <u>L</u> . <u>UNKNOWN</u> <u>#1</u>		
	22.	Hypothecium hyaline with a fulvous to fulvous-brown layer below		
	22.	Hypothecium dark brown <u>L</u> . cfr. <u>PROTABACINA</u>		
23.	Hypothecium and exciple dark brown-black; spores often halonate when young			
23.	Hypothec	ium hyaline to brown; exciple <u>+</u> hyaline internally		
	24.	Thallus C+ red <u>L</u> . <u>MANNII</u>		
	24.	Thallus C 25		
25.	Apotheci	a <u>+</u> innate, level with thallus ; margin thin <u>L</u> . <u>TESSELLATA</u>		
25.	Apotheci	a adnate, above thallus level; margin <u>+</u> thick		
÷ .	26.	Hypothecium <u>+</u> hyaline, sometimes greyish below; thallus IKI <u>L</u> . <u>PLANA</u>		
	26.	Hypothecium hyaline above, browning below; thallus IKI+ blue		
27.	Thallus ≤ 1.0 m	creamy white, K+ yellow; apothecia m wide; spores ll-l6 X 5.5-7 μm <u>L</u> . cfr. <u>CRUCIARIA</u>		
27.	Thallus K-; apot	light grey, often with orange patches, hecia > 1.0 mm; spores 9-12 X 5-6 μm <u>L. LAPICIDA</u>		

LECIDEA ALBOFUSCESCENS Nyl., Flora 50:370. 1867.

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<u>Thallus</u> crustose; smooth, thin, and continuous to more often scattered to grouped, small corticate granules; whitish-to yellowish grey. Hypothallus absent.

<u>Apothecia</u> common, often abundant, scattered to grouped, 0.4-0.8(-1.0) mm wide. Proper margin at first thin, <u>+</u> shiny, then <u>+</u> excluded, black.

Disc admate, moderately constricted, round to a little irregular, initially plane then slightly to moderately convex, <u>+</u> matt, smooth to minutely roughened, epruinose; light cinnamon brown, reddish-brown, brown to black (usually all colours on the same thallus, if large enough). Hypothecium yellow-brown to medium brown (under LM; under dissecting microscope dark brown_black); exciple hyaline on the outer edge; epithecium light brown, paraphyses strongly coherent; hymenium hyaline, 75 µm high. <u>Spores</u> 8 per ascus, simple, hyaline, citriform or fusiform with pointed or rounded ends, 11-13 X 5-6 µm.

Spot Tests: thallus K-, C-, P-, IKI-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; collected only on <u>Picea sitchensis</u> twigs.

Selected Specimens: 5365, 5405.

Local Abundance and Distribution: rare; not collected in the CDFD subzone, collected in the adjacent CH zone, especially the Spruce/Fog subzone.

<u>Remarks</u>: The citriform spores plus light/dark apothecia seem very distinctive but were not mentioned in the abbreviated description available in Ozenda & Clauzade (1970). <u>L</u>. <u>carnulenta</u> (Tuck.) Fink, known from Washington, has the distinguishing character of a "darker coloured proper margin" (Howard, 1950). However, its hypothecium is hyaline to yellowish-brown or brownish and the thallus is greenish-grey to brownish (Fink, 1935). The spores are described as only ellipsoid and ovoid-ellipsoid.

This local collection matches perfectly the <u>L</u>. <u>albofuscescens</u> specimen from Graham Island, Queen Charlotte Islands (Lichenes Canadenses Exsiccati, No. 127; UBC).

<u>LECIDEA BERENGERIANA</u> (Mass.) Th. Fr., Lich. Scand. 2:433. 1874. Biatora berengeriana Mass., Ricerch. Auton. Lich., 128. 1852. <u>Thallus</u> crustose; of loosely grouped and piled, corticate granules, less than 0.2 mm wide, sometimes almost lobed; light green or light greenish grey. Hypothallus absent.

<u>Apothecia</u> common, scattered, adnate and barely constricted to constricted, 0.6-1.1(-1.5) mm wide. Margin concolorous and lighter coloured than the disc, even to slightly raised, not very conspicuous, usually excluded early Disc round to somewhat irregular, concave at first quickly becoming plane, often almost plane with the edges recurved, light brown-tan to dark brown. Hypothecium medium reddish brown, often with blue-black granular deposits in the upper parts, lighter coloured below; hymenium 55-75 μ m high, <u>+</u> hyaline to occasionally light brownish; epithecium light yellow; paraphyses coherent, laxer in KOH, simple or slightly branched; outer exciple varying from almost hyaline to medium brown fading internally or not, of radiating large-celled, thin-walled hyphae; inner exciple (near base) usually dark brown. Spores 8 per ascus, hyaline, fusiform-ellipsoid, simple or very occasionally 1-septate, 11-15 X 4-5 μ m.

Spot Tests: thallus K-, C+, KC-, P-; hymenium IKI+ faint blue in patches.

<u>Substratum/Habitat</u>: terricolous, muscicolous, corticolous; collected mainly on soil, especially soil rich in humus; also once each on moss and the base of Arbutus, in both cases these were poorly developed.

Selected Specimens: 4120, 5233.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at inland sites, especially higher elevations, also collected in adjacent zones but not as common.

<u>World Distribution</u>: circumpolar arctic-alpine (Thomson, 1979). In North America, Wetmore (1968) described its distribution as Arctic-Boreal. It has been reported from Greenland (Lynge, 1940), New York (Lowe, 1939), Saskatchewan (Looman, 1962), and Alaska (Thomson, 1979).

<u>Remarks</u>: The apothecia of the local material commonly have a dark upper hypothecium and dark inner exciple which are separated by a lighter region, the lower hypothecium (?) which strongly contrasts with the two tissues. This center area may be so darkened in dark apothecia that the contrast is not so great, but, there is usually some apparent difference. The apothecia of one collection had a \pm light coloured lower exciple and was placed here because the outer exciple showed the same radiating large-celled hyphae as are in other typical <u>L</u>. <u>berengeriana</u> collections. Furthermore, in the unusual collection, blue-black granular deposits were confined to the hypothecium.

There is some difference of opinion concerning these dark deposits and in which tissues they occur, in this species and <u>L. fusca</u>. According to Harris (1977) these granules are confined to the hypothecium in <u>L. berengeriana</u> and commonly in the hypothecium and hymenium, and sometimes the inner exciple of <u>L. sanguineoatra</u> (Wulf.) Ach. (=<u>L. fusca p.p.</u>). Thomson (1979) stated that <u>L. berengeriana</u> sometimes has black granules in the hymenium and hypothecium while <u>L. fusca</u> often has them in the hypothecium and sometimes in the hymenium. Magnusson (1952) mentioned blue-green grains in the thecium of <u>L. atrofusca Fr. (=L. fusca</u>) but not <u>L. berengeriana</u>.

LECIDEA BOTRYOSA (Fr.) Th. Fr., Lich. Scand. 1:454. 1874. Biatora botryosa Fr., Kgl. Vetensk.-Akad. Nya Handl.:268. 1822.

<u>Thallus</u> crustose; of scattered, small granules or larger, contiguous, verruculose granules, \pm becoming sorediate, white-grey to medium grey. Hypo-thallus not observed.

<u>Apothecia</u> common, single and scattered to often several arising from an old ascocarp and then appearing clustered, 0.3-0.6 mm wide. Proper margin thin, persistent, concolorous with the disc but <u>+</u> outlined by a fine, white

pruinia on the edge. Disc sessile to substipitate, constricted, round, <u>+</u> plane, shiny and epruinose to matt and finely white pruinose, especially towards the margin; black, or medium to dark brown. Hypothecium dark brown; hymenium 50 µm high, hyaline with light brownish patches or light orangebrown; epithecium granular orange-brown; paraphyses strongly coherent. Spores 8 per ascus, hyaline, simple, fusiform, 9-13 X 3-4 µm.

<u>Spot Tests</u>: thallus K-, C-, KC-, P-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous and lignicolous; collected on burned stumps, burned logs, and once on living <u>Pseudotsuga</u>.

Selected Specimens: 430, 3852B.

Local Abundance and Distribution: infrequent; scattered throughout the southern part of the CDFD subzone, not collected in the adjacent zones.

World Distribution: tentatively circum(north)temperate.

LECIDEA cfr. CRUCIARIA Tuck., Syn. N.A. Lich.2:67. 1888.

<u>Thallus</u> crustose; varying from thin, discontinuous rimose-cracked to thick, continuous, cracked-areolate with areoles deeply to often incompletely cracked; surface subpruinose and appearing almost chalky, or more often epruinose and somewhat gently verruculose; creamy-buff or yellowish-white. Hypothallus black, usually conspicuous except on the roughest sandstone, inconspicuous and present only at the margin or often very conspicuous between scattered areoles, occasionally giving the whole thallus a bluish tinge when viewed from a distance.

<u>Apothecia</u> common, innate to quickly subsessile or sessile with the proper margin cracked free of the thallus tissue, 0.7-1.1(-1.3) mm wide. Proper margin thick, <u>+</u> even with disc, commonly persistent, occasionally reduced and inconspicuous in convex apothecia, black or with a bluish tinge, epruinose. Disc <u>+</u> round, plane to slightly convex, often initially pruinose, eventually epruinose or with outer part only pruinose, or occasionally still entirely pruinose; minutely roughened, matt; black. Hypothecium dark brown below with the top 25-100 µm hyaline, <u>+</u> wedges of pale (reddish-)brown, lightly to moderately inspersed with oil droplets above; paraphyses strongly coherent, exciple blue on the outer edge, internally at the top hyaline to pale brown becoming dark brown below and fading into the hypothecium; epithecium sordid green-brown to occasionally almost black; hymenium hyaline to sometimes greenish or pale green-brown, 70-80 µm high. <u>Spores</u> 8 per ascus, hyaline, simple, pointed-ellipsoid, oblong-ellipsoid, to ovoid, 11-16 X 5.5-7.0 µm.

<u>Spot Tests</u>: thallus K+ yellow, C-, KC-, P-, IKI+ blue (quick; dark); hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstones, conglomerate, shales, and igneous rocks in the suprahaline zone.

Selected Specimens: 1836, 2599A.

<u>Local Abundance and Distribution</u>: occasional; scattered throughout the CDFD subzone at maritime sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from California (Tuckerman, 1888; Herre, 1910; Magnusson, 1935) and Oregon (Fink, 1935).

<u>Remarks</u>: The species, tentatively identified as <u>L</u>. <u>cruciaria</u>, is characterized by the IKI+ thallus, (sub-) sessile apothecia with thick margin and dark hypothecium (under DM) or dark below and light above (throughLM).

Among the local species, <u>L</u>. <u>tessellata</u> is closest with a similar lightcoloured, IKI+ thallus and black, innate apothecia. However, <u>L</u>. <u>tessellata</u> never has a creamy (yellowish ting) thallus that is K+ yellow, but its apothecia are <u>+</u> plane with only a thin proper margin, and remain innate or level with the areoles. In most keys this species fits into <u>L</u>. <u>lapicida</u> but that species has a hyaline to pale brown hypothecium and no mention is made of it being inspersed. Furthermore, the spores of <u>L</u>. <u>lapicida</u> are on the small side with a range of 8-13 X 5-6 μ m. Thomson (1969) mentioned a dark brown-black hypothecium but in a later description (Thomson, 1979) he described the hypothecium as "pale above or the lower part brownish". Furthermore, Thomson (1969, 1979) stated that the thallus is K- and lacks atranorin, while most other publications described <u>L</u>. <u>lapicida</u> as K+ yellow or even K+ yellow turning red-brown after a few minutes (Ozenda & Clauzade, 1970). The local species is, therefore, similar to, but distinct from, <u>L</u>. <u>lapicida</u>.

There are also two North American endemics to which the local material seems close: L. cruciaria Tuck., described from California and L. amabilis B. de Lesd., described form Mexico. Both, unfortunately are said to be IKI-. The latter is very similar to the local material with "surface on the whole smooth, but surface of the single areoles, which are separated by irregular cracks, very minutely subverrucose... Hypothecium thick, + brown, upper limit somewhat indistinct " (Magnusson, 1935a). The thallus colour, hymenium, epithecium, and spore size also correspond closely. However, no mention is made of an inspersed hypothecium and no other description is available for that species. In L. cruciaria, the hypothecium is described as being hyaline above becoming brownish and then pale brown below (Magusson, 1935a). Herre (1910a) described the thallus as "more or less marked by tortuous black hypothalline lines" which Magnusson disputed. In the local material both . forms are seen. Tuckerman's type was from very "lax" sandstone which suggests a disrupted thallus, in which case the hypothallus probably would be inconspicuous. It should be noted that both types were based on material only a few centimeters square (Magnusson, 1935a) which could lead to many misconceptions in a polymorphic species.

Both <u>L</u>. <u>amabilis</u> and <u>L</u>. <u>cruciaria</u> seem similar to the local material, with the former the closest. However, it appears that <u>L</u>. <u>cruciaria</u> should not be ignored, since it has a similar and also geographically closer type locality than <u>L</u>. <u>amabilis</u> as well as an earlier publication date, should the two prove synonymous. Many of the conflicts may result from the poor, small type specimen of <u>L</u>. <u>cruciaria</u>. The two specimens need to be examined and the problem studied further.

L. cruciaria has not been reported from the province.

LECIDEA cfr. ELABENS Fr., Vet. Akad. Handl.:256. 1822.

Lecidea melancheima Tuck., Proc. Amer. Acad. Arts & Sci.1:260. 1848.

<u>Thallus</u> crustose; thin, smooth, continuous; appearing as a light grey stain on the bark. Hypothallus absent.

<u>Apothecia</u> common, scattered, adnate, not constricted, 0.3-0.5(-0.9) mm wide. Proper margin sometimes very inconspicuous, not immediately apparent because it is the same colour and texture as the disc, at other times obvious, thick and raised, persistent or not. Disc plane, usually a little irregular rather than round, minutely roughened or smooth, epruinose; brownblack or black, becoming almost transparent when wet. Hypothecium hyaline with light orange-brown streaks or entirely orange-brown; paraphyses appearing simple but probably branched below (rather tightly coherent) with an enlarged, dark brown, globose apical cell; hymenium 35-50 μ m high, fulvous to a very light brownish, darkest near the epithecium. <u>Spores</u> 8 per ascus, hyaline, ellipsoid-fusiform or sometimes reniform or narrowly diamond-shaped, $8-9(-13) \times (-5) \mu$ m.

<u>Spot Tests</u>: thallus K sordid yellow, C-, KC-, P- (under the LM thallus fragment is P+ faint orange but no colour change noted under the DM).

Substratum/Habitat: lignicolous and corticolous; collected once each on

the bark of a fallen tree and trunk of Quercus.

Selected Specimen: 2720A.

Local Abundance and Distribution: rare; distribution poorly known, collected on two islands (Hornby Island in the northern part, Prevost Island in the southern part) in the CDFD subzone, not collected in adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct in the Northern Hemisphere; in North America reported from New York (Lowe, 1939), Iowa and Minnesota (Fink, 1935), South Dakota (Wetmore, 1968), and Colorado (Anderson, 1964). Both Herre (1910a) and Hasse (1913) reported it from California but these records were not acknowledged by Anderson (1964) or Wetmore (1968) and may be based on misidentifications, although it is listed by Tucker & Jordan (1978).

These two collections are referred only tentatively to <u>L</u>. <u>elabens</u> because of the following differences. Usually a well developed thallus is present which is granulose to verruculose and reacting P+ orange, K+ yellow. Furthermore, the apothecia, although plane at first, becomes "subplane to convex" (Anderson, 1964). The difference may be a result of immaturity of the local specimens.

Another species, <u>L</u>. <u>myriocarpella</u> (Merr.) Zahlbr., described from Washington, has a very thin thallus and similar, except smaller, apothecia, 0.1-0.25 mm (Fink, 1935).

LECIDEA FUSCA (Schaer.) Th. Fr., Lich. Scand.2:435. 1874.

Lecidea sphaerioides . fusca Schaer., Lich. Helv. Spicil.: 166. 1833.

<u>Thallus</u> crustose; thin, <u>+</u> continuous and smooth; light yellow-green to light greenish-grey.

<u>Apothecia</u> common, usually scattered, round to often irregular, adnate, 0.4-1.2 mm wide. Proper margin concolorous to darker than the disc, at first thick and raised, very abruptly thinning and then usually excluded. Disc subplane to quickly convex, hardly constricted, tan to dark brown or mottled. Hypothecium dark reddish brown throughout or slightly lighter below (but not pale); hymenium 60-75 μ m high, <u>+</u> hyaline with scattered blue-black granular deposits; exciple <u>+</u> dark reddish brown throughout or a little paler towards the base, the outer exciple of very small, indistinct hyphae; epithecium yellow; paraphyses coherent, laxer in KOH, simple to often branched. <u>Spores</u> 8 per ascus, hyaline, fusiform-ellipsoid, simple or occasionally l-septate, 12-17 X 4-5 μ m.

Spot Tests: thallus K-, C-, KC-, P-; hymenium IKI+ pale blue.

<u>Substratum/Habitat</u>: muscicolous; collected once. It has also been reported as terricolous, and especially humicolous (Thomson, 1979; Anderson, 1964).

Selected Specimen: 44.

Local Abundance and Distribution: rare; distribution poorly known, collected on one Gulf Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumboreal(-circumarctic-alpine). Because <u>L</u>. <u>fusca</u> is sometimes split into two species, and also confused with <u>L</u>. <u>berengeriana</u>, its exact distribution is uncertain.

<u>Remarks</u>: Some floras prefer to recognize two species, <u>L</u>. <u>sanguineoatra</u> (Wulf.) Ach. and <u>L</u>. <u>templetonii</u> Tayl., instead of <u>L</u>. <u>fusca</u>. <u>L</u>. <u>sanguineoatra</u> has redder, quickly convex apothecia with paler exciple and always simple spores while <u>L</u>. <u>templetonii</u> is considered to have darker brown-black apothecia that usually remain plane and have a dark exciple and simple to 3-septate spores. The local material was intermediate in many of these characters so the more conservative, single-species concept was followed.

LECIDEA FUSCOATRA (L.) Ach., Meth. Lich.:44. 1803.

Lichen fuscoatra L., Sp. Pl.:1140. 1753.

<u>Thallus</u> crustose, approaching squamulose; of rounded to oval, scattered areoles or angular by compression when grouped, 0.5-1.0(-1.4) mm wide, smooth to minutely uneven; <u>+</u> plane, occasionally slightly lobed and almost squamulose; shiny, reddish brown with a white or grey inner edge and then a black outer edge, sometimes, especially in young areoles the grey edging covering much of the upper surface. Hypothallus black, conspicuous when areoles scattered, otherwise just at the margin of the thallus.

<u>Apothecia</u> common, between areoles, not usually abundant, \pm scattered, 0.6-1.5 mm wide. Proper margin thin to occasionally thick, raised, persistent, black. Disc adnate, hardly constricted, plane to moderately convex, round to more often angular by compression, or sometimes flexuous, minutely roughened, \pm lightly dusted with grey pruinia; black. Hypothecium dark brown, thick, often over 200 µm thick; exciple dark brown-black externally but lighter internally (under DM; under LM all the exciple looks \pm dark); paraphyses branched, strongly coherent; epithecium greenish-black, greenishbrown to brown; hymenium 65-75 µm high, faint greenish. <u>Spores</u> not observed often, hyaline, ellipsoid, simple, 13-15 X 5 µm.

<u>Spot Tests</u>: thallus cortex (on filter paper under DM) K<u>+</u> brownishyellow, KC+ red, C<u>+</u> red; medulla and cortex (LM) C+ red, P-, IKI-; exciple (LM) C+ red.

<u>Substratum/Habitat</u>: saxicolous; collected on both sandstone, granitic and other igneous rocks.

Selected Specimens: 2150, 4975.

Local Abundance and Distribution: occasional scattered throughout the CDFD subzone, more common at inland sites but also present at maritime sites,

not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumtemperate; known from Europe (Ozenda & Clauzade, 1970; Duncan, 1970), North America, and Asia (Hertel, 1977); in North America it has been reported from Michigan (Harris, 1977) and Washington (Howard, 1950), Fink (1935) mentions it as occurring from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: The inconspicuous C+ reaction makes it quite possible to overlook under the DM. A thin section under the LM is very obviously C+ red. Ozenda & Clauzade (1970) stated that both the medulla and cortex are C+ but this is only reliably observed on a cross-section under the microscope. The dark colour of the cortex obscures the positive reaction under the DM although a KC+ test is reliably seen on the filter paper under the DS by placing an areole cortex down and then flooding first with K and then C. The red colouration diffuses away from the dark coloured areole.

Spore production is negligible in this species despite the abundance of apothecia. As a result <u>L</u>. <u>fuscoatra</u> may be confused with <u>Rhizocarpon boland-</u> <u>eri</u> which also has low fertility and a very similar thallus. See the latter species for comments.

<u>L</u>. protabacina Nyl., described from California, and <u>L</u>. <u>cascadensis</u> H. Magn., described from Washington, are very similar to <u>L</u>. <u>fuscoatra</u>. This group of IKI-, C+, tan to brown coloured, areolate-subsquamulate species needs to be re-evaluated. <u>L</u>. <u>cascadensis</u>, with red-brown, white-ringed areoles, is particularly close to the local <u>L</u>. <u>fuscoatra</u>.

Note: The distinctive white/black edging of the areoles in the local collections is not mentioned in European descriptions.

LECIDEA GRANULOSA (Hoffm.) Ach., Meth. Lich.:65. 1803.

<u>Verrucaria</u> granulosa Hoffm., Adumbr. et Descript. Plant. Lich.2:21, Tab. 30, fig. 3. 1794.

Lecidea quadricolor (Dicks.) Borr., Engl. Flora 5:182. 1833.

<u>Thallus</u> crustose; of scattered, convex granules, becoming lobed to continuous and verruculose, sometimes falsely cracked-areolate on drying; light grey to dark bluish-grey. Soredia usually present, scarce and confined to tops of occasional granules or abundant and spreading over most of thallus; fine or sometimes granular; dark grey or light-yellowish, <u>+</u>dark particles. Hypothallus absent.

Apothecia often present, scattered to grouped and then crowded, adnate, appressed to substratum or slightly constricted, 0.5-1.8 mm wide. Proper margin thick, raised, often becoming flexuous, usually persistent, edge usually concolorous with disc with the lower sides very light, almost pinkish coloured. Disc \pm plane, occasionally convex, slightly irregular to often flexuous with age, black or pinkish or mottled. Hypothecium hyaline but appearing darker with dense granular deposits; hymenium 55-75 µm high, dirty yellow; epithecium brown, granular; paraphyses strongly coherent. <u>Spores</u> 8 per ascus, hyaline, simple, oblong-ellipsoid, 10-14 X 4-5 µm.

<u>Spot Tests</u>: thallus C+ red; hypothecium, epithecium, and exciple (LM) C+ rose; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: lignicolous, terricolous/humicolous, and corticolous (at bases of old trees); collected twice on rotting wood, twice on soil and adjacent dead plant material, and once on <u>Pseudotsuga</u> bark. The last collection was somewhat unusual with a darker thallus colour and sterile condition. Often accompanied by <u>L</u>. <u>uliginosa</u>.

Selected Specimens: 3646, 4132.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, not collected in the adjacent zones during the present study, but known there from other collections.

<u>World Distribution</u>: circumboreal (Thomson, 1979) in the Northern Hemisphere, also reported from the Southern Hemisphere. In North America it has been reported from Alaska (Thomson, 1979), Greenland (Lynge, 1940), Nova Scotia (Lamb, 1954), the Smoky Mountains (Degelius, 1941), South Dakota and Wyoming (Wetmore, 1968), Arizona (Weber, 1963), and Washington (Howard, 1950).

<u>Remarks: L. flexuosa</u> (Fr.) Nyl. is sometimes separated as a distinct species from <u>L. granulosa</u>. According to Wetmore (1968) <u>L. granulosa</u> has convex, tan/brown apothecia with disappearing margin, spores 8-14 X 4-6 μ m, and lignicolous or terricolous habit while <u>L. flexuosa</u> has plane, red/brown apothecia with persistent, raised margin, spores 6-8 X 3 μ m, and lignicolous habit. According to Brodo (1968) <u>L. aeruginosa</u> Borr. (=<u>L. flexuosa</u>) "has black or lead-coloured plane apothecia, each with a thin hyaline hypothecium; <u>L. granulosa</u> has large, brown, irregularly convex to almost hemispherical apothecia, each with a thick opaque hypothecium". Since the local material has overlapping characteristics, only <u>L. granulosa</u> has been recognized although if two species were recognized, it appears closer to <u>L. flexuosa</u>.

LECIDEA LAPICIDA (Ach.) Ach., Meth. Lich.: 37. 1803.

Lichen lapicida Ach., Lich. Svec. Prodromus:61. 1798.

<u>Thallus</u> crustose; thick areolate-cracked, sometimes incompletely cracked; light grey \pm orange patches. Hypothallus black, \pm conspicuous, marginal and covering rock crystals projecting through the thallus from the substratum.

<u>Apothecia</u> common, scattered to often clustered, 0.8-1.5(-2.5) mm wide. Proper margin thick, raised, \pm shiny, persistent, often flexuous, epruinose, black. Disc not or hardly constricted, \pm plane, sometimes undulate or slightly concave if very lobulate; round to irregularly lobed or angular by pressure; matt, minutely roughened, black, \pm very light grey pruinia. Hypothecium hyaline immediately below hymenium for 35 µm and then pale (yellow-) brown and increasingly darker downward for most of the thickness of the hypothecium; exciple (blue-)black or green-black on outer edge becoming fulvous or hyaline internally and extending down beside hypothecium; epithecium green-black; paraphyses coherent, \pm simple below, branching at top; hymenium 45-50 µm high, hyaline. <u>Spores</u> 8 per ascus, hyaline, simple, (oblong-)ellipsoid, 9-12 X 5-6 µm.

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<u>Spot Tests</u>: thallus K-, C-, KC-, P-, IKI+ blue; hymenium IKI+ blue; exciple K+ faint yellow wash.

<u>Substratum/Habitat</u>: saxicolous; collected twice on conglomerate rocks. Selected Specimens: 2203A, 4676.

Local Abundance and Distribution: rare; distribution poorly known, one collection at an inland, higher elevation (600 m) in the CDFD subzone, also collected once in the adjacent CDFW subzone at 660 m.

<u>World Distribution</u>: circumpolar, arctic-alpine (Thomson, 1979). Anderson (1964) described it as widely distributed in arctic and mountainous Europe and Asia. In North America it is known from "Ellesmere Island to Alaska, and south to Maine, Wisconsin, Minnesota, New Mexico and California (Thomson, 1979).

<u>Remarks</u>: Among the local species, <u>L</u>. <u>lapicida</u> has a resemblance to <u>Huilia nigrocruenta</u>, both bearing large, adnate hardly constricted, black apothecia. <u>H</u>. <u>nigrocruenta</u>, however, has much larger spores and a completely dark exciple which is K+ blood red. <u>L</u>. <u>cruciaria</u> also is similar with an internally light exciple, but it has a creamy-coloured thallus which is K+ yellow (see below) and smaller apothecia.

Thomson (1969, 1979) maintained that <u>L</u>. <u>lapicida</u> is K- (lacking atranorin) while other authors (Ozenda & Clauzade, 1970; Anderson, 1964) stated it to be K+ yellow; the latter author stated that stictic acid is present. Hertel (1975) described <u>L</u>. <u>lapicida</u> as a very polymorthpic species and suggested that more study is needed concerning the hypothecium colour, apothecia form, spore size, and chemistry.

LECIDEA MANNII Tuck., Syn. N. A. Lich.2:75. 1888.

Lecidea atrolutescens Nyl., Lich. South. Calif., edit. 2:20. 1898.

<u>Thallus</u> crustose; cracked areolate to areolate; areoles 0.6-1.3(-1.6) mm wide, from slightly to strongly convex or undulate, separated by deep cracks or closely abutting and fusing, glossy-cartilaginous, buff to tawny-brown, some white edged (from either a light pruinia or a disruption of the cortex), sometimes increasing to give the areoles a tartareous appearance, areoles then usually <u>+</u> thin and plane. Hypothallus black, usually inconspicuous.

<u>Apothecia</u> common, sometimes abundant, usually \pm scattered, 0.5-1.5 mm wide. Proper margin thin to thick, \pm raised, persistent, black, occasionally appearing white because of a heavy pruinia. Disc innate, usually quickly adnate, or slowly and then with margin appearing white and thalline; not to only slightly constricted, \pm plane to a little convex, round to often a little irregular or lobulate; black, \pm light white pruinose. Hypothecium \pm hyaline immediately below thecium, then a fulvous to light brown strip which is occasionally even a medium brown; exciple dark externally, \pm hyaline internally or greyish with granular deposits; epithecium greenish-brown to greenish black; hymenium 55-70 µm high, light greenish to hyaline below and sordid fight green-brown above. <u>Spores</u> 8 per ascus, simple, hyaline, oblong-ellipsoid, ll-l4 X 5-6 μm, not abundantly produced, but some usually present.

<u>Spot Tests</u>: thallus K-, C+ red (cortex), P-, IKI-; hymenium and hypothecium KIK+ blue; exciple C+ red (LM).

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone and conglomerate, granitic and other igneous rocks.

Selected Specimens: 1473, 2849.

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Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both maritime and inland sites, not collected in the adjacent zones (see Figure 20).

<u>World Distribution</u>: western North American endemic; described from California.

<u>Remarks</u>: <u>L</u>. <u>mannii</u> is distinguished by the light-coloured, white-rimmed areoles, C+ red cortex and exciple, and the fulvous to <u>light</u> brown hypothecium. It differs from <u>L</u>. <u>atrofusca</u> which is also C+, in the lighter coloured areoles (which are obviously C+ under the DM), white rather than white-and-black edged areoles, the tendency for thin areoles to become <u>+</u> tartareous, a <u>+</u> inconspicuous hypothallus, and the lighter coloured hypothecium.

The thallus is variable in this species, ranging from glossy, tawnycoloured, convex areoles (<u>+</u> white edges) to thin, plane, almost white tartareous areoles. However, both extremes usually show indications of the other end of the spectrum. For example, the depauperate thalli usually have some areoles where the center is glossy and brown and the robust thalli often have some small, thin, partially tartareious areoles.

<u>L. fuscatoatra</u> Nyl. <u>in</u> Hasse, described from California, is a very similar species with slightly smaller spores (Hasse, 1913). The two type spec-



imens should be compared.

Hertel (1973) examined the types of <u>L</u>. <u>mannii</u> and <u>L</u>. <u>atrolutescens</u>. He placed the latter into synonymy with <u>L</u>. <u>mannii</u>.

L. mannii is reported here as new to the province.

LECIDEA MONTICOLA Ach., Lich. Helvet. Spicil., Sect.4-5:161. 1833.

Protoblastenia monticola (Ach.) Stein., Verhandl. zool.-bot. Gesellsch. Wein

61:48. 1911.

<u>Thallus</u> crustose; <u>+</u> inconspicuous, from scattered <u>+</u> smooth granules to thin and continuous; light grey. Hypothallus absent.

<u>Apothecia</u> common, scattered, 0.3-0.8 mm wide. Proper margin initially thick, raised and shiny, becoming thinner, \pm matt, and even with disc, persistent or excluded in very convex apothecia, black. Disc round to often a little irregular, plane becoming slightly to moderately convex, moderately constricted, \pm smooth, slightly shiny to matt, brown, reddish brown to black. Hypothecium medium to dark orang-brown or reddish brown; hymenium hyaline, 60-75 µm high; epithecium orange-brown; paraphyses coherent but appearing \pm straight and slender in water; in KOH slender and simple to short branched at apices. Spores 8 per ascus, ellipsoid, hyaline, simple, 9-13 X 4.5-5.5 µm.

<u>Spot Tests</u>: thallus K<u>+</u> yellow, C-, KC-, P-, IKI-; hymenium IKI+ blue, K-.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstones with all but one being calcareous (HCl+).

Selected Specimens: 1054, 2706.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, present but not as common in the adjacent zones.

<u>World Distribution</u>: probably circumtemperate; known from Europe (Duncan, 1970) and North America (Hale & Culberson, 1970). Ozenda & Clauzade (1970)

describedits distribution as "throughout the Northern Hemisphere".

<u>Remarks</u>: <u>L. monticola</u> is distinguished by the (red-)brown disc with black margin, dark hypothecium and exciple, and calcareous substratum. There is some resemblance to several of the <u>Lecidella</u> species.

Sometimes the substratum is only HCl+ in the very vicinity of the thallus and not on the edge of the rock where it is most convenient for spot testing with acid. Some collections are mixed HCl- and HCl+ pieces.

L. monticola is reported here as new to the province.

LECIDEA PHAEOPS Nyl., Not. Sallsk. Faun. & Fl. Fenn. 4:5. 1858.

<u>Thallus</u> crustose; finely cracked-areolate, areoles not completely separate, closely grouped, continuous, steep-sided, rather regular, thick; surface <u>+</u> smooth, dull, almost tartarous; cream-white, pale grey-white. Hypothallus absent.

<u>Apothecia</u> innate, actually often somewhat below thallus level, abundant, 0.2-0.3(-0.5) mm wide; thallus cracks often along one or more sides of the apothecia so the ascocarps are somewhat "free-standing". Proper margin occasionally visible on very young apothecia, thin, even, slightly paler than disc, excluded early. Disc round, oval, or irregularly elongate, plane, slightly shiny; dark red-brown to black. Hypothecium dark red-brown, unevenly pigmented; epithecium medium brown to red-brown; paraphyses coherent, complex-branched; hymenium pale yellowish, 75 µm high. <u>Spores</u> 8 per ascus, simple, fusiform-ellipsoid to 'banana-shaped', hyaline, 14-18 X 4 µm.

Spot Tests: thallus K+ faint yellow, KC-, C-, P-.

<u>Substratum/Habitat</u>: saxicolous, collected once on igneous rocks in the suprahaline zone.

Selected Specimen: 4185.

Local Abundance and Distribution: rare; distribution poorly known,

collected in the very south of the CDFD subzone (Metchosin area), not collected in the adjacent zones during the present study but known from other collections from the Spruce/Fog subzone of the Coastal Hemlock zone.

<u>World Distribution</u>: uncertain ; reported from Europe and Asia (Ozenda & Clauzade, 1970). It was not included in Hale & Culberson (1970) and therefore may be new to North America.

L. phaeops Nyl. is reported here as new to the province.

LECIDEA PLANA (Lahm.) Nyl., Flora 55:552. 1872.

Lecidella plana Lahm., Parerga Lich.:211-212. 1861.

<u>Thallus</u> crustose; rimose or finely areolate-cracked, < 0.5 mm wide, not continuous, thickest around apothecia, light to medium grey, appearing quite blue-grey from a distance, a reflection of the nature of the hypothallus. Hypothallus black, thin; at margin and between scattered areoles.

<u>Apothecia</u> scattered or often grouped, (0.6-)0.8-1.2(-1.6) mm wide. Proper margin thick, raised, <u>+</u> shiny, flexuous, persistent, pruinose, black. Disc plane, round becoming lobed, often irregular if grouped, not to slightly constricted, matt, epruinose, black (even when wet). Hypothecium hyaline in the upper 75-100 µm, below a little greyish; exciple externally black, internally pale orange-brown; paraphyses coherent, branched at apices; epithecium black (green-black occasionally); hymenium 50-55 µm high, hyaline or sordid black above. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoidoblong or oblong, $(10-)12-13 \times 3-4.5 \mu$ m.

<u>Spot Tests</u>: thallus K-, C-, KC-, P-, IKI-; hymenium and upper hypothecium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected once on a loose cobble and once on igneous rock.

Selected Specimens: 4735, 5213.

Local Abundance and Distribution: rare; distribution poorly known, one collection at a higher elevation inland in the CDFD subzone; one collection from an inland site in the adjacent CDFW subzone.

<u>World Distribution</u>: tentatively circumtemperate in the Northern Hemisphere; known from Europe, Japan, South America (northern Andes, Colombia), and North America (Hertel, 1975). In North America it has been reported from Washington (Culberson & Hertel, 1979), South Dakota and Wyoming (Wetmore, 1968), Greenland (Lynge, 1940), Cape Breton Island (Lamb, 1954a), New York (Lowe, 1939), New Mexico (Egan, 1972), Michigan (Harris, 1977; no planaic acid), and California and Nevada (Fink, 1935). Many of these reports could be based on other species in the <u>L. plana-L. lithophila</u> complex.

<u>Remarks</u>: <u>L</u>. <u>plana</u> is distinguished by the reduced thallus, hyaline hypothecium, internally light exciple, low hymenium, and narrow spores. This matches very closely the description of <u>L</u>. <u>hassei</u> Zahlbr., known from southern California and New Mexico (Magnusson, 1935). However, according to the excellent key for cryptothalline <u>Lecidea</u> in Hertel (1975) that species has marginally narrower spores, averaging 2.7 μ m wide, while those of <u>L</u>. <u>plana</u> average 3.5 μ m wide. Although widespread species, no comparative, complete description was available for <u>L</u>. <u>plana</u>, making the very miniscule difference in spore width between the two species unimpressive. However, it has been pointed out that <u>L</u>. <u>hassei</u> which contains schizopeltic acid, is chemically distinct from <u>L</u>. <u>plana</u> which contains planaic acid (Culberson & Hertel, 1979). The chemical nature of the local material therefore requires checking.

LECIDEA cfr. PROTABACINA Nyl., Bull. South. Calif. Acad. 2:60. 1903.

<u>Thallus</u> crustose; areolate; the areoles clustered to separate, usually of groups irregularly placed on the hypothallus; areoles 0.6-1.2 mm wide, round to oval, slightly convex in a 'shield' shape or sometimes angular by compression, steep-sided, occasionally cracked and slightly lobulate; surface slightly shiny, <u>+</u> smooth; dark tawny brown, sometimes almost reddish brown with some edges indistinctly blackened (or more rarely whitened) or not. Hypothallus black, indistinct.

<u>Apothecia</u> common, abundant, scattered to grouped, 0.8-1.5(-2.0) mm wide. Proper margin thin, even with disc or a little raised, <u>+</u> persistent, black. Disc adnate, not constricted, initially round to angular when among grouped areoles, becoming lobulate and cracked or fissured with age; initially plane but then slightly convex or undulate and then often appearing almost concave, minutely roughened, <u>+</u> light white pruinia; black. Hypothecium dark(reddish-) brown; epithecium (green-)brown, often granular; hymenium 65 μ m high, light greenish or greenish-brown above and <u>+</u> a little reddish-brown below; paraphyses strongly coherent but branched only at apices; exciple dark on the outer edge, light internally. <u>Spores</u> not observed. According to Fink (1935) the spores are long-ellipsoid, 8-12 X3-4 μ m.

<u>Spot Tests</u>: thallus K-, C+ red (cortex and medulla, LM), KC+ red (on filter paper under DM), P-, IKI-; hymenium IKI+ blue; exciple and epithecium C+ red (LM).

Substratum/Habitat: saxicolous; collected twice on igneous rock.

Selected Specimens: 3845, 5142.

Local Abundance and Distribution: rare; distribution poorly known, collected inland at two exposed sites both higher elevations, one in the south of the CDFD subzone, the other in the north; not collected in the

adjacent zones.

<u>World Distribution</u>: western North American endemic; described from California, also reported from Washington (Fink, 1935).

<u>Remarks</u>: <u>L</u>. cfr. <u>protabacina</u> is distinguished by the dark coloured areolate-squamulate thallus, indistinct black hypothallus, dark brown hypothecium, and C+ red cortex, medulla, exciple, and epithecium. (This is based on the local material; the type specimen has not been seen).

It is very close to <u>L</u>. <u>fuscoatra</u>, differing in the C+ epithecium, slightly yellower areoles which lack the white/black detailed edges, and the reduced hypothallus. The indistinct hypothallus may be caused by the substratum of the few local collections rather than the typical state; even <u>L</u>. <u>fuscoatra</u> can have a reduced hypothallus at times.

There are two North American endemics which have dark brown areolessquamules and a brown hypothecium, <u>L. cascadensis</u> and <u>L. protabacina</u>. The former is described as having white-edged areoles much like <u>L. fuscoatra</u>, leaving <u>L. protabacina</u> as the more likely candidate. Both, however, are described as being C- (Magnusson, 1935a) which, given the relative obscurity of that reaction in the local material, may have been overlooked. The types of the IKI-, C+ group need to be examined and the species re-evaluated.

LECIDEA SULPHUREA (Hoffm.) Wahlenb., Flora Lappon.:477. 1812.

Verrucaria sulphurea Hoffm., Descript. et Adumbrat. Plant. Lich. 1:56, Tab.

11, fig. 3. 1790.

Lecanora sulphurea (Hoffm.) Ach., Lich. Univ.: 399. 1810.

<u>Thallus</u> crustose; of scattered, convex granules, 0.4-0.4 mm wide, which usually are compacted into thick, deeply-cracked verruculose areoles, 0.7-1.3 mm wide, <u>+</u> matt, sometimes finely cracked, almost tartareous; yellow to greyish-yellow. Hypothallus absent.

Apothecia abundant, crowded to scattered, 0.4-0.7(-1.0) mm wide.

Proper margin initially thin, raised, eventually becoming reduced or excluded, \pm shiny; initially sometimes pale yellow like the thallus, then becoming black or initially black. Disc round to irregular-oval, plane to slightly convex (occasionally very convex), often minutely roughened especially with age, \pm matt, initially immersed, usually becoming subsessile or adnate, occasionally just level with the thallus even with age; black, epruinose (once with a light bluish pruinia). Hypothallus \pm hyaline (DM) to light fulvous (LM); exciple externally dark green-black, pale internally; epithecium bright green-black to sordid green-brown, often with brownish granules; paraphyses slender, coherent, with enlarged apical cell, usually branched near the apices; hymenium 60-80 μ m high; hyaline or light green above. Spores 8 per ascus, hyaline, oval-ellipsoid, simple, 11-13 X 6-8 μ m.

<u>Spot Tests</u>: thallus K+ yellow (sometimes turning orange), C+ yellow, KC+ orange, P-, IKI-: hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected primarily on sandstone but also on conglomerate and granitics. It is especially common in the supralittoral zone, although also present at inland sites.

Selected Specimens: 1373B, 2907.

Local Abundance and Distribution: occasional; scattered throughout the southern part of the CDFD subzone at maritime sites, particularly abundant on the Gulf Isands; not collected in the adjacent zones.

<u>World Distribution</u>: western North Americia-Europe-eastern Asia disjunct; in Europe known from England (Duncan, 1970), France and North Africa (Ozenda & Clauzade, 1970); in Asia reported from China, Nepal, and U.S.S.R. (Hertel, 1977); not listed in Hale & Culberson (1970) and possibly new to North America; also reported from Argentina (Grassi, 1950) in the Southern Hemisphere. Remarks: L. sulphurea is characterized by the yellow thallus which is

C+ yellow (but not orange), light hypothecium, and branched paraphyses. It is very similar to <u>Lecidella subincongrua</u> which is also very common on seashore rocks. See that species for comments.

The local material differs in some small respects from the descriptions of European L. <u>sulphurea</u> although it matches very closely the description given in Ozenda & Clauzade (1970) except for the slightly narrower spores (9-12 X 4-5 μ m). All the European descriptions have narrower spores: 10-13 X 5-6 μ m (Duncan, 1970; Flètcher, 1975a), 10-15 X 5-6 μ m (Smith, 1918). Furthermore, in some discriptions the thallus is given as sulphurgreen to yellow-grey and a limiting black-green hypothallus is also mentioned in some (Duncan, 1970). These slight discrepancies from the local material are mentioned because of L. <u>brandegei</u> Tuck. and L. <u>tessellina</u> Tuck., two North American endemics, which appear similar in the descriptions of Fink (1935).

L. sulphurea is reported here as new to the province.

LECIDEA TESSELLATA (Sm.) Floerke, Deutschl. Lich. 4:5. 1819.

Lichen tessellatus Sm., Engl. Bot. 8:pl. 533. 1799.

Lecidea columbiana H. Magn., Medd. från Göteborgs Bot. Trädg. 10:33. 1936.

<u>Thallus</u> crustose; up to 9 cm in diameter, cracked-areolate with the cracks sometimes incomplete; continuous, thick, up to 1 mm thick; areoles angular, steep-sided, \pm flat to slightly convex, the surface smooth or often gently to minutely verruculose, \pm matt; white or light grey. Hypothallus absent or occasionally visible at margin, thin, black.

<u>Apothecia</u> common, scattered to often grouped, initially immersed, becoming level with the areoles, 0.7-1.3(-1.6) mm wide. Proper margin thin, raised, often crisped or leaning towards the apothecia center, exposing the

lower part of the exciple, black, \pm persistent, sometimes not visible in young apothecia which are still attached to the thalline tissue on the sides or white speckled with remnants of the areoles. Disc round to angular by compression, sometimes cracking, usually plane, occasionally slightly convex, black, \pm light white pruinia. Hypothecium \pm hyaline; exciple dark brown-black externally, hyaline to pale reddish internally, usually at least partially reduced; epithecium green-black; paraphyses coherent but simple, occasionally appearing with fine granules; hymenium 55-60(-180) µm high, pale green above, hyaline below or entirely pale green. Spores 8 per ascus, hyaline, simple, ovoid, 10-12 X 5 -6 µm; not usually present; observed only once in the specimen with the 180 µm high hymenium.

<u>Spot Tests</u>: thallus K-, KC-, C-, P-, IKI+ faint purple (see below); hymenium and hypothecium IKI+ blue.

<u>Substratum /Habitat</u>: saxicolous; collected primarily on sandstone, only once on igneous rock.

Selected Specimens: 137, 1318.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at maritime sites; not collected in the adjacent subzones.

<u>World Distribution</u>: circumarctic-alpine-circumboreal; Hertel (1977) described its distribution as "mountains and steppe of the Holarctic" listing Asian localities in Iran, Pakistan, Afganistan, Mongolia, U.S.S.R., China, and Nepal; also reported from Venezuela and Argentina in the Southern Hemisphere (Hertel, 1971a, 1977).

<u>Remarks</u>: <u>L</u>. <u>tessellata</u> is distinguished by the thick, continuous, whitish thallus, the innate apothecia, and hyaline hypothecium. <u>L</u>. <u>phaeops</u>, also with innate apothecia, has much smaller ascocarps that have a reddish colour in the epithecium, hypothecium and occasionally the hymenium. <u>L</u>. cfr. <u>cruc-</u> iaria is also similar. See the latter species for comments. The positive IKI test of <u>L</u>. <u>tessellata</u>, which is necessary for identification in many keys, is very faint or, more precisely, it is a partial speckling of the medulla (DM), often more noticeable on the edge of an aerole than a cut surface. Pressure from the edge of a razor blade often is sufficient to make the IKI solution wet the areole surface. It is quick reaction albeit not dramatic. Herre (1910a), with an otherwise very complete description of <u>L</u>. <u>tessellata</u>, stated it to be IKI-. Anderson (1964) said the reaction varied from "blue-purple or in some forms weak bluish".

Although <u>L</u>. <u>columbiana</u>, described from British Columbia, is listed in Hale & Culberson (1970), Anderson (1964) reduced it to synonymy with <u>L</u>. <u>tessellata</u>.

LECIDEA ULIGINOSA (Schrad.) Ach., Meth. Lich.:43. 1803.

Lichen uliginosa Schrad., Spicil. Flor. German. 1:88. 1794.

<u>Thallus</u> crustose; of minute, < 0.1 mm, shiny papillae or granules, few and scattered or more often abundant, continuous, or cracked-areolate on drying; dark brown. Hypothallus absent.

<u>Apothecia</u> common, scattered, adnate to slightly immersed in the granules, 0.3-0.7(-1.0) mm wide. Proper margin thin, even, lighter coloured than the disc, sometimes becoming flexuous, and often excluded. Disc <u>+</u> round, slightly constricted with age, at first <u>+</u> plane, becoming slightly to strongly convex and then tuberculate; dark brown to black. Hypothecium dark brown below, lighter brown above; hymenium 100 μ m high, golden-brown; epithicium orange-brown; paraphyses slender, in a fine branched and anastomosing network, visible when lax in KOH. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, simple, 10-15 X 6-8 μ m.

<u>Spot Tests</u>: thallus not tested; hymeniumIKI + blue, K+ golden-yellow. Substratum/Habitat: terricolous and lignicolous; collected once from

thin soil in an exposed outcrop area; several sterile collections from rotting wood with Lecidea granulosa.

Selected Specimens: 780, 4701.

Local Abundance and Distribution: infrequent; scattered throughout the southern part of the CDFD subzone, mainly at inland sites; not collected in the adjacent zones.

World Distribution: circumarctic-circumtemperate (Thomson, 1979).

LECIDEA UNKNOWN #1

<u>Thallus</u> crustose to squamulose; occasionally reduced to slightly lobed areoles but commonly squamulate. Squamules concave or occasionally plane, <u>+</u> broadly and centrally attached, round to irregularly lobed and undulate, 0.5-1.3 mm wide, scattered to contiguous and occasionally imbricate; glossy, reddish-brown with a roughened black edge; black below. Hypothallus black, usually thick and conspicuous.

<u>Apothecia</u> usually present, <u>+</u> scattered, between squamules, 0.6-1.2 (-1.6) mm wide. Proper margin thick, raised, <u>+</u> persistent, black. Disc adnate, constricted, round to flexuous, concave quickly becoming plane and then convex, with or without a light white pruinia; black. Hypothecium dark brown; exciple dark brown externally, <u>+</u> hyaline within; epithecium dark brown to purplish-brown; paraphyses strongly coherent; hymenium 75 µm high, hyaline <u>____</u> with light brownish patches. Spores not observed.

<u>Spot Tests</u>: thallus K<u>+</u> dirty yellow (cortex), C-, KC-, P-, IKI-; hymenium IKI+ blue; exciple C-.

<u>Substratum/Habitat</u>: saxicolous; collected from granitics and other igneous rocks, also once collected from conglomerate.

Selected Specimens: 7337.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, especially common in the southern part of the subzone; present

but not very common in the adjacent zones to the south.

World Distribution: unknown.

<u>Remarks</u>: This <u>Lecidea</u> is distinguished by the glossy, reddish-brown, black-edged squamules that are C-. It may belong in the genus <u>Psora</u> but has strong affinities to the <u>L</u>. <u>fuscoatra</u> group (despite the C- reaction) and so has been placed, at least temporarily, in <u>Lecidea</u>.

Within the local flora this unidentified species is superficially very similar to both <u>Lecidea fuscoatra</u> and <u>Rhizocarpon bolanderi</u>. All have (red-) brown areoles or squamules which are edged in white and/or black, a black hypothallus, and moderate to large-sized black apothecia. In <u>Lecidea fusco</u>-atra the thallus is really only areolate, becoming lobed-areolate in the best-developed specimens; the areoles are \pm plane and not ascendant on the edges; the outer black edging on the squamules is not ragged or tattered in appearance. The hymenium of <u>L</u>. <u>fuscoatra</u> is also a diffuse greenish colour. However, the easiest way to distinguish <u>L</u>. <u>fuscoatra</u> is the C+ red reaction of the exciple (LM) or the KC+ red of the thallus cortex (on filter paper, DM).

Herre (1910a) described <u>L</u>. <u>fumosa</u> (Hoffm.) Ach. (= <u>L</u>. <u>fuscoatra</u>) material from California as having "concave, rarely flat or convex" squamules which are C-. This possibly may refer to this unidentified <u>Lecidea</u>.

<u>Rhizocarpon bolanderi</u> can be distinguished, of course, by the brown, muriform spores. However, since it is often sporeless, <u>R</u>. <u>bolanderi</u> can be confirmed by the flat-peltate squamules with smooth grey margin rather than the concave squamules with the ragged black (and inner white) edging on the margins of the unidentified Lecidea.

Lecidea cascadensis H. Magn. has red-brown squamules which are white edged but the areoles-squamules are plane and matt with inconspicuous hypothallus (Magnusson, 1935a).

Lecidea unknown #1 somewhat resembles Lecidea ventosa Vain., which is

known only in a sterile condition from Finland. <u>L</u>. <u>ventosa</u> is composed of "greasy-" smooth, rust brown squamules with light-coloured margin and black lower surface. The squamules are ascendant or concave (Schneider, 1980). However, no mention is made of a prominent hypothallus.

LECIDELLA Koerb. emend Hert. & Leuck.

Thallus crustose; often yellowish and C+ orange from xanthones, or greyish.

Ascocarp an apothecium. Proper margin usually well-developed at least when young. Asci with a distinctly amyloid tholus (IKI+ blue); paraphyses + simple, and often free, especially in KOH.

Mainly saxicolous, also corticolous and muscicolous.

Until recently Lecidella was usually included in Lecidea sens. lat.

References: Magnusson (1945), Poelt (1961), Leuckert & Hertel (1971), Hertel & Leuckert (1969), Hertel (1968, 1970, 1971), Poelt & Vězda (1981).

LECIDELLA ELAEOCHROMA (Ach.) Choisy, publication information not available. Lecidea parasema var. elaeochroma Ach., Methol. Lich.: 36. 1803. Lecidea elaeochroma (Ach.) Ach., Synops. Lich.: 18. 1814.

<u>Thallus</u> crustose; up to 3 cm in diameter; thin, even, or finely cracked to finely verruculose, sometimes thicker and becoming <u>+</u> cracked-areolate; light grey to yellowish grey. Hypothallus blue-black, visible at thallus edge or through cracks, sometimes absent.

<u>Apothecia</u> abundant, usually scattered, 0.5-1.1 mm wide. Proper margin at first shiny, thick and raised, then thick but even with disc and finally (occasionally quickly) excluded; black. Disc constricted at base, plane, usually becoming slightly to strongly convex, but sometimes remaining plane; often tuberculate with age; black, or in shaded locations a little brownish. Hypothecium golden brown; hymenium 60-75 μ m high; epithecium blue, blueblack or green-black; paraphyses simple, <u>+</u> free. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, simple, epispore distinct, ca.0.75 μ m wide; 11-15 X 7-8 μ m.

<u>Spot Tests</u>: thallus K+ yellow, KC+ orange, C<u>+</u> orange (negative if thallus lacking the yellowish coloration which is not common in the local material); hypothecium K+ brighter yellow.

<u>Substratum/Habitat</u>: corticolous; collected on all types of trees but primarily on Al<u>nus</u>.

Selected Specimens: 2571, 4064.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone, especially towards the western edge, primarily at inland sites; present although not as abundant in the adjacent zones.

World Distribution: uncertain; perhaps western North America-Europe

disjunct (following Thomson, 1979). The distribution of <u>L</u>. <u>elaeochroma</u> has often been described as "cosmopolitan" (Ozenda & Clauzade, 1970). In North America it has been reported as "Pan-Boreal" (Wetmore, 1968) based on reports from Quebec (Lepage, 1979), Smoky Mountains (Degelius, 1941), Arizona (Weber, 1963), Washington (Howard, 1950), and South Dakota (Wetmore, 1968). However, Thomson (1979) described its distribution as distinctly western occurring from "Alaska to Alberta, Saskatchewan, California, and west of this line".

LECIDELLA SCABRA (Tayl.) Hert. & Leuck., Willdenowia 5:375. 1969. Lecidea scabra Tayl., Flora Hiber. 2:121. 1836.

<u>Thallus</u> crustose; thin, discontinuous, often around sand grains; of tiny, scattered, convex granules or almost areolate with thicker 'lumps'; light white-grey or sometimes faintly yellowish-grey. Soralia always present although sometimes few, expecially if thallus is abundantly fertile, 0.3-0.7 mm wide, isolated with convex heaps of granular soredia or abundant and confluent, yellowish but often grey or greyish-blue on the edges, sometimes entire soralia greyish-blue. Hypothallus inconspicuous, usually not observed, blue-black.

<u>Apothecia</u> often present, adnate, constricted, 0.3-0.8 mm wide. Proper margin initially thick, shiny, raised, eventually or sometimes quickly even with the disc and finally excluded; black. Disc shiny at first, then matt, concave then quickly plane, and then often convex, sometimes becoming almost tuberculate in the last stage; black. Hypothecium medium yellow-brown; hymenium 50-70 μ m high, not inspersed; epithecium usually a vivid green or blue-green, sometimes greenish-blue; paraphyses simple, coherent at tips, free in KOH. <u>Spores</u> 8 per ascus, simple, hyaline, ellipsoid or with one side flattened, epispore distinct, ca. 0.75 μ m thick; 12-13(-15) X 7-8 μ m.
Spot Tests: soredia K+ yellowish, KC+ orange, C+ orange.

<u>Substratum/Habitat</u>: saxicolous; collected mainly on sandstone, often with other <u>Lecidella</u> species, but also on conglomerates and granitic igneous rock.

Selected Specimens: 2593, 2850A.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, especially towards the eastern edge of the Gulf Islands, at both maritime and inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: uncertain; known from Europe and North America; in North America it has been reported from Newfoundland (Poelt, 1961) and South Dakota (Wetmore, 1968).

<u>Remarks</u>: The thallus is inconspicuous and is undoubtedly more common locally than the few collections would indicate.

L. scabra is reported here as new to the province.

LECIDELLA cfr. SPITSBERGENSIS (Lynge) Hertel & Leuck., Willdenowia 5:375.

1969.

Lecidea spitsbergensis Lynge, Skr. Svalbard Ishavet 79:10. 1940.

Lecidea rolleana H. Magn., Meddel. Goteb. Bot. Tradg. 16:133. 1945.

<u>Thallus</u> crustose; thin, of discontinuous areoles of more commonly thick, continuous, cracked-areolate; dirty light grey to quite showy whitish-grey. Hypothallus not observed.

<u>Apothecia</u> common, usually abundant, adnate to somewhat subsessile and level with the thallus, hardly constricted to not constricted, scattered or grouped and confluent, 0.4-0.9 mm wide. Proper margin thin, raised, shiny, excluded if disc becomes convex; black. Disc round to slightly irregular, occasionally flexuous, flat to slightly convex or strongly convex; <u>+</u> shiny, especially when young, often matt with age; black. Hypothecium hyaline, not distinctly separate from hymenium, up to 50 μ m thick; hymenium 75-80 μ m high, inspersed with tiny granules, hyaline or faintly aeruginose above; epithecium strikingly aeruginose green, occasionally a little blue or even light sordid green; paraphyses coherent, freer in KOH although remaining coherent at the apices, some simple but always a few branching or sometimes most branching; exciple of large-celled, thin-walled, radiating hyphae, pigmented dark bluish-black in the cell walls (lumina <u>+</u> hyaline) both internally and externally on the upper section, excipular tissue below the hypothecium becoming medium to dark orange-brown. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, epispore distinct, ca. 0.75 μ m thick; 11-13 X 6-7 μ m.

<u>Spot Tests</u>: thallus K+ yellow, C-, KC-, P-; excipular tissue below hypothecium K+ brighter orange-yellow coloured (intensified).

<u>Substratum/Habitat</u>: saxicolous; collected mainly on sandstone (HCl-) but also once on granitic igneous rock.

Selected Specimens: 1303, 1770.

Local Abundance and Distribution: occasional; scattered in the southern part of the CDFD subzone, especially on the Gulf Island, primarily at maritime sites but also occasionally at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumboreal-alpine; reported from Spitzbergen, most of Europe, Asia (Caucasus, Iran, Pakistan, China) and North America (Alberta, Wyoming) according to Hertel (1970).

<u>Remarks</u>: <u>Lecidella spitsbergensis</u> is characterized by the inspersed hymenium, light coloured hypothecium, aeruginose green epithecium, and K+ yellow thallus (atranorin present). The coherent, branched paraphyses are not typical of <u>Lecidella</u> in general and therefore are often overlooked in most keys, e.g. Ozenda & Clauzade (1970), although they are noted in Poelt (1961). This initially caused much confusion with the identification of the local material. Specimen #1770 was kindly identified as <u>L</u>. <u>spitsbergensis</u> by Dr. Poelt, who pointed out that this is a rather polymorphic species. The local material, indeed, does appear slightly different from 'typical' <u>L</u>. <u>spitsbergensis</u> which has an exciple coloured only on the outer edge, slightly larger spores (12-18 X 6.5-9 μ m), and a preference for calcareous substrata. Furthermore <u>L</u>. <u>spitsbergensis</u> s. str. is an arctic-alpine-boreal species which the distribution of the local material does not reflect. The local material is concentrated on the Gulf Islands in the southern part of the CDFD subzone and is not found in the adjacent zones. Most arctic-alpine -boreal species are found locally at inland, exposed, higher elevations within the CDFD subzone and also the adjacent zones.

The local material is very similar to <u>L</u>. <u>spitsbergensis</u> but further study is required.

L. spitsbergensis has not been reported previously from the province.

LECIDELLA STIGMATEA (Ach.) Hertel & Leuck., Willdenowia 5:375. 1969. Lecidea stigmatea Ach., Lich. Univ.:161. 1810.

<u>Thallus</u> crustose; of scattered, thin granules or quite thick, verruculose and continuous cracked-areolate; dirty light grey. Hypothallus absent.

<u>Apothecia</u> common, usually abundant, adnate, 0.5-1.3 mm wide. Proper margin thin to thick, shiny, initially raised, becoming thinner and level with disc, occasionally excluded early; black. Disc round to irregular, sometimes flexuous, scattered to grouped, sometimes with several growing from an old apothecium in a cauliflower effect; plane or sometimes convex; black. Hypothecium hyaline, often with a fulvous to a pinkish area in a streak below the hymenium, sometimes appearing finely inspersed with oil droplets; exciple vivid black-blue on the outer edge, fading and becoming pale inward and downward in the exciple, grey amorphous granules often

clustered near the base; hymenium not inspersed, 65-80 μ m high, <u>+</u> hyaline; paraphyses simple; epithecium dark blue-green, sordid green, light brown, or reddish brown. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, epispore distinct, ca. 0.75 μ m wide; 13-16 X 7-8 μ m.

Spot Tests: thallus K+ yellow, KC-, C-, P-.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone, granitics, and other igneous rocks.

Selected Specimens: 1560, 3042.

Local Abundance and Distribution: infrequent; scattered in the southern part of the CDFD subzone at both inland and maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-alpine-circumboreal in the Northern Hemisphere; reported from Europe, U.S.S.R. (Hertel, 1971a), Pakistan, India, Nepal, and China (Hertel, 1977), and North America; in North America reported from Alaska (Thomson, 1979), Ellesmere Island (Thomson, 1959), Saskatchewan (Looman, 1962), Quebec (Lepage, 1972), Colorado (Anderson, 1962), Arizona (Weber, 1963), South Dakota and Wyoming (Wetmore, 1968), Wisconsin (Hertel, 1971a), and California (Thomson, 1979); also reported from Venezuela and New Zealand in the Southern Hemisphere (Hertel, 1971b).

<u>Remarks</u>: <u>L</u>. <u>stigmatea</u> is characterized by the light-coloured hypothecium and exciple which is dark externally but pale internally. The European descriptions do not mention the inspersed hypothecium observed occasionally in the local material nor the amorphous granules in the immediate region of the base. Anderson (1964) described the "medullary excipulum...as rarely sparsely inspersed with small, colorless granules". The wide variation in epithecium colour has been observed by many workers (Anderson, 1962; Wetmore, 1968; Poelt, 1961). Poelt (1961) stated that <u>L</u>. <u>stigmatea</u> is a very polymorphic species. <u>L</u>. <u>stigmatea</u> is reported here as new to the province although it is mentioned as present on the Queen Charlotte Islands in an unpublished report of Brodo (1980).

LECIDELLA SUBINCONGRUA Nyl. var. ELAEOCHROMOIDES (Nyl.) Hertel & Leuck., Willdenowia 5:375. 1969.

<u>Lecidea parasema</u> var. <u>elaeochromoides</u> Nyl., Flora 66:201. 1873. Lecidea catalinaria Stiz., Bull. Torrey Bot. Club 24:447. 1897.

Lecidea subincongrua Nyl. Var. elaeochromoides (Nyl.) Poelt, Ber. Bayer Bot.

Ges. 34:86. 1961.

<u>Thallus</u> crustose; up to 7 cm wide; of separate, rounded, <u>+</u> shiny granules, 0.2-0.5 mm wide; or granules fusing into deeply cracked and sometimes widely separated verruculose areoles, 0.5-3.0 mm wide; light yellow. Hypothallus blue-black, inconspicuous.

<u>Apothecia</u> common, scattered or grouped, adnate, constricted, 0.5-1.2 (-1.6) mm wide. Proper margin usually thin, raised, very shiny, persistent unless disc becomes very convex; black or occasionally with a yellowish tinge when young, like thallus. The disc plane or following contours of underlying areoles, occasionally convex, roundish or angular by compression often becoming flexuous with age, shiny when young, matt with age; black. Hypothecium yellow brown to reddish brown, often darkest below and lighter towards hymenium; epithecium vivid aeruginose blue to black at tips of paraphyses; hymenium 75-110 μ m high, hyaline or bluish tints diffusing down from epithecium or occasionally even pinkish tints diffusing up from hypothecium; paraphyses simple, coherent at tips, free in KOH. <u>Spores</u> 8 per ascus, simple hyaline, ellipsoid or with one flat side, epispore distinct, c. 0.75 μ m wide; 12-14 X 6-8 μ m.

Spot Tests: thallus K+ yellow, C+ orange, P-; hymenium IKI+ blue;

hypothecium C+ darker coloured, then bleaching out.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone, conglomerate, and granitic rock in the supralittoral zone.

Selected Specimens: 261, 1006.

<u>Abundance and Local Distribution</u>: occasional; scattered in the southern part of the CDFD subzone at maritime sites, especially concentrated on the Gulf Islands; one collection in the adjacent CDFW subzone.

<u>World Distribution</u>: western North America-Europe disjunct; although considered maritime and Mediterranean in Europe it has been reported as far as Great Britian (Duncan, 1970); in North America it has been reported from coastal California and Baja California (Hertel, 1971a).

<u>Remarks: L. subincongrua var. elaeochromoides</u> is distinguished by the yellow thallus which is C+ orange and the black, level apothecia with persistent, shiny proper margin. Internally the apothecia have a dark hypothecium, simple paraphyses and aeruginose blue epithecium. <u>Lecidea sulphurea</u> is superficially very similar, with a yellow thallus and similar ascocarps. However, its thallus is never shiny and the apothecia are usually quickly convex with margin excluded. Furthermore, internally the apothecia of <u>L. sulphurea</u> have a light coloured hypothecium, sordid greenish-black epithecium, and paraphyses which branch at least at the apices. Actually the paraphyses of <u>Lecidella subincongrua</u> may branch occasionally but then usually below the epithecium and <u>Lecidea</u> sulphurea may have some simple paraphyses but the tips are swollen and often beset with knobby protuberances.

Herre (1910) stated the yellow thallus of <u>Lecidea enteroleuca</u> Ach. var. <u>theioplaca</u> Tuck., found along the California coast, precludes a positive yellow spot test with KOH but the reaction is actually quite distinct, although, sometimes it helps to squash a thallus fragment on filter paper

and then touch with KOH, when in doubt.

<u>L. subincongrua</u> var. <u>elaeochromoides</u> is reported here as new to the province. Earlier reports of <u>Lecidea latypea</u> Ach. and <u>L. latypiza</u> Nyl. from the coastal area of British Columbia probably refer to <u>L. subincongrua</u>.

LEPRARIA Ach.

Thallus crustose; completely leprose, unstratified and lacking any distinct morphological structures; of scattered sorediate masses to sublobate on a membranous hyphal mat. Phycobiont a green alga.

Ascocarps unknown.

Saxicolous, corticolous, lignicolous, and muscicolous.

Lepraria has not been recently monographed and is in need of review. Laundon (1981) has segregated the yellow(-green) species as the genus Chrysothrix.

The treatment given here is only tentative pending monographic treatment of the genus.

- Thallus of very fine granules (< 0.1 mm), forming thin to thick, greenish grey or bluish grey mats; typically in sheltered, shaded locations L. INCANA
- 1. Thallus of moderately large (> 0.2 mm), mealy granules, greyish-white; typically in exposed locations <u>L</u>. <u>NEGLECTA</u>

LEPRARIA INCANA (L.) Ach., Lich. Suec. Prodr.:7. 1798. Byssus incana L., Sp. Pl.:1169. 1753.

<u>Thallus</u> crustose; often quite extensive, covering large areas (up to 8 cm broad); entirely leprose, typically thick up to 1 mm thick, but occasionally thick, usually composed of a very thin coating of fine granules (< 0.1 mm wide) over a hyphae-granules mixture; greenish-grey, bluish grey (to pale yellowish-grey with aging in herbarium specimens); margin indistinct, not lobate.

Ascocarps not observed; unknown to science.

Spot Tests: thallus K+ yellow, P+ yellow (turning orange); see below.

<u>Substratum/Habitat</u>: corticolous, terricolous, saxicolous, and muscicolous; often on the bases of trees in shaded areas, also preferring shaded locations (i.e. rock overhangs) on other substrata.

Selected Specimens: 181, 4436.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially in shaded or protected habitats, also present in the adjacent zones.

World Distribution: uncertain.

<u>Remarks</u>: Preliminary TLC and re-crystalization tests on several local specimens indicate that the material is not homogenous (as is also indicated by the morphology of some of the specimens). Most specimens contain atranorin and apparently divaricatic acid (the re-crystalization test was not conclusive in all cases). Additionally, many specimens also contained zeorin and one or two unknown.

The K+, P+ spot tests observed in the local material are also shared by <u>L</u>. <u>finkii</u> (B. de Lesd.) Harris, ined., a species described from eastern North America, but also known from the western United States, Europe, Asia, and Australia (Harris, 1977). <u>L</u>. <u>finkii</u> contains atranorin, zeorin, stictic and constictic acids. In a comparison of <u>L</u>. <u>incana</u> and <u>L</u>. <u>finkii</u> in Brodo (1981), <u>L</u>. <u>incana</u> is described as having a thin thallus which is K+ yellow and P- while <u>L</u>. <u>finkii</u> has a thick thallus which is K+ yellow and P+ orange (stictic acid and zeorin). In an earlier paper (Brodo, 1968), <u>L</u>. <u>incana</u> was described as containing atranorin with or without fumarprotocetraric acid. Brodo (1981) referred specimens containing atranorin and fumarprotocetraric or protocetraric acid to L. lobificans Nyl. Lepraria species are known to produce a number of secondary metabolites. Magnusson (1952) noted many different reactions to the standard spot tests within some of the common Lepraria species. Brodo (1968) pointed out that chemical variation in the group held promises in clearing up some of the taxonomic probelms in this group. The promise is not yet been kept since Lepraria remains unmonographed.

Other reports of the chemistry of <u>L</u>. <u>incana</u> are lacking although divaricatic acid, the substance that appears to be present in the local material, has been previously reported from a German specimen of <u>L</u>. <u>aeruginosa</u> (Wigg.) Sm. (Culberson et al., 1977). This actually may be a reference to <u>L</u>. <u>incana</u> since Hawksworth et al. (1980) list <u>L</u>. <u>aeruginosa</u> auct. (non (Weis) Sm.) as a synonym of <u>L</u>. <u>incana</u>.

LEPRARIA NEGLECTA auct., s. lat.

.5

<u>Thallus</u> crustose; effuse and covering large areas to more determinate and small, almost sub-lobate; composed of moderately large granules, closely compacted but thin; dirty grey.

Ascocarps not observed; not known yet to science.

<u>Spot Tests</u>: thallus K+ yellow, P+ yellow turning orange-red. (See below). <u>Substratum/Habitat</u>: saxicolous; over both igneous and sedimentary rocks, especially in exposed habitats.

Selected Specimens: 1419, 3855.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at exposed sites; also present in the adjacent zones.

World Distribution: uncertain; reported from Europe and North America.

<u>Remarks</u>: The separation of this species from the local <u>L</u>. <u>incana</u> is not always clear-cut, with part of the problem lying in the heterogenous nature of both species. TLC and re-crystalization tests on the local material of

<u>L</u>. <u>neglecta</u> are conflicting, with the TLC indicating similarity with <u>L</u>. <u>incana</u> collections while re-crystalization tests, in at least one case, clearly indicated alectoronic acid but failed to detect atranorin, zeorin, etc. The answer to this problem may lie in a mixture of the two species being present in the same collection.

LEPROCAULON Ny1.

Primary thallus crustose to squamulose; granulose-sorediate, verruculose, to squamulate; usually evanescent. Secondary thallus minutely fruticose; composed of pseudopodentia. Pseudopodentia ecorticate, slender, up to 25 mm tall, \pm nodular to powdery protuberances which are vaguely to distinctly forming phyllocladia. Cephalodia absent.

Ascocarps unknown. Pycnidia unknown.

Leprocaulon is a chemically very complex group.

All substrata; most commonly terricolous or saxicolous among mosses.

Although formerly included in <u>Stereocaulon</u> the resemblance is superficial. <u>Leprocaulon</u> is better considered as close to <u>Lepraria</u>.

References: Lamb and Ward (1974)

Thallus yellowish or pale yellow-green. <u>L. MICROSCOPICUM</u>
 Thallus grey or white <u>L. SUBALBICANS</u>

<u>LEPROCAULON</u> <u>MICROSCOPICUM</u> (Vill.) Gams ex D. Hawksw., Trans & Proc. Torguay Nat. Hist. Soc. 16:128. 1974.

<u>Lichen microscopicum</u> Vill., Histoire des Plantes de Dauphine 3:946. 1789. <u>Stereocaulon microscopicum</u> (Vill.) Frey, Kryptogamen-Flora, 9, Abt. 4, 1: 89. 1932.

<u>Primary thallus</u> not observed. <u>Secondary thallus</u> minutely fruticose; consisting of tiny, terete pseudopodentia, up to 2 mm high; branched several times at the base and along the pseudopodentia; dense, central axial strand present; decorticate; covered with numerous, small, granular, decorticate phyllocladia; thalli separate and single or compacted into pulvinate cushions; the entire thallus tinged pale yellow or when thalli abundant then greenish(-yellow).

Apothecia not observed; not known to science.

<u>Spot Tests</u>: K-, KC+ yellow (washing away from fragment on filter paper under DM), P-.

<u>Substratum/Habitat</u>: saxicolous and "muscicolous"; collected once on <u>Selaginella wallacei</u> at an inland, higher elevation, exposed site and once on igneous rock in the supralittoral zone of a headland maritime site.

Selected Specimens: 4166C, 7349.

Local Abundance and Distribution: rare; distribution poorly known, collected twice on the Saanich Peninsula in the southern part of the CDFD subzone; not collected in adjacent zones.

<u>World Distribution</u>: western North America-Europe disjunct; 'European' distribution actually includes North Africa and Asia Minor; in North America reported from New Mexico, Colorado, California, South Dakota, and Washington; also reported from Australia in the Southern Hemisphere; the presence of <u>L. microscopicum</u> in Australia is theorized to be an example of human longdistance dispersal on stones from Europe used as ships' ballast (Lamb & Ward, 1974).

<u>Remarks</u>: According to Lamb & Ward (1974) the pseudopodentia may be upwards of 6 mm tall and rather slender, 0.1-0.2 mm wide. Furthermore, the primary thallus is described as granulose-sorediate and persistent. It was not observed in either of the local collections. The yellow coloration is very faint in some cases but is unmistakable against a white background, i.e. filter paper.

LEPROCAULON SUBALBICANS (Lamb ex Imsh .) Lamb & Ward, Journ. Hat. Bot. Lab. 38:534. 1974.

Stereocaulon subalbicans Lamb ex Imsh., Bryologist 60:220. 1957.

Primary thallus not observed. <u>Secondary thallus</u> minutely fruticose: consisting of tiny, terete pseudopodentia; 0.5-2.5 mm high; simple or branched several times at the base and/or along the pseudopodentia; decorticate; covered with numerous, small (ca. 0.2 mm wide), granular, decorticated, vague phyllocladia; without a dense central axis. The entire thallus appearing powdery, white, the phyllocladia slightly greyer, the base occasionally brownish.

Apothecia not observed; not known to science.

Spot Tests: K+ yellow, KC-, C-, P+ yellow, slowly turning orange.

<u>Substratum/Habitat</u>: 'muscicolous'; collected once growing on <u>Selaginella</u> <u>wallacei</u> at an exposed, higher elevation, inland site.

Selected Specimen: 4166A.

Local Abundance and Distribution: rare; collected once in the southern part of the CDFD subzone, not collected in adjacent zones.

<u>World Distribution</u>: southern South America-North America disjunct; in North America one chemical strain is found in Colorado, Montana, Washington, Alberta, and British Columbia; a second chemical strain is known from Alaska and Greenland (Lamb & Ward, 1974).

Remarks: The single local collection of L. subalbicans displays only the

smaller, congested growth form of the species. The pseudopodentia are reported to grow up to 1 cm in height.

The local material was initially keyed out as <u>L</u>. <u>albicans</u> (Th. Fr.) Nyl. as phyllocladia were interpreted to be more distinct than the "concolorous, ill-defined, irregular, small lumps" (Lamb & Ward, 1974) attributed to <u>L</u>. <u>subalbicans</u>. However, the illustrations in Imshaug (1957) and Lamb & Ward (1974) are the same as the local material. In North America, <u>L</u>. <u>albicans</u> is known only from Mexico and Alaska. The Alaska strain contains squamatic acid (among several acids) and would be UV+. Reports of <u>L</u>. <u>albicans</u> from British Columbia (Otto & Ahti, 1967) are all from the southwestern portion of the province, including the Victoria area, and probably are referable to <u>L</u>. <u>subalbicans</u>.

Because of the chemistry and distinct geographical distribution Lamb & Ward (1974) stated that it seems probable the local strain of L. <u>subalbicans</u> should be distinguished eventually as a separate species.

LEPTOCHIDIUM Choisy

Thallus foliose; moderate sized lobes, similar in appearance to <u>Leptogium</u> or <u>Collema</u> but containing the blue-green alga <u>Scytonema</u> instead of <u>Nostoc</u>; corticate on the upper and lower surface.

Ascocarp an apothecium. Thalline margin present. Spores 8 per ascus, hyaline, l-septate.

Terricolous among mosses.

Monotypic genus.

References: Jørgensen (in Poelt & Vézda, 1977).

LEPTOCHIDIUM ALBOCILIATUM (Desm.) Choisy, Bull. Mens Soc. Linn. Lyon 21: 165. 1952.

Leptogium albociliatum Desm., Annal. Scienc. Nat., Bot., ser. 4, 4:132. 1855. Polychidium albociliatum (Desm.) Zahlbr., Naturl. Pflanzenfamil., 1,

Teil, Abt.1:157. 1906.

<u>Thallus</u> foliose; orbicular, 3-7 cm broad. Lobes linear, 3-5 mm wide, appressed with margins and ends raised and undulate. Upper surface dull to slightly shiny, <u>+</u> even; isidia present, granular becoming lobulate, laminal, usually abundant; fine, short white hairs present on lobe margins and larger isidia; blackish green-grey, dark greyish blue-green. Below white tomentose, tomentum becoming grouped into fasiculate-like rhizines, bare zone near margin.

Apothecia common, laminal, sessile, 0.6-1.0 mm wide. Margin containing algae, whitish or darkening, thin, often with white hairs, finally excluded. Disc plane, orange-brown. Hymenium 100 μ m high; epithecium somewhat orange; hypothecium hyaline. <u>Spores</u> 8 per ascus, hyaline, pointed-ellipsoid to oblong-ellipsoid, 1-septate, 20-25 X (5-)6-7 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; among moss over rock, usually on shaded, sloping surfaces.

Selected Specimens: 1805B, 4502.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at higher elevations inland, not collected in adjacent zones.

<u>World Distribution</u>: western North American-eastern North America (Greenland)-Europe disjunct; in western North America reported from California to Alaska (Brodo & Alstrup, 1981).

<u>Remarks</u>: The gelatinous nature of the thallus has resulted in this species to be mistaken often for, and sometimes included in, <u>Leptogium</u>. The white ciliate margins and isidia and, when fertile, the 1-septate spores, distinguished <u>Leptochidium albociliatum</u> from any of the local species of <u>Leptogium</u>.

LEPTOGIUM (Ach.) Gray

Thallus commonly foliose, sometimes minutely so, or occasionally minutely fruticose. Upper cortex and usually lower cortex present with blue -green algae (<u>Nostoc</u>) scattered in between in a homoiomerous arrangement, traversed by scattered, interwoven hyphae, or, in one group, hyphae forming a paraplectenchymatous tissue; \pm isidia; dark bluish, greenish, or brownish grey. Naked and smooth below or with thick, white tomentum.

Ascocarp an apothecium, sessile or stipitate, hardly constricted. Thalline margin present. Disc (red-)brown to black. Spores 8 per ascus, hyaline, muriform or several septate, ellipsoid, fusiform, or accicular, averaging 15-35 X 7-14 µm.

Corticolous (usually bases of deciduous trees), also saxicolous and terricolous.

<u>Leptogium</u> is not known to contain lichen acids; the thalli are not generally spot tested and this section is omitted in the following descriptions.

The presence of the cortex, at least the upper cortex, quickly separates <u>Leptogium</u> from <u>Collema</u>. A quick dissection and examination of a small whole mount (a cross-section is not necessary) under the LM readily shows a conspicuous 'brick-work' in those specimens with a cortex.

References: Sierk (1964), Jørgensen (1971, 1973, 1975; in Poelt & Vezda,
1977). Jørgensen (1975) contains a key to the ventrally tomentose species.
1. Thallus large, > 1 cm broad; lobes \pm > 2 mm wide
1. Thallus small, $\pm < 1$ cm broad; lobes < 2 mm wide
2. Thallus with white tomentum abundant on the lower surface \ldots 3
2. Thallus naked below, or with only scattered tufts of hairs for attachment
3. Hyaline hairs abundant on margins; spores 1-septate <u>LEPTOCHIDIUM</u> <u>ALBOCILIATUM</u> (p. 431)
3. Without hyaline hairs on the margins; spores muriform4
 Thallus distinctly wrinkled; isidia cylindrical with apical dimple
4. Thallus not wrinkled; isidia granularL. <u>SATURNINUM</u>
5. Lobes elongated, sides and ends turned under to form 'horns' <u>L</u> . <u>PALMATUM</u>
5. Lobes not turned under6
6. Thallus isidiate7
6. Thallus not isidiate8
7. Isidia few, lobulate; thallus >125 μ m thick <u>L</u> . <u>PLATYNUM</u>
7. Isidia abundant to few, cylindrical to clavate, sometimes lobulate; thallus < 100 µm thickL. UNKNOWN #1
8. Margins <u>+</u> entire9
8. Margins lobulate to lacerate
9. Lobes corticate (check with LM)10
9. Lobes ecorticate; supralittoral zone <u>COLLEMA</u> <u>FECUNDUM</u> (p. 274)
<pre>10. Lobes few, rounded; apothecia crowded, subsessile; spores 4 per ascus; corticolous L. UNKNOWN #2</pre>
<pre>10. Lobes abundant, crowded; apothecia adnate, scattered; spores (6-)8 per ascus; terricolous or muscicolous</pre>

11.	Lobes margi	obscurely wavy-wrinkled, up to 100 µm thick; ns lacerate <u>L</u> . <u>LICHENOIDES</u>
11.	Lobes the co and so	evenly and finely wrinkled, anastomosing at enter, > 125 μm thick; lobules present laminally ometimes marginally
	12.	Lobes terete, not at all flattened; constricted at intervals
	12.	Lobes flattened (ultimate tips <u>+</u> terete) not constricted at intervals13
13.	Lobes	<u>+</u> free, finely divided; on trees or sandy soil15
13.	Lobes sands	appressed, not finely divided; on tone in 'drip" areas
	14.	Thallus paraplectenchymatous L. <u>TENUISSIMUM</u>
	14.	Thallus not paraplectenchymatous, but of loosely interwoven hyphae between an upper and lower cortexL.LICHENOIDES

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LEPTOGIUM FURFURACEUM (Harm.) Sierk, Bryologist 67:266. 1964. Leptogium hildenbrandii var. furfuraceum Harm., Lich. France 1:118.

<u>Thallus</u> foliose; 2.0-3.4 mm broad. Lobes rounded, 2-5 mm wide, \pm appressed with margins and ends lightly ascendant but the very edges revolute; slightly and minutely transversely wrinkled; matt or slightly shiny, 200(-300) µm thick; of loosely interwoven hyphae; isidia abundant, cylindrical-clavate, simple or branched, up to 1 mm tall, scattered to grouped longitudinally, wrinkled to smooth, with very tip shiny, darker coloured, and dimpled; dark olive brown, fuscous black. Below slightly wrinkled, all except the margins covered with white tomentum; tomentum up to 200 um long, composed of elongate, cylindrical cells.

Apothecia not observed. According to Sierk (1964) the apothecia are

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1905.

rare, 0:5-0.8 mm wide; thalloid exciple entire to isidiate, spores ellipsoid, muriform (3 septa transversely, 1 septum longitudinally), 23-26 X 7-9 μm.

<u>Substratum/Habitat</u>: corticolous, collected only on the trunks of <u>Quercus</u>.

Selected Specimens: 174, 4090.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at both inland and maritime sites; not collected in the adjacent zones (see Figure 21).

<u>World Distribution</u>: western North America-Europe disjunct in the Northern Hemisphere; in Europe concentrated around the Mediterranean; in North America reported from California to southern British Columbia and east to South Dakota and Texas; also reported from East Africa in the Southern Hemisphere (Jørgensen, 1975; Sierk, 1964).

<u>Remarks</u>: According to Sierk (1964) <u>L</u>. <u>furfuraceum</u> may be much larger, reaching a diameter of 8 cm.

LEPTOGIUM LICHENOIDES (L.) Zahlbr., Cat. Lich. Univ. 3:136. 1924. Tremella lichenoides L., Sp. Pl.:1157. 1753.

<u>Thallus</u> foliose, usually pulvinate; 1.5-7 cm broad. Lobes usually short, ascending and very crowded into a cushion-like shape, occasionally lobes looser, wider, and spreading more horizontally; 0.25-2.0(-3.0) mm wide; margins varying from dentate (usually on the outer edge of thallus) to finely dissected-fimbriate with the outgrowth terete (usually at least in the center of thallus and often the entire thallus); edges very shiny to occasionally duller; lightly wrinkled to almost ridged with wrinkles stronger below; 75-100 µm thick; of loosely interwoven hyphae; olivaceous black, fuscous black, or black, with greenish colour more evident below or



occasionally whole thallus rather greenish in shaded locations.

Apothecia occasional, laminal, adnate, often constricted at base, 0.3-0.7 mm wide. Thalline margin lobulate to fimbriate-isidiate, becoming partially excluded to expose light orange-coloured proper margin. Disc dark orange-brown, plane to concave. Hypothecium 150-175 μm high. <u>Spores</u> (6-)8 per ascus, hyaline, muriform, (6-8 septa transversely; 2-3 longitudinally), 35-52 X 16-20 μm.

<u>Substratum/Habitat</u>: terricolous, on thin soil among mosses especially in crevices in rock; also occasionally corticolous on Quercus.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone, especially at inland sites, also present in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumtemperate (Thomson, 1979) in the Northern Hemisphere; also reported from New Zealand (Martin, 1968) and Australia (Filson & Rogers, 1979) in the Southern Hemisphere.

<u>Remarks:</u> <u>L. lichenoides</u> is distinguished by the fimbriate lobe margins. On the basis of the material examined it was not possible to segregate <u>L. californicum</u> Tuck., which is reported to be present locally (Sierk, 1964) and which is very similar to <u>L. lichenoides</u>. Indeed, problems were also encountered in separating <u>L. sinuatum</u> from the latter in certain cases. A comparison of the three species based on descriptions in Sierk (1964) shows a broad overlap in thallus size, lobe size, lobe thickness, and spore size and septation (see Table II). Presumably the key character separating these three species is the lobe margins with coloration and wrinkling also playing a determining role. <u>L. sinuatum</u> has margins which are "entire to finely lobulate to fimbriate"; and <u>L. californicum</u>, "entire to lubulate to granular". <u>L. sinuatum</u> and <u>L. lichenoides</u> are both described as lead grey to brown while <u>L. californicum</u> ranges from lead grey to "commonly greenish to olivaceous to brown". <u>L. lichenoides</u> is stated to be distinctly wrinkled while the other two vary from smooth or roughened to wrinkled. It is apparent that the three species are hardly distinctive, with species limits within a character range seeming to be rather arbitrary. In spite of this difficulty, it must be admitted that <u>L</u>. <u>sinuatum</u> and <u>L</u>. <u>lichenoides</u> appear distinctive enough in the local collections, although the amount of thallus wrinkling seems to be an unreliable character and the occasional specimen is difficult to determine because the degree of margin laceration appears intermediate.

Based on the few specimens of <u>L</u>. <u>californicum</u> available in the UBC herbarium and UW and determined by Sierk, a clear concept of <u>L</u>. <u>californicum</u> could not be formed. Sierk (1964) used coloration and degree of wrinkling to distinguish this species, but the colour may be affected by habitat (in shaded habitats thalli are usually less browned and therefore greener or bluer in colour) and the wrinkling does not seem a consistent character in this small group. The greenish thallus attributed to <u>L</u>. <u>californicum</u> is also present towards the base of the thallus in the other two species. In shaded habitats the thallus is likely to bear larger lobes that are less crowded and greener, features ascribed to <u>L</u>. <u>californicum</u>.

It is interesting to note that two of the older floras for western North America list only a single species of the <u>L</u>. <u>lichenoides</u> - <u>L</u>. <u>calif-ornicum</u> complex. Howard (1950) noted only <u>L</u>. <u>lichenoides</u> and Herre (1910a) listed only <u>L</u>. <u>californicum</u>. Indeed in the recent <u>Macrolichens of Alaska</u> (Krog, 1968), although both species are listed, the author stated that she had not "seen sufficient material to distinguish it (<u>L</u>. <u>californicum</u>) successfully from L. lichenoides".

<u>L</u>. <u>californicum</u>, from the local material and limited herbarium specimens available, seems to be a doubtful species. It may be that <u>L</u>. <u>californ</u>icum does not occur locally; it also could possibly be a distinct yet 'subtle' species not easily circumscribed by written descriptions. The prob-

Table II. Comparison of characters of <u>Leptogium sinuatum</u>, <u>L. lichenoides</u>, and <u>L. californicum</u> from Sierk (1964.

	L. SINUATUM	<u>L. LICHENOIDES</u>	L. CALIFORNICUM
thallus diameter	2-5 cm	1-6 cm	2-10 cm
lobe width	1.0-4.0 mm	1.0-4.0 mm	0.5-3.0 mm
lobe thickness	60-135 μm	75-150 μm	70-170(-200) μm
lobe margins	entire to irregularly cut to lobulate	entire to commonly finely lobulate to fimbriate	entire to lobulate to lacerate to granulate
lobe surface	roughened to distinctly and irregularly wrinkled	distinctly wrinkled	smooth to distinctly wrinkled
colour	lead grey to mostly dark brown	lead grey to brown	lead grey to commonly greenish to olivaceous to brown
thalline margin	entire, sometimes periclinally wrinkled	lobulate or with coral- loid outgrowths	entire to granulate to lobulate
spores	25-35 X 12-14 µm 7 septa transversely 1-2 septa longitudinally	18-45 X 11-16 µm 5-9 septa transversely 1-3 septa longitudinally	25-45 X 12-15 μm 3-7 septa transversely 1-2 septa longitudinally
substratum	soil, rocks, bark	commonly on rocks (usually calcareous), generally among moss	mossy rocks, occasionally soil, rarely trees

lem requires further study. (The type of <u>L</u>. <u>californicum</u> has not been examined).

LEPTOGIUM PALMATUM (Hedw.) Mont., Hist. Nat. Canar. 3(2):128. 1840. Lichen palmatus Hedw., Fl. Angl. ed. 2:535. 1778.

<u>Thallus</u> foliose; 6-11 cm broad or in even larger loose mats. Lobes free, <u>+</u> ascending, irregularly linear elongate, up to 3 cm long, edges of the margins and tips revolute, or branching with only the young lobules corniculate, <u>+</u> shiny, especially near the tips; finely wrinkled, more pronounced when wet; 50(-80) μ m thick; of loosely interwoven hyphae; below etomentose, finely wrinkled, wrinkles fewer than on upper surface but often sharper, longer, and lighter coloured; deep grey, brownish grey, fuscous black, fuscous, often browner when viewed under DM.

<u>Apothecia</u> often present, usually adnate, laminal, crowded to scattered, 0.3-0.9 mm wide. Thalline margin thin to largely excluded; proper margin light-coloured, thick becoming thin. Disc concave to plane, reddish brown or darker. Hymenium 150-200 μm high; epithecium reddish brown to almost hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to ellipsoid- elongate, muriform (5-9 septa transversely; 1-2 septa longitudinally), 35-48(-60) X 11-16 (-20) μm.

<u>Substratum/Habitat</u>: terricolous; on thin soil over rock with mosses. <u>Selected Specimens</u>: 1089, 1956.

Local Abundance and Distribution: frequent (present at almost one-half of collection sites); scattered throughout the CDFD subzone; also collected in adjacent zones.

<u>World Distribution</u>: western North America-Europe-eastern Asia (Japan) disjunct; in North America reported from California to Alaska and east to Idaho but much more frequent along the coast.

LEPTOGIUM PLATYNUM (Tuck.) Herre, Proc. Wash. Acad. Sci.12:144. 1910. Leptogium californicum var. platynum Tuck., Syn. N. Amer. Lich.1:159. 1882.

<u>Thallus</u> foliose; up to 9 cm broad. Lobes irregular, fusing centrally although marginally separate, marginally slightly ascendant with ultimate edges <u>+</u> revolute, 2-3.5 mm wide, finely wrinkled; margins entire to lobulate; 130-175(-200) μ m thick; lobules few but always present, on lamina and sometimes on edges of margin (seem too frequent for wound regeneration of 'excessive' wrinkles); <u>+</u> shiny towards edges; dull black sometimes with a purplish tinge, brownish-black. Below naked with scattered tufts of hairs for attachment; bluish-grey.

<u>Apothecia</u> occasional, laminal, immersed to slightly raised, 0.3-0.6 mm wide. Thalline margin on slightly raised apothecia as a series of <u>+</u> abrupt, raised wrinkles; occasionally lobulate-isidiate. Proper margin light coloured. Hymenium 150 μm high; epithecium yellowish. <u>Spores</u> 8 per ascus, hyaline, elongate-ellipsoid to ellipsoid, muriform (7-9 septa transversely; 0-2 septa longitudinally), 35-50 X 9-15 μm.

Substratum/Habitat: saxicolous; usually among mosses.

Selected Specimens: 4073, 4496.

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Local Abundance and Distribution: infrequent; concentrated on the western edge of the CDFD subzone but also one collected from the Gulf Islands, more common at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from California, Washington, and Texas (Sierk, 1964).

<u>Remarks</u>: Herre's description (1910a) of <u>L</u>. <u>platynum</u> succinctly described the species..."thallus...indeterminate through fusion of adjacent plants; irregular...occasionally minutely lobulate...surface finely striate or wrinkled...". The lobules are much more common on the local material than the above description or that of Sierk (1964), who mentioned that the margins may be lobulate, would suggest. Furthermore, the local material, while thicker than other local <u>Leptogium</u>, just reaches the lower range of thallus thickness, (150-)250-500 µm, mentioned in Sierk (1964). The presence of the lobules and thinner thallus than Sierk's monograph description led to some doubt and problems in identifying the local material. A loan from COLO of a New Mexico specimen proved to be a direct match. The thallus thickness of the COLO specimen was only 180-200 µm.

L. platynum is reported here as new to the province.

<u>LEPTOGIUM SATURNINUM</u> (Dicks.) Nyl., Act. Soc. Linn. Bord., 21:272. 1856. <u>Lichen saturninus</u> Dicks., Fasc. Pl. Crypt. Brit.2:21. 1790

<u>Thallus</u> foliose; 12-24 mm wide. Lobes rounded, \pm smooth, dull to slightly shiny, 5-9 mm wide, \pm free and ascending; margins entire, revolute, dull; 110-250 µm thick; of scattered interwoven hyphae; isidia abundant to sparse, usually crowded, granular; olivaceous black, dark olive grey. Below covered in white tomentum, 40-80 µm long, longer at anchorage points, composed of elongate, cylindrical cells.

<u>Apothecia</u> present in both specimens observed, laminal, 0.7-1.7 mm wide. Disc plane, reddish brown. Hymenium 100 μ m high; epithecium reddish brown, coloration diffusing down into the hymenium. <u>Spores</u> not observed. According to Sierk (1964) the spores are ellipsoid, muriform (3-4 septa transversely; 1 septum longitudinally, 20-25 X 7-10 μ m.

<u>Substratum/Habitat</u>: corticolous, collected once each on <u>Salix</u> sp. and <u>Acer</u>.

Selected Specimens: 4364, 6419.

Local Abundance and Distribution: rare; distribution poorly known; one collection on the southwestern edge of the CDFD subzone and one in the adja-

cent CDFW subzone, both inland sites.

<u>World Distribution</u>: (circum(low)arctic)-circumboreal; in North America extending south in the western mountains, also reported from New Zealand (Martin, 1966) in the Southern Hemisphere.

<u>Remarks</u>: According to Sierk (1964) the thallus of <u>L</u>. <u>saturninum</u> may reach a much larger size than that observed in the local material, up to 6 cm broad.

LEPTOGIUM SINUATUM (Huds.) Mass., Mem. Lichenogr.:88. 1853. Lichen sinuatus Huds., Fl. Angl. ed. 2. 2:535. 1778.

<u>Thallus</u> foliose; loosely to tightly pulvinate, 3-10 cm broad. Lobes 2-6 mm wide (curved and difficult to measure), short, occasionally entire but usually slightly to moderately dentate, also sometimes lobulate with extremes sometimes present on same thallus; slightly to very shiny on margins; lightly wrinkled to almost smooth; 70-75(-100) µm thick; of loosely interwoven hyphae; fuscous-black. Below naked, with wrinkles more distinct than above, often greenish-blue in colour.

<u>Apothecia</u> occasional, laminal, subsessile to adnate, 0.3-0.7 mm wide. Thalline margin often minutely lobulate. Disc plane to concave, reddish brown. Hymenium 150-175 μ m high. <u>Spores</u> (6-)8 per ascus, hyaline, muriform (5-8 septa transversely; 1-2 septa longitudinally, (32-)38-45 X 13-18 μ m.

<u>Substratum/Habitat</u>: saxicolous or terricolous, on thin soil over rock or directly on rock, often among moss.

Selected Specimens: 1938, 2037.

Local Abundance and Distribution: infrequent; on the Gulf Islands in the southern part of the CDFD subzone; not collected in adjacent zones.

World Distribution: circum(north)temperate in the Northern Hemisphere

(Sierk, 1964); but also reported from the 'north slope' of Alaska (Thomson, 1979); also reported from New Zealand (Martin & Child, 1972) and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks</u>: <u>L</u>. <u>sinuatum</u> is distinguished by the entire to lobulate margins, pulvinate habit, and lack of vegetative propagules. See <u>L</u>. <u>lichenoides</u> for additional comments.

<u>LEPTOGIUM</u> <u>TENUISSIMUM</u> (Dicks.) Fr., Corp. Fl. Prov. Suec.1:293. 1835. Lichen tenuissimum Dicks., Pl., Crypt. Brit.1:12. 1785.

<u>Thallus</u> minutely foliose; 0.8-1.6 cm wide. Lobes short and <u>+</u> appressed, 0.5-1.5 mm wide, edges becoming or strongly dissected into terete outgrowths; the lobes sometimes reduced to abundant coralloid outgrowths; 80-100 μ m thick; paraplectenchymatous; dark grey, olivaceous black, or fuscous black. Naked below.

<u>Apothecia</u> common, laminal, 0.3-0.8 wide. Thalline margin entire, somewhat excluded exposing edge of proper margin. Disc concave to plane, orange to dark brown. Hymenium 150 µm high. <u>Spores</u> muriform (7 septa transversely; (0-)1 septum longitudinally), 28-36 X 10-13 µm.

<u>Substratum/Habitat</u>: terricolous and corticolous; collected once each on Quercus and <u>Arbutus</u>, additionally one Macoun (UBC) specimen on sandy soil.

Selected Specimen: 4748.

Local Abundance and Distribution: infrequent; distribution poorly known, scattered in the southern Vancouver Island part of the CDFD subzone, not collected in the adjacent zones.

World Distribution: circumtemperate (Sierk, 1964).

<u>Remarks</u>: <u>L</u>. <u>tenuissimum</u> is distinguished by the small thallus and paraplectenchymatous structure of the lobes. It is superficially similar to pulvinate, corticolous forms of <u>L</u>. <u>lichenoides</u> although the lobes are not crowded as in that species but instead are appressed. Thalli that are reduced to abundant coralloid outgrowths can be separated from <u>L</u>. <u>teretius</u>-culum by the lack of constrictions. Furthermore, all three collections of <u>L</u>. <u>tenuissimum</u> were fertile while <u>L</u>. <u>teretiusculum</u> is usually sterile.

<u>LEPTOGIUM TERETIUSCULUM</u> (Floerke) Arn., Lich. Flora Munchen 2:26. 1892. Collema teretiusculum Floerke, Flora Crypt. Germ 3:551. 1831.

<u>Thallus</u> munitely fruticose, up to 7 mm broad. Lobes small, 0.05 mm wide, ascending, terete, occasionally irregularly branched, constricted at branch points and elsewhere; paraplectemchymatous; 75-100 μ m; blackish green, greenish grey.

<u>Apothecia</u> not observed. Also not observed by Sierk (1964) who cited an earlier description in Magnusson (1934); apothecia placed towards the end of branches, 0.2-0.4 mm wide, with a thick, smooth thalline margin; <u>spores</u> 8 per ascus, 20-25 X 10-11 μ m, initially 3-septate becoming muriform.

<u>Substratum/Habitat</u>: corticolous; collected once on the trunk of <u>Quercus</u> with <u>Collema</u> <u>nigrescens</u>, more abundant in the bark crevices with the <u>Collema</u> occupying the surface of the bark scales.

Selected Specimen: 4520.

Local Abundance and Distribution: rare (see below); distribution poorly known, collected once near Ladysmith in the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia (Japan)^{*} disjunct; in North America reported from New England, British Columbia, and Alberta (Sierk, 1964).

<u>Remarks</u>: The single local specimen was collected as an admixture to the much more conspicuous <u>Collema</u> species. The very minute thallus, plus perhaps

a preference for the sheltered crevices of the bark, make \underline{L} . <u>teretiusculum</u> a very inconspicuous species. It is probably more common locally than the single collection indicates.

LEPTOGIUM UNKNOWN #1

<u>Thallus</u> foliose; 2-3 cm broad. Lobes 1.5-4.0 mm wide, rounded, "cupulate" with center appressed and margins abruptly upturned, margins entire to isidiate; upper surface dull with margins very shiny; smooth to weakly wrinkled; 75-80 µm thick; approaching paraplectenchymatous in places although hyphae obvious elongated horizontally in mid-thallus sections; isidia abundant, dense, cylindrical-clavate becoming lobulate, sometimes branched, on lamina, margins, and upturned ventral surfaces, tips darker than thallus, shiny; black, fuscuous-black, blackish grey. Below naked, bluish.

<u>Apothecia</u> occasional, laminal, 0.3-0.8 mm wide. Thalline margin entire or slightly isidiate, not apparently excluded (proper margin not visible). <u>Spores</u> 8 per ascus, hyaline, ellipsoid to elongate-ellipsoid, muriform (5-7 septa transversely; 0-1 septa longitudinally), 32-55 X 8-15 µm.

Substratum/Habitat: saxicolous; collected twice on sandstone.

Selected Specimens: 1899, 5507.

Local Abundance and Distribution:.rare; distribution poorly known; collected twice at inland, higher elevation sites on the Gulf Islands in the southern part of the CDFD subzone; not collected in adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This species is characterized by the dark coloured, isidiate thallus with large spores. It seems closest to <u>L</u>. <u>arsenei</u> Sierk, described from, and known only from, the southeastern United States. However, <u>L</u>. <u>arsenei</u> has a wrinkled and very thick (200-500 μ m) thallus; it has not yet been collected in the fertile state. L. cyanescens (Ach.) Koerb., a very widespread, isidiate species, has much smaller spores (18-23 X 6-8 μ m) and a lead blue thallus colour.

LEPTOGIUM UNKNOWN #2

<u>Thallus</u> foliose; 1.4-4.0 cm broad. Lobes short and rounded, 2-8 mm wide, almost smooth to crinkled or very minutely wrinkled, \pm dull to slightly shiny on margins, \pm ascending and imbricate; margins usually entire, occasionally lobulate; (130-)150-200 µm thick; hyphae scattered and loosely interwoven; <u>Nostoc</u> chains long; brown, fuscous black, clove brown, brownish grey, or slate coloured. Below naked, more distinctly wrinkled than upper surface.

Apothecia common, abundant, laminal on both dorsal and raised ventral surfaces, often occupying most of lobe; immersed to subsessile to almost sessile, 0.2-0.5 mm wide. Thalline margin thick, entire when apothecia raised slightly above thallus; slightly excluded to expose light coloured proper margin. Disc concave to almost plane, reddish brown. Hymenium 120-125 µm high; epithecium orange to faint yellow. <u>Spores</u> 4 per ascus, hyaline, ellipsoid to oblong-ellipsoid, ends pointed to rounded; muriform (7 septa transversely; 1(-2)septa longitudinally), (30-)32-35(-40) X 10-13 µm.

<u>Substratum/Habitat</u>: corticolous; collected twice on <u>Quercus</u> and once each on <u>Acer</u>, <u>Arbutus</u>, and <u>Thuja</u>. The last is a Macoun collection (UBC, as <u>L. pulchellum</u>).

Selected Specimens: 3694, 4411.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone but especially concentrated on the Saanich Peninsula, not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This unidentified <u>Leptogium</u> is characterized by the 4-spored asci, moderate-sized spores, <u>+</u> subsessile apothecia, and corticolous habit. Sierk (1964) reported that all but one North-American species are 8-spored. <u>L</u>. <u>crenatellum</u> Tuck., known from the eastern United States (Hale, 1979) and Europe (Sierk, 1964) is 4-spored. <u>L</u>. <u>crenatellum</u> has a thinner thallus (60-130 µm), smaller spores (15-20 X 6-7 µm), and a rather specialized habitat (periodically inundated trunks by freshwater). <u>L</u>. <u>corticola</u> (Tayl.) Tuck., despite being 8-spored has some similarity also to the local material. It is also an eastern North American species. The report of <u>L</u>. <u>corticola</u> (as <u>L</u>. <u>pulchellum</u>) from British Columbia (Otto & Ahti, 1967) is actually this unknown species. The other reports of <u>L</u>. <u>corticola</u> from western North America (Howard, 1950; Herre, 1917; Fink, 1935) are all from Washington and usually are not acknowledged as correct. They also may be this species. <u>L</u>. <u>corticola</u> has a heavily and irregularly wrinkled thallus and smaller spores (16-26 X 10-13 µm).

LEPTOGIUM UNKNOWN #3 (section Homodium)

<u>Thallus</u> minutely foliose, up to 1 mm broad. Lobes elongate-linear, \pm narrow, 0.05-0.2 mm wide, flattened, appressed, crowded and overgrowing other lobes; ultimate tips and new branches approaching terete, shiny, darker coloured, often upturned; 60-75 µm thick; paraplectenchymatous; black. Below attached by numerous hyaline hairs.

<u>Apothecia</u> occasional, laminal, adnate, 0.3-0.5 mm wide. Thalline margin thick, entire, not excluded (proper margin not visible). Disc brownish black, plane. Hymenium 150 µm high. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, muriform (5-septa transversely; 0-1 septa longitudinally), 22-33 X 9-15 µm.

<u>Substratum/Habitat</u>: saxicolous; collected three times on sandstone, twice with <u>Pannaria maritima</u>, on possible drip surfaces in the supralittoral

zone.

Selected Specimens: 929B, 997B.

Local Abundance and Distribution: infrequent (see below); collected only on Galiano Island of the Gulf Islands in the southern part of the CDFD subzone; not collected in adjacent zones.

World Distribution: unknown.

<u>Remarks: L. unknown #3</u> is characterized by the very minute foliose thallus with paraplectenchymatous structure and linear little-branched lobes. Because of the paraplectenchymaous organization of the lobes it belongs in section <u>Homodium</u>, a poorly known section of the genus <u>Leptogium</u>. Utilizing Sierk (1964) the local material does not readily key to any of the seven species reported for North America. The lobes of the unidentified material are slightly flattened and linear although not distinctly foliose, but closer to foliose than fruticose. <u>L. rivale</u> Tuck. appears close with thallus flat, tightly appressed, attached to the substratum by numerous hairs and very similar apothecia and spores. However, it appears to be a montaine species; loan material from COLO was considerably larger than the local material both in over-all thallus size and lobe width.

LETHARIA (Th. Fr.) Hue

Thallus fruticose; usually tufted, sometimes pendulous; with or without isidia or soredia; subterete, foveolate; attached by a holdfast; chartreuse to bright fluorescent yellow-green (vulpinic acid).

Ascocarp an apothecium, terminal to subterminal. Thalline margin present, prominent. Spores 8 per ascus, hyaline, simple, ellipsoid.

Corticolous, occasionally lignicolous.

A genus of two species, although occasionally several species usually considered part of <u>Evernia</u>, are also included, e.g. Ozenda & Clauzade (1970).

There is one local species.

References: Schade (1954, 1955).

LETHARIA VULPINA (L.) Hue., Nouv. Arch. Mus. IV.1:57. 1899. Lichen vulpinus L., Spec. Plant.:1155. 1753.

<u>Thallus</u> fruticose; tufted, 1-6 cm long. Branches terete to commonly irregularly angled, foveolate; up to 2 mm wide; branching dichotomously numerous times; surface dull to pulverulent; isidiate, isidia scant to very abundant, short cylindrical, papillate, sometimes breaking up into soredia, covering most branches; pale lemon yellow, citron yellow, light fluourescent greenish yellow, occasionally olive yellow. Attached by a darkening holdfast to the substratum.

<u>Apothecia</u> not observed. According to Schade (1954) the apothecia are uncommon, subterminal with the remaining ultimate branch tip deflected at right angles, up to 11 mm wide with a thalline margin, <u>+</u> soredia; spores 8 per ascus, simple, hyaline, 7.5-8.1 X 3.7-4.8 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; primarily on the exposed or dead trunks of Pseudotsuga.

Selected Specimens: 3920, 4379.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone primarily at higher elevations inland, concentrated towards the western boundary; also present in the adjacent zones.

<u>World Distribution</u>: western North America-Europe disjunct; the 'European' range includes Asia Minor and North Africa; in North America reported from California to Alaska with an eastern extension to Saskatchewan (Looman, 1962) and South Dakota (Wetmore, 1968).

<u>Remarks</u>: Locally <u>L</u>. <u>vulpina</u> produces only rather stunted, small thalli, never the abundant and luxuriant growth observed in the interior of the province.

<u>L</u>. <u>vulpina</u> is often described as sorediate (Herre, 1919a, Howard, 1950, Schade, 1954, Hale, 1969; Bird, 1970) although others call it isidiate (Poelt, 1969; Dahl & Krog, 1973).

<u>L</u>. <u>columbiana</u> (Nutt.) Thoms. (=<u>L</u>. <u>californica</u> (Lev.) Hue), the esorediate/nonisidiate species in this species pair, is endemic to western North America but is not yet known locally.

LICHENOTHELIA D. Hawksw.

Thallus crustose; areolate; black. Perhaps unlichenized but usually associated with various algae.

Ascocarp an ascomata, subsessile, forming a convex or hemispherical ascostroma of pseudoparenchymatous cells with a dark brown or black outer wall, finally appearing somewhat lecideine as a central disc-like depression forms from dissolution of tissue immediately above the asci which is surrounded by a rim of undissolved tissue. Pseudoparaphyses very irregularly branched and anastomosing, persistent. Asci bitunicate, thick-walled, arising at one or more levels within the ascocarp. Ascospores ellipsoid to soleiform, golden to dark brown, 1- to 3-septate or submuriform, often constricted at the central septum, with a gelatinous epispore.

Saxicolous.

<u>Lichenothelia</u> is a recently described genus formed from the <u>Microthelia</u> aterrima group.

There is one local species.

References: Hawksworth (1981).

LICHENOTHELIA UNKNOWN #1

<u>Thallus</u> crustose; at first orbicular becoming irregular, up to 7 cm broad, very finely rimose to areolate, less regular and thinner towards the margin, sometimes becoming fimbriate; black, dark grey.

<u>Ascostoma</u> immersed in larger areoles, sometimes somewhat convex and appearing perithecia-like, 0.1-0.2 mm wide. Ostiole not visible but occasionally a rather large, single punctiform depression present (=lecideine appearance). Asci ovoid, thick-walled, bitunicate. Pseudoparaphyses distinctly septate, few present. <u>Spores</u> 8 per ascus, brown (sometimes initially hyaline but then browning with age), ovoid, 1-septate, constricted at the septum, with the narrower end sometimes elongate, $(16-)20-22 \times 8-10$ µm.

Spot Tests: hymenium IKI+ faint yellow.

Substratum/Habitat: saxicolous; collected once on igenous rock.

Selected Specimen: 4968.

<u>Abundance and Local Distribution</u>: rare; distribution poorly known, collected once at Nanoose Hill in the northern part of the CDFD subzone, not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: The local collection would have been identified as <u>L</u>. <u>metzleri</u> (Lahm) D. Hawksw. except that Hawksworth (1981) described the distribution of that species as alpine. Additionally he mentioned an undescribed North American species, for which no characteristics are given, that will be published later by Dr. A. Henssen. Since the local material has already been reported new to the province once, as <u>Microthelia aterrima</u> (Anzi)Zahlbr. (=<u>Lichenothelia scopularia</u> (Nyl.) D. Hawksw.) in Noble (1978), it seems prudent to leave it identified only to the genus level now rather than possibly correcting a second new-to-the-province record based on the one specimen.

LOBARIA (Schreb.) Hoffm.

Thallus foliose; thalli small to large; usually distinctively wrinkled to pitted; often with internal cephalodia, soredia, isidia, or lobules; the lower surface with a continuous tomentum or reticulately arranged and separated by white naked areas. Phycobiont a green or blue-green alga.

Ascocarp a hemiangiocarpic apothecium, substipitate, submarginal, tending towards the thickened ridges. Thalline margin present, often covered with warty protuberances. Spores 8 per ascus, usually hyaline when mature, acicular or fusiform, (1-)3-septate. Locally the apothecia are often parasitized.

Primarily corticolous but also saxicolous and terricolous.

References: Hakulinen (1964), Jordan (1973), Yoshimura (1971).

1.	Thallus fringed with lobulesL. <u>OREGANA</u>
1.	Thallus not lobulate; often sorediate or isidiate, or no vegetative propagules present
	2. Thallus esorediate and nonisidiate <u>L. LINITA</u>
	2. Thallus sorediate or isidiate
3.	Thallus strongly reticulately ridged; phycobiont a green alga
3.	Thallus smooth to shallowly pitted (scrobiculate); phycobiont a blue-green alga4
- 4. Upper surface with white hairs; medulla K-, P-; thallus grey-black <u>L</u>. <u>HALLII</u>
- 4. Upper surface without hairs; medulla K+ orange, P+ orange; thallus green-yellow to olive-brown L. SCROBICULATA

LOBARIA HALLII (Tuck.) Zahlbr., Cat. Lich. Univ. 3:321. 1925.

Sticta hallii Tuck., Proceed. Amer. Acad. Arts. Sc. 12:168. 1877.

<u>Thallus</u> foliose; 3-5 cm broad. Lobes 6-12 mm wide, rounded, <u>+</u> shallowly pitted and faintly ridged; upper surface covered, usually densely, by white hairs, concentrated toward the margins, occasionally smooth and shiny or pulverulent toward the center; sorediate, soredia granular, darkening, in pustular maculiform soralia, laminal, but grouped towards the margins; dark grey to dark olive grey. Lower surface covered by a dense tomentum, tan to light brown with numerous pulverulent white, naked areas arranged so that the tomentum appears vein-like. Phycobiont a blue-green alga.

<u>Apothecia</u> not observed. According to Jordan (1973) the apothecia are rare, laminal, up to 2.2 mm wide; disc flat to convex, brown; thalline margin minutely warty and villose; spores 8 per ascus, some aborting, dark brown, l-septate, fusiform with tips mammillate, 23-41 X 9-14 µm.

Spot Tests: medulla K-, P-.

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Substratum/Habitat: corticolous; collected twice on Quercus.

Selected Specimens: 4093, 4218B.

Local Abundance and Distribution: rare; distribution poorly known, collected in the southern part of the CDFD subzone on the western border at higher elevation inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America (Greenland)-Europe(Scandinavia) disjunct (Jordan, 1973); in western North America reported from California north to Alaska and east to Idaho and Montana

(Jordan, 1973) (see Figure 69).

<u>Remarks</u>: The local specimens of <u>L</u>. <u>hallii</u> are much smaller than the maximum of 11 cm given by Jordan (1973). Krog (1968) reported that some Alaskan specimens were up to 17 cm in diameter.

LOBARIA LINITA (Ach.) Rabenh., Deutschl. Kryptog.Fl. 2:65. 1845. Sticta linita Ach., Synops. Lich.:234. 1814.

<u>Thallus</u> foliose; 10-12 cm broad. Lobes 1-2.5 cm broad, rounded to truncate, wrinkled to faintly reticulately-ridged; upper surface shiny, smooth, lacking soredia, isidia, and lobules; internal cephalodia present that produce globose swellings; greyish green to olive brown at the margins. Lower surface with numerous large, white naked areas separated by short, yellow-brown tomentum. Phycobiont a green alga; cephalodia containing a blue-green alga.

<u>Apothecia</u> numerous, laminal, narrowly short-stipitate, (1.5-)2.5-3.5(-5.0) mm wide. Thalline margin thin, finely crenulate to tomentose, algae confined to the lower part of the disc. Disc plane to slightly convex, orange-brown. Hymenium 90-100 µm high; paraphyses simple, coherent at tips; epithecium brown; hypothecium fulvous. <u>Spores</u> 8 per ascus, hyaline, fusiform, 1-(3-)septate, 28-32(-36) X 6-8 µm.

Spot Tests: medulla P-.

<u>Substratum/Habitat</u>: saxicolous; collected once over conglomerate; very shaded.

Selected Specimen: 4670.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Mt. Prevost (660 m) in the adjacent CDFW subzone; not collected in the CDFD subzone.

LOBARIA OREGANA (Tuck.) Muell. Arg., Flora 72:364. 1889.

Sticta oregana Tuck., Bull. Torry. Bot. Club 5:20. 1874.

<u>Thallus</u> foliose; 12-20(-30) cm broad. Lobes 1.6-3.6 cm wide, rounded to subdivided and elongate, free, pendent. Upper surface shiny, smooth, shallowly reticulately ridged; lobules present, few to abundant, on lobe margins; cephalodia present, internal, producing globose swellings on upper or lower surface; green, becoming buff to yellowish in herbarium specimens. Lower surface with large light-coloured naked areas separated by tan to brown tomentum arranged in almost a reticulate pattern. Phycobiont a green alga; cephalodia containing a blue-green alga.

<u>Apothecia</u> common, laminal, 2-3 mm wide, shortly stipitate. Thalline margin thin, smooth. Disc plane, reddish brown. Hymenium 80-100 μ m high; paraphyses simple, coherent at apices; epithecium yellow-brown; hypothecium fulvous. <u>Spores</u> 8 per ascus, acicular, hyaline, 1-septate, sometimes vaguely 3-septate, straight to curved, (40-)50-60 X 5-7 μ m. According to Jordan (1973) the apothecia become strongly convex and will turn black when parasitized. He reported the spores as larger, 42-73(-85) X 4.5-9.5 μ m.

Spot Tests: medulla P+ orange.

<u>Substratum/Habitat</u>: corticolous, primarily on conifers <u>Selected</u> <u>Specimens</u>: 2681, 5248.

Local Abundance and Distribution: infrequent; collected in the CDFD subzone only in the northern part, always at inland sites; also collected in the adjacent zones (see Figure 20).

<u>World Distribution</u>: western North American endemic; reported from California north to Alaska (Jordan, 1973).



LOBARIA PULMONARIA (L.) Hoffm., Deutschl. Fl.:146. 1796. Lichen pulmonarius L., Spec. Plan.:1145. 1753.

Thallus foliose; 6-13(-20) cm broad. Lobes 8-16(-26) mm wide, short and rounded but usually tending towards linear and truncate with a large crescent-shaped sinus. Upper surface shiny, smooth, but with an over-all reticulately ridged pattern; cephalodia occasional, immersed, producing globose swellings on the upper and lower surfaces; sorediate-isidiate, the isidia appearing papillate to sometimes coralloid, marginal or laminal on ridges, soralia maculiform, absent to slight in very young thalli; yellowish green, olive buff, cream buff, brown. Lower surface of large, raised, naked white areas, outlined by tan to brownish tomentum, naked areas and tomentum almost forming, together, a vein-like network.

<u>Apothecia</u> not common, marginal, on narrow short stipes, 1.6-4.0 mm wide. Thalline margin finely villose. Disc plane becoming variously contorted, reddish brown. Hymenium 75 µm high; paraphyses simple, coherent at tips; epithecium yellowish; hypothecium fulvous. <u>Spores</u> 8 per ascus, hyaline, fusiform, 1- to 3-septate, 28-32 X 6-8 µm. Apothecia often infected by an ascomycete; blackened.

Spot Tests: medulla P+ orange.

<u>Substratum/Habitat</u>: primarily corticolous on deciduous trees, especially on Quercus; also occasionally saxicolous.

Selected Specimens: 2437, 5118.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone, primarily at inland sites; present, but not as common, in the adjacent zones.

World Distribution: circumtemperate (Krog, 1968); in North America

actuallý absent from the Central Plains, on the west coast reported from California to Alaska; also reported from Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

LOBARIA SCROBICULATA (Scop.) DC., Fl. France, ed. 3, 2:402. 1805. Lichen scrobiculatus Scop., Flora Carniol., ed. 2, 2:384. 1772. Lobaria verrucosa (Huds.) Hoffm., Deutsch. Flora:146. 1796.

<u>Thallus</u> foliose; 4-10 cm broad, orbicular. Lobes 0.6-1.6(-2.6) cm wide, rounded, free, thick and cartilaginous. Upper surface smooth to shallowly pitted and slightly ridged (scrobiculate), shiny or more commonly pulverulent especially toward the margins; rarely a few scattered hyaline hairs near margins or around soralia; soredia always present, whitish to darkening, granular, in marginal or laminal soralia, the laminal soralia pustular, maculiform, grouped toward the margins; pale greenish yellow, dark olive buff, buff-brown, often darker toward the margins. Lower surface covered by a dense tomentum, dark brown at center, lighter towards the margins; numerous pulverulent, white, naked areas, 0.8-2.0(-3.4) mm wide, narrow white pulverulent zone along the margin.

<u>Apothecia</u> not observed. According to Jordan (1973) the apothecia are rare and often parasitized, up to 1.5 mm wide; disc plane becoming irregular and convex, reddish and darkening; thalline margin papillate; spores 8 per ascus, hyaline, 1- to 3-septate, acicular, 61-72 X 6-8 µm. According to Yoshimura (1971) the spores can be up to 7-septate.

Spot Tests: medulla P+ orange-red (19 specimens), P- (2 specimens).

<u>Substratum/Habitat</u>: primarily saxicolous among mosses and <u>Selaginella</u> wallacei, occasionally also corticolous on Quercus.

Selected Specimens: 4218A, 5471.

Local Abundance and Distribution: frequent; scattered throughout the

CDFD subzone at both inland and maritime sites, present but not as common in the adjacent zones.

<u>World Distribution</u>: circumartic-circumtemperate (Thomson, 1979) in the Northern Hemisphere; preferentially oceanic; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: According to Krog (1968) the P+ strain is worldwide while the P- strain is restricted to northwestern North America. Jordan (1973) did not report a P- strain from North America at all. He stated that the P+ and K+ reactions could be used to separate <u>L</u>. <u>scrobiculata</u> from the similar L. hallii.

According to Jordan (1973) <u>L</u>. <u>scrobiculata</u> is collected primarily on trees and soil, but rarely on rocks. Yoshimura (1971) stated its common substratum is tree bases while Hakulinen (1964) described it as primarily saxicolous. Ahti (pers. comm.) stated that it is saxicolous in northern Scandinavia, corticolous and saxicolous in southern Scandinavia.

LOPADIUM Koerb.

Thallus crustose, approaching squamulose. Phycobiont a green alga. Ascocarp an apothecium, sessile to stipitate. Proper margin present. Hypothecium pale to dark; asci unitunicate, thick-walled, with I+ blue tholus. Spores 1-8 per ascus, hyaline to pale brown, thin-walled, muriform, often large.

Corticolous, saxicolous, humicolous-muscicolous.

There is one local species.

LOPADIUM PEZIZOIDEUM (Ach.) Koerb., Syst. Lich. Ger.:210. 1855.

Lecidea pezizoidea Ach., Lich. Univ.:182. 1810.

<u>Thallus</u> crustose; 3-6 cm broad; scant and scurfy to well-developed and of imbricate, flattened, granulose-squamules; green, olive brown, dark olive buff, to brown.

<u>Apothecia</u> common, stipitate, frequently oriented in one direction, 0.6-1.6 mm wide. Proper margin shiny, black, entire to finely wrinkled, appearing involute. Disc concave, becoming plane, blac-, matt, roughened. Hymenium 125 µm high; paraphyses simple, apically enlarged, apiculate, capitate; hypohtecium light to dark brown. Spores 1 per ascus, oblong, hyaline, muriform (18-20 septa transversely; 8-10 septa longitudinally), 70-80(-95) X 25-30 µm (see Figure 17).

<u>Spot Tests</u>: hymenium IKI+ blue; spores and ascal jelly usually IKI+ yellow or yellow-orange.

Substratum/Habitat: corticolous; on conifers, especially <u>Pseudotsuga</u>.

Selected Specimens: 4071, 5075.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone primarily along the western boundary but also higher elevations on the Saanich Peninsula, one collection only on the Gulf Islands; present in the adjacent zones.

<u>World Distribution</u>: circumarctic-alpine with an extension south along the Pacific coast to Washington and to New Brunswick along the Atlantic Coast. The northern collections are muscicolous, humicolous, and corticolous; the southern collections are primarily corticolous (Thomson, 1979).

MASSALONGIA Koerb.

Thallus squamulate to foliose; small, rosette-shaped; lobes elongated, brown; with or without isidia; rhizines present, brown or blackish. Phycobiont a blue-green alga (Nostoc in clumps)

Ascocarp a hemiangiocarpic apothecium, laminal or marginal. Proper margin present with pseudoexcipulum also present and adhering to the first. Asci cylindrical with apically thickened walls. Spores 8 per ascus, hyaline, ellipsoid to fusiform, 1- to 3-septate.

Muscicolous, saxicolous, occasionally terricolous. There is one local species.

References: Henssen (1963a).

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MASSALONGIA CARNOSA (Dicks.) Koerb., Syst. Lich. Ger.: 109. 1855. Lichen carnosus Dicks., Fasc. Plant. Cryptog. Brit. 2:21. 1790.

<u>Thallus</u> foliose; small, orbicular, (1.5-)3-4(-6) cm broad, closely adhering to or following the substratum. Lobes 8-10 mm long, up to 1 mm wide, elongate, margins very irregular; smooth and shiny to cracked and dull; isidiate, isidia usually numerous, marginal to terminal, globular to cylindrical; chestnut brown, buff brown, lighter below. Rhizines present, inconspicuous, brown.

<u>Apothecia</u> often present, submarginal, 0.6-1.2 mm wide. Margin proper but with algae present below apothecia and often extending up towards the margin (pseudoexcipulum); thick becoming thinner, often lighter coloured than the disc. Disc at first concave, becoming plane, orange or reddish brown, sometimes blackening. Hymenium 80 μm high; paraphyses simple, septate, apically coherent; epithecium light brown. <u>Spores</u> 8 per ascus, hyaline, fusiform-acicular, 1-septate, (25-)27-30 X 5-7 μm (often immature).

<u>Pycnidia</u> not observed. According to Henssen (1963) the pycnidia are brown; pycnospores dumbbell-shaped, 4-6 X 1 µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: usually muscicolous, occasionally saxicolous; often accompanied by <u>Polychidium muscicola</u>; exposed locations.

Selected Specimens: 861, 4700.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone especially at higher elevations inland (exposed locations) but also present at maritime locations; also present but not as common in the adjacent zones.

<u>World Distribution</u>: tentatively circumboreal(-circumarctic); in North America reported from Ellesmere Island and Baffin Island west to Alaska and south to New England in the east and California and Colorado in the west (Thomson, 1979; Henssen, 1963a); also reported from New Zealand (Martin, 1966), Argentina (Grassi, 1950), and Antarctica (Lindsay, 1977) in the Southern Hemisphere.

<u>Remarks</u>: According to Henssen (1963a), <u>Massalongia</u> has a pseudoexcipulum which is variously developed in such a way that young apothecia may have a thalline margin and older apothecia a proper margin. The apothecia have thus been described as both lecanorine and lecideine.

MELANELIA Essl.

Thallus foliose; radiately lobed; lobes short and rounded or elongate; with or without isidia, soredia, pseudocyphellae; corticate above and below, upper cortex prosoplectenchymatous; brown, olive-brown, black-brown, usually HNO3-. Below black, pale, or mottled; rhizinate, rhizines usually simple.

Ascocarp an apothecium, laminal, sessile, thalline margin present. Spores 8 per ascus, simple, ellipsoid, hyaline, thin-walled.

Saxicolous or corticolous.

Until recently <u>Melanelia</u> was part of <u>Parmelia</u>. See <u>Parmelia</u> for additional comments.

References: Esslinger (1973a, 1977b, 1978a), Ahti (1966b, 1969).

1.	Esorediate and nonisidiate, often fertile 2		
1.	Isidiat	e or sorediate, usually sterile	
	2.	Spores 8 per ascus <u>M. SUBOLIVACEA</u>	
	2.	Spores 16+ per ascus <u>M. MULTISPORA</u>	
3.	Pseudoc brown o red	docyphellae large, laminal; sorediate; thallus n only on the margins, centrally greyish, C+ <u>PARMELIA</u> <u>STICTICA</u> (p. 531)	
3.	Lacking and inc thallus	pseudocyphellae, or pseudocyphellae small onspicuous; isidiate or isidiate-sorediate; totally (olive-)brown, not greyish, C+ red	
	4.	Major lobes covered with and often hidden by small lacinae or large flattened isidia; saxicolous <u>M</u> . <u>PANNIFORMIS</u>	
	4.	Lobes not hidden by lacinae or large flattened isidia, although often isidiate (coralloid, globular), sorediate; saxicolous or corticolous	
5.	Isidia(-sorediate) granular or globular in warty piles, coalescing; saxicolous6		
5.	Isidia separate, discrete, either cylindrical or spatulate, scattered, corticolous or saxicolous		
	6.	Isidia tiny, granular; cortex HNO3 M. DISJUNCTA	
	6.	Isidia globular, larger, > 0.1 mm; cortex HNO3+ blue-green NEOFUSCELIA VERRUCULIFERA (p. 491)	

- 7. Isidia flattened, hollow; medulla C- M. EXASPERATULA
- 7. Isidia cylindrical, solid; medulla C+ red M. GLABRATULA

<u>MELANELIA DISJUNCTA</u> (Erichs.) Essl., Mycotaxon 7:46. 1978. <u>Parmelia disjuncta</u> Erichs., Ann. Mycol. 37:78. 1939.

<u>Thallus</u> foliose; 4-7 cm broad. Lobes 0.5-0.75(-1.0 at lobe ends) mm wide, linear, appressed, contiguous, flat to convexly curved. Upper surface smooth to irregularly pitted, shiny especially towards lobe ends; isidia-soredia finely granular, in convex warty piles, sometimes excavated in center, coalescing, infrequently breaking up into whitish soredia, usually dark brown-black; fuscous-black to fuscous. Lower surface black, shiny; rhizines simple, black, abundant.

<u>Apothecia</u> observed once, laminal, 0.7-0.8 mm wide. Thalline margin smooth. Disc concave, shiny, light brown. Hymenium 35-40 µm high; paraphyses coherent; epithecium light brown; hypothecium thick, 50 µm high. <u>Spores</u> not observed. According to Lynge (1921) the apothecia are rare, inconspicuous, up to 2 mm wide; the margin smooth becoming crenulate and sorediate, the spores biseriate, ellipsoid, simple, 10.5-12 X 5-6.5 µm.

Spot Tests: medulla K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: saxicolous; collected only on igneous rocks. Selected Specimens: 4733a, 4955.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone more commonly, but not exclusively, at exposed, higher elevations inland, not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumboreal in the Northern Hemisphere (Krog, 1968; Esslinger, 1977b).

Remarks: Parmelia sorediosa Almb., out of which Lynge & Scholander

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(1932) segregated <u>P. granulosa</u> (=<u>Melanelia disjuncta</u>), is also known from the province but the former's isidia are discrete and scattered, and its lobes are duller and less contiguous. Imshaug (1957) stated that the soralia of <u>M. dusjunta</u> are confluent and blackened compared to the discrete, white, terminal, and often stipitate soralia of <u>M. sorediosa</u>. Wetmore (1968) added that <u>M. disjuncta</u> has thicker, smooth, convex or flat lobes while <u>M. sorediosa</u> has thinner, slightly reticulately ridged at the lobe ends and somewhat concave. Esslinger (1977b) stated that the most reliable character for separating <u>M. disjuncta</u> from <u>M. sorediosa</u> was the pseudocyphellae present in the former although they may be "somewhat obscure and difficult to see" in blackened specimens. Additionally he pointed out the lobe tips of <u>M. disjuncta</u> were often broadened and usually rather shiny while those of <u>M. sorediosa</u> were seldom broadened and usually more or less dull.

MELANELIA EXASPERATULA (Nyl.) Essl., Mycotaxon 7:47. 1978. Parmelia exasperatula Nyl., Flora 56:299. 1873.

<u>Thallus</u> foliose; 3-4 cm broad. Lobes 1.5-2.0 mm wide, linear, appressed but with the lobe ends free and ascending. Upper surface smooth to faintly reticulately pitted at lobe ends, shiny, especially at lobe tips; isidiate, isidia hollow, flattened, lobulate, 0.5-0.8 mm long, usually dense towards thallus center giving thallus a 'fuzzy' appearance; brown, greenish-brown. Below light brown, shiny, with conolorous, simple rhizines.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Esslinger (1977) the apothecia are uncommon, sessile, up to 3 mm broad; thalline margin initially entire becoming crenate or crenate-papillate; <u>spores</u> 8 per ascus, broadly ellipsoid to almost subglobose, 8-10.5 X 5.5-8 µm.

Spot Tests: medulla C-.

<u>Substratum/Habitat</u>: corticolous; collected once each on <u>Alnus</u>, <u>Pseudo-</u> <u>tsuga</u>, and an unidentified, deciduous shrub.

Selected Specimens: 1043B, 4127.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at inland sites; also collected once in the adjacent zones.

<u>World Distribution</u>: possibly circumboreal-circumtemperate (Esslinger, 1977).

<u>Remarks</u>: The hollow, spatulate, isidiate and C- thallus distinguish this species from <u>P</u>. <u>glabratula</u> which is also corticolous. (N.B. <u>P</u>. <u>exas</u>-<u>peratula</u> is occasionally also saxicolous). See James & Rose (1974a) for a comparative table of other similar species.

MELANELIA GLABRATULA (Lamy) Essl., Mycotaxon 7:47. 1978.

Parmelia glabratula Lamy., Bull. Soc. Bot. France 30:345. 1883.

<u>Thallus</u> foliose; 2-6(-9) cm broad. Lobes 1-2(-3) mm wide, linear, thin, appressed but with margins free and imbricate, <u>+</u> fanning out at lobe tips. Upper surface dull to shiny with lobe tips very shiny, smooth, often with low ridges running parallel to lobe length; isidiate, isidia few to abundant especially towards center, cylindrical occasionally becmong coralloid, fragile, easily breaking off exposing medulla (lobes also easily abraded), small lobules often present; coloration varying widely, from brown to olive brown to olive green. Lower surface black, occasionally dark brown with light brown lobe tips, shiny, smooth to reticulate; rhizines simple, black, sometimes white-tipped, abundant.

<u>Apothecia</u> observed only once, apothecia immature, laminal. According to Esslinger (1977) the apothecia are frequent, sessile, up to 6 mm wide; thalline margin entire becoming papillate or isidiate; spores 8 per ascus,

ellipsoid to rarely almost subglobose, 10-14 X 5.5%9.5 µm.

Spot Tests: medulla C+ red, fading.

<u>Substratum/Habitat</u>: corticolous (2/3 of collections) and saxicolous (1/3 of collections); when corticolous usually on deciduous trees and shrubs especially Alnus, Quercus, and Holodiscus.

Selected Specimens: 1543, 3608A.

Local Abundance and Distribution: frequent (present at more than onehalf of collection sites); scattered throughout the CDFD subzone, present but not as abundant in the adjacent CDFW subzone, absent in the CH zone.

<u>World Distribution</u>: North America-Europe (Esslinger, 1977b); in North America concentrated in the Great Lakes region and oceanic western North America but also several central continental locations. Krog (1968) suggested the distribution may be circumboreal-circumtemperate.

<u>Remarks</u>: The C+ red reaction is best observed if the thallus is pressed with a probe after the C is applied.

Some of the colour variation is caused by exposure/insolation differences with a thallus on a twig often being dark brown on the upper surface of the twig and grading around to olive on the twig's under surface.

MELANELIA PANNIFORMIS (Nyl.) Essl., Mycotaxon 7:46. 1978.

Parmelia prolixa f. panniformis Nyl., Synop. Method. Lichen.:397. 1860. Parmelia panniformis (Nyl.) Vain., Medd. Soc. Fauna Pl. Fenn.6:124. 1881.

<u>Thallus</u> foliose; 2-6 cm broad. Major lobes 0.5-0.8 mm wide, appressed, somewhat imbricate, smooth to slightly reticulate; smaller lobules or lacinae present, scattered to <u>+</u> covering the large lobes in imbricate mounds, 0.1-0.2 mm wide, short; older portions of thallus with well-developed lacinae becoming areolately cracked; blackish brown, shiny especially at lobe tips. Lower surface black, browning towards lobe tips, shiny, somewhat; reticulate;

rhizines simple, black.

<u>Apothecia</u> occasional, laminal, 1-3 mm wide. Thalline margin thick, crenulate to covered with small lobules. Disc dark brown, shiny, concave becoming plane. Hymenium 40-55 μ m high; paraphyses coherent; epithecium light brown. <u>Spores</u> 8 per ascus, ellipsoid to oblong, hyaline, simple, 10-12 X 5-7 μ m.

Spot Tests: none.

Substratum/Habitat: saxicolous; collected on igneous rocks.

Selected Specimens: 3638, 4592.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at exposed, higher elevations inland, (not collected on the Gulf Islands); not collected in the adjacent zones.

<u>World Distribution</u>: probably circumarctic-circumboreal in the Northern Hemisphere; also present in Venezuela and Chile in South America (Esslinger, 1977b).

MELANELIA MULTISPORA (Schneid.) Essl., Mycotaxon 7:48. 1978.

Parmelia multispora Schneid., A Guide to the Study of Lichens: 154. 1898.

<u>Thallus</u> foliose; 2-4 cm broad. Lobes 1.5-2.0 mm wide, linear, apically rounded, appressed with margins free and imbricate. Upper surface smooth to faintly reticulately pitted especially at the lobe tips; shiny; nonisidiate, esorediate; olive green to olive brown. Lower surface dark brown, tan at lobe tips, with abundant simple, brown rhizines.

Apothecia common, laminal, 0.75-1.25 mm wide. Thalline margin thick, smooth to crenulate. Disc concave, shiny, concolorous with thallus. Hymenium 50-60 µm high; paraphyses coherent; epithecium light brown. <u>Spores</u> not observed. According to Ahti (1966) the apothecia are 2-2.5 mm wide, sessile, plane to convex when old; disc dark red-brown, margin verrucose

to smooth, sparsely pseudocyphellate; spores subspherical to short ovoid, $6-8 \times 6-10(-13) \mu m$ usually 16 per ascus.

Spot Tests: K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: corticolous, collected once on <u>Alnus</u> trunk. Selected Specimen: 4655A.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CDFW subzone, also one collection of Macoun from Sidney on the Saanich Peninsula in the CDFD subzone.

<u>World Distribution</u>: western North America endemic; reported from California to Alaska extending inland to Montana (Esslinger, 1977b) (Figure 63).

<u>Remarks</u>: The 16-spored asci are the primary distinguishing character separating <u>P</u>. <u>multispora</u> from <u>P</u>. <u>subolivacea</u>, however, Ahti (1966) reported that <u>P</u>. <u>multispora</u> also has a thinner thallus (80-105 μ m thick compared with 160 μ m for <u>P</u>. <u>subolivacea</u>), tighter appressed habit, and a tendency to form marginal lobules.

Schneider (1898) apparently described the species as having a minimum of 50 spores per ascus, causing Herre (1946) to erect <u>P</u>. <u>olivacea</u> var. <u>polyspora</u> for the 16-24 spored material. After he examined the type that showed mainly 16-spored asci Ahti concluded that Schneider was mistaken.

The specimen collected during the present study lacked mature spores. It has been determined as <u>M</u>. <u>multispora</u> on the basis of the thin thallus (90 μ m thick) and the presence of some marginal lobules. Macoun's collection from Sidney possessed 16+ spores per ascus (UBC).

MELANELIA SUBOLIVACEA (Nyl.) Essl., Mycotaxon 7:49. 1978.

Parmelia subolivacea Nyl., Bull. Torrey Bot. Club 24:445. 1897.

<u>Thallus</u> foliose; 4 cm broad. Lobes \pm appressed, margins imbricate, 1.0-1.75 mm, lobe ends \pm rounded. Upper surface shiny and smooth towards lobe ends, duller and roughened towards the center; nonisidiate, esorediate; fuscous black to dark olive. Lower surface brown, darker towards the center; rhizines present, simple, brown to black.

<u>Apothecia</u> laminal, 2.0-3.5 mm wide. Thalline margin even. Disc shiny, lighter brown than the thallus, concave. Hymenium 50-60 µm high; paraphyses coherent; epithecium brownish. <u>Spores</u> 8 per ascus, hyaline, simple, ovoid to subglobose, 8-11 X 6-8 µm.

Spot Tests: K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Cornus</u> <u>nuttalii</u>. Selected Specimen: Bird & Bird, 23791 (CAL).

Local Abundance and Distribution: rare; distribution poorly known, not collected during the present study, one collection by Bird & Bird (1973) from Saltspring Island in the southern part of the CDFD subzone.

<u>World Distribution</u>: western North America-eastern North America-Europe (Canary Islands) disjunct; in eastern North America found only in Michigan; concentrated in western North America (Esslinger, 1977b).

<u>Remarks</u>: According to Ahti (1966) <u>M. subolivacea</u> is unusual in its wide choice of corticolous substrata that include not only many deciduous trees but also a variety of conifers.

<u>M. olivacea</u> (L.) Ach. is very similar to <u>M. subolivacea</u> and may be distinguished by its P+ red medulla. <u>M. olivacea</u> is known from Alaska and eastern North America, being replaced in the southern to middle parts of western North America by <u>P. subolivacea</u>. Many early North American floras recognized only the one species, <u>M. olivacea</u>.

The specimen cited in Bird & Bird (1973) has been examined (CAL-23791) and is indeed 8-spored.

MENEGAZZIA Mass.

Thallus foliose; lobes inflated (hollow), elongate-linear, with perforations through the upper surface; upper surface light coloured, lower surface black; rhizines lacking.

Ascocarp an apothecium, sessile to stipitate. Thalline margin present, well-developed. Spores 2-4(-8) per ascus, hyaline, thick-walled, often large.

Corticolous and saxicolous.

The genus <u>Menegazzia</u> is concentrated in the Southern Hemisphere. There is one local species.

References: Santesson (1943).

<u>MENEGAZZIA TEREBRATA</u> (Hoffm.) Mass., Neag. Lich.:3. 1854. <u>Lobaria terebrata</u> Hoffm., Deutschl. Flora:151. 1796. Parmelia pertusa Schaer., Lich. Helvet. Spicil., sect. 10:457. 1840.

<u>Thallus</u> foliose; orbicular, up to 6 cm broad. Lobes 1-2 mm wide, hollow, dichotomously branched, contiguous, slightly flattened, usually appressed but occasionally slightly free and imbricate. The upper surface shiny, smooth; with small, infrequent perforations into the medullary cavity, up to 1 mm wide, mid-lobe; sorediate, soredia in stipitate soralia which may break open centrally creating a hole into the medullary cavity, margins of soralia reflexed, covered in granular soredia; pale green, pale yellowish green, pale yellowish glaucous. Lower surface rugose, black, browning at the lobe ends, visible from above as a black margin along the lobe sides. Rhizines absent. <u>Apothecia</u> not observed. According to Smith (1918) the apothecia are up to 4 mm wide; disc reddish brown; the margin entire or crenulate, prominent; spores 2-4 per ascus, very large, 45-60 X 22-29 µm. According to Hillmann (1936) the margin is also sometimes sorediate; asci and spores usually poorly developed; the spores 2, seldom 4, per ascus, thick-walled.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; on deciduous trees especially <u>Alnus</u>. Selected Specimens: 2166, 3631.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, especially toward the southern part; present in the adjacent zones; locally not as abundant nor as large as seen on the adjacent British Columbia mainland (Lynn Canyon, Stave Lake, Bridal Veil Falls).

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia (Japan) disjunct; according to Ozenda & Clauzade (1970) it is present in the boreal and mountainous regions of the Northern Hemisphere; also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks: M. terebrata</u>, especially small thalli, can resemble appressed forms of <u>Hypogymnia physodes</u>. The perforations of the upper surface of the <u>Hypogymnia</u> can be used to separate the two species if soredia are absent in the young thalli.

MICAREA Fr. em Hedl.

Thallus crustose; granulose to verruculose, with or without soredia. Ascocarp an apothecium, completely lacking both proper and thalline margin, or proper margin only present initially and then quickly excluded.

Paraphyses slender, branching and anastomosing, very coherent with abundant hymenial jelly. Asci short, thick-walled with an IKI+ blue external layer and simple tholus. Spores 8 per ascus, hyaline, simple to several septate.

Corticolous, lignicolous, saxicolous, and terricolous-humicolous.

Micarea is composed of species formerly considered part of Lecidea,

Catillaria, and Bacidia.

References: Vézda & Wirth (1976), Poelt & Vézda (1977).

Spores 3-septate M. PELIOCARPA 1. Spores simple and/or 1-septate 2 1. 2. Corticolous 4 2. Ascocarp black; hymenium blue-green M. SYLVICOLA 3. Ascocarp white to yellowish; hymenium hyaline M. cfr. LITHINELLA 3. Epithecium pigmented sordid dark (brown-) 4. black, C+ rose, K+ purple-red (quick) M. DENIGRATA Epithecium hyaline to granulose golden 4. brown, C-, K- or hymenium K+, C+ purplish (slow) in only parts of ascocarp 5 Ascocarps 0.1-0.3 mm wide, rapidly becoming 5. Ascocarps 0.3-0.7(-1.0) mm wide, remaining plane or 5. shield-shaped and then becoming undulate, tuberculate + confluent M. GLOBULARIS

MICAREA DENIGRATA (Fr.) Hedl., Bih. K. Sv. Vet. Adad. Handl.18(3):19. 1892. Biatora denigrata Fr., Kgl. Vetensk.-Akad. Nya Handl.:265. 1822.

<u>Thallus</u> crustose; varying from well-developed, grouped, smooth verrucae to scant granules \pm disappearing into substratum; dark grey to yellowish grey.

- Figure 23. Selected spores of <u>Micarea</u>, <u>Opegrapha</u>, <u>Phlyctis</u>, <u>Porina</u>, and <u>Pyrenula</u>. Collection numbers of specimens are given in brackets.
- A. <u>Micarea</u> globularis (2640)
- B. <u>Micarea peliocarpa</u> (5416)
- C. <u>Micarea prasina</u> (4049)
- D. <u>Opegrapha</u> <u>ochrocheila</u> (i) spore (ii) pycnospores (5420)
- E. <u>Opegrapha pulicaris</u> (817)
- F. Phlyctis speirea (4136)
- G. <u>Porina</u> <u>chlorotica</u> (465)
- H. Porina guentheri (5080B)
- I. <u>Pyrenula occidentalis</u> (Macoun specimen, UBC-L7609)

















10 µ m

<u>Apothecia</u> scattered to often grouped, broadly adnate, 0.2-0.5 mm wide. Proper margin absent. Disc <u>+</u> shiny, plane to often slightly convex, often slightly tuberculate and confluent; mottled tan/black with black predominating or entirely blackened. Hypothecium hyaline to fulvous; epithecium pigmented sordid grey-brown or blackish; hymenium 30-35 µm high; paraphyses branched, coherent. <u>Spores</u> 8 per ascus, hyaline, 1-septate or sometimes simple intermixed, ellipsoid, cells equal or one narrower and longer, straight or curved, 8-11(-13) X 2.5-3 µm

<u>Spot Tests</u>: thallus C+ bright orange (on well-developed thalli); epithecium K+ immediately bright violet, C+ reddish extending down into hymenijm.

<u>Substratum/Habitat</u>: lignicolous and corticolous; collected once on a fence post with <u>Cladonia macilenta</u> and <u>Lecidea uliginosa</u> and once at the base of <u>Pseudotsuga</u>.

Selected Specimens: 1276B, 6456.

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Local Abundance and Distribution: rare; distribution poorly known, both specimens collected in the southern part of the CDFD subzone; not collected in adjacent zones.

<u>World Distribution</u>: circumtemperate (Ozenda & Clauzade, 1970); first reported from North America from South Dakota and Wyoming (Wetmore, 1968).

<u>Remarks</u>: One collection with a well-developed, C+ thallus keys out to <u>Catillaria spodiza</u> (Nyl.) Zahlbr. in Ozenda & Clauzade (op. cit.). Hawksworth et al. (1980) included <u>C</u>. <u>spodiza</u> in <u>Micarea denigrata</u>.

MICAREA GLOBULARIS (Ach. ex Nyl.) Hedl., Bih. K. Sv. Vet. Akad. Handl. 18, afd.3, no.3:88. 1892.

Lecidea globularis Ach. ex Nyl., Lich. Scand.: 202. 1861.

Micarea misella (Nyl.) Hedl., Bih. K. Sv. Vet. Akad. Handl. 18, afd.3,

not3:88. 1892.

Lecidea asserculorum sensu Th. Fr., non Ach.

<u>Thallus</u> crustose; scant to well-developed on the same thallus; of scattered minute granules that break down to form a little to abundant soredia; pale yellowish grey to yellowish green.

<u>Apothecia</u> abundant, <u>+</u> scattered, broadly adnate, not constricted, 0.3-0.7(-1.0) mm wide. Proper margin absent or present only initially, quickly excluded. Disc commonly somewhat irregular, very slightly convex (shield-shaped), undulate, sometimes becoming confluent and tuberculate with age (=largest apothecia); initially tan, quickly becoming mottled tan-greyblack with tan persisting longest toward the margins. Hypothecium hyaline to fulvous; epithecium hyaline to pale sordid grey, pigmented (in darker apothecia); hymenium fulvous, 50-55 µm high. Paraphyses branched, tightly coherent. <u>Spores</u> 8 per ascus, hyaline, narrowly ellipsoid to oblongellipsoid, straight, mainly (or only) simple, occasionally a few l-septate, 9-12 X 3-4 µm (see Figure 23).

<u>Spot Tests</u>: thallus K<u>+</u> faint yellow, KC-, C-, P-; hymenium K+ purple (slow, colour persistent only in parts of apothecium squash), C<u>+</u> purple (like K reaction).

<u>Substratum/Habitat</u>: corticolous; collected once on old trunk bark of Thuja.

Selected Specimen: 2640.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Denman Island in the northern part of the CDFD subzone; not collected in the adjacent zone.

<u>World Distribution</u>: circumboreal (?); in North America reported from Michigan (Harris, 1977) and California (Tucker & Jordan, 1978).

Remarks: M. globularis is very similar to M. prasina, the local speci-

mens differing from the former in their possession of larger (visible to the naked eye) ascocarps that are shield-shaped for a long time before they become undulate or tuberculate.

MICAREA cfr. LITHINELLA (Nyl.) Hedl., Bih. Dgl. Svensk. Vetensk.- Akad.

Handl. 18, afd. B, no. 3:78,83,97. 1892.

Lecidea lithinella Nyl., Flora 63:390. 1880.

<u>Thallus</u> crustose; from thin, scattered granules to continuous, thick, and rimose-cracked; light yellowish grey to light yellow tan.

<u>Apothecia</u> common, abundant, scattered to sometimes grouped and confluent, 0.1-0.3 mm wide. Proper margin not observed. Disc adnate, not constricted, usually slightly irregular or occasionally round, plane to usually convex, in some cases becoming a little tuberculate; white to light yellowish. Hypothecium hyaline; hymenium 30-50 μ m high, <u>+</u> hyaline; epithecium hyaline; paraphyses strongly coherent, barely visible, in KOH slender, anastomosing. <u>Spores</u> 8 per ascus, ellipsoid, ovoid, hyaline, simple to sometimes 1-septate, 6-8 X 2.5-3 μ m.

<u>Spot Tests</u>: thallus K-, C-, KC-, P-, IKI-; hymenium K-, C-, IKI+ blue. <u>Substratum/Habitat</u>: saxicolous; collected once on sandstone and once on a loose cobble, both times with <u>Huilia crustulata</u>.

Selected Specimens: 2760, 3135B.

Local Abundance and Distribution: rare; distribution poorly known, collected once each on Hornby Island and Thetis Island in the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-Europe disjunct; Ozenda & Clauzade (1970)reported M.lithinella from Sweden and central Europe.

<u>Remarks</u>: Vézda & Wirth (1976) described <u>M</u>. <u>lithinella</u> as having a K+ purple hymenium and slightly darker apothecia. Ozenda & Clauzade (1970) described the apothecia as dirty yellow to brownish red. The local material has a definitely K- thecium and very light apothecia but otherwise is very close to <u>M. lithinella</u>. <u>M. bauschiana</u> (Koerb.) V. Wirth & Vezda has a K- thecium but larger spores ($6.5-12 \times 3.5-5 \mu m$) and a reddish, scaly-isidiate thallus. This latter species has been reported from Ontario (Brodo, 1981). It has black to greenish brown ascocarps and a greenish grey, rimose-areolate to granulose thallus.

<u>M. lithinella</u> is reported tentatively as new to the province. It is not listed in Hale & Culberson (1970).

MICAREA PELIOCARPA (Anzi) Coppins & R. Sant., publication information not available.

Bilimbia peliocarpa Anzi, Atti Soc. Ital. Sci. Nat. 9:250. 1866.

<u>Micarea</u> violacea Hedl., Bihang Kg. Svensk. Vetensk.-Akad. Handl.18:80, 91. 1892.

Micarea trisepta auct. p.p.

<u>Thallus</u> crustose; determinant, usually verruculose, occasionally scant; bright green to grey.

<u>Apothecia</u> abundant, scattered to clustered, adnate, 0.2-0.4 mm wide. Proper margin thin, entire, white, disappearing early, occasionally not visible even initially. Disc plane becoming slightly convex, white, bluish, blue-grey to mottled black. Hypothecium hyaline; epithecium green-blue, bluish, to greyish (depending on apothecia colour); hymenium 45-50 µm high; paraphyses branched, coherent. <u>Spores</u> 8 per ascus, hyaline, fusiform, straight to curved, 3-septate, often with a slight almost imperceptible constriction at central septum, 16-25 X 4-5 µm (see Figure 23).

<u>Spot Tests</u>: thallus K-, C<u>+</u> red, KC+ reddish, P-; epithecium K-, C+ red. Substratum/Habitat: saxicolous, corticolous, lignicolous; collected on

sandstone, granitic rock, driftwood, decaying twigs on the ground, <u>Alnus</u> and Pseudotsuga branch.

Selected Specimens: 214, 5416.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone especially at inland sites but also present at maritime sites; also present in the adjacent zones.

<u>World Distribution</u>: circumtemperate (Ozenda & Clauzade, 1970); in North America reported from South Dakota (Wetmore, 1968) and New York (Brodo, 1968).

<u>Remarks</u>: <u>M</u>. <u>peliocarpa</u> is similar to <u>Bacidia naegelii</u> in the darkish disc with disappearing light-coloured margin and fusiform, 3-septate spores. It differs from the latter in the usually well-developed green or grey thallus, branched and anastomosing paraphyses, slightly larger spores, and the C+ red hymenial reaction.

Tha apothecia of <u>M</u>. <u>peliocarpa</u> are often described as quickly convex and without a margin. This produced difficulties in the identification of the local saxicolous material because the light coloured margin seemed to be an obvious and distinctive character. In the examination of a European lignicolous specimen, however, the same character was noted in seveal of the young apothecia.

Vězda and Wirth (1976) described the thallus as C+ red. One local collection was, indeed, distinctly C+ red but the others were C-, although the KC test was always + reddish, especially with generous application of C.

<u>Micarea melaena</u> (Nyl.) Hedl. is known from other collections to be presesnt in the adjacent zones on Vancouver Island. Like <u>M. peliocarpa</u>, its spores are 3-septate. However, <u>M. melaena</u> has totally black ascocarps and a dark hypothecium that reacts K+ purple-red.

M. peliocarpa is reported here as new to the province.

MICAREA PRASINA Fr., Syst. Orb. Veg.:27. 1825.

Catillaria prasina (Fr.) Th. Fr., Lichenogr. Scandin.1:573. 1874.

Catillaria micrococca (Koerb.) Th. Fr., Lichenogr. Scandin.1:571. 1874.

<u>Thallus</u> crustose; of scattered minute granules (0.05 mm wide) abundant to only a few around apothecia, often containing abundant, hyaline, thin, 'sheets' of crystals; light greenish grey to dark green.

<u>Apothecia</u> abundant, \pm scattered, 0.1-0.3 mm wide. Proper margin absent. Disc slightly to strongly convex; tan to more commonly mottled bluegrey or dark greyish, often mottled but not completely blackened. Hypothecium hyaline to fulvous; epithecium hyaline to granulose, sordid goldenbrown; hymenium (25-)40-50 µm high, \pm masses of small granules; paraphyses few, branched, coherent. <u>Spores</u> 8 per ascus, hyaline, simple and 1-septate (usually both present), ellipsoid, often with one cell slightly longer and narrower, usually straight, 8-11 X 2.5-3 µm (see Figure 23).

<u>Spot Tests</u>: thallus C-; epithecium K-, C-; hymenium C<u>+</u>, K<u>+</u> purplish (after several seconds but persisting, concentrated below the epithecium, usually in scattered portions of the ascocarp squash).

<u>Substratum/Habitat</u>: corticolous; collected twice on <u>Alnus</u> trunk and once on Pseudotsuga.

Selected Specimens: 3946B, 4027B.

Local Abundance and Distribution: infrequent; collected twice in the southern part of the CDFD subzone at higher elevations inland; not collected in the adjacent zones.

<u>World Distribution</u>: "cosmopolitan, but absent from the arctic and tropics" (Ozenda & Clauzade, 1970); distribution uncertain.

Remarks: M. prasina was collected only accidently as an admixture to

larger, more conspicuous crustose species. It is likely to be much more common locally than the few collections indicate.

The spores of a single apothecium tend to be either mainly simple or mainly septate but the alternate spore type is always present at least in a small percentage. Other apothecia from the same thallus may favour the alternate combination.

M. pasina is reported here as new to the province.

MICAREA SYLVICOLA (Flot.) Vězda & V. Wirth, Folia Geobot. Phytotax.:11:99. 1976.

Lecidea sylvicola Flot., Lich. Sil. Exicc. no. 171. 1829.

<u>Thallus</u> crustose; thinnish, rimose-cracked, medium grey to brownish grey. Hypothallus absent.

Apothecia common; scattered to grouped and confluent and then appearing tuberculate; 0.2-0.5 mm wide. Proper margin absent. Disc slightly to moderately convex, adnate, not constricted, \pm matt, surface minutely roughened (velvety); black. Hypothecium medium brown, thin; epithecium greenblack; hymenium 35 µm high, partly to entirely vivid green or green-blue; paraphyses strongly coherent. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid to oblong-ellipsoid, 7-8 X 2.503.5 µm.

Spot Tests: thallus not tested; hymenium IKI+ yellow-orange.

<u>Substratum/Habitat</u>: saxicolous; collected once on sandstone with <u>Trapelia involuta</u>.

Selected Specimen: 1507.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Saturna Island in the southern part of the CDFD subzone at a higher elevation inland; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe disjunct; in North America reported from Ohio and Minnesota (Fink, 1935).

Remarks: M. sylvicola is reported here as new to the province.

MICROCALICIUM Vain.

Thallus crustose. Parasitic on lichens or algae, or saprophytic. Ascocarp an apothecium, stalked to sessile, with a greenish mazaedium. Asci in chains, without hook formation. Spores non-septate when contained in asci, continuing to mature after release into mazaedium until 1- to 3-

(7-)septate and spiral ridges formed.

Saxicolous, corticolous, and lignicolous lichens.

There is one local species.

References: Tibell (1978).

MICROCALICIUM SUBPEDICELLATUM (Schaer.) Tibell, Bot. Not. 131:240. 1978. Calicium subpedicellatum Schaer., Naturwiss. Anz. Allg. Schweiz. Ges.

Gesammten Naturwiss. 5:35. 1821.

Microcalicium disseminatum (Ach.) Vain., Lichengr. Fenn. 3:78. 1927

Thallus crustose; indistinct, + immersed in substratum.

<u>Apothecia</u> stipitate. Stalks short, ca. 0.1 mm high, dark brown, roughened or longitudinally ridged, stout, occasionally very reduced. Exciple only slightly wider than stalk, reduced. <u>Spores</u> 6-8 per ascus, simple, oblong, light greenish with spirally sculptured walls, 5-7 X 2-2.5 µm, realeased early to form a dark green mazaedium which is extruded in a cylindrical shape some distance beyond the excipulum. Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; perhaps lichenicolous; collected once on <u>Thuja</u> with <u>Chaenotheca</u> <u>ferruginea</u> and <u>Calicium</u> adspersum.

Selected Specimens: 3724B.

Local Abundance and Distribution: rare; collected once in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct; Tibell (1978) described it as "widely distributed in the Northern Hemisphere...temperate to northern boreal", however, in North America it is reported for only British Columbia, Ontario, and Michigan (Tibell, 1975).

<u>Remarks</u>: The local collection is very distinctive and despite the limited amount of material (5 apothecia) is obviously <u>M. subpedicellatum</u>. However, the spore measurements are smaller than those given by Tibell (1978), 11.5-15 X 3.4-4.2 μ m, and on the lower end of those given by Poelt (1969), 5-12 X 2-4 μ m. The spores of the local material were probably immature, since the spores of this species continue to mature after release into the mazaedium, eventually becoming 1- to 3-septate.

MYCOBLASTUS Norm.

Thallus crustose; smooth to verruculose.

Ascocarp an apothecium. Proper margin present but usually quickly excluded. Disc dark brown to commonly black, convex, tuberculate, and sometimes confluent. Asci bitunicate. Spores 1-4(-8) per ascus, hyaline, simple, thick-walled, often large.

Corticolous, muscicolous-terricolous.

Anderson & Carmer (1974) stated that <u>Mycoblastus</u> was ascolocular and therefore more closely related to <u>Micarea</u> than to <u>Lecidea</u>. Poelt & Vězda (1981) have maintained Mycoblastus in the Lecideaceae.

Most of the local material has been made available to a student of Dr. C. Wetmore for a study of the genus <u>Mycoblastus</u> in North America. The treatment given here is only tentative, pending the results of that revision.

References: Anders (1929), Schauer (1965), Anderson & Carmer (1974); James (1971).

 Apothecia red-brown to black; spores 15-25 X 10-12 μm, 8 per ascus <u>M. TORNOËNSIS</u>
Apothecia black; spores 50-100 X 30-40 μm, 1-2 per ascus 2

- Hypothecium with a blood-red layer; spores 75-100 X 35-40 μm, l/ascus M. <u>SANGUINARIUS</u>
- 2. Hypothecium hyaline; spores 55-65 X 30-38 μm, 2/ascus M. AFFINIS

MYCOBLASTUS AFFINIS (Schaer.) Schauer, Lichenes Alpinus Ex., Fasc. 12,

No. 230. 1964.

Lecidea affinis Schaer., Enumer. Critic. Lich. Europ.: 132. 1850.

<u>Thallus</u> crustose; thin, scurfy in places to areolate or slightly verruculose; shiny; grey to yellowish blaucous. Hypothallus absent.

<u>Apothecia</u> abundant, scattered to grouped and then commonly confluent, broadly adnate, 0.7-1.2(-1.5) mm wide. Proper margin black, excluded early. Disc convex to tuberculate, shiny, black. Hymenium 125 µm high; paraphyses coherent; epithecium blue-black, the blue coloration suffusing partially

down the hymenium; hypothecium hyaline sometimes darkening. Spores 2 per ascus, hyaline simple, ellipsoid, 55-65 X 30-38 μ m, with a distinct epi-spore, 5 μ m thick.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; collected twice on the trunk of <u>Pseudotsuga</u>.

Selected Specimens: 2502B, 5278.

Local Abundance and Distribution: rare; distribution poorly known, one collection on Denman Island in the northern part of the CDFD subzone, one collection in the adjacent CDFW subzone, both inland sites.

<u>World Distribution</u>: uncertain; reported from Europe, 'Asia septentrionale' (Ozenda & Clauzade, 1970), and North America (Hale & Culberson, 1970).

<u>Remarks</u>: Confusion still exists regarding the nature of <u>M</u>. <u>affinis</u>. Although Anders (1929) considered both <u>M</u>. <u>affinis</u> (as <u>M</u>. <u>alpinus</u>) and <u>M</u>. <u>melinus</u> to fall within the variation of <u>M</u>. <u>sanguinarius</u>, Schauer (1965) reinstated <u>M</u>. <u>affinis</u> as the species lacking the red layer in the hypothecium. Indeed, two recent European floras have segregated further; they recognize three species in the complex. Ozenda & Clauzade (1970) recognized <u>M</u>. <u>affinis</u> as lacking the red layer in the hypothecium but with spore characters identical to <u>M</u>. <u>sanguinarius</u>, and <u>M</u>. <u>melinus</u> with 2 spores per ascus and smaller spores, plus <u>M</u>. <u>sanguinarius</u>. Poelt (1969) and Poelt & Vězda (1977), on the other hand, regarded <u>M</u>. <u>affinis</u> as the species with the smaller, 2 spores per ascus and <u>M</u>. <u>alpinus</u> as the species similar to <u>M</u>. sanguinarius, but lacking the red layer in the hypothecium.

MYCOBLASTUS SANGUINARIUS (L.) Norm., Nyt. Mag. Nat. 7:237. 1853.

Lichen sanguinarius L., Spec. Plant.:1140. 1753.

<u>Thallus</u> crustose; thick, strongly verrucose, shiny; greyish or yellowish glaucous to pale glaucous green.

Apothecia scattered to grouped and then confluent, broadly adnate, not constricted, (0.5-)1.0-2.0(-2.4) mm wide. Proper margin black, excluded early. Disc slightly irregular in outline, convex to tuberculate, shiny, black. Hymenium 150-175 µm high; epithecium blue-black, suffusing blue partway down into hymenium; paraphyses coherent; hypothecium with blood-red layer. <u>Spores</u> 1 per ascus, hyaline, oblong-ellipsoid, simple, 75-100 X (33-)35-50 µm, with thick epispore, 5-7 µm, often thicker at the ends.

Spot Tests: none.

<u>Substratum/Habitat</u>: primarily corticolous on <u>Pseudotsuga</u>, also one collection saxicolous on sandstone.

Selected Specimens: 4286, 5100.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone only at higher elevations inland; also collected in the adjacent zones at inland sites.

World Distribution: (circumarctic-)circumboreal (Thomson, 1979).

<u>Remarks</u>: The red layer in the hypothecium is the most efficient way to distinguish <u>M</u>. <u>sanguinarius</u> from <u>M</u>. <u>affinis</u> but the former also has one, larger, oblong spore per ascus in addition to commonly larger apothecia and a thicker thallus. According to Anders (1929) <u>M</u>. <u>affinis</u> intergraded into <u>M</u>. <u>sanguinarius</u>. However, Schauer (1965), after examining the same specimen upon which Anders had made his observation, concluded that this was not the case, and that the two species were distinct. The latter paper also

pointed out that the spores were delicate and that rough examination would cause the loss of cytoplasm and result in a swelling of the walls. With this caution in mind, the two species are also though to differ in the thickness of the epispore. <u>M. sanguinarius</u> has a epispore thickness of 5-8 μ m; M. affinis has an epispore thickness of 3-5 μ m (Poelt, 1969).

<u>MYCOBLASTUS TORNOËNSIS</u> (Nyl.) R. Anderson, Bryologist 77:220. 1974. Lecidea tornoënsis Nyl., Herbar. Mus. Fenn.:110. 1859.

<u>Thallus</u> crustose; scurfy, occasionally continuous but then thin and roughened; shiny, especially on elevated spots, or \pm dull; dark olive brown to brown.

<u>Apothecia</u> scattered to grouped and confluent, broadly adnate, not constricted, 0.5-1.0(-1.3) mm wide. Proper margin smooth, thin, concolorous with disc, excluded early. Disc round to often irregular, initially plane becoming roughly convex but often tuberculate, shiny, orange-red becoming variously mottled black/red-brown to totally black. Hymenium 75 μ m high, hyaline to light yellow; paraphyses simple, coherent, dark brown to orangebrown capitate; epithecium <u>+</u> orange-brown; hypothecium hyaline or light yellow. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 17-20(-23) X 10-12 μ m with a distinct epispore, 1.0-2.5 μ m thick.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; primarily on <u>Pseudotsuga</u>, but also collected once on Alnus and Salix sp.

Selected Specimens: 847, 3995A.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at higher elevations inland; also collected at inland sites in the adjacent zones (see Figure 24).

World Distribution: probably (circumarctic-)circumboreal; in North


America extending southwards in the east and in the west as far as California (Thomson, 1979; Anderson & Carmer, 1974).

<u>Remarks</u>: <u>M</u>. <u>tornoënsis</u> is regarded as a <u>Lecidea</u> species in many treatments (Thomson, 1979; Hawksworth et al., 1980) although as Hawksworth et al. stated, it is "of uncertain position".

NEOFUSCELIA Ess1.

Thallus foliose to occasionally almost crustose or sub-fruticose; lobes short and rounded to elongate-linear; corticate on the upper and lower surfaces, upper cortex prosoplectenchymatous, HNO₃+ blue-green; with or without isidea; soredia and pseudocyphellae absent. Lower surface rhizinate or lacking rhizines; rhizines simple.

Ascocarp an apothecium, laminal, sessile. Thalline margin present. Spores 8 per ascus, ellipsoid, simple, hyaline, thin-walled.

Saxicolous, occasionally terricolous.

<u>Neofuscelia</u> was formerly part of <u>Parmelia</u>. See that genus for additional comments. <u>Neofuscelia</u> is closely allied to <u>Melanelia</u>, another segregate genus of <u>Parmelia</u>. See Esslinger (1977b, 1978a) for a comparison of Neofuscelia and Melanelia.

There is one local species.

References: Esslinger (1973a, 1977b, 1978a).

NEOFUSCELIA VERRUCULIFERA (Nyl.) Essl., Mycotaxon 7:53. 1978.

Parmelia verruculifera Nyl., Flora 61:247. 1878.

Parmelia glomellifera (Nyl.) Nyl., Flora 64:435. 1881.

Thallus foliose; 4-7 cm broad. Lobes 0.5-1.0 mm wide, linear, appressed

with margins imbricate. Upper surface dull to shiny at the margins, smooth to very faintly reticulately ridged at the lobe tips; isidiate, isidia laminal, rare to very dense especially in the thallus center, irregularly rounded in warty pustules which coalesce, easily breaking or dissolving into soredia; blackened transverse cracks in older parts of thallus; olive brown to fuscous black. Lower surface shiny black, browning towards tobe tips; rhizines common, simple, black.

<u>Apothecia</u> not observed. According to Esslinger (1977) the apothecia are rare, sessile to short stipitate, up to 3.5 mm wide; margin entire to weakly crenulate becoming isidiate; spores 8 per ascus, ellipsoid, simple, 8-10 X 4.5-6 µm.

<u>Spot Tests</u>: K-, C-, KC<u>+</u> pink, P-; cortex HNO_3 + blue-green; divaricatic acid in G.E. (narrow, hyaline crystals branching at right angles).

<u>Substratum/Habitat</u>: saxicolous; on sandstone, conglomerate, and igneous rocks.

Selected Specimens: 2748, 4115.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both inland and martime sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-Europe(including Asia Minor and North Africa) disjunct; in North America reported from Baja California north to southern British Columbia and east to Idaho, South Dakota, and Wyoming (Esslinger, 1977b) (see Figure 68).

<u>Remarks: N. verruculifera</u> is easily separated from the other common saxicolous brown <u>Parmeliae</u> (locally <u>Melanelia</u> glabratula and <u>M. disjuncta</u>)

by the irregularly rounded and abrading isidia of <u>Neofuscelia verruculifera</u> compared to the cylindrical-coralloid isidia of <u>Melanelia glabratula</u> or the very fine isidia of <u>M. disjuncta</u>. <u>Neofuscelia verruculifera</u> and <u>Melanelia</u> disjuncta often occur together.

<u>N. verruculifera</u> is one of two morphologically very similar species. the other, <u>N. loxodes</u> (Nyl.) Essl., is usually a paler brown with thicker and sometimes broader lobes, hollow isidia and distinct maculae. Its chemistry is also different. In North America the two species have very similar ranges, occurring in western North America along the coast and extending inland to South Dakota and Wyoming. <u>N. loxodes</u> is known only from California to Washington while <u>N. verruculifera</u> ranges further north into British Columbia.

Some nomenclatural confusion surrounds <u>N</u>. <u>verruculifera</u> and <u>N</u>. <u>loxodes</u>. Most authors agreed that two species exist but various names are used. Dahl & Krog (1973), Laundon (1970), and Duncan (1970) used <u>Parmelia loxodes</u> Nyl. and <u>P. isidiotyla</u> Nyl.; Ozenda & Clauzade (1970) and Poelt (1969) used <u>P. isidiotyla</u> and <u>P. glomellifera</u>; Esslinger (1973a) used <u>P. loxodes</u> and <u>P. verruculifera</u>. Esslinger's treatment was based on an examination of the type specimens. For a discussion of this problem and a complete comparison of the two species see the last paper.

The report of <u>Parmelia substygia</u> Rås. (= <u>Melanelia substygia</u> (Rås.) Essl.) from Saltspring Island (Bird & Bird, 1973) is based on a specimen of N. verruculifera (CAL-19207).

NEPHROMA Ach.

Thallus foliose; thalli of moderate to large size, up to 15 cm; both surfaces corticate; with or without internal cephalodia, soredia, or isidia greyish to brownish or yellow in one northern species. Lower surface smooth tomentose, with or without tubercles.

Ascocarp an apothecium, immersed on the margins of the lower surface, large. Thalline and proper margins both absent, or with narrow proper margin. Spores 8 per ascus, fusiform, 3-septate, light brown, thin-walled.

Saxicolous, terricolous among mosses and corticolous usually on tree boles or trunks; typically in lightly shaded, moist, cool habitats.

References: Wetmore (1960, 1980).

1.	Medulla yellow, K+ purple-redN. LAEVIGATUM
1.	Medulla white, K 2
	2. Lower surface with white tubercles <u>N</u> . <u>RESUPINATUM</u>
	2. Lower surface without tubercles <u>N</u> . <u>HELVETICUM</u>

NEPHROMA HELVETICUM Ach., Lich. Univ.:523. 1810.

Nephroma resupinatum f. helveticum (Ach.) Rabh., Deutschl. Kryptog.- Flora

2:68. 1845.

<u>Thallus</u> foliose, up to 6 cm broad. Lobes 3-5 mm wide, short linear, short linear, apically rounded, appressed with the margins free and imbricate. Upper surface smooth and shiny, occasionally pulverulent at lobe tips; medulla white; margins toothed to lobulate- fringed; laminal isidia present, rounded to flattened to nearly foliate; clove brown, fuscous black. Lower surface densely tomentose; dark brown, lighter toward the margin.

Apothecia common, immersed, marginal, on the lower surface. Disc 4-7 mm wide, variously contorted, brownish. Hymenium 100 µm high; paraphyses simple, coherent; epithecium yellow-brown. <u>Spores</u> 8 per ascus, light brown, ellipsoid-fusiform, 3-septate, straight, 21-26 X 6-8 µm.

Spot Tests: medulla K-.

<u>Substratum/Habitat</u>: corticolous; collected twice on the trunk of Quercus.

Selected Specimens: 4578A, 4965C.

Local Abundance and Distribution: rare; distribution poorly known.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct;(Krog, 1968) described var. <u>sipeanum</u> as "boreal-subtropical, incompletely circumpolar"; also reported from New Zealand (Martin, 1966) in the Southern Hemisphere.

<u>Remarks</u>: Wetmore (1960) recognized two varieties of <u>N</u>. <u>helveticum</u> based on isidia shape, tomentum, and thallus thickness. Var. <u>helveticum</u> has variable tomentum, flattened isidia, thin thallus, and is primarily an eastern North American taxon; var. <u>sipeanum</u> has heavy tomentum, rounded isidia, thick thallus, and is mainly a western North American species. The local material falls within var. sipeanum.

NEPHROMA LAEVIGATUM Ach., Syn. Lich.:242. 1814.

Nephroma lusitanicum Schaer., Enumer. Critic. Lich. Europ.: 323. 1850.

<u>Thallus</u> foliose; up to 11 cm broad, orbicular. Lobes 2.5-7 (-12) mm wide, apically rounded, appressed but margins free and imbricate. Upper surface smooth, shiny; margins often fringed by small lobules; medulla

yellow to orange; clove brown, olive brown, fucous black, occasionally lighter grey. Lower surface naked, smooth to wrinkled, orange-tan to tan.

<u>Apothecia</u> common, abundant, immersed, marginal on the lower surface. Disc reddish brown, 3-9 mm wide, often recurved. Thin proper margin present. Hymenium 60-75 μ m high; paraphyses simple, coherent; epithecium brownish. <u>Spores</u> 8 per ascus, yellowish to brown, ellipsoid-fusiform, 3-septate, 18-22 X 5-7 μ m.

Spot Tests: medulla K+ purple-red.

<u>Substratum/Habitat</u>: primarily saxicolous on sandstone, conglomerates, and igneous rocks; also occasionally corticolous, especially on <u>Quercus</u>.

Selected Specimens: 720, 4817A.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone, but especially common at maritime sites; present but not as common in the adjacent CDFW subzone.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct; reported by Krog (1968) as "widely distributed boreal-subtropical, suboceanic species"; in North America reported from California to Alaska in the west, and New England to Newfoundland in the east (Wetmore, 1960).

<u>Remarks</u>: Wetmore (1960) stated that the medulla may occasionally be white, but the K spot test would still be positive purple. However, Duncan (1970) noted that the forms with a white medulla in England are K-. Ozenda and Clauzade (1970) stated that whatever its colour, the medulla was always K+ rose-red in collections made in France.

NEPHROMA RESUPINATUM (L.) Ach., Lich. Univ.:522. 1810.

Lichen resupinatus L., Spec. Plant.:1148. 1753.

<u>Thallus</u> foliose; 4-7 cm broad. Lobes 5-10 (-12) mm wide, free and imbricate, short, rounded. Upper surface with hyaline hairs towards the margins, centrally smooth and shiny; dark grey, brownish grey, or olive grey. Lower surface thickly tomentose, tan to brownish, thinner toward the margins and then usually wrinkled; plus short, white tubercles, scattered among the tomentum.

<u>Apothecia</u> common, immersed, marginal on the lower surface, 3-8(-11) mm wide. Disc reddish brown, variously contorted. Hymenium 55-65 µm high; paraphyses simple, coherent; epithecium brownish. <u>Spores</u> 8 per ascus, light yellowish-brown, fusiform sometimes slightly constricted at septa, straight to curved, 3-septate, (20-)23-30 X 5-7 µm

Spot Tests: medulla K-.

<u>Substratum/Habitat</u>: corticolous; primarily on <u>Quercus</u>, also once saxicolous on shaded, igneous rock.

Selected Specimens: 1740, 4104.

Local <u>Abundance and Distribution</u>: infrequent; scattered throughout the CDFD subzone especially at inland sites, not collected in the adjacent zones.

World Distribution: circumboreal-circumtemperate (Krog, 1968).

<u>Remarks</u>: According to Wetmore (1960) isidia may be present in <u>N</u>. <u>re</u>-<u>supinatum</u> and the tubercles may be scarce and/or hidden in the tomentum. The tubercles were very obvious in all the local collections. These small, white points superficially resemble cyphellae or pseudocyphellae, until closely examined.

NORMANDINA Nyl.

Thallus squamulose; round to somewhat lobed with a marginally raised rim; sorediate; appressed; upper cortex poorly developed, lower cortex absent. Phycobiont a green alga.

Ascocarps and pycnidia unknown.

Corticolous, occasionally saxicolous.

<u>Normandina</u> is a monotypic genus. It was formerly included in the Verrucariales on the basis of perithecia containing brown, 7-septate spores (Swinscow, 1963b). However, the fruiting structures actually belong to a lichenicolous fungus, <u>Sphaerulina chlorococca</u> (Henssen, 1976). Poelt and Vézda (1981) have included <u>Normandina</u> in the Lichenes Imperfecti.

References: Henssen (1976).

NORMANDINA PULCHELLA (Borr.) Ny1., Ann. Sci. nat., Bot., sér. 4, 15: 382. 1861.

Verrucaria pulchella Borr., Engl. Bot., tab. 2602, fig. 1. 1829.

<u>Thallus</u> squamulose; 0.8-2.0(-3.2) mm wide. Squamules scattered and solitary, or grouped; horizontally appressed with a narrow raised, sometimes cracked rim, initially round becoming semi-circular or ear-shaped; upper surface uneven becoming granulose sorediate towards the center, in larger thalli the soredia sometimes arranged in concentric rings; pale glaucous green to dark bluish glaucous, whiter below.

Ascocarps not observed; not known to science.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; commonly on <u>Quercus</u>, but more commonly lichenicolous on large foliose corticolous lichens, especially <u>Nephroma laevigatum</u>.

Selected Specimens: 4568, 4817B.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at both inland and maritime sites, not collected during the present study in the adjacent zones, but known to be present in the Fog/Spruce subzone of Coastal Hemlock zone from other collections.

<u>World Distribution</u>: (sub)tropical-temperate regions (Ozenda & Clauzade, 1970); Degelius (1935) stated it had a "considerably wide distribution" both in the Northern and Southern Hemispheres; in the Southern Hemisphere reported from New Zealand (Martin, 1966), Argentina (Grassi, 1950), and Tristan da Cunha (Jørgensen, 1977).

OCHROLECHIA Mass.

Thallus crustose; thin and smooth to verruculose-areolate, sometimes minutely fruticose, or \pm disappearing within the substratum; with or without soredia or isidia; usually white to yellowish grey.

Ascocarp an apothecium, finally sessile, often constricted. Thalline margin present, often thick and prominent. Disc pink, yellow, to light brownish, often pruinose. Paraphyses slender, branched and anastomosing. Spores 2-8 per ascus, simple, hyaline, ellipsoid, usually thin-walled, often large.

Corticolous, saxicolous, terricolous-muscicolous.

Ochrolechia is intermediate in some respects between <u>Lecanora</u> and <u>Pertusaria</u> and so its placement oscillates between the Lecanoraceae (Culberson & Hale, 1970; Ozenda & Clauzade, 1970) and the Pertusariaceae (Duncan, 1970; Poelt, 1973; Poelt & Vězda, 1981).

The genus <u>Ochrolechia</u> in North America is currently being studied by I. M. Brodo and M. Dibben. The treatment given here is tentative, pending the outcome of their investigations.

References: Verseghy (1962), Howard (1970 - key not recommended).

1.	Corticolous 2
1.	Saxicolous or muscicolous 5
	2. Disc epruinose; thallus and disc C+ red
	2. Disc epruinose; thallus and disc C+ red
3.	Thallus verruculose; spores > 55 µm long; pinkish proper margin often showing through thalline margin with age; usually on <u>Pseudotsuga</u> <u>O. OREGONENSIS</u>
3.	Thallus <u>+</u> smooth; spores < 55 μ m long; thalline margin not excluded with age; usually on <u>Alnus0. LAEVIGATA</u>
	<pre>4. Thallus usually farinose, pure white; disc C-, UV+ yellowish</pre>
^	4. Thallus not farinose, greyish; disc C+red, UV0. <u>PALLESCENS</u>
5.	Sorediate <u>O</u> . <u>ANDROGYNA</u>
5.	Esorediate
	6. Muscicolous; disc pruinose, C <u>O</u> . <u>UPSALIENSIS</u>
	6. Saxicolous; disc C+ red, epruinose
7.	Thallus thickly verruculose-areolate, with convex verrucae that crack, becoming tartareous; at sunny supralittoral sites
7.	Thallus thin, of scattered verrucae, not tartareous; shaded sites, usually inland <u>0</u> . <u>UNKNOWN #1</u>

OCHROLECHIA ANDROGYNA (Hoffm.) Arn., Flora 68: 236. 1885.

Lichen androgynus Hoffm., Enumer. Lich. 56, tab. 7, fig. 3. 1784.

<u>Thallus</u> crustose; up to 10 cm broad, thin, smooth to verruculose, closely adhering to substratum; soredia common, abundant, yellowish, granular, in globose soralia; thallus whitish grey.

<u>Apothecia</u> not observed. According to Verseghy (1962) the apothecia are 2-4 mm wide; thalline margin thick and sorediate; disc concave, pale brick-red; spores 30-40 X 13-22 µm.

<u>Spot Tests</u>: thallus and soredia K<u>+</u> yellow (soredia actually brownish), C+ red, P+ yellowish.

<u>Substratum/Habitat</u>: saxicolous, on sandstone and granitic rock; also once 'muscicolous' on <u>Selaginella</u> <u>wallacii</u>.

Selected Specimens: 1514, 2856.

Local Abundance and Distribution: infrequent; collected on the Gulf Islands only, in the southern part of the CDFD subzone at both exposed, higher elevations inland and less commonly at maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumarctic-circumboreal in the Northern Hemisphere ; typically reported as more widespread, i.e. circumarctic-circumtemperate (Howard, 1970; Thomson (1979), however, in Howard (op. cit.) it is mapped as not much further south than the U.S.A.-Canada border in North America.

<u>Remarks</u>: The typical form of <u>0</u>. <u>androgyna</u> is corticolous with other forms being muscicolous and saxicolous (Verseghy, 1962; Howard, 1970). Most of the local material falls into f. <u>saxorum</u> (Oeder) Vers. which Verseghy (1962) listed as a European lichen, although citing a collection from Labrador.

OCHROLECHIA FARINACEA Howard, Bryologist 73: 98. 1970.

<u>Thallus</u> crustose; elongated-orbicular along substratum, up to 7 cm broad of continuous, smoothly rounded verrucae, usually crowded and farinose, occasionally scattered with pruinia <u>+</u> absent; occasionally verrucae breaking down to form granulose-soredia; snowy white.

<u>Apothecia</u> common, scattered to crowded, adnate, 1.4-2.0 (-2.8) mm wide. Thalline margin thick, entire, smooth, remaining prominent, <u>+</u> pruinose. Disc concave becoming plane, yellow-tan to sometimes pale reddish, always heavily pruinose. Hymenium 225-250 µm high; epithecium brownish-grey; hypothecium hyaline. <u>Spores</u> 8 per ascus, ellipsoid, simple, hyaline, 50-65 X 25-33 µm

<u>Spot Tests</u>: thallus and disc K-, KC-, C-; disc UV+ yellow Substratum/Habitat: corticolous; primarily on Quercus.

Selected Specimens: 2047, 2759.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone especially but not exlusively near the ocean; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from Oregon and Washington (Howard, 1970).

<u>Remarks</u>: The type specimen of <u>O</u>. <u>farinacea</u> has been examined. Fortuitously it consists of a generous sized collection since many portions have been ruined by previous 'area' spot testing. The spot tests reported by Howard, specifically the thalline margin P+ deep orange and the disc K+ salmon pink, C+ pale pink, P+ deep yellow, were checked and all found to be negative like the local material.

The UV+ reaction of the disc always shows in some of the discs of a collection, although some individual discs may be UV-.

According to Brodo (pers. comm.) <u>O</u>. <u>farinacea</u> may fall within the species limits of O. szataläensis Vers.

<u>O</u>. <u>farinacea</u> was reported new to the province in Noble (1978) as a result of the present study.

<u>OCHROLECHIA LAEVIGATA</u> (Räs.) Vers., Beih. Nova Hedw. 1:86. 1962. <u>Ochrolechia pallescens</u> var. <u>laevigata</u> Räs., Ann. Bot. Soc. Zool. Bot. Fenn.

Vanamo 20(3):9. 1944.

<u>Thallus</u> crustose; often orbicular, 2.5-4.5 cm broad, smooth, continuous, thin, with age finely cracked especially horizontally; pale olive grey, greenish white.

<u>Apothecia</u> common, usually scattered, sessile, 1.0-1.6 (-2.0) mm wide. Thalline margin thick, smooth to faintly cracked, prominent, partially reduced with age. Disc concave becoming plane, flesh to tan or pink, epruinose. Hymenium 250(-300) µm high; epithecium greyish; hypothecium hyaline. <u>Spores</u> (frequently immature or not formed) 8 per ascus, ellipsoid, hyaline, simple, 40-50 X 18-26 µm

Spot Tests: thallus K-, C+ red; disc C+ red.

<u>Substratum/Habitat</u>: corticolous; primarily on <u>Alnus</u> but also occasionally on other smooth-barked deciduous trees.

Selected Specimens: 1069, 2624.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone, present but not as common in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported and described from Washington (Verseghy, 1962).

OCHROLECHIA OREGONENSIS H. Magn., Meddel. Göteb. Bot. Trädg. 13:251. 1939.

<u>Thallus</u> crustose; up to 8 cm broad, \pm continuous, shiny to dull, very irregularly verrucose, thinner toward the margin; whitish grey to light olive grey.

<u>Apothecia</u> abundant, scattered to crowded, constricted, adnate, (1.8-)2.0-3.2(-5.0) mm wide. Thalline margin thick and smooth to thin and verruculose, the top edge thinning at an early stage to expose parts of the proper exciple, then partially excluded with age so that proper margin is distinctly and entirely visible. Disc concave becoming plane to slightly convex, yellowish brown to pale orange brown, slightly uneven to minutely papillate; occasionally several young discs regenerating within one old apothecium. Hymenium (275-)300-375 μ m high; paraphyses very slender, coherent; epithecium granular, greyish to light brownish; hypothecium yellowish. <u>Spores</u> 8 per ascus, hyaline, simple, irregularly oblong-ellipsoid, (55-)62-75(-86) X 22-37 μ m.

Spot Tests: disc and thallus (cortex) C+red; hymenium IKI+blue.

<u>Substratum/Habitat</u>: corticolous; expecially on <u>Pseudotsuga</u> trunks, both living or dead.

Selected Specimens: 219, 2496.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone primarily at inland sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: western North American endemic; known from California to British Columbia (Magnusson, 1939a).

OCHROLECHIA PALLESCENS (L.) Mass., Nuov. Ann. Sci. Nat. Bologna 7:212. 1853. Lichen pallescens L., Spec. Plant. :1142. 1753.

<u>Thallus</u> crustose; 2.5-6 cm broad, thin, smooth to verruculose; greyish white.

<u>Apothecia</u> common, scattered, sometimes crowded, sessile, (1.0-)1.3-2.2 mm wide. Thalline margin thick, smooth, remaining prominent. Disc concave becoming <u>+</u> plane, flesh-coloured, heavily scabrous-pruinose. Hymenium 250-275 µm high; epithecium greyish; hypothecium hyaline to fulvous. <u>Spores</u> 8 per ascus, ellipsoid, hyaline, $(45-)50-65 \times 22-28 \ \mu m$

Spot Tests: thallus K-, C-, KC-; disc C+ red.

<u>Substratum/Habitat</u>: corticolous; primarily on <u>Pseudotsuga</u> but also collected from Alnus, Salix sp., and driftwood.

Selected Specimens: 205, 5907.

Local Abundance and Distribution: occasional; scattered throughout the Gulf Islands from Denman Island in the north of the CDFD subzone to South Pender Island in the southern part, primarily, but not exclusively at inland sites, one collection from the adjacent strip of Vancouver I. still within the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumtemperate in the Northern and Southern Hemispheres (Ozenda & Clauzade, 1970); this species is often considered very widespread, i.e. 'cosmopolitan' in Verseghy (1962).

<u>Remarks</u>: <u>O</u>. <u>pallescens</u> often has been treated in a rather wide sense. Records of this species from the interior of British Columbia (Howard, 1970) have been set aside as probable misidentifications (Brodo, pers. comm.). The local material agrees with the concept of <u>O</u>. <u>pallescens</u> given in Verseghy (1962). OCHROLECHIA TARTAREA (L.) Mass., Ricerch. Auton. Lich.: 30. 1852. Lichen tartareus L., Spec. Plant.: 1141. 1753.

<u>Thallus</u> crustose; up to 8 cm broad; centrally of thick, crowded, shiny, globose granules, often topped with apothecial initials, sometimes cracking open but not sorediate, marginally usually of thinner, flattened, sometimes scattered, elongate, partially ascendant granules; off-white to pale olive-buff, or ivory yellow.

<u>Apothecia</u> common (but perhaps immature in local material), scattered to crowded, 1.5-2.5 mm broad. Thalline margin thick, smooth, <u>+</u> white pruinose. Disc concave becoming plane, yellow-brown, epruinose. Hymenium 250 μ m high; epithecium greyish; hypothecium fulvous. <u>Spores</u> 8 per ascus, ellipsoid, simple, hyaline, 45-58 X 20-27 μ m

Spot Tests: thallus and disc C+ red.

<u>Substratum/Habitat</u>: saxicolous; on igneous rocks in the supralittoral zone.

Selected Specimens: 4314, 5325.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Discovery Island near Victoria in the southern part of the CDFD subzone; also once in the adjacent CDFW subzone.

<u>World Distribution</u>: circumboreal-circumtemperate in both hemispheres (Ozenda & Clauzade, 1970); montane in Europe, North America and probably Asia (Verseghy, 1962).

<u>Remarks</u>: <u>0</u>. <u>tartarea</u> used to be considered the common and abundant <u>Ochrolechia</u> in western North America. Herre (1910a) considered it to be a corticolous species while Howard (1950) also included saxicolous and occasionally terricolous forms as well. However, Verseghy (1962), pointed out that <u>0</u>. <u>tartarea</u> is nearly exclusively a saxicolous species with spores 36-48 X 22-27 μ m or, according to Ozenda and Clauzade, 20-55 X 10-30 μ m. The corticolous <u>Ochrolechia</u> species with large spores in western North America is <u>O. oregonensis</u>.

The local <u>O</u>. <u>tartarea</u> has much smaller apothecia than the 2.5-5 mm given in Verseghy (1962) but the collections are small and possibly immature. Although Verseghy (1962) listed <u>O</u>. <u>tartarea</u> as a montane species Fletcher (1975a) described it as common and widespread at maritime sites in Great Britain.

OCHROLECHIA UPSALIENSIS (L.) Mass., Ricerch. sull'Auton. Lich. Crost.:31. 1852.

Lichen upsaliensis L., Spec. Plant.:1142. 1753.

Thallus crustose; up to 6 cm broad; smooth to nodulose or verrucose, shiny; white to greyish.

<u>Apothecia</u> common, often abundant and crowded, adnate, 0.9-2.0(-2.2)mm wide. Thalline margin thick, smooth becoming slightly striate. Disc concave becoming plane, white, pale yellow or sometimes orange, heavily pruinose to granulose. Hymenium 275-300 µm high; paraphyses simple, apically coherent; epithecium dark grey with pruinia granules; hypothecium yellowish. <u>Spores</u> 8 per ascus, hyaline, ellipsoid-oblong, simple, $38-70(-82) \times 30-42$ µm.

Spot Tests: thallus and disc K-, C-, P-.

<u>Substratum/Habitat</u>: muscicolous, or often growing on <u>Selaginella</u> wallacii and often extending onto adjacent soil or rock.

Selected Specimens: 4072, 5115.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone as exposed, higher elevations inland, present but not as

common in the adjacent zones (see Figure 25).

<u>World Distribution</u>: circumarctic-alpine (Thomson, 1979) in the Northern Hemisphere; also reported from the Falkland Islands (Grassi, 1950) in the Southern Hemisphere.

OCHROLECHIA UNKNOWN #1

<u>Thallus</u> crustose; varying from thin, scattered verruculose granules to moderately thick, nearly continuous, verruculose crust; matt; pearly grey. White hypothallus occasionally present at margin.

<u>Apothecia</u> scarce to abundant, usually scattered, adnate, moderately constricted, 1.2-2.5 mm wide. Thalline margin smooth, very thick and prominent initially, slightly reduced with age, not excluded or partially excluded although occasionally radially cracked. Disc round, concave becoming plane, <u>+</u> papillose surface; pale yellowish brown, epruinose. Hyothecium hyaline; hymenium 225-325 μ m high, hyaline, thalline margin <u>+</u> containing masses of small crystals between cortex and irregular algal layer. <u>Spores</u> (6-) 8 per ascus, hyaline, simple, ellipsoid, 48-70 X 21-35 μ m.

Spot Tests: thallus (cortex) and disc C+ red.

<u>Substratum/Habitat</u>: saxicolous; almost exclusively on sandstone (HCl-) in shaded or partially shaded locaitons, occasionally on conglomerate.

Selected Specimens: 941, 4563.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone especially, but not exclusively, at inland sites; not collected in the adjacent zones.

World Distribution: unknown.



Remarks: This unidentified Ochrolechia species is characterized by the thin, continuous to often effuse thallus and its shaded, inland habitat. The small apothecia would also appear distinctive since they never reach the measurements given in Verseghy (1962) for 0. tartarea (2.5-5 mm), however, what is considered to be 0. tartarea among the local material also has smaller apothecia although they appear immature. The primary difference between the local O. tartarea and O. unknown #1 is the better developed thallus of the former, which is composed of very convex granules that eventually crack and become rather tartareous, plus a rather distinctive yellow-buff coloration. The differences may be a result of extremes of substratum and insolation. O. tartarea, locally has been collected only on hard igneous rocks in the exposed supralittoral The unidentified species grows more commonly on sandstone, the zone. friable nature of which might disrupt and thin the thallus, and shade, which may produce appaler thallus.

Verseghy (1962) described a species, <u>O</u>. <u>apiculata</u> Vers., which is very similar to <u>O</u>. <u>tartarea</u>, from which it differs in the granulose thallus, smaller apothecia with pruinose disc, and thick-walled, apiculate asci. The type is the only specimen listed. It is given as "Nordamerika: Kanada:Jitahi Bay, near Wellington; at 2 m above sea level.(H. Allen, 1835), Herb. of the Plant. Research Station Palmerston North, New Zealand, sub. <u>O</u>. <u>tartarea</u>". Despite the obvious disc and ascal differences of <u>O</u>. <u>apiculata</u> from the local material its type locality was curious as Wellington near Nanaimo was producing coal by the mid 1800's although not as early as 1835. However, there are also several Wellingtons on the east coast of Canada, none apparently with a Jitahi Bay (which could be a local name). An attempt was made to check the type label but the specimen could not be located at W. After much consideration, and weighting towards the collector (a well-known New Zealand collector) and original herbarium, it was concluded that there was a strong possibility that the type locality was actually <u>T</u>itahi Bay, near Wellington, New Zealand.

Two of the specimens contain rock framgents and the apothecia show portions of the proper margin through the thalline margin. They do not appear to agree with the majority of the collections; they may represent a different species but only fragments are present. More material is required for study of the anomalous collections.

OPEGRAPHA Humb.

Thallus crustose; sometimes <u>+</u> disappearing into the substratum. Phycobiont a green alga (Trentepohlia).

Ascocarp a lirelliform pseudothecium, immersed to sessile, round to usually markedly elongate, simple to branched, straight or flexuous. Proper exciple carbonaceous. Paraphyses branched, anastomosing, coherent. Asci bitunicate, IKI-. Spores 8 per ascus, ellipsoid to fusiform, 1- to several transverse septa, usually hyaline or sometimes brownish.

Corticolous, lignicolous, or saxicolous.

References: Redinger (1936-38), Poelt (1969).

 1. Spores 5-septate
 0. PULICARIS

 1. Spores 3-septate
 2

- Pycnidia and/or apothecia with an orangebrown pruinia, K+ red; pycnospores 13-18 μm long..... <u>0</u>. <u>OCHROCHEILA</u>
- Pycnidia and apothecia without pruinia, K-; pycnospores 4-5 μm long <u>0</u>. <u>HERBARUM</u>

OPEGRAPHA HERBARIUM Mont., Archiv. Botan. 2:302, tab. 15, fig. 1. 1833. Opegrapha betulina Sm., Engl. Bot., tab. 2281. 1811.

<u>Thallus</u> crustose; continuous, smooth, thin, sometimes <u>+</u> immersed below the upper dead cortical cells of substratum; whitish grey to faintly yellowish grey.

<u>Pseudothecia</u> common, abundant, scattered to crowded, sometimes <u>+</u> aligned, sometimes <u>+</u> intersecting, straight to curved, lirelliform, 0.6-1.6(-2.5) mm long, 0.1-0.3 mm wide. Remnants of old pseudothecia often present, degraded to substratum level. Proper margin black, carbonaceous, at first rounded and closed, finally separating to expose disc. Disc plane, black, epruinose. Hypothecium dark brown; epithecium dark brown; hymenium 65-75 µm high. <u>Spores</u> 6-8 per ascus, hyaline, 3-septate, irregular ellipsoid-fusiform with one of the middle cells enlarged, 18-22 X 5-7 µm.

<u>Pycnidia</u> common, black, <u>+</u> immersed; pycnospores hyaline, cylindrical, 4-5 X l μ m.

<u>Spot Tests</u>: upper hymenium IKI+ bluish, lower hymenium IKI+ yelloworange.

<u>Substratum/Habitat</u>: corticolous and lignicolous; collected on a wide variety of trees including <u>Quercus</u>, <u>Alnus</u>, and <u>Juniperus scopulorum</u> plus driftwood and pilings.

Selected Specimens: 3084, 3803.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, also collected in the adjacent zones at a maritime site.

<u>World Distribution</u>: tentatively western North America-Europe disjunct; in North America reported from California (Fink, 1935; Tucker & Jordan, 1978).

<u>Remarks</u>: The collections on driftwood and pilings had thinner thalli but otherwise appeared the same as the corticolous specimens. Because of the lignicolous substratum these specimens would key to <u>O. protuberans</u> Zahlbr. (Redinger, 1936-38; Poelt, 1969) in European floras.

OCHROLECHIA OCHROCHEILA Nyl., Flora 48: 212. 1865.

<u>Thallus</u> crustose; thin, smooth, continuous, sometimes <u>+</u> immersed below dead outer layer of substratum; greyish-white.

<u>Pseudothecia</u> common, abundant, scattered to very crowded, sessile, straight to curved, lirelliform, 0.6-1.5 mm long, 0.2-0.3 mm wide. Margins black, carbonaceous, initially rounded and closed, then separating and thin. Disc brownish to black, plane. Disc and/or upper edges of margins lightly to heavily orange-brown pruinose, occasionally absent. Hymenium 50-60 µm high; epithecium golden brown; hypothecium brown. <u>Spores</u> 8 per ascus, hyaline, irregular ellipsoid with one of the center cells enlarged, 3-septate, 13-15 X 4-5 µm (see Figure 23).

Pycnidia common, scattered, black, partially immersed, sometimes covered in pruinia like the apothecia; old pycnidia degraded to blackened pits; pycnospores hyaline, acicular with one end slightly narrower, faintly 1- to 2-septate, 13-18 X 1 µm.

<u>Spot Tests</u>: pruinia on apothecia and pycnidia K+ red-purple; epithecium and hypothecium IKI+ blue, lower hymenium IKI+ orange-yellow.

<u>Substratum/Habitat</u>: corticolous and lignicolous; collected once each on driftwood and Quercus.

Selected Specimens: 2728, 5420.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Hornby Island in the northern part of the CDFD subzone, also one collection in the adjacent zones also at a maritime site.

World Distribution: western North America-Europe disjunct; not listed in Hale and Culberson (1970).

<u>Remarks</u>: Redinger (1936-38) described the pycnospores of <u>0</u>. <u>ochro-</u> <u>cheila</u> as 10-12 X 0.7 μ m and Ozenda and Clauzade (1970) and Poelt (1969) followed or agreed with him. The larger pycnospores of the local collections agree more with those of <u>0</u>. <u>rufescens</u> Sandst., which is known to occur in the Queen Charlotte Island (Lichenes Canadensis Exsiccati No. 136), however, the small spores, pruinia, and the K+ spot test of the exciple rather than the thallus agree with the descriptions of <u>0</u>. <u>ochrocheila</u>. Hawksworth et al. (1980) treated <u>0</u>. <u>rufescens</u> as a synonym of 0. ochrocheila.

0. ochrocheila is reported here as new to the province.

OPEGRAPHA PULICARIS (Hoffm.) Schrad., Lich. Univ.:251. 1810. Lichen pulicaris Hoffm., Enumer. LIch. 14, tab. 3, fig.2,f. 1784.

<u>Thallus</u> crustose; smooth sometimes with scattered white crystals, sometimes below the dead outer cell layer of the substratum; greyishwhite.

Pseudothecia common, abundant, scattered to crowded, straight,

curved, or angled, lirelliform, 0.7-1.3(-1.7) mm long, 0.3-1.5 mm wide with ends <u>+</u> rounded. Margins black, carbonaceous, separating early to expose the disc, becoming <u>+</u> inconspicuous except at the ends. Disc plane, epruinose, brown to reddish black or black. Hypothecium light brown; epithecium light brown; hymenium 60-75 μ m high. <u>Spores</u> 8 per ascus, hyaline, irregularly fusiform with one or both mid-cells enlarged, 5-septate, 20-24 (-27) X 6-7 μ m (see Figure 23).

<u>Pycnidia</u> black, partially sunken, common; pycnospores hyaline, cylindrical, 3-4 X l μ m.

Spot Tests: hymenium IKI+ yellow-orange.

Substratum/Habitat: corticolous; exclusively on Quercus.

Selected Specimens: 817, 4588.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: uncertain; described as "more or less cosmopolitan" by Ozenda and Clauzade (1970).

<u>Remarks</u>: <u>O. pulicaris</u> falls within the <u>O. varia</u> complex. This complex varies in the width, length, and shape of the pseudothecia, display of the disc, presence of pruinia, reaction of the hymenium to IKI, and the shape of the spores. The separation of the various species is far from clear-cut.

PANNARIA Del.

Thallus squamulose to foliose; corticate on the upper surface, lower surface ecorticate; with or without soredia or isidia; dark brown to bluish. Black hypothallus often present. Phycobiont a blue-green

alga, <u>Nostoc</u> or Scytonema.

Ascocarp an apothecium, eventually sessile, laminal. Thalline margin present, occasionally only a proper margin present. Spores 8 per ascus, simple, hyaline, fusiform-ellipsoid, often with a distinct and sometimes ornamented epispore.

Corticolous, saxicolous, terricolous, muscicolous.

<u>Pannaria</u> is often restricted to species possessing a thalline margin, those with a proper margin are then referred to <u>Parmeliella</u>. Jørgensen (1978) stated that the presence or absence of a thalline margin is not a reliable character to separate the two genera. Jørgensen refrained from an exact definition of <u>Pannaria</u>, <u>Parmeliella</u>, or <u>Psoroma</u>, pending study of the non-European species. Two of the local species lack a thalline margin, but following Jørgensen they are included in <u>Pannaria</u> although Hawksworth et al. (1980) still listed such species in Parmeliella.

References: Tavares (1965), Weber (1965), Jørgensen (1978).

1.	Sorediate <u>P</u> . <u>MEDITERRANEA</u>
1.	Esorediate 2
	2. Thalline margin distinctly present
	2. Thalline margin absent; proper margin present
3.	Terricolous-muscicolousP. <u>PEZIZOIDES</u>
3.	Corticolous <u>P</u> . <u>LEUCOSTICTOIDES</u>
	 Squamules deeply crenate-digitate; margins con- colorous with rest of lobe; usually corticolous<u>P</u>. <u>SAUBINETII</u>
	4. Squamules dentate; lobes brown with margins and nodules white(-blue) felted; saxicolous usually in the supra- littoral zone

PANNARIA LEUCOSTICTOIDES Ohlss., Bryologist 76: 379. 1973.

<u>Thallus</u> squamulose-foliose; orbicular, 1.0-1.6(-2.4) cm broad. Centrally composed of small squamules with nodules, <u>+</u> raised, crenulate margins, often broken up into areoles; marginally lobed, with lobes 1.5-3.0 mm long, 0.5-1.0 mm wide, slightly ascending, edges <u>+</u> pruinose, margins and young lobes and nodules white-felted; dark grey with lobes apically blackened, and squamules <u>+</u> browning to buff, nodules lighter coloured. Lobes light coloured below. Hypothallus black, extending beyond lobes, conspicuous, thick, often appearing almost rhizinate.

<u>Apothecia</u> common, often crowded towards the middle, 0.7-1.6 mm wide. Thalline margin conspicuous, whitened, crenulate. Disc concave, becoming plane or sometimes convex, shiny, red-brown to darkening. Hymenium 110-125 µm high; paraphyses simple, coherent at the apices; epithecium (gold-)brown. <u>Spores</u> 8 per ascus, uniseriate, hyaline, subglobose to ellipsoid, often apically pointed, simple, 12-18 X 8-10 µm.

<u>Spot Tests</u>: hymenium IKI+ blue-green turning orange in thinner sections.

<u>Substratum/Habitat</u>: corticolous on deciduous trees, primarily <u>Quercus</u>, sometimes overgrowing other epiphytic lichens.

Selected Specimens: 3009, 5156.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone primarily but not exclusively at inland sites; not collected during the present study from the adjacent zones but known from other studies to be present there.

<u>World Distribution</u>: western North American endemic; described from British Columbia, also reported from California (Ohlsson, 1973).

<u>Remarks: P. leucostictoides</u> is separated from <u>P. leucosticta</u>, an eastern North America-Europe-southeast Asia species, according to Ohlsson (1973) by the non-apiculate espispore and the presence of atranorin. Jorgensen (1978) pointed out that <u>P. leucostictoides</u> is easily distinguished from the other species, even in the field, by its white scabrid to pruinose lobes that give the thallus a bluish colour. He agreed with Ohlsson on the distinctive lack of an apiculate epispore in the local species. However, some of the local material did indeed have apiculate spores. This point requires further study.

Ohlsson (1973) mentioned that <u>P</u>. <u>leucostictoides</u> lacked the crystals found on the lobes of <u>P</u>. <u>leucosticta</u> but Jørgensen (1978) suggested that this is a result of the newness of the <u>P</u>. <u>leucostictoides</u> collections, and believed that the crystals probably will develop as the herbarium material ages. Jørgensen (1978) also reported the hymenial reaction with IKI is positive blue-green, rapidly turning red-brown rather than the positive blue reported in Ohlsson (1973). The local material was indeed IKI+ blue-green but only turned orange in the thinner sections.

PANNARIA MARITIMA P. M. Jorg., Opera Bot. 45: 114. 1978.

<u>Thallus</u> squamulate; up to 6 cm broad. Squamules up to 1 mm wide. occasionally marginally lobate and centrally areolate-cracked, developing erect nodules or papillae, <u>+</u> crowded squamules; margins of squamules and nodules covered by a white pruinose felt giving the thallus a bluish tinge; otherwise fuscous, dark olive brown. Hypothallus not observed.

<u>Apothecia</u> occasionally present, often hidden among squamules, adnate to subsessile, 0.7-1.3(-2.0) mm wide. Proper margin concolorous with disc, usually distinct. Disc plane to slightly convex, shiny, dark

reddish brown. Hymenium 100 μ m high; paraphyses coherent; epithecium light brown. <u>Spores</u> not abundantly developed, 8 per asucs, hyaline, ellipsoid with apices slightly pointed, epispore thin but distinct, 17-20 X 8-10 μ m.

Spot Tests: hymenium IKI+ blue-green.

<u>Substratum/Habitat</u>: primarily saxicolous on drip surfaces especially in the supralittoral (shaded) zone, occasionally inland; one tentative collection from Pseudotsuga log.

Selected Specimens: 2839, 3954.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone almost exclusively at maritime sites; also present and abundant at maritime sites in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from Washington and British Columbia (Jørgensen, 1978).

<u>Remarks</u>: The type specimen of <u>P</u>. <u>maritima</u> was collected in Ucluelet on the west coast of Vancouver Island. Unfortunately, a printing error on a local map inaccurately labelled Terrace Beach as "Middle Beach"; Middle Beach is located some 40 km north of the actual type locality.

PANNARIA MEDITERRANEA C. Tav., Port. Acta. Biol. (B) 8:5,6. 1965.

<u>Thallus</u> squamulose or reduced to crustose; squamules centrally appressed but often ascending towards the margins, up to 4 mm wide or coalescing to cover larger areas; shiny; olivaceous brown with sides of margins slightly white-felted; soredia present, coarsely granular, developing on the lower side of the margins, often forming bulging soralia, concolorous with the lobes but often slightly white-felted like the lobe margins; often whole thallus dissolving into soredia. Hypothallus sometimes visible, thin, black.

<u>Apothecia</u> not observed. According to Jorgensen (1978) "apothecia are rare, 0.5-1.5 mm wide, with brown disc". According to Tavares (1965) the apothecia are reddish brown, initially with a crenulate thalline margin which becomes excluded as the disc becomes convex. The much paler proper margin then becomes visible.

Spot Tests: none

Substratum/Habitat: corticolous; collected only on Quercus.

Selected Specimens: 2132, 6663.

Local Abundance and Distribution: rare; distribution poorly known, collected once near Nanaimo and once on Saltspring Island within the CDFD subzone; not collected in the adjacent zones (see below).

World Distribution: western North America-Europe disjunct (Jørgensen, 1978).

<u>Remarks</u>: There are several saxicolous collections of <u>Pannaria</u> from steep, drip surfaces in the adjacent zones that are sterile and remain unidentified. The thallus is completely dissolved into steel-blue soredia; the phycobiont is a blue-green alga. It appears similar to, but slightly different from, the corticolous collections of <u>P. mediterranea</u> collected in the CDFD subzone and so the two have been treated separately. It may be another Pannaria species.

PANNARIA PEZIZOIDES (G. H. Web.) Trevis, Schedae Lich. Veneta No. 98. 1869. Lichen pezizoides G. H. Web., Spicil. Flora Goett.: 200,201. 1778.

<u>Thallus</u> crustose; nearly squamulose, up to 9 cm broad; of granules or very tiny, imbricate, crenulate squamules; brown, dark greyish, or slate. Hypothallus not observed. <u>Apothecia</u> common, abundant and crowded, sessile to subsessile, 0.9-1.6(-2.0) mm wide. Thalline margin present, crenulate, persistent. Disc plane and round to irregular, sometimes confluent, light orange to commonly red-brown, shiny. Hymenium 125-150 μ m high; paraphyses simple, coherent at the apices; epithecium yellowish. <u>Spores</u> 8 per ascus, uniseriate, hyaline, ellipsoid, <u>+</u> tapered ends, epispore distinct, unevenly thickened, 20-25 X 9-12 μ m.

Spot Tests: hymenium IKI+ blue.

<u>Substratum/Habitat</u>: muscicolous, especially on slanted surfaces; sometimes overgrowing adjacent rock; also collected once on humus.

Selected Specimens: 4307, 5185.

Local Abundance and Distribution: infrequent; scattered throughout the local CDFD subzone especially at maritime sites, present also in the adjacent zones.

<u>World Distribution</u>: circumarctic-alpine - circumboreal (Thomson, 1979); widespread in the Northern Hemisphere in temperate and arctic America and Asia (as well as Europe) according to Jørgensen (1978).

PANNARIA SAUBINETII (Mont.) Nyl., Mem. Soc. Scienc. Nat. Cherbourg 2:324. 1854.

<u>Parmelia saubinetii</u> Mont., Ann. Sci. Nat. Bot. Ser. 2, 6:331. 1836. Parmeliella saubinetii (Mont.) Zahlbr., Osterr. Bot. Zeitschr. 59:498.

1909.

<u>Thallus</u> squamulose; 2.5-7.0 cm wide. Squamules small, 0.5-1.0 mm wide, slightly to deeply incised, at first appressed becoming ascendant and imbricate; pale grey, pearl grey, occasionally buff or dark slate grey and then margins paler. Hypothallus absent.

<u>Apothecia</u> common, usually abundant, adnate, 0.5-1.1(-2.0) mm wide. Proper margin conspicuously lighter coloured than the disc, becoming excluded. Disc plane becoming convex, light orange, sometimes darkening to reddish orange. Hymenium 110-130 μ m high; paraphyses coherent; epithecium golden-brown. <u>Spores</u> 8 per ascus, uniseriate, hyaline, simple, ellipsoid, <u>+</u> tapered ends, epispore thin sometimes indistinct, 17-20(-22) X 7.5-10 μ m

<u>Spot Tests</u>: hymenium IKI+ blue-green, quickly turning reddish yellow in parts.

<u>Substratum/Habitat</u>: primarily corticolous; especially on the loose bark at the base of Arbutus; occasionally saxicolous.

Selected Specimens: 3874, 4398.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at both maritime and inland sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: western North America-Europe disjunct (Jørgensen, 1978); in North America reported from California, Oregon, Washington, and British Columbia (Weber, 1965; Ohlsson, 1973).

<u>Remarks</u>: Jørgensen (1978) described the British Columbia collections as very close to that of the European <u>P</u>. <u>saubinetii</u> and stated that after study it may, indeed, prove to be the same species.

PARMELIA Ach.

Thallus foliose. Lobes linear to rounded, often reticulately cracked; with or without isidia, soredia, cilia, or pseudocyphellae; corticate on both surfaces with upper cortex an anticlinal hyphae; rhizines simple to squarrose.

Ascocarp an apothecium, laminal. Thalline margin present. Spores 8 per ascus, ellipsoid to subglobose, simple, hyaline, thin-walled.

Corticolous, saxicolous, occasionally terricolous.

<u>Parmelia</u>, established in 1803 by Acharius, is "one of the most commonly collected and widespread foliose genera" (Hale, 1967b). Over 1,000 species have been described in <u>Parmelia</u> (Hale, 1965a; Nash, 1974). Such a large genus is not homogeneous and various groups have been segregated and sometimes recognized as separate genera. The hollow, nonrhizinate genera, <u>Menegazzia</u>, <u>Cavernularia</u>, and <u>Hypogymnia</u> are now firmly established as genera in their own right although some lichenologists regarded them as only subgenera as late as the 1970's,e.g. Ozenda and Clauzade (1970) and Duncan (1970).

Accepting the exclusion of the above genera, the remainder of <u>Parmelia</u> was usually divided into the subgenera <u>Xanthoparmelia</u>, <u>Melanoparmelia</u>, <u>Amphigymnia</u>, and <u>Parmelia</u>, or, very roughly the 'yellow-greens', the 'browns', and the 'greys' (with the last two subgenera combined). Most keys were based on coloration rather than the exact subgenus. <u>Xanthoparmelia</u> has now been raised to the generic level (Hale, 1974c); <u>Amphigymnia</u> is recognized as the genus <u>Parmotrema</u> (Hale, 1974a); and one section of subgenus <u>Parmelia</u> is delimited as genus <u>Hypotrachyna</u> (Hale, 1974b). Various other genera also have been recognized but they are not found locally. Esslinger (1978a) recently raised the 'browns' to genus status with the publication of <u>Allantoparmelia</u>, <u>Melanelia</u>, and <u>Neofuscelia</u>. The new segregate genera are not yet universally accepted. Hawksworth et al. (1980) recognized only <u>Allantoparmelia</u>. <u>Parmelia</u> sens. lat. thus remains in a very unsettled state. For this reason and for easier comparison with other keys, species of the more recently segregated genera are included in the following key.

Of the local species remaining in <u>Parmelia</u>, all are <u>pseudocyphellate</u> with with the pseudocyphellae small and inconspicuous in the linear-lobed <u>P. saxatilis</u> group and large and noticeable in the <u>P. borreri</u> group.

References: Culberson (1962), Hale (1965a, 1965b, 1967a, 1973, 1975), Hale and Kurokawa (1964), Krog (1970).

1. Thallus small, < 3 cm broad; lobes < 1 mm wide; corticolous 1. Thallus moderate to large, usually >3 cm; lobes >1 mm wide; corticolous or saxicolous (or if lobes 1 mm and the thallus small, then saxicolous) 2 2. Thallus brown or grey 6 3. Rhizines simple; lacking pseudocyphellae 4 3. Rhizines branched or simple (if simple then rare); pseudocyphellae present or absent5 4. Esorediate; lobes large, > 1 mm wide XANTHOPARMELIA CUMBERLANDIA (p. 771) 4. Sorediate; lobes small, <1 mm wide..XANTHOPARMELIA MOUGEOTII (p. 772) <5. Lobes elongate-linear; rhizines branched and abundant 5. Lobes obtuse and rounded; rhizines simple, not abundant P. FLAVENTIOR 6. Thallus with margin black ciliaPARMOTREMA ARNOLDII (p. 539)

7.	Thallus olive-brown to brown-black8
7.	Thallus grey with <u>+</u> slightly browned edges14
·	8. Thallus with small laciniae or large flattened isidia covering the main lobes; saxicolous
	 8. Thallus without laciniae or flattened isidia covering lobes but often isidiate (coralloid, globular) or sorediate or neither; saxicolous or corticolous
9.	Isidiate or sorediate10
9.	Nonisidiate and esorediate13
	<pre>10. Isidia(-soredia) granular or globular in warty mounds, coalescing; saxicolous</pre>
	10. Isidia separate, discrete, either cylindrical or spatulate, scattered; corticolous or saxicolous
11.	Isidia tiny, granular; cortex HNO ₃ <u>MELANELIA DISJUNCTA</u> (p.465)
11.	Isidia globular, larger, > 0.1 mm; cortex HNO ₃ + blue-green <u>NEOFUSCELIA</u> <u>VERRUCULIFERA</u> (p.491)
	<pre>12. Isidia flattened, hollow; medulla C EXASPERATULA (p. 466)</pre>
	<pre>12. Isidia cylindrical, solid; medulla C+ red GLABRATULA (p. 467)</pre>
13.	Spores 8 per ascus MELANELIA SUBOLIVACEA (p. 470)
13.	Spores 16+ per ascus
	14. Thallus isidiate15
	14. Thallus sorediate 17
15.	Medulla K P. PSEUDOSULCATA
15.	Medulla K+ yellow turning red16
	16. Isidia finely coralloid, abundant and congested; corticolous and occasionally saxicolous P. UNKNOWN #1 (see P. saxatilis)
	<pre>16. Isidia large, abundant but usually scattered; saxicolous P. SAXATILIS</pre>

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<u>P. SUBRUDECTA</u>

PARMELIA FLAVENTIOR Stirt., Scottish Natur. 4:254. 1877-78.

Parmelia andreana Muell. Arg., Rev. Mycol. 1:169. 1879.

Parmelia kernstockii Lynge & Zahlbr., Annal. naturh. Hofmus. Wien 27:271.

1913.

Parmelia soredica sensu Herre (1910), non Nyl.

<u>Thallus</u> foliose; 4-8 cm broad. Lobes 4-7 mm wide, broad and rounded. Upper surface dull, smooth with either a few, small pseudocyphellae toward the lobe tips or pseudocyphellae abundant, up to 0.7 mm wide; sorediate, soralia mainly linear and marginal, maculiform when laminal; yellow to greenish yellow. Lower surface smooth to rugulose, shiny, black with a wide (5 mm) light brown margin.

<u>Apothecia</u> not observed. According to Du Rietz (1925) the Asian and European collections are sterile while the American and African collections are moderately fertile; the apothecia are short pedicellate, imperforate; thalline margin thick, crenulate, becoming sorediate; disc concave, shiny, chestnut brown, up to 5 mm wide; asci and spores not observed. According to Herre (1910a) the spores are ellipsoid, 12.25-15.5 X 7.3-11 µm.

<u>Pycnidia</u> occasional, immersed, black, scattered; pycnospores not observed. According to Du Rietz (1925) the pycnospores are oblong-subcylindrical, 8.5-9 X 1.5 µm.

<u>Spot Tests:</u> medulla C+ red.

Substratum/Habitat: saxicolous and corticolous; the best developed

specimens were collected from conglomerate and sometimes adjacent <u>Selaginella</u> wallacei; the single corticolous collected was on <u>Acer</u>.

Selected Specimens: 307, 791A.

Local Abundance and Distribution: infrequent; collected on two of the southern Gulf Islands in the CDFD subzone at exposed, higher elevations inland; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct in the Northern Hemisphere; Schubert and Klement (1966) reported it from India and suggested it might be circumtemperate; in North America, however, it is found in the Great Lakes region and California-southern Rockies in the west; also reported from East Africa (Krog & Swinscow, 1977) in the Southern Hemisphere.

<u>Remarks</u>: The subgeneric affinities of <u>P</u>. <u>flaventior</u> are uncertain. Because of the dark underside and broad, naked marginal zone Hale (1959) suggested that it belonged to the subgenus <u>Amphigymnia</u> but Culberson (1962) included it in the <u>P</u>. <u>borreri</u> group (subgenus <u>Parmelia</u>) on the basis of pseudocyphellae and chemistry. Hale (1965b) later excluded it from the subgenus Amphigymnia.

<u>P. ulophyllodes</u> (Vain.) Sav., known from California (Hale, 1979) and Alberta (Bird & Marsh, 1973a) is similar to <u>P</u>. <u>flaventior</u> but lacks pseudocyphellae.

PARMELIA PSEUDOSULCATA Gyeln., Ann. Mus. Nat. Hungar.:28. 282. 1934.

<u>Thallus</u> foliose; orbicular or fragmented, 3-6 cm broad. Lobes 1-1.5 mm wide, elongate-linear, appressed, quite separate and not overlapping. Upper surface shiny, smooth to slightly reticulately ridged especially towards the lobe ends; isidiate, isidia abundant in older sections of thallus, often

concentrated on the margins, cylindrical occasionally becoming coralloid; greyish white becoming glaucous green toward the lobe tips. Lower surface shiny black with abundant dichotomously branched rhizines, extending \pm beyond the margin.

Spot Tests: medulla K-, P+ red.

<u>Substratum/Habitat</u>: corticolous; only collected on <u>Pseudotsuga</u>. <u>Selected Specimens</u>: 4040, 5280B.

<u>Local Abundance and Distribution</u>: infrequent; collected towards the western boundary of the CDFD subzone at inland sites; present and more common in the adjacent zones.

<u>World Distribution</u>: western North America in the Northern Hemisphere and South Africa in the Southern Hemisphere (Hale, pers. comm.); in North America reported from Oregon and Washington (Hale, 1979) and British Columbia (Ohlsson, 1973).

<u>Remarks</u>: <u>P</u>. <u>pseudosulcata</u> was described as having a K+ yellow medulla (Gyelnik, 1934a) although the type specimen is K- (Hale, pers. comm.).

Besides the chemical differences, <u>P</u>. <u>pseudoculcata</u> can be separated easily in the field by the more elongate, separted (not overlapping) lobes and the isidia obviously more concentrated along the margin, from <u>P</u>. <u>unknown</u> #1 and <u>P</u>. <u>saxatilis</u> (usually saxicolous).

PARMELIA SAXATILIS (L.) Ach., Meth. Lich.: 204. 1803.

Lichen saxatilis L., Spec. Plant.:1142. 1853.

<u>Thallus</u> foliose; 5-10(-14) cm broad, orbicular or occasionally fragmented. Lobes 1-3 mm wide, linear, appressed, or edges and margins free and imbricate. Lobe ends blunt or occasionally wide and rounded. Upper surface dull to shiny, weakly reticulately ridged, crests often becoming pseudocyphellate; isidia abundant, rarely scarce (when young), developing on ridge crests first, cylindrical to coralloid, often browning at the apex; grey or pale olive grey with lobe ends or sometimes the whole thallus browned, only the ridges remaining white-grey (especially saxicolous specimens). Lower surface shiny, black, browning at the tips; rhizines abundant, simple, black, scattered.

<u>Apothecia</u> occasional, laminal, 1-6(-10) mm wide. Thalline margin present, thick, crenulate to more commonly isidiate. Disc concave becoming variously concavely contorted, light red-brown. Hymenium 50-65 µm high; paraphyses coherent; epithecium yellow-brown. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, with distinct epispore, 15-18(-21) X 8-13 µm.

<u>Pycnidia</u> occasional, black, immersed; pycnospores hyaline, cylindrical 5-7 X 1.5 µm.

Spot Tests: medulla K+ yellow turning orange-red, P+ orange.

<u>Substratum/Habitat</u>: primarily saxicolous; on both sandstones and conglomerates as well as igneous rocks; also corticolous,primarily on coniferous (Pseudotsuga) but also on deciduous trees (see below).

Selected Specimens: 4714, 4853.

Local Abundance and Distribution: frequent (present at over one-half of the major collection sites); scattered throughout the CDFD subzone at both inland and maritime sites, also present in the adjacent zones (see Figure 26).

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Ahti, 1977); according to Thomson (1979) circumarctic-circumboreal; according to Krog (1968) circumarctic-circumtemperate; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), Argentina (Grassi, 1950), and Antarctica (Lindsay, 1977) in the Southern Hemisphere.



<u>Remarks</u>: The corticolous collections (actually also saxicolous, especially when colonized trunks are near a saxicolous substratum) were slightly different in appearance from the typical saxicolous specimens. The corticolous collections had very fine, dense isidia, less ridging, and less browned thalli. Both T. Ahti and P. M. Jørgensen, during separate field trips, stated that this mainly corticolous taxa was not the same as the <u>P. saxatilis</u> found in Europe. However, Dr. M. Hale, Jr. initially considered it to fall within <u>P. saxatilis</u> (Hale, pers. comm.) but now is of the opinion it deserves species status. This has been revealed in the study of a <u>Parmelia</u> species restricted to the tree canopy in the interior of British Columbia and currently being described by T. Goward and T. Ahti. The interior species and the coastal species require comparison. The coastal species is treated as <u>P. unknown #1</u> pending further study.

PARMELIA STICTICA (Duby) Nyl., Bull. Soc. Linn. Normandie 2(6): 270. 1872. Parmelia borreri var. stictica Duby, Botan. Gallic 2:601. 1830.

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<u>Thallus</u> foliose; 3-7 cm broad. Lobes 2-4 mm wide, linear, appressed, sides contiguous and overlapping. Upper surface shiny, smooth to slightly ridged near the margins; pseudocyphellae present, maculiform, 0.3-1.0 mm wide, rounded becoming linear with increasing size, common on crests of ridges and very noticeable on the brown margins, becoming sorediate toward the center; sorediate, soredia large, granular, abundant, darkening; pale olive grey to mineral grey with 1 cm or more of the margins browned. Lowr surface shiny, black, browning towards the lobe ends; rhizines simple, black-brown, abundant.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Ozenda and Clauzade (1970) the apothecia are 2-8 mm wide, slightly pedicellate, concave; margin sorediate; spores 10-19 X 8-11 μ m. According to Hillmann (1936) the

pycnospores are strikingly long, 10-18 X 0.5 µm.

Spot Tests: medulla C+ red.

<u>Substratum/Habitat</u>: saxicolous; on sandstones, conglomerates and igneous rocks, appearing to prefer the supralittoral zone but also occurring in the open, inland outcrops.

Selected Specimens: 1922, 4825.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at maritime and inland sites, not collected during the present study in the adjacent zones but known from other collections to be present in the supralittoral zone of the Fog/Spruce subzone of the CH zone (Figure 27).

<u>World Distribution</u>: tentatively western North America-eastern North America(Greenland)-Europe disjunct in the Northern Hemisphere; also reported from Ethiopia and Keny in Africa (Krog & Swinscow, 1977) and South America (Hale, 1965b) in the Southern Hemisphere.

<u>Remarks</u>: The <u>P</u>. <u>redecta</u> Ach. reported from Saltspring Island (Bird & Bird, 1973) is actually P. stictica.

PARMELIA SUBRUDECTA Nyl., Flora 69:320. 1886.

Parmelia dubia (Wulf.) Schaer., Lich. Helvet. Spicil., sect. 10:453. 1840.

<u>Thallus</u> foliose; 5-10 cm broad. Lobes 5-10(-12) mm wide, apically rounded, appressed to the substratum centrally and over much of the thallus but margins and lobe ends free, ascending, <u>+</u> imbricate. Upper surface smooth to faintly wrinkled, shiny, with numerous pseudocyphellae, up to 0.5 mm long; sorediate, soralia both marginal and slightly laminal, laminal soredia also developing around the pseudocyphellae; pale olive grey, faintly yellowish glaucous, to glaucous green. Lower surface smooth, shiny, tan; rhizines simple, abundant to the margins, tan to sometimes brownish.



<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Hillmann (1936) the apothecia are rare, up to 9 mm wide, concave then plane; the margin at first smooth and thick becoming thin and sorediate; spores mainly ellipsoid, 10-19 X 8-11 μ m; the pycnidia are straight with one end often inflated, 4-6 X 0.5-1.0 μ m.

Spot Tests: thallus C+ red.

<u>Substratum/Habitat</u>: saxicolous and corticolous;on <u>Pseudotsuga</u> and <u>Holodiscus</u>.

Selected Specimens: 3627, 4604.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone primarily at inland sites, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct; almost pantemperate or perhaps pantropical; in North American heavily concentrated in the Great Lakes-Appalachian area with scattered collections in the southern United States and again in California; also reported from South Africa and Australia (Hale, 1965b) in the Southern Hemisphere.

<u>Remarks: P. subrudecta</u> belongs to the <u>P. borreri</u> group which also includes the local <u>P. stictica</u> and (perhaps) <u>P. flaventior</u>. Within the more restricted <u>borreri</u> complex are several species differing in chemistry and coloration of the lower surface. Unfortunately <u>P. subrudecta</u> was recently called <u>P. borreri</u> until examination of the type revealed a black lower surface and a different chemistry from the usual concept of that species (Hale, 1965b). This necessitated the adoption of the epithet <u>subrudecta</u> for the commoner species with the tan coloured lower surface. <u>P. borreri</u> s. str.(with a black lower surface) is also known to occur in western North America (Hale, 1979). PARMELIA SULCATA Tayl., Flora Hibernica 2: 145. 1836.

<u>Thallus</u> foliose; orbicular or fragmented, 4-11 cm broad. Lobes 1-3 mm wide, linear, appressed to occasionally somewhat free and imbricate. Upper surface faintly reticulately ridged especially at lobe tips, shiny; linear pseudocyphellae present, especially on crests of ridges; sorediate, soredia developing along the crest cracks; white to mineral grey with lobe tips <u>+</u> browned. Lower surface black, brown at lobe tips; rhizines black, simple, becoming squarrose, abundant. Rhizines and black lower margin often visible from above.

Apothecia rare, observed once, laminal. Disc concave, light brown, 1-3 mm wide; margin concolorous with the thallus, sorediate. Hymenium 35-40 μ m high; paraphyses coherent; epithecium yellow-brown. <u>Spores</u> not observed. According to Howard (1950) the spores are 8 per ascus, hyaline, ellipsoid, 10-16.5 X 6.6-8.2 μ m. Hillmann (1936) stated the spores are 13-15 X 5.5-6.0 μ m.

Spot Tests: medulla K+ yellow.

<u>Substratum/Habitat</u>: primarily corticolous, occasionally saxicolous; collected most frequently on <u>Pseudotsuga</u> and <u>Quercus</u> but also on a wide variety of other deciduous trees and shrubs. Collected once growing over a liverwort, <u>Frullania</u> sp., and once on <u>Thuja</u> leaves. This foliicolous habit has been reported and discussed by Vitt et al. (1973).

Selected Specimens: 871, 2200B.

Local Abundance and Distribution: frequent (present at over one-half of the major collection sites; scattered throughout the CDFD subzone; present but not as common in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumtemperate (Thomson, 1979) in the Northern Hemisphere; also reported from New Zealand (Martin, 1966) and

Argentina (Grassi, 1950) in the Southern Hemisphere.

PARMELIOPSIS (Stizenb.) Nyl.

Thallus foliose, small rosettes; lobes narrow, linear, appressed; upper and lower surfaces corticate, formed of anticlinnaly woven hyphae; with or without soredia or isidia. Lower surface rhizinate.

Ascocarp an apothecium, laminal, sessile to adnate. Thalline margin present. Spores 8 per ascus, subspherical, ellipsoid to oblong, sometimes curved, hyaline, simple.

Pycnidia immersed; fulcrum exobasidial; pycnospores cylindrical, short and straight or longer and curved.

Primarily corticolous, occasionally saxicolous.

References: Riddle (1917).

1.	Thallus greyish to white <u>P</u> . <u>HYPEROPTA</u>
1.	Thallus greenish-yellow
	2. Corticolous; medulla KP. <u>AMBIGUA</u>
	2. Saxicolous; medulla K+ vellowXANTHOPARMELIA MOUGEOTII (p. 772)

PARMELIOPSIS AMBIGUA (Wulf.) Nyl., Sym. Lich. 2:54. 1863. Lichen ambiguus Wulf., Collect. Botan. 4:239, tab. 4, fig. 2. 1790.

<u>Thallus</u> foliose; roughly orbicular, 1-2(-3) cm broad. Lobes 0.5-1.0 mm wide, linear, usually separate to sometimes <u>+</u> contiguous, closely appressed even at the lobe ends. Upper surface dull, smooth, occasionally cracking; sorediate, soredia mainly laminal especially toward the thallus center but

occasionally terminal, heaped to excavated in maculiform soralia; sulphur yellow to pale greenish yellow. Lower surface shiny, brown to black, brownish at lobe tips; rhizines simple, black, numerous but scattered.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Hillmann (1936) it fruits frequently in the mountains, infrequently in the lowlands. According to Howard (1950) the apothecia are rare, up to 4 mm wide; disc pale to chestnut brown, concave to flat; spores usually curved, oblong-ovoid, simple, $6.0-13.0 \times 2.5-3.3 \mu m$. The pycnidia are minute, immersed (Riddle, 1917) and frequently empty (Hillmann, 1936); pycnospores cresent to hooked shaped, $12-18 \times 0.5-1.0 \mu m$.

Spot Tests: medulla K-.

<u>Substratum/Habitat</u>: corticolous; collected only on <u>Pseudotsuga</u>. Selected Specimens: 4907, 6426.

Local Abundance and Distribution: infrequent; one collection in the CDFD subzone at a high elevation inland on Saltspring Island; also collected and more common in the adjacent CDFW subzone.

<u>World Distribution</u>: circumarctic-circumtemperate (Krog, 1968); according to Thomson (1979) circumarctic-circumboreal.

Remarks: See Xanthoparmelia mougetoii for comments.

PARMELIOPSIS HYPEROPTA (Ach.) Arn., Verh. Zool.-Bot. Gesellsch. Wien. 30:

117. 1880.

Parmelia hyperopta Ach., Syn. Lich.: 208. 1814.

Parmeliopsis diffusa(Web.) Riddle, Bryologist 20:75. 1917.

<u>Thallus</u> foliose; orbicular or fragmented, 2-3 cm broad. Lobes 0.5-1.0 cm broad. Lobes 0.5-1.0 mm wide, linear, adnate, not contiguous but widely separated. Upper surface smooth, dull to shiny, cracked in places; sored-



iate; soredia granular, confined to maculiform soralia, laminal and terminal; pale olive grey, pale glaucous, to white. Lower surface shiny brown to black; rhizines simple, black, browning at lobe ends.

<u>Apothecia</u> rare, liminal, stipitate, 1.5-1.75 mm wide. Thalline margin present, concolorous with thallus. Disc plane, brown. Hymenium partly to entirely brownish, 40 µm high; spores not observed. According to Hillmann (1936) the apothecia are rare, the margin becoming coarsely sorediate; spores short cylindric, straight to cresent shaped, 8.5-10.2 X 2-4 µm.

<u>Pycnidia</u> not observed. According to Hillmann (1936) the pycnidia are black; pycnospores curved or hooked, seldom straight, 16-22 X 0.5-0.8 µm.

Spot Tests: cortex K+ yellow.

<u>Substratum/Habitat</u>: corticolous, occasionally lignicolous; collected primarily on <u>Pseudotsuga</u>, occasional on other conifers.

Selected Specimens: 2420, 5225.

Local Abundance and Distribution: infrequent; two collections on Denman Island in the northern part of the CDFD subzone, present and more common in the adjacent CDFW subzone (see Figure 28).

<u>World Distribution</u>: circumarctic(low)-circumtemperate (Krog, 1968); according to Thomson (1979) it is circumboreal-curcum(sub)arctic; also reported from Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

PARMOTREMA Mass.

Thallus foliose; lobes loosely adnate to ascending, broad and apically rounded; corticate above and below, both with a palisade plectenchyma; with or without soredia. Below with a distinct marginal barezone, rhizines simple and often sparse.

Ascocarp an apothecium, laminal, sub-stipitate to stipitate, often perforate. Thalline margin present. Spores 8 per ascus, hyaline, simple, ellipsoid.

Corticolous, saxicolous, and lignicolous.

<u>Parmotrema</u> was formerly part of <u>Parmelia</u>, section <u>Amphigymnia</u>. There is one local species.

References: Hale (1965a, 1974a).

PARMOTREMA ARNOLDII (DR.) Hale, Phytologia 28:35. 1974.

Parmelia arnoldii DR., Nyt Magaz. f. Naturvid 62:80. 1924.

<u>Thallus</u> foliose; 4-11 cm broad. Lobes 6-10 mm wide, rounded, ascending. Upper surface smooth, dull to shiny; marginally edged with a thin, black line and simple, sometimes bifuricate, black cilia, 1-3(-5) mm long; sorediate, soredia granular, darkening, submarginal, the lobe becoming revolute and on narrow lobes curling under also on the sides until the soralium is cresent-shaped. Lower surface black with a wide brown margin, shiny, sometimes slightly rugulose in places; rhizinate, rhizines common, black, simple.

Apothecia not observed. According to Howard (1950) the apothecia are rare, 2-12 mm wide; disc brown; margin entire; spores ellipsoid, 11-17 X 7-11 μm. According to Hale (1965) the spores are larger, 15-20 X 9.5-12 μm.

<u>Pycnidia</u> uncommon, observed once; marginal on a lobe tip, clustered, black; pycnospores hyaline, cylindrical, slightly thicker at one end, 8-10 X l µm.

Spot Tests: medulla K-, KC+ red; cortex K+ yellow.

<u>Substratum/Habitat</u>: corticolous; primarily on <u>Pseudotsuga</u> but also occasionally on other conifers and deciduous trees and shrubs; also one saxicolous collection on sandstone.

Selected Specimens: 2620, 3842.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone primarily, but not exclusively, at inland sites; also present in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct but possibly pantropic with oceanic extensions; also reported from New Zealand (Martin & Child, 1972), Argentina (Grassi, 1950), and Chile (Degelius, 1935) in the Southern Hemisphere.

<u>Remarks</u>: The presence of the black marginal cilia and the K- medulla spot test are the distinguishing characters of <u>P. arnoldii</u>. <u>P. perlatum</u> (Huds.) Choisy, also known from western North America, may be distinguished by the K+ yellow of the medulla. Hale (1979) described <u>P. perlatum</u> as "quite common on oaks in California and Oregon".

PELTIGERA Ŵilld.

Thallus foliose, often large; upper surface corticate, with or without a tomentum of fine hairs especially near the margins; lower surface ecorticate but often veined and rhizinate; with or without isidia, soredia, or cephalodia. Phycobiont a blue-green or a green alga; in the latter case then cephalodia present on upper or lower surface containing a blue-green alga.

Ascocarp a hemiangiocarpic apothecium, marginal on the upper surface, often with both sides reflexed and appearing 'saddle-shaped', brownish, sunken. Thalline margin present, usually crenate. Spores (2-)8 per ascus, hyaline or browning, ellipsoid to acicular, 3- to many septate.

Terricolous, occasionally corticolous, often among mossess in partially shaded locations.

Peltigera is one lichen genus which is known to possess species where the one mycobiont (=lichen) can parasitize either a blue-green or green alga to produce two distinctly different thalli. According to Brodo and Richardson (1978) the "green algal thallus is dominant and fertile whereas the blue-green part is small and gall-like, and is called a cephalodium. Occasionally cephalodia become very well developed and may survive as independent thalli...". Both the biological relationships involved and the ensuing nomenclatural problems are very complex and as yet unresolved. The topic is mentioned here only beause chimeroid associations (mixture of both morphotypes) in Peltigera were studied by Brodo and Richardson (1978) based on major collections from the present study area, especially the Saanich Peninsula. Apparently P. aphthosa is capable of producing two morphotypes locally. The typical thallus contains a green alga as the major phycobiont but the cephalodia (containing blue-green algae) on the upper surface may become so well developed that after breaking off they are capable of a separate existence. It is suggested tentatively that the separate blue-green morphotype may be equivalent to P. avenosa Gyeln. The problem requires further study.

<u>O</u>. <u>Vitikainen</u> is currently monographing <u>Peltigera</u>. A representative sample of the local material has been sent to him and some of the preliminary results are presented here. This treatment, however, is only tentative pending the completion of his monograph.

Chemistry has not yet proven important in the genus <u>Peltigera</u>. The 'Spot Test' section is omitted in this group.

l. Major phycobiont a green alga (grass-green in colour)
l. Major phycobiont a blue-green alga (blue-green, blackish-green) 4
 Thallus small, < 3 cm, fan-shaped and erect, attached only at one edge; cephalodia on base or on lower surface along veins
 Thallus moderate to large, > 3 cm, orbicular, multi-lobed, attached over most of the surface except for ascending margins; cephalodia scattered on the upper surface
3. Thallus distinctly veined below, rhizines abundant; cephalodia grouped, small; back of apothecia ecorticate or with cortical patches
 Thallus indistinctly or not veined, blackened toward the center on lower surface, rhizines usually sparse; cephalodia abundant, large becoming lobed; back of apothecia corticate
4. Thallus sorediate 5
4. Thallus esorediate 6
5. Soredia marginal; thallus moderate to large, > 3 cm <u>P</u> . <u>COLLINA</u>
5. Soredia laminal; thallus small, < 3 cm
6. Upper surface with tomentum present at least at lobe margins7
6. Upper surface lacking tomentum
7. Thallus isidiate, marginal
7. Thallus nonisidiate8
8. Thallus thin, < 200 µm thick; upper surface shiny; rhizines simple, 'fuzzy', long P. MEMBRANACEA
8. Thallus thick, > 250 μm thick; upper surface dull; rhizines fasciculate or if simple then not 'fuzzy'9
9. Lobe ends <u>+</u> upturned, margins often ruffled; thallus often cracked; lobes narrow, < 1.5 cm wide <u>P</u> . <u>RUFESCENS</u>
9. Lobe ends <u>+</u> downturned, margins not ruffled, lobes wide, \geq 1.5 cm wide; surface not obviously cracked <u>P</u> . <u>CANINA</u>
10. Thallus isidiate
10. Thallus nonisidiate11

<u>PELTIGERA APHTHOSA</u> (L.) Willd., Flora Berol.:347. 1787. Lichen aphthosus L., Spec. Plant.:1148. 1753.

<u>Thallus</u> foliose; orbicular, covering large areas. Lobes 7(-11) cm long, 2.0-4.4 cm wide, imbricate, margins free and rounded, often slightly involute. Upper surface smooth and shiny, occasionally cracked, with hyaline hairs toward the margins; cephalodia few, scattered, large, warty becoming peltate and lobed, 0.6-1.2(-3.0) mm wide; green, sometimes browning. Lower surface black, white toward the margin, cottony (= ecorticate), occasionally somewhat obscurely veined; rhizines few, fasiculate, white to black. Phycobiont a green alga; cephalodia containing a blue-green alga.

<u>Apothecia</u> infrequent, marginal on narrow lobes, immersed, 5-9 mm wide. Crenate thalline margin present. Disc red-brown or darker, sides reflexed. Reverse side of apothecium corticate. Spores hyaline, acicular, 3-7(-9)septate, straight to curved, $48-75 \times 4-7 \mu m$.

<u>Substratum/Habitat</u>: terricolous; especially among moss, occasionally on thin soil over bedrock.

Selected Specimens: 1945, 4551.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at both inland and maritime sites, also present in the adjacent

zones.

<u>World Distribution</u>: circumarctic-circumboreal (Thomson, 1979); also reported from Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks: P. aphthosa</u> is not as common locally as <u>P. leucophlebia</u>. See <u>P. leucophlebia</u> for comments.

<u>PELTIGERA CANINA</u> (L.) Willd., Flora Berol., Prodrom:347. 1787. <u>Lichen caninus</u> L., Spec. Plant.:1149. 1753.

<u>Thallus</u> foliose; up to 18 cm broad. Lobes thick, > 250 μ m thick, 4-9 cm long, 1.2-2.4 cm wide, the very tips of the lobes <u>+</u> turned down. Upper surface <u>+</u> dull near the center, occasionally slightly cracked becoming white tomentose towards the outer 2-3 cm of the lobe; buff brown toward the center and smoke grey toward the pruinose margins. Lower surface with slightly raised veins that are pale but browning towards the center; rhizines usually fasciculate, sometimes simple but then not 'fuzzy', pale or occasionally darkening. Phycobiont a blue-green alga.

<u>Apothecia</u> occasional, marginal, on narrow fertile lobes (often lacking tomentum), ≤ 8 mm wide. Disc red-brown, sides <u>+</u> reflexed. <u>Spores</u> hyaline, acicular, 3- to 12-septate, 48-67 X (2-)3-4(-5) μ m.

<u>Substratum/Habitat</u>: terricolous; among mosses in shaded locations. <u>Selected Specimens</u>: 4053, 5254.

Local Abundance and Distribution: infrequent; collected twice in the CDFD subzone, both at inland sites, also present in the adjacent zones.

<u>World Distribution</u>: (circum(low)arctic-)circumboreal in the Northern Hemisphere; often referred to as 'cosmopolitan', e.g. Thomson (1979), but that is usually in reference to <u>P. canina</u> s. lat.; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and

Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: <u>P. canina</u>, <u>P. rufescens</u>, and <u>P. membranacea</u> are all very similar in possessing tomentum on the upper surface. In conservative treatments the first two species are regarded as a single species (Thomson, 1950, 1979). <u>P. membranacea</u>, the most common of the three locally, is the most distinctive with a very thin, shiny thallus and fuzzy, simple and long rhizines. <u>P. rufescens</u> is the next most common locally. It has more or less up-turned, narrower, browned and often cracked lobes compared to <u>P. canina</u>. Dahl and Krog (1973) suggested that the veins of <u>P. rufescens</u> are also much more anastomosing than the veins of <u>P. canina</u>.

<u>PELTIGERA COLLINA</u> (Ach.) Schrad., Journ. für Bot. 5(1):78. 1802.
<u>Lichen collinus</u> Ach., Lich. Suec Prodr.:162. 1798.
Peltigera scutata auct., non (Dicks.) Duby

<u>Thallus</u> foliose; 6-12 cm broad. Lobes 5-10 mm wide, appressed, with margins free and ascending, often imbricate, margins flexuous. Upper surface smooth and shiny, cracks numerous, margins sometimes pulverulent and scabrous; sorediate, soredia marginal and occasionally laminal on cracks, granular; olive grey, olive brown, to dark grey. Lower surface brown veined with white-cottony interspaces; rhizines common, tan to usually brown, fasciculate, along the veins. Phycobiont a blue-green alga.

<u>Apothecia</u> uncommon, marginal on the upper surface, sunken, 1.5-4 mm wide. Disc black, reflexed. Hymenium 75-100 μ m high; paraphyses simple, stout, coherent; epithecium brown. Spores 8 per ascus, hyaline, acicular, 3-septate, (40-)50-60 X 3-5 μ m.

<u>Substratum/Habitat</u>: usually saxicolous among mosses but also fairly common corticolous on the bases of <u>Quercus</u> and <u>Acer</u>, especially among mosses.

Selected Specimens: 314, 1152.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially but not exclusively at inland sites, present but not as common in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia disjunct; rare and restricted in eastern North America (Ahti, 1964; Hansen, 1962); also possibly rare and restricted in eastern Asia since many reports from there are now discounted, but still reported from India (Singh, 1964); also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: Thomson (1950) stated that the soredia and veins may be absent and the spores up to 7-septate, 26-64 X 2.5-5.5. μ m, often degenerating. One specimen examined (US) lacked soredia but was abundantly fertile. It has been identified as <u>P. horizontalis</u> despite the reflexed apothecia. There were scabrosities and associated light pruinia as is common in sorediate specimens of <u>P. collina</u>.

PELTIGERA DEGENII Gyeln., Magy. Bot. Lapok. 25:253. 1926.

<u>Thallus</u> foliose; up to 14 cm broad. Lobes thin, 3-7 cm long, (0.4-) 1.0-2.0(-3.4) cm wide. Upper surface smooth, very shiny, etomentose; pale olive-grey, deep greenish blue-slate. Lower surface light coloured with thin, raised, pale veins becoming browner toward the center; rhizines simple but not fuzzy, pale toward the margins, up to 6 mm long. Phycobiont a blue-green alga.

<u>Apothecia</u> fairly common, on narrow raised lobes, 3-6 mm wide. Disc red-brown or darkening, sides reflexed. Spores hyaline, acicular-fusiform, 3- to 7-septate, 48-65 X 3-4 µm.

<u>Substratum/Habitat</u>: terricolous; among mosses or over rotten logs. Selected Specimens: 2402, 3116.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, also collected in the adjacent zones.

<u>World Distribution</u>: uncertain; in North America reported from the boreal zone in the east (Thomson, 1950; Ahti & Vitikainen, 1977; Lepage, 1972) but suggested as "probably widespread" (Ahti & Vitikainen, 1977); reported from Europe, Japan, South America (Bolivia) and India (Thomson, 1959).

<u>Remarks: P. degenii</u> is distinguished from the much more locally common <u>P. membranacea</u>, which it resembles in the thin, shiny thallus, by the lack of tomentum on the upper surface and the non-fuzzy although simple rhizines. The raised veins separate <u>P. degenii</u> from <u>P. polydactyla</u>.

PELTIGERA LEUCOPHLEBIA (Nyl.) Gyeln., Magy. Bot. Lapok. 24:79. 1926. Peltigera aphthosa var. leucophlebia Nyl., Syn. Lich. 1:323. 1860.

<u>Thallus</u> foliose; covering large areas. Lobes 6(-13) cm long, 1.2-2.4 (-4.0) cm wide, imbricate, margins ascending and rounded, involute. Upper surface smooth and shiny with hyaline to brown hairs at the lobe ends; cephalodia common, abundant, clustered on the upper surface, small, 0.2-1.4 (-3.4) mm wide, usually remaining warty but sometimes becoming peltate and lobed (see below); green, sometimes part or entire thallus browning especially in exposed locations. Lower surface faintly to distinctly veined, white to blackening; rhizines common, fasciculate, black to occasionally white, usually abundant, on veins. Phycobiont a green alga; cephalodia containing a blue-green alga.

Apothecia infrequent, marginal on narrow lobes on the upper surface,

sunken, 4-9 mm wide. Disc reddish brown, darkening, sides reflexed. Reverse side of apothecia corticate to ecorticate. Hymenium 85-100 μ m high; paraphyses simple, coherent at tips; epithecium brownish. <u>Spores</u> 8 per ascus, hyaline, acicular, 3- to 7-(-9) septate, straight to curved, (40-)48-62(-80) X 4-7 μ m.

<u>Substratum/Habitat</u>: terricolous; among mosses and <u>Selaginella</u> <u>wallacei</u>, often on thin soil over rock especially sloping or vertical surfaces.

Selected Specimens: 1051, 4599.

Local Abundance and Distribution: frequent (collected at nearly one-half of the major collection sites); scattered throughout the CDFD subzone especially, but not exclusively, at inland sites; also collected in the adjacent zones.

World Distribution: circumarctic-circumboreal(-circumtemperate)(Ahti, 1964; Krog, 1968).

<u>Remarks</u>: <u>P. leucophlebia</u> and <u>P. aphthosa</u> are extremely closely related species that are often lumped together as <u>P. aphthosa</u> (Thomson, 1950, 1979; Ozenda & Clauzade, 1970; Duncan, 1970; Hale, 1969). Traditionally, in the two-species concept, their separation has been based on the simple presence or absence of veins on the lower surface (<u>P. leucophlebia</u> with veins and <u>P. aphthosa</u> without). In the monograph of the North American species of <u>Peltigera</u> (Thomson, 1950) only <u>P. aphthosa</u> was recognized with three varieties (var. <u>typica</u>, non-veined; var. <u>leucophlebia</u>, distinct white veins; var. <u>variolosa</u>, brown to black veins) because...

"the gradation from one variety into the other was so complete that it is often (my emphasis) difficult to decide into which category a particular specimen should be placed."

However, Ahti (1964) in a paper on boreal Ontario lichens stated that...

"in the writer's opinion the so-called intermediate forms between the species are not common at all, contrary to what has been claimed. Indeed, a schematic distinction according to presence or absence of veins on lower surface leads to confusion, but if the two species are examined in such localities in nature where they are growing intermingled or side by side, several important differences become obvious. Their different ecological requirements constitutes one of the best characters, which makes the identification rather easy in the field. For instance, <u>P. leucophlebia</u> avoids high acid habitats, while <u>P.aphthosa</u> is typical of such sites."

. . . .

In a flora of Alaska macrolichens Krog (1968) admitted that "<u>P</u>. <u>aphthosa</u> and <u>P</u>. <u>leucophlebia</u> may at times be difficult to separate". <u>P</u>. <u>leucophlebia</u> is described as distinctly veined with rhizines usually well developed and the ventral surface of the apothecia as decorticate or only with cortex in patches; <u>P</u>. <u>aphthosa</u> was described as smooth, pitted or <u>slightly</u> (my emphasis) veined below with few rhizines and the ventral surface of the apothecia corticate.

In a report of Peltigeraceae of Newfoundland (Ahti & Vitikainen, 1977) it was stated that <u>P. aphthosa</u> is "generally perfectly distinct from <u>P. leucophlebia</u>", although it was admitted that the Newfoundland specimens of <u>P. leucophlebia</u> were 'intermediate'. Regarding these collections it was stated, "in habit they rather resemble <u>P. leucophlebia</u>".but "the underside of the apothecia is clearly corticate, which is generally a character of <u>P. aphthosa</u>."

Thomson (1979) reported that an examination of herbarium material showed no significant correlation between veins and the ventral surface of the apothecium being smooth versus no veins (or broad veins) and ventral surface of the apothecia being verruculose (and then decorticate). He stated that during development of the apothecia the ventral surface always starts as a continuous cortex that is coarsely wrinkled which then breaks up into coarse verrucules that may be shed producing a decorticate or partially decorticate surface. He regarded <u>P. leucophlebia</u> and <u>P. aphthosa</u> as one species being only extremes of a long series, which has ecotypic, but no taxonomic significance.

Brodo and Richardson (1978) reported that a distinct difference in the cephalodia of the two species can:

"almost always be seen: whereas cephalodia of <u>P</u>. <u>aphthosa</u> are flat, becoming minutely lobate even when they do not expand and become subfoliose, cephalodia of <u>P</u>. <u>leucophlebia</u> are invariably tiny, convex, and entire. In both species, cephalodia can occur in slight depressions, but depressions are much more frequent and pronounced in <u>P</u>. <u>leucophlebia</u>. Unfortunately for taxonomists, these distinctions do not hold true throughout the range of the two species and, in fact, seem to be characteristic only in euoceanic areas."

Additionally <u>P</u>. <u>aphthosa</u> also tends to have wider lobes, fewer but larger cephalodia that are scattered over the upper surface, and a 'stiffer' feel to the lobes while <u>P</u>. <u>leucophlebia</u> tends towards small, more flaccid lobes with abundant but smaller cephalodia (Ahti, pers. comm.)

Examination of the local material produced numerous problems since most keys operate on the character of presence or absence of veins and sometimes the corticate/decorticate lower surface of the apothecia. As pointed out above, <u>P. aphthosa</u> s. str. may have a slightly veined lower surface and the cortication of the ventral surface of the apothecia is not absolute either. Despite this, over 75% of the local material did fall quite readily into one or the other of the two species. The remaining 25% shifted back and forth depending on what was considered 'distinct' veins during that day's work. However, when in addition to venation, the rhizines, lobe width, abundance, shape, and distribution of cephalodia, lobe stiffness, and cortication of the apothecia were all taken into consideration then nearly all specimens fell easily into <u>P. leucophlebia</u> or <u>P. aphthosa</u>. Unidentifiable specimens were usually small, although at least one specimen appears to be a mixed collection. Indeed, the two species often occur together locally so care must be taken during collection to sample from but one thallus.

PELTIGERA MEMBRANACEA (Ach) Nyl., Bull. Soc. Linn. Normand., sér. 4, 11:

74. 1887.

Peltidea canina var. membranacea Ach., Lich. Univ.:518. 1810.

<u>Thallus</u> foliose; orbicular, up to 26 cm broad. Lobes very thin to moderately thin (150-200 µm thick), 4-8(-13) cm long, (1.0-)1.4-2.6(-3.4) cm wide, ends rounded and slightly revolute, sides often partially involute. Upper surface smooth and very shiny, white tomentum present especially toward very edges of lobes (end 0.5-1.0 cm); grey, light olive-grey, occasionally light brown toward center of thallus. Lower surface with pale to light brown, raised and rounded veins; rhizines pale, simple and 'fuzzy', often long (up to 1.2 cm). Phycobiont a blue-green alga.

<u>Apothecia</u> common, marginal, on narrow lobes or often several on a large rounded lobe, ecorticate below, immersed, 3-7 mm wide. Disc circular: to elongated with sides reflexed or not. <u>Spores</u> hyaline, fusiform, 5- to llseptate, 48-77 X 2.5-4 µm.

<u>Substratum/Habitat</u>: terricolous; in shaded locations on dirt roadcuts, rotten logs, and thin soil over rock, usually among mosses.

Selected Specimens: 211, 1082.

Local Abundance and Distribution: frequent (collected at over one-half of major sites); scattered throughout the CDFD subzone usually at inland sites; also present and common in the adjacent zones (see Figure 29).



<u>World Distribution</u>: western North America-eastern North America(uncommon)-Europe-eastern Asia disjunct; with southern outliers in Costa Rica and Papua (Thomson, 1950; Hale, 1979); temperate, slightly oceanic.

<u>Remarks</u>: <u>P. membranacea</u> is distinguished by the thin, shiny thallus with raised, rounded veins, and simple, fuzzy rhizines. The rhizines are a dependable character even when exposed thalli may have become more thickened and browned than usual and hence similar to <u>P. canina</u>. Locally <u>P. membranacea</u> is very abundant and common while <u>P. canina</u> is rare.

Fertile lobes commonly lack the tomentum present on sterile lobes such that abundantly fertile thalli may be almost etomentose and will key out to <u>P. degenii</u>. In such cases the youngest, 'prefertile' lobes usually still have tomentum.

PELTIGERA PACIFICA Vitik., ined.

<u>Thallus</u> foliose; orbicular, up to 16 cm broad. Lobes fairly thick, > 200 µm thick, 3-8 cm long, 0.6-1.4 cm wide, with the nonisidiate margins <u>+</u> slightly downturned. Upper surface dull to slightly shiny, smooth to slightly scabrid or with a faint reticulation, etomentose, sometimes slightly pruinose; isidiate, isidia common, abundant, and crowded, scale-like, upright on margins and also on at least some cracks or thallus injuries, occasionally on lower surface near margins; grey, brownish grey. Lower surface light coloured with pale, raised veins, darkening slightly toward the center; rhizines pale to browning, simple (not fuzzy) or fasciculate, on veins. Phycobiont a glue-green alga.

Apothecia not observed.

<u>Substratum/Habitat</u>: terricolous; collected on soil with mosses or hepatics, sometimes on thin soil over rock.

Selected Specimens: 2171, 5283B.

Local Abundance and Distribution: infrequent; collected twice within the CDFD subzone, once at a higher (ca. 500 m) inland site and once near the western boundary, also collected in the adjacent zones. In collections independent of the present study <u>P</u>. pacifica was found to be fairly common in the adjacent zones.

World Distribution: western North American endemic.

<u>Remarks</u>: The local material was originally identified as <u>P</u>. <u>praetextata</u> (Floerke) Vain., although the lack of tomentum was noted and puzzled over. <u>P</u>. <u>praetextata</u> is part of the <u>P</u>. <u>canina</u> group which all possess tomentum. All local material so far examined lacks tomentum and is therefore identified as <u>P</u>. <u>pacifica</u>. However, there were only a few specimens available. Detailed treatment regarding the separation of <u>P</u>. <u>pacifica</u> and <u>P</u>. <u>praetex-</u> tata and their exact distributions must await Vitikainen's monograph.

<u>P. lepidophora</u> (Nyl.) Vain., a species with peltate, laminal isidia has been reported from Saltspring Island (Bird & Bird, 1973) but the specimen upon which the report is based is actually a very small, blackened <u>P. leucophlebia</u> (or possibly <u>P. aphthosa</u>). However, Thomson (1950) reported <u>P. lepidophora</u> from the American Gulf Islands so perhaps that species will eventually be collected here.

<u>PELTIGERA POLYDACTYLA</u> (Neck) Hoffm., Descript. et Adumbr. Plant. Lich. 1:19. 1790.

Lichen polydactylus (polydactylon) Neck., Method. Muscor.: 85. 1771.

<u>Thallus</u> foliose; orbicular or fragmented, 7-13 cm broad. Lobes 1.0-2.2(-3.2) cm wide, imbricate, rounded, edges often upturned. Upper surface shiny and smooth even at lobe tips; etomentose; grey, greyish olive, to blackish slate. Lower surface cottony; veins broad and flattened, usually brown or sometimes very obscure; rhizines fasciculate, white to black, on the veins. Phycobiont a blue-green alga.

<u>Apothecia</u> common, marginal, immersed at the tips of narrow raised lobes, (1.6-)3.0-6.0 mm long. Disc reddish brown to black, longer than broad, sides reflexed, with crenulate thalline margin. <u>Spores</u> 8 per ascus, hyaline, acicular, straight to curved, (4-)7- to 12-(-18) septate, 50-82(-100) X 3-4 μm.

<u>Substratum/Habitat</u>: usually terricolous; among mosses on the ground or dirt banks, occasionally among mosses on boulders or other rock surfaces, occasionally on mossy, rotten logs.

Selected Specimens: 1145, 2179.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially at inland sites, also present in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumtemperate (Krog, 1968) in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks: P. horizontalis</u> (Huds.) Baumg. has been reported from Saltspring Island on the basis of sterile material (Bird & Bird, 1973). <u>P. horizontalis</u> differs from <u>P. polydactyla</u> primarily in fertile characters having horizontally held apothecia which are plane and round, and 3-septate spores, 24-45 X 3.5-6 µm. <u>P. horizontalis</u> also tends to have a more 'dimpled' upper surface but it does not appear to be an absolutely reliable character. Therefore sterile material, as Bird and Bird pointed out, cannot be ascertained to either species. <u>P. polydactyla</u> definitely does occur locally; there is fertile material to prove it. <u>P. horizontalis</u> is not yet known with certainty from Vancouver Island although it is known to occur abundantly in the interior of the province. Thomson (1950) reported one specimen from Vancouver Island. An examination of the specimen in question (FH) showed it to be <u>P</u>. <u>collina</u> in an abundantly fertile and therefore nonsorediate condition. While <u>P</u>. <u>horizontalis</u> cannot be ruled out as occurring locally there are no fertile specimens available to confirm its presence. All the local sterile material has therefore been conservatively grouped with <u>P</u>. <u>polydactyla</u>.

<u>P. polydactyla</u> is treated here in the wide sense; there are several segregate species that are regaining popularity. O. Vitikainen is currently examining the local material. See Vitikainen (in Poelt & Vézda, 1981) for his treatment of the European complex.

<u>PELTIGERA RUFESCENS</u> (Weis.) Humb., Flor. Friburg. Specim.:2. 1793. Li<u>chen caninus</u>, <u>rufescens</u> Weis., Plant. Cryptog. Flor. Geottingens:79. 1770.

<u>Thallus</u> foliose; orbicular, up to 10 cm broad. Lobes 2-4 cm long, 0.6-1.4(-2.0) cm wide, thick (> 250 μ m), often cracking transversely or irregularly, the very edges with a slightly thickened 'lip'; centrally adnate with the margins and edges ascending and <u>+</u> ruffled. Upper surface smooth at center, <u>+</u> dull, often becoming scabrid towards the circumference with the outermost edge always white tomentose; grey, olive brown, to dark brown. Below light coloured with pale to darkening, slightly raised veins; cottony; rhizines fasciculate, pale to usually dark brown. Phycobiont a blue-green alga.

<u>Apothecia</u> occasional, vertically positioned on narrow lobes, marginal, sunken, 4-8 mm long. Disc reddish brown, sides <u>+</u> reflexed. <u>Spores</u> hyaline, fusiform to acicular, 3- to 9-septate, 52-70 X 3-4 μ m.

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<u>Substratum/Habitat</u>: terricolous; on soil in exposed locations, often with moss.

Selected Specimens: 4099, 4728.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD sbuzone at inland sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumtemperate (Krog, 1968; Ahti, 1964) in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks: P. rufescens</u> is still regarded occasionally as part of P. canina, i.e. Thomson (1979). See <u>P. canina</u> for comments.

One of the local specimens was determined as <u>P ponogensis</u> Gyeln. by O. Vitikainen (pers. comm.). <u>P ponojensis</u> is very similar to <u>P. rufescens</u> and often not recognized as a separate species. It has an epruinose upper surface which is whitish below with raised, pale veins and light coloured, almost unbranched rhizines as well as large (up to 1 cm broad), plane apothecia; <u>P. rufescens</u> is regarded as having a white, pruinose center and rather thick tomentum above, below as having dark, branched rhizines and darkening but not conspicuously raised veins with apothecia with reflexed sides (Vikikainen, in Poelt & Vězda, 1981).

PELTIGERA SPURIA (Ach.) DC., Flore Franc., ed. 3, 2:406. 1805. Lichen spurius Ach., Lichenogr. Suec. Prodrom.:159. 1798.

<u>Thallus</u> foliose; of lone orbicular lobes which become elongated or grouped. Lobes 2-8 mm wide, edges ascending. Upper surface shiny and smooth with white tomentum toward the margins or larger lobes, lacking in

small lobes; sorediate, soralia laminal in small to large orbicular areas, soredia granular, greyish-blue, leaving decorticate areas; dark glaucous grey, deep greenish grey. Lower surface with pale, raised veins on large lobes; rhizines simple and pale. Phycobiont a blue-green alga.

<u>Apothecia</u> not observed. According to Vitikainen (in Poelt & Vézda, 1977) the apothecia are less than 5 mm long. According to Duncan (1970) the spores are elongate-fusiform, 5- to 7-septate, 55-75 X 3.5-4.5 µm.

Substratum/Habitat: terricolous; collected once on loose soil.

Selected Specimen: 1024B.

Local Abundance and Distribution: rare (see below); distribution poorly known, collected once on Galiano Island in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumtemperate (Krog, 1968; Ahti, 1964) in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: Thomson (1950, 1979) regarded the small size and soredia production in <u>P</u>. <u>spuria</u> as worthy of only varietal recognition and grouped it within <u>P</u>. <u>canina</u>.

<u>P. spuria</u> is probably much more frequent in the study area than the single collection indicates, being overlooked because of its small size. Vitikainen (in Poelt & Vézda, 1981)suggested it may be ephemeral.

PELTIGERA VENOSA (L.) Baumg., Fl. Lips.:561. 1790.

Lichen venosus L., Spec. Plant.:1148. 1753.

<u>Thallus</u> foliose; of single,or occasionally multiple, fan-shaped lobes, 6-14 mm high, attached at the narrow end by short stubby rhizines to the substratum. Upper surface shiny, smooth; green to olive buff. Lower surface brown veined with white cottony interspaces; cephalodia small, warty, blackish, at the base or along the veins. Phycobiont a green algal; cephalodia containing a blue-green alga.

<u>Apothecia</u> usually present, marginal on the upper surface, 2-5 mm wide. Disc oval, reddish brown to black, concave to plane. Crenate margin often present. Hymenium 100-125 μ m high; paraphyses simple, coherent at tips; epithecium gold-brown. <u>Spores</u> 8 per ascus, ellipsoid-fusiform, light yellowish, 3-septate, 30-42 X 6-8 μ m.

<u>Substratum/Habitat</u>: terricolous; especially on shaded, new roadcuts, also occasionally muscicolous on sloping surfaces.

Selected Specimens: 1023, 4541A.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at inland sites, also present in the adjacent zones.

World Distribution: circumarctic-circumtemperate (Krog, 1968).

<u>Remarks</u>: Krog (1968) reported <u>P</u>. <u>venosa</u> as a calciphilous species. This was not noted locally.

Many of the local collections have small lichen thalli containing bluegreen algae associated with the bases of their lobes. This is perhaps another example of the mycobiont being capable of producing two different morphotypes depending on the phycobiont available (see <u>Peltigera</u> introduction). This requires further study.

PERTUSARIA DC.

Thallus crustose, occasionally minutely fruticose; with or without soredia or isidia.

Ascocarp an apothecium, solitary or several immersed in a \pm elevated

verruca of thalline tissue. Disc opening by a pore and therefore appearing perithecium-like or expanding and distinctly lecanorine. Paraphyses slender, branched and anastomosing. Spores 1-8 per ascus, simple, hyaline, ellipsoid or oblong-ellipsoid, thick-walled, often large.

Corticolous, saxicolous, occasionally terricolous.

References: Dibben (1981).

1.	Saxicolous 2
1.	Corticolous 3
	2. Thallus fertile, esorediate <u>P</u> . <u>CHIODECTONOIDES</u>
	2. Thallus sterile, sorediate <u>P</u> . <u>AMARA</u>
3.	Thallus sorediate, sterile4
3.	Thallus fertile, esorediate or sorediate only on fertile verrucae5
	 Soredia KC+ violet, K+ yellow, P+ red; soredia coarsely granular in excavated soraliaP. AMARA
	4. Soredia KC-, K+ yellow, or yellow turning orange, P+ red; soredia finely granular in globose soralia <u>P</u> . <u>BOREALIS</u>
5.	Apothecia pertusariate, fertile verrucae opening by ostioles <u>P</u> . <u>LEUCOSTOMA</u>
5.	Apothecia lecanorate, disc well-exposed
	6. Fertile verrucae appearing like a 'stack of plates', P+ red; spores 20 X 10 μm <u>P</u> . <u>SUBAMBIGENS</u>
	6. Fertile verrucae not built up like a stack of plates (or if raised then spores 130-165 X 35-50 μm), P 7
7.	Borders of fertile verrucae becoming tattered then sorediate; spores l/ascus, 130-165 X 35-50 μ m <u>P. OPHTHALMIZA</u>
7.	Borders of verrucae esorediate; spores 2-8/ascus, < 130 µm long 8
- 8. Apothecia subsessile; thallus C-, nontuberculate; spores 2/ascus, 70-130 X 30-45 µm..... P. STENHAMMARI
- 8. Apothecia in raised verrucae, somewhat constricted (looking like a <u>Lecanora</u> species); thallus C+ red, with scattered white tubercles; spores 8/ascus, 15-20 X 12-14 µm P. GLAUCOMELA

PERTUSARIA AMARA (Ach.) Nyl., Bull. Soc. Linn. Normandie, sér. 2,6:288. 1872. Variolaria amara Ach., Kongl. Vetensk. Acad. Nya Handl. 30(3):163. 1809.

<u>Thallus</u> crustose; 4-6(-10) cm broad, centrally cracked usually in a radial direction, to almost areolate, often becoming folded-plicate and appearing like raised veins running radially, marginally the areoles larger or completely fused to form a distinct margin, smooth and shiny except where disrupted by soralia; sorediate, soredia coarsely granular, in erumpent to more commonly excavated soralia, showy white; pale grey, olive grey with the margin sometimes yellower than the central part of the thallus, also occasionally with blackish lines or zones towards the periphery but essentially unzoned to the naked eye.

<u>Apothecia</u> not observed. According to Dibben (1980) the apothecia are not common and frequently immature when present, one per verruca (usually aborting and developing into the soralia instead), spores 1 per ascus, 103-348 X 26-82 µm.

<u>Spot Tests</u>: soredia KC+ violet (fleeting),<u>K+</u> yellowish, C-, P<u>+</u> red.

<u>Substratum/Habitat</u>: corticolous and saxicolous; when corticolous most frequent on deciduous trees and shrubs.

Selected Specimens: 2568, 2974.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both inland and maritime sites; not collected in the adjacent zones.

World Distribution: tentatively circumtemperate in the Northern Hem-

isphere, but largely absent from the Rocky Mountains and Great Plains in North America; also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: Locally the saxicolous form is much more common than the corticolous form. The former has less abundant and less distinctly excavated soralia and the thallus is often thinner with the 'veins' more distinct and obvious, running around minor obstructions on the substratum.

The KC+ violet reaction is often very faint and fleeting, with some portions of the same thallus reacting more distinctly than other parts. The P+ reaction is very strong and quick when present; collections from the same site may be mixed with regard to this reaction.

See P. borealis for other comments.

PERTUSARIA BOREALIS Ericks., Ann. Mycol. 36:354. 1938.

<u>Thallus</u> crustose; orbicular, up to 5 cm broad; thin and rimose and only slightly cracking to almost approaching areolate; margin distinct but unzoned; slightly shiny; sorediate, soredia farinose to finely granular, whiter than the thallus, soralia scattered occasionally fusing, slightly elevated becoming rather high-arched; light olive-grey.

<u>Apothecia</u> not observed. According to Dibben (1980) the apothecia are unknown being totally replaced by the soralia.

<u>Spot</u> <u>Tests</u>: K+ yellow to yellow-brown, KC-, C-, P+ yellow turning orange-red.

Substratum/Habitat: corticolous, all collections from Alnus.

Selected Specimens: 2667, 4485.

Local Abundance and Distribution: infrequent; scattered along the western boundary of the CDFD subzone (not collected in the Gulf Islands);

also present in the adjacent zones.

<u>World Distribution</u>: western North American endemic (Dibben, 1980); described from Alaska, also reported from Washington. Dibben (1980) mentioned a single specimen from Quebec which requires -substantiation but suggested the species may be panboreal in North America.

<u>Remarks</u>: <u>P. borealis</u> strongly resembles the corticolous form of <u>P. amara</u>. The soredia of the former is perhaps finer and its soralia never become excavated like in <u>P. amara</u> but instead become high-arched. In young specimens the KC+ violet reaction in <u>P. amara</u> is the best character for identification, although the reaction is ephemeral and must be watched for carefully. The compound which produces this reaction, picrolichenic acid, also produces a very bitter taste while the constituents of P. borealis do not have a strong taste.

P. borealis is reported here as new to the province.

PERTUSARIA CHIODECTONOIDES Bagl. ex Mass., Misc. Lich.: 26. 1856.

<u>Thallus</u> crustose; 2-4 cm broad, thin to moderately thick, rimose to cracked-areolate, areoles up to 1 mm across; matt to apparently pruinose (or dusty); margin indistinct, not zoned; pale grey, light greyish olive.

Apothecia common, lecanorate, scattered, sunken in fertile verrucae, 0.2-0.5 mm across, round to commonly irregularly elongated. Fertile verrucae not to only slightly raised above surrounding areoles; the margin around the apothecia raised, cracking to tattered, whiter than surrounding thallus, appearing slit- or volcano-like. Disc black, plane or concave, epruinose, shiny. Hymenium 175-190 µm high; epithecium greyish-brown, paraphyses slender, anastomosing, but not entirely coherent. <u>Spores</u> 8 per ascus, uniseriate to biseriate, hyaline, ellipsoid to'tear-drop' shaped, epispore thick (2-5 µm), 28-37 X 15-21 µm.

<u>Spot Tests</u>: thallus K<u>+</u> yellow, KC-, C-, P-; epithecium K+ light violet (slow).

<u>Substratum/Habitat</u>: saxicolous; primarily on sandstone, almost exclusively in the supralittoral zone.

Selected Specimens: 2550, 3955.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, present but not as common at maritime sites in the adjacent zones.

World Distribution: western North America-Europe disjunct; in North America reported only from California (Dibben, 1980).

<u>Remarks: P. chiodectonoides</u> is superficially similar to some <u>Aspicilia</u> species but the large, thick-walled spores readily separate it.

The K spot test of the thallus is actually best observed under the LM in the thalline tissue surrounding the hymenium where the positive yellow reaction proceeds slowly to produce red crystals (norstictic acid) in all the local specimens. Dibben (1980) stated that the norstictic acid was only present in some specimens.

P. chiodectonoides is reported here as new to the province.

PERTUSARIA GLAUCOMELA (Tuck.) Nyl., Bull. Soc. Linn. Normandie, sér. 4,

1:282. 1887.

Lecanora oculata subsp. glaucomela Tuck., Gen. Lich.: 118. 1872.

<u>Thallus</u> crustose; thin to moderately thick in places, <u>+</u> continuous, following the substratum; slightly shiny with scattered minute, punctate, white tubercles; pale olive-grey, pearl grey.

Apothecia scattered, lecanorate, \pm rounded to elongate-linear when

crowded, (0.6-)0.9-1.4(-1.7) mm wide. Margin entire and smooth to slightly crenulate. Disc tan at first, quickly blackening, dull, plane to slightly convex. Paraphyses slender, slightly branched but largely free except coherent at apices; epithecium greyish-black. <u>Spores</u> 8 per ascus, uniseriate, simple, hyaline, wide-ellipsoid with distinctly thickened epispore (ca. 3 μ m thick), 15-20 X 12-14 μ m.

<u>Spot Tests</u>: thallus C+ red (faint, ephemeral), P-, C-; epithecium K+ purplish.

<u>Substratum/Habitat</u>: corticolous; collected once on the dead twigs of maritime <u>Picea sitchensis</u> and once inland on <u>Pinus contorta</u>.

Selected Specimens: 4344B, 5409A.

Local Abundance and Distribution: rare; distribution poorly known, collected once on the western border of the CDFD subzone (specimen small, poorly developed), present and more abundant and better developed in the adjacent zones, specifically the Fog/Spruce subzone of the CH zone.

<u>World Distribution</u>: western North America endemic; oceanic; reported from California to northern British Columbia (Dibben, 1980).

<u>PERTUSARIA</u> <u>LEUCOSTOMA</u> (Bernh.) Mass., Ricerch. Auton. Lich. Crost:188. 1852. <u>Sphaeria leucostoma</u> Bernh., Arch. Bot. 2(1):11. 1800.

Pertusaria leioplaca (Ach.) DC., Fl. Franc. ed. 3, 6:173. 1815.

<u>Thallus</u> crustose; very thin and smooth to slightly scaly or thin and rimose; matt to slightly shiny; pale olive buff, pale grey, pale olivegrey.

<u>Apothecia</u> pertusariate, one to four per fertile verruca. Fertile verrucae domed, steep-sided and flat-topped, scattered or occasionally grouped and fused, 0.6-1.3 mm wide; with one to three ostioles in slight, central, <u>+</u> shiny yellow depressions on the top. Epithecium hyaline; paraphyses free, slender, slightly anastomosing. <u>Spores</u> (2-)4(-6) per ascus, simple, hyaline, ellipsoid, thick-walled $(2.5-5.0 \ \mu m \ thick)$, 55-75 X 27-32 μm .

Spot Tests: thallus K+ yellowish, KC-, C-, P-; epithecium K-.

<u>Substratum/Habitat</u>: corticolous; collected on several deciduous trees and shrubs including <u>Alnus</u>, <u>Holodiscus</u>, <u>Acer</u>, and <u>Quercus</u>, usually, but not exclusively, on the branches rather than the trunks.

Selected Specimens: 3687B, 4019.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, primarily at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia disjunct; in North America coastal in the west but more continental in the east; according to Dibben (1980) almost pantemperate in the Northern Hemisphere.

<u>Remarks</u>: According to Dibben (1980) the thallus is weakly P+ yellow and K+ yellow. The P reaction was not observed in the local material.

This is the only local <u>Pertusaria</u> with pertusariate apothecia; the remaining species have the disc clearly expanding into lecanorate apo-

PERTUSARIA OPHTHALMIZA (Nyl.) Nyl., Flora 48:354. 1865.

Pertusaria velata subsp. *P. multipuncta var. ophthalmiza Nyl., Lich. Scand.:180. 1861.

<u>Thallus</u> crustose; 2-4(-7) cm broad; thin, continuous to cracked to almost verruculose-areolate; occasionally tuberculate or slightly powdery,

to completely smooth; margin often distinct being edged in black,but not distinctly zonate; sorediate, soredia confined to the fertile verrucae see below); pale olive-buff, light olive-grey.

<u>Apothecia common</u>, lecanorate, abundant, 1(-2) per fertile verruca, immersed in protuberant verruca, 0.5-1.0 mm wide. The verrucarial margin splitting and cracking, becoming sorediate to a greater or lesser extent, whiter than the thallus. Disc plane, black, often covered in white pruinia and eventually white soredia. Hymenium 150-175 µm high; epithecium grey-black; hypothecium hyaline. <u>Spores</u> 1 per ascus, hyaline, ellipsoid-oblong, simple, distinctly thickened epispore, 130-165 X 35-52 µm.

<u>Spot Tests</u>: thallus K- or + sordid faint yellow, C-, KC-, P-; epithecium K-.

<u>Substratum/Habitat</u>: corticolous; on both conifers and deciduous trees, the latter exclusively Alnus.

Selected Specimens: 129, 4721.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, present and perhaps more common in the adjacent zones.

World Distribution: circumboreal (-circumtemperate)(Dibben, 1980).

<u>Remarks:</u> <u>P. ophthalmiza</u> is similar to the local <u>P. amara</u>; both species are sorediate and corticolous but the soredia of <u>P. ophthalmiza</u> is KC-, not as distinctly granular nor produced as abundantly as in the <u>P. amara</u>. Additionally <u>P. ophthalmiza</u> always has apothecia while <u>P. amara</u> was never observed fertile. Indeed the fertile verrucae of <u>P. ophthalmiza</u> are often incompletely sorediate (the verrucarial margin only cracked and tattered). In this case, if the verrucae are well-developed, the material would resemble some collections of P. subambigens (which is P+ red). Until recently this species commonly was called <u>P</u>. <u>multipuncta</u> but it is, in fact, different from the European species treated under that name.

PERTUSARIA STENHAMMARI Helb., Ofvers. Föch. Kongl. Svensk. Vetonsk.-Akad.

22:463. 1866.

<u>Thallus</u> crustose; thin, smooth and continuous, or scattered; matt; pale grey, light olive grey, or olive grey.

<u>Apothecia</u> lecanorate, 1(-2) per fertile verruca. Verrucae only slightly elevated above the level of the thallus, sides moderately to gradually sloped, 0.4-1.0 mm wide. Margins raised above the disc, becoming blackened and sometimes slightly cracked. Old verrucae sometimes shed from thallus, leaving circular scar-depressions. Disc black, plane, shiny to matt. Epithecium hyaline to greyish-black; paraphyses slender and free although coherent at apices. <u>Spores</u> 2 per ascus, simple, hyaline, ellipsoid, or slightly pointed at one end, with a distinct epispore (5-6 µm thick at sides and often much thicker at pointed end), 72-132 X 30-45 µm.

Spot Tests: thallus K-, C-, KC-, P-; epithecium K+ violet.

Substratum/Habitat: corticolous; collected three times on Alnus.

Selected Specimens: 2570, 4488B.

Local Abundance and Distribution: infrequent; scattered along the western boundary of the CDFD subzone at inland sites; not collected in the adjacent zones during the present study but, from other collections, known to be present there.

World Distribution: western North America-eastern North America-Europedisjunct; according to Dibben (1980) "panboreal disjunct".

PERTUSARIA SUBAMBIGENS Dibb., Milwaukee Public Museum, Publ. Biol. Geo.

5:1-162.

<u>Thallus</u> crustose; smooth to more commonly rimose-cracked, occasionally almost verruculose; slightly shiny; deep olive buff, deep olive grey, to _pale olive-grey.

<u>Apothecia</u> lecanorate, 1(-4) per verrucarial wart. The verrucae vertically elongating and eventually forming a series of concentrically piled rings ('stacked' plates) which may be entire or cracked, 0.8-1.2(-1.5) mm wide. The disc pink or tan, becoming brown-black, moderately white pruinose, concave becoming <u>+</u> plane. The hymenium 125-150 µm high; epithecium granular, dark grey; paraphyses free in KOH. <u>Spores</u> 8 per ascus, uniseriate, simple, hyaline, ellipsoid to somewhat pointed at the ends, epispore usually distinct but only 1 µm thick, 17-22 X 8-10 µm.

<u>Spot Tests</u>: thallus K+ yellow, C-, KC-, P+ yellow, quickly turning red; epithecium K-.

<u>Substratum/Habitat</u>: corticolous; collected primarily on conifers, mainly Pseudotsuga, also one collection from Alnus.

Selected Specimens: 4737, 5214.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone, especially at inland sites, present but not as common in the adjacent zones.

<u>World Distribution</u>: western North American endemic; oceanic; reported from California to British Columbia (Dibben, 1980).

<u>Remarks</u>: When young, the thallus of <u>P</u>. <u>subambigens</u> can appear verrucose with abundant, immature, fertile verrucae. Even when the discs are finally evident the vertical elongating and build-up of concentric tiers of the verrucae may not have taken place yet in most verrucae, although a few are often more advanced than the rest. Thalli with tattered verrucarrial tiers, or with the tattered remnants of the apothecial veil evident, may resemble <u>P. ophthalmiza</u> but the small spores which are 8/ascus and P+ thallus easily distinguishes P. subambigens.

Until recently <u>P</u>. <u>subambigens</u> was included within the South African species P. ambigens (Nyl.) Tuck.

PHAEOPHYSCIA Moberg

Thallus foliose; small, orbicular, \pm loosely appressed; with or without isidia or soredia; epruinose; upper and lower cortex present, both paraplectenchymatous; (grey-)brown, occasionally greenish brown. Below dark brown to black, occasionally pale, with simple, concolorous rhizines.

Ascocarp an apothecium, laminal, sessile. Thalline margin present, often with rhizinae (corona) below and occasionally with hyabine hairs on top edge. Spores 8 per ascus, 1-septate (polarilocular), brown, thickwalled.

Pycnidia immersed, laminal; pycnospores ellipsoid, << 4 μ m.

Saxicolous, corticolous, terricolous.

<u>Phaeophyscia</u> is a recent segregate genus which was formerly part of Physcia.

References: Thomson (1963), Esslinger (1977a, 1978b), Moberg (1977).

- 1. Thallus esorediate, maculate; corticolous P. CILIATA
- Thallus sorediate, smooth; saxicolous, occasionally corticolous
 <u>P</u>. <u>ORBICULARIS</u>

<u>PHAEOPHYSCIA CILIATA</u> (Hoffm.) Moberg, Symb. Bot. Upsal. 22:30. 1977. Lichen <u>ciliatus</u> Hoffm., Enum. Lich.:69. 1784.

<u>Thallus</u> foliose; orbicular, 2-3 cm broad. Lobes linear, 0.5-0.8 mm wide, pinnately branched, adnate, separate, dull, smooth, esorediate; greyish brown to light brown. Below brown-black; rhizines abundant, extending beyond margins, black.

<u>Apothecia</u> common, laminal, adnate to sessile, 0.8-1.4 mm wide. Thalline margin thick, entire with abundant to sparse, short, white rhizines on the lower edge. Disc concave becoming plane, black, epruinose. Hymenium 100 μ m high; paraphyses simple, coherent; epithecium gold-brown to brown. <u>Spores</u> 8 per ascus, ellipsoid to oblong, 1-septate, polarilocular, dusky brown, (22-)24-27 X (7-)8-9(-10) μ m.

Spot Tests: cortex K-.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Alnus</u> with <u>Physcia</u> <u>aipolia</u>.

Selected Specimen: 5053B.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CDFW subzone; not collected in the CDFD subzone.

<u>Remarks</u>: Esslinger (1978b) has recently described a new species, P. hirtella, which Thomson (1963) had considered part of P. <u>ciliata</u>.

<u>P. hirtella</u> is separated from the latter species by the "sparce to numerous pale or almost hyaline cortical hairs, especially on the lobe ends and/or margins, the upper surface often distinctly white maculate" and the pale cortical hairs on the upper part of the exciple as well as the darkened

rhizines around the base.

PHAEOPHYSCIA ORBICULARIS (Neck.) Moberg, Symb. Bot. Upsal. 22:44. 1977. Lichen orbicularis Neck., Delicae Gallo-Beligicae: 509. 1768.

<u>Thallus</u> foliose; orbicular, 1-2 cm broad, or coalescing to cover large areas. Lobes 0.5-0.8(-1.1) mm wide, pinnately branched, usually contiguous or marginally imbricate, adnate, lobe tips sometimes ascending, crenate; sorediate, soredia granular, brown-black to greenish especially when breaking down, in marginal soralia, sometimes apical on short side lobes or laminal and globose; brownish grey, blackish grey, brown, sometimes with a sheen. Below black, shiny; rhizines simple, black, often white-tipped, occasionally protruding beyond margins.

<u>Apothecia</u> uncommon, observed once, laminal, 0.8-2.4 mm wide. Thalline margin entire to crenulate. Disc reddish brown to black, epruinose. Hymenium 80-85 µm high; paraphyses simple, coherent; epithecium dark goldbrown. Spores 8 per ascus, 1-septate, polarilocular, brown, 17-20 X 7-9µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: primarily saxicolous, especially in the supralittoral zone; occasionally corticolous.

Selected Specimens: 190, 1310.

Local Abundance and Distribution: frequent; scattered mainly throughout the Gulf Islands in the southern part of the CDFD subzone; present but not as common in the adjacent zones.

World Distribution: tentatively western North American-Europe disjunct.

<u>Remarks: P. orbicularis</u>, until recently, was treated as a very polymorphic species. Eastern North American material has been segregated into at least two other species; P. orbicularis s. str. in North America is known only in the west. <u>P. adiastola</u> (Essl.) Essl. differs primarily in its possession of terminal and marginal soralia with soredia that are coasrsely granular to isidioid; <u>P. pusilloides</u> (Zahlbr.) Essl. has capitate, primarily terminal soralia on main lobes or small lateral lobes, projecting, dark rhizines, and frequently, a corticolous habit; <u>P. orbicularis</u> is "characterized by its laminal and submarginal punctiform to irregular soralia and relatively fine granular soredia" (Esslinger, 1978b). The local material falls closer to <u>P. orbicularis</u> than to the other two species but the characters are slightly overlapping and not mutally exclusive. The problem requires more study.

PHLYCTIS (Wallr.) Flot.

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Thallus crustose; with or without soredia. Phycobiont a green alga. Ascocarp an apothecium, round, subsessile. Thalline margin and proper margin indistinct or poorly developed. Paraphyses simple to branched. Spores 1-8 per ascus, hyaline, muriform with many cells.

Primarily corticolous.

Thallus sorediate <u>P</u>. <u>ARGENA</u>
Thallus esorediate, abundantly fertile <u>P</u>. <u>SPEIREA</u>

<u>PHLYCTIS ARGENA</u> (Ach.) Flot., Bot. Zeit. 8:572. 1850. Lichen argenus Ach., Lich. Suec.:8. 1798.

<u>Thallus</u> crustose; gently verruculose towards the margins; matt, subpruinose; the verrucae quickly bursting open to produce soredia, the isolated soralia quickly becoming confluent and broadly eroded accounting for

most of the thallus; medulla thick and cottony especially towards the center; soredia granular, white to (yellow-)orange (especially in herbarium specimens); pale grey. Hypothallus usually absent, occasionally present, thin, white.

<u>Apothecia</u> not observed. According to Ozenda and Clauzade (1970) the apothecia are very rare, 0.2 mm wide, immersed singly in pulverulent verrucae with the general appearance of soralia; disc black, pruinose; spores 1 per ascus, <u>+</u> ellipsoid, 100-150 X 25-50 μ m.

<u>Spot Tests</u>: thallus K+ yellow turning orange(-red), under LM producing narrow red crystals, C-(or+ faint yellow), P+ yellow(-orange).

<u>Substratum/Habitat</u>: corticolous; on deciduous trees especially <u>Quercus</u>. <u>Selected Specimens</u>: 872, 3633.

Local Abundance and Distribution: uncertain; reported from Europe and North America; in North America reported from Ontario (Brodo, 1981), Michigan (Harris, 1977), and New Hampshire, Oklahoma, Washington, Oregon, and California (Fink, 1935).

Remarks: See P. speirea.

PHLYCTIS SPEIREA Merr., Ottawa Naturalist 27:118,119. 1913.

<u>Thallus</u> crustose; 2-4 cm broad; scurfy to rimose-cracked, not distinctly areolate, particles very irregular and diffuse, esorediate; pale grey, olivegrey, light mineral grey. Hypothallus white, very finely fibrous, sometimes visible at the margin and occasionally throughout if thallus thin and scurfy.

<u>Apothecia</u> abundant, 1(-2) immersed in verrucae. The verrucae irregularly breaking or cracking open showing the medulla which is whiter than remainder of thallus, 0.4-0.6(-0.8) mm wide. Disc plane, black and shiny or more commonly heavily white pruinose; pruinia sometimes clumped coarsely together

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(not distinctly sorediate). Hymenium up to 175 μ m high; paraphyses slender, anastomosing but free except at the apices where coherent; epithecium yellowish to brownish. <u>Spores</u> 1 per ascus, hyaline to yellowish, roughly 'ellipsoid, often narrower at one or both ends, occasionally nearly apiculate, muriform (27-46 transverse septa, 8-12 longitudinal septa), 95-150 X 25-45 μ m (see Figure 23).

<u>Spot Tests</u>: thallus K+ yellow turning red, producing narrow red crystals under LM, C-, P+ orange.

<u>Substratum/Habitat</u>: corticolous; collected on <u>Salix</u>, <u>Acer</u>, and once, very abundantly, on <u>Holodiscus</u>.

Selected Specimens: 4136, 7383.

Local Abundance and Distribution: infrequent; collected only on the Saanich Peninsula in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; described from Sidney on the Saanich Peninsula, British Columbia, also known from Washington (Ryan, pers. comm.)

<u>Remarks</u>: Merrill described <u>P. speirea</u> from material collected by J. Macoun in Sidney on the Saanich Peninsula. As Merrill himself admitted, the new species was very close to <u>P. argena</u>, differing, he said, in thallus colour and aspect of the apothecia (Merrill, 1913). <u>P. argena</u> is an abundantly sorediate species that is rarely fertile. European specimens of <u>P. argena</u> do, indeed, look lighter white in colour but this is caused by the extensive production of soredia and the resulting exposure of the paler medulla. Portions of the thallus undisturbed by soredia are the same colour as the local P. speirea.

However, the few local collections of P. speirea are definitely not

sorediate. The fertile verrucae do crack open irregularly but they do not become sorediate. The apothecia are often heavily pruinose with the pruinia often coarsely clumped together but again it is not a sorediate condition. In some respects this cracking open of verrucae is reminiscent of <u>Pertusaria</u> <u>ophthalmiza</u> which, however, does become sorediate eventually. <u>Phylctis</u> <u>speirea</u> does not become sorediate although more collections of this species are necessary to confirm that this is its standard state. Based on the esorediate character, <u>P. speirea</u> does seem sufficiently different from <u>P. argena</u> to be maintained as a separate species. It may be another example of the sorediate-sterile/esorediate-fertile species-pairs common on the west coast of North America with the sorediate species occurring again in Europe, e.g. <u>Letharia vulpina-L. columbiana</u>, <u>Cavernularia hultenii-C</u>. lophyrea, Ramalina <u>leptocarpha-R</u>. <u>subleptocarpha</u> (not in Europe).

The common fertile European <u>Phylctis</u> species is <u>P</u>. <u>agelaea</u> (Ach.) Flot. It has 2(-4) spores per ascus with the spores apiculate and 45-90 X 20-35 μ m.

PHYLLISCUM Nyl.

Thallus minutely foliose to foliose-squamulose; umbilicate. Phycobiont a blue-green alga (Croococcus).

Ascocarp an apothecium, usually immersed, opening by a small ostiole and therefore perithecium-like. Paraphyses gelatinizing or persistent. Spores 8(-16) per ascus, hyaline, simple, round to oval.

Saxicolous.

There is one local species.

References: Henssen (1963e).

PHYLLISCUM DEMANGEONII (Moug. & Mont.) Nyl., Mémoir. Soc. Imp. Scienc. Nat. Cherbourg 3:166. 1855.

Collema demangeonii Moug. & Mont., Ann. Sci. Nat. Bot. 3, 12:291. 1849.

<u>Thallus</u> minutely foliose; 0.8-3.0 mm broad, centrally attached. When large, lobes centrally \pm fused and marked into small sections by light creases; marginally lobes \pm distinct, flattened, short, 0.6 mm wide; \pm shiny; brownish black, dark below. Upper and lower cortex strongly reddish in colour under LM.

<u>Apothecia</u> laminal and usually central, immersed, <u>+</u> thalline tissue swollen above, opening by a small punctiform, <u>+</u> depressed 'ostiole'. Paraphyses not distinct. Spores 16 per ascus, hyaline, simple, oblongellipsoid, 10-12 X 5-6 μ m

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; collected once on sandstone and adjacent Aspicilia sp.

Selected Specimen: 1091B.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Galiano Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia disjunct; in North America reported from New England, Massachusetts (Fink, 1935), North Carolina (Yoshimura & Sharp, 1968), and California (Tucker & Jordan, 1978); also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: Some descriptions of <u>Phylliscum</u> describe a red colour in the gelatin coating of the algal cells. The cell walls of the local material were hyaline and thick-walled. The only reddish coloration was confined to the cortical areas.

P. demangeonii is reported here as new to the province.

PHYSCIA (Schreb.) Mich.

Thallus foliose; orbicular, linear-lobed, \pm loosely appressed, upper (paraplectenchymatous) and lower (usually prosoplectenchymatous) surfaces corticate, upper cortex K+ yellow, containing atranorin; with or without soredia; whitish grey to dark grey, with or without pruinia. Lower surface white to light brown, rhizinate.

Ascocarp an apothecium, laminal, sessile to substipitate. Thalline margin present. Spores 8 per ascus, brown, l-septate, polarilocular (Physcia-type).

Pycnidia immersed; pycnospores subcylindrical, > 4 cm long. Corticolous and saxicolous.

<u>Physcia</u> has recently had several segregate genera removed, namely <u>Phaeophyscia</u>, <u>Physciopsis</u>, and <u>Physconia</u>. The local segregates are also included in the Physcia key below.

References: Thomson (1963), Moberg (1977), Maas Geesteranus (1952).

1.	Thallus sorediate	2
1.	Thallus esorediate	9
	2. Thallus ciliate	3
	2. Thallus eciliate (rhizines may project beyond margin)	4
3.	Soralia labriform <u>P</u> . <u>TENEL</u>	LA
3.	Soralia helmet-shaped <u>P</u> . <u>ADSCENDE</u>	<u>NS</u>

	4. Thallus <u>+</u> pruinose 5
	4. Thallus <u>+</u> epruinose 6
5.	Soralia labriform on ascending lobe tips; lobes 0.4-0.5 mm wide; medulla K PHYSCONIA PERISIDIOSA (p. 591)
5.	Soralia marginal; lobes > 0.5 mm wide; medulla K+ yellow
	6. Thallus grey-white 7
	6. Thallus dark, grey-brown <u>PHAEOPHYSCIA ORBICULARIS</u> (p. 573)
7.	Soralia laminal, globose <u>P</u> . <u>CAESIA</u>
7.	Soralia terminal, labriform 8
	8. Medulla K+ yellow; cortex white-spotted <u>P</u> . <u>VAINIO</u> I
	8. Medulla K-; cortex <u>+</u> smooth, not white-spotted <u>P</u> . <u>DUBIA</u>
9.	Rhizines conspicuously projecting beyond margins; exciple with corona of rhizines; upper surface <u>+</u> smooth, brownish
9.	Rhizines inconspicuous although sometimes projecting; exciple smooth, lacking a corona; upper surface <u>+</u> white-spotted, whitish-grey
	10. Corticolous; cortex white-spotted <u>P</u> . <u>AIPOLIA</u>
	<pre>10. Saxicolous; cortex roughened but not white-spotted</pre>

PHYSCIA ADSCENDENS (Fr.) Oliv., Fl. Lich. Orne 1:79. 1882.

Parmelia stellaris var. adscendens Fr., Summa Veg. Scand. 1:105. 1845.

<u>Thallus</u> foliose; forming small rosettes, 1-2(-3) cm broad. Lobes linear, pinnately branched, 0.4-0.7(-1.1) mm wide, separate and adnate to free and imbricate, dull; upper surface white-spotted; ciliate, cilia white to usually black, 1-2(-3) mm long, simple to bi- or tri-furcate, marginal; sorediate, soredia farinose to granular, white to greenish, in apical, helmet-shaped soralia (the upper cortex becoming vaulted or hooded, soredia formed below from medullary tissue, lower cortex at least partially intact,

leaving a cavity for the soredia, upper cortex finally perforated, finally reduced to nearly labriform-like structure); whitish-grey to greenish flaucous. Below usually white; rhizines black, few.

<u>Apothecia</u> not common, substipitate, laminal, 1.1-3.1 mm broad. Thalline margin thin, crenulate, occasionally sorediate. Disc plane, dull, velvety, black, sometimes faintly white pruinose. Hymenium 65-80 µm high; paraphyses coherent; epithecium dark brown. <u>Spores</u> 8 per ascus, oblongellipsoid, grey-brown, 1-septate, polarilocular, 15-18(-20) X 7-9 µm.

<u>Pycnidia</u> often present on fertile thalli, otherwise not common, black, immersed; pycnospores hyaline, cylindrical, $3-4 \times 0.8 \mu m$.

Spot Tests: cortex K+ yellow.

<u>Substratum/Habitat</u>: saxicolous and corticolous; when corticolous then primarily on deciduous trees and shrubs.

Selected Specimens: 1898, 2466.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate (Thomson, 1979); also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: <u>P. tenella</u> is separated from <u>P. adscendens</u> by the labriform instead of helmet-shaped soralia. Thomson (1963) questioned the necessity of maintaining two separate species. <u>Hypogymnia physodes</u> commonly has labriform soralia but occasionally helmet-shaped soralia are produced in specimens. These are not given separate species status. Maas Geesteranus (1952), however, pointed out that the two types of soralia in <u>Physcia</u> are produced in different manners. In <u>P. adscendens</u> the upper and lower cortex separate with soredia formed mainly from medullary tissue, the upper cortex vaults to form the helmet-shaped structure producing a cavity with holes finally appearing in the upper cortex as the soralium is destroyed. Usually at least some lobes are in the last stage. In <u>P</u>. <u>tenella</u> the lower cortex and medulla together form the soredia, the upper cortex may sometimes arch but a cavity is never produced.

PHYSCIA AIPOLIA (Ehrh. ex Humb.) Furnr., Naturh. Topogr. Regensburg 2:249. 1839.

Lichen aipolius Ehrh. ex Humb., Florae Fribergensis:19. 1793.

<u>Thallus</u> foliose; orbicular, 1-4 cm broad. Lobes linear, <u>+</u> plane, 0.5-1.1 mm wide, adnate, separate to occasionally imbricate, dull with obvious white-spotting of the upper cortex; white. Below light coloured; rhizines light to blackish, simple becoming branched, sometimes projecting beyond margins although not usually conspicuous.

Apothecia usually present, abundant towards the center, laminal, adnate, 0.8-1.3(-1.8) mm wide. Thalline margin thick, entire to crenulate. Disc plane, dull, black, sometimes white pruinose. Hymenium 80-100 µm high; paraphyses coherent; epithecium light brown. <u>Spores</u> 8 per ascus, ellipsoid to oblong, l-septate, polarilocular, greyish to dark brown, 18-24 X 8-10 µm.

Spot Tests: cortex and medulla K+ yellow.

<u>Substratum/Habitat</u>: corticolous; on a wide varity of deciduous trees and shrubs including <u>Sambucus</u> racemosa, <u>Holodiscus</u>, <u>Quercus</u>, <u>Crataegus</u> douglasii, and especially <u>Acer</u>.

Selected Specimens: 1732, 3986A.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone especially, but not exclusively, at inland sites; also present, but not as common, in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate (Krog, 1968) in the Northern Hemisphere; also reported from Australia (Filson & Rogers, 1979), Uruguay (Osorio, 1981), and Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks: P. aipolia</u> is very similar to <u>P. stellaris</u> (L.) Nyl., which is known from Alaska, Alberta, and Washington. The latter species differs in the K- medulla and a smooth rather than a white-spotted upper surface.

<u>P. aipolia</u> is occasionally saxicolous, where it can be confused with <u>P. phaea</u> (Tuck.) Thoms. <u>P. phaea</u> has been reported from Mayne Island within the present study area on the basis of a Macoun collection (Thomson, 1963). However, that record is not accepted here until confirmatory collection(s) are made. According to Thomson (op. cit.) <u>P. phaea</u> differs from <u>P. aipolia</u> in its bluer coloration and narrower spores, although the measurements overlap. Moberg (1977) separated the two species by the smaller spores (15-21 X 7-10 μ m), smaller apothecia (up to 2 mm but mostly about 1 mm wide), and convex, narrow (<1 mm) lobes of <u>P. phaea</u>.

PHYSCIA CAESIA (Hoffm.) Fürnr., Naturh. Topogr. Regensburg 2:250. 1839. Lichen caesius Hoffm., Enum. Lich.:65. 1784.

<u>Thallus</u> foliose; orbicular, 1.5-3(-6) cm broad. Lobes linear, 0.6-1.0 (-1.2) mm wide, dull, slightly to strongly white-spotted, adnate, usually separate to slightly imbricate, pinnately-branched, sorediate, soredia in laminal globose soralia, especially toward the center of the thallus; white to blue-grey. Below light coloured; rhizines simple to branched, dark brown to black, sometimes extending beyond the margins.

<u>Apothecia</u> uncommon, laminal, 0.6-1.1(-2.2) mm wide. Thalline margin thick, entire to crenulate. Disc plane, black, usually epruinose.

Hymenium 55-75 μ m high; paraphyses simple, coherent; epithecium orangebrown. Spores 8 per ascus, ellipsoid-oblong, l-septate, polarilocular, brownish, 18-23 X 7-10 μ m.

Spot Tests: cortex and medulla K+ yellow.

<u>Substratum/Habitat</u>: saxicolous; common in the supralittoral zone but also found inland.

Selected Specimens: 2470, 3872.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone primarily at maritime sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: circumarctic(-circumtemperate) (Krog, 1968) in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972), Australia (Filson & Rogers, 1979), and Argentina (Grassi, 1950) in the Southern Hemisphere.

PHYSCIA CASCADENSIS H. Magn., Annal. Crypto. Exot. 5:30. 1932.

<u>Thallus</u> foliose; orbicular, 3-5 cm broad. Lobes crowded, convex, often imbricate, adnate, 1.0-1.5 mm wide, dull, minutely uneven on the upper surface but not distinctly white-spotted, the very tips of lobes fanning out and incised; esorediate, nonisidiate; pearl grey, pale olive grey, sometimes slightly pruinose at lobe tips. Below light coloured, rhizines simple to branched, light coloured.

<u>Apothecia</u> often present, abundant, adnate, laminal, (0.7)1.2-1.9 mm wide. Thalline margin entire. Disc <u>+</u> plane, black, often white pruinose. Hymenium 75 µm high; paraphyses simple, coherent; epithecium brown. <u>Spores</u> 8 per ascus, oblong to oblong-ellipsoid, l-septate, polarilocular, brown, 16-18 X 5-6 µm. Spot Tests: medulla and cortex K+ yellow.

Substratum/Habitat: saxicolous; in open, exposed locations.

Selected Specimens: 1889, 2980,

Local Abundance and Distribution: infrequent; scattered throughout the Gulf Islands in the southern part of the CDFD subzone at both maritime and inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North America; reported from California, Mexico, Colorado, New Mexico, and Washington (Weber, 1963).

<u>Remarks</u>: <u>P. cascadensis</u> is similar to <u>P. phaea</u> (Tuck.) Thoms. in the saxicolous habit, convex lobes, and small(er) spores than the comparative <u>P. aipolia/P.stellaris</u>. <u>P. cascadensis</u>, however, lacks the white-spotting and blue-grey or violet-grey coloration found in <u>P. phaea</u>. <u>P. phaea</u> has been reported from the study area (Thomson, 1963) on the basis of a Macoun collection from Mayne Island. This report is not accepted here pending further collection(s) of <u>P. phaea</u> locally.

P. cascadensis was reported as new to the province in Noble (1978) on the basis of the present study.

PHYSCIA DUBIA (Hoffm.) Lettau, Hedw. 52:254. 1912. Lobaria dubia Hoffm., Deutsch. Flora:156. 1796.

<u>Thallus</u> foliose; orbicular, 1.6-3.0 cm broad, or coalescing to cover larger areas. Lobes short, ascendant, imbricate, often <u>+</u> convex, 0.8-1.1 mm wide, dull, smooth to minutely rugose but not white-spotted, the very ends fanning out slightly on the outermost lobes, crenulate to deeply incised; sorediate, soredia granulate, whitish and darkening, in labriform soralia, sometimes spreading over larger areas; white with greyer margins. Below light coloured; rhizines simple, light coloured and darkening to brown.

<u>Apothecia</u> not observed. According to Thomson (1963) the apothecia are uncommon, sessile, laminal, up to 2.5 mm wide; disc black, epruinose; spores 8 per ascus, 1-septate, brown, 15-23 X 6-11 µm.

Spot Tests: cortex K+ yellow; medulla K-.

Substratum/Habitat: saxicolous.

Selected Specimens: 651, 3867 B.

Local <u>Abundance</u> and <u>Distribution</u>: infrequent; scattered throughout the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-(circumtemperate) (Krog, 1968) in the Northern Hemisphere.

<u>Remarks</u>: The above description refers to older thalli, according to Thomson (1963) and Maas Geesteranus (1952),who described the younger thalli as having long, narrow lobes which are shortened through continued soredial production.

<u>PHYSCIA TENELLA</u> (Scop.)DC., Flore Franç., ed. 3, 2:396. 1805. Lichen tenellus Scop., Flora Carniolica, ed. 2:394. 1772.

<u>Thallus</u> foliose; orbicular, 1.0-3.0 cm broad. Lobes adnate to more commonly free and ascending, imbricate, little to frequently irregularly pinnately branched, linear, 0.4-0.7 mm wide, dull, \pm distinctly whitespotted; cilia abundant on lobe margins, 1-2(-3) mm long, white to commonly darkened, simple to polyfurcate; sorediate, soredia granular, greenish, in terminal labriform soralia with the upper cortex not or little vaulted; white to glaucous green. Lower surface pale coloured; rhizines present.

<u>Apothecia</u> occasional, laminal, substipitate, 1.1-3.0 mm wide. Thalline margin entire. Disc plane, black, epruinose. Hymenium 55-65 µm high; paraphyses coherent. <u>Spores</u> 8 per ascus, ellipsoid to ellipsoidoblong, l-septate, polarilocular, brown, 16-20 X 7-9 μm.

<u>Pycnidia</u> common, black, immersed; pycnospores hyaline, cylindrical, 3-4 X 0.75 μm.

Spot Tests: cortex K+ yellow.

<u>Substratum/Habitat</u>: saxicolous and corticolous; when corticolous primarily on deciduous trees and shrubs.

Selected Specimens: 1523B, 4819.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone especially, but not exclusively, at maritime sites; not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal(-circumtemperate) in the Northern Hemisphere; also reported from Australia (Weber & Wetmore, 1972) and New Zealand (Martin, 1968) in the Southern Hemisphere.

<u>Remarks: P. tenella</u> is very similar to <u>P. adscendens</u> which has helmet-shaped soralia instead of labriform soralia and is much more common locally than is the former species. See P. adscendens for comments.

PHYSCIA VAINIOIRas., Medd. Soc. F. Fl. Fenn. 46:166. 1921.

<u>Thallus</u> foliose; orbicular, 1.5-2.2 cm broad. Lobes adnate, 0.8-1.0 mm wide, dull, white-spotted, separate to contiguous, pinnately branched; sorediate, soredia granular, greyish in labriform soralia on short side branches as well as marginal and laminal; pearl grey. Below light coloured; ed; rhizines simple to branched, dark-coloured.

<u>Apothecia</u> and pycnidia not observed. According to Thomson (1963) the apothecia are rare, up to 1.5 mm wide with a brown-black sometimes pruinose disc; spores brown or greenish-brown, polarilocular, constricted at the septum, 15-22 X 7.5-9.5 μm.

Spot Tests: cortex and medulla K+ yellow.

Substratum/Habitat: saxicolous; collected once on sandstone.

Selected Specimen:

Local Abundance and Distribution: rare; distribution poorly known, collected once on Saturna Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumboreal in the Northern Hemisphere; in North America reported from British Columbia, Colorado, and Minnesota (Thomson, 1963).

<u>Remarks</u>: In general appearance <u>P</u>. <u>vainio</u> is closest to <u>P</u>. <u>dubia</u> differing from the latter in the cortical white-spotting and K+ yellow spot test of the medulla. Because of these two characters <u>P</u>. <u>vainio</u> is actually closely related to <u>P</u>. <u>aipolia</u> and <u>P</u>. <u>caesia</u>. Moberg (1977) regarded <u>P</u>. <u>wainioi</u> (=<u>P</u>. <u>vainio</u>) and <u>P</u>. <u>caesia</u> as but one species differing only in soralia type, being labriform in the former and capitate in the latter. He reported that the type of soralium formed was based on external factors, primarily exposure to wind and moisture, with the labriform or crateriform soralia produced when the soredia are dispensed quickly leaving an excavated structure and the capitate soralium produced when the soredia are retained for a long time "thus eventually forming a globular protuberance". Hawksworth et al (1980) still recognized <u>P</u>. <u>vainioi</u> as distinct from <u>P</u>. <u>caesia</u> and this has been followed here. The argument of whether or not the soralia are distictly different is similar to the P. adscendens/P. tenella dispute.

PHYSCONIA Poelt

Thallus foliose; lobes linear, upper surface (thickly scleroplectenchymatous) corticate; with or without soredia or isidia; brownish, often completely or partially white pruinose. Lower surface usually black, sometimes white; rhizines usually squarrose, sometimes simple.

Ascocarp an apothecium,laminal. Thalline margin present, often lobulate or sorediate. Spores 8 per ascus, brown, l-septate, polarilocular, usually > 27 µm X 15 µm.

Pycnidia immersed; pycnospores subcylindrical, > 4 cm. Corticolous, saxicolous, terricolous.

<u>Physconia</u> is a segregate genus of <u>Physcia</u>, being separated on the basis of cortical structure, pruinose thallus, lack of atranorin in the upper cortex (K-), and evenly-thickened large broad spores (Poelt, 1965).

References: Poelt (1966), Vitikainen (1968), Moberg (1977), Thomson (1963).

- Soralia labriform on ascendant lobe tips; rhizines often protuberant; lobes 0.4-0.5 mm wide; medulla K-.....P. PERISIDOSA

PHYSCONIA ENTEROXANTHA (Nyl.) Poelt, Nova Hedw. 12:125. 1965 Physcia enteroxantha Nyl., Flora 56:196. 1873.

<u>Thallus</u> foliose; orbicular, 1.5-3.5(-5) cm broad. Lobes 0.5-1.0 mm wide, linear, pinnately branched, separate to commonly marginally imbricate, dull, smooth, heavily white pruinose to only partially pruinose; sorediate, soredia granular, occasionally large-isidioid, brown to white, uwually with a yellowish tinge, soralia marginal, cresent-shaped, not usually extending to the apices, sometimes scant; medulla white to pale yellow; fuscous brown, to olive-grey brown. Below black, marginally sometimes tan; rhizines black, simple, quickly becoming squarrose and forming a dark mat.

<u>Apothecia</u> uncommon, adnate, laminal, 1.3-2.2 mm wide. Thalline margin granular sorediate, thick. Disc concave to plane, black, white pruinose. Hymenium 100-110 μm high; paraphyses simple, coherent; epithecium (orange-)brown. <u>Spores</u> 8 per ascus, brown, 1-septate, constricted at the septum, polarilocular, 25-32 X 11-15(-17) μm.

Spot Tests: medulla and soredia K+ yellow.

<u>Substratum/Habitat</u>: corticolous and saxicolous; when corticolous primarily on <u>Quercus</u>.

Selected Specimens: 3620, 4111.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at both maritime and inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia (Himalayas) disjunct; in North America reported from California north to Alaska in the west and the Great Lakes-Appalachian region in the east.

<u>Remarks: P. enteroxantha</u> is one of four sorediate(-isidiate) species in the <u>P. grisea</u> complex which Poelt (1966) separated by rhizine type, colour of the lower surface, and medulla-soredia colour (and K reaction). <u>P. grisea</u> (Lam.) Poelt s. str. is not yet known from British Columbia; reports of <u>P. grisea</u> from the province belong to other species in the complex. <u>P. grisea</u> s. str. has a whitish under-surface and whitish, simple rhizines.

<u>P. enteroxantha</u> was reported new to the province in Noble (1978) as a result of the present study.

<u>PHYSCONIA PERISIDIOSA</u> (Erichs.) Moberg, Synb. Bot. Upsal. 22(1):90. 1977. Physcia perisidiosa Erichs., Verhandl. Bot. Vereins Prov. Brandenburg 72:

57. 1930.

Physconia farrea auct.

<u>Thallus</u> foliose; occasionally orbicular but usually irregular, 1.5-4.0 cm broad. Lobes adnate, 0.4-0.5 mm wide, linear, separate, dull, lobe tips to entire thallus white pruinose; sorediate, soredia whitish granular, in ascending labriform soralia, terminal or on short side branches; fuscous, buff-brown. Below light coloured at ends, finally blackening toward the very center; rhizines abundant, squarrose, black, forming a felt-like mat which often extends beyond the lobes.

<u>Apothecia</u> not observed. According to Vitikainen (1968), the apothecia are slightly cup-shaped, 0.5-2.0 mm wide, brown, sparsely pruinose; thalline margin nearly entire with only small fissures; spores brown, constricted at the septum, 20-25 X 10-14 μ m. According to Mogerg (1977) the spores are larger, 28-35 X 16-21 μ m.

Spot Tests: medulla and soredia K-.

Substratum/Habitat: corticolous; primarily on Quercus.

Selected Specimens: 1723C, 4089.

Local Abundance and Distribution: infrequent; scattered throughout the southern part of the CDFD subzone especially, but not exclusively, at inland sites; not collected in the adjacent zones.

World Distribution: tentatively circumboreal(-circumtemperate) in the

Northern Hemisphere.

<u>Remarks: P. perisidiosa</u> differs from other members of the <u>P. grisea</u> complex in possessing conspicuously labriform soralia which are terminal on short side branches or occasionally on the main branches, the light coloured lower surface (finally darkening) with black, squarrose rhizines and the K- medulla. Moberg (1977) also described <u>P. perisidiosa</u> as having a shiny upper surface and short, narrow lobes compared to the dull upper surface and elongated, broad lobes of <u>P. enteroxantha</u>. Moberg (op. cit.) reported <u>P. perisidiosa</u> as having lobes 0.5-1.0 mm wide and <u>P. enteroxantha</u> as "up to 3 mm broad". The local <u>P. perisidiosa</u> is usually slightly narrower, never reaching 1.0 mm wide and local <u>P. enteroxantha</u> also narrower that the European specimens, being only up to 1 mm broad but still usually wider that <u>P. perisidiosa</u>.

PILOPHORUS Th. Fr.

Primary thallus crustose; granulose to squamulose, sometimes distinctly areolate; cephalodia present, occasionally also on secondary thallus, sacculate; grey or grey-green; occasionally absent. Secondary thallus fruticose; of pseudopodentia, upright, simple to branched, separate to clustered; with or without soredia. Phycobiont a green alga; cephalodia containing a blue-green alga.

Ascocarp an apothecium, terminal on the pseudopodentia, occasionally sessile on the primary thallus, usually spherical, occasionally clavate or triangular, black. Spores 8 per ascus, ellipsoid to oblong-ellipsoid, hyaline, simple. Proper margin disappearing early.

Saxicolous, usually on silicate rock.

References: Jahns (1970, 1981), Sato (1940), Kurokawa and Shibuichi (1970).

PILOPHORUS ACICULARIS (Ach.) Th. Fr., De <u>Stereocaulis</u> & <u>Pilophoris</u> Comm.: 41. 1857.

Baeomyces acicularis Ach., Meth. Lich.: 328. 1803.

<u>Primary thallus</u> crustose; granular to areolate, usually inconspicuous or disappearing. <u>Secondary thallus</u> of many pseudopodentia, 1.0-1.8(-3.0) cm tall, 0.5-1.1 mm wide, usually simple but occasionally dichotomously or multi-branched, becoming hollow, covered with dull areoles or incompletely covered. Both primary and secondary thallus yellowish glaucous, greenish glaucous to greenish grey. Cephalodia present on both thalli, larger on primary thallus, hemispherical, whitish-tan to brownish.

<u>Apothecia</u> abudnant, terminal on pseudopodentia, globose to slightly irregular, black, 0.6-1.6(-2.0) mm high. Hymenium 75-100 μ m high; paraphyses black tipped; epithecium violet-black. <u>Spores</u> 8 per ascus, hyaline, ellipsoid-fusiform, 16-24(-32) X 5-6 μ m.

<u>Pycnidia</u> frequent, black on short podentia or short lateral branches of fertile pseudopodentia; pycnospores hyaline, cylindrical to cresent-shaped, 6-8 X l μ m.

Spot Tests: K+ yellow, P-

<u>Substratum/Habitat</u>: almost exclusively saxicolous; however, also collected once on a hard decorticate log, twice on exposed roots, and once on soil.

Selected Specimens: 1148, 2411.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at inland sites; present and much more luxurient in the adjacent zones.

<u>World Distribution</u>: amphi-Pacific; China, Japan, Aleutian Islands, Alaska, British Columbia, Washington, Oregon, California, and Idaho (Jahns, 1981; Krog, 1968), concentrated in British Columbia and Washington; outliers are reported from Bellville, Ontario in North America (Jahns, 1981) and southern African and Australia (Kurokawa & Shibuichi, 1970) but the latter two, in particular, and perhaps the first are apparently incorrect.

<u>Remarks: P. clavatus</u> Th. Fr. is reported from Saltspring Island (Bird & Bird, 1973) on the basis of a specimen collected by Macoun and reported as <u>Pilophorus clavata</u> n. sp. in Macoun (1902). However, no mention is made of any other specimens, especially the specimen collected by Macoun in 1887 from Mt. Mark further north on Vancouver Island which is the holotype (Fries, 1888). It is probable that only one collection site is actually involved and that this is another example of the locality errors for which Macoun's early collections are so notorious. It is more likely that the Mt. Mark location is the correct one as <u>P. clavatus</u> is not yet know with certainty from CDFD subzone while it is common in the CH zone. During the present study <u>P. clavatus</u> was collected twice, one near Port Renfrew and once near Mt. Arrowsmith. McMinn (1960) has also

reported collections from the Nanaimo Lakes area of the CDFW subzone. The specimens were not available for confirmation, having been destroyed in a house fire (McMinn, pers. comm.)

<u>P. clavatus</u> as its name implies has elongated, triangular apothecia, occasionally with 'bush-like' primordia at the neck of the apothecia, a persistent primary thallus, small pseudopodentia, and a much darker green thallus colour than that of <u>P. acicularis</u>. It is $K \pm yellow$, P-.

<u>P. nigrocaule</u> Sâto is not yet known from the CDFD subzone either being much more common in the coastal montane areas. However, it has been collected recently from low elevations on Quadra Island near Campbell River on Vancouver Island (Schofield, UBC). Like <u>P. clavatus, P. nigrocaule</u> has a persistent primary thallus, short pseudopodentia with a <u>+</u> internally black axis and covered with thick, white, convex granules, and subglobose apothecia. It is K+ yellow, P+ orange. Jahns (1981) pointed out that the blackened axis after which the species is named is actually not entirely diagnostic of the species as several other <u>Pilophorus</u> species have, or sometimes have, blackened axes.

PLACOPSIS (Nyl.) Lindsay

Thallus crustose; placoidal, with discrete marginal lobes; upper cortex present; with or without soredia or isidia; cephalodia present, sessile, flattened, orbicular, often radially cracked or with a roughened surface, occasionally immersed; pale grey to reddish. Phycobiont a green alga; cephalodia containing a blue-green alga.

Ascocarp an apothecium, sessile or subsessile. Thalline margin present. Disc plane, with or without pruinia. Paraphyses slender, free, moniliform near the apices. Asci cylindrical or sometimes cylindric-

clavate. Spores 8 per ascus, usually uniseriate, ellipsoid, hyaline, simple.

Saxicolous on noncalcareous rocks, occasionally terricolous.

<u>Placopsis</u> is closely related to <u>Lecanora</u>, subgenus <u>Placodium</u>, differing in the presence of cephalodia and the cylindrical asci.

There is one local species.

References: Lamb (1947).

<u>PLACOPSIS GELIDA</u> (L.) Lindsay, Transact. Linn. Soc. London 25:536. 1866. Lichen gelidus L., Mantissa 1:133. 1767.

Lecanora gelida (L.) Ach., Lich. Univ.:429. 1810.

<u>Thallus</u> crustose; placoidal; areolate in the center, marginally lobed, 1.0-3.5(-6.0) cm broad; orbicular, often coalescing irregularly to cover large areas. Upper surface shiny, smooth to cracked, almost scabrid occasionally; sorediate, soredia granular, in excavated to globular soralia, abundant to scarce, often greener than thallus; cephalodia present, prominent, usually at least one central, sessile, flattened, radially cracked, plus often smaller laminal ones, pink-buff; whitish grey to tangrey.

<u>Apothecia</u> common, laminal, sessile, 0.8-1.8 mm wide. Thalline margin thick, smooth. Disc concave becoming plane, salmon to pink coloured, heavily to sometimes thinly pruinose. Hymenium 175-200 µm high; paraphyses coherent at the apices; hymenium and sometimes the hypothecium flesh to pink coloured. <u>Spores</u> 8 per ascus, uniseriate, hyaline, ellipoid, simple, 17-20 Χ 9-12 μm.

<u>Pycnidia</u> not observed. According to Lamb (1947) the pycnidia are immersed and indicated by brown-blackish spots; pycnospores straight or cresent shaped, 15-27 X 0.5 µm.

Spot Tests: medulla C+ red.

<u>Substratum/Habitat</u>: saxicolous; on both sandstones and igneous rocks, often on sloping or vertical surfaces.

Selected Specimens: 2452, 4358.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone but thalli small, poorly developed, sterile and often inconspicuous on the Gulf Islands, near the western boundary usually better developed and often fertile (see Figure 30); present and usually luxuriant in the adjacent zones.

<u>World Distribution</u>: circumarctic-oceanic with boreal-oceanic extensions; also reported from Java, New Zealand and Chile in South America (Lamb, 1947) in the Southern Hemisphere; in North America reported from coastal arctic areas (Barrett & Thomson, 1975; Thomson, 1979), Bering Straits, Aleutian Islands, SW coastal Alaska south to California, plus an isolated outlier in eastern North America (New Hampshire) which Hale (1979) does not acknowledge; also very common in Greenland (Lamb, 1947) (see Figure 49).

PLACYNTHIUM (Ach.) Gray

Thallus squamulose to minutely foliose, commonly forming small rosettes. Lobes stellate, filiform, flat, or canaliculate, closely adnate to the substratum with rhizines; above black, brown, or olive; below usually blue-green. Isidia sometimes present, cylindrical or flattened.


Prothallus sometimes present, black. Phycobiont blue-green.

Ascocarp an apothecium, laminal. Thalline margin present in one species, others with proper margins. Disc black to brown. Spores 8 per ascus, hyaline, oblong-fusiform, 1- or 3-septate.

Saxicolous, often on limestone.

There is one local species.

References: Henssen (1963d).

PLACYNTHIUM NIGRUM (Huds.) Gray, Nat. Arr. Brit. Pl. 1:395. 1821.

Lichen niger Huds., Fl. Angl. ed. 2, 2:524. 1778.

Thallus minutely foliose-squamulose; effuse; fusing to cover large areas. Squamules distinct only marginally, there separate, small, ca.0.5 mm; but quickly becoming obscured by abundant isidia and fusing to form a thick mat in the center, sometimes cracked-areolate; olive-brown to olive. Isidia cylindrical, branched, \pm constricted at branching points, horizontally and vertically aligned, \pm shiny, concolorous with thallus, 0.05 mm wide, up to 1 mm long. Hypothallus very evident at margin and elsewhere between cracks in thallus, black. Rhizines not observed. Phycobiont blue-green.

<u>Apothecia</u> not observed. According to Henssen (1963d) the apothecia are 1 mm wide with dark proper margin, brown-black disc which is initially urceolate becoming flat or convex; the spores are hyaline, narrowly ellipsoid, 1- to 3-septate, 10-17 X 3.5-5.5 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; collected once on sloping, exposed limestone accompanied by Aspicilia contorta.

Selected Specimen: 7387.

Local Abundance and Distribution: rare; collected once in the CDFD subzone (Sunken Garden of Butchart Gardens, on the Saanich Peninsula); not collected in the adjacent zones. Butchart Gardens stands on one of the "Sutton" limestone desposits scattered on both sides of Saanich Inlet. <u>P. nigrum</u> is present possibly at other deposits of the limestone lenses.

<u>World Distribution</u>: tentatively circumarctic to circumtemperate in the Northern Hemisphere (Thomson, 1979; Henssen, 1963d); also reported from New Zealand (Martin & Child, 1972) in the Southern Hemisphere.

PLATISMATIA Culb. & C. Culb.

Thallus foliose; narrow to broad lobed; upper and lower cortex present, prosoplectenchymatous; upper surface smooth to ridged; with or without isidia, soredia, lobules, puncta, or pseudocyphellae; lower surface naked, black, with or without scarce, scattered rhizines.

Ascocarp an apothecium, often rare, usually laminal, often perforate with age. Thalline margin present, algae absent below the subhymenium. Spores 8 per ascus, hyaline, simple, short-ellipsoid to subglobose, small, $5-8 \times 3-5 \mu m$.

Pycnidia immersed, marginal, often empty; pycnospores cylindrical, 4-5 X l $\mu m.$

Primarily corticolous, occasionally saxicolous.

References: Culberson and Culberson (1968).

- 4. Thallus pseudocyphellate and isidiate (sometimes very lightly) on the ridges, IKI- P. NORVEGICA
- Thallus not pseudocyphellate, not ridged; sorediate to isidiate especially on the margins, IKI+ blue..... P. GLAUCA

PLATISMATIA GLAUCA (L.) Culb. & C. Culb., Contrib. U.S. Natl. Herb.34:530 1968.

Lichen glaucus L., Sp. Pl.:1148. 1753. Cetraria glauca (L.) Ach., Meth. Lich.:296. 1803.

<u>Thallus</u> foliose; up to 9 cm broad. Lobes 0.4-2.0 cm wide, rounded to deeply incised, <u>+</u> free and ascending. Upper surface smooth to slightly pitted, dull to shiny; occasionally short, fruticose projections on the edges of some lobes, 1.0-4.0 mm long, 0.2-0.4 mm wide; sorediate, soredioseisidiate, or isidia usually present marginally or rarely laminally; pale green, yellowish glaucous with the margins sometimes browned. Below shiny black turning brown or white along the margins or infrequently mottled white-black, smooth to faintly reticulately ridged; rhizines simple, black, occasionally present.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Culberson and Culberson (1968) "the apothecia are very rare, 0.5-1.0 cm broad, marginal, perforate or not;...;spores 8, small, ellipsoid to ovoid, 3.5-8.5 X 3-5 µm. Pycnidia not seen." According to Hillmann (1936) the pycnospores are straight, thickened at one end, 6-7 X 0.8-1.0 µm.

Spot Tests: upper cortex IKI+ blue, medulla P-.

<u>Substratum/Habitat</u>: corticolous; primarily on <u>Pseudotsuga</u> twigs, branches, and trunks, also infrequently on a wide range of deciduous trees and shrubs and other conifers; collected once on sandstone and twice on wooden fences.

Selected Specimens: 2413, 3841.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially at inland sites, also collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; in western North America reported from California north to Alaska and east to Saskatchewan, Wyoming, and South Dakota; in eastern North America reported from the Great Lake-Appalachian region north to Greenland; also reported from Chile in South America and the mountains of Kenya, Uganda, and Tanzania in Africa in the Southern Hemisphere (Culberson & Culberson, 1968; Krog & Swinscow, 1975).

<u>Remarks</u>: <u>P. glauca</u> is a morphologically very plastic species. Because of the marginal isidia-soredia the narrow-lobed forms can approach <u>P. herrei</u> in appearance. However, the latter species is only isidiate. The faintly reticulate, broad-lobed forms can be similar to <u>P. norvegica</u> which, however, is always IKI- in the local specimens.

<u>PLATISMATIA HERREI</u> (Imsh.) Culb. & C. Culb., Contrib. U.S. Natl. Herb. 34: Cetraria herrei Imsh., Bryologist 57:6. 1954.

<u>Thallus</u> foliose, up to 6(-10) cm broad. Lobes 1-2 mm wide, linear, free and ascending, sometimes broadened to 5 mm at the base. Upper surface

shiny, smooth; isidiate, isidia simple and cylindrical to coralloid, abundant, especially dense along the margin, rarely laminal; pale green, to greyish green. Lower surface shiny, smooth to rugulose, mottled whiteblack-brown with lobe ends often darkening; rhizines infrequent, black, simple.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Culberson and Culberson (1968) "apothecia not common, 3-8 mm broad, terminal, imperforate; ...spores 8 ellipsoid or spheroid, 4-5 X 5-8 µm. Pycnidia few, black, minute, marginal; conidia 1-5 µm, rod-shaped".

Spot Tests: upper cortex IKI+ blue.

<u>Substratum/Habitat</u>: corticolous, primarily on <u>Pseudotsuga</u>, but also collected from a wide variety of other conifers and deciduous trees and shrubs; collected once on driftwood.

Selected Specimens: 2423, 3629.

Local Abundance and Distribution: frequent (present at almost onehalf of the major collection sites); scattered throughout the CDFD subzone especially at inland istes; also present but not as common in the adjacent zones.

<u>World Distribution</u>: western North American endemics; <u>+</u> coastal, extending from California north to SW Alaska (Culberson & Culberson, 1968) (see Figure 60).

<u>Remarks</u>: The separation of <u>P</u>. <u>herrei</u> and <u>P</u>. <u>glauca</u> is not always easy especially in small thalli as the former may have a wide base and the latter may have rather narrow lobes occasionally. However, <u>P</u>. <u>herrei</u> is only isidiate while <u>P</u>. <u>glauca</u> tends to be isidiate-sorediate.

PLATISMATIA LACUNOSA (Ach.) Culb. & C. Culb., Contrib. U.S. Natl. Herb. 34:

541. 1968.

Cetraria lacunosa Ach., Meth. Lich.:295. 1803.

<u>Thallus</u> foliose; 3-9 cm broad. Lobes 6-10 mm wide, <u>+</u> slightly involute, attached over much of the lower surface but margins free. Upper surface shiny, extremely steeply reticulately ridged with ridges rising at almost 90° from the lower pits; nonisidiate, nonsorediate, nonpseudocyphellate; off-white with the margins slightly browned. Lower surface shiny, slightly pitted-ridged; off-white, browning and blackening toward the center; rhizines sparse, simple, brown.

Apothecia occasional, marginal to submarginal, 2-11 mm wide. Disc reddish-brown, irregular, concave becoming plane or contorted. Hymenium 35-40 µm high; paraphyses coherent; epithecium reddish-brown. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, <u>+</u> pointed at one end, uniseriate, 6-8 X 3-5 µm.

<u>Pycnidia</u> marginal, black, barrel-shaped; pycnospores hyaline, constricted in the middle, 5-7 X l μ m.

<u>Spot Tests</u>: medulla P+ orange-red.

Substratum/Habitat: corticolous; collected twice on Alnus.

Selected Specimens: 5425, 6084.

Local Abundance and Distribution: rare; distribution poorly known, collected twice in the CH zone; not collected in the CDFD subzone.

<u>Remarks</u>: Sparsely isidiate forms of <u>P</u>. <u>norvegica</u> resemble <u>P</u>. <u>lacunosa</u> but the former has pseudocyphellae on the ridges and the latter has a P+ orange spot test. PLATISMATIA NORVEGICA (Lynge) Culb. & C. Culb., Contrib. U.S. Natl. Herb. 34: 543. 1968.

<u>Cetraria lacunosa</u> f. <u>norvegica</u> Lynge, Skrift., Mat.-Naturv.-Kl. (Kristiania) 1921(7):196. 1921.

Cetraria norvegica (Lynge)DR., Bot. Notiser 1924:59. 1924.

<u>Thallus</u> foliose; up to 8 cm broad. Lobes 1-1.5 cm wide, rounded with at least the margins free and ascending. Upper surface shiny, sometimes dull, slightly to usually distinctly reticulately ridged; isidiate, isidia scarce to abundant, mainly on the ridges; pseudocyphellate, especially on the ridges; pale olive-grey, yellowish glaucous with the margins often browned. Lower surface shiny, smooth to faintly reticulately ridged, black with a broad brown margin; rhizines black, simple, at places of attachment.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Culberson and Culberson (1968) the apothecia are unknown in North America, 0.7-1.5 cm wide, irregular, perforate; spores ellipsoid, 6-8.5 X 3-4 μ m; the pycnidia are immersed, marginal; pycnospores not observed.

<u>Spot Tests</u>: upper cortex IKI-, according to Culberson and Culberson (1968) it may also be IKI+ pale lavender, but this was not observed in the local material.

<u>Substratum/Habitat</u>: corticolous; collected on both <u>Thuja</u> and <u>Pseudo</u>tsuga, also once saxicolous on igneous rock.

Selected Specimens: 4313, 5240.

Local Abundance and Distribution: infrequent; scattered in the CDFW subzone and the CH zone but not collected in the CDFD subzone (see Figure ... 31).

<u>Remarks</u>: See <u>P. lacunosa</u> and <u>P. glauca</u> for comments.



PLATISMATIA STENOPHYLLA (Tuck.) Culb. & C. Culb., Contrib. U.S. Natl. Herb.

34:548. 1968.

<u>Cetraria lacunosa</u> b. <u>stenophylla</u> Tuck., Syn. N.A. Lich. 1:35. 1882. Cetraria <u>stenophylla</u> (Tuck.) Merr., Bryologist 13:27. 1910.

<u>Thallus</u> foliose; 4-8 cm broad. Lobes (0.5-)1-2(-4) mm wide, linear, often concavely curved and trough-like, free and ascending. Upper surface shiny, smooth to pitted; esorediate and nonisidiate; glaucous green to pale buff green. Lower surface smooth to finely reticulately ridged, dull to usually shiny, white with black-brown areas especially toward the lobe ends; rhizines simple, black, sparse, a few only at the base for attachment.

<u>Apothecia</u> occasional, 1 to several at the lobe tips, up to 7 mm wide. Disc concave when young, becoming plane or convex and often irregular, brown. Cortex on lower side of apothecia roughened to form tiny lobules. Hymenium brownish, 35 µm high; spores not observed. According to Culberson and Culberson (1968) the spores are ellipsoid or spheroid, 4-5 X 5-8 µm.

<u>Pycnidia</u> common, black, marginal especially toward the lobe ends; pycnospores hyaline, cylindrical, 3-5 X 0.8 µm. According to Culberson and Culberson (1968) the pycnospores are 5-8 X 1.0 µm.

Spot Tests: upper cotex IKI+ blue.

Substratum/Habitat: corticolous; primarily on Pseudotsuga.

Selected Specimens: 3891, 4233B.

Local Abundance and Distribution: infrequent; scattered along the southwestern boundary of the CDFD subzone at higher elevations inland, present and much more luxuriant in the adjacent CDFW subzone; not collected north of Maple Mt.-Mt. Prevost near Duncan, also not reported from the Queen Charlotte Islands (Brodo, 1980).

<u>World Distribution</u>: western North American endemic; reported from California north to Vancouver Island, British Columbia (Culberson &

POLYCHIDIUM (Ach.) Gray

Thallus minutely fruticose; forming small, shrubby growths; dichotomously branched; main branches with a paraplectenchymatous cortex, single layer; green or brown. Phycobiont a glue-green alga (Nostoc or Scytonema).

Ascocarp an apothecium, lateral. Proper margin present, thick. Disc small, brown. Asci cylindrical. Paraphyses simple, septate, apically thickened. Spores 8 per ascus, hyaline, ellipsoid or fusiform, simple or 1-septate, thin or thick walled.

Muscicolous, corticolous, lichenicolous.

There is one local species.

References: Henssen (1963f).

<u>POLYCHIDIUM MUSCICOLA</u> (Sw.) Gray, Nat. Arr. Brit. Pl. 1:402. 1821. <u>Lichen muscicola</u> Sw., Nova Acta Acad. Upsal. 4:248. 1784.

<u>Thallus</u> fruticose, forming small pincushions, 3-11 cm broad, up to 1 cm high. Branches terete, up to 1.5 mm wide, shiny at least at the apices, smooth to slightly roughened, dichotomously branched; black, basally olivaceous black. Brittle when dry. Phycobiont a blue-green alga.

<u>Apothecia</u> common, abundant, lateral, 0.4-1.5 mm wide. Margin proper, thick. Disc orange-brown, red-brown to blackening, concave becoming plane, sometimes irregularly convoluted. Hymenium 80-90 µm high; paraphyses simple, septate, coherent at tips; epithecium light brown. Spores 8 per ascus, hyaline, oblong to fusiform-acicular, 1-septate, sometimes constricted, (22-)24-30 X 5-7 μm.

<u>Pycnidia</u> not observed. According to Henssen (1963f) the pycnidia are brown; pycnospores $1.5-3.5 \times 1 \mu m$.

Spot Tests: hymenium IKI+ blue.

<u>Substratum/Habitat</u>: muscicolous and saxicolous; commonly among mosses over rocks in exposed locations.

Selected Specimens: 4784, 5168.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone especially the southern half at both maritime and inland sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: tentatively circumboreal(-circumtemperate) in the Northern Hemisphere; often described as a temperate species (Henssen, 1963f; Ozenda & Clauzade, 1970) but also reported from the North Slope of Alaska, Ellesmere Island, Greenland and Iceland (Thomson, 1979); also reported from New Zealand (Martin, 1966) in the Southern Hemisphere.

POLYSPORINA Vězda

Thallus crustose; sometimes immersed within the substratum; occasionally parasitic on other lichens.

Ascocarp an apothecium, immersed to adnate. Proper margin present, black, carbonaceous, raised, often initially involute then opening slightly with age to expose the black, 'button-dimpled' to gyrose disc. Paraphyses branched and anastomosed, indistinctly septate; epithecium carbonaceous. Spores 100+ per ascus, hyaline, simple, ellipsoid to cylindrical.

Saxicolous or lichenicolous.

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There is one local species.

References: Vězda (1978); Vězda and Steiner (in Poelt & Vězda, 1981).

POLYSPORINA SIMPLEX (Davies) Vězda, Folia Geobot. Phytotax., Praha 13:399. 1978.

Lichen simplex Davies, Transact. Linn. Soc. London 2:283. 1793. Sarcogyne simplex (Davies) Nyl., Mem. Soc. Sci. Nat. Cherbourg 2:337. 1854.

<u>Thallus +</u> absent; present only as a few clumps of algae and thalline tissue at base of ascocarps.

<u>Apothecia</u> abundant, somewhat impressed in substrata hollows, commonly clustered and distorted by compression, 0.3-0.4(-0.6) mm wide. Proper margin very thick and swollen, raised, shiny, becoming radially cracked or creased in several places, often involute, partially obscuring disc; concolorous with disc. Disc concave, basally constricted, <u>+</u> round but often distorted by compression or by irregularities in the substratum, shiny, black, everted 'button-dimpled', epruinose. Hypothecium hyaline to occasionally pale yellow or almost orange; epithecium black carbonaceous at very top, immediately below a strong yellow that diffuses down the hymenium; exciple carbonaceous black throughout; hymenium 65-80 μ m high, hyaline or pale yellow. Spores 100+ per ascus, hyaline, simple, cylindrical, 3-5 X 1-1.5(-2) μ m.

<u>Spot Tests</u>: hymenium IKI+ yellow-orange; hypothecium IKI+ blue. <u>Substratum/Habitat</u>: saxicolous; on sandstone (HCl-).

Selected Specimens: 621, 1665.

Local Abundance and Distribution: rare; distribution poorly known (see below), collected twice as admixtures of other collections on the Gulf Islands in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumarctic-circumboreal in the Northern Hemisphere; in North America reported from Ellesmere Island (Thomson, 1959) and south to the Smoky Mountains in the east and New Mexico in the west (Magnusson, 1935b).

<u>Remarks: P. simplex</u> is quite small and rather inconspicuous. It is probably more common locally than the few collections indicate.

PORINA Muell. Arg.

Thallus crustose; well developed or disappearing within the substratum. Phycobiont a green alga (<u>Trentepohlia</u>).

Ascocarp a perithecium, partially covered or not covered with thalline tissue, usually composed of both a dark, carbonaceous, apically capping involucrellum and a hyaline to brown, flask-shaped excipulum; single to clustered. Asci unitunicate, fusiform-clavate, thin-walled. Paraphyses free, simple or occasionally branched, slender, persistent. Spores 8 per ascus, hyaline, 3- or transversely several septate, also occasionally with longitudinal septa.

Saxicolous, corticolous, muscicolous.

References: Swinscow (1962).

1.	. Corticolous	• • •	<u>P</u> . <u>AENEA</u>
1.	. Saxicolous	• • • •	2
	2. Spores 3-septate	<u>P</u> .	<u>CHLOROTICA</u>
	2. Spores 7-septate	<u>P</u>	. <u>GUENTHERI</u>

<u>PORINA AENEA</u> (Wallr.) Zahlbr., Cat. Lich. Univ. 1:363. 1922. <u>Verrucaria aenea</u> Wallr., Flora Crypt. German. 3:299. 1831. <u>Porina carpinea</u> (Pers. ex Ach.) Zahlbr., Nat. Pfl. 1:66. 1907.

<u>Thallus</u> crustose; up to 2 cm broad, primarily thin, shiny, smooth, scattered scurfy brownish granules on a white hypothallus; overall appearing pale brownish grey, light greyish olive.

<u>Perithecium</u> sessile, scattered, 0.2-0.3 mm wide, covered by a black involucrellum, the lower part of which remains as a black ring after the excipulum and rest of involucrellum disintegrate. Ostiole occasionally visible as a single, apical depression. Paraphyses simple, coherent, persistent. Asci <u>+</u> cylindrical, apically thin walled. <u>Spores</u> 8 per ascus, fusiform, hyaline, 3-septate, (16-) 18-22 X 3-4(-5) µm

Spot Tests: granules K+ yellow.

<u>Substratum/Habitat</u>: corticolous; collected twice on deciduous trees. Selected <u>Specimens</u>: 1243, 4125.

Local Abundance and Distribution: rare; distribution poorly known, collected once on the Saanich Peninsula and once on Prevost Island both in the southern part of the CDFD subzone at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumboreal in the Northern Hemisphere; Zahlbruckner (1922)suggested it is "widely distributed in most temperate regions", however, Swinscow (1962) mentioned no records from central or eastern Asia; in North America reported from California (Fink, 1935) and Michigan (Harris, 1977).

<u>Remarks</u>: <u>P. aenea</u> was reported new to the province in Noble (1978) as P. carpinea as a result of the present study. PORINA CHLOROTICA (Ach.) Muell. Arg., Rev. Mycol. 6: 20. 1884. Verrucaria chlorotica Ach., Lich. Univ.:283. 1810.

<u>Thallus</u> crustose; continuous, covering areas up to 10 cm wide, <u>+</u> smooth and glossy to regularly cracked-areolate; dull; light greyish olive, deep olive buff, dark grey, deep purplish grey, sometimes faintly white pruinose.

<u>Perithecia</u> sessile, scattered but usually abundant, covered by a black involucrellum, matt to shiny, 0.2-0.4 mm wide. Ostiole occasionally visible as a single, apical depression. Paraphyses simple, <u>+</u> coherent, persistent. Asci <u>+</u> cylindrical. <u>Spores</u> 8 per ascus, fusiform, hyaline, (1-)3-septate, 18-22(-25) X (4-)5-6 µm. (see Figure 23).

Spot Tests: thallus K+ (yellow-)orange.

<u>Substratum/Habitat</u>: saxicolous; on shaded rocks in the supralittoral zone.

Selected Specimens: 1831, 3864.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, also collected in the adjacent zones at maritime sites.

World Distribution: tentatively circumboreal.

<u>PORINA GUENTHERI</u> (Flot.) Zahlbr., Cat. Lich. Univ. 1:384. 1922. Verrucaria guentheri Flot., Bot. Zeit. 8:575. 1850.

<u>Thallus</u> crustose; thin, smooth, continuous, cracked to tartareous; deep greenish grey, green.

<u>Perithecia</u> sessile, scattered to grouped, simple to compound, 0.4-0.5 mm wide with apically black involucrellum. Ostiole not commonly visible, apical, single, often whole perithecium cracking open from the ostiole.

Paraphyses persistent. <u>Spores</u> 8 per ascus, hyaline, fusiform (often rounded at one end), (3-)7-septate, 25-32 X 5-7 µm (see Figure 23).

Spot Tests: none.

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<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous sandstone on a river bank.

Selected Specimens: 5080.

Local Abundance and Distribution: rare; distribution poorly known, collected once at Englishman River Falls Prov. Park west of Parksville in the CDFW subzone; not collected in the CDFD subzone.

<u>Remarks</u>: Swinscow (1962) described the spores of <u>P</u>. <u>guentheri</u> as much larger than those seen in the local collection, 35-45 X 5-6 μ m, with some of the English varieties even longer. Ozenda & Clauzade (1970) stated the spores are 15-32 X 5-6 μ m.

<u>P.guentheri</u> was reported new to the province in Noble(1978) as a result of the present study.

PROTOBLASTENIA J. Stein.

Thallus crustose; granulose to cracked-areolate, occasionally squamulose, K-, often poorly developed or disappearing within the substratum.

Ascocarp an apothecium, immersed to sessile, yellow or red to black, often K+ purple. Proper margin present, usually quickly excluded. Paraphyses simple. Spores 8 per ascus, hayline, simple, ellipsoid, sometimes narrowly ellipsoid..

Pycnidia immersed, fulcrum endobasidial; pycnospores bacilliform. Corticolous, saxicolous (often calcicolous), occasionally terricolous. References: Poelt & Vězda (1977).

1.	Corticolous 2
1.	Saxicolous 3
	2. Thallus yellow, granular-sorediate, C+ orange, P-; disc dark brown to red-brown
	2. Thallus grey to green-grey, cracked-areolate, C-, P+ orange; disc scarlet P+ orange; disc scarlet
3.	Apothecia orange, K+ purple, embedded in substratum <u>P</u> . <u>INCRUSTANS</u>
3.	Apothecia (red-)black-brown, K-, sessile <u>LECIDEA MONTICOLA</u> (p. 403)

<u>PROTOBLASTENIA</u> <u>INCRUSTANS</u> (DC.) J. Stein., Verhandl.zool.-bot. Gesellsch. Wien 65:203. 1915.

Patellaria incrustans DC., Flore Franç., ed. 3, 2:361. 1805.

<u>Thallus</u> crustose; inconspicuous, continuous, very thin; white to light grey or evanescent. Hypothallus not observed.

<u>Apothecia</u> common, scattered, 0.2-0.4 mm wide, emarginate. Disc immersed in the substratum (level with surface of rock), <u>+</u> plane, round, oval or a little irregular, orange. Paraphyses coherent. <u>Spores</u> 8 per ascus, ellipsoid to pointed ellipsoid, hyaline, simple, 10-12 X 5-7 μ m.

Spot Tests: epithecium and orange granules in hymenium K+ rose-violet.

<u>Substratum/Habitat</u>: saxciolous; collected once on calcareous sandstone on a river bank with <u>Lecidea monticola</u>.

Selected Specimen: 5079.

Local Abundance and Distribution: rare; distribution poorly known, collected once in Englishman River Falls Prov. Park near Parksville in the CDFW subzone; not collected in the CDFD subzone. <u>Remarks</u>: Poelt (1969) and Poelt and Vězda (1977) described the apothecia of <u>P. incrustans</u> as convex while Magnusson (1952) described them as "somewhat plane to subconvex". Ozenda and Clauzade (1970) stated the the apothecia are not very convex.

<u>P. incrustans</u> is reported here as new to the province.

<u>PROTOBLASTENIA QUERNEA</u> (Dicks.) Clauza. ex Vézda, Lichenes Selecti Exsiccati (Brno) No. 594. 1967.

<u>Lichen querneus</u> Dicks., Fasc. Cryptog. Brit. 1:9, tab. 2, fig. 3. 1875 <u>Lecidea quernea</u> (Dicks.) Ach., Meth. Lich.:62. 1803.

Pyrrhospora quernea: (Dicks.) Koerb., Syst. Lich. Germn.:209, tab. 1, fig. 7. 1855.

<u>Thallus</u> crustose; of scattered to grouped, totally sorediate granules; dark olive-buff, buff, to yellow.

<u>Apothecia</u> uncommon, often absent, sessile or nearly subsessile in the granules, 0.3-0.7 mm wide. Proper margin a little paler than disc, thin, quickly excluded. Disc dark red brown, blackening, initially plane becoming very convex, 'velvety', matt or slightly shiny. Hymenium 45-55 μ m high, faintly coloured from the epithecium, ascal contents sometimes also concolorous with epithecium; epithecium granular, orange-brown, bluish-black in darkened apothecia; hypothecium fulvous to brownish, not distinctly separate from the hymenium. <u>Spores</u> 8 per ascus, hyaline, oblong to oblong-ellipsoid, epispore distinct, 11-13(-15) x 5-6 μ m.

Spot Tests: thallus C+ orange, P-; epithecium K+ pink-red.

<u>Substratum/Habitat</u>: corticolous and lignicolous; the corticolous collection was from a deciduous shrub.

Selected Specimens: 162, 6151.

Local Abundance and Distribution: rare; distribution poorly known, collected once on South Pender Island in the southern part of the CDFD subzone and once in the adjacent CDFW subzone.

<u>World Distribution</u>: uncertain; reported from Europe and North America; in North America reported from Minnesota, Montana, and California (Fink, 1935).

<u>Remarks</u>: <u>P. quernea</u> was reported new to the province in Noble (1978) as a result of the present study.

PROTOBLASTENIA RUSSULA (Ach.) Räs., Revist. Sudamer. Bot. 5:67. 1938. Lecidea russula Ach., Meth. Lich.:61. 1803.

<u>Thallus</u> crustose; 1.0-2.5 cm broad, smooth, thin and shiny, to thicker and cracked-areolate, usually continuous but occasionally granules scattered on a black hypothallus although hypothallus usually absent in better developed thalli; esorediate; pale grey to greyish olive.

<u>Apothecia</u> abundant, scattered, occasionally crowded, sessile, 0.5-1.0(-1.5) mm wide. Proper margin lighter coloured than disc, indistinct, disappearing. Disc plane to slightly convex, closely following the substratum, not constricted, round to often lobed, \pm shiny, scarlet to brownish-red or red. Hymenium 35-45 µm high, granular, hyaline, to light orange; epithecium granular, orange; hypothecium hyaline, not distinctly separated from hymenium. <u>Spores</u> 8 per ascus, hyaline, elongate, fusiform to cylindrical, 10-12(-14) X 2-3 µm.

<u>Spot Tests</u>: thallus P+ orange (often slow or only in portions of thallus); epithecium K+ rose; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; usually on <u>Pseudotsuga</u>, occasionally on <u>Alnus</u>.

Selected Specimens: 3119, 4046A.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone mainly at inland sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: uncertain, "tropical-subtropical-temperate regions" (Ozenda & Clauzade, 1970); also reported from Australia (Weber & Wetmore, 1972) and Argentina (Grassi, 1950) in the Southern Hemisphere.

Remarks: The local material is totally nonsorediate and abundantly fertile making it key out readily to P. russula. However, the species was initially thought to be P. cinnabarina (Somm.) Räs., which is abundantly sorediate and rarely fertile and known to be present in the province. The apothecia of the latter are described as 0.4-1.2 mm broad, often grouped, initially with a proper margin that is excluded as the disc quickly becomes convex; the spores are often lacking or poorly formed, 9-10 X 2-4 µm; the thallus is pale greyish and K+ yellow, P+ orange-red (Poelt & Vezda, 1977; Ozenda & Clauzade, 1970). The apothecia of P. russula are described as 0.5-1.5 mm broad, plane to slightly convex, with an initially distinct proper margin which becomes + excluded with age; spores 7.5-11 X 3-4 µm; thallus yellowish to greenish grey often with a black hypothallus, no spot tests are reported but lichexanthone present in thallus (citation as above). Fink (1935) stated that P. russula has a yellow to reddish hypothecium while that of P. cinnabarina is hyaline. No other descriptions confirm this point. P. cinnabarina prefers acidic bark, including hazel, rowan, alder, and birch according to Duncan (1970) in the boreal-arctic regions (Poelt & Vézda, 1977) while P. russula is a tropical-temperate species reported from myrtle (Ozenda & Clauzade, 1970). Fink (1935) reported P. russula as occurring from New York to Florida and then westward to the

Rocky Mountains while <u>P</u>. <u>cinnabarina</u> is reported in Washington, Oregon, and California, but otherwise there are very additonal records of either species from North America. Because the local material is esorediate, it automatically falls into <u>P</u>. <u>russula</u> but this is not completely satisfactory. The material requires further study.

 \underline{P} . <u>russula</u> has not been reported previously from the province.

PSEUDEPHEBE Choisy

Thallus fruticose, centrally sometimes compacted and subcrustose; prostrate, <1 cm tall, attached throughout its length to the substratum by hapters. Branches minute, terete to slightly compressed, even to uneven, matt to shiny; brown to black. Isidia, soredia, and pseudocyphellae absent.

Ascocarp an apothecium. Thalline margin present, smooth to ciliate, persistent to excluded. Disc brown to brown-black. Spores 8 per ascus, hyaline, simple, without a distinct epispore, 7-12 X 6-8 µm.

Saxicolous or terricolous on stony ground.

Until recently <u>Pseudephebe</u> was included usually in <u>Alectoria</u> and sometimes <u>Parmelia</u>. Brodo and Hawksworth (1977) stated that it cannot be placed satisfactorily in either genus.

<u>Pseudephebe</u> is composed of two species. There is only one local species.

References: Brodo and Hawksworth (1977).

PSEUDEPHEBE PUBESCENS (L.) Choisy, Icon. Lich. Univ., ser. 2, 1: sine pagin. 1930.

Lichen pubescens L., Sp. Pl. 2:1155. 1753.

<u>Alectoria pubescens</u> (L.) R. Howe, Class. Fam. Usneaceae:23. 1912 ___et Bull. Torr. Bot. Club 39:201. 1912.

Parmelia pubescens (L.) Vain., Medd. Soc. Fauna Fl. Fenn. 14:22. 1886.

<u>Thallus</u> fruticose; prostrate, forming mats, attached by scattered hapterons; branches slender, 0.1-0.2 mm wide, wiry, shiny, smooth to knobby, dichotomously branched, slightly flattened; fuscous-black, lighter below.

Apothecia and pycnidia not observed. Hillmann (1936) stated that the apothecia are rare in Europe. Hawksworth (1972) reported fertile material frequent from collections above 2,000 ft. (= 610 m) in Great Britain. He described them as lateral with a smooth thalline margin, marginally dentate to ciliate, disc dull, black-brown, plane becoming convex, up to 5.5 mm wide; spores 8 per ascus, simple, hyaline, ellipsoid, 7-12 X 6-8 μ m; pycnidia occasional, black on tubercles; pycnospores 5-7 X 1 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; collected twice on conglomerate (HC1-) at exposed sites at higher elevations (589 m, 600 m).

Selected Specimens: 2207A, 4687.

Local Abundance and Distribution: rare; on two exposed mountain tops, one within the CDFD subzone and one in the adjacent CDFW subzone (see Figure 32).

<u>World Distribution</u>: circumarctic-alpine in the Northern Hemisphere also "correctly reported in the Southern Hemisphere...from Antarctica, Argentina..., Australia, New Zealand, Patagonia, Tasmania, and Tierra del Fuego...no verified records for either the African continent or the Indonesian-Malaysian islands" (Hawksworth, 1972).



PSEUDOCYPHELLARIA Vain.

Thallus foliose; broad lobed, often with reticulations; with or without soredia; upper and lower surfaces both corticate (paraplectenchymatous); below with or without tomentum, plus pseudocyphellae (unrimmed pores). Phycobiont a blue-green alga.

Ascocarp an apothecium, substipitate, laminal to marginal. Thalline margin present. Spores (6-)8 per ascus, hyaline and browning, fusiform, 1- to several transverse septa.

Saxicolous and corticolous.

<u>Pseudocyphellaria</u> is closely related to and formerly part of <u>Sticta</u> which possesses true cyphellae (rimmed pores). Both genera are better represented in the Southern Hemisphere than in the Northern Hemisphere.

References: Magnusson (1940a).

1.	Thallus esorediate, usually fertile $\dots \dots \dots P$.	<u>AN</u>]	THRASPIS
1.	Thallus sorediate, rarely fertile	• • • •	2
	2. Soredia and pseudocyphellae yellow	<u>P</u> .	CROCATA
	2. Soredia and pseudocyphellae white	<u>P</u> .	ANOMALA

PSEUDOCYPHELLARIA ANOMALA (Merr.) H. Magn., Acta Horti Gothb. 13:248.

1940. (nom. illeg.)

Sticta limbata var. anomala Merr., Lich. Exs. No. 25. 1909.

<u>Thallus</u> foliose; 4-8 cm broad. Lobes 0.8-1.6(-3.2) cm wide, short and rounded. Upper surface shiny and smooth but overall slightly wrinkled and ridged; sorediate-isidiate, initially brown papillate-isidiate with the isidia breaking into white soredia, laminal in coalescing punctiformmaculiform soralia on the ridges; dark olive-buff, olive-brown, to fuscous. Lower surface covered with tan-brown tomentum plus scattered white, 0.3-0.6 mm wide pseudocyphellae, only a few towards the center in small thalli; rhizines few, scattered.

<u>Apothecia</u> rare, the few observed all parasitized, laminal, black, 1.5-4 mm wide. Spores hyaline, 3-septate, ellipsoid-fusiform, 18-20 X 4-5 μ m. According to Magnusson (1940a) the apothecia are 2-3 mm wide; disc red-brown, plane; margin scabrid becoming thin; spores oblong, 1- becoming 3-septate, 20-25 X 7.5-8.5 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: primarily corticolous; especially on <u>Quercus</u> but also on conifers; also one collection saxicolous on conglomerate.

Selected Specimens: 5054, 5472A.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at inland sites; present and often more luxuriant in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from California to Alaska; oceanic (Krog, 1968).

<u>Remarks: P. anomala</u> is presumably the sorediate counterpart of <u>P. anthraspis</u> (Magnusson, 1940a). Of the material examined from Vancouver Island of both species, <u>P. anthraspis</u> is typically larger with the reticulations much more distinctly formed, compared to <u>P. anomala</u>. Herre (1942) stated that the two were actually only one species since large specimens of <u>P. anthraspis</u> often become sorediate on some of the lobes. Krog (1968), however, supported <u>P. anomala</u> as a separate species, stating that even very young specimens were sorediate and that the pseudocyphellae were small, punctiform and regular, while those in <u>P</u>. <u>anthraspis</u> were elongated and irregular.

PSEUDOCYPHELLARIA ANTHRASPIS (Ach.) H. Magn., Acta Horti Gothb. 13:248. 1940. Sticta anthraspis Ach., Meth. Lich.: 280. 1803.

<u>Thallus</u> foliose; 8-18 cm broad. Lobes (6-)14-24(-32) mm wide, rounded, sometimes elongated, spatulate, reticulately ridged, <u>+</u> free and ascending. Upper surface smooth, shiny to matt; esoredaite; light brownish olive, olive brown, buff brown. Lower surface covered by tan tomentum with scattered pseudocyphellae, white, 0.1-0.3(-1.0) mm wide.

<u>Apothecia</u> common, laminal, 1.2-4.2 mm wide, narrowly short stipitate. Disc reddish brown, darkening, plane eventually convex. Thalline margin initially pubescent, at length disappearing. Hymenium 75-100 μ m high; paraphyses simple, coherent at tips; epithecium yellowish; hypothecium fulvous. <u>Spores</u> 8 per ascus, hyaline, 1- to eventually 3-septate, fusiform, straight to curved, 25-32 X 6-8 μ m.

<u>Pycnidia</u> immersed, especially on the ridges, ostiole black; pycnospores hyaline, cylindrical with inflated ends, 5-7 X l μ m.

Spot Tests: none.

Substratum/Habitat: corticolous; especially on conifers.

Selected Specimens: 4327, 5063.

Local Abundance and Distribution: infrequent; one collection from Goldstream Prov. Park at the southwest end of the Saanich Peninsula on the western boundary of the CDFD subzone; present, more common and luxuriant in the adjacent zones. (see Figure 33).

<u>World Distribution</u>: western North American endemic; reported from California to Alaska (Krog, 1968) (see Figure 58).



<u>Remarks</u>: Krog (1958) reported only one chemical strain (P-) from Alaska. Ohlsson (1973) stated that, like <u>P. anomala</u>, there is both a P+ and P- strain of <u>P. anthraspis</u>.

PSEUDOCYPHELLARIA CROCATA (L.) Vain., Hedwigia 37:34. 1898.

Lichen crocatus L., Mantissa Alter.: 310. 1771.

<u>Thallus</u> foliose; 2-4 cm broad. Lobes up to 8 mm wide, short and rounded. Upper surface shiny and smooth with an overall shallow reticulation; sorediate, soredia abundant in maculiform soralia, laminal, mainly confined to the ridges but also slightly marginal, bright yellow; brown. Lower surface covered in tan tomentum with scattered pseudocyphellae, yellow, 0.3-1.6 mm wide, absent on smaller lobes. Medulla white.

<u>Apothecia</u> and <u>pycnidia</u> not observed. According to Magnusson (1940b) the apothecia are rare, sessile on the ridges, 1.5-2.5 mm wide, blackishbrown, plane; margin thin; spores dark yellow-brown, 1-septate, 22-26 X 8-9 μm.

Spot Tests: none.

Substratum/Habitat: corticolous; on both deciduous and evergreen trees Selected Specimens: 4224, 5053.

Local Abundance and Distribution: infrequent; scattered at higher elevations inland towards the western boundary of the CDFD subzone, present and more luxuriant in the adjacent zones.

<u>World Distribution</u>: tentatively circumtropic with oceanic extensions into temperate latitudes; in North America known from Oregon to Alaska in the west and the Great Lakes-Appalachian region in the east (Ohlsson, 1973).

<u>Remarks</u>: <u>P</u>. <u>mougeotiana</u> (Del.) Vain., known from the NE coast of Vancouver Island (Ohlsson, 1973), is very similar to <u>P</u>. crocata, differing in its longer, plane lobes with marginal soralia. However, the soralia of <u>P</u>. <u>mougeotiana</u> are also occasionally laminal (Magusson & Zahlbruckner, 1944). Martin and Child (1972) separated the two species on the basis of <u>P</u>. <u>mougeotiana</u> having a reddish-brown thallus and K- medulla. Another yellow sorediate <u>Pseudocyphellaria</u> species reported from Vancouver Island is <u>P</u>. <u>aurata</u> (Ach.) Vain. It differs from <u>P</u>. <u>crocata</u> in possessing a green phycobiont while the latter has a blue-green phycobiont.

PSORA Hoffm. emend. G. Schneider

Thallus squamulose; up to 5 mm broad, margins always free and often ascending, single and scattered to grouped and imbricate, upper surface corticate (pseudoparenchymatous), lower surface ecorticate; esorediate and nonisidiate; often pruinose. Phycobiont a green alga.

Ascocarp an apothecium, laminal to marginal. Disc very convex, brown to black. Margin absent or indistinct;proper margin present but excluded early. Hymenium 80-100 μ m high. Hypothecium orange to pink. Spores 8 per ascus, hyaline, simple, ellipsoid.

Terricolous, occasionally saxicolous.

<u>Psora</u> has often been included in <u>Lecidea</u> s. lat. Schneider (1980) has recently monographed the segregate genus, subdividing it even further. <u>Hypocenomyce</u>, because of its squamulose growth form was treated usually with <u>Psora</u> but Schneider separated the former on the basis of its plectenchymatous upper cortex, often sorediate condition, lower hymenium (40-50 μ m), proper margin, ellipsoid-fusiform sometimes septate spores, and corticolous habit. There is one local species.

References: Schneider (1980), Anderson (1964).

<u>PSORA NIPPONICA</u> (Zahlbr.) G. Schneider, Biblthca Lich. 13:117. 1980
 <u>Lecidea nipponica</u> Zahlbr., Botan. Magaz. Tokyo 41:330. 1927.
 <u>Psora novomexicana</u> B. de Lesd., Rev. Bryol. & Lichenol. 12:49. 1942.
 Lecidea novomexicana (B. de Leds.) W. Web., Bryologist 65:251. 1963.

<u>Thallus</u> squamulose; of grouped and imbricate, rounded squamules, simple to lobed, up to 5 mm wide, the margins ascending and involute exposing the lower surface and almost completely hiding the upper surface; smooth to cracked; greenish-tan to greenish-brown above, whitish below.

Apothecia common, laminal, 1- to several per squamule, 0.8-1.3 mm wide. Proper margin thin, quickly excluded, lighter coloured than the disc, often with a reddish tint. Disc slightly to strongly convex, constricted, somewhat stipitate, black. Hypothecium hyaline; hymenium 100 µm high, hyaline to yellowish-red; epithecium brown to yellow-brown; paraphyses strongly coherent; exciple hyaline or light fulvous. Asci often with brown, granular contents. <u>Spores</u> not observed often, 8 per ascus, hyaline, simple, ellipsoid, 12-13 X 5 µm.

<u>Spot Tests</u>: thallus (upper cortex) C+ red; epithecium K+ purplishred; exciple and/or hymenium C+ red (occasionally also the hypothecium reacting positively before quickly fading.

<u>Substratum/Habitat</u>: terricolous; on thin soil among moss in cracks and crevices of exposed igneous outcrops.

Selected Specimens: 4069, 4246B.

Local Abundance and Distribution: infrequent; distribution poorly known, two collections from the CDFD subzone at higher exposed elevations inland near the western boundary, also one collection from a similar habitat in the adjacent CDFW subzone; known from other collections to be present in the CH zone at lower elevations along an occasionally inundated river bank.

<u>World Distribution</u>: amphi-Pacific (possibly disjunct Japan-western North America); in North America reported from South Dakota, New Mexico, Arizona, Colorado, California, Oregon, Washington, and British Columbia (Wetmore, 1968; Anderson, 1964; Schneider, 1980; Noble, 1978).

<u>Remarks</u>: <u>P. nipponica</u> was reported as new to the province in Noble (1978) as <u>Lecidea novomexicana</u> as a result of the present study plus additional collections from the interior of the province.

PSOROMA Michx.

Thallus squamulose to occasionally foliose; upper (paraplectenchymatous) and lower (interwoven periclinal hyphae) cortex present. Phycobiont a green alga.

Ascocarp an apothecium, laminal, adnate or sessile. Thalline margin present, commonly crenulate. Disc concave to plane, reddish-brown. Spores 8 per ascus, hyaline, simple, ellipsoid to spherical, thin walled but ornamented.

Saxicolous, terricolous, and corticolous.

<u>Psoroma</u> is better represented in the Southern Hemisphere than in the Northern Hemisphere.

There is one local species.

References: Jørgensen (1978).

<u>PSOROMA HYPNORUM</u> (Vahl) Gray, Nat. Arr. Brit. Pl. 1:445. 1821. Lichen hypnorum Vahl, Icon. Plant. Daniae 6:8. 1787.

<u>Thallus</u> squamulose, up to several cm broad. Squamules imbricate, crenate, up to 0.6 mm wide; green, olive grey, lighter below. Phycobiont a green alga.

Apothecia common, often crowded, 1.0-3.4 mm wide. Thalline margin crenulate to squamulate, occasionally with hyaline hairs. Disc concave, quickly becoming plane to slightly contorted, red-brown, shiny becoming dull. Hymenium 90-110 um high; paraphyses coherent; epithecium yellowbrown. <u>Spores</u> 8 per ascus, uniseriate, hyaline, simple, ellipsoid to tapering apically, epispore distinct, outer wall irregularly thickened, 16-20 X 8-10 µm.

Spot Tests: hymenium IKI+ (green-)blue.

<u>Substratum/Habitat</u>: muscicolous-terricolous; often over moss and humus.

Selected Specimens: 3970, 4356.

Local Abundance and Distribution: infrequent; scattered along the western boundary of the CDFD subzone at inland, often higher elevations, present also in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumarctic-alpine in the Northern Hemisphere (Thomson, 1979).

PYRENULA Ach.

Thallus crustose; sometimes immersed within the substratum. Phycobiont a green alga (Trentepohlia).

Ascocarp a perithecium, compound, naked to immersed with a single, central ostiole. Paraphyses slender, simple, persistent; asci bitunicate, clavate. Spores 8 per ascus, brown, ellipsoid to oblong-ellipsoid, usually 3- but up to 7-septate, with thick walls and lenticular lumina.

Corticolous.

Pyrenula is represented better in tropical and subtropical regions.

References: Harris (1973).

PYRENULA OCCIDENTALIS (Harris) Harris ex Noble, ined.

Pyrenula neglecta Harris var. occidentalis Harris, Michigan Botanist 12:

45. 1973.

<u>Thallus</u> crustose; orbicular, up to 4 cm broad, shiny, continuous; olive-buff.

<u>Perithecia</u> common, scattered to grouped, sessile, 0.5-0.7 mm wide with a shiny, black, domed involucrellum. Ostiole often not visible or as an obscure depression, sometimes papillate. Paraphyses simple, thin, persistent; hymenium inspersed with oil droplets; asci cylindrical. <u>Spores</u> 8 per ascus, uniseriate, brown, often lighter at the ends, broadly ellipsoid, 3-septate with very thick-walled septa that produce four diamond-shaped to lenticular lumina, the end lumina immediately against the spore wall end (wall not thickened at the ends), 16-22 X 7-9 µm (see Figure 23). <u>Spot Tests</u>: perithecium K+ reddish purple (squash or cross-section under LM); hymenium IKI+ yellowish-orange; thallus UV+ pale yellow.

<u>Substratum/Habitat</u>: corticolous; two herbarium specimen reported from <u>Cornus nuttallii</u>.

Selected Specimens: UBC-L7609, UBC-L7610.

Local Abundance and Distribution: rare; distribution poorly known, collected twice by Macoun, once from the Saanich Peninsula in the southern part of the CDFD subzone and once from Comox in the adjacent CDFW subzone; no collections of this species were made during the present study.

<u>World Distribution</u>:western North America-Europe(Norway)-eastern Asia (Siberia) disjunct (Harris, 1973, pers. comm.) in the Northern Hemisphere; in North America reported from California, Oregon, Washington, and British Columbia (Harris, 1973); also reported from South Africa in the Southern Hemisphere (Harris, pers. comm.).

<u>Remarks: P. occidentalis</u> was described initially as a subspecies of the eastern North American species <u>P. neglecta</u>. Var. <u>occidentalis</u> was separated from the latter on the basis of slightly larger but still overlapping spores and a UV- thallus (lichexanthone absent)(Harris, 1973). It is now also known to have a thin layer of orange anthraquinone pigment <u>+</u> confined to the surface of the ascocarp which is lacking from <u>P. neglecta</u> (Harris, pers. comm.). On the basis of this, plus the earlier two characters, <u>P. neglecta var. occidentalis</u> is to be raised to species rank.

Despite the lack of lichexanthone in <u>P</u>. <u>occidentalis</u> the two examined local specimens do fluoresce slightly but still distinctly under UV light. However, the fluorescence is slight compared with that observed in <u>P</u>. <u>neglecta</u> (Brodo, pers. comm).

P. occidentalis is reported from several substratabesides that of

the <u>Cornus</u> of the local material. It has been collected on <u>Alnus</u>, <u>Acer</u> circinatum, and Abies as well.

Another <u>Pyrenula</u> is known from the Vancouver area. It differs from <u>P. occidentalis</u> in the uninspersed hymenium, the slightly larger spores with end lumina that are separated from the end spore wall by a thickened wall. It is apparently undescribed (Harris, pers. comm.).

RAMALINA Ach.

Thallus fruticose; caespitose to pendulous, commonly with flattened branches; entirely radially corticate (pseudoparenchymatous) underlain by strands of cartilaginous tissue; medulla thin, of arachnoid hyphae; with or without soredia or pseudocyphellae; with a basal holdfast; yellowish-green to greenish-yellow.

Ascocarp an apothecium, (sub-)terminal, marginal or laminal, sessile to substipitate. Thalline margin present. Disc concave, ochraceous to flesh-coloured, \pm pruinia. Spores 8 per ascus, ellipsoid to fusiform, straight to often curved, hyaline, 1-(3-)septate.

Corticolous or saxicolous.

References: Bowler and Rundel (1977), Howe (1913-1914), Krog and James (1977), Rundel and Bowler (1976), Rundel, Bowler, and Mulroy (1972).
3.	Thallus hollow with perforations into medullary cavity; nonsorediate, usually fertile R . <u>DILACERATA</u>
3.	Thallus not hollow; sorediate, usually sterile
	4. Branching dichotomous; soralia orbicular; medulla P+ red (occasionally P-) <u>R</u> . FARINACEA
	 Branching mainly basal and palmate; soralia slit-like, marginal; thallus PR. SUBLEPTOCARPHA

<u>RAMALINA DILACERATA</u> (Hoffm.) Hoffm., Herbarium vivum, sive collectio plantarum siccarum, caesareae universitatis Mosquensis:451. 1825.
<u>Lobaria calycaris *L. dilacerata</u> Hoffm., Deutschl. Fl. 2:140. 1795.
<u>Ramalina minuscula</u> (Nyl.) Nyl., Bull. Soc. Linn. Normandie, sér. 2, 4:164. 1870.

Fistulariella minuscula (Nyl.) Bowler & Rundel, Mycotaxon 6:199. 1977.

<u>Thallus</u> fruticose; tufted, 1-3 cm long. Branches <u>+</u> flattened, shiny, striated to often perforated (openings into the medullary cavity), 0.5-1.2 (-2.0) mm wide, little branched; algae often isolated in clumps making some parts of the thallus almost transparent; yellowish glaucous, green, + paler to one side.

<u>Apothecia</u> always present, subterminal, often with the ultimate branch tip deflected towards base and the apothecia thus appearing apical, 1.0-3.6(-5.0) mm wide. Disc concave to nearly urceolate becoming plane, occasionally splitting; heavily pruinose. Hymenium 50-60 µm high; paraphyses coherent; epithecium black. <u>Spores</u> 8 per ascus, hyaline, oblongellipsoid, 1-septate, 11-15 X 5-7 µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; on smooth-barked deciduous trees, especially Alnus and <u>Holodiscus</u>.

Selected Specimens: 3782, 4324B.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone; present but not as common in the adjacent zones.

<u>World Distribution</u>: circumboreal(-circumtemperate)(Krog, 1968) in the Northern Hemisphere; also reported from New Zealand (Martin & Child, 1972). and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

<u>Remarks</u>: There are several species of tufted and freely fruiting <u>Ramalina</u> that form a complex of incompletely understood taxa. Bowler and Rundel (1977) have segregated recently the hollow, perforate species and recognized them separately as <u>Fistulariella</u>. That genus is not recognized in this treatment. Bowler and Rundel (1977) provided a key to North American species; Du Rietz (1929a) contains an additional key.

<u>R. fastigiata</u> (Pers.) Ach., reported from Saltspring Island (Bird & Bird, 1973) is a densely tufted, slightly larger (up to 5 cm), non- to subfistulose species which lacks perforations and in North America is known only from the east (Krog & James, 1977; Hale, 1979). The local reports are probably <u>R. dilacerata</u>.

RAMALINA FARINACEA (L.) Ach., Lich. Univ.:606. 1910.

Lichen farinaceus L., Spec. Plant.:1146. 1753.

<u>Thallus</u> fruticose; tufted, 3-8 cm long. Branches flattened, stiff, smooth, shiny, <u>+</u> dichotomously branched, 0.3-1.1 mm wide but some thalli with branches up to 2.5 mm wide, becoming finely branched and subterete apically, often ending in a small recurved tip; sorediate, soredia granular, soralia marginal, short, lenticular; algae and medulla often absent from some areas of thallus and these areas almost transparent; light green to yellowish green.

Apothecia rare, marginal, sessile to substipitate, 0.6-1.5 mm wide.

Thalline margin smooth, thick, finally excluded. Disc flesh-coloured, pruinose, plane becoming convex. Hymenium 50-55 µm high; paraphyses simple, apically coherent; epithecium brown. <u>Spores</u> 8 per ascus, hyaline, oblongellipsoid, l-septate, ll-15 X 4-6 µm.

Spot Tests: medulla and soredia P+ orange(-red), occasionally P-.

<u>Substratum/Habitat</u>: corticolous; primarily on deciduous trees and shrubs especially <u>Alnus</u>, <u>Quercus</u>, and <u>Holodiscus</u> but also on some conifers; one saxicolous collection from sandstone.

Selected Specimens: 1327, 3687A.

Local Abundance and Distribution: frequent (at almost one-half of the major collection sites); scattered throughout the CDFD subzone especially but not exclusively, at maritime sites; also collected at maritime sites in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate (Krog, 1968) in the Northern Hemisphere; also reported from New Zealand (Martin, 1966) and Australia (Weber & Wetmore, 1972) in the Southern Hemisphere.

Remarks: See R. subleptocarpha for comments.

<u>RAMALINA MENZIESII</u> Tayl., non Tuck., Lond. J. Bot. 6:189. 1847. <u>Ramalina reticulata</u> (Noehd.) Kremp., Geschichte Litt. Lich. 1:86. 1867.

<u>Thallus</u> fruticose; pendulous, up to 30 or more cm long. Branches flattened, shiny, faintly to strongly striated, 0.2-0.6 mm wide, with some sections reticulately perforated producing a 'lace-effect' although these netted regions sometimes scarce; cream buff, yellowish glaucous, to yellowgreen.

<u>Apothecia and pycnidia</u> not observed. According to Herre (1910a) California specimens are abundantly fertile with apothecia scattered; spores ellipsoid or oblong, straight or curved, 1-septate, 10.8-15.75 X 4.25-4.8 μ m. According to Howard (1950) the apothecia are 1-3 mm wide, sessile; disc concolorous with thallus to salmon colored; thalline margin disappearing; spores hyaline, 11.5-16.5 X 3.9-5.9 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; on a wide variety of conifers and deciduous trees and shrubs, usually collected on seashore trees or up to several hundred meters inland, often thickly draping higher branches and then only collected as windfalls; observed in abundance at several locations on large, often isolate Acer.

Selected Specimens: 3692, 4462.

Local <u>Abundance and Distribution</u>: occasional; scattered throughout the CDFD subzone at maritime or nearby sites, also collected at maritime sites in the adjacent zones (see Figure 34).

<u>World Distribution</u>: western North American endemic; reported from California to Alaska; 'euoceanic' (Krog, 1968).

<u>Remarks</u>: The local collections often have but a few reticulate areas, these being reduced to the ends or margins of wide major branches. The degree of development of the reticulations has been attributed to water relations with several morphological variations being described (Rundel, 1974).

The unfortunate rejection of the very appropriate name <u>R</u>. <u>reticulata</u> for <u>R</u>. <u>menziesii</u> Tayl. and the resulting change of <u>T</u>. <u>menziesii</u> Tuck. to R. leptocarpha Tuck. is explained by Weber (1970).



<u>RAMALINA SUBLEPTOCARPHA</u> Rundel & Bowler, Bryologist 79:368. 1976. <u>Ramalina menziesii</u> f. <u>sorediata</u> Tuck., Proc. Wash. Acad. Sci. 12:219. 1910. Ramalina irregularis H. Magn., Svensk Bot Tidskr. 53:305. 1959.

<u>Thallus</u> fruticose, up to 6 cm long. Lobes few, mainly basal, palmately branched but occasionally dichotomously branched, (0.5-)2.5-6.0) mm wide, flattened, linear, occasionally fenestrate, slowly narrowing to an attenuated tip, shiny, smooth or faintly longitudinally striate to lacunose; sorediate, soredia farinose, in marginal slit-like soralia, occasionally laminal; green, yellowish-glaucous.

<u>Apothecia</u> rare, observed once, marginal, sessile to substipitate, 0.8-1.6 mm wide. Disc flesh-coloured, pruinose, concave becoming plane. Thalline margin thin, entire, commonly cracking. Hymenium 50 µm high; paraphyses simple, coherent; epithecium brownish from pruinia. Spores 8 per ascus, hyaline, ellipsoid, slightly curved, l-septate, 10-15 X 4-5 µm.

Spot Tests: medulla and soredia P-.

<u>Substratum/Habitat</u>: corticolous; on deciduous shrubs or trees. Selected Specimens: 6420, UBC-L7803.

Local Abundance and Distributon: rare; distribution poorly known, collected once on the Saanich Peninsula and once on Mandarte Island, both in the southern part of the CDFD subozne; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from Baja California (Rundel & Bowler, 1976) north to the Fraser Valley, British Columbia (see Figure 54).

<u>Remarks</u>: <u>R</u>. <u>subleptocarpha</u> is morphologically very plastic. The specimens vary from smooth, narrow, and short to lacunose, wide, and long (up to 18 cm long and 1.6 cm wide in a specimen from the Fraser Valley, UBC-L7804). However, the thallus is always distinctly flattened and sorediate. The narrower specimens resemble <u>R</u>. <u>farinacea</u> and can be separated by the slit-like soralia with scarce soredia, primarily basal palmate branching, and P- reaction. <u>R</u>. <u>farinacea</u>, on the other hand, tends to have nearly orbicular soralia with abundant protruding soredia, dichotomous branching, and usually a P+ red reaction.

The laminal soralia in <u>R</u>. <u>subleptocarpha</u> are infrequent and limited to specimens from the Pacific Northwest (Rundel, pers. comm.).

RAMALINA THRAUSTA (Ach.) Nyl., Syn. Lich. 1:296. 1860. <u>Alectoria thrausta</u> Ach., Lich. Univ.:596. 1810. Ramalina crinalis (Ach.) Gyeln., Fedde Repert. 38:251. 1935.

<u>Thallus</u> fruticose; pendent, up to 10 cm long, of dull to slightly shiny, terete to rather irregularly shaped (both flattened and constricted) dichotomously branched, main branches, 0.3-0.4 mm wide, apically the filaments become fine, knobby (algae restricted to certain areas, constricted in non-alga areas), with apices curled or hooked, often with a granular, terminal 'isidioid-peg'; green, pale green, pale yellowish grey-green.

Apothecia and pycnidia not observed. Apothecia unknown.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Pseudotsuga</u>. Selected Specimen: 3341.

<u>Abundance and Local Distribution</u>: rare; distribution poorly known, collected once on the Saanich Peninsula near the western boundary of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate (Krog, 1968) in the Northern Hemisphere; also reported from New Zealand (Martin, 1966) in the Southern Hemisphere.

RHIZOCARPON (Ram.) Th. Fr.

Thallus crustose; smooth and continuous to more commonly crackedareolate to distinctly areolate; grey or yellow-green; black hypothallus often well developed.

Ascocarp an apothecium, immersed to sessile on the hypothallus. Proper margin present. Disc black. Paraphyses branched and anastomosed, tightly coherent. Spores 2-8 per ascus, hyaline to usually dark brown, 1-septate to muriform, often with a hyaline halo or gelatinous epispore.

Saxicolous.

References: Runemark (1956a, 1956b), Lynge (1932), Thomson (1967b), Feuerer (in Poelt & Vězda, 1981).

1.	Saxicolous 2
1.	Overgrowing <u>Selaginella wallacei</u> or over <u>Ochrolechia</u> <u>upsaliensis</u> on <u>S. wallacei</u> <u>R. UNKNOWN</u> <u>#1</u>
	2. Thallus brown, grey, or white 3
	2. Thallus yellow-green or yellow10
3.	Thallus squamulose <u>R. BOLANDERI</u>
3.	Thallus crustose4
	4. Spores 1-septate5
	4. Spores 3-septate, submuriform, or muriform6
5.	Spores hyaline <u>R</u> . <u>HOCHSTETTERI</u>
5.	Spores darkening early <u>R</u> . cfr. <u>JEMTLANDICUM</u>
	6. Spores hyaline, darkening only at the end
	6. Spores brown early8

7.	Spores 3-septate to submuriform <u>R</u> . <u>DISTINCTUM</u>
7.	Spores finally muriform <u>R</u> . <u>OBSCURATUM</u>
	8. Spores 2/ascus <u>R. DISPORUM</u>
	8. Spores 8/ascus9
9.	Thallus white, <u>+</u> smooth, C-; apothecia subsessile; substratum HCl+R. <u>PERLUTUM</u>
9.	Thallus grey or grey-brown, of swollen, separate areoles, C+ red; apothecia sessile or adnate; substratum HClR. <u>GRANDE</u>
	10. Thallus IKI-; hypothallus absent of slightly evident; spores 15-24 X 9-10 μm <u>R</u> . <u>VIRIDIATRUM</u>
	<pre>10. Thallus IKI+ blue; hypothallus black and conspicuous; spores > 25 μm long</pre>
11.	Apothecia attached and partially encompassed by an areole <u>R</u> . <u>SPHAEROSPORUM</u>
11.	Apothecia separated from (although adjacent to) and surrounded by a single areole12
	<pre>12. Hymenium hyaline; epithecium reddish, K+ purplish</pre>
	12. Hymenium greenish; epithecium brown or green-brown, K

<u>RHIZOCARPON</u> <u>BOLANDERI</u> (Tuck.) Herre, Proc. Wash. Acad. Sci. 12: 106. 1910. Buellia bolanderi Tuck., Gen. Lich.: 189. 1872.

<u>Thallus</u> squamulose; squamules 0.8-1.7 mm wide, peltate, largely free from the substratum, initially round and plane and attached in the center, becoming lobed and plane to involute, margin whitish-grey and raised as a narrow lip; brown or reddish-brown, below black. Hypothallus conspicuous, black, thick, often fimbriate at the margin.

<u>Apothecia</u> scattered to grouped, stipitate, 0.5-1.5 mm wide. Proper margin raised, thick, quickly excluded. Disc plane becoming convex, <u>+</u> round, surface becoming uneven, fissured, or broken into separate portions, black. Hypothecium dark brown; epithecium blackish, a little purplish immedFigure 35. Selected spores of <u>Rhizocarpon</u> I. Collection numbers of specimens are given in brackets.

- A. <u>Rhizocarpon</u> <u>bolanderi</u> (4151A)
- B. Rhizocarpon disporum (3278)
- C. Rhizocarpon distinctum (3455)
- D. <u>Rhizocarpon geographicum</u> (4678A)
- E. <u>Rhizocarpon</u> grande (4711)
- F. <u>Rhizocarpon hochstetteri</u> (5170)
- G. <u>Rhizocarpon</u> cfr. jemtlandicum (3489)
- H. Rhizocarpon obscuratum (2403)



Figure 36. Selected spores of <u>Rhizocarpon</u> II. Collection numbers of specimens are given in brackets.

- I. <u>Rhizocarpon perlatum</u> (5077)
- J. Rhizocarpon riparium (4678B)
- K. Rhizocarpon sphaerosporum (2196)
- L. Rhizocarpon viridiatrum (3709)
- M. Rhizocarpon unknown <u>#1</u> (4154)





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iately below; exciple dark brown externally; hymenium 100 μ m high, hyaline, or with brownish patches. <u>Spores</u> 2 per ascus, brown, oblong-ellipsoid, muriform (7-9 latitudinal septa; 3-5 longitudinal septa), often slightly constricted in center, 35-45 X 18-28 μ m, with a gelatinous halo (see Figure 35).

<u>Spot Tests</u>: thallus IKI-, K-, C-, KC-, P-; hymenium IKI+ blue; exciple and epithecium <u>+</u> purplish.

<u>Substratum/Habitat</u>: saxicolous; collected twice on igneous rocks on exposed hillsides at higher elevations inland.

Selected Specimens: 3644, 4151A.

Local Abundance and Distribubion: rare; distribution poorly known; collected twice on the Saanich Peninsula in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America(Greenland)-Europe(Scandinavia) disjunct (Thomson, 1967b; Degelius, 1956; Gelting, 1954); in western North America reported from California, Oregon, Washington, Nevada, Alberta (Drumheller) (Thomson, 1967b) and British Columbia (Otto & Ahti, 1967).

<u>Remarks</u>: <u>R</u>. <u>bolanderi</u> and <u>Lecidea unknown #1</u> are superficially similar. The latter also has a brown squamulose thallus with large, black apothecia but it lacks the raised, grey, marginal lip present on the squamules of <u>R</u>. <u>bolanderi</u>. Instead the edge of the squamules is raggedly outlined in white and black.

It appears that <u>R</u>. <u>bolanderi</u> is sometimes parasitized by 'Lecanora' scotopholis. See the latter species for comments.

<u>RHIZOCARPON DISPORUM</u> (Naeg. ex Hepp) Muell. Arg., Rev. Mycol. 1:170. 1879. Lecidea dispora Naeg. ex Hepp, Flecht. Eur. No. 28. 1853.

<u>Thallus</u> crustose; completely divided into areoles which are scattered to contiguous, usually convex, grey pruinose, or exposing a brown coloration if abraided. Hypothallus black, conspicuous between areoles or sometimes only visible at margin, occasionally inconspicuous when substratum is friable.

<u>Apothecia</u> scarce to abundant, usually scattered, adnate or sometimes level with areoles, 0.5-0.8(-1.0) mm wide. Proper margin usually thick, slightly raised, persistent or occasionally almost excluded, black. Disc plane, not constricted, surface minutely roughened, black or sometimes reddish black. Hypothecium medium brown; epithecium brown with a slight reddish tinge; hymenium 100-140 μ m high, <u>+</u> hyaline. <u>Spores</u> 2 per ascus, brown, oblong to ellipsoid, muriform (7-13 latitudinal septa; 3-5 longitudinal septa; first walls darkest), often constricted at the center, 42-60 X 20-25(-32) μ m (see Figure 35).

<u>Spot Tests</u>: thallus IKI-, K-, KC-, C-, P-; hymenium IKI+ blue; epithecium K+ red-violet (almost a bleaching reaction rather than a colour change).

<u>Substatum/Habitat</u>: saxicolous; collected on all rock types in the supralittoral zone.

Selected Specimens: 3278, 4172.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites; not collected in the adjacent zones.

<u>World Distribution</u>: (circumarctic-alpine-)circumboreal in the Northern Hemisphere (Thomson, 1979; Ozenda & Clauzade, 1970); also reported from New Zealand (Martin, 1966) and Argentina (Grassi, 1950) in the Southern Hem-

isphere.

RHIZOCARPON DISTINCTUM Th. Fr., Lich. Scand. 1:625. 1874.

<u>Thallus</u> crustose; areolate; areoles thin, <u>+</u> plane, irregular angular to occasionally incompletely cracking, scattered in groups to usually almost continuous; medium grey to grey-brown. Hypothallus present, black.

<u>Apothecia</u> common, scattered to grouped, level with the areoles to almost adnate, 0.3-0.8 mm wide. Proper margin thin, raised or even, persistent although often inconspicuous because of similarity with disc, <u>+</u> shiny, black. Disc round to angular by compression, <u>+</u> plane, not constricted, matt, black. Hypothecium medium (gold-)brown; epithecium black to reddish black; exciple (reddish-)brown externally; hymenium 90-100 μ m high, hyaline. <u>Spores</u> 8 per ascus, hyaline, oblong to pointed-ellipsoid, submuriform (initially 3- to 4-septate but quickly with one or more of these primary cells dividing longitudinally), (21-)25-28(-30) X (9-)11-12 μ m, with a gelatinous halo (see Figure 35).

<u>Spot Tests</u>: thallus IKI+ blue, K-, C-, KC-, P-; hymenium IKI+ blue; epithecium K+ purplish (bleaching reaction); exciple K+ reddish purple (colour change, confined to exciple, no washing of colour away).

<u>Substratum/Habitat</u>: saxicolous; collected on conglomerate, and granitic and other igneous rock.

Selected Specimens: 1385C, 2592.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at both inland and maritime sites; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively (circumarctic)-circumboreal; Thomson (1967b) reported it from arctic Canada, Greenland, Novaya Zemlya, and

Europe and suggested it was perhaps an amphi-Atlantic species; however, outside this range it has been reported from Wyoming (Wetmore, 1968), California (Herre, 1910a; Fink, 1935) and British Columbia (Merrill, 1914). Ozenda and Clauzade (1970) stated it is found throughout the temperate and cold regions of the Northern Hemisphere; also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: None of the available descriptions mentioned the exciple of <u>R</u>. <u>distinctum</u> as K+ red. Thomson (1967b) actually stated it is K- for the material he examined. The western North American specimens perhaps require further study.

<u>RHIZOCARPON</u> <u>GEOGRAPHICUM</u> (L.) EC., Flore Franç.:365. 1805. <u>Lichen geographicum</u> L., Sp. Pl.:1140. 1753.

<u>Thallus</u> crustose; areolate; areoles angular and clustered, \pm continuous occasionally rounded, incompletely cracked and separate, especially at thallus margin, \pm plane, smooth, almost shiny; greenish-yellow. Hypothallus black, conspicuous at margin and between separated areoles, black.

<u>Apothecia</u> abundant, clustered, occasionally scattered, below or level with areoles, not attached to areoles, 0.5-1.0 mm wide. Proper margin thin, raised, persistent. Disc angular by compression, <u>+</u> plane, surface minutely roughened but shiny, black. Hypothecium medium (golden-)brown; epithecium pale red to reddish brown; hymenium <u>+</u> hyaline, 135-150 μ m high. <u>Spores</u> 8 per ascus, brown, ellipsoid, muriform (3-5 latitudinal septa; 1-2 longitudinal septa), 26-32 X 12-16 μ m, with a gelatinous halo (see Figure 35).

<u>Spot Tests</u>: thallus IKI+ blue, K-, C-, KC-, P+ yellow; hymenium IKI+ blue; epithecium K+ purplish (bleaching reaction).

Substratum/Habitat: saxicolous; collected once on conglomerate.

Selected Specimen: 4678A.

Local Abundance and Distribution: rare; distribution poorly known, collected once at a higher elevation (660 m) inland in the CDFW subzone, not collected in the CDFD subzone.

<u>Remarks:</u> <u>R</u>. <u>geographicum</u> is distinguished by the green-yellow thallus which is IKI+ blue and the red-brown epithecium which is K+ purple. <u>R</u>. <u>viridiatrum</u>, which is much more common in the area, also has a K+ epithecium but possesses an IKI- thallus, poorly developed hypothallus, dull apothecia which are often raised above the areoles, and spores which are smaller and quickly blacken to obscure the septation. <u>R</u>. <u>riparium</u> is essentially the same as <u>R</u>. <u>geographicum</u> but with a greenish hymenium that is K-.

<u>R</u>. <u>geographicum</u> is a very widespread, polymorphic species with a much larger range in spore size and chemistry than the single local collection exhibits.

<u>RHIZOCARPON</u> <u>GRANDE</u> (Floerke) Arn., Flora 54:149. 1871.
<u>Lecidea</u> <u>petraea</u> *β* <u>fuscoatra</u> <u>C</u>. <u>grandis</u> Floerke, Flora 11:690. 1828.

<u>Thallus</u> crustose; of separate to incompletely cracked areoles; continuous or often clustered in groups, areoles rounded to angular by compression, slightly convex; white-grey or somewhat brownish. Hypothallus black, conspicuous between areoles or often wide at the margin.

<u>Apothecia</u> common, usually abundant, scattered or grouped, level with areoles or adnate, 0.4-0.7(-0.9) mm wide. Proper margin thin, even or slightly raised, black, often very inconspicuous because of similarity to disc. Disc round to angular, <u>+</u> plane, usually smooth, sometimes shiny, black. Hypothecium medium brown; epithecium brown with reddish tints or sordid green (green-brown, green-black); hymenium 100-125 μ m high, hyaline if epithecium red-brown, pale greenish if epithecium sordid green. <u>Spores</u> 8 per ascus, brown, oblong to ellipsoid, muriform (7 latitudinal septa; 1-3 longitudinal septa), 30-40 X 10-14 μ m, with a gelatinous halo (see Figure 35).

<u>Spot Tests</u>: thallus IKI+ faint blue, K-, C+ red (cortex and medulla, strong and persistent), P<u>+</u> orange; hymenium IKI+ blue; epithecium K+ red (if epithecium brown-red) or K- (if epithecium sordid green).

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone, conglomerate, and igneous rock.

Selected Specimens: 4667, 4711.

Local Abundance and Distribution: infrequent; collected in the Duncan and Saltspring Island area of the CDFD subzone; once from a high elevation (500 m) but also once from a supralittoral site, also one collection in the adjacent CDFW subzone at a high elevation (630 m) inland.

<u>World Distribution</u>: circumarctic-circumtemperate (Thomson, 1979) in the Northern Hemisphere; also reported from New Zealand (Galloway, 1968) in the Southern Hemisphere.

<u>Remarks: R. grande</u> is usually described as having a K+ violet epithecium (Poelt, 1969; Ozenda & Clauzade, 1970); Wetmore, 1968). Thomson (1967b), however, described it as "usually K+". Additionally Thomson (op. cit.) is the only one who described the epithecium colour as olivaceous brown as well as reddish brown. From the local material examined the K reaction appears to be a bleaching reaction rather than a colour change such that a reddish brown epithecium would bleach to reddish and an olivaceous brown epithecium would not. Other than the epithecium colour and associated K reaction the local material closely agrees with the European descriptions. <u>RHIZOCARPON</u> <u>HOCHSTETTERI</u> (Koerb.) Vain., Acta Suc. F. Fl. Fenn. 53:280. 1922. Catillaria hochstetteri Koerb., Parerga Lich.:195. 1861.

Thallus crustose; thin, \pm continuous, cracked-areolate to chinkyareolate, areoles plane, 0.2-0.4 mm wide; medium grey, grey-brown, or almost reddish brown. Hypothallus absent or at margin only.

<u>Apothecia</u> few, <u>+</u> scattered, between areoles, 0.3-0.6 mm wide. Proper margin thin, occasionally thick, raised, persistent, black. Disc plane, round, black. Hypothecium medium-brown; epithecium sordid (green-)grey; exciple greenish-black or bluish black on the outer edge; hymenium 80-90 µm high, hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, 1-septate (cells equal or often one shorter and/or wider), (13-)16-23 X 7-11 µm (see Figure 35).

<u>Spot Tests</u>: thallus IKI-, K-, KC-, C-, P-; hymenium IKI+ blue; epithecium K-.

<u>Substratum/Habitat</u>: saxicolous; collected three times, twice on igneous rocks and once on sandstone.

Selected Specimens: 4777, 5170.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at inland and maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumboreal (Thomson, 1979) in the Northern Hemisphere.

<u>Remarks</u>: Most European descriptions of <u>R</u>. <u>hochstetteri</u> listed somewhat larger spores than those observed in the local material: 19-29 X 9-14 μ m (Ozenda & Clauzade, 1970; Magnusson, 1952); 25-36 X 12-17 μ m (Duncan, 1970); 19-24 X 9-14 μ m (Poelt 1969). Thomson (1967b, 1979) listed a much wider range, 11-29 X 9-14 μ m.

RHIZOCARPON cfr. JEMTLANDICUM Malme, Svensk Bot. Tidskr. 8:283. 1914.

<u>Thallus</u> crustose; areolate; areoles scattered to clustered in groups, plane to slightly convex, the larger ones often incompletely cracking, 0.4-0.6(-0.8) mm wide; brown-grey to almost purple-grey. Hypothallus conspicuous between the areoles, black.

<u>Apothecia</u> scarce to abundant, scattered to grouped, level with areoles or adnate if thallus very thin, 0.4-0.8(-1.0) mm wide. Proper margin thin, raised or occasionally even, persistent. Disc round to irregular by compression, not constricted, <u>+</u> plant, surface almost smooth, black. Hypothecium medium brown; epithecium brown, orange-brown or brown with reddish purple sections immediately below; hymenium 120-130 um high, hyaline; exciple reddish brown. <u>Spores</u> 8 per ascus, brown, pointed-ellipsoid, 1-septate, 27-33 X 12-16 μ m (see Figure 35).

<u>Spot Tests</u>: thallus IKI-, K+ yellow, KC-, C-, P+ orange; hymenium IKI+ blue; exciple K+ blood red with some colour washing away; epithecium K- or K+ violet-red (bleaching reaction).

Substratum/Habitat: saxicolous; collected once on igneous rock.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Saltspring Island at an inland site, in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumarctic(-circumboreal); reported from Scandinavia, Spitzbergen, Bear Island, Taimir Peninsula (Siberia), Baffin Island, Ellesmere Island, Greenland (Thomson, 1967b) as well as Maine (Degelius, 1940).

<u>Remarks</u>: The local material is only tentatively identified as <u>R</u>. <u>jemtlandicum</u> because there is only a single collection and it is intermediate between <u>R</u>. <u>jemtlandicum</u> and <u>R</u>. <u>cinereonigrum</u> Vain. Both species have 1-septate, brown spores, and both probably contain stictic acid (K+ yellow, P+ orange). Thomson (1967b) mentioned in his key that R. cinereonigrum contained stictic acid but in the accompanying text stated that although it was K+ yellow it was P- and therefore lacked stictic acid. Runemark (1956a), listed R. cinereonigrum as containing stictic acid. In contrast R. jemtlandicum is described as having a greenish-black to olivaceous epithecium (K-) and an excipe that is K+ violet-reddish while R. cinereonigrum is described as having a red-brown epithecium (K+ violet-red) and K- exciple (Thomson, 1967b). Feuerer (in Poelt & Vězda, 1981) also added that R. cinereonigrum has a greyish thallus with apothecia to over 1 mm wide; R. jemtlandicum a greyish brown to reddish grey thallus with apothecia 1-1.5 mm wide. The local material shares characters of both species, having a K+ exciple as well as a reddish-brown epithecium. The thallus colour has definite purplish tints that would appear to be similar to the reddish grey reported for R. jemtlandicum. The latter species is much more widespread, being probably circumpolar while R. cinereonigrum has a much more restricted distribution, being reported from Finland, Novaya Zemlya, and Greenland (Thomson, 1967b). Bird and Bird (1973) recently reported it from Saltspring Island. That specimen has not been examined.

The local material appears to be closest to \underline{R} . <u>jetlandicum</u>, agreeing in the excipular reaction, spore size and septation, and thallus coloration but differing in the epithecium colour and apothecia size. This problem requires further study.

<u>RHIZOCARPON</u> <u>OBSCURATUM</u> (Ach.) Mass., Ric. Lich.: 103, f. 207. 1852. Lecidea petraea var. obscurata Ach., Lich. Univ.: 156. 1810.

<u>Thallus</u> crustose; usually thin, \pm continuous, finely cracked-areolate with areoles smooth and plane, occasionally slightly convex; grey to brown-

ish-grey with black hypothallus present at margin or inconspicuous depending on substratum. On cobbles the thallus is often very thin, discontinuous, incompletely areolate-cracked and \pm shiny with a black conspicuous hypothallus between areoles and forming a large border at the margin.

Apothecia usually abundant, <u>+</u> scattered, level with areoles or occasionally adnate, 0.4-0.7(-1.0) mm wide. Proper margin thick, persistent, usually raised, smooth, often shiny, black with occasionally remnants of thallus persistently clinging. Disc plane, occasionally slightly convex, not constricted, minutely roughened, black or occasionally reddish-brown. Hypothecium dark orange-brown; exciple externally blue-black; epithecium pale to medium brown, sordid brown, or green-brown; hymenium 90-130 µm high, hyaline or scattered brownish patches, occasionally pale sordid green toward top. <u>Spores</u> 8 per ascus, hyaline to finally browning, oblong to ellipsoid, initially 3-septate quickly becoming submuriform (3-7 latitudinal septa; 0-2 longitudinal septa with end cells usually undivided), 21-27(-32) X 10-12 µm, usually with a gelatinous halo (see Figure 35).

<u>Spot Tests</u>: thallus IKI-, C-, K-, KC-, P-; hymenium IKI-; epithecium K-; exciple K+ sordid yellow wash (slow).

<u>Substratum/Habitat</u>: saxicolous; common on all rock types plus loose cobbles.

Selected Specimens: 838, 2403.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at both inland and maritime sites; also present, but not as common, in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumboreal; known from Europe (Poelt, 1969), Novaya Zemlya, Bear Island, Jan Mayen, Spitzbergen, Greenland, Siberia and in North America from Newfoundland, Maine, Massachusettes, New Jersey, New York, Tennessee, Illinois, Wisconsin, Minnesota (Thomson,

1967b), Ontario (Brodo, 1981), Michigan (Harris, 1977), Saskatchewan (Bird, 1972), and Colorado (Anderson & Carmer, 1974).

<u>Remarks</u>: The spore range reported for <u>R</u>. <u>obscuratum</u> usually ranges much higher than that observed in the local material, up to 50 μ m in length (Duncan, 1970) and correspondingly larger apothecia. The local material agrees in the smaller spores and apothecia size with var. <u>obsur-</u> atum described in Poelt (1969).

RHIZOCARPON PERLUTUM (Nyl.) Zahlbr., Pflanzenf. 1. 18:138. 1905. Lecidea perluta Nyl., Flora 59:575. 1876.

Rhizocarpon petraeum (Wulf.) Mass., non auct., Ricerch. Auton. Lich.: 102. 1852.

<u>Thallus</u> crustose; thin, discontinuous or continuous, <u>+</u> smooth or finely cracked, almost pure white. Hypothallus black, thin, barely outlining the discontinuous thallus.

<u>Apothecia</u> abundant, scattered, <u>+</u> immersed to subsessile and then immediate thallus raised up in an almost pseudothalline margin which may become partially darkened like the adjacent proper margin, finally cracking separate or remaining partially attached to proper margin, 0.6-1.1 mm wide. Proper margin <u>+</u> thick, raised, persistent, black or partially whitened from shreds of adjacent pseudothalline margin. Disc plane, surface <u>+</u> smooth, brown-black to black, epruinose. Hypothecium orange-brown; epithecium pale or sordid grey; hymenium 150-160 µm high, hyaline. <u>Spores</u> 8 per ascus, hyaline or finally darkening with age or also when aborted, oblong or ellipsoid-pointed, or enlarged at one end, muriform (5-9 latitudinal septa; 0-3 longitudinal septa with end cells usually undivided), (27-)32-42 X 11-16 µm (see Figure 36).

<u>Spot Tests</u>: thallus IKI-, K-, KC-, C-, P-; hymenium IKI+ blue; epithecium K-.

<u>Substratum/Habitat</u>: saxicolous; collected once on sandstone (HCl+ in places) with Lecidea monticola.

Selected Specimen: 5077.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CDFW subzone on a river bank, not collected in the CDFD subzone.

<u>Remarks</u>: <u>R</u>. <u>perlutum</u> slightly resembles <u>R</u>. <u>obscuratum</u> with raised, persistent margin, subsessile apothecia and thin thallus but the former species has a very white coloured thallus which is not areolate-cracked with larger apothecia and spores.

R. perlutum is reported here as new to the province.

RHIZOCARPON RIPARIUM Räs., Ann. Bot. Soc. Zool.-Bot. Fenn. Vanamo 16:60. 1942.

Rhizocarpon lindsayanum Räs., Revist. Sudamer. Bot. 7:87. 1942.

<u>Thallus</u> crustose; areolate, areoles 0.4-1.1 mm wide, rounded, incompletely cracking and separate, to smaller, angular and \pm continuous; \pm plane, smooth, shiny; greenish yellow. Hypothallus black, conspicuous at margin and between areoles.

Apothecia scarce, level or below level of areoles, not attached to areoles, scattered to grouped, 0.3-0.6 mm wide. Proper margin thin, raised, persistent. Disc oval to angular, plane, shiny, black. Hypothecium medium (orange-)brown; epithecium pale brown; hymenium 130-175 µm high, pale green. Spores 8 per ascus, brown (or first blue-grey), ellipsoid, muriform (3-5 latitudinal septa; 1-3 longitudinal septa, some septa oblique), 27-37 X 13-18 µm, often with a gelatinous halo (see Figure 36). <u>Spot Tests</u>: thallus IKI+ blue, K-, KC-, C-, P+ yellow; hymenium IKI+ blue; epithecium K-.

<u>Substratum/Habitat</u>: saxicolous; collected once on conglomerate. Selected Specimen: 4678B.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CDFW subzone at a high elevation (630 m) inland; not collected in the CDFD subzone.

<u>Remarks</u>: Some authors believe <u>R</u>. <u>riparium</u> is possibly a form of <u>R</u>. <u>geographicum</u> but continue to recognize it at the species level (Duncan, 1970; Wetmroe, 1968). According to Thomson (1967b) and also what was observed in the local material, <u>R</u>. <u>obscuratum</u> exhibits the same variation of epithecium colour that is used to separate these two species.

RHIZOCARPON SPHAEROSPORUM Räs., Ann. Bot. Soc. Zool. -Bot. Fenn. Vanamo 19:

6. 1944.

<u>Thallus</u> crustose; areolate; the areoles round to slightly lobed, scattered or clustered in groups or scattered at the margin and continuous toward the center, plane to slightly convex or older areoles very convex, smooth, matt to almost shiny; bright yellow-green. Hypothallus black, at margin and between scattered areoles.

<u>Apothecia</u> few to abundant, lower or level with areoles, attached closely to at least one areole which partially arches around it, 0.2-0.5 mm wide. Proper margin inconspicuous to often thick on exposed side and inconspicuous on attached areole side, or occasionally thick on both sides, black, matt. Disc round to oval-elongate, concave to sometimes plane, minutely roughened, but shiny black. Hypothecium medium (orange-)brown; epithecium pale brown; hymenium 150-200 µm high, hyaline to often pale greenish throughout or above. <u>Spores</u> 8 per ascus, brown, oblong to pointed ellipsoid, muriform (7-9 latitudinal septa; 1-3 longitudinal septa), 35-44 X 14-17 μm, often with a gelatinous halo (see Figure 36).

<u>Spot Tests</u>: thallus IKI+ blue, K<u>+</u> yellow, C-, P<u>+</u> orange; hymenium IKI+ blue; epithecium K-; exciple K<u>+</u> orange or orange-brown.

<u>Substratum/Habitat</u>: saxicolous; on igneous rocks and the pebbles of conglomerate on exposed hillsides inland.

Selected Specimens: 3643, 4165A

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone especially toward the western boundary at higher elevations inland, absent from the Gulf Islands except for Saltspring Island; present also in the adjacent zones (see Figure 37).

<u>World Distribution</u>: western North America-Europe disjunct; in North America reported from Colorado (Anderson, 1965).

RHIZOCARPON VIRIDIATRUM (Wulf.) Koerb., Syst. Lich. German.:262. 1855. Lichen viridiater Wulf., Collect. Botan. 2:186. 1788.

<u>Thallus</u> crustose; areolate; areoles irregular, 0.3-0.5(-0.9) mm wide, <u>+</u> plante, occasionally smooth to more often finely cracked or wrinkled to subpulverulent, scattered to more often grouped and continuous; yellowishgreen. Hypothallus often absent, occasionally as a very thin, inconspicuous, and incomplete black webbing at margin or between areoles, especially on smooth, hard rock surfaces.

<u>Apothecia</u> scarce to often abundant, scattered to grouped, 0.3-0.7 mm wide. Proper margin thin, even, persistent or excluded, black. Disc adnate, level with areoles or raised, free from areoles, round to angular by compression, plane to slightly convex, surface minutely roughened, black. Hypothallus medium to dark brown; epithecium dense black almost granular, red-purple immediately below; hymenium 85-125 µm high. <u>Spores</u> 8



per ascus, brown to quickly very dark and septation obscured, ellipsoid, muriform (3(-5) latitudinal septa; at least one cell becoming longitudinally septate, often obliquely), 15-21(-25) X 8-11 µm (see Figure 36).

<u>Spot Tests</u>: thallus IKI-, C-, K-, KC-, P-; hymenium IKI+ blue; epithecium K+ brighter red below black layer.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone, comglomerate, granitic and other igneous rocks.

Selected Specimens: 2578, 4165 B.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone at both inland and maritime sites; not collected in the adjacent zones (see Figure 38).

<u>World Distribution</u>: tentatively western North America-Europe disjunct; described as "widely distributed in temperate regions of the northern and southern hemisphere, also known from mountains in the tropics" (Runemark, 1956b); also reported from South Africa, Australia, New Zealand, Juan Fernandez as well as high altitudes in East Africa and Bolivia in South America (Runemark, 1956b) in the Southern Hemisphere; in North America reported only from California (Herre, 1910a; Hasse, 1913; Fink, 1935; Runemark, 1956b).

<u>Remarks: R. viridiatrum</u> is usually described as parasitic on <u>Lecidea</u> and <u>Aspicilia</u> species. In most cases the local material was closely associated with other crustose species especially <u>Aspicilia</u> species but also several times with <u>Pertusaria chiodectonoides</u> which is itself only infrequent in the study area.

Runemark (1956b) described the European distribution of <u>R</u>. viridiatrum as being bound to the middle European oak region, rarely occurring in the Mediterranean region with its northermost limit coinciding with the begin-



ning of the boreal conifer forest region.

R. viridiatrum is reported here as new to the province.

RHIZOCARPON UNKNOWN #1

<u>Thallus</u> crustose; smooth, very thin, light grey to brown-grey or <u>+</u> obsolete and present only below or in the immediate vicinity of apothecia. Hypothallus absent.

<u>Apothecia</u> abundant, often clustered, adnate, 0.2-0.5 mm wide. Proper margin thin, entire, black, quickly excluded. Disc not constricted, round or oval or angular by compression, plane to slightly convex, black. Hypothecium brown-black; epithecium thick, (blue-)black, granular; hymenium 90-110 μ m high; largely hyaline but with blackish and/or small purplishred granules; paraphyses branched, coherent. <u>Spores</u> 8 per ascus, pale blue-black becoming quite dark black and obscuring septation, muriform (3-5 longitudinal septa; 1-2 latitudinal septa with end cells undivided), often constricted at middle, 22-27(-35) X 12-16 μ m, <u>+</u> faint halo (see Figure 36).

Spot Tests: thallus not tested; hymenium and epithecium K-.

<u>Substratum/Habitat</u>: 'muscicolous'; collected once on dead <u>Selaginella</u> <u>wallacei</u> with and often overgrowing <u>Ochrolechia</u> <u>upsaliensis</u>, possibly parasitic on the latter.

Selected Specimens: 4154.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Mt. Finlayson on the southwestern boundary of the CDFD subzone; not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: Most <u>Rhizocarpon</u> species are saxicolous and have a <u>+</u> welldeveloped, often areolate thallus with a black hypothallus. However,

many species of Rhizocarpon are parasitic on other lichens which may be the case here, explaining the very reduced thallus. Like the local R. viridiatrum, a known parasitic species, this Rhizocarpon has a black, granular epithecium and very dark spores. Feuerer (in Poelt & Vézda, 1981) included two species belonging to subgen. Phaeothallus. R. malenconianum (Llimona & Werner) Hafell. & Mayrhofer is apparently parasitic on Diploschistes which is always on gypsum. It has 0.4-0.7 mm broad apothecia which are thinly rimmed or rim absent, convex; spores mostly 3-septate or faintly muriform, dark brown to black-brown, 15-23 X 6-10 µm. R. advenulum (Leight.) Hafell. & Poelt is parasitic on Pertusaria species. It has apothecia 0.4-0.7 mm wide, plane to slightly convex, rimmed when young, later excluded; spores 1-septate, 18-23 X 11-15 µm. R. advenulum is known only from Great Britain while R. malenconianum is more widespread with records from Norway, France, Spain, and Czechoslovakia. The local material would appear closest to R. malenconianum on spore description alone. The problem requires further study and the collection of additional material.

Fink (1935) mentioned one species of <u>Rhizocarpon</u> with reduced thallus, <u>R. athalloides</u> (Nyl.) Hasse, collected in southern California. However, that species apparently belongs in <u>Gyalideopsis</u> (Vězda, 1972).

RINODINA (Ach.) Gray

Thallus crustose; granulose, verrucose, to cracked-areolate; with or without soredia or isidia; usually grey. Hypothallus occasionally present.

Ascocarp an apothecium, subsessile to sessile. Thalline margin present, concolorous with the thallus or darker but not usually concolorous with the disc, persistent to excluded. Disc brown or black. Paraphyses

<u>+</u> simple, free; hypothecium usually hyaline, occasionally darkening. Spores 8(-24) per ascus, brown, ellipsoid, usually 1-septate and polarilocular, sometimes 3-septate, occasionally septum absent but walls still thickened-polarilocular.

Corticolous, lignicolous, saxicolous, muscicolous.

<u>Rinodina</u> in North America is currently being studied by Dr. J. Sheard. who has examined a representative sample of the local flora. Some of his preliminary results are presented here. This treatment is only tentative pending completeion of the monograph.

<u>Rinodina</u> is currently being studied also by European lichenologists and has resulted in several segregate genera being removed. These include <u>Rinodinella</u> (Mayrhofer & Poelt, 1978a) and <u>Phaeorrhiza</u> (Mayrhofer & Poelt, 1978b) which do not occur locally although the latter does occur in the interior of the province.

References: Sheard (1967), Magnusson (1947a, 1947b, 1953), Mayrhofer and Poelt (1979), Poelt (1969).

1. Saxicolous	2
1. Corticolous or muscicolous	5
<pre>2. Thallus K+ yellow; light grey to off-white; spores >16 μm long</pre>	. 3
2. Thallus K-; dark grey, sometimes olive green in shade; spores < 16 μm longR. <u>GENNAL</u>	RII
3. Spores mischoblastic (thick-walled all over; lumina hour-glass shaped) <u>R. VERRUC</u>	DSA
3. Spores polarilocular	. 4

	 Apothecial margin becoming crenulate; disc epruinose; spores < 20 μm long, lumina remaining angular<u>R</u>. <u>CONFRAGOSA</u>
	 Apothecia margin + entire (to subcrenulate); disc lightly white pruinose; spores > 20 μm, lumina becoming rounded with age
5.	Muscicolous
5.	Corticolous
	6. Spores 3-septate when mature
	6. Spores 1-septate even with age7
7.	Thallus K-; apothecia ≤ 0.5 mm
7.	Thallus K+ yellow; apothecia > 0.5 mm
	8. Hypothallus conspicuous, black; thallus purplish-tan (to grey); disc subsessile, <u>+</u> pruinose; margin not concolorous with the thallus <u>R</u> . <u>HALLII</u>
	8. Hypothallus absent (or inconspicuous); thallus brown or often whitish; disc adnate to sessile; margin concolorous with thallus9
9.	Thallus and/or thalline margin sorediate, or thallus isidiate10
9.	Thallus and thalline margin esorediate and nonisidiate
	1 <u>0</u> . Thallus and margin sorediate
	10. Thallus isidiate #1
11.	Thallus light grey or white, K+ yellow12
11.	Thallus dark brown, KR. <u>EXIGUA</u>
	12. Spores 15-17 μm long <u>R</u> . <u>MARYSVILLENSIS</u>
	12. Spores 20-25 μm long

RINODINA ARCHAEA (Ach.) Arn., Flora 64:195. 1881.

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Parmelia sophodes var. archaea Ach., Meth. Lich.: 156. 1803.

<u>Thallus</u> crustose; smooth, thin, barely coating substratum, sometimes scant or indistinct; whitish-grey. Hypothallus absent.

Apothecia abundant, crowded, sessile, 0.2-0.5 mm wide. Thalline

Figure 39. Selected spores of <u>Rinodina</u>, <u>Thelotrema</u>, and <u>Toninia</u>. Collection numbers of specimens are given in brackets.

- A. Rinodina bolanderi (4183)
- B. Rinodina conradii (7302)
- C. <u>Rinodina confragosa</u> (1761)
- D. <u>Rinodina gennarii</u> (1769)
- E. <u>Rinodina hallii</u> (1501B)
- F. <u>Rinodina willeyi</u> (4147B)
- G. Rinodina verrucosa (837)
- H. <u>Rinodina</u> unknown <u>#1</u> (7409)
- I. Thelotrema lepadinum (2163)
- J. Toninia ruginosa (3968B)


margin entire, thin, sometimes excluded. Disc plane, black. Hymenium 50 μ m high; epithecium light orange-brown; hypothecium hyaline to faintly greyish. <u>Spores</u> 8 per ascus, brown, polarilocular, 1-septate with distinct septum, not constricted on one side causing spore to appear slightly bent, 18-24 X 7-8(-10) μ m.

Spot Tests: thallus not tested; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: 'muscicolous'; collected once on <u>Selaginella</u> wallacei with <u>Ochrolechia upsaliensis</u>.

Selected Specimen: 885B.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Galiano Island in the southern part of the CDFD subzone at an exposed, high elevation (300 m) inland; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively cincumarctic-circumboreal with "uncertain range in North America due to difficulties in identifications and confusions with related species" (Thomson, 1979); also reported from Antarctica (Lindsay, 1977) as <u>R. archaeoides</u>.

<u>Remarks</u>: This single specimen was originally determined as <u>R</u>. <u>archae-oides</u> H. Magn. because of the substratum but apparently this species does not differ significantly from <u>R</u>. <u>archaea</u> (Sheard, pers. comm.). <u>R</u>. <u>archaea</u> is usually considered a boreal species this is corticolous on conifers. Most floras recognize both species.

The thallus of <u>R</u>. <u>archaea</u> is described as varying from grey to brown (Ozenda & Clauzade, 1970). The muscicolous form (<u>R</u>. <u>archaeoides</u>) is usually described as brown (Ozenda & Clauzade, 1970; Wetmore, 1968), however the local material is decidedly light coloured. Magnusson (1947b), in publishing the name <u>R</u>. <u>archaeoides</u>, described the thallus as "albescens". Wetmore (1968) noted that the young spores of <u>R</u>. <u>archaea</u> were not constricted, while the older spores were sometimes constricted at the septum.

For additional comments see R. exigua.

RINODINA BOLANDERI H. Magn., Bot. Not. 1947:51,52. 1947.

<u>Thallus</u> crustose; of scattered, small, flattened areoles, or appearing granulose if areoles are all similar in size; thicker around apothecia; becoming well developed in some specimens and areoles then becoming free at margins and ascending, although not quite squamulate; light grey to greenish grey. Hypothallus absent.

Apothecia scattered, subsessile becoming adnate, 0.5-1.5 mm wide. Thalline margin entire, smooth to usually crenulate in large apothecia. Disc black, plane, lightly white pruinose or not, especially toward the margin. Hymenium 65-75 µm high; epithecium dark to golden brown; hypothecium light fulvous. <u>Spores</u> 8 per ascus, brown, ellipsoid, polarilocular, septum + distinct, 19-24 X 9-10 µm (see Figure 39).

Spot Tests: thallus K+ yellow.

<u>Substratum/Habitat</u>: saxicolous and corticolous; collected once on igneous rock and once on <u>Quercus</u>, the latter collection sent to CANL for exsiccati distribution.

Selected Specimens: 4083, 7288.

Local Abundance and Distribution: rare; distribution poorly known, collected twice on the Saanich Peninsula in the southern part of the CDFD subzone at inland sites, not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; described from California; also tentatively reported (cfr.) from the Canary Islands (Gilbert, 1982).

<u>Remarks:</u> <u>R</u>. <u>bolanderi</u> was originally described as humicolous (Magnus son, 1947a). Sheard (pers. comm.) reported that it has the ability to grow on a wide variety of substrata including rocks, bark, and moss.

Saxicolous <u>R</u>. <u>bolanderi</u> is very similar to (perhaps inseparable from) R. confragosa. See that species for comments.

<u>R. bolanderi</u> was reported new to the province in Noble (1978) as a result of the present study.

<u>RINODINA CONFRAGOSA</u> (Ach.) Koerb., Syst. Lich. Germ.:125. 1855. Parmelia confragosa Ach., Method. Lich. 33. 1803.

<u>Thallus</u> crustose; irregular, granulose; granules scattered or continuous to piled, loosely attached, sometimes flattened and becoming lobate and large; whitish to pale grey.

<u>Apothecia</u> few to abundant, scattered to grouped and crowded, subsessile among granules, to adnate, constricted, 0.5-1.3(-2.0) mm wide. Thalline margin thick and prominent, entire and roughened to <u>+</u> crenulate, sometimes excluded in very convex apothecia. Disc dark brown to black, plane becoming slightly to strongly convex. Hymenium 75-80(-110) µm high; epithecium dark brown; hypothecium hyaline. <u>Spores</u> 8 per ascus, brown, ellipsoid, polarilocular with a distinct septum, 20-23(-27) X 8-10 µm (see Figure 39).

Spot Tests: thallus K+ yellow; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; on all rock types in the supralittoral zone.

Selected Specimens: 1005, 1761.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circum(north)temperate in the Northern Hemisphere; described as "panboreal" by Wetmore (1968) citing reports from the Canadian Eastern arctic (Lynge, 1947) to the Smoky Mountains (Degelius, 1940) and west to Arizona (Weber, 1963) and Washington (Howard, 1950); considered "North Temperate" by Brodo (1968); also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: The separation of <u>R</u>. <u>confragosa</u> from saxicolous specimens of <u>R</u>. <u>bolanderi</u> is not entirely clear. Sheard (pers. comm.) stated that <u>R</u>. <u>bolanderi</u> is a "bigger edition" of <u>R</u>. <u>confragosa</u> with both species often having a well-developed cortex on the underside of the apothecial margin. Although there is an overlap in spore size, there is a statistical difference with <u>R</u>. <u>confragosa</u> having spores (15.6-)17.1-17.9(-19.3) X (7.5-) 9.3-10.5(-12.4) μ m and <u>R</u>. <u>bolanderi</u> having spores (17.6-)23.2-24.0(-28.7) X (8.6-)11.3-12.3(-14.9) μ m. Additionally <u>R</u>. <u>bolanderi</u> has spores with a less well developed septum and the lumina do not retain their angularity, becoming round with age

However, in a recent treatment of saxicolous European <u>Rinodina</u> (Mayrhofer & Poelt, 1979) the spore size is given as 17-27 X 8-13 µm for <u>R. confragosa</u>. This overlap problem requires further study.

The descriptions of European <u>R</u>. <u>confragosa</u> have the apothecia described as much smaller than that observed in the local material, i.e. 0.35-0.6 mm (Sheard, 1967) and 0.3-0.7 mm (Ozenda & Clauzade, 1970). Mayrhofer and Poelt (1979) stated a larger maximum measurement of 1.5 mm for the apothecia. RINODINA CONRADII Koerb., Syst. Lich. German.: 123. 1855.

Rinodina intermedia Bagl., Comm. Soc. Critt. Ital. 1:313. 1863.

<u>Thallus</u> crustose; of separate, small, dark granules, crowded around apothecia, disappearing. Hypothallus absent.

<u>Apothecia</u> scattered, sessile, 0.3-0.4 mm wide. Thalline margin thick, entire, lighter coloured than the disc. Disc plane, shiny, dark red-brown to brown. Epithecium reddish brown. <u>Spores</u> 8 per ascus, brown, roughly ellipsoid, initially 1-septate (not or only slightly constricted), the initial two lumina separating early to form four lumina (functionally 3septate), lumina rounded to six-angled, walls all thickened except between recently separated lumina, 21-30 X 10-12 µm (see Figure 39).

Spot Tests: none.

<u>Substratum/Habitat</u>: muscicolous; collected once on <u>Selaginella</u> <u>wallacei</u> with <u>Sticta</u> <u>fuliginosa</u>.

Selected Specimen: 4500B.

Local Abundance and Distribution: rare; distribution poorly known, collected once near Ladysmith in the CDFD subzone; not collected in the adjacent zone during the present study but known from other collections to be present there.

<u>World Distribution</u>: tentatively circumtemperate in the Northern Hemisphere (Topham & Walker, 1982; Ozenda & Clauzade, 1970); reported as "scattered throughout the lowlands in most part of Euorpe, W. Siberia, and probably North America" (Magnusson, 1947b); but reported from Greenland, Spitsbergen, Iceland, and in North America only reported in the west in Washington, Colorado, and California; also reported from New Zealand (Martin, 1966) and Argentina (Grassi, 1950) in the Southern Hemisphere. 674

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<u>RINODINA EXIGUA</u> (Ach.) Gray, Natur. Arrang. Brit. Plants 1:450. 1821. Lichen exiguus Ach., Lich. Suec. Prodrom.:69. 1798.

<u>Thallus</u> crustose; continuous, verruculose and \pm shiny, or dull and granulose; brownish grey to brown.

<u>Apothecia</u> common, scattered, occasionally crowded, sessile, 0.3-0.7 mm wide. Thalline margin thin, entire, or granulose. Disc black, plane. Hymenium 60-80 μ m high; epithecium light orange-brown; hypothecium hyaline. <u>Spores</u> 8 per ascus, brown, polarilocular, septum distinct, often slightly constricted, 16-20(-22) X 7-8(-10) μ m.

Spot Tests: thallus not tested; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous and lignicolous; on deciduous trees and shrubs and driftwood.

Selected Specimens: 881A, 3986F.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone, especially the southern part, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circum(north)temperate-circumboreal in the Northern Hemisphere (Makarevich, 1963); also reported from New Zealand (Topham & Walker, 1982) and Argentina (Grassi, 1952) in the Southern Hemisphere.

<u>Remarks</u>: The descriptions of European <u>R</u>. <u>exigua</u> described the thallus as light to dark, ash to greenish grey (Sheard, 1967; Duncan, 1970; Ozenda & Clauzade, 1970) while the local material has a very dark thallus. The species is poorly known in North America and may not be the same as the European (Sheard, pers. comm.). Magnusson (1947b) stated that he had not seen any authentic material of R. exigua from North America. <u>R. exigua</u> is similar in some respects to <u>R. archaea</u> (Ach.) Arn. <u>R. exigua</u> is described as having smaller spores (15-17 X 7-8.5 μ m) and the ends of the spore wall and the septum both thickened (= more angular lumina), while <u>R. archaea</u> is described as having larger spores (17-24 X 8-10 μ m) and only the septum of the spore thickened (= more rounded lumina).

RINODINA GENNARII Bagl., Comment. Soc. Crit. Ital. 1(1):17. 1861.

Rinodina subexigua (Nyl.) Oliv., Memoir. Soc. Nation. Sicence. Natur.

Cherbourg 37:170. 1909.

Rinodina salina Degel., Ark. Bot. 30:55. 1942.

<u>Thallus</u> crustose; areolate or more commonly granulose, indefinite, irregularly covering areas up to 10 cm broad. Areoles contiguous, smooth, thin; granules large, scattered, roughened, irregular; pale brownish, brownish grey. Hypothallus sometimes evident in areolate forms, slightly darker than the thallus.

<u>Apothecia</u> common and abundant, <u>+</u> sessile, 0.3-0.6 mm wide. Thalline margin entire but usually not smooth, variously cracked or roughened but not striate, persistent. Proper. margin sometimes visible as a lighter coloured rim between thalline margin and disc. Disc dark brown to black, occasionally irregularly coloured, plane to becoming slightly convex. Hymenium 55-65 μ m high; epithecium light to dark brown; hypothecium hyaline. <u>Spores</u> 8 per ascus, brown, ellipsoid, polarilocular with indistinct septum, 13-16 X 7-8 μ m (see Figure 39).

Spot Tests: thallus K-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; on all rock types, almost exclusively in the supralittoral zone.

Selected Specimens: 1557, 2603.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone primarily at maritime sites, present in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europe disjunct; in eastern North America reported from New Brunswick, Maine, and New York (Brodo, 1968).

<u>Remarks</u>: The indeterminate form of the local <u>R</u>. <u>gennarii</u> is common on rough, friable substrata such as sandstones where the thallus is reduced to inconspicuous granules and the abundant apothecia outline the thallus. The determinant, areolate form is restricted to smooth igneous rocks.

RINODINA HALLII Tuck., Bull. Torr. Bot. Club 5:20. 1874.

<u>Thallus</u> crustose; forming small orbicular thalli, 0.6-1.2 cm broad, occasionally up to 3 cm broad; \pm shiny, smooth, and continuous to cracked and rimose; pale yellowish tan, pale purplish brown, occasionally lighter and grey to greenish grey. Hypothallus black, present at margin.

<u>Apothecia</u> subsessile becoming sessile, not constricted, 0.4-0.9 mm wide. Margin lacking algae, light reddish-brown to blackish, nearly translucent, thin, exluded in very convex apothecia. Disc plane, occasionally becoming convex, black-brown, <u>+</u> heavily white pruinose in both young and old apothecia. Hymenium 70-75 μ m high, nearly 100 μ m high in convex apothecia; epithecium ornage-brown; hypothecium hyaline to light fulvous. <u>Spores</u> 8 per ascus, brown, ellipsoid, polarilocular, septum distinct or indistinct, 19-23 X 8-9 μ m (see Figure 39).

<u>Spot Tests</u>: thallus not tested; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; usually on a wide variety of deciduous trees and shrubs, one very abundant collection from <u>Thuja</u>.

Selected Specimens: 1431, 4841B.

Local Abundance and Distribution: occasional; scattered throughout the the CDFD subzone at both inland and maritime sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North American endemic; reported from Washington, Oregon, California (Fink, 1935; Magnusson, 1947a) and British Columbia (Otto & Ahti, 1967) as far north as the Queen Charlotte Islands (Brodo, 1980).

<u>Remarks</u>: The purplish-brown colour of the thallus with the delimiting black hypothallus and pruinose biatorine apothecia make <u>R</u>. <u>hallii</u> very distinctive. The spores have been reported as much larger, e.g. 19-30 X 9-15 μ m (Tuckerman, 1974) and 19-28 X 8-12 μ m (Hasse, 1913). Tuckerman (1888) later reported that the white pruinia on the apothecia was an uncommon condition but most of the local material is pruinose or partially so.

RINODINA MARYSVILLENSIS H. Magn., Ann. Cryptogam. Exot. 5:31. 1932.

<u>Thallus</u> crustose; verruculose-areolate, sometimes scant; greenish grey to greenish white. Hypothallus absent.

<u>Apothecia</u> common, abundant and crowded, 0.4-0.7 mm wide. Thalline margin thick, white, entire becoming slightly crenulate, persistent after disc has degenerated. Disc black, plane. Hymenium 75 µm high; epithecium medium to dark brown; hypothecium hyaline. <u>Spores</u> 8 per ascus, brown, polarilocular with walls irregularly thickened but lumina <u>+</u> rounded and small, septum distinct to indistinct, not constricted, 15-17 X 8-10 µm.

<u>Spot Tests</u>: thallus K+ yellow(-orange), KC+ orange-red (slow); hymenium IKI+ blue.

Substratum/Habitat: corticolous; collected once on Quercus.

Selected Specimen: 3616.

Local Abundance and Distribution: rare; collected once on the Saanich Peninsula in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: western North America endemic (Sheard, pers. comm.); described from Washington, also reported for Oregon (Pike, 1973) and California (Tucker, 1973).

<u>Remarks</u>: According to Sheard (pers. comm.) <u>R</u>. <u>marysvillensis</u> is a common corticolous species of western North America distinguished by its "K+ yellow thallus, expanded lower cortex of the apothecium, and polarilocular spores". Magnusson (1932) described the species as having slightly larger spores (18-20 X 10 μ m) and with a dark, <u>+</u> blackish grey thallus. The local material has a very light coloured thallus. Sheard (pers. comm.) stated that this species is sometimes infested with blue-green algae which causes the thallus to be much darker, and that the spores range from (15.4-)18.1-19.7(-22.4) X (8.2-)9.4-10.2(-11.4) μ m.

Fragments of another whitish <u>Rinodina species</u> were collected at Botanical Beach near Port Renfrew (CH zone) on <u>Picea sitchensis</u> twigs. The thallus is K- and the spores much larger (26-30 X 12 μ m) and constricted, compared to <u>R. marysvillensis</u>. It is possibly an undescribed species (Sheard, pers. comm.). It has not been collected in the CDFD subzone; further study must await additional collections.

<u>R. marysvillensis</u> was reported new to the province in Noble (1978) as a result of the present study).

RINODINA VERRUCOSA (Merr.) Sheard, ined.

<u>Thallus</u> crustose; indeterminant, granulose; granules contiguous to scattered, flattened, large, matt; greyish white. Hypothallus absent.

<u>Apothecia</u> common, subsessile often becoming <u>+</u> sessile, 0.5-0.8 mm wide. Thalline margin entire, irregular, thick to thin, often finally excluded. Proper margin visible as a thin, black rim between disc and thalline margin. Disc plane, 'velvety', black. Hymenium 85-90 µm high; epithecium dark brown; hypothecium hyaline. <u>Spores</u> 8 per ascus, mischoblastic (walls thickened apically, laterally, and medianly to produce a lumina which is hourglass-shaped with the top and bottom indented), septum indistinct appearing as a hazy darkened region medially, occasionally medially dilated, light grey-brown, 22-28 X 11-15 µm (see Figure 39).

Spot Tests: thallus K+ yellow; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: saxicolous; collected twice on sandstone in the supralittoral zone.

Selected Specimens: 938, 3240.

Local Abundance and Distribution: rare; distribution poorly known, collected twice in the Gulf Islands at maritime sites in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: eastern North America-western North America disjunct (Sheard, pers. comm.); reported from Ontario (Wong & Brodo, 1973).

<u>Remarks</u>: <u>R</u>. <u>verrucosa</u> is distinguished from the other light coloured K+ <u>Rinodina</u> species by its irregular thalline margin and especially, the mischoblastic spores. RINODINA WILLEYI Sheard, ined.

Thallus crustose; only 2 cm broad, sorediate, thick, becoming slightly coralloid; greyish olive with coralloid portions brown tipped. Hypothallus absent.

<u>Apothecia</u> few, crowded, sessile, 0.5-1.0 mm wide. Thalline margin thick, crenulate, becoming pulverulent. Proper margin visible between disc and thalline margin, thin, but turgid and raised. Disc plane, black, lightly white pruinose or epruinose. Hymenium 80-100 μ m high; epithecium orange-brown; hypothecium yellow. <u>Spores</u> 8 per ascus, brown, initially polarilocular, finally <u>+</u> evenly thin-walled and constricted at the center, septum distinct, 25-31 X 12-16 μ m (see Figure 39).

Spot Tests: thallus K+ faint yellow; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; one small collection from <u>Quercus</u> with <u>Melanelia glabratula</u>.

Selected Specimen: 5157B.

Local Abundance and Distribution: rare; distribution poorly understood, collected once near Nanaimo at an exposed inland site in the CDFD subzone; not collected in the adjacent zones, however, similar material collected, apart from the present study, from Lynn Canyon near Vancouver.

<u>World Distribution</u>: western North America-eastern North America disjunct, concentrated primarily in the east (Sheard, pers. comm.)

<u>Remarks</u>: An attempt to collect additional material of <u>R</u>. <u>willeyi</u> in the study area was unsuccessful. The original collection site on a hillside above Departure Bay, Nanaimo, was destoyed with the building of a subdivision.

There are several sorediate European species of <u>Rinodina</u> (Poelt, 1969) but all have much smaller spores than <u>R</u>. willeyi.

The local collection of <u>R</u>. willeyi is the first specimen from western

North America (Sheard, pers. comm.).

RINODINA UNKNOWN #1

<u>Thallus</u> crustose; sometimes reduced to scattered small granules (ca. 0.1 mm) but usually distinctly and almost entirely isidiate except in close proximity to the ascocarps where it is thin, scattered to clustered verrucae; isidia varying from coralloid and upright to digitate-constricted and dorsoventrally oriented, up to 0.5 mm long; medium greenish-grey. Hypthallus whitish, almost absent.

Apothecia usually scarce, sometimes abundant in clusters, adnate, hardly constricted, 0.4-0.7 mm wide. Thalline margin present, smooth to often crenate, raised, concolorous with thallus. Disc plane, round to slightly irregular, black, epruinose. Hypothecium hyaline; paraphyses abundantly branched towardthe apices terminating in a globose cell which is 'black-brown capped'; hymenium 65-75 μm high, not sharply separated from the hypothecium. <u>Spores</u> 8 per ascus, brown, polarilocular, septum usually distinct, usually with thickened end walls and thin side walls, 15-19 X 7-9 μm (see Figure 39).

Spot Tests: thallus K-, C-, KC-, P-.

<u>Substratum/Habitat</u>: corticolous; collected once on an old, roadside Quercus with Candel<u>aria concolor</u>.

Selected Specimen: 7409.

Local Abundance and Distribution: rare; distribution poorly known; collected once near Victoria in the southern part of the CDFD subzone; not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: The spores of <u>Rinodina</u> <u>unknown</u> <u>#1</u> were abundantly produced in all ascocarps examined, however, they were always over-mature or perhaps aborted in some cases. The exact shape of the cell wall and lumina is, therefore,open to question although a few greyish-brown, presumeably young spores were often found as described above in each ascocarp.

Because of the colour of the thallus and size of the spores the local material does not agree with any isidiate European species of <u>Rinodina</u>. <u>R. isidioides</u> (Borr.) Oliv. is isidiate and greyish with apothecia 0.5-0.8 mm wide which remain plane but the spores are 20-25 X 12-14 μ m; <u>R. dalmatica</u> Zahlbr., <u>R. furfuracea</u> H. Magn., and <u>R. malangica</u> (Norm.) H. Magn. have thalli which are dark brown in colour. Furthermore <u>R. dalmatica</u> has larger spores (20-24 X 12-14 μ m), <u>R. furfuracea</u> has apothecia which become convex and exlude the thalline margin, and <u>R.malangica</u> has very small apothecia (up to 0.4 mm broad).

Magnusson (1947b) included two isidiate species of <u>Rinodina</u> from Siberia. One of these <u>R. excrescens</u> Vain., is similar in many respect to the local material. <u>R. excrescens</u> has a "grey or greenish white-grey" thallus "consisting of small verrucae, at last growing out and subcoralloid". similar-sized apothecia (0.5-0.8 mm) although constricted at the base, and similar-sized spores (15-20 X 8-10 µm) which in the type specimen are "mostly old and deformed, no young ones seen, but wall apparently unequally thickened with apical wall convex inwards...". Magnusson (op. cit.) concluded that "on account of the deformed apothecia with gelatinous paraphyses (the paraphyses were deformed and no ends visible) and only old spores it is difficult to form a definite opinion of the relationahip of this species with other species..."

<u>R. papillata</u> H. Magn. has been described from eastern North America (Magnusson, 1953). Its thallus is described as densely papillate, in part narrowly squamuliform, becoming isidioid in older, densely fertile sections.

The apothecia are 0.5-0.7 mm wide, paraphyses lax and free; spores greenishbrown, 17-19 X 8-9 um with distinct septum, thick uniform walls, and rounded lumina. The spores and paraphyses are not the same as the local material.

In a discussion of <u>R</u>. <u>isidioides</u> in the British Isles, Sheard (1967) mentioned having examined other isidiate or papillate species from North and South America but no further information was given.

SARCOGYNE Flot.

Thallus crustose; often very reduced and almost absent.

Ascocarp an apothecium, subsessile to adnate. Proper margin present, thin, carbonaceous or not on the outer edge, \pm persistent, black. Paraphyses simple, septate, coherent to free. Hypothecium hyaline to darkening. Spores 100-200 per ascus, hyaline, simple, cylindrical to ellipsoid or subglobose, small.

Usually saxicolous, occasionally terricolous; often calcicolous.

References: Magnusson (1935b), Poelt (1969).

Hypothecium <u>+</u> hyaline; hymenium 75-110 μm...... <u>S. REGULARIS</u>
 Hypothecium orange; hymenium 130-150 μm<u>S. UNKNOWN #1</u>

<u>SARCOGYNE REGULARIS</u> Koerb., Syst. Lich. Germ.:267. 1855. Sarcogyne pruinosa auct., non (Sm.) Koerb.

<u>Thallus</u> crustose; almost absent to thin, scurfy and <u>+</u> continuous to finely cracked-areolate; medium grey to yellowish grey. Hypothallus absent.

<u>Apothecia</u> abundant, <u>+</u> scattered, slightly impressed in substrata hollows, closely adnate, moderate constricted or unconstricted, (0.5-)

0.8-1.0(-1.3) mm wide. Proper margin raised, smooth, shiny, persistent, black. Disc usually plane, sometimes concave especially when young, initially round usually becoming quite irregular or flexuous; surface smooth, occasionally minutely wrinkled, often shiny, reddish black to black, epruinose. Hypothecium hyaline to pale greyish, thin; external edge of exciple brown-black fading gradually to hyaline internally or sometimes pale (orange-)brown; epithecium orange-brown or orange; paraphyses simple, septate, tightly coherent at apices; hymenium (75-) 90-110 μ m high, + hyaline. Spores 150+ per ascus, hyaline, simple, cylindrical, 3-5 X 1-2 μ m.

<u>Spot Tests</u>: thallus K-, KC-, C-, P-; hymenium IKI+ blue then often slightly yellow in the thinner sections.

<u>Substratum/Habitat</u>: saxicolous; collected primarily on calcareous sandstone and mortar curbs/foundations/walls, also once on calcareous conglomerate; often in partially shaded rather than completely exposed habitats.

Selected Specimens: 2126B, 2752A.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at both inland and maritime sites; not collected in the adjacent zones (see Figure 40).

<u>World Distribution</u>: circumarctic-circumboreal; reported in North America from Greenland, Ellesmere Island, N.W.T., Alaska (Thomson, 1979), Washington (Howard, 1950), South Dakota, Wyoming (Wetmore, 1968), Ontario (Brodo, 1981), Michigan (Harris, 1977), Colorado (Shushan & Anderson, 1969), New Mexico (Egan, 1972), and California (Magnusson, 1935b).

<u>Remarks</u>: The most common form of <u>S</u>. <u>regularis</u> has a pruinose disc. The local material, however, was completely naked.



SARCOGYNE UNKNOWN #1

<u>Thallus</u> crustose; scattered, inconspicuous, grey granules among rock crystals of substratum. Hypothallus absent.

<u>Apothecia</u> scattered, 0.6-1.1 mm wide. Proper margin initially black, shiny, slightly raised becoming excluded. Disc plane becoming slightly convex, minutely roughened, red-black to black, epruinose. Hypothecium pale orange or bright orange-red, 75-100 μ m thick; exciple black on outer edge, pale brown inside or bright orange(-red); epithecium orange to orangebrown; paraphyses coherent at tips; hymenium 130-150 μ m high. <u>Spores</u> 150+ per ascus, hyaline, simple, cylindrical to almost ellipsoid, 5-7 X (1.5-)2 μ m.

<u>Spot Tests</u>: thallus not tested; hymenium IKI+ blue slowly becoming a little tawny, K-

<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous conglomerate.

Selected Specimen: 3026.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Gabriola Island in the CDFD subzone; not collected in the adjacent zones.

World Distribution: unknown.

<u>Remarks</u>: This species is distinguished by the bright orange colour of the hypothecium and exciple (internal) and also the large spores. Most species of <u>Sarcogyne</u> have hyaline or dark brown hypothecia (Poelt, 1969 Magnusson, 1935b). The single collection is quite small and additional collections are necessary to resolve the problem.

SCOLICIOSPORUM Mass.

Thallus crustose; ecorticate; granulose, verruculose to furfuraceous. Ascocarp a biatorine apothecium. Initially plane and marginate be-

coming convex and immarginate. Exciple of radiating, branched and anastomosing hyphae. Paraphyses also branched and anastomosed. Spores acicular, curved to spiral, 3- to many septate.

Corticolous and saxicolous.

Until recently Scoliciosporum was usually included in Bacidia.

There is only one local species.

References: Vézda (1978).

SCOLICIOSPORUM cfr. PERPUSILLUM Lahm ex Koerb., Parerg. Lich. 3:24]. 1861

<u>Thallus</u> crustose; effuse, usually very small, up to 5 mm wide, commonly granular, occasionally cracked-areolate; green, greyish-green.

<u>Apothecia</u> abundant, often crowded, adnate to almost subsessile, 0.1-0.3 mm wide. Proper margin very thin, usually disappearing early. Disc plane to sometimes convex; light to dark brown soon becoming black and shiny. Hypothecium hyaline; epithecium brown (if disc light coloured) to sordid green, blue-green, or green-brown; hymenium 35-40 μ m high; paraphyses branched, coherent. <u>Spores</u> 8 per ascus, hyaline, acicular, curled, (3-)5- to 7-septate, 20-35(-48) X 2-2.5 μ m (see Figure 9).

Spot Tests: eithecium K-, C-; hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; on twigs of both conifers and deciduous trees.

Selected Specimens: 1334B, 3678B.

Local Abundance and Distribution: infrequent; usually collected as an admixture with other more conspicuous taxa, probably much more common than the few collections indicate; scattered throughout the subzone; not collected in the adjacent zones.

World Distribution: western North America-Europe disjunct.

<u>Remarks</u>: The local material was first identified to <u>S</u>. <u>umbrinum</u> (Ach.) Arn. (= <u>Bacidia umbrina</u> (Ach.) Bausch), a widely distributed species that has apothecia 0.3-0.8 mm wide, commonly 3-(but up to 7-)septate spores, and a predominatly saxicolous habitat.

Using Vézda (1978) the local material readily keys to <u>S</u>. perpusillum but it is a little-referred-to-species. A more detailed description and/or comparative material is needed to ascertain the identity of the local collections.

'<u>Bacidia</u>' <u>endocyanea</u> (Tuck. ex Will.) Zahlbr., described from eastern North America is very similar, with small, micareoid ascocarps, spores of the same size, septation, and curled condition, and a corticolous-lignicolous habitat (Harris, 1977; Fink, 1935). However, it has a dark hypothecium (described as purplish, K+ green, by Harris and as dark brown to blackish by Fink.

SPHAEROPHORUS Pers.

Thallus fruticose; caespitose; branches terete or flattened, solid; paraplectenchymatous cortex present.

Ascocarp an apothecium, terminal, often immersed in capitate swellings, later opening to expose a plane to globose disc and creating a torn, irregular thalline margin. Asci dissolving to form, along with the loose spores and fragments of paraphyses, a powdery mazaedium. Spores 8 per ascus, uniseriate, simple, globose, brown.

Corticolous, lignicolous, saxicolous, and terricolous.

There is one local species.

References: Tibell (1975).

<u>SPHAEROPHORUS</u> <u>GLOBOSUS</u> (Huds.) Vain., Result. Voyage S.Y. Belgica, Bot.:35. 1903.

Lichen globosus Huds., Flora Anglica:460. 1762.

<u>Thallus</u> fruticose; tufted; 1-4.5(-7.0) cm high. Main branches 0.5-1.0 mm wide, terete to slightly flattened, solid, shiny, foveolate with numerous minor secondary branches; secondary branches 0.2-0.3 mm wide, short, terete; whitish, grey-brown, to tawny olive, paler on one wide.

Apothecia uncommon, terminal, spherical, 0.8-1.9 mm wide, on thicker (1.0-2.1 mm wide), longer (3+ cm) main branches that have few secondary branches; initially immersed then breaking open apically leaving a torn and irregular thalline margin. <u>Spores 8 per ascus</u>, uniseriate, initially hyaline then purple within the ascus, becoming black and irregularly globose when released by disintegration of asci and forming a powdery mazaedium; 8-12 µm wide.

<u>Pycnidia</u> common on fertile thalli, black, terminal or subterminal on secondary branches; pycnospores hyaline, short-cylindrical, 2,5-3.5 X l µm.

Spot Tests: medulla IKI+ blue.

<u>Substratum/Habitat</u>: primarily corticolous on <u>Pseudotsuga</u>, rarely on other trees; also saxicolous or among mosses or on thin soil over rock.

Selected Specimens: 1707, 2447.

Local Abundance and Distribution: frequent (present at almost one-half of the major collection sites); scattered throughout the CDFD subzone at both inland and maritime sites, present and abundant also in the adjacent zones; fertile collections not as common in the CDFD subzone as the adjacent zones (see Figure 41).

<u>World Distribution</u>: circumarctic-alpine - circumboreal (Thomson, 1979; Tibell, 1975); in North America extending south in oceanic regions to New England in the east and California in the west (see below).

<u>Remarks</u>: The local material was very seldom fertile with only five collections that tended to occur towards the western border of the CDFD subzone and were primarily but not exclusively inland. These fertile collections tended to have a reduced number of secondary branches.

The oceanic specimens from the southern part of the range of <u>S. globosus</u> tend to have more numerous, small, lateral branches than the more sparsely branched artic-alpine collections. The southern material is sometimes regarded as a different species, <u>S. tuckermanii</u> Rås., which was described from the interior of British Columbia, and is also known from Asia (Thomson, 1979). As noted, the amount of branching is reduced when the thallus is fertile and whether this character is reliable to separate the two taxa requires further study.

<u>S. melanocarpus</u> (Sw.) DC. has been reported from Victoria on the basis of an early collection of J. Macoun (Macoun, 1902; Lye, 1969). The specimen is reported as collected from <u>Picea sitchensis</u>, which is very rare in the Victoria area, but much more common to the west, especially from Sooke westwards. It seems probable that the <u>S. melanocarpus</u> specimen was collected outside the CDFD subzone and is therefore not included here. S. meanocarpus differs from S. <u>globosus</u> in the IKI-, flattened branches.



SPILONEMA Bornet

Thallus minutely fruticose or foliose; pseudoparenchymatous at the base, otherwise composed of hyphae aligned with and extending parallel within the algal sheath; attached by rhizines, often blue-green coloured; brown, brown-black, blue-green to purple-black. Phycobiont a blue-green alga (Stigonema).

Ascocarp an apothecium, terminal. Proper margin present, thin, excluded. Hypothecium brown or epithecium, hyaline, and sometimes the hypothecium blue-green or purple. Asci cylindrical, apically thickened wall; paraphyses simple, septate, and thick. Spores 8 per ascus, hyaline, simple, oval.

Usually saxicolous, occasionally muscicolous and corticolous.

There is one local species.

References: Henssen (1963f).

SPILONEMA REVERTENS Nyl., Flora 48:601. 1865.

<u>Thallus</u> minutely fruticose; orbicular, 2-12 mm wide. Lobes very small, 1 mm wide, marginally thicker and horizontal, centrally very dense, much branched, <u>+</u> vertical; becoming thick cracked-areolate, often wearing away leaving circumference of outer lobes; rhizines present, hyaline becoming bright bluish; central hyphae also becoming blue coloured, otherwise thallus black.

<u>Apothecia</u> not common, embedded in dense, central portions of thallus, 0.1-0.5 mm wide. Proper margin quickly excluded. Disc convex, black. <u>Spores</u> 8 per ascus, hyaline, simple, elongate-ellipsoid, hyaline, 7-ll X 4-5 µm.

<u>Pycnidia</u> black; pycnospores hyaline, cylindrical, 2.5-3.5 X 1.5 µm. Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; on all types of rock in the supralittoral zone.

Selected Specimens: 2920B, 4247.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at maritime sites, not collected in the adjacent zones during the present study but reported from the west coast of Vancouver Island (Benton et al., 1977).

<u>World Distribution</u>: circumtemperate in the Northern Hemisphere (Henssen, 1963f; Ahti, 1964; Galun, 1970).

STAUROTHELE Norm.

Thallus crustose; epilithic or endolithic. Phycobiont a green alga (Trebouxia).

Ascocarp a perithecium, single, simple or compound with a covering involucrellum, immersed or superficial, containing green algal cells. Periphyses present; asci thin-walled, unitunicate; paraphyses soon gelatinizing. Spores 2-8 per ascus, hyaline, yellowish or browning, muriform.

Primarily saxicolous, often calcicolous.

There is one local species.

References: Swinscow (1963a).

STAUROTHELE HAZSLINSZKWI(Koerb.) J. Stein., Ann. Naturhist. Hofmus. Wien 20(1905):384. 1907.

Sphaeromphale hazslinszky Koerb., Parerg. Lich.: 331. 1863.

<u>Thallus</u> crustose; irregular, up to 4 cm broad, thin, rimose-cracked; dark grey, brownish-black, blackish brown. Hypothallus absent.

Perithecia common, scattered, sessile, partially covered by thallus, <u>+</u> steep-sided, covered by a <u>+</u> shiny black involucrellum or hidden completely by thalline tissue. Ostiole single, opical, large, easily observed. Paraphyses gelatinizing. Hymenium containing abundant, coccoid algae, 3-5 μm wide. <u>Spores</u> 2 per ascus, oblong-ellipsoid, yellowish and remaining light coloured, muriform (8-12 latitudinal septa; 3-5 longitudinal septa), 30-45 X 11-17 μm.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous; on a sloping surface (probably seepage surface) with Dermatocarpon miniatum.

Selected Specimen:

Local Abundance and Distribution: rare; distribution poorly known, collected once in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-Europe disjunct; in Europe boreal-montane (Ozenda & Clauzade, 1970); first reported for North America by Wetmore (1968) from South Dakota.

<u>Remarks</u>: <u>S. hazslinszky</u> is similar to <u>S. fissa</u> (Tayl.) Zwackh which has brown, usually larger spores (35-50 X 15-25 μ m). Wetmore (1968) described the involucrellum of <u>S. hazslinszky</u> as larger and blacker than <u>S. fissa</u> while Ozenda and Clauzade (1970) reported the perithecia of the former as 0.2-0.3 mm and the latter as 0.3-0.5 mm. On the basis of the

light coloured spores S. hazslinszky has been reported here.

S. hazslinszky is reported here as new to the province.

STENOCYBE Nyl.

Thallus crustose; poorly developed or absent. Phycobiont absent. Ascocarp an apothecium, terminal on a slender, black stipe. Proper Exciple closed but finally opening; black. Paraphyses simple, slender; asci cylindrical, thick-walled, not dissolving, unitunicate. Spores 8 per ascus, oblong-ellipsoid to fusiform; brown, 3- to 7-septate.

Corticolous, lichenicolous, or muscicolous.

<u>Stenocybe</u> is traditionally treated with the lichenized fungi despite apparent lack of a phycobiont. It has a close similarity to other genera of the Calicicales because of the slender, black, stipitate apothecia.

References: Tibell (1975).

Spores finally 7-septate, 41-57 X 8-12 μm<u>S</u>. <u>UNKNOWN #1</u>
 Spores 3-septate, 22-32 X 7-8 μm<u>S</u>. <u>MAJOR</u>

STENOCYBE MAJOR Nyl. ex Koerb., Bot. Nob. 1854:84. 1954.

Thallus absent.

<u>Apothecia</u> terminal, on slender, shiny, black stipes, 0.7-0.8 mm tall; excipulum narrowly urceolate. <u>Spores</u> 8 per ascus, fusiform, brownish with the end cells slightly paler, 3-septate, 22-32 X 7-8 µm.

Spot Tests: none.

Substratum/Habitat: corticolous; collected twice among Arthonia ssp.

(once on <u>Abies grandis</u> and once on <u>Pseudotsuga</u>) and also once each among <u>Buellia penichra on Pseudotsuga</u> and among <u>Mycoblastus tornoënsis</u> on <u>Thuja</u>.

Selected Specimens: 3737B, 5303B.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone; also present in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia(Japan) disjunct; in North America reported from British Columbia, Washington, California in the west and Ontario, Michigan, and New York in the east (Tibell, 1975; Fink, 1935; Herre, 1910a).

<u>Remarks</u>: Tibell (1975) suggested that <u>S</u>. <u>major</u> is restricted to <u>Abies</u> species. The local material was collected on <u>Pseudotsuga</u> and <u>Thuja</u> besides <u>Abies grandis</u>.

STENOCYBE UNKNOWN #1

Thallus not observed.

<u>Apothecia</u> terminal, on shiny, slender, 0.5-1.0 mm high stalks with a shiny, black, narrowly urceolate excipulum. <u>Spores</u> 8 per ascus, light grey becoming brown, (1-)3- to 7-septate, with the outer cells a little paler, fusiform, 41-57 X 8-12 µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous; collected twice on <u>Pseudotsuga</u> and once on <u>Salix</u> sp. among more conspicuous species, including <u>Parmeliopsis</u> ambigua and <u>Ochrolechia oregonensis</u>.

Selected Specimens: 1497B, 4683B.

<u>Abundance and Local Distribution</u>: infrequent; scattered throughout the CDFD subzone primarily at inland sites, also present in the adjacent zones.

<u>World Distribution</u>: western North American endemic; from California (Herre, 1910a, as S. major) north to British Columbia (Tibell, pers. comm.).

<u>Remarks</u>: This <u>Stenocybe</u> is an undescribed species which Dr. L. Tibell intends to publish at some future date (Tibell, pers. comm.). It is not included in Tibell (1975).

STEREOCAULON Hoffm.

Primary thallus crustose; thin, discontinuous and granulose to areolate; usually eveanescent. Secondary thallus fruticose; of cylindrical, solid pseudopodentia, erect to dorso-ventral, simple to branched, with cephalodia and phyllocladia; with or without assimilative tissure, tomentum, or soredia. Phyllocladia specialized assimilative branchlets; granular to expanded flattened-squamulose or coralloid; radially to dorso-ventrally arranged on the pseudopodentia. Phycobiont a green alga; cephalodia containing a blue-green alga (Nostoc or Stigonema).

Ascocarp an apothecium, terminal or on small lateral branches. Pseudothalline margin occasionally present and then excluded; proper margin usually excluded too. Disc brown to black, plane to convex. Spores 8 per ascus, hyaline, fusiform to acicular, 3- to 7-septate.

Saxicolous or terricolous.

References: Magnusson (1926), Lamb (1951, 1977, 1978).

1.	Thallus pulvinate, < 2.5 cm tall; pseudopodentia decumbent, etomentose; phyllocladia coralloid to digitate-coralloid; saxicolous	
 Thallus loosely branched, > 2.5 cm tall; pseudopodentia erect to decumbent, tomentose; phyllocladia granulose and digitate-coralloid or squamulose-dentate 		
	 Phyllocladia squamulose-dentate; tomentum thick; apothecia lateral, abundant, small (≤ 1.0 mm); terricolousS. SASAKII 	
	 Phyllocladia both granulose and digitate-coralloid; tomentum thin; apothecia few, terminal, large (> 1.5 mm); saxicolousS. INTERMEDIUM 	

STEREOCAULON INTERMEDIUM (Sav.) H. Magn., Göteb. K. Vetensk. -o. Vitterh.

-Samh. Handl. ser. 4, 30(7):23. 1926.

<u>Stereocaulon coralloides</u> f. <u>intermedium</u> Sav., Bot. Materialy, Notul. System. ex Inst. Cryptog. Hort. Bot. Petropol. 2(11):163. 1923.

<u>Thallus</u> fruticose; pseudopodentia loosely arranged, erect, little branched, 5-8 cm tall, covered \pm completely with a short, fine tomentum which is cream coloured above, brown below. Phyllocladia few and scattered, mainly granulose on the fertile pseudopodentia but also with a few branchedcoralloid, the latter much more abundant below on the nonfertile pseudopodentia; white to pale grey. Cephalodia abundant, tuberculoid with minute convolutions or somewhat irregular-roughed, 0.5-1.2 mm wide, pale bluishgrey, \pm white pruinia covering, or occasionally brownish. Primary thallus absent.

<u>Apothecia</u> abundant, terminal on the longer pseudopodentia, initially plane with a pseudothalline rim (pale, white) quickly becoming convex and rim excluded, dark brown to black, 1.6-5.0 mm wide. Hymenium 40 μ m high. <u>Spores</u> 5-8 per ascus, hyaline, 3-septate, bacilliform (pointed at one end, rounded at the other), curved to straight, 33-40 X 3-4 μ m. Spot Tests: thallus K+ yellow, C-, KC+ red (fleeting), P+ yellow.

<u>Substratum/Habitat</u>: saxicolous; collected once on igneous rock tailings of an abandoned iron mine.

Selected Specimen: 4302.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CDFW subzone at an inland site, not collected in the CDFD subzone during the present study but reported from Saltspring Island in the southern part by Bird and Bird (1973).

<u>World Distribution</u>: amphi-Pacific (Kamchatka, Sakhalin, and Bering Island in eastern Asia; Alaska Yukon south to California) plus Newfoundland in North America.

<u>Remarks:</u> <u>S. intermedium</u> is similar to <u>S. sterile</u> in having digitatecoralloid phyllocladia but, unlike the latter, the former also has granular phyllocladia as well. Additionally the pseudopodentia of <u>S. intermedium</u> are larger, erect, and tomentose. Lamb (1978) mentioned a small, pulvinate morphotype, f. <u>compactum</u>, which other than tomentum and granular phyllocladia would be very close to <u>S. sterile</u>. It has not been encountered during the present study.

STEREOCAULON SASAKII Zahlbr., Feddes Repert. 33:48. 1933.

<u>Thallus</u> fruticose; pseudopodentia slightly branched, erect to more often partically decumbent, up to 6 cm tall, covered in moderate to very thick, spongy pale tomentum. Phyllocladia squamulose-dentate, scattered and radially arranged to often dorso-ventrally arranged and very close together, especially towards the apices of the pseudopodentia, often initially almost granular, usually pale grey or whitish (one specimen centrally green-grey, marginally white), occasionally pale greenish-grey. Cephalodia usually abundant below, pale bluish, 0.2-1.0 mm wide, usually simple, subglobose occasionally becoming slightly convoluted with increase in size, sometimes partially hidden within the tomentum, occasionally visible from above and then browning. Primary thallus usally absent, observed once on a pebble; scattered areoles becoming squamulose like the phyllocladia.

Apothecia often present, abundant, lateral, 0.5-1.0(-1.3) mm wide. Pseudothalline margin initially present; pale, whitish, sometimes slightly tomentose, usually quickly excluded. Proper margin concolorous with the disc, sometimes covered by the pseudothalline margin, usually also quickly excluded. Disc plane, becoming slightly convex, pale almost transparent brown to black. Hymenium 55-60 µm. <u>Spores</u> not observed often, hyaline, 3-septate, fusiform-acicular (one end pointed, the other end rounded), 32-35 X 2.5 µm.

Spot Tests: thallus K+ yellow, C-, KC+ red (fleeting), P+ yellow(pale).

<u>Substratum/Habitat</u>: terricolous; usually among mosses over thin soil, sometimes attached to pebbles within the soil.

Selected Specimens: 1088, 2408.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone but more common towards the western boundary, especially but not exclusively, at inland sites; also present in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North Americaeastern Asia disjunct; actually primarily amphi-Pacific with an outlier in eastern North America; in North America reported from Alaska to California and inland to New Mexico and Colorado, and in the east in Minnesota and Michigan (Lamb, 1977).

Remarks: This very common local species appears to possess sterile

and fertile morphotypes. The fertile thalli tend to have fewer phyllocladia that are more radially arranged (independent of whether the pseudopodentia are erect or decumbent) and moderate tomentum. The sterile thalli tend to have very tightly packed phyllocladia that are arranged dorso-ventrally especially toward the apices of the pseudopodentia and a very thick, spongy tomentum on the reverse side.

The typical form of <u>S</u>. <u>sasakii</u> is found only in eastern Asia. The species is represented in North America by var. <u>tomentosoides</u> Lamb and var. <u>simplex</u> (Ridd.) Lamb. The former has congested phyllocladia that become incised to digitate-squamulose, but is otherwise much like the typical variety. The latter is distinguished by the "simple to sparingly branched pseudopodentia and the scanty and scattered phyllocladia in a thick, spongy tomentum". The varieties discussed in Lamb (1977) do not completely match what was observed in the local material.

The typical variety of <u>S</u>. <u>sasakii</u> is morphologically analogous to <u>S</u>. <u>tomentosum</u> Fr., differing only in chemistry and geographic distribution. Lamb (1977) stated that the common North American representative, var. <u>tomentosoides</u>, is "more or less equivalent to <u>S</u>. <u>tomentosum</u>" although also saying that it "may prove to be specificially distinct from <u>S</u>. <u>sasakii</u>". However, even <u>S</u>. <u>sasakii</u>, itself, is often not recognized at the species level, e.g. Thomson (1979), Hale (1979).

STEREOCAULON STERILE (Sav.) Lamb ex Krog, Norsk Polarinst. Skr. 144:89. 1968.

<u>Stereocaulon evolutum</u> f. <u>sterile</u> Sav., Bot. Materialy, Notul. Syst. ex Inst. Cryptog. Hort. Bot. Petropol. 2)11):165. 1923.

<u>Thallus</u> fruticose; of pseudopodentia forming a very dense, pulvinate cushion, 1.5-2.0(-3.0) cm high and up to 6 cm broad. Pseudopodentia <u>+</u> nar-

rowly and centrally attached to substratum, centrally ascending and marginally decumbent and then ascending, moderately branched, usually naked, or occasionally very faintly tomentose towards the base; pale whitish grey or yellowish towards the base. Phyllocladia coralloid to coralloid-flattened or digitate when young, up to 2.0 mm long, and 0.2 mm wide, <u>+</u> totally covering pseudopodentia dorsally but occasionally scattered, white to pale grey. Cephalodia scarce to often abundant, visible from above between the phyllocladia but also from below, tuberculoid with minute, smooth convolutions, pale brown to (violet-)brown often masked with a white, pruinialike covering, 0.8-2.0 mm wide. Primary thallus not observed.

<u>Apothecia</u> uncommon, observed once, terminal, on elongated (3 cm tall) pseudopodentia, 1.2-2.0(-3.0) mm wide, plane becoming convex and often cracking with increase in size. Pseudothalline margin present initially; thin, white, quickly becoming excluded. Hymenium 55-65 µm high, hyaline, paraphyses loosely coherent; epithecium brownish. <u>Spores</u> (5-)8 per ascus, hyaline, 3-septate, straight to curved, fusiform-acicular (one end pointed, the other end rounded), (28-)30-36 X 3-4 µm.

<u>Spot Tests</u>: thallus K+ yellow (strong), C-, KC+ (purple-)red (fleeting), P<u>+</u> yellow.

<u>Substratum/Habitat</u>: saxicolous; on conglomerate and occasionally sandstones and igneous rocks in crevices and cracks on exposed hillsides, primarily but not exlusively inland; especially on sloping surfaces.

Selected Specimens: 4855, 4252.

Local Abundance and Distrbiution: frequent; scattered throughout the CDFD subzone especially but not exclusively at exposed, higher elevations inland, more common toward the western boundary but not avoiding the Gulf Islands; present but not as common in the adjacent zones.

<u>World Distribution</u>: amphi-Pacific; reported from California north to Alaska and also Kamchatka in eastern Asia (Lamb, 1977) (see Figure 53).

<u>Remarks</u>: Despite the large number of local specimens the material was difficult to identify because of inconsistencies between Lamb (1978) which contained a key to the boreal <u>Stereocaulon</u> and Lamb (1973) which contained a description of <u>S. sterile</u>. Following Lamb (1978), <u>S. sterile</u> must lack a pseudothalline margin of the apothecia and the cephalodia must be scarce and inconspicuous. However, Lamb (1973) described the cephalodia as "usually numerous and sometimes quite conspicuous" and a pale, non-prominent pseudothalline margin is described for young apothecia.

The separation of <u>S</u>. <u>sterile</u> from <u>S</u>. <u>intermedium</u> f. <u>compactum</u> is not entirely clear. Lamb (1978) described the latter as crustose-pulvinate but otherwise a detailed description of f. <u>compactum</u> is not available. The pseudopodentia of <u>S</u>. <u>intermedium</u> are typically tall (up to 8 cm), erect, slightly tomentose with both coralloid and grain-like phyllocladia, pale aeruginose-grey cephalodia, and large apothecia.

STICTA (Schreb.) DC.

Thallus foliose, moderate to large; upper and lower surfaces corticate (paraplectenchymatous); with or without soredia, isidia, or internal cephalodia; above smooth to tomentose; below short-tomentose with rimmed pores (cyphellae); rhizines present for attachment. Phycobiont a blue-green alga (<u>Nostoc</u>) or a green algal (<u>Palmella</u>), if the latter then cephalodia containing a blue-green alga also present.

Ascocarp an apothecium, marginal or laminal, sessile to substipitate. Thalline or proper margin present. Spores 8 per ascus, hyaline to brown, fusiform to acicular, 1- to 7-septate. Corticolous, saxicolous, or muscicolous.

The genus <u>Sticta</u> is represented beter in the Southern Hemisphere than in the Northern Hemisphere.

1.	Sorediate, not isidiate	<u>s</u> .	LIMBATA
1.	Isidiate, not sorediate		2
	2. Isidia laminal, lobes roundedS.	FUL	IGINOSA
	2. Isidia marginal, lobes elongate-linear	<u>s.</u>	VEIGELII

<u>STICTA FULIGINOSA</u> (Dicks.) Ach., Meth. Lich.:280. 1803. Lichen fuliginosus Dicks., Fasc. Plant. Cryptog. Brit. 1:13. 1785.

<u>Thallus</u> foliose; 3-6(-12) cm broad. Lobes several, 1-2.5 cm wide, rounded, ascending, frequently perforated. Upper surface shiny, smooth to slightly wrinkled or ridged; isidiate, isidia abundant, scattered, cylindrical to coralloid, black (frequently darker than the upper surface); black to olive grey. Lower surface smooth to slightly ridged with thin to dense tomentum; pale buff; cyphellae rounded to elongated, 0.4-1.0(-2.0) mm wide, few in small specimens. Many collections with a distinct odor, roughly a 'seaweed-fish' smell.

<u>Apothecia</u> not observed. According to Herre (1910a) not fertile in North America and only rarely fertile in Europe. According to Smith (1918) and Lynge (1921) the apothecia are very rare, small, scattered, reddish-brown with crenulate thalline margin; spores fusiform, hyaline, 1- to 3-septate, 25-40 X 5-8 µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous and corticolous; primarily among mosses over sloping rock surfaces, often shaded; corticolous collections often
small, mainly on Quercus.

Selected Specimens: 155, 4497.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially, but not exclusively, at inland sites; also present in the adjacent zones.

<u>World Distribution</u>: tentatively circumtropical with oceanic extensions into temperate latitudes; sometimes considered incompletely circumtemperate (Krog, 1968; Jørgensen, 1977); in North America reported from New Mexico-California north to Alaska in the west and the Great Lakes-Appalachian region in the east (Hale, 1979); also reported from New Zealand (Martin & Child, 1972), Australia (Weber & Wetmore, 1972), Argentina (Grassi, 1950) and Tristan da Cunha (Jørgensen, 1977) in the Southern Hemisphere.

STICTA LIMBATA (Sm.) Ach., Meth. Lich.: 280. 1803.

Lichen limbatus Sm., Engl. Botan. 16:1104. 1803.

<u>Thallus</u> foliose; 3-5 cm broad. Lobes one to several, 1-1.5(-2.5) cm wide, rounded, ascending, margins revolute. Upper surface shiny, smooth, sorediate; soredia whitish brown along cracks, margins, and in maculiform soralia adjacent to the margin; olive brown, brownish grey. Lower surface with tomentum thinning toward the margins, ivory yellow, buff, honey yellow; cyphellae numerous, pale coloured, 0.4-1.2(-2.8) mm wide.

<u>Apothecia</u> not observed. According to Herre (1910a), Smith (1918), Ozenda and Clauzade (1970) the apothecia are unknown. According to Fink (1935) the apothecia are 0.6-2.0 mm wide, flat and convex, dull black; thalline margin thin and disappearing; spores brown, oblong-ovoid, 1septate, slightly constricted, 15-22 X 5-8 µm.

Spot Tests: none.

<u>Substratum/Habitat</u>: primarily saxicolous, occasionally corticolous; common among moss over sloping rock surfaces, infrequent on deciduous trees including Quercus, <u>Acer</u>, <u>Salix</u> sp., and <u>Arbutus</u>.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone; present but not as common in the adjacent zones.

<u>World Distribution</u>: western North America-eastern North America-Europedisjunct; suboceanic-temperate (Krog, 1968); Krog (1968) expressed doubt about a report from Newfoundland (Macoun, 1902) believing it to be only western North America-Europe and definitely absent in Asia, however, Hale (1979)reported it from the Appalachians in eastern North America.

Remarks: Sticta limbata and S. fuliginosa are often collected together.

<u>STICTA WEIGELII</u> (Isert ex Ach.) Vain., Lich. Bres. 1:189, 190. 1890. <u>Sticta damaecornis</u> var. <u>weigelii</u> Isert ex Ach., Lich. Univ.:446. 1810.

<u>Thallus</u> foliose; 5 cm broad. Lobes elongate-linear, 4-7 mm wide, margins imbricate, lobe ends <u>+</u> rounded. Upper surface smooth and shiny; isidiate, isidia papillate to short cylindrical, thickly and primarily along the thallus cracks, scarcer at lobe ends, brown, darker than the thallus; buff brown, buff-olive with lobe ends darkening. Lower surface covered by a dark tan to browning towards the center, thick tomentum; cyphellae abundant, white regular, oval, 0.3-0.5 mm wide, larger toward the center.

<u>Apothecia</u> not observed. According to Fink (1935) the apothecia are 0.8-2.0 mm wide, sessile, scattered with flat, reddish brown disc; thin exciple that disappears; and, spores fusiform, 1- to 3-septate, 26-36 X 6-9 μ m.

Spot Tests: none.

<u>Substratum/Habitat</u>: corticolous and saxicolous; collected once on a shaded, mossy cliff and once by Bird and Bird (1973) on <u>Holodiscus</u>.

Selected Specimens: 6430.

Local Abundance and Distribution: rare; distribution poorly known, collected only on Saltspring Island in the southern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively pantropical with oceanic extensions into the temperate latitudes; "widely distributed in Asia and North America" tropical-temperate (Krog, 1968), not reported from Europe; in North America reported from coastal California to Alaska, Mexico-New Mexico-Arizona, and the Gulf of Mexico States north to the Great Lakes (Hale, 1979).

<u>Remarks</u>: The single local collection was rather small. <u>S. weigelii</u> is reported up to 15 cm in diameter (Hale, 1969).

STRANGOSPORA Koerb.

Thallus crustose; often poorly developed. Hypothallus absent. Ascocarp an apothecium. Proper margin indistinct to well-developed. Paraphyses branched and partially anastomosing below with abundant hymenialjelly, above unbranched, <u>+</u> free, and not apically swollen. Asci broadly clavate with a thick, amyloid (IKI+ blue) wall and well-developed amyloid tholus. Spores 30-100+ per ascus, simple, hyaline, clavate.

Corticolous and lignicolous.

<u>Strangospora</u> has recently been removed from <u>Biatorella</u>. The latter often has brightly coloured apothecia (not usually brown to black), paraphyses which are simple below and branched above, and clavate asci (rather than broadly clavate) with non-amyloid tholus.

There is one local species.

References: Magnusson (1935b), James (1971), Poelt and Vézda (1977).

<u>STRANGOSPORA</u> <u>MORIFORMIS</u> (Ach.) B. Stein, Kryptog.-Flora Schlesien 2:176. 1879.

Arthonia moriformis Ach., Syn. Lich.: 5. 1814.

Biatorella moriformis (Ach.) Th. Fr., Lich. Scand. 1:401. 1874.

<u>Thallus</u> crustose; continuous, although very thin and hardly evident except for the discoloration of the bark; light grey to almost white. Hypothallus absent.

Apothecia abundant, scattered to grouped and then confluent, adnate, 0.2-0.6 mm wide. No margin observed. Disc quickly convex, round to often slightly irregular, epruinose but slightly roughened, slightly shiny, black or occasionally paler in the center of the disc (more noticeable when wet). Hypothecium hayline; epithecium sordid golden brown toward the outside of the disc, otherwise sordid greenish-brown; hymenium 50-55 µm high; paraphyses coherent especially below, indistinct in water, unbranched above. Asci broadly saccate to pear-shaped, 40 X 10-12 µm, thick-walled especially at the apex. <u>Spores</u> 100+ per ascus, simple, hyaline, roughly globose, 2-2.5 µm.

Spot Tests: hymenium IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Quercus</u>. <u>Selected Specimen</u>: 2758.

Local Abundance and Distribution: rare; distribution poorly known,

collected once on Hornby Island in the northern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-Europe disjunct; in North America reported from California (Hasse, 1913; Magnusson, 1935b), Washington (Howard, 1950), Oregon (Pike, 1973), South Dakota (Wetmore, 1968) and Quebec (Lepage, 1972) although Magnusson (1935b) expressed doubt about the correctness of the eastern United States records and they are therefore excluded here.

<u>Remarks</u>: The single local collection has spores slightly smaller than those typically reported for <u>S</u>. <u>moriformis</u>, 3-3.5 µm wide (Poelt & Vězda, 1977; Ozenda & Clauzade, 1970).

THAMNOLIA Ach. ex Schaer.

Thallus fruticose; of erect or prostrate, <u>+</u> simple branched; <u>+</u> terete, hollow, entirely corticate (paraplectenchymatous); tapering apically; white. Ascocarps and pycnidia unknown.

Terricolous.

<u>Thamnolia</u> is a monotypic genus (see below). Until recently <u>Thamnolia</u> was usually placed in the Usneaceae. Poelt and Vězda (1981) include it in the Lichenes Imperfecti.

References: Culberson (1963b).

THAMNOLIA VERMICULARIS (Sw.) Ach. ex Schaer., Enum. Crit. Lich. Europ.:243. 1850.

Lichen vermicularis Sw., Meth. Muscor.: 37. 1781.

<u>Thallus</u> fruticose; podentia-like, hollow, little branched to simple, terete to slightly flattened, (0.5-)0.75-1.0(-1.5) mm wide, 2.5-4.0(-6.5) cm high, variously curved; erect to prostrate; scattered to grouped. Surface smooth to faintly striated; dull, chalk-like, becoming roughened, pulverulent especially at the apices; white to pale grey.

Apothecia and pycnidia not observed.

<u>Spot Tests</u>: thallus K+ yellow then golden yellow, P+ orange-red, UV-. <u>Substratum/Habitat</u>: terricolous or saxicolous; growning among mosses and <u>Selaginella wallacei</u>, thin soil, or directly over rock.

Selected Specimens: 4144, 4750.

Local Abundance and Distribution: infrequent; scattered at exposed, higher elevations inland especially toward the southwestern border of the CDFD subzone, also present in the adjacent zones at higher elevation inland sites; most of the elevations are between 500-630 m but one collection was made at approximately 100 m on Mount Douglas in the Victoria area (see Figure 42).

World Distribution: circumarctic-alpine in the Northern and Southern Hemispheres (Thomson, 1979).

<u>Remarks</u>: The chemically different <u>T</u>. <u>vermicularis</u> var. <u>subuliformis</u> (Ehrh.) Schaer. (= <u>T</u>. <u>subuliformis</u> (Ehrh.) Culb.) is UV+, K+ weak yellow, and P+ yellow. It is morphologically identical to <u>T</u>. <u>vermicularis</u> var. <u>vermicularis</u>. Var. <u>subuliformis</u> is the more common of the two varieties in the Northern Hemisphere (Sato, 1965). All collections from Vancouver Island at UBC were checked along with the specimens from the present study but only var. <u>vermicularis</u> has been collected on Vancouver Island although both varieties are present on the mainland. Since Sâto (1962) found numerous collections were sometimes necessary from the same site before the



alternate variety is discovered, all future Vancouver Island collections will require checking.

<u>T. vermicularis</u> var. <u>subuliformis</u> is treated still occasionally at the species level, e.g. Thomson (1979) and Hale (1979).

THELOMMA Mass.

Thallus crustose; thin and smooth to verrucose or placoidal; corticate; greyish.

Ascocarp an apothecium immersed in smooth or uneven semiglobose or conical thalline verrucae. The excipulum thickened and dark brown to black at the base, laterally very thin and usually hyaline. Asci usually cylindrical, obovate in one species, disintegrating early to form a powdery mazaedium along with the liberated spores. Spores 8 per ascus, uniseriate, simple and spherical or ellipsoid, 1-septate, and often constricted, blackish-brown, with an ornamented surface.

Primarily saxicolous (HCl-), also lignicolous.

References: Tibell (1976).

Spores non-septate; saxicolous<u>T</u>. <u>MAMMOSUM</u>
 Spores l-septate; lignicolous<u>T</u>. <u>OCCIDENTALE</u>

THELOMMA MAMMOSUM (Hepp) Mass., Atti Imp. Reg. Inst. Ven. Sci. ser.3, 5: 268. 1860.

<u>Cyphelium mammosum</u> Hepp, Neue Denkschr. Allg. Schweiz. Ges. Gesammten Naturwiss. 15, 4:147. 1857.

Cypheliopsis bolanderi (Tuck.) Vain., Acta Soc. Faun. Flor. Fenn. 57:16.

1927.

<u>Thallus</u> crustose; orbicular, up to ll cm broad, or more commonly irregular, coalescing to cover large areas; areolate. Areoles up to l mm thick, dull, roughened, crenate, fan-like margin which blackens at the very edge of thallus; white to pale grey. Hypothallus black.

<u>Apothecia</u> common, 0.3-1.2 mm wide, 1 or sometimes more immersed in a raised areole which darkens around the base, up to 2 mm high. Thalline verrucae white. Hypothecium black; asci dissolving leaving spores free in a powdery mazaedium which is sometimes extruded. <u>Spores 8 per ascus</u>, brown to brown-black, globose, irregularly ornamented, 9-15 µm.

<u>Pycnidia</u> immersed in regular areoles, with wide ostiole, brown, blackening; pycnospores hyaline, cylindrical, 5-7 X 1-1.5 µm.

Spot Tests: thallus KC+ rose.

<u>Substratum/Habitat</u>: saxicolous; in the supralittoral zone on both sandstones and igneous rocks.

Selected Specimens: 1381A, 2921.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone from Nanaimo south, at maritime sites, also one collection from the adjacent CDFW subzone near Sooke (see Figure 43).

<u>World Distribution</u>: western North America-Europe (Canary Islands and Portugal) disjunct; in North America reported from Baja California north to British Columbia (Tibell, 1976)(see Figure 67); locally the Tinson Pt., Gabriola Island is the northernmost location in western North America.

<u>Remarks</u>: In California and the Canary Islands <u>T</u>. <u>mammosum</u> is not restricted to the supralittoral zone as it is locally. There, it may occur inland up to elevations of 700 and 800 m (Tibell, 1976).



<u>THELOMMA</u> <u>OCCIDENTALE</u> (Herre) Tibell, Bot. Not. 129:237. 1976. Cyphelium occidentale Herre, Proc. Washington Acad. Sci. 12:62. 1910.

<u>Thallus</u> crustose; in oblong-orbicular patches up to 4.5 cm long; crackedareolate; areoles thin, dull to shiny; roughened; sometimes only verrucose; marginally thinner, smaller-areolate, becoming almost marginally lobed in places; pale grey.

<u>Apothecia</u> abundant, 0.5-1.1 mm wide, immersed in elevated areoles, up to 1 mm high. Exciple thick and dark basally, thin and hyaline laterally. <u>Spores</u> 8 per ascus, uniseriate but released early to form a powdery mazaedium which is extruded; dark brown, smooth, 1-septate, constricted at the septum, 18-25 X 10-13 μ m.

Spot Tests: thallus K-, KC-.

<u>Substratum/Habitat</u>: lignicolous; collected once on a wooden beam of a wharf and once on an unpainted fir fence; also observed once but not collected on a unpainted wooden building beside the beach.

Selected Specimens: 2228, 6319.

Local Abundance and Distribution: rare; distribution poorly known, collected twice in the southern part of the CDFD subzone at both inland and maritime sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North America endemic; reported from California north to southern Alaska (Tibell, 1976).

THELOTREMA Ach.

Thallus crustose; sometimes immersed in substratum. Phycobiont a green alga (Trentepohlia).

Ascocarp an apothecium, immersed to sessile in thalline verrucae. Disc round or elongate, punctiform or narrowly opening. Both thalline and proper margins present; proper margin initially covering disc, then tearing open and finally disintegrating; thalline margin persistent. Paraphyses simple; asci unitunicate, thick-walled, IKI-. Spores 1-8 per ascus, hyaline to brown, several septate or muriform, with spherical or lenticular lumina.

Primarily corticolous, occasionally saxicolous.

The genus <u>Thelotrema</u> is somtimes regarded as containing only those species with hyaline, muriform spores (Hale, 1974). The genus is best developed in tropical eastern Asia.

There is one local species.

References: Salisbury (1972).

THELOTREMA LEPADINUM Ach., Meth. Lich.: 132. 1803.

<u>Thallus</u> crustose; up to 4 cm broad, or several thalli coalescing and irregularly covering areas up to 9 cm broad; smooth to slightly verruculose, continuous, often slightly cracked, thin, shiny to dull; pale grey.

<u>Apothecia</u> abundant, hidden within crater-like thalline verrucae that open by means of a pore, 1.5-1.8 mm wide. Exciple irregularly torn, overarching the disc, with hyaline periphyses on the underside. Disc tan to darkening, plane, pruinose. Hymenium 150 μ m high; paraphyses simple, coherent at the apices; epithecium hyaline to darkening. <u>Spores</u> 1-4(-6) per ascus, hyaline, fusiform to compress diamond-shaped, muriform (16-20 latitudinal septa; 2-4 longitudinal septa), thick epispore, 80-110(-155) X 18-22(-30) μ m (see Figure 39).

Spot Tests: asci IKI+ yellow-orange.

<u>Substratum/Habitat</u>: primarily corticolous, also one collection on sandstone; corticolous collections mainly on <u>Alnus</u> but occasionally on other deciduous trees and shrubs or conifers.

Selected Specimens: 2433, 4900.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones especially at inland sites.

<u>World Distribution</u>: tentatively western North America-eastern North America- Europe-eastern Asia disjunct in the Northern Hemisphere; also possibly pantropical with oceanic extensions in temperate latitude; often considered 'cosmopolitan'(Salisbury, 1972; Martin & Child, 1972; Ozenda & Clauzade, 1970); in North America reported from New England to Florida-Louisiana in the east and California to British Columbia in the west (Fink, 1935); also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), Argentina (Grassi, 1950), and Tristan da Cunha (Jørgensen, 1977) in the Southern Hemisphere.

TONINIA Th. Fr.

Thallus squamulose, occasionally almost crustose or minutely fruticose; sometimes marginally lobed; corticate (pseudoparenchymatous).

Ascocarp an apothecium, sessile. Proper margin present, often excluded, dark. Disc black, plane to convex. Hypothecium hyaline to darkening; paraphyses simple, free to coherent; asci clavate to cylindrical-clavate, unitunicate, thin-walled, IKI+ blue with IKI+ blue tholus. Spores 8 per ascus, hyaline, oblong-ellipsoid to acicular, 1- to 7-septate.

Terricolous and saxicolous, often calcicolous.

There is one local species.

References: Lamb (1954b).

<u>TONINIA RUGINOSA</u> (Tuck.) Herre, Prod. Wash. Acad. Sci. 12:103. 1910. Lecidea ruginosa Tuck., Lich. Calif.:25. 1866.

<u>Thallus</u> squamulose-verruculose; squamules not distinctly lobed, more verrucae-like; initially turgid, separate becoming contorted and crowded; shiny; up to 2 mm wide; buff brown, olive brown, to olive buff.

<u>Apothecia</u> few or abundant and crowded, adnate, constricted, 0.6-1.4 mm wide. Proper margin initially thick, raised, smooth, concolorous with disc or blacker, becoming thin, even but not excluded. Disc <u>+</u> plane but conforming to the underlying substratum, round, often becoming flexuous, black or dark reddish brown. Hypothecium yellowish above; epithecium red-brown fading reddish down through the hymenium; hymenium 60 μ m high; paraphyses simple, coherent. <u>Spores</u> 8 per ascus, hyaline, acicular with one-half <u>+</u> distinctly narrower (1-)3-septate, (24-)26-32 X 2.5-3 μ m (see Figure 39).

<u>Spot Tests</u>: thallus K-, C-, P-; epithecium K+ reddish (more an intenssification than a colour change).

<u>Substratum/Habitat</u>: saxicolous; collected once on sandstone in the supralittoral zone.

Selected Specimen: 3968B.

Local Abundance and Distribution: rare; distribution poorly known, collected once near Sidney on the Saanich Peninsula in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-South America(Argentina) disjunct (Lamb, 1954b); in North America reported from California to Washington (Fink, 1935), Colorado (Shushan & Anderson, 1969) and New Mexico (Egan, 1971).

<u>Remarks</u>: Lamb (1954) reported the spores of <u>T</u>. <u>ruginosa</u> as 34-47 X 2.0-2.5 μ m while Tuckerman (1882) and Herre (1910a) described the hypothecium as dark yellowish brown; Egan (1971) as red-brown; and Lamb (1954b) as colorless below and sordid yellow-brown above.

TRAPELIA Choisy

Thallus crustose to minutely squamulose.

Ascocarp an apothecium, sessile to adnate, with a pseudothalline veil (devoid of algal cells). Proper margin present. Paraphyses slender, <u>+</u> branched and anastomosing, not apically enlarged; asci subcylindrical, unitunicate, thin walled, almost lacking a tholus. Spores 8 per ascus, hyaline, simple, ellipsoid.

Saxicolous or terricolous.

<u>Trapelia</u> was formerly treated as part of <u>Lecidea</u>. It has a position somewhat intermediate between <u>Lecidea</u> and <u>Lecanora</u>.

References: Hertel (1969b, 1977).

TRAPELIA INVOLUTA (Tayl.) Hertel, Herzogia 2:508. 1973.

Lecanora involuta Tayl., Flora Hibernica:134,135. 1836.

Lecidea ornata (Somm.) Hue, Bull. Soc. Bot. France, 34:470. 1887.

<u>Trapelia</u> ornata (Somm.) Hertel, Vortrage Gesamtgebiet Botanik, N.F.,4:181. 1970.

Thallus crustose; continuous, cracked-areolate or contiguous areoles to

separate areoles; areoles <u>+</u> flat and smooth or occasionally finely pruinose, sometimes becoming moderately convex; marginal areoles often elongated but not squamulose; light white-grey to pinkish grey. Hypothallus absent.

<u>Apothecia</u> occasional, abundant when present, scattered, 0.4-0.8 mm wide. Proper margin thin, even, persistent or not, paler, concolorous to darker than disc, often obscured by a white pseudothalline margin that may, or may not, be present, usually very thick initially but quickly becoming tattered fragments; commonly disappearing with age. Disc adnate, initially very concave becoming plane or slightly concave, moderately constricted, surface roughened to finely cracked, light pinkish tan, pale pinkish brown to dark brown. Hypothecium hyaline, thin; hymenium 100-125 μ m thick, patches of yellow or yellow-orange throughout; paraphyses very slender, branched or simple, <u>+</u> free; exciple dark brown, thin; epithecium granular, orange-brown. <u>Spores</u> 8 per ascus, simple, oblong-ellipsoid to ellipsoid, hyaline to pinkish, 16-20 X 7-10 μ m.

<u>Spot Tests</u>: thallus (cortex and medulla) C+ red, K-, P-; epithecium C+ red.

<u>Substratum/Habitat</u>: saxicolous; collected several times on sandstone and conglomerate, and once on granitic rock, usually at least partially shaded.

Selected Specimens: 858, 3133.

Local Abundance and Distribution: infrequent; scattered mainly in the southern part of the CDFD subozne; not collected in the adjacent zones during the present study but known to be present there from other collections.

<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia(Japan) disjunct; in North America reported from Nova Scotia to Georgia as well as Ontario (Brodo, 1981) and Michigan (Harris,

1977) in the east and California to British Columbia in the west; apparently more common in oceanic regions although still present in some scattered continental areas; also reported from Kenya (Hertel, 1973, 1975a) in the Southern Hemisphere.

<u>Remarks</u>: The local material was originally determined as <u>T</u>. <u>coarctata</u> (Sm.) Choisy after comparison with COLO loan material. However, that species is purely crustose while <u>T</u>. <u>involuta</u> varies from marginally notchareolate to minutely squamulose. The local material was never observed as squamulose but well-developed thalli were usually clearly areolate with the marginal areoles elongated and giving the thallus a distinct effigurate appearance when small. Large specimens may lack the margin because collecting prejudice is attracted to the fruiting parts of the thallus rather than ensuring that a marginal sample is also taken. Harris (1977) suggested that depauperate specimens of <u>T</u>. <u>involuta</u> are perhaps indistinguishable from <u>T</u>. <u>coarctata</u>. Hertel (1973) claimed that there are only occasional problematical specimens.

TRAPELIOPSIS Hertel & G. Schneider

Thallus squamulose; upper surface corticate (plentenchymatous), lower surface ecorticate; algae not confined to a distinct layer.

Ascocarp an apothecium, marginal or laminal. Proper margin present, usually paler than the disc, finally excluded. Disc plane becoming convex and immarginate. Paraphyses slender, branched and slightly anastomosing; asci subcylindrical, thin walled with distinct tholus (IKI-). Spores 8 per ascus, hyaline, simple, ellipsoid.

Terricolous, saxicolous, and lignicolous.

There is once local species.

References: Schneider (1980).

TRAPELIOPSIS WALLROTHII (Floerke ex Spreng.) Hertel and G. Schneider, Biblioth. Lich. 13:153.(1979) 1980.

Lecidea wallrothii Floerke ex Spreng. Neue Entdeck. 2:96. 1820.

<u>Thallus</u> crustose-squamulose; of flattened, lobed, tightly imbricate and appressed areoles becoming free and slightly ascending towards the margin. Upper surface minutely cracked or smooth; white or creamy coloured if apothecial initials abundant. Lower surface ecorticate, light coloured.

<u>Apothecia</u> occasionally present, laminal, often grouped, constricted, adnate, 0.9-2.0 mm wide. Proper margin at first thick, somewhat raised becomming thinner but not excluded with age; concolorous with the thallus or as little darker, lightly pruinose. Disc plane sometimes becoming convex, round to slightly irregular or a little flexuous, sometimes confluent if in groups; pinkish brown to black, <u>+</u> a light white pruinose especially toward the margin. Hypothecium hyaline but dense with small granular deposits; hymenium 100 μ m high, yellowish; epithecium brown or orange-brown; paraphyses coherent. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 7-9 X 3-4 μ m.

<u>Spot Tests</u>: thallus (medulla and upper cortex) C+ red; hypothecium and exciple C+ red.

<u>Substratum/Habitat</u>: terricolous; collected on thin soil in cracks and crevices of exposed outcrops.

Selected Specimens: 6325, 6128.

Local Abundance and Distribution: rare; distribution poorly known, collected on Galiano Island and the Saanich Peninsula both in the southern part of the CDFD subzone, at inland exposed sites; not collected in the adjacent zones.

<u>World Distribution</u>: western North America-Europe disjunct; in North America reported from California.

<u>Remarks: T. wallrothii</u> was reported new to the province as <u>Lecidea</u> wallrothii in Noble (1978) as a result of the present study.

UMBILICARIA Hoffm.

Thallus foliose; attached by a central umbilicus; monophyllous to polyphyllous; upper and lower surfaces corticate (paraplectenchymatous); with or without isidia, soredia, or reticulations above; with or without rhizines, trabeculae, or lamellae below; grey to brownish-black.

Ascocarp an apothecium, laminal, sessile to stipitate. Proper margin present or absent in some species, black. Disc black, smooth to gyrose. Asci clavate, unitunicate. Spores (1-)8 per ascus, hyaline to browning, simple to muriform, ellipsoid.

Saxicolous.

<u>Umbilicaria</u> has at times been subdivided into various segregate genera. Llano (1950) recognized five genera including <u>Lasallia</u>, <u>Agyrophora</u>, <u>Omphalo-discus</u>, <u>Actinogyra</u>, and <u>Umbilicaria</u>, primarily on the basis of apothecial type. Except for <u>Lasallia</u> the apothecial characters are now thought to be unworthy of generic rank and the other genera are now included within <u>Umbilicaria</u>.

References: Llano (1950, 1965), Kershaw (1961), Bird and Marsh (1973b), Herre (1911).

1.	Thallus isidiate <u>U</u> . <u>DEUSTA</u>
1.	Thallus nonisidiate2
	 Thallus reticulately ridged, especially toward the center; ridges and umbo pruinose
	2. Thallus not reticulately ridged3
3.	Lower surface smooth to coarsely papillose4
3.	Lower surface with rhizines, trabeculae, or lamellae6
	4. Margins finely fenestrate
	4. Margins <u>+</u> even to lacerate but not fenestrate
5.	Thallus monophyllous
5.	Thallus polyphyllous
	6. Margins finely fenestrate
	6. Margins <u>+</u> even to lacerate but not fenestrate
7.	Rhizines ball-tipped, especially towards the margins <u>U</u> . <u>POLYRRHIZA</u>
7.	Rhizines not ball-tipped

UMBILICARIA ANGULATA Tuck., Syn. Lich. New Engl.:74. 1848; Proc. Amer. Acad. Arts Sci. 1:266. 1848.

Umbilicaria semitensis Tuck., Gen. Lich.: 31. 1872.

Gyrophora angulata (Tuck.) Herre, Contrib. U.S. Natl. Herb. 13:318. 1911.

<u>Thallus</u> foliose; 2-4 cm broad; monophyllous or appearing polyphyllous from numerous folds; thick. Upper surface shiny or greyed by pruinia; smooth or with many small superficial cracks; margins shallowly lacerate; deep grey, brownish grey or clove brown sometimes with a faint purplish sheen. Lower surface black; rhizines present toward margin, trabeculaelamellae thick toward the center where the surface is also coarsely papillate; umbilicus obscure.

<u>Apothecia</u> common, sessile, plane becoming convex, irregular, 1-2 mm wide, black. Margin thick, black, and flexuous; gyri concentric, thick to faint. <u>Spores</u> 8 per ascus, hyaline, simple, oblong to widely ellipsoid, 18-25 X 10-13 µm. According to Llano (1950) the spores are hyaline and simple becoming brown and muriform, 12-29 X 6-18 µm (see below).

<u>Pycnidia</u> common, especially concentrated toward the margin, immersed; pycnospores hyaline, cylindrical, $3-5 \times 1 \mu m$.

Spot Tests: medulla C+ red.

<u>Substratum/Habitat</u>: saxicolous; on both conglomerate and igneous rocks at high elevations inland.

Selected Specimens: 4146B, 4669.

Local Abundance and Distribution: infrequent; scattered at exposed higher elevations (600 m, 630 m, 250 m) inland along the western boundary of the CDFD subzone and adjacent zones.

<u>World Distribution</u>: western North American endemic; 'alpine'; reported from California to the Aleutian Islands and Bering Strait region of Alaska.

<u>Remarks</u>: Tuckerman (1972) also described <u>U</u>. <u>semitensis</u> from California, later (Tuckerman, 1882) reducing it to a variety of <u>U</u>. <u>angulata</u>, stating the only difference was in the spores which were initially hyaline and simple, as in <u>U</u>. <u>angulata</u> s. str., but then became brown and muriform. <u>U</u>. <u>semitensis</u> was recognized by Sholander (1934) and Frey (1936) but Llano (1950), after comparing the two taxa, recognized only <u>U</u>. <u>angulata</u>. UMBILICARIA DEUSTA (L.) Baumg., Fl. Lips.:571. 1790.

Lichen deustus L., Sp. P1.:1150. 1753.

<u>Thallus</u> foliose; 1-2.5(-4) cm broad; polyphyllous or monophyllous. Lobes 6-12 mm wide, thin, contorted, margins cracked and revolute. Upper surface shiny; isidiate, isidia cylindrical becoming coralloid, sometimes lobate, scattered over the upper surface; blackish brown, drab black, becoming lighter toward the center. Lower surface smooth, often foveolate; umbilicus black, central to marginal; black-brown.

<u>Apothecia</u> not observed. According to Llano (1950) North American material is sterile. According to Frey (1933) the apothecia are mainly malformed; spores seldom developing and then mostly malformed, 18-27 X 7-12 µm.

Spot Tests: medulla C+ red.

Substratum/Habitat: saxicolous; on sloping igneous rocks.

Selected Specimens: 4147, 4691.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone but except for Saltspring Island absent from the Gulf Islands, at both inland and maritime sites; also present in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumboreal (Thomson, 1979) in the Northern Hemisphere; also reported from New Zealand (Martin, 1966) in the Southern Hemisphere.

<u>Remarks</u>: Since <u>U</u>. <u>deusta</u> is found from sea level upwards, its absence from most of the Gulf Islands is perhaps related to their sedimentary substratum although <u>U</u>. <u>deusta</u> was once collected from conglomerate on Mt. Maxwell on Saltspring Island. UMBILICARIA HAVAASII Llano, Monogr. Umbil. West. Hemisp.:136. 1950.

<u>Thallus</u> foliose; 2-4 cm broad; monophyllous. Upper surface with a white pruinose, ridged pattern, originating around the eroded or depressed umbo and then fading marginally where the colour becomes dark grey to fuscous black; margins lacerate, involute. Lower surface tan-white becoming sooty black toward the margins; umbilicus obscure, dark; rhizines few and scattered toward the margin; occasionally erect, black rhizines also present in tufts on the upper surface or on margins of lobes.

<u>Apothecia</u> occasional, stipitate, laminal, 0.5-1.5 mm wide. Margin proper, thin, black. Disc black, with concentric gyri. <u>Spores</u> 8 per ascus, simply, hyaline, ellipsoid to oblong, 13-16(-19) X 5-8 μ m. According to Llano (1950) the spores are spherical to ellipsoid, 10.2-20.4 X 6.3-8.5 μ m.

<u>Pycnidia</u> scattered toward the margins, black, immersed to slightly protruding; pycnospores hyaline, cylindrical, 5-7 X 1.5-2 μ m.

Spot Tests: medulla C+ red.

<u>Substratum/Habitat</u>: saxicolous; collected once on conglomerate. Selected Specimens: 4690.

Local Abundance and Distribution: rare; distribution poorly known, collected once at an exposed, higher elevation (630 m) inland in the CDFW subzone; also known from Mt. Benson near Nanaimo (Llano, 1950) from an early collection of J. Macoun.

UMBILICARIA PHAEA Tuck., Lich. Calif.: 15. 1866.

<u>Thallus</u> foliose; 1.5-5(-10) cm broad; monophyllous. Upper surface shiny, smooth to minutely cracked; umbo elevated, sometimes white pruinose; margin usually tattered to irregularly incised; dark grey, clove brown to black, sometimes lighter toward the center. Lower surface black or brown, lighter toward the margins, distinctly verrucose; umbilicus compact, usually central.

<u>Apothecia</u> common and abundant, sessile, 0.5-1.0 mm wide. Proper margin thin, black. Disc black with numerous concentric gyri, plane to convex, round to irregular especially when crowded. <u>Spores</u> not observed. According to Llano (1950) the spores are hyaline to light brown, simple, 6.8-17 \times 3.4-8.5 µm.

<u>Pycnidia</u> common, abundant toward the margins, immersed; pycnospores hyaline, cylindrical, $3-5 \times 1 \mu m$.

Spot Tests: medulla C+ red.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstones and igneous rocks.

Selected Specimens: 3651, 4145.

Local Abundance and Distribution: occasional; scattered throughout the southern part of the CDFD subzone at both inland and maritime sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: western North America-South America (Chile) disjunct; in North America reported from Baja California north to southern British Columbia and inland from the Northwest Territories, Alberta, Montana, Idaho, Nevada, Utah, Colorado, and Nebraska (Llano, 1950).

<u>Remarks</u>: Despite extensive northward extensions in the continental portion of its range, <u>U. phaea</u> apparently does not extend as far north coastally. It is absent from Alaska (Krog, 1968) and the Queen Charlotte Islands in British Columbia (Brodo, 1980).

The collections of <u>U</u>. <u>phaea</u> from Chile are slightly different morphologically from North American material. The former have a more granuloseareolate upper surface and lamellae occasionally present on the lower surface. Llano (1950) place it in <u>U</u>. <u>phaea</u> but as a separate variety.

UMBILICARIA POLYPHYLLA (L.) Baumg., Fl. Lips.:571. 1790.

Lichen polyphyllus L., Sp. Pl.:1150. 1753.

Gyrophora polyphylla (L.) Funck, Crypt. Gewächse:4. 1804.

<u>Thallus</u> foliose; 1.5-4(-7) cm broad; polyphyllous. Lobes 2-8(-14) mm wide, irregular and very lacerated. Upper surface shiny, smooth; umbo often hidden by small lobes; brown to fuscous-black. Thallus occasionally mono-phyllous, then the major lobe lacerate with small, narrow minor lobes over the umbo.

Apothecia not observed. According to Llano (1950) the apothecia are rare, mostly peripheral, 0.5-1.5 mm wide, sessile, irregular; disc black, convex, with few gyri; margin thick; spores ellipsoid to irregular, hyaline, 11.9-18.7 X 3.4-6.8 µm.

<u>Pycnidia</u> not observed. According to Frey (1933) the pycnidia are uncommon; pycnospores 4-5 X 1 µm.

Spot Tests: medulla C+ red.

<u>Substratum/Habitat</u>: saxicolous, collected primarily on igneous rocks, also occasionally on conglomerate.

Selected Specimens: 4673, 5110.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone primarily, but not exclusively, at higher elevations inland, absent from the Gulf Islands except for Saltspring Island; present in the adjacent zones (see Figure 44).

<u>World Distribution</u>: circum(low)arctic-circumtemperate in the Northern Hemisphere (Krog, 1968), in the Southern Hemisphere reported from South America (Chile, Argentina), Falkland Islands, Australia, New Zealand (Llano, 1950) and Antarctica (Frey, 1933).



<u>Remarks</u>: <u>U</u>. <u>polyphylla</u>, like <u>U</u>. <u>deusta</u>, appears to have a preference for the harder igneous substrata in the study area, avoiding the friable sandstones although it is apparently more tolerant of conglomerate substrata than the latter species.

<u>UMBILICARIA POLYRRHIZA</u> (L.) Ach., Vetensk. -Akad. Nya Handl. 15:92. 1794. <u>Lichen polyrrhizos</u> L., Sp. Pl.:1151. 1753.

Gyrophora polyrrhiza (L.) Koerb., Parerg. Lich.:41. 1859.

Actinogyra polyrrhiza (L.) Schol., Nyt Magn. Naturvid. 75:28. 1934.

<u>Thallus</u> foliose; 2-3(-6) cm broad; monophyllous or polyphyllous. Lobes 6-10(-18) mm wide, shallowly lacinate. Upper surface smooth, shiny; sepia to olive brown with the center occasionally a lighter greyish olive or green. Lower surface black; rhizines abundant, toward the center long and branched, toward the margin short and ball-tipped, often protruding beyond the margin and erupting through holes onto the upper surface; umbilicus obscure.

<u>Apothecia</u> uncommon, 1-3 mm wide, sessile, laminal. Proper margin absent. Disc black, with radially arranged gyri, plane to convex. <u>Spores</u> not observed. According to Llano (1950) the spores are 8 per ascus, hyaline, simple, 8.5-9 X 3.4-6 µm.

<u>Pycnidia</u> common, immersed; pycnospores hyaline, cylindrical, 4-5 X 1.0 µm.

Spot Tests: medulla C+ red.

Substratum/Habitat: saxicolous; usually igneous rock.

Selected Specimens: 4146A, 4989.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at exposed, higher elevations inland, not collected in the adjacent zones (see Figure 46).



<u>World Distribution</u>: western North America-eastern North America-Europe disjunct in the Northern Hemisphere; in North America rare and restricted in the east being reported for Minnesota (Llano, 1950), South Dakota (Fink, 1935) and Baffin Island (Bird et al., 1980), in the west reported from California to British Columbia and again in the Northwest Territories (Bird et al., 1980; Llano, 1950); also reported from Chile and the Falkland Islands in the Southern Hemisphere.

<u>UMBILICARIA TORREFACTA</u> (Lightf.) Schrad., Spicil. Fl. German. 1:104. 1794. <u>Lichen torrefactus</u> Lightf., Fl. Scotica 2:862. 1777. <u>Gyrophora torrefacta</u> Cromb., Monogr. Lich. Brit. 1:329. 1894.

<u>Thallus</u> foliose; 1.5-2.5(-5) cm broad; monophyllous. Upper surface shiny; margins finely perforated or lacerated and then growing together to form suture-like marks; umbo raised; dark olive-brown. Lower surface light brown to blackening; verrucose, especially toward the center, sometime trabeculae and lamellae present; rhizines also occasionally present toward the periphery.

<u>Apothecia</u> common, laminal, 0.5-1.5 mm wide. Proper margin thick, flexuous, black. Disc plane to convex, gyri concentric, somewhat obscure. Spores 8 per ascus, hyaline, broadly ellipsoid, 8-11 X 6-8 µm.

<u>Pycnidia</u> common, scattered over the upper surface, immersed; pycno-spores hyaline, cylindrical, 3-5 X 0.75 μ m.

Spot Tests: medulla C+ red.

<u>Substratum/Habitat</u>: saxicolous; on both igneous and conglomerate rocks. Selected Specimens: 4799, 4877.

Local Abundance and Distribution: infrequent; scattered toward the western boundary of the CDFD subzone at exposed, higher elevations inland,

also present in the adjacent zones.

World Distribution: circumarctic-circumboreal in the Northern Hem-

USNEA P. Browne ex Adans.

Thallus fruticose; tufted to pendent; typically attached by a basal holdfast and then branching isotomically or anisotomically to produce few to many major branches; with or without soralia, isidia, pseudocyphellae, spinules, fibrils, or papillae; possessing a central cartilaginous axis which may be hollow or solid (local species), a compact to lax or inflated medulla, and brittle cortex or occasionally decorticate; green, yellowgreen, or sometimes red, often darkening in the herbarium

Ascocarp an apothecium, lateral to (sub-)terminal, round but very thin. Thalline margin present usually with abundant fibrils. Disc large, pale flesh-coloured, lightly white pruinose. Spores 8 per ascus, simple, hyaline, ellipsoid.

Corticolous, lignicolous, occasionally saxicolous.

<u>Usnea</u> is a notoriously complex, and taxonomically is among the most difficult of macrolichen genera. This results in part from their "very considerable environmental variability, the precise extent of which is unknown" (Tallis, 1959) and because of a lack of any modern treatment of the group. The genus is morphologically complex because of very subtle morphological variants and because the morphological structures of the group are still not satisfactorily elucidated. Soralia, for example, are "present in far fewer species of the genus than is commonly supposed... It is eroded pseudocyphellae that are commonly mistaken for soralia..." (Swinscow & Krog, 1974). According to Fiscus (1972) "<u>Usnea</u> has long posed a problem because in many primarily asexual groups, a seemingly continuous array of morphological forms has precluded the recognition of well-defined species". The last taxonomic treatment of the genus was a world monograph published by Motyka in 1936-38 with most current species concepts still originating from this work despite being confused with many imperfections.

With this in mind, the treatment given for local <u>Usnea</u> can only be tentative. This is not meant to discourage collection or identification of its taxa nor spread the epidemic "<u>Usnea</u>-avoidance" phobia displayed by many expert lichenologists (e.g. Harris, 1977) but merely as a warning that the treatment here is imperfect and obviously will change, perhaps quite radically, with an imporved understanding of this complex genus. To encourage their handling, many of the local species have an extensive discussion of their individual problems and difficulties and/or different ideas for handling of the various complexes in other publications.

References: Asahina (1956, 1968), Fiscus (1972), Herre (1963), Hale (1962), Motyka (1936-38, 1947), Tallis (1959), Swinscow and Krog (1974, 1975, 1976, 1978, 1979). Herre (1963) and Swinscow and Krog (1974, 1975, 1976, 1978, 1979), although dealing with exotic taxa are useful for comments on morphology and species concepts. Dahl and Krog (1973) contains a helpful diagram of some morphological structures.

1.	Thallus pendulous, > 15 cm long2
1.	Thallus tufted to subpendulous, <15 cm long4
	 Thallus consisting of <u>+</u> single main branch with numerous fibrils; main branches decorticate; axis IKI+ blue<u>U</u>. LONGISSIMA
	 Thallus consisting of more than one major branch; main branches corticate; axis IKI
3.	Main branches angular and foveolate; lacking papillae, abundant fibrils, isidia, isidia-soredia, and punctiform pseudocyphellae
3.	Main branches <u>+</u> terete; or if slightly angular then one or more present of papillae, fibrils, isidia, isidia-soredia, punctiform pseudocyphellae
	 Thallus fertile; lacking soredia, isidia, or soredia-isidia<u>U</u>. <u>FLORIDA</u>
	 Thallus sterile, or if fertile then also sorediate, isidiate, or sorediate-isidiate
5.	Some of major branches constricted and also constricted where lateral branches leave main branches; medulla lax, axis narrow (<1/3 branch diameter)6
5.	Branches (both major and minor) not consistently constricted; medulla usually compact, axis usually >1/3 branch diameter8
	6. Thallus with tubercles (raised, punctiform pseudo- cyphellae) that are entirely isidiate or becoming isidiate7
	6. Thallus with superficial soralia that erode (become concave) with age <u>U</u> . <u>GLABRATA</u>
7.	Thallus stiff; becoming yellowish(-brown) in the herbarium with age; medulla K+ yellow
7.	Thallus soft; remaining greenish in the herbarium with age; medulla K <u>U</u> . <u>FRAGILESCENS</u>
	8. Thallus subpendulous; with raised tubercles and papillae
	8. Thallus usually tufted (< 6 cm long), if subpendulous then only papillate9
9.	Thallus sorediate-isidiate
9.	Thallus sorediate

- 10. Thallus short-tufted, <6 cm; soralia quickly becoming excavated and encircling branches.....<u>U</u>. <u>FULVOREAGENS</u>
- 10. Thallus long-tufted, up to 10 cm; soralia <u>+</u> remaining punctiform and superficial; even with age not usually encircling branches<u>U</u>. <u>GLABRESCENS</u>

USNEA CAVERNOSA Tuck., Lake Superior:171. 1850.

<u>Thallus</u> fruticose; penduous, 15-36+ cm; holdfast typically absent; with several larger main branches, angular, <u>+</u> slightly foveolate, 0.4-0.8 mm wide, little branched; minor branches 0.1-0.2(-0.3)mm wide, slightly angular or almost terete, with faint, white, fissural pseudocyphellae; very ultimate branchlets often slightly uneven, nodular, or twisted, sinuate, and the very tip blackened; papillae, isidia, soredia, and punctiform pseudocyphellae all absent; abundant dense fibrils also lacking but scattered, short fibrils occasional; axis between 1/3 and 1/2 of branch diameter; greenish-grey to yellowish-grey.

<u>Apothecia</u> occasional, lateral, round, very thin, 1.5-5 mm wide. Thalline margin present, thin, with scattered, long fibrils. Disc slightly concave to plane, flesh-coloured, thinly white pruinose. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 10 X 5 µm.

<u>Spot Tests</u>: medulla (especially next to axis) K+ yellow turning orange (faint), C-, KC-, P+ yellow turning orange (sometimes faint); axis IKI-.

<u>Substratum/Habitat</u>: corticolous; on both conifers and deciduous trees but more common on <u>Pseudotsuga</u> and dead branches of <u>Arbutus</u>, often with the morphologically very similar Alectoria <u>vancouverensis</u>.

Selected Specimens: 1780, 2449.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone especially but not exclusively at higher elevations inland, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively circumboreal; reported from Europe, Russia (Urals, Siberia), and North America (Motyka (1936-38); in North America described as "pan-boreal" (Wetmore, 1968), reported from Alaska (Krog, 1968), British Columbia, Washington, Alberta, California, New Mexico, Ontario, Quebec, New England, Michigan, a questionable specimen from Florida, but also Cuba and Mexico (Motyka, op. cit.) as well as South Dakota and Wyoming (Wetmore, 1968).

<u>USNEA FILIPENDULA</u> Stirt., Scott. Nat.:104. 1881. <u>Usnea dasypoga</u> auct., non (Ach.) Shirley <u>Usnea monstruosa</u> auct., non Vain.

<u>Thallus</u> fruticose; subpendulous; 6-14 cm long; attached by a slightly blackened holdfast. One to usually several main branches; main branches 0.7-1.3 mm wide, abundantly papillose although papillae reduced toward apices and also toward holdfast; with abundant fibrils and lateral branches basally, becoming unbranched and lacking fibrils toward the apices; occasionally also with basal spinules; tuberculate, tubercles usually abundant on both main and also minor branches especially toward apices, 0.1-0.2(-0.4) mm wide, which develop a few to abundant isidia; greyish green to yellowish green.

<u>Apothecia</u> not observed. According to Motyka (1936-38) the apothecia are lateral or terminal, up to 0.7 mm wide, with numerous marginal fibrils.

<u>Spot Tests</u>: medulla and tubercles K+ yellow (faint), KC-, C-, P+ yellow (strong, often turning orange on the tubercles); axis IKI-.

Substratum/Habitat: corticolous; primarily on Pseudotsuga.

Selected Specimens: 4451, 5088B.

Local Abundance and Distribution: occasional; scattered throughout the

CDFD subzone, also present in the adjacent zones.

World Distribution: circumtemperate-circumboreal (Krog, 1968).

<u>Remarks</u>: <u>U. filipendula</u> sens. str. contains salacinic acid (K+ yellow turning red; P+ yellow) and usnic acid (Asahina, 1956; Hale, 1979). However, <u>U. muricata</u> Mot., which Hawksworth et al. (1980) suggested may be synonymous with <u>U. filipendula</u>, and <u>U. subscabrata</u> (Vain.) Mor. which Carlin and Swahn (1977) reduced to synonymy with <u>U. filipendula</u>, have been reported as K- (Ozenda & Clauzade, 1970).

Tallis (1959) stated that the species of the <u>U</u>. <u>dasypoga</u> aggregate "are very indistinctly limited; it is not always possible to assign specimens to any one taxon with any degree of certainty". The local material may not be <u>U</u>. <u>filipendula</u> in the strict sense. Besides differing in chemistry, <u>U</u>. <u>filipendula</u> is usually described as longly pendulous, up to 25 cm (Asahina, 1956; Duncan, 1970) while the local material is consistently in the shorter range described for the species.

<u>U. filipendula</u> is described usually as sorediate, but since no soredia are actually produced this is another example in the genus <u>Usnea</u> where tuberculate pseudocyphellae have been termed soralia. Ozenda and Clauzade (1970) referred to the pseudocyphellae as both soralia and nodules. Because of their large size they have been called tubercles here.

<u>U. ceratina</u> Ach. has been reported from Saltspring Island (Bird & Bird, 1973). According to Tallis (1959) <u>U. ceratina</u>, although usually a very distinct species, can produce forms which are very close to the <u>U. dasypoga</u> aggregate (= <u>U. filipendula</u>). The former may be distinguished by its sparse branching, often rosy tinge of the medulla (Tallis, 1959) or pink axis (Duncan, 1970), angular and twisted, non-papillate main branches and sorediate tubercles (Duncan, 1970; Dahl & Krog, 1973) while U. fili-

<u>pendula</u> has abundant branching especially above, white medulla and axis, <u>+</u> terete branches although they can be deformed by abundant tubercles, abundant papillae, and isidiate tubercles. Tallis (1959), however, disagreed with two of the last points concerning <u>U</u>. <u>ceratina</u>, stating its soredia are "tuberculate-isidiose" and the main branches are papillose.

<u>USNEA FLORIDA</u> (L.) Wigg., Primit. Flor. Holsat.:91. 1790. Lichen floridus L., Spec. Plant.:1156. 1753.

<u>Thallus</u> fruticose; tufted; 5-10 cm long; basal holdfast blackened or unblackened; composed of several major branches bearing few to abundant or sparse short branches and/or fibrils. Major branches terete, 1.0-1.5 mm wide, very papillate; probably greenish-grey when fresh becoming sordid yellowish-brown with age in the herbarium.

<u>Apothecia</u> abundant, usually subterminal with ultimate end of branches deflected or continuing on to produce another ascocarp, 3-17 mm wide. Thalline margin producing abundant, simple to branched fibrils. Disc flesh-coloured, faintly pruinose. <u>Spores</u> not observed.

<u>Spot Tests</u>: medulla K+ yellow, KC+ yellow, C-, P+ yellow quickly turning orange; axis IKI-.

<u>Substratum/Habitat</u>: corticolous; collected once on <u>Acer</u> sp., probably A. macrophyllum.

<u>Selected Specimens</u>: not collected during the present study but two specimens (one probably a duplicate) were collected by J. Macoun in 1914; UBC-L8313, UBC-L8314.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Mayne Island in the southern part of the CDFD subzone, not collected in the adjacent zones.
<u>World Distribution</u>: tentatively western North America-eastern North America-Europe-eastern Asia disjunct, but only common in Europe; often refered to as 'cosmopolitan'.

<u>Remarks</u>: Although many of J. Macoun's records are skeptically regarded here and in other publications, the two specimens cited here were collected after his retirement and are more reliable. Furthermore, although records of species in the <u>U</u>. <u>florida</u> complex are confined to the very southwest in western North America there is another collection from British Columbia (Fraser Valley) in UBC.

U. florida s. lat. is composed of taxa with tufted or relatively short branches that terminate in abundant apothecia. Soredia and isidia are absent. Motyka (1936-38) separated the complex primarily on geography and medullary reaction to K. U. florida s. str., although separated into many subspecies was considered to be mainly European, although a few localities in eastern North America are cited, and to be K-. U. tristis Mot., U. arizonica Mot., U. evansii Mot., and U. retifera Mot. were described from the United States and separated primarily on medullary reaction.and secondarily on colour, medulla thickness, branching habit, and presence of papillae. Hale (1962) recognized U. strigosa (Ach.) Easton, which often has a red medulla and possesses usnic acid <u>+</u> norstictic and galbinic, or psoromic, or fumarprotocetraric acids, as the main species in the eastern United States. <u>U. evansii</u> and <u>U. tristis</u> are regarded as only minor variants of this species (Hale, 1979) while <u>U</u>. <u>florida</u> was regarded as being characterized by thamnolic acid and essentially restricted to Europe (Hale, All western North American material was treated in Hale (1979) as 1962). belonging to U. arizonica and containing usnic and salazinic acids. However, Asahina (1968) reported a specimen from New Mexico (University of Colorado Museum Lichenes Exsiccati No. 116) as containing thamnolic acid

and, therefore, referable to U. florida.

Fiscus (1972) chemically studied the <u>U</u>. <u>florida</u> complex in North America and reported a wide array of secondary products which may be grouped into thirteen different chemical strains. The thamnolic acid strain is reported fromFlorida and New Mexico and may be equivalent to the European <u>U</u>. <u>florida</u>. Fiscus (op. cit.) stated that the morphological variation of the complex is subtle and requires study before a reasonable taxonomy of this group can be expected.

Although <u>U</u>. <u>florida</u> contains thamnolic acid, an acid that usually reacts K+ yellow and P+ orange, the reaction with K is not always distinct in this species. Motyka (1936-38) reported it was K-. Asahina (1968) stated that its "medullary reactions are generally very obscure" with only the medullae of receptacles reacting positively with K".

<u>USNEA FRAGILESCENS</u> Hav. ex Lynge, Videns. Selsk. Skrift. 1, Mat. -Naturv. Kl., 7:230. 1921.

Usnea mollis Stirt., Scott. Natur. 6:109. 1881.

<u>Thallus</u> fruticose; subpendulous, 8-10 cm long; flaccid; basal holdfast only slightly blackened, matt to slightly shiny; medulla very lax and arachnoid; axis < 1/4 of branch diameter away from constrictions. Major branches 1.0-1.5 mm wide, occasionally constricted and articulated to expose axis, papillate to faintly papillate; scattered white tubercles (possibly scars of eroded fibrils) present; side branches and fibrils abundant, constricted where they leave major branches and occasionally elsewhere, elongate, slender, with abundant tubercles (= 'soralia') which may become isidiate and \pm remaining punctiform; pale green or greenish-grey.

Apothecia not observed. Also not observed by Motyka (1936-38).

<u>Spot Tests</u>: medulla K-, KC-, C-, P+ yellow turning orange near the axis; axis IKI-.

Substratum/Habitat: corticolous; collected once on Salix sp.

Local Abundance and Distribution: rare; distribution poorly known; collected once on South Pender Island in the southern part of the CDFD subzone, not collected in the adjacent zones during the present study although reported from the Queen Charlotte Islands (Brodo, 1980).

<u>World Distribution</u>: uncertain; reported by Motyka (1936-38) from Europe and western North America; mentioned by Ozenda and Clauzade (1970) additionally from New Zealand.

<u>Remarks</u>: The single local collection of <u>U</u>. <u>fragilescens</u> differs from the local collections of <u>U</u>. <u>inflata</u> in the former's softer, more flexible thallus which is still distinctly greenish coloured (not browning or yellowing at all), and K- medulla. The former is also only sparsely isidiate and inconspicuously so (see below) while the latter is commonly abundantly and conspicuous isidiate. The <u>U</u>. <u>fragilescens</u> specimen is not distinctly glossy although parts are slightly shiny and the papillae are very numerous and conspicuous, however, these characters are apparently variable within the two complexes involved.

The tubercles of the single local <u>U</u>. <u>fragilescens</u> specimen are distinctly but not as obviously raised as in the three local specimens of <u>U</u>. <u>inflata</u>. Furthermore, the isidia were very rare and small in the former. Indeed, the specimen was originally thought to have only soredia but closer examination disclosed the isidia on some branches. The tubercles are 'almost sorediate' but it is questionable whether they are actively producing soredia. According to Dobson (1979) <u>U</u>. <u>fragilescens</u> does not produce soredia, only isidia, although most descriptions mentioned isidiate soralia. According to Swinscow and Krog (1975) it is the eroded pseudocyphellae (= raised, semiglobose, pseudocyphellate papillae = tubercles) that "are commonly mistaken for soralia, but they do not produce soredia, though occasionally the distinction can seem artificial owing to breaking away of medullary tissue".

It should be noted in reference to the discolouring of \underline{U} . <u>inflata</u> in the herbarium versus the lack of discolouring in \underline{U} . <u>fragilescens</u>, that Swinscow and Krog (1978) found pendulous <u>Usnea</u> species to show a wide variation in the colour of live thalli. They did not consider colour an important diagnostic charcter. Furthermore, they found that any colour change after collection was of no "practical use in delimiting species".

Swinscow and Krog (op. cit.) claimed that a matt versus glossy cortex is of no taxonomic significance in <u>Usnea</u> "though they may differ between local populations within species". However, in the limited local collections the glossy cortex versus matt or slightly shiny cortex appears a consistent character.

<u>U. mollis</u> Stirt. was separted formerly on the basis of subdichotomous and divergent branching, dense papillae, and corticolous habit from <u>U</u>. <u>fragilescens</u> which was restricted to collections with subsympodial and convergent branching, sparse papillae, and saxicolous habit. Hawksworth et al. (1980) regarded the two taxa as synonymous.

One specimen of <u>U</u>. <u>fragilescens</u> at UBC (Lichenes Canadenses Exsiccati No. 7.) is stiff and yellowed with age and would be determined under the treatment given here as <u>U</u>. <u>inflata</u>. The separation of the two species requires further study. See <u>U</u>. <u>inflata</u> for additional comments.

<u>USNEA FULVOREAGENS</u> (Ras.) Mot., sens. lat., Lich. Gen. Usnea Stud. Monogr.: 284. 1936-38.

<u>Usnea glabrescens</u> var. <u>fulvoreagens</u> Räs., Suom. Tiedeak. Toim. A, 34, 4:20. 1931.

Usnea soredifera sensu Mot., non (Arn.) Lynge

<u>Thallus</u> fruticose; tufted, 3-5(-7) cm long; attached by a distinct, slightly blackened holdfast. Main branches terete, up to 1 mm wide, usually distinctly papillose, usually with abundant short fibrils or branches. Minor branches not papillose, lacking fibrils but often with scattered, small, white, papillate pseudocyphellae; toward the apices becoming sorediate; the soralia initially punctiform with granular soredia but usually becoming highly eroded, irregularly shaped, completely encircling the branches with the adjacent cortex often arching up or reflexed; green to yellowish-green.

<u>Apothecia</u> observed once, subterminal, 2.5-3 mm wide, with thalline margin fibrillose. Disc plane, round, flesh-coloured, faintly pruinose. Spores not observed.

<u>Spot Tests:</u> medulla K-, KC-, C-, P+ bright yellow or P+ pale yellow turning orange; axis IKI-.

<u>Substratum/Habitat</u>: corticolous; collected primarily on <u>Pseudotsuga</u> and <u>Quercus</u>.

Selected Specimens: 761, 2080A.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone, also present in the adjacent zones.

<u>World Distribution</u>: tentatively circumboreal-circumtemperate (Krog, 1968) in the Northern Hemisphere; also reported from Argentina (Grassi, 1950) in the Southern Hemisphere. <u>Remarks</u>: The local material is not homogeneous. The papillae vary from abundant to almost absent and from short and faint to distinctly elongated. There is also considerable chemical variability.

According to Carlin and Swahn (1977) <u>U</u>. <u>arnoldii</u> Mot., <u>U</u>. <u>compacta</u> Mot., <u>U</u>. <u>lapponica</u> Vain., <u>U</u>. <u>laricina</u> Vain. ex Räs., <u>U</u>. <u>sorediifera</u> (Arn.) Lynge, <u>U</u>. <u>substerilis</u>, and <u>U</u>. <u>fulvoreagens</u> are all synonymous with U. perplexans Stirt., although the last epithet is not typically utilized.

USNEA GLABRATA (Ach.) Vain., Annal. Acad. Scienc. Fenn., ser. A. 6(7):7. 1915.

Usnea plicata var. glabrata Ach., Lich. Univ.:624. 1810.

<u>Thallus</u> fruticose; tufted; 3-6 cm long; stiff; glossy; basal holdfast not or hardly blackened; medulla arachnoid and lax; axis < 1/3 of branch diameter. Major branches up to 1.5 mm wide, <u>+</u> smooth, not papillose; with a few constrictions or constrictions and articulations restricted to where lateral branches and/or fibrils are attached to main branches; fibrils/ spinules abundant to sparse above; lower on the thallus, especially near apices, soralia usually abundant, initially superficial and punctiform becoming excavated and irregular, soredia granular to subgranular, never really farinose; greenish-yellow.

Apothecia not observed. Also not observed by Motyka (1936-38).

<u>Spot Tests</u>: medulla K+ sordid yellow, KC-, C-, P+ yellow quickly turning orange-red (especially near axis or soredia); axis IKI-.

Substratum/Habitat: corticolous; collected on Quercus.

Selected Specimens: 2403D, 3703C.

Local Abundance and Distribution: infrequent; scattered throughout in the CDFD subzone, not collected in the adjacent zones.

<u>World Distributions</u>: tentatively circumboreal-circumtemperate (Krog, 1968); reported from Europe, Asia (Caucasus to Siberia), and North America (Mexico, California, New Mexico, British Columbia, Quebec, and Alaska) (Motyka, 1936-38; Krog, 1968).

<u>Remarks</u>: The local collections of <u>U</u>. <u>glabrata</u> are very similar to <u>U</u>. <u>fulvoreagens</u> in the small, tufted thalli with terminal soralia. However, the former species lacks papillae and, instead, has constrictitions where lateral branches attach to the main branches, a thick arachnoid medulla, and narrow axis.

The medulla of European specimens of <u>U</u>. <u>glabrata</u> is reported as K+ red and P+ red (Tallis, 1959; Ozenda & Clauzade, 1970). <u>U</u>. <u>glabrata</u> subspp. <u>pseudoglabrata</u> Asah., described from Japan, is reported to differ from the species in the distinct K+ red and P+ yellow reaction caused by salacinic acid <u>+</u> barbatic acid. Culberson (1970) reported only usnic acid in U. glabrata.

Two slightly different specimens (388B, 4341) have been tentatively included with <u>U. glabrata</u>. The thalli in question possess smooth, glossy branches that are constricted at major branching points and have terminal eroded soralia as in the more typical local collections of <u>U. glabrata</u>. However, both specimens have abundant, minute red spots (K-) on the cortex when viewed under the DM which do not actually change the overall greenish coloration of the plant and the axis reacts distinctly C+ yellow-orange. Dobson (1979) stated that a red coloration can result from poor condition and/or decomposition of salazinic acid. The latter does not appear to be the case here, since the red spotting is cortical and not medullany where salazinic acid would be located. However, there is a possibility of some type of infection although examination of cross-sections failed to show any foreign bodies. <u>USNEA</u> <u>GLABRESCENS</u> (Nyl. ex Vain.) Vain., s. lat., Meddel. Soc. Fauna Flora Fennica 48:173. 1924.

<u>Usnea barbata</u> var. <u>glabrescens</u> Nyl. ex Vain., Meddel. Soc. Fauna Flora Fennica 2:46. 1878.

Usnea distincta Mot., Lich. Generis Usnea Stud. Monogr.: 298. 1936-38.

<u>Usnea</u> <u>extensa</u> Vain., Muistiinpanoja prof. A. Ahlquistin kolmannelta tutkimusretkeltä Länsi-Siperiassa 4:68. 1928.

<u>Thallus</u> fruticose; subpendulous, up to 12 cm long; attached by a slightly blackened holdfast. Major branches terete, papillose, with abundant fibrils or secondary branches, <u>+</u> rather regular transverse cracks. Minor branches simple or somewhat dichotomously branched, long and slender, very gradually attenuated, not papillose, lacking fibrils but with scattered punctiform, white, even or slightly raised pseudocyphellae above; below becoming sorediate, soralia punctiform and almost superficial but eventually some becoming more excavated and irregular, not usually encir-cling the braches nor the adjacent cortex arching up.

<u>Apothecia</u> not observed. According to Motyka (1936-38) the apothecia are very rare, subterminal, ca. 0.5 cm wide with a few fibrils on the margin.

<u>Spot Tests</u>: K+ yellow (turning orange), KC-, C-, P+ yellow; axis IKI-.

<u>Substratum/Habitat</u>: corticolous; collected once each on <u>Pseudotsuga</u> and <u>Tsuga</u>.

Selected Specimens: 151C, 5268B.

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Local Abundance and Distribution: rare; distribution poorly known, collected once on South Pender Island in the southern part of the CDFD subzone; also once in the adjacent CDFW subzone.

<u>World Distribution</u>: circumboreal(-circumtemperate) (Krog, 1968); Motyka (1936-38) reported <u>U. glabrescens</u> from Europe, Siberia, eastern North America (Quebec) and western North America (Washington).

<u>Remarks</u>: <u>U glabrescens</u> is very similar to <u>U</u>. <u>fulvoreagens</u>, differing primarily in the much larger size of the thallus. Furthermore, the secondary branches are very slender and elongated and the soralia tend to stay punctiform rather than quickly becoming excavated and irregular. These are only tendencies. Tallis (1959) described <u>U</u>. <u>extensa</u> as possessing superficial, farinosely sorediose soralia that are "never so prominently excavated as in <u>U</u>. <u>distincta</u> aggregate and <u>U</u>. <u>fulvoreagens</u>". He described <u>U</u>. <u>distincta</u> as having soralia that are punctiform and not excavated <u>when</u> young (my emphasis), and rarely becoming confluent when old. Hawksworth et al. (1980) reduced both <u>U</u>. <u>extensa</u> and <u>U</u>. <u>distincta</u> to synonyms of U. glabrescens.

<u>USNEA INFLATA</u> Del., Botan. Gallic. 2:615. 1830. <u>Usnea cornuta</u> Koerb., Par. Lich.:2. 1859. <u>Usnea intexta</u> Stirt., Scott. Natur. 6:102. 1881. <u>Usnea subpectinata</u> Stirt., Scott. Natur. 6:108. 1881.

<u>Thallus</u> fruticose; subpendulous, 4-9 cm long; basal holdfast not or only slightly blackened, not constricted; stiff; entire thallus very glossy; cortex brittle. Major branches 0.8-1.5 mm wide, usually constricted where they join the major branches (often broken or cracked), often abruptly attenuated; abundantly isidiate; isidia massed on raised tubercles (0.1-0.3 mm wide) that resemble soralia when isidia completely shed but not appearing to produce soredia at all; yellowish-brown (8 year old herbarium specimens), presumably greenish or yellowish-green when fresh.

Apothecia not observed. Also not observed by Motyka (1936-38).

<u>Spot Tests</u>: thallus (medulla) K+ yellow, KC-, C-, P+ orange or yellow turning orange; axis IKI-.

<u>Substratum/Habitat</u>: corticolous; collected twice on <u>Pseudotsuga</u> and once on Holodiscus.

Selected Specimens: 1949, 4463.

Local Abundance and Distribution: infrequent; collected twice in the southern part of the CDFD subzone, and once abundantly in the adjacent CH zone.

<u>World Distribution</u>: uncertain; primarily Europe but also reports of U. intexta from Mexico and Africa (Algeria) (Motyka,1936038).

Remarks: The local material is represented by only three collections that differ in the presence/absence of papillae and fibrils/spinules but otherwise appear uniform. The major branches and often the minor ones, where they join the major branches, are moderately constricted; all collections are very glossy with the cortex both brittle and nearly translucent (herbarium material); the medulla was very lax and thick compared to the small axis (away from constriction points), and the isidia were abundant on all but the largest branches on slightly raised tubercles that resemble raised soralia when the isidia are entirely shed. The local material appears to fall closest to U. inflata which formerly was regarded as the shiny, non-papillose, little-branched, wide axis, saxicolous species of an (at least) four-species complex. The other species, U. cornuta Koerb., U. subpectinata Stirt, and U. intexta Stirt., included narrow axes, matt, highly-branched, corticolous forms that are regarded as synonyms of U. inflata by Hawksworth et al. (1980). Interestingly one little-branched local collection was also the only papillose specimen and would not have

readily separated into any of the above former species.

<u>U. fragilescens</u> Hav. (= <u>U. mollis</u> Stirt.) is very similar and also found locally. It has articulated, constricted branches and isidia but its thallus is noticeably flaccid, usually K-, and does not turn yellow-brown with age in the herbarium. See that species for further comments.

The local material also appears close to U. bismolliuscula Zahlbr., described from Japan (Asahina, 1956). U. bismolliuscula, like the local material, has isidiate soralia that are tuberculate. A complete description of the soralia in U. inflata was not readily available. Tallis (1959) refered to the inflata-frgailescens-glabrata aggregate as having "soredia erumpent from tubercles". Ozenda and Clauzade (1970) stated that the soralia of U. inflata complex arise from nodules. Reference to soralia persists, no doubt, as the tubercles of the local material are widely open to the white medulla, often becoming rather convexly shaped, but usually partially or entirely covered in isidia. Resemblance to soralia is strongest when the isidia have been brushed off and the medullary layer below is slightly disturbed, although no soredia, either granular or farinose, are produced. The actual species limits of U. bismolliuscula are vague. Moryka (1936-38) included it in section Stramineae while U. inflata belonged to section Glabratae. The two sections are actually close, with one of major differences being that Stramineae is commonly composed of long and pendulous species while Glabratae is composed of species with much smaller thalli, usually less than 10 cm long. Motyka's description of U. bismolliuscula is apparently based on a large thallus fragment lacking a holdfast and since that fragment is 8 cm long it was assumed that the thallus is normally pendent. Asahina (1956) stated the thallus is usually 3-8 cm long but occasionally as long as 20 cm. Motyka (op. cit.) described it as

flaccid, which would place it closer to <u>U</u>. <u>fragilescens</u>, however, the thallus does turn brown in herbarium specimens and is K+ yellow as in <u>U</u>. <u>inflata</u>. The problem of the identity of <u>U</u>. <u>bismolliuscula</u> requires further study.

USNEA LONGISSIMA Ach., Lich. Univ.: 262. 1810.

<u>Thallus</u> fruticose; pendulous; filamentous; with one main branch, 15-30 cm or more long; central strand terete to often somwhat angular, 0.3-0.7 mm wide, axial cord proportionally very thick (> 2/3 width of branch diameter), smooth but quickly becoming at least partially or entirely decorticate, with abundant but spaced secondary lateral filaments; secondary filaments 0.5-2.0 cm long, simple, initially at right angles to main stem but longer ones becoming somewhat curved; smooth and corticate, or sometimes with scattered, punctiform pseudocyphellae; esorediate, nonisidiate; pale greenish to straminous yellow.

<u>Apothecia</u> not observed. According to Fink (1935) the apothecia are very rare, small (1-3 mm across), terminal; spores 7-10 X 4-6 μ m.

Spot Tests: medulla K-, KC-, C-, P-; axis IKI+ blue.

<u>Substratum/Habitat</u>: corticolous; collected from <u>Tsuga</u> <u>heterophylla</u> and <u>Pseudotsuga</u>, especially as windfalls.

Selected Specimens: 5372, 5465.

Local Abundance and Distribution: infrequent; not collected in the CDFD subzone; collected three times in the CH zone, especially but not exclusively in the Fog/Spruce subzone, however, reported by Macoun (1902) from Burnside Road, Victoria (see below).

<u>World Distribution</u>: uncertain; according to Krog (1968) "largely circumboreal-temperate"; according to Ahti (1977) it is oceanic-boreal in 3 out of 4 such regions in the Northern Hemisphere (= disjunct); Motyka (1936-38) reported it from Europe, Asia Minor, eastern Asia (China, Japan, Siberia), and North America; in North America reported from California north to Alaska in the west and Ontario, Quebec, Nova Scotia, Minnesota, and New England in the east.

<u>Remarks: U. longissima</u> is known in Europe to prefer old forest stands (Essen et al., 1981) and so Macoun's early collection of this species in the CDFD subzone is quite reasonable since virgin forests were still present locally at the turn of the century. Macoun's record has therefore, been accepted here unlike several other of his early reports.

Motyka (1936-38) recognized a number of varieties within <u>U</u>. <u>longissima</u> including var. <u>perciliata</u> Mot. based on a collection from Vancouver Island (Bronlinto Strait, 1894 Trelease). This variety is distinguished by the pale yellow thallus and long, little-branched main filaments.

USNEA SCABIOSA Mot., Lich. Gen. Usnea Monogr.: 148. 1936-38.

<u>Thallus</u> fruticose; pendulous; basal holdfast usually absent in larger thalli; 20-34+ cm long; composed of several main branches, 0.4-0.8 mm wide, subterete to often slightly angular (with one or more low ridges) or occasionally foveolate; very faintly papillose or papillae absent; usually with abundant but scattered, minute, simple spinules, 1 mm long, sometimes concentrated along pseudocyphellae, very easily abraded, leaving slightly raised punctiform scars (= punctiform, white pseudocyphellae), often with abundant annulate cracks with cortex smoothed in to the axis and occasionally articulated; minor branches <u>+</u> terete, occasionally slightly angular, often slightly twisted towards tips, usually abundant, slightly raised, white, linear pseudocyphellae; becoming somewhat sinuous towards tips; true isidia and soredia absent; greyisy green to yellowish green.

<u>Apothecia</u> not observed. According to Motyka (1936-38) the apothecia are lateral, up to 0.5 cm wide with long and short fibrils on the margin.

<u>Spot Tests</u>: medulla (especially beside axis) K+ yellow turning orange (slow), KC-, C-, P+ yellow turning orange; axis IKI-.

<u>Substratum/Habitat</u>: corticolous; usually on <u>Pseudostuga</u> but some tentatively identified specimens also collected from <u>Quercus</u> and <u>Pinus</u> <u>contorta</u>; often with <u>Alectoria</u> <u>vancouverensis</u> and <u>Usnea</u> <u>cavernosa</u>.

Selected Specimens: 2449, 1779.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone primarily but not exclusively at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-eastern North America disjunct; Motyka (1936-38) reported it from Vermont, New Mexico (type locality), and British Columbia (Sidney, Vancouver Island - Macoun, 1912) with later reports also recording it from Quebec, Saskatchewan, and South Dakota (Wetmore, 1968).

<u>Remarks</u>: The local material is not completely homogeneous. The major characters in the larger specimens are the annulate constrictions of the main branches which are almost terete but still slightly ridged or foveolate along with scattered small spinules that break off to leave white puntiform scars and often very faint papillae. Several small thalli are tentatively also included here (8-15 cm long) but the bases are very papillate and numerous fibrils are present also towards the base; the terminal ends, however, approach the appearance of the larger thalli. It is not inconceivable that the small thalli are just young specimens that eventually will develop into the larger form.

The local material has been tentatively determined as U. scabiosa.

Hale (1979) grouped <u>U</u>. <u>scabiosa</u> with the pendulous, angularly ridged and constricted eastern North American species <u>U</u>. <u>angulata</u> Ach. <u>U</u>. <u>scabiosa</u> is said to differ in the rugose cortex and numerous short fibrils or isidia. Wetmore (1968) and Motyka (1936-38) did not mention constrictions. The former described <u>U</u>. <u>scabiosa</u> as "somewhat penduous, 10-20 cm long, rugulose-foveolate; isidiate-soredia near tips of branches". Both Hale (op. cit.) and Wetmore (op. cit.) stated that it contains only usnic acid (K-,P-). This, however, does not entirely exclude the local material from being <u>U</u>. <u>scabiosa</u> as many <u>Usnea</u> species have acid deficient strains.

U. tichodea Ach. has been reported twice from British Columbia, once each from the Queen Charlotte Islands (Weber & Shushan, 1959) and Saltspring Island (Bird & Bird, 1973). U. trichodea is usually considered to be an eastern North Ameircan species although there have been other reports of it from the west coast (California) besides the two from this province. Brodo (1968) described U. trichodeaas being pendent with exceedingly slender filaments, articulations with conspicuous swollen joints, but never tuberculate or papillate with frequent dichotomous branching but perpendicular side branching infrequent; a reddish brown axis; and cortex intact. Hale (1979) contained a shorter description, stating the thallus to be penduous, often with the main branches annulate and cracked with no fibrils and a smooth main base. The description in Fink (1935) is much broader and included soredia, rough to smooth base, seamed or ridged, and numerous fibrilloid branchlets. This latter description may be responsible for some of the western reports. Brodo (1968) suggested that the Queen Charlotte Islands' report could be U. hossei Vain. Form subtrichodea Asahina, described from Japan, contains usnic and stictic acids (Asahina, 1956).

Interestingly there are also several reports of <u>U</u>. <u>articulata</u> (L.) Hoffm. from western North America which are now thought to be misidentifications, e.g. Tucker and Jordan (1978).

It would appear that there is a fairly widespread western North American <u>Usnea</u> species (perhaps more than one) that bears annular constrictions. While most <u>Usnea</u> species may have a few annular cracks, perhaps produced by drying after collection or even mechanical injury in living material which would be more extensive in pendulous species. The local material has very regular constrictions with the cortex smoothly curved in to almost meet the axis showing that the plant continued to live after the cracking had occurred. In some cases the constrictions are irregular and appear articulated like the jointed appendages of crabs.

USNEA SUBFLORIDANA Stirt., Scott. Nat.: 294. 1880.

Usnea comosa (Ach.) Vain., Meddel. Soc. Faun. Fl. Fenn. 48:173. 1924.

<u>Thallus</u> fruticose; short-tufted, up to 6 cm long; blackened holdfast present. Major branches terete, up to 0.7 mm wide, papillate, usually with abundant fibrils and/or shorter spinules or longer side branches. Apices of minor branches with very faint irregular, linear pseudocyphellae that quickly erode to form slightly concave, often irregular small pits, plane or only slightly raised above level of branch, which quickly produce several to many pointed, cylindrical isidia; greenish-grey to yellow-green.

Apothecia not observed. According to Ozenda and Clauzade (1970)

the apothecia are terminal to subterminal, 5-10 mm wide, with abundant marginal fibrils.

<u>Spot Tests</u>: medulla (especially next to axis) K<u>+</u> yellow turning orange KC, C-, P<u>+</u> yellow turning orange; axis IKI-; negative strains more common.

<u>Substratum/Habitat</u>: corticolous; especially common on <u>Pseudotsuga</u> but also on most other species of trees.

Selected Specimens: 1779, 2043B.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone; also present in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate in the Northern Hemisphere (Krog, 1968); also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: According to Tallis (1959) <u>U</u>. <u>subfloridana</u> is one of the most variable species of <u>Usnea</u> often intergrading into "other members of the <u>U</u>. <u>comosa</u> group, and also into <u>U</u>. <u>ceratina</u>, <u>U</u>. <u>mollis</u> (= <u>U</u>. <u>fragil</u>-<u>escens</u>), <u>U</u>. <u>flammea</u>, <u>U</u>. <u>hirta</u>, and <u>U</u>. <u>florida</u>; often it can be identified only by elimination of all other possibilities".

The local material is not homogeneous. For example, one collection tentatively identified as <u>U</u>. <u>subfloridana</u> has typically longer (6-10 cm) thalli, distinct soralia toward the apices with isidia developing further up the branches, and a K+ red, P+ orange medulla.

VERRUCARIA Schrad.

Thallus crustose; thin and subgelatinous to thickly cracked- areolate; occasionally immersed in the substratum; ecorticate to corticate. Hypothallus sometimes present. Phycobiont a green alga.

Ascocarp a perithecium; sessile to immersed; <u>+</u> a dark carbonized involucrellum. Ostiole punctiform; paraphyses gelatinizing early. Spores 8 per ascus, usually hyaline, simple, oblong-ellipsoid to broadly ellipsoid, sometimes globose.

Saxicolous.

The local maritime species of Verrucaria are a very polymorphic group and have not been critically handled here. In a study of the marine and maritime lichens of nearby Fidalgo Island in Washington (Ryan, 1981) over ten species of <u>Verrucaria</u> are recognized, many unnamed, or identifed only to group.

References: Santesson (1939), Swinscow (1968).

1.	Non-mari	ine 2
1.	Marine,	on seashore rocks, <u>+</u> submerged at times 10
	2.	In moving freshwater <u>V</u> . <u>MARGACEA</u>
	2.	Not in freshwater 3
3.	Thallus	sorediate-isidiate <u>V</u> . <u>TECTORUM</u>
3.	Thallus	not sorediate-isidiate 4
	4.	Thallus greenish 5
	4.	Thallus brown, black, or whitish; not green

5.	Thallus distinctly areolate; perithecia > 0.3 mm wide; spores > 20 μ m long <u>VIRIDULA</u>
5.	Thallus continuous; perithecia < 0.3 mm wide; spores < 20 µm long
	6. Thallus whitish or pale grey7
	6. Thallus brownish to black 8
7.	Spores < 15 µm long <u>V. MURALIS</u>
7.	Spores > 15 μ m long; often in the supralittoral zones <u>V</u> . <u>PROMINULA</u>
	8. Thallus very thin, smooth, and shiny <u>V. FUSCONIGRESCENS</u>
	8. Thallus thin to thick, rimose to areolate, often matt 9
9.	Thallus finely rimose, blackish; spores usually <25 µm long
9.	Thallus thickly areolate; light to dark brown; spores >25 μm long
	10. Thallus black, <u>+</u> dull, evenly cracked <u>V</u> . <u>MAURA</u>
	<pre>10. Thallus greenish-black, very glossy, not or hardly cracked <u>V</u>. cfr. <u>MUCOSA</u></pre>

VERRUCARIA cfr. FLOERKEANA DT. *& Sarnth., Die Flecht. Tirol:524. 1902.

<u>Thallus</u> crustose; irregular, covering rather large areas; thin, \pm continuous, not smooth but verruculose to obscurely roughened; fuscous, olive brown with some lighter areas; distinctly green under the DM.

<u>Perithecia</u> common, abundant, sessile, black, sides gently sloped becoming globose, 0.14-0.2 mm wide. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, simple, hyaline, ellipsoid, 12-15 X 5-6 µm.

Spot Tests: hymenium IKI+ rose-orange.

<u>Substratum/Habitat</u>: saxicolous, collected once on sandstone at an inland site.

Selected Specimen: 3747.

Local Abundance and Distribution: rare; distribution poorly known,

collected once on the northern end of the Saanich Peninsula in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: uncertain; tentatively western North America-Europe disjunct.

<u>Remarks: V. floerkeana</u> is not listed in Hale & Culberson (1970) or several other regional floras for North America. It may be new to North America. The local specimen requires comparison with European material.

VERRUCARIA FUSCONIGRESCENS Nyl., Bull. Soc. Linn. Normand., sér.2,6:266,

314. 1872.

<u>Thallus</u> curstose; irregular; very thin, continuous to partially absent with 'cobweb'-like thallus left; shiny; brown to brown-black or black.

Perithecia common, abundant, scattered, sessile with low-sloping involucrellum, shiny black, 0.2-0.4 mm wide. Ostiole obscure, occasionally visible as a single, apical depression. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, (12-)15-16(-18) X 5-7 μm.

Spot Tests: hymenium IKI+ light orange.

<u>Substratum/Habitat</u>: saxicolous; on both conglomerates and igneous rocks. <u>Local Abundance and Distribution</u>: infrequent; scattered throughout the CDFD subzone primarily at inland sites; not collected in the adjacent zones.

<u>World Distribution</u>: uncertain; reported from Europe and North America; boreal-temperate according to Ozenda & Clauzade (1970); in North America reported from Texas (Fink, 1935).

Remarks: V. fusconigrescens is reported here as new to the province.

VERRUCARIA MACROSTOMA Duf. ex DC., Flor. Franc. 2:319. 1805.

<u>Thallus</u> crustose; irregular, up to 4 cm broad; thick, clearly areolate; areoles shiny to matt, averaging 0.5 mm; fuscous, olive brown to brown.

<u>Perithecia</u> common, scattered, partially to totally immersed (thallus rising up in hemispherical swellings), 0.5-0.7 mm wide; exposed perithecium shiny black. Ostiole inconspicuous to conspicuous and apically depressed. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 26-35 X 10-14 µm.

Spot Tests: hymenium IKI+ red.

<u>Substratum/Habitat</u>: saxicolous; collected on sandstone once,HCl+. Selected Specimens: 934, 2831A.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at both inland and maritime sites, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-Europe disjunct; in Europe reported as Mediterranean (Ozenda & Clauzade, 1970).

<u>Remarks</u>: The areoles of <u>V</u>. <u>macrostoma</u> have a tendency to become subsquamulose (Ozenda & Clauzade, 1970; Smith, 1926) which was not observed in the local material.

V. macrostoma is reported here as new to the province.

VERRUCARIA MARGACEA (Wahlenb.) Wahlenb., Fl. Lappon.:465. 1812.

Thelotrema margaceum Wahlenb., Meth. Lich., Suppl.: 30. 1803.

<u>Thallus</u> crustose; irregular, up to 5 cm broad; appearing smooth and continuous but under DM rimose; thin, especially cracking aroung perithecia; black, dull greenish black, under DM greenish. Hypothallus present, thin,

black. Marginally (near other lichen thalli) becoming abruptly thickened and cracked.

<u>Perithecia</u> common, sessile, as conspicuous hemispherical flat-topped swellings, 0.4-0.5 mm wide. Ostiole not observed although sometimes apically depressed. Perithecia eventually cracking. Paraphyses gelatinizing. Spores 8 per ascus, hyaline, ellipsoid, simple, 23-28 X 10-11 µm.

Spot Tests: hymenium IKI+ rose-orange (faint).

<u>Substratum/Habitat</u>: saxicolous; collected once in a fast-flowing mountain creek.

Selected Specimen: 5013.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the Coastal Hemlock zone; not collected in the CDFD subzone.

Remarks: The local specimen is intermediate in some respects between \underline{V} . <u>margacea</u> and \underline{V} . <u>latebrosa</u> Koerb. It has the green-black coloration of the former and the cracked-rimose thallus of the latter. The spores are on the small side compared with 25-37 X 12-20 µm reported for \underline{V} . <u>margacea</u> and 25-35 X 12-15 µm reported for \underline{V} . <u>latebrosa</u> (Swinscow, 1968). However, as Swinscow pointed out there are many environmental stresses associated with this sort of habitat and "specimens with the thallus depauperate or of an unusual colour or abnormally thick and cracked are commonly seen".

VERRUCARIA MAURA Wahlenb., Meth. Lich.: 19. 1803.

<u>Thallus</u> crustose; irregularly coverning large areas; finely cracked, sometimes nearly areolate; areoles very steep-sided; carbonaceous; slate black, blackish green-grey, black. <u>Perithecia</u> abundant, immersed in large areoles, 0.3-0.6 mm wide, slightly rounded above. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid to oblong-ellipsoid, 12-18 X (5-)6-8 µm.

Spot Tests: hymenium IKI+ orange-red.

<u>Substratum/Habitat</u>: saxicolous; on all rock types, restricted to the littoral zone just above the barnacle zone or slightly higher in the supralittoral zone in shaded places; often forming an extensive black band along the seashore.

Selected Specimens: 3783, 5334.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone and adjacent zones at maritime sites.

<u>World Distribution</u>: western North America-eastern North America-Europeeastern Asia disjunct in the Northern Hemisphere; also reported from New Zealand (Martin, 1966), Australia (Weber & Wetmore, 1972), and Argentina (Grassi, 1950) in the Southern Hemisphere.

VERRUCARIA cfr. MUCOSA Wahlenb., Meth. Lich.: 23. 1803.

<u>Thallus</u> crustose; irregular, up to 5 cm broad, continuous; smooth to often very slightly cracked; very shiny giving whole thallus a glossy appearance; deep olive grey, dull greenish-black, slate-olive, dark olive.

<u>Perithecia</u> common, immersed, producing globose to faintly rounded swellings on the thallus, 0.4-0.6 mm wide. Ostiole often conspicuous, single, apical, often with a small portion of perithecium visible too, black. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, ellipsoid-ovoid, often irregular, 11-15 X 6-7 μm.

<u>Pycnidia</u> common, immersed, visible as surface cracks; pycnospores hyaline, cylindrical with ends slightly inflated, 3-4 X l µm.



Spot Tests: none.

<u>Substratum/Habitat</u>: saxicolous, collected once on igneous rocks in the supralittoral zone with V. maura.

Selected Specimen: 4433B.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CH zone; not collected in the CDFD subzone.

<u>Remarks</u>: <u>V. mucosa</u> is similar to <u>V. maura</u> but differs in the lack of a regular cracked-areolate thallus and the darker green coloration of the former. Santesson (1939) described <u>V. mucosa</u> as not glossy while the local collection is very shiny. Taylor (1974) described <u>V. mucosa</u> as smooth and tough, continuous although often with necral cracks, thick (130-150 μ m), and occasionally with a white hypothallus.

VERRUCARIA MURALIS Ach., Meth. Lich.:115. 1803.

Thallus crustose; effuse, smooth, thin, shiny; whitish.

<u>Perithicia</u> common, abundant, crowded to scattered, sessile, initially low and spreading, finally sharply rounded, occasionally fused with neighbouring perithecia, shiny, black. Ostiole conspicuous, apical, large. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, ellipsoid, 19-22 X 7-10 µm.

Spot Tests: hymenium IKI+ orange-red.

<u>Substratum/Habitat</u>: saxicolous; collected once on shale-phyllite at an inland site.

Selected Specimen: 5442B.

Local Abundance and Distribution: rare; distribution poorly known, collected once in the CH zone; not collected in the CDFD subzone.

Remarks: V. muralis is reported here as new to the province.

VERRUCARIA NIGRESCENS Pers., Ust. Ann. Bot. 14:36, 1795.

<u>Thallus</u> crustose; irregular, covering large areas, thin to thickish, finely rimose; black, slate black. Hypothallus present, black.

Perithecia common, immersed (but thallus slightly swelling up), 0.2-0.4 mm wide. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, oblong-ellipsoid, 15-20(-22) X 5-8 µm.

Spot Tests: hymenium IKI+ red.

<u>Substratum/Habitat</u>: saxicolous; collected twice on igneous rocks at an inland site and once on sandstone on a river bank.

Selected Specimens: 4217A, 4782.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone at inland sites; also present in the adjacent zones.

<u>World Distribution</u>: circumarctic-circumtemperate; "widely distributed in most of North America" (Thomson, 1979); also reported from New Zealand (Martin & Child, 1972) in the Southern Hemisphere.

<u>Remarks</u>: The black hypothallus can be inconspicuous especially when the thallus is also the same black tint. According to Ozenda & Clauzade (1970) the perithecia eventually becomes sessile in <u>V</u>. <u>nigrescens</u>. This was not observed in the local material.

VERRUCARIA PROMINULA Nyl., Flora 43:545. 1860.

<u>Thallus</u> crustose; effuse, covering large areas, thin, rimose-cracked, tartareous; pale grey, light olive grey, light greyish olive.

<u>Perithecia</u> common, scattered, sessile, shiny, black, 0.3-0.5 mm wide, <u>+</u> steep-sided, <u>+</u> apically flattened or slightly depressed, quickly disintegrating to circular black rings on the thallus. Ostiole not observed. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, broadly ellipsoid to subglobose, 10-12 X 6-7 µm.

Spot Tests: hymenium IKI+ rose-red.

<u>Substratum/Habitat</u>: saxicolous; collected once on calcareous shale in the supralittoral zone.

Selected Specimen: 2247A.

<u>Abundance and Local Distribution</u>: rare; distribution poorly known, collected once on Saltspring Island in the southern part of the CDFD subzone; not collected in the adjacent zones.

World Distribution: tentatively western North America-Europe disjunct.

<u>Remarks</u>: The perithecia of this specimen are very conspicuous, reflecting the colour contrast of thallus and perithecia. The local material had slightly smaller perithecia than that given in Ozenda & Clauzade (1970) (averaging 0.9 mm) but fell within the range given by Duncan (1970) and Smith (1926).

V. prominula is reported here as new to the province.

<u>VERRUCARIA TECTORUM</u> (Mass.) Koerb., Parerg. Lich.:368. 1863. <u>Lithoicea tectorum</u> Mass., Symmict. Lich.:91. 1855.

<u>Thallus</u> crustose; irregular, up to 5 cm broad, with rather medium to thick areoles, scattered to usually contiguous, occasionally indistinct, the edges becoming abundantly sorediate-isidiate, lighter-coloured than areoles, slightly yellowish; thallus cinnamon brown. Hypothallus sometimes present at margin and between scattered areoles, blackish.

<u>Perithecia</u> common, abundant, scattered to grouped, <u>+</u> sessile, low globose or apically slightly flattened, black-brown, 0.4-0.6 mm wide. Ostiole not obvious. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, simple, oblong-ellipsoid, 19-25 X 8-10 μm. Spot Tests: hymenium IKI+ rose-orange; soredia K+ faint yellow.

<u>Substratum/Habitat</u>: saxicolous; collected once on sandstone in the supralittoral zone.

Selected Specimen: 2831B.

Local Abundance and Distribution: rare; distribution poorly known, collected once on Hornby Island in the northern part of the CDFD subzone, not collected in the adjacent zones.

<u>World Distribution</u>: tentatively western North America-Europe disjunct. <u>Remarks</u>: Ozenda & Clauzade (1970) described the perithecia as only 0.3 mm wide, few, and often absent.

Hawksworth et al. (1980) regarded <u>V</u>. <u>tectorum</u> as only a form of <u>V</u>. <u>viridula</u>.

V. tectorum is reported here as new to the province.

<u>VERRUCARIA</u> VIRIDULA (Schrad.) Ach., Meth. Lich. Suppl.:16. 1803. Endocarpum viridulum Schrad., Spic. Fl. Germ.:192, pl.2, f.4. 1794.

<u>Thallus</u> crustose; irregular, up to 7 cm broad; areolate, the areoles up to 0.5 mm wide, irregular, contiguous to quite separate; green, greyish olive. Hypothallus not observed.

<u>Perithecia</u> common, scattered, prominent but slightly to entirely covered with areoles, 0.6-0.7 mm wide, black. Ostiole obscure. Paraphyses gelatinizing. <u>Spores</u> 8 per ascus, hyaline, ellipsoid to ovoid, simple, 24-32 X 11-13(-15) μm.

Spot Tests: hymenium IKI+ rose-orange.

<u>Substratum/Habitat</u>: saxicolous; once each on sandstone and igneous rock. Selected Specimens: 1663B, 4063.

Local Abundance and Distribution: rare; distribution poorly known,

collected once on Mayne Island and once on the Saanich Peninsula in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: uncertain; tentatively western North Americaeastern North America-Europe-eastern Asia disjunct; in North America reported from Vermont, Ohio, Illinois, Minnesota, and California (Fink, 1935).

XANTHOPARMELIA (Vain.) Hale

Thallus foliose; lobes elongate, radiating; with or without soredia or isidia; upper and lower surface corticate, of palisade plectenchyma and a pored epicortex; yellow-green (usnic acid). Below rhizinate, rhizines simple.

Ascocarp an apothecium, laminal, sessile. Thalline margin present. Spores 8 per ascus, simple, hyaline, ellipsoid.

Saxicolous, occasionally terricolous.

<u>Xanthoparmelia</u> was formerly included in <u>Parmelia</u>. While all <u>Xantho-</u> <u>parmelia</u> species are yellow-green (contain usnic acid) not all yellow-green <u>Parmeliae</u> belong in <u>Xanthoparmelia</u>.

References: Egan (1975), Hale (1955, 1964, 1967a), Nash (1974). Nash (1974) contains a useful key to <u>Xanthoparmelia</u> species in western North America.

1.	EsorediateX. CUMBERLANDII
1.	Sorediate2
	2. Lobes < 1 mm wide; soredia laminal
	2. Lobes > 1 mm wide; soredia (sub-)marginal or terminal4
3.	Corticolous; medulla K <u>PARMELIOPSIS</u> <u>AMBIGUA</u> (p. 536)
3.	Saxicolous; medulla K+ yellow X. MOUGEOTII

- 4. Lobes elongate-linear; rhizines abundant, dichotomously branched, projecting beyond margin <u>HYPOTRACHYNA SINUOSA</u> (p. 324)
- 4. Lobes rounded, apically rotund; rhizines scarce, simple, not projecting ... PARMELIA FLAVENTIOR (p. 526)

<u>XANTHOPARMELIA CUMBERLANDIA</u> (Gyeln.) Hale, Phytologia 28:487. 1974. <u>Parmelia subconspersa</u> var. <u>cumberlandia</u> (Gyeln.) Hale, Bryologist 70:416. 1967.

<u>Thallus</u> foliose; orbicular, 6-12 cm broad. Lobes 1-3 mm wide, much branched, appressed, imbricate, linear, apically rounded, the very ends of the lobes often fanning out. Upper surface shiny, smooth to slightly cracked; nonisidiate, esorediate; pale yellow-green to sulphur yellow, <u>+</u> blackening lobe tips and cracks. Lower surface tan, rhizines simple, tan abundant.

<u>Apothecia</u> common, laminal, 2-7 mm wide. Thalline margin thick, entire to crenulate. Disc reddish brown to darkening, concave becoming variously contorted. Hymenium 40-50 µm high; paraphyses coherent; epithecium brown. Spores 8 per ascus, hyaline, ellipsoid to oblong, 8-12 X 5-6 µm.

Spot Tests: medulla K+ yellow or yellow turning orange.

<u>Substratum/Habitat</u>: saxicolous; on sandstones, conglomerates and igneous rocks in both the supralittoral zone at maritime sites and exposed locations at inland sites.

Selected Specimens: 2844, 4633.

Local Abundance and Distribution: frequent (present at over one-half of the collection sites); scattered throughout the CDFD subzone at both maritime and inland sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: eastern and western North America disjunct (absent from the Great Plains) (Hale, 1967, 1979).

<u>Remarks</u>: This is the only large <u>Xanthoparmeliae</u> found locally. It is very closely attached to the rocks; a paint scraper is needed to remove it in one piece (more or less) or the substratum must be collected too. During an early stage of the present study one rather unusually rugose specimen was confirmed as containing norstictic, stictic, and constictic acids by Dr. Egan. Dr. Hale also subsequently confirmed <u>X. cumerlandia</u>.

References to only <u>Parmelia taractica</u> (=Xanthoparmelia taractica (Kremplh.) Hale) from Saltspring Island are undoubtedly <u>X</u>. <u>cumberlandia</u>. <u>X</u>. <u>taractica</u> is only loosely applied to the substratum and contains salazinic acid (K+ yellow turning red). <u>Parmelia mexicana</u> (=Xanthoparmelia mexicana (Gyeln.) Hale) has also been reported from Saltspring Island (Bird & Bird, 1973). Only one of two specimens was available for loan from CAL. It was nonisidiate and can also be referred to <u>X</u>. <u>cumberlandia</u>.

XANTHOPARMELIA MOUGEOTII (Schaer.) Hale, Phytologia 28:488. 1974. Parmelia mougeotii Schaer., Enum. Lich.:46. 1850.

<u>Thallus</u> foliose; orbicular to fragmented and irregular, 2-5 cm broad. Lobes 0.4-0.7(-0.9) mm wide, linear, appressed, occasionally fan-shaped at lobe tips. Lobes with numerous transverse cracks producing an areolate appearance in older parts of thallus. Upper surface shiny, smooth except for transverse cracks; sorediate, soredia granular, in capitate soralia, toward center of thallus or spreading and covering all but the lobe ends, sulphur yellow even when thallus blackened; pale green, sulphur yellow, or slightly to completely blackened from the center outwards. Lower surface shiny, black; rhizines simple, black, abundant.

<u>Apothecia</u> uncommon, laminal, 0.5-0.7(-1.0) mm wide. Thalline margin thick, entire to sorediate, concolorous with thallus. Disc concave becoming plane, shiny, dark reddish brown. Hymenium 50-65 µm high; paraphyses coherent; epithecium yellow-brown to brown. <u>Spores</u> 8 per ascus, hyaline, simple, oblong to ovoid, 8-10 X 5-7 µm.

<u>Pycnidia</u> uncommon, black, scattered; pycnospores hyaline, cylindrical, 6-8 X 1 um.

Spot Tests: medulla K+ faint yellow, P+ orange.

<u>Substratum/Habitat</u>: saxicolous; on sandstones, conglomerates, granitics and other igneous rocks; especially partially shaded habitats.

Selected Specimens: 2867, 4943.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone primarily but not exclusively at inland sites; present but not as common in the adjacent CDFW subzone.

<u>World Distribution</u>: western North America-Europe disjunct; in North America reported previously from Colorado and Montana (Anderson, 1967); also reported from New Zealand (Martin, 1966) and the Falkland Islands (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: The narrow lobes and closely appressed habit of <u>X</u>, <u>mougeotii</u> closely resembles <u>Parmeliopsis ambigua</u>. <u>X</u>. <u>mougeotii</u> is always saxicolous and has a K+ yellow, P+ orange medulla while <u>P</u>. <u>ambigua</u> is locally only corticolous and is K-, P- in the medulla.

<u>X. mougeotii</u> was reported new to the province in Noble (1978) as a result of the present study.

XANTHORIA (Fr.) Th. Fr.

Thallus foliose; radiate, linear-lobed; upper and lower surfaces corticate (paraplectenchymatous); with or without soredia or isidia; yellow to deep orange above (K+ purple); below pale coloured, rhizines simple, uaually pale coloured.

Ascocarp an apothecium, laminal, adnate to substipitate. Thalline margin present, with or without fibrils. Disc orange. Epithecium granular, orange (K+ purple). Spores 8 per ascus, hyaline, ellipsoid, l-septate, polarilocular.

Saxicolous, corticolous.

References: Almborn (1963), Poelt (1969).

- - Lobes narrow, < 0.5 mm, ends usually pointed; soralia irregular, marginal to slightly laminal, soredia often isidiform X. CANDELARIA
 - Some lobes wide, >0.6 mm wide, ends rounded to truncate; soralia usually labriform, occasionally also marginal, soredia not isidiform X. FALLAX
- 3. Thallus orange-red to red, > 1.5 cm broad; lobes separate, linear, adnate; saxicolous X. <u>ELEGANS</u>
- 3. Thallus yellow to yellow-orange, usually < 1.5 cm broad; lobes contiguous, overlapping, imbricate, free to loosely adnate; often forming pulvinate cushions; commonly corticolous L. POLYCARPA

XANTHORIA CANDELARIA (L.) Th. Fr., Genera heterolichenum Europaea recognita.

:61. 1861.

Lichen candelarius L., Sp. Pl.:1141. 1753.

<u>Thallus</u> foliose; orbicular to fragmented, coalescing to cover up to 5 cm broad areas. Lobes loosely adnate to more commonly ascending, narrow, 0.3-0.5 mm wide, frequently branched, elongate, almost fruticose, occasionally lobes wider, short, and little branched; sorediate, soredia marginal and especially apical, large, granular to isidioid; cadmium orange, yelloworange, sometimes pale yellow or green-yellow in shaded locations. Lower surface white; rhizines few, simple, white.

<u>Apothecia</u> rare, laminal, stipitate, 0.9-1.1 mm wide. Thalline margin entire, smooth. Disc orange, matt, plane. Hymenium 55 µm high; epithecium orange, not obviously granular; hypothecium hyaline. <u>Spores</u> not observed. According to Rudolf (1955) the spores are 8 per ascus, polarilocular, 10.4-3.0 X 5.1-7.0 µm with isthmus about 4 µm wide.

Spot Tests: thallus K+ purple; epithecium K+ rose.

<u>Substratum/Habitat</u>: primarily saxicolous in the supralittoral zone, occasionally corticolous.

Selected Specimens: 257, 3238.

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone especially at maritime sites; present but not as common in the adjacent zones.

<u>World Distribution</u>: circumtemperate in the Northern Hemisphere; considered circumboreal-circumarctic-alpine by Thomson (1979); also reported from Australia (Weber & Wetmore, 1972) and Argentina (Grassi, 1950) in the Southern Hemisphere.

XANTHORIA <u>ELEGANS</u> (Link) Th. Fr., Nova Acta Reg. Soc. Scient. Upsal. ser. 3, 3:169. 1861.

<u>Lichen elegans</u> Link, Ann. der Naturgesch. 1:37. 1791 <u>Caloplaca elegans</u> (Link) Th. Fr. Lich. Scand.1:168. 1871.

<u>Thallus</u> foliose; 3-5 cm broad. Lobes linear, 0.5-0.7(-1.0) mm wide, up to 1 cm long, occasionally branching, separate, convexly curved (appearing high arched with lower surface also curved), adnate to loosely attached, centrally becoming somewhat granular, center sometimes absent. Upper surface dull, vaguely ridged or irregular; orange-red, orange chrome, ochraceous orange. Lower surface lighter coloured, yellow to whitish; rhizines very few, scattered, pale.

<u>Apothecia</u> usually present towards center of thallus, sessile to substipitate, 0.7-1.8 mm wide. Thalline margin excluded; proper margin exposed, thin. Disc plane, concolorous or darker than thallus. Hymenium 80 µm high; epithecium granular, dark orange-brown; hypothallus hyaline. <u>Spores</u> 8 per ascus, hyaline, ellipsoid, polarilocular, isthmus usually distinct, septum 1/3 of spore length, 11-13 X 6-8 µm.

Spot Tests: thallus and disc K+ purple.

<u>Substratum/Habitat</u>: saxicolous; collected once on igneous rock in the supralittoral zone.

Selected Specimen: 3272.

Local Abundance and Distribution: rare; distribution poorly known, collected once on the Saanich Peninsula in the southern part of the CDFD subzone; not collected in the adjacent zones.

<u>World Distribution</u>: circumboreal (Ahti, 1977) in the Northern Hemisphere; sometimes reported as 'cosmopolitan' (Thomson, 1979); also reported from New Zealand (Martin & Child, 1972), Argentina (Grassi, 1950) and Antarctica (Lindsay, 1977) in the Southern Hemisphere.

XANTHORIA FALLAX (Hepp) Arn., Verh. Zool.-Bot. Ges. Wien 30:121. 1881. Physcia fallax Hepp., Flora 41:307. 1858.

<u>Thallus</u> foliose; orbicular, 2-4 cm broad; occasionally fragmented, with single or isolated lobes. Lobes broad, 0.6-2.0 mm wide, plane and adnate at margin, centrally ascending; if isolated single lobes then <u>+</u> completely ascending. Upper surface smooth, <u>+</u> shiny; sorediate, soralia actually primarily on the lower surface (labriform) with lobes often becoming arched but some soredia often initially only marginal, soredia farinose to granular but not isidiose, yellow or yellow-orange; lobe margins sometimes minutely crenulate but not sorediate; ends broadly rounded to truncate; yellow to orange-red. Lower surface white; rhizines white, simple, abundant.

<u>Apothecia</u> rare, observed once, laminal, substipitate, up to 2 mm wide. Thalline margin present, thick, smooth to granulose-sorediate, persistent. Disc plane becoming variously contorted, concolorous with thallus. Epithecium granular, orange; hymenium 35 μ m high. <u>Spores</u> 8 per ascus, hyaline, ellipsoid-oblong, straight to curved, l-septate, polarilocular, 10-15 X 3.4-5 μ m.

Spot Tests: thallus K+ purple; epithecium K+ rose.

<u>Substratum/Habitat</u>: primarily corticolous; collected once on <u>Juniperus</u> <u>scopulorum</u>, <u>Pseudotsuga</u>, and <u>Quercus</u>; also one tentative collection from sandstone; apparently more common in the Victoria urban area on large roadside trees with <u>Candelaria concolor</u>.

Selected Specimens: 3167, 7406.

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone especially at inland sites; not collected in the adjacent zones.

World Distribution: circumboreal(-circumtemperate) (Thomson, 1979) in
the Northern Hemisphere; also reported from Kenya (Almborn, 1963) in the Southern Hemisphere.

<u>Remarks: X. fallax</u> is similar to <u>X. candelaria</u> differing in the wider lobes and soralia that become labriform. The local material of <u>X. fallax</u> falls into two different forms. One is a more or less complete, orbicular thallus with the outer lobes adnate and usually nonsorediate and the more central lobes ascending and sorediate (the soredia initially are laminal but eventually extensively cover the lower surface sometimes with an arching of the upper surface of the lobe); the second form consists of more or less single or several lobes that are isolated, not forming an orbicular thallus, completely free and ascending and abruptly forming distinct apical, labriform soralia. The latter form may also have smaller and presumably younger associated narrower lobes that have soredia along the margins and below but which are not distinctly labriform.

The reports of <u>X</u>. <u>parietina</u> (L.) Th. Fr. from the study area (Bird & Bird, 1973) may actually refer to younger orbicular thalli of <u>X</u>. <u>fallax</u> where the central lobes have yet to become sorediate. <u>X</u>. <u>parietina</u> forms large thalli (up to 6 cm broad) with adnate to loosely attached, contiguous or separate linear lobes that are broad to narrow, often undulate; often with a wrinkled surface but esorediate. In North America <u>X</u>. <u>parietina</u> is restricted to the coastal northeastern United States and Canada; earlier reports from California are now though to be misidentifications (Tucker & Jordan, 1978).

XANTHORIA POLYCARPA (Hoffm.) Rieb., Jahresb. Ver. vater1. Naturk. Wurtt.

47:252. 1891.

Lecanora polycarpa Hoffm., Deutsch. Flora:159. 1796.

Thallus foliose; orbicular, 0.6-1.2(-1.8) cm broad; usually forming a

thick, pulvinate pincushion. Lobes narrow, 0.1-0.3 mm wide, frequently branched, imbricate, adnate, to \pm free and ascending in the center. Upper surface smooth, \pm shiny; cream yellow to yellow-orange. Lower surface white; rhizines absent to few, white, inconspicuous.

Apothecia numerous, abundant, usually crowded towards the center of thallus, occasionally even obscuring the marginal lobes, stipitate, 0.6-1.4(-2.5) mm wide. Thalline margin entire, smooth to crenulate. Disc plane, matt, yellow to usually orange. Hymenium 55-65 µm high; epithecium granular, orange; hypothecium hyaline. <u>Spores 8 per ascus, hyaline, ellipsoid, simple, polarilocular, isthmus distinct, septum almost 1/2 spore length, 11-15 X 7-8 µm.</u>

Spot Tests: thallus K+ purple; epithecium K+ rose.

<u>Substratum/Habitat</u>: corticolous; primarily on deciduous trees and shrubs but occasionally also on conifers.

Selected Specimens: 1325, 3606B.

Local Abundance and Distribution: occasional; scattered throughout the CDFD subzone, present but not as common in the adjacent zones.

<u>World Distribution</u>: circumboreal-circumtemperate (Krog, 1968) in the Northern Hemisphere; also reported from Argentina (Grassi, 1950) in the Southern Hemisphere.

<u>Remarks</u>: All the local material has been referred to <u>X</u>. <u>polycarpa</u> although there are several closely allied species described from or reported from the west coast of North America. Their exact species limits, in some cases, require study. Hale (1979) described <u>X</u>. <u>polycarpa</u> as 1-2 cm broad with closely adnate, often crowded lobes that are hidden by the numerous apothecia. He noted that the western North American collections tend to be smaller than the eastern and called <u>X</u>. <u>ramulosa</u> (Tuck.) Herre although "the taxonomy of the group is poorly known". Herre (1910) described the latter species as small, closely appressed, pale yellow to greenish yellow with minute and scattered lobules that were only slightly branched and with very small apothecia. He said it was an "insignificant little plant...readily overlooked..."that."...resembles <u>Candelaria</u> concolor, from which it may be best distinguished by the difference in spores". Fink (1935) says <u>X</u>, <u>ramulosa</u> is "yellow to yellowish gray, composed of minute, scattered, sparingly branched, semi-cylindrical, slightly ascending, finally imbricated lobules ...apothecia minute, 0.3-0.8 mm, subsessile". Rudolf (1955) described its branches as very finely branched, 0.2-1.3 mm across, becoming subterete at times although he reports the apothecia as larger, 0.8-1.5 mm wide. He described its appearance as that of a very finely branched <u>X</u>. <u>polycarpa</u> with the intricately interwoven branches giving the thallus a distinctive appearance.

<u>X. subramulosa</u> Räs. has been reported from coastal Alaska (Krog, 1968). It is also a small, nonsorediate species with lobes up to 2 mm long and up to 2 mm long and up to 0.3 mm wide. However, it has distinctive, short, marginal fibrils on the upper surface as well as rhizines on the lower surface.

<u>X. hasseana</u> Räs., as with <u>X. ramulosa</u>, is also supposed to resemble superficially <u>X. polycarpa</u> differing in the narrow lobes which almost become isidiate along the margin and the less appressed thallus (Ohlsson, 1973). It occurs from California to British Columbia.

XYLOGRAPHA Fr.

Thallus crustose, poorly developed, often immersed in substratum. Phycobiont a green alga.

Ascocarp an apothecium, subsessile to sessile, round to elongate-linear,

simple to sometimes branched, usually small (<2 mm). Proper margin reduced or absent. Hypothecium hyaline; disc pale or at least initially light coloured; paraphyses simple. Spores 8 per ascus, hyaline, simple, ellipsoid, thin-walled.

Lignicolous, occasionally corticolous.

1.	Thallus	sorediate .	•••••••••••••••••••••••••••••••••••••••	<u>X</u> :	VITILIGO
1.	Thallus	esorediate		<u>x</u> .	ABIETINA

<u>XYLOGRAPHA</u> <u>ABIETINA</u> (Pers.) Zahlbr., Cat. Lich. Univ.2:151. 1922. Hysterium abietinum Pers., Observ. Mycol. 1:3. 1796.

<u>Thallus</u> crustose, poorly developed, immersed in and indicated by a pale greyish stain on the substratum; often covered by black granules (not soredia) scattered in direction of wood grain that encapsulate green algae, however, may not be the phycobiont.

<u>Apothecia</u> usually present, scattered to often arranged in lines in direction of wood grain, narrowly elongate with ends pointed, subsessile to adnate, 0.4-0.7 mm long, 0.05-0.15 mm wide. Proper margin initially hyaline then browning slightly, very thin, slightly raised. Disc just visible between edges of margin, slightly concave to plane, hyaline to browning. Hypothecium hyaline; hymenium 75 μ m high; epithecium pale brown; paraphyses simple, coherent. <u>Spores</u> 8 per ascus, often biseriate, hyaline, simple, thin-walled, ellipsoid, 12-15 X 6.5-8 μ m.

Spot Tests: thallus and apothecium K-, P-.

<u>Substratum/Habitat</u>: lignicolous; collected on driftwood and rotting logs, at both maritime and inland sites.

Selected Specimen

Local Abundance and Distribution: infrequent; scattered throughout the CDFD subzone; also present in the adjacent zones.

<u>World Distribution</u>: circumboreal in the Northern Hemisphere (Ozenda & Clauzade, 1970; Wetmore, 1968).

<u>Remarks</u>: The apothecia of <u>X</u>. <u>abientina</u> may be much larger than those observed in the local material. Ozenda & Clauzade (1970), Wetmore (1968), and Fink (1935) reported the apothecia as ranging up to 2 mm in length.

A species of <u>Xylographa</u>, <u>X</u>. <u>hians</u> Tuck., is described from western North America. Fink (1935) separated <u>X</u>. <u>hians</u> from <u>X</u>. <u>abietina</u> on the basis of the former having small apothecia (0.3-0.5 mm in length) while the latter had apothecia that sometimes reached upward of 1.5 mm in length. Additionally the apothecia of <u>X</u>. <u>hians</u> were described as circular to oblong or broadly ellipsoid while those of <u>X</u>. <u>abietina</u> were long and narrow. Wetmore (1968) described the apothecia of the two species as overlapping in length but with <u>X</u>. <u>hians</u> (0.5-1.5 mm long) generally shorter than <u>X</u>. <u>abietina</u> (1-2 mm long). Additionally, he stated that the apothecia of <u>X</u>. <u>hians</u> are usually pale colored straight or irregular, and contain norstictic acid initially. The apothecia of <u>X</u>. <u>abietina</u> are described as usually dark colored, straight and unbranched, and lacking norstictic acid even in young ascocarps. Wetmore (1968) questioned the distinctness of <u>X</u>. <u>hians</u> but relegated the decision to a monographer.

The type of <u>X</u>. <u>micrographa</u> Merr. has been examined. It does not noticeably differ from <u>X</u>. <u>abietina</u>. According to Merrill (1913) <u>X</u>. <u>micro-</u> grapha has the internal characteristics of <u>X</u>. <u>abientina</u> and the external characteristics of <u>X</u>. <u>hians</u>. A decision regarding <u>X</u>. <u>micrographa</u> awaits further study of X. hians.

<u>XYLOGRAPHA VITILIGO</u> (Ach.) Laundon, Lichenologist 2:147. 1964. Spiloma vililigo Ach., Meth. Lich.:10, pl. 1, f. 4. 1803.

Xylographa spilomatica (Anzi) Th. Fr., Lich. Scand.:639. 1874.

<u>Thallus</u> crustose; largely immersed in the substratum and appearing as an elongated white stain in the direction of the wood grain; soralia abundant, emergent, almost round to usually elliptical in the direction of wood grain, high-arched; soredia coarsely granular, dark brown or abraded to expose whitish(-green) soredia or medullary tissue.

<u>Apothecia</u> scarce, soralia typically reduced in immediate vicinity, elongate, sometimes narrowly elongate, often clustered and occasionally linearly arranged, (sub-)sessile becoming adnate with age, 0.3-0.5 mm long, 0.15-0.3 mm wide. Proper margin very thin, raised, initially hyaline becoming pale brown with age. Disc initially hyaline, browning with age, concave becoming plane to a little convex with age. Hypothecium hyaline; epithecium pale brown; paraphyses simpel, \pm coherent; hymenium 90 µm high. <u>Spores</u> 8 per ascus, uniseriate, very thin-walled, hyaline, simple, ellipsoid, 12-14 X 6-7.5 µm.

Spot Tests: K+ pale yellow.

<u>Substratum/Habitat</u>: lignicolous; common on driftwood at maritime sites. <u>Selected Specimens</u>:

Local Abundance and Distribution: frequent; scattered throughout the CDFD subzone at ocean sites; also present in the adjacent (sub-)zones at ocean sites.

<u>World Distribution</u>: uncertain; known from Europe and North America; in North America reported from Colorado, South Dakota, Wyoming, Montana, Alberta, northern Ontario, British Columbia (Queen Charlotte Islands), Alaska, and the Northwest Territories (MacKenzie Delta) (Brodo, 1976).

DISCUSSION

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DISTRIBUTION OF LICHENS WITHIN THE COASTAL DOUGLAS-FIR DRY SUBZONE

Individual lichen species are not uniformly distributed throughout the study area. Instead, each species often has a recognizeable distribution pattern. Despite the restriction of this study to a single subzone, it is possible to discern eight distribution groups with seven subgroups. Additional distribution patterns may become apparent when information is available from the adjacent zones of Vancouver Island and the mainland of British Columbia.

Some of the distributions reflect frequency, climate, substratum restrictions, or the influence of man. In most cases it has not been possible to select a single factor that controls these distributions since many factors, interacting synergistically, dictate where a lichen can survive. In spite of this, easily measured variables (e.g. precipitation and elevation) are often used to characterize the resulting patterns.

The distribution of lichens within the study area and adjacent subzones is assumed to be reflected by their collection site maps which are presented in the body of the flora for some representative species. However, the distribution of a species is not necessarily equivalent with its collection site map. There are a large number of major collection sites (121) and the density of the major collection sites in the study area averages 1 per 16 sq. km. However, the selection of the collection sites was not random. Selection was dictated by ease of access (e.g. roads, ferries, lack of fences), initial assessment of the site (e.g. non-urban, relatively undisturbed), and time limitations. Selection was limited by the great degree of human alteration of the natural vegeation of the subzone. It is acknowledged that these selection biases may prejudice the resulting maps. But, it is felt that the collection site maps, based on 121 sites,

are a reasonable approximation of the actual distributions and can be used as a reliable foundation for the following discussion.

Some patterns are apparent from examination of the collection site maps (e.g. oceanic patterns), some can be deduced by comparison of the collection site maps to the reference map and precipitation map, Figures 1 and 2, (e.g. high elevation patterns, western and northern infringing patterns), while others show very localized habitat patterns which are not obvious upon examination of the collection site maps (e.g. calcicole patterns).

The open circles on the collection site maps denote major collection sites. Sites where few collections were taken are not marked and, therefore, some collections are marked occasionally at locations not denoted by a circle. Sometimes sites for UBC herbarium species have been added. These also occur at locations not marked with a circle.

A. WIDESPREAD

Some species are common in the CDFD subzone. Such species have wide ecological amplitudes, are omnicolous, and/or prefer habitats or substrata that are common in the study area.

i) Widespread in the CDFD subzone as well as in adjacent (sub-)zones

Some species, including <u>Ramalina farinacea</u>, <u>Placopsis gelida</u> (Figure 30), <u>Sphaerophorus globosus</u> (Figure 41), <u>Parmelia saxatilis</u> (Figure 26), <u>Melanelia glabratula</u>, <u>Peltigera membranacea</u> (Figure 29), <u>Pilophorus acicu-laris, Leptogium palmatum</u>, <u>Graphis scripta</u>, <u>Thelotrema lepadinum</u>, and <u>Platismatia glacua</u>, are common throughout the CDFD subzone as well as common to fairly common in the adjacent zones studied. Some of these, including <u>Melanelia glabratula</u>, are both saxicolous and corticolous; others, while

either saxicolous or corticolous, grow on a wide variety of rock types (if saxicolous) or many tree and shrub species (if corticolous). <u>Platis-</u> <u>matia glauca</u>, <u>Parmelia sulcata</u>, and <u>Ramalina farinacea</u> grow on both coniferous and deciduous tree species. Others, like <u>Spherophorus globosus</u> (although also lignicolous and saxicolous at times) is particularly common on conifers, especially <u>Pseudotsuga menziesii</u>, a tree species which is very common in the study area. Similarly <u>Graphis scripta</u> is very common on <u>Alnus rubra</u>, another common tree species.

Most of these species display no elevational restriction within the CDFD subzone, and are found from sea level maritime sites to sites at various higher elevations. Some taxa, including <u>Dermatocarpon reticulatum</u>, <u>Parmelia stictica</u>, and <u>Cladina portentosa</u>, are more common at ocean sites but also occur inland at exposed, sunny locations. Most, however, are not found in the very exposed 'alpine'-like habitat which is rare in the study area.

Many species that are noted to be widespread in the study area and adjacent zones, are also widespread in their world distributions, typically belonging to one of the circumpolar elements.

Some species, while widespread in the CDFD subzone and adjacent zones, do exhibit a decrease in their luxuriance and/or fertility in a west-to-east direction. For example, <u>Pilophorus acicularis</u>, while common locally, never produces the large luxuriant colonies observed on the west side of Vancouver Island. <u>Sphaerophorus globosus</u> (Figure 41) shows a slight decrease in fertile collections towards the east with fertile collections absent in the most easterly locations, the Gulf Islands. <u>Placopsis gelida</u> (Figure 30) shows a decrease in both luxuriance and fertility as one proceeds eastward in the study area.

ii) <u>Widespread in the CDFD subzone but usually absent or rare in the</u> adjacent (sub-)zones

Some species are widespread within the study area while they are typically absent or very rare in the adjacent zones on Vancouver Island. Sometimes a decrease in abundance or luxuriance is shown from east to west. Taxa that show this distribution are <u>Lobaria scrobiculata</u>, <u>Xanthoparmelia</u> <u>mougeotii</u>, <u>Evernia prunastri</u> (Figure 16), <u>Rhizocarpon viridiatrum</u> (Figure 36), <u>Platismatia herrei</u>, and <u>Lecidea mannii</u> (Figure 20). <u>Platismatia herrei</u> overlaps into the adjacent zones but is not as common there.

Many of the species in this group, like group 'Ai', which are widespread in both areas, grow on a wide range of substrata and occur at all elevations. Many of these species show widespread world distributions. Others show more limited distributions (e.g. western North American endemic, western North America-Europe disjunct).

B. OCEANIC DISTRIBUTIONS

Although many species exhibit oceanic distributions in their overall world distributions, the term oceanic is used in a more restricted sense here.

i) Marine Oceanic

Several species of the CDFD subzone are very closely tied to the marine environment. These species tolerate or require a large degree of salinity that is provided by sea-water. Species are found in the lowest part of the supralittoral zones or in the higher parts of the littoral itself. <u>Arthopyrenia halodytes</u> is locally very common on barnacles and tolerates two submersions a day in the salt water. Verrucaria maura

(Figure 46) forms the black stain in the lower part of the supralittoral zone. Both species are known from only marine sites throughout their extensive world distributions.

ii) <u>Strictly oceanic</u> (but not marine)

'Strictly oceanic' is a grouping used here for those species that are found at beach sites in the CDFD subzone although many are known from inland locations in other parts of their world ranges. These species appear higher up in the supralittoral zone than those belonging in the 'marine oceanic' subgrouping. Other species common on the seashore are found in the 'Widespread' group since they are also common inland.

Some species restricted to ocean sites in the CDFD subzone are at (or near) the northern limit of their range in North America. Many belong to the California subgroup of the western North American endemic element (e.g. <u>Caloplaca laeta</u>, Figure 12; <u>C. bolacina</u>, <u>Lecania fructigena</u>, and <u>L. dudleyi</u>) or the Mediterranean subgroup of the western North America-Europe disjunct element (e.g. <u>Thelomma mammosum</u>, Figure 43; <u>Lecidella subincongrua</u> var. <u>elaeochromoides</u>). These species are sometimes found inland in hot Mediterranean regions.

Other species, restricted locally to oceanic sites, show much more northern affinities and perhaps are restricted to a maritime environment. This includes <u>Bacidia alaskensis</u> (Figure 10), <u>Caloplaca oraphila</u>, <u>Pannaria</u> <u>maritima</u>, <u>Collema fecundum</u> (Figure 15), <u>Lecania aipospila</u>, and <u>Lecanora</u> <u>straminea</u>. This group includes both widespread species including the last two listed species, which are circumarctic, as well as more distributionally limited species. The first four species listed above, are currently thought to be restricted to western North America. Several species that are strictly oceanic in the CDFD subzone, including <u>Spilonema revertens</u>, <u>Rhizocarpon disporum</u>, <u>Lecidea sulphurea</u>, and <u>Rinodina gennerii</u>, are widespread world species and probably are not strictly oceanic; little is known of their western North American distributions.

All the species cited are saxicolous as an oceanic habitat might dictate. There are also a small number of species that are lignicolous on driftwood and, consequently, restricted to oceanic sites in the CDFD subzone. These include <u>Buellia fosteri</u>, <u>Lecanora grantii</u> (which is also saxicolous), and perhaps <u>Thelomma occidentale</u>. There is also one corticolous species, <u>Ramalina menziesii</u> (Figure 34), that is predominantly oceanic in the CDFD subzone. It is usually found on seaside trees or, occasionally, up to $\frac{1}{2}$ km inland. The collection furthest inland came from Cowichan Bay where <u>R. menziesii</u> grows on <u>Acer</u> which bounds the estuary.

iii) <u>Hyperoceanic</u>

The hyperoceanic subgrouping comes closest to the looser use of the term oceanic, and denotes regions of high precipitation and mild climate. Species which are hyperoceanic in the study area are present, usually in abundance, on the west coast of Vancouver Island (250+ cm precipitation per year) and then, depending on individual limitations, occur eastward to varying degrees. They may:

- (a) approach the boundary of the CDFD subzone, but not occur within the subzone, e.g. <u>Platismatia norvegica</u> (Figure 31), <u>P. lacunosa</u>, <u>Pilophorus</u> clavatus, and Lecidea albrofuscescens;
- (b) penetrate into the northern portion of the CDFD subzone which has the highest precipitation in the subzone (see Figure 2), e.g. <u>Lobaria oregana</u> (Figure 22), <u>Parmeliopsis hyperopta</u> (Figure 28),

7.90

- and Icmadophila ericetorum (Figure 18);
- (c) occur at the higher elevation sites (which typically have more precipitation than the surrounding lowlands) in the CDFD subzone, especially along the western edge of the subzone, and primarily toward the southern section where highlands, hills, and monadnocks are more frequent, e.g. <u>Parmeliopsis ambigua</u>, <u>Lopadium pezizodium</u>, <u>Mycoblastus tornoensis</u> (Figure 24), <u>Lecanactis megaspora</u>, and <u>Parmelia pseudosulcata</u>, and;
- (d) occur in high humidity microenvironments such as canyons (e.g. <u>Pseudocyphellaria anthraspis</u> in Goldstream Provincial Park, Figure 33), alder thickets (e.g. <u>Menegazzia terebrata</u>), north-facing drip surfaces (e.g. <u>Baeomyces rufus</u>), and shaded and sheltered drip surfaces (e.g. Dimerella lutea).

Some hyperoceanic species appear in more than one of the above locations in the CDFD subzone. Higher elevations and the northern part of the subzone (lower elevations), i.e. 'b' and 'c' together, is a very common combination.

Many of the hyperoceanic species are widespread in their world distributions. However, a large number are also more restricted, being either boreal disjuncts or western North American endemics.

C. EXPOSED, HIGHER ELEVATION DISTRIBUTIONS

i) 'Pseudo-alpine'

True alpine habitats are not found in the CDFD subzone since, by definition, the subzone includes only elevations below 610 m. However, Mount Maxwell on Saltspring Island and Mount Prevost, just outside the CDFD subzone are both approximately this elevation with exposed, southwest facing summits where conditions in very small pockets (often the edges of very steep and high

cliffs) approach the extremes generally found at higher elevations or at low elevations of more northerly places. Adjacent phanerogam vegetation is typical of the CDFD or CDFW subzones. Many of the lichen species found here are regarded as arctic-alpine or alpine in their world distributions. Examples of lichens with a 'pseudo-alpine' distribution in the CDFD subzone include <u>Pseudephebe pubescens</u> (Figure 32), <u>Cornicularia normoerica</u>, <u>Rhizocarpon riparium</u>, <u>R. geographicum</u>, <u>Umbilicaria havaasii</u>, <u>Haematomma</u> lapponicum, Lobaria linita, and Lecidea lapicida.

ii) Moderately High Elevations, Exposed

Many of the local hillsides, monadnocks, and cuesta-like ridges have treeless, rocky, southwest-facing slopes on or near their summits which contain species not found in similar saxicolous, exposed habitats at lower elevations (i.e. beach sites). This flora includes <u>Ochrolechia upsaliensis</u> (Figure 23), <u>Rhizocarpon sphaerosporum</u> (Figure 37), <u>Thamnolia vermicularis</u> (Figure 42), many of the <u>Umbilicaria</u> species (Figure 44 and 45), <u>Cladonia</u> <u>uncialis</u>, <u>Cladonia bellidiflora</u>, and perhaps <u>Rhizocarpon bolanderi</u>. (Scant, sterile collections of what is probably <u>R</u>. <u>bolanderi</u> have been collected from ocean sites.) Several of the above species are arctic-alpine in their world distributions, but their presence within the CDFD subzone is too widespread at non-alpine sites to include them in the 'pseudo-alpine' subgroup. <u>Thamnolia vermicularis</u>, for example, is known from a lower slope of Mount Douglas at slightly below 100 m.

D. MESIC-FORESTS

Many species are found associated with <u>Pseudotsuga</u> forests. Since <u>Pseudotsuga</u> is abundant locally these lichens sometimes approach the 'Widespread' distribution pattern. Those listed here tend to be uncommon

or more closely tied to the mesic forests than are the wider ranging species, including <u>Platismatia herrei</u>. Mesic-forest species typically are found inland although they do not strictly avoid ocean sites.

Some lichen species appear to prefer an open type forest structure, e.g. <u>Cyphelium inquinans</u>, <u>Chrysothrix chlorina</u>, <u>Haematomma herrei</u>, <u>Pannaria</u> <u>saubinetii</u> (actually almost 'Widespread'), <u>Pertusaria leucostoma</u>, <u>P. sub-</u> <u>ambigens</u>, and <u>Hypocenomyce scalaris</u>. Other species prefer a more shaded, partially closed forest structure, e.g. <u>Parmotrema arnoldii</u>, <u>Lecanora</u> <u>demissa</u>(Figure 19), <u>Sticta fuliginosa</u>, <u>S. limbata</u>, <u>Cetraria orbata</u>, <u>Phlyctis speirea</u>, and Catillaria columbiana.

E. DRY, QUERCUS FORESTS DISTRIBUTION

Many species are found associated with the <u>Quercus</u> groves, both on the hillsides (which are interfingered with the 'Moderately High Elevation, Exposed' subgroup) and at lower elevations in the vicinity of Victoria. These species are typically epiphytes of <u>Quercus</u> although some species are terricolous or saxicolous in the abundant microhabitats that are associated in the hillside outcropings with <u>Quercus</u>. Examples of species in this group include <u>Leptogium furfuraceum</u> (Figure 21), <u>Trapeliopsis wallrothii</u>, <u>Bacidia rubella</u>, <u>Pannaria leucostictoides</u>, <u>P. mediterranea</u>, <u>Lobaria hallii</u>, <u>Peltigera leucophlebia</u>, <u>Physconia enteroxantha</u>, and Collema nigrescens.

Species with disjunct world distributions are common in this group.

F. CALCICOLE DISTRIBUTION

Some species in the CDFD subzone and adjacent CDFW subzone have a strict requirement for a calcareous substratum. There are only a few scattered, small limestone deposits in the southern part of the study area while calcareous sandstones are scattered throughout the area. Many of the seashore <u>Lecania</u> species are found frequently on calcareous substrata but apparently are not restricted to them. Others, like <u>Lecidea</u> <u>monticola</u>, <u>Protoblastenia</u> incrustans, <u>Gyalecta</u> jenensis, and <u>Aspcilia</u> contorta are restricted to calcareous substrata although tolerant of many types of calcareous rock. <u>Placynthium</u> nigrum is restricted to limestone.

G. URBAN, OR URBAN-PREFERRING, DISTRIBUTION

Some species were more common or only collected in proximity to urbanized areas. <u>Candelariella concolor</u> and <u>Xanthoria fallax</u> are both common on roadside trees around Victoria. <u>Candelariella vitellina</u> (corticolous form) was also more richly represented near Victoria but was not usually on roadside trees. Calcicoles that effectively grow on the abundant mortar substrata common in the urban environment include <u>Candelariella aurella</u>, <u>Sarcogyne</u> <u>regularis</u> (Figure 40), and <u>Caloplaca feracissima</u>. The first two species are found also in non-urban areas on naturally occurring calcareous substrata, but not as abundantly as would be expected.

For the most part the urban flora has been ignored in this present treatment. There may be many more lichen species that show an urban pattern. The species noted are only the obvious ones observed in a very cursory treatment.

H. RARE SPECIES WITH POORLY KNOWN DISTRIBUTIONS

Many species were collected only once or twice during this study. Their distributions within the CDFD subone remain poorly known. Some appear - to be infrequent throughout their entire distributional range while others are often more abundant in adjacent zones, just infringing on the CDFD subzone. The latter pattern was not always apparent from the limited exam-

ination of these zones.

Representative species collected only once or twice at scattered sites thoughout the CDFD subzone include <u>Diploschistes bisporus</u>, <u>Verrucaria</u> <u>prominula</u>, <u>Lecania cyrtella</u>, <u>Phylliscum demangeonii</u>, <u>Toninia ruginosa</u>, <u>Rhizocarpon cinereonigrum</u>, and <u>Gyalideopsis alnicola</u>.

Some species are rare since the substratum or specific habitat is uncommon within the study area. These are included in the appropriate group despite their rarity.

PHYTOGEOGRAPHICAL RELATIONSHIPS OF THE LICHEN FLORA OF THE COASTAL DOUGLAS-FIR DRY SUBZONE

I. Lichen Phytogeography

It is not possible to cite an introductory paper on lichen phytogeography. To provide the foundation for the phytogeographical analysis of the local lichen flora that follows an examination of some pertinent points and problems in lichen phytogeography is provided here.

A. Introduction and Background

Lichens, despite the delicate balances that a symbiotic relationship implies, are unusual plants in their tolerance of a very wide range of habitats. Although often showing distinct individual optimum tolerances, as a group they tolerate great extremes in temperature, light, water, humidity, nutrients, and substratum, which accounts for their distribution from the tropics to the poles and from the marine intertidal zone to mountain summits. As individual taxa, as also with genera and families, however, they are not ubiguitous. Indeed, with increased collection in poorly known areas and, more significantly, with modern systematic treatment, the distribution of lichen species usually show restricted ranges that frequently fall, as vascular plants and bryophytes, into recognizeable patterns.

The study of lichen phytogeography is just in its infancy. Although several important facts concerning lichens and their distributions were noted comparatively early, lichen phytogeography has not developed in correspondence with the time elapsed nor has it kept abreast of the geography in other plant groups. Prior to 1965 there are only a few scattered papers that mention or discuss the distribution of lichens, e.g. Smith (1921), Du Rietz (1929b, 1940), Lynge (1933), Degelius (1935), Dahl (1946, 1954, 1955), and Herre (1910b). Herre (op. cit.) noted two facts pertinent to the lichen phytogeography of western North America. He pointed out (1) the very high proportion of endemics in the lichen flora of California and (2) the many species disjunct between western North America and Europe.

After 1965 many papers were published that discussed lichen phytogeography. These included Yoshimura (1968b), Culberson (1972), Kurokawa (1972), Thomson (1972), Ahti (1977), Lindsay (1977), Rogers (1977), and Kärnefelt (1980). It also became standard to discuss the phytogeographical elements composing floras, e.g. Krog (1968), Wetmore (1968), and Brodo (1968).

B. Generalizations in Lichen Phytogeography

Several tenets have emerged from many of these recent papers concerning lichen phytogeography. These include the following observations:

- (1) species reproducing vegetatively by soredia or isidia have
- wider distributions than very similar species that are typically fertile and lack vegetative propagules;
- (2) lichens display the same distribution patterns and disjunctions as other known cryptogams (bryophytes and hepatics) and higher plants;
- (3) like the known cryptogams, but unlike the higher plants, many species are very widespread; and,
- (4) like the cryptogams, but unlike vascular plants, most of the disjunctions occur at the species level (although vicariads are known as well) while in phanerogams disjunctions are more typically at the genus or family level.

Two assumptions are made typically in many of these papers. It is assumed that:

(1) lichens are comparatively very ancient in origin, are slowly

evolving plants; and,

(2) since the distribution patterns of lichens are the same as phanerogams, then the historical and ecological factors that have produced the latter must also have produced the lichen distributions.

Several of these points bear further discussion.

i) <u>Comparison of dispersal mechanism as inferred from the distribu-</u> <u>tions of vegetatively and sexually reproducing species</u>

Phytogeographical discussions often contain comments on the types and efficiency of propagules available for dispersal of the species involved. In lichens, like many cryptogams but unlike most phanerogams, both special vegetative propagules as well as sexual propagules are produced. All these structures are rather small and therefore presumeably easily transported. In the dry state, lichen thalli are readily broken and thallus fragmentation may also be important in some cases, especially in species like Thamnolia vermicularis, which lack both types of propagules but are widely distributed throughout the world. Species that reproduce vegetatively (that is by soredia or isidia), rarely produce ascocarps while esorediate/ nonisidiate species are often commonly and abundantly fertile. However, very little is known about the sexual process among lichens. For symbiotic organisms such a mode of dispersal appears handicapped from the beginning since the fungal spores are usually produced and transported without the accompanying phycobiont and must therefore 'chance upon' and re-establish the symbiosis to reach the starting point of soredia/isidia. However, many fertile species are widespread, testifying to the effectiveness of the method, although some dissemination perhaps could have been accomplished by fragmentation. Thomson (1972) suggested, regarding lichen spores, that "it would not be expected that these would be produced in such abundance

if they were not functional".

Pyatt (1973) has discussed the variety of lichen propagules in lichens while Bailey (1976) has reviewed the methods of dispersal and establishment. The latter author pointed out that although

"the evidence suggests that lichens have extremely efficient methods of dispersal ... we know nothing of the distance to which dispersal is effective".

It has been demonstrated that all these propagules are readily transported for great distances by wind and shorter distances by water. It has been demonstrated by washing birds' feet that they transport soredia short distances (Bailey & James, 1979). This suggests the possibility of long distance dispersal during their migrations. However, it should be noted that Cruden (1966) depreciated the possibility of birds as agents of longdistance dispersal for plant disjunctions between North and South America. Much more importantly, the viability of these propagules after transport has never been demonstrated. Lindsay (1977) suggested that the greater efficiency of soredia for long-distance dispersal is demonstrated by a comparison of the floras of two younger, adjacent islands to continental Antarctica. He reported that sorediate macrolichens were much more common than species relying on ascospores or thallus fragmentation. He stated that the reverse was true for microlichens, since very few were sorediate. To the contrary Kristinsson (1972) reported that, of the two initial crustose colonizers of Surtsey, near Iceland, both were sorediate species. Thomson (1972) commented on the overall abundance of sexually reproducing species compared to vegetatively reproducing species in arctic North America; Hale (1967) noted the relative abundance of isidiate and sorediate species in the flora of temperate North America. Lindsay's (1977) comparison of the two younger, adjacent islands also showed the comparative impoverishment of their floras when compared to continental Antarctica

which illustrates that the dispersal ability of lichens is not as efficient as is commonly thought. Bailey (1976) also concluded that dispersal and establishment distances for lichens may be much less than expected. He cited an unpublished study by R. C. Tapper that suggested <u>Evernia prunastri</u> effectively disperses its soredia only 30 m and <u>Ramalina farinacea</u> only 20 m.

Kurokawa (1972) believed that the wider distributions of vegetatively reproducing species indicated that soredia/isidia have an advantage for propagation of the species; indeed, isidiate/sorediate species often have wider distributions that nonisidiate/esorediate (= often fertile) species. Degelius (1954), in a study of European Collema, noted that typically fertile species included those with both wide and limited distributions while the isidiate species were all widely distributed. Hale (1965a) also noted in Parmelia section Amphygmnia (= Parmotrema), that in the typical species pair (with one fertile and the other its more-or-less equivalent vegetatively -reproducing species) the nonsorediate species was confined to tropical regions and many were restricted to one continent. The sorediate counterpart was more widely distributed into the temperate regions. The same was found for some pairs of Hypotrachyna species (Hale, 1975). Since the fertile species is usually considered to be the 'original' species, with the vegetatively reproducing species evolving secondarily from it, the 'younger' species often has the wider distribution. As already stated, Kurokawa (1972) interpreted this to imply the dispersal advantage of soredia/isidia over ascospores, however, the competative advantage of the latter diaspores, in almost identical taxa, especially in the 'marginal' areas, is also suggested by the evidence.

ii) <u>Similarities and differences of lichen distributions</u>with other plant groups

Since lichens respond to factors that affect all living organisms, it is not surprising that the known distributions of lichens are similar to those of other plant groups. Species of lichens that require oceanic conditions to survive and reproduce will be distributed mainly in those regions where such conditions prevail. Explanations for the distributions are not always obvious since environmental influences on distribution are usually found to be a complex of interactions rather than independent actions by one or two factors, as shown by the ecology of marine lichens (Taylor, 1974). A comparison of lichen distributions, including disjunctions, with vascular plants (Thorne, 1972) and bryophytes (Schofield & Crum, 1972) shows great similarity. However, one point is obvious: lichens have more similarities with bryophytes than with vascular plants. The individual species of lichens are often very widely distributed both longitudinally and latitudinally. Arctic and boreal species in the Northern Hemisphere are quite often circumpolar as well as ranging through more than one zone, e.g. arctic-boreal, boreal-temperate, or even arctic-temperate (Ahti, 1977; Bird et al., 1980) although as Ahti (op. cit.) stated many of the wide ranging species actually have a major zone preference where they are better developed or more abundant. Additionally, some of this wide latitudinal range is the result of poor phytogeographic interpretation, i.e. where orographic stations of northern elements are at their southern limits or where maritime stations of more southern elements are at their northern limits, and are not discerned as such. This wide latitudinal range of lichens is similar to that of bryophytes but not to vascular plants. According to Ahti (1977) the number of circumpolar lichens is very high and correspondingly, there is a "rarity of local or even regional

endemics, which are common in boreal vascular plants". He stated that "from the point of view of phytogeography the boreal lichens may be related in may respects to other cryptogams notably macrofungi, bryophytes, and pteridophytes, rather than phanerogams". The flora in the vicinity of Inuvik, N.W.T., is composed of 86% circumpolar species and only 4% North American endemics (Bird et al., 1980). Alaska, which is a larger, more heterogenous unit and also with more southern oceanic influences in part, is reported to have 61% circumpolar species and 7% North American endemics (Krog, 1968). Ahti (op. cit.) suggested that the boreal macrolichen flora is composed of somewhere between 60-70% circumpolar species. Similarly Schofield and Crum (1972) reported that most bryophytes are widely distributed with "more than 60% of the flora of arctic and boreal regions" being "made up of the same species". Schofield (1969), in discussing the flora of the Pacific Northwest stated that there were remarkably few endemic species among the boreal bryophytes as most were circumpolar while in contrast the conspicuous boreal phanerogams, the trees and shrubs, were almost all entirely endemic to North America.

Among the lichens, as in other plant groups, decreasing latitude also shows a decrease in the circumpolar element and an increase in endemics and disjunctions. The arctic and boreal biome are almost continuous in the Northern Hemisphere because of the closeness of the continents with compartively uniform environmental conditions that are tolerated by species with rather wide ecological amplitude. However, the temperate zone has vast oceans currently separating the continents as well as geographical barriers that produce great differences in rainfall; the temperate area of the Northern Hemisphere forms not one fairly uniform zone like the arctic or boreal, but is longitudinally dissected into several phytogeoclimatic zones. Thus it is not surprising that among the lichens of Long Island, New York, there is a decrease in the circumpolar elements (ca. 52%) or at least ones that are present in North America, Europe, and Asia, while 24% of the species are endemic to North America. Also not unexpectedly, the endemics occur totally among Long Island's temperate lichen element while the "Arctic-Boreal" element present in New York is nearly all of circumpolar taxa.

The disjunctions shown by lichens also increase in the temperate zone and are the same as those shown in other plant groups. The Japan-eastern North America disjunction, made famous by Asa Gray, is also well displayed in the lichens (Yoshimura, 1968b; Culberson, 1972; Kurokawa, 1972) as are the other classic disjunctions, e.g. amphi-Atlantic, amphi-Pacific, western North America-Europe disjunct, bipolar, etc. In the phanerogams these disjunctions are not usually of identical species but of two, closely related species (vicariads) or genera. In lichens, again as in bryophytes, the disjunctions are commonly, although not exclusively, of the same species. Vicarious species are known also among lichens.

iii) The evolutionary rate in lichens; historical lichen geography

Many comments have been made incidentally concerning the evolutionary rate of lichens. Because so many of the species are very widespread and disjunctions occur primarily at the species level, it is assumed that speciation in lichens, as a response to the different local conditions, is less rapid than in phanerogams. Ahti (1977) maintained that the evolutionary rate of the boreal lichens, as a whole, is "slow". The abundance of species relying on vegetative propagation is suspected as an important factor in delaying speciation. Lindsay (1977) quoted both Lamb (1970) and Rudolph (1967) as noting the Antarctic lichen flora as a whole is evolving extremely slowly with genetic recombination being a rare event. However, so little has been carefully documented concerning the sexual process in lichens, and since conceiveably other processes could also be at work (e.g. great plasticity, superior dispersal, etc.) any estimate of the evolutionary rate among lichens can only be an assumption, no matter how logical it appears. Indeed, Thomson (1963) considered a phylogenetic discusion of any lichen group to be a "flight of fancy", based totally on surmises such as the supposed primitiveness and advancement of certain morphological characters.

The other assumption concerning lichen geography, that the substantiated historical factors that produced phanerogamic distributions, have produced modern lichen distributions too, is also unproven. However. Culberson (1972) believed that "so similar in fact are the well documented ranges of lichens to the ranges of vascular plants that the conclusion that both resulted from the same physio-ecological and historical factors is inescapable". Similarly Yoshimura (1968b) stated that "since the distribution patterns of Cladonia species are similar to those of angiosperms and bryophytes, the centers in which Cladonia species originated and from which they dispersed may have been the same in which the angiosperms and bryophytes originated and began their dispersal". Unlike phanerogams there is no substantial fossil record nor genetical evidence to support or suggest previous lichen distributions. Smith (1921) stated that lichen fossil records are scanty and of doubtful determination. Smith mentioned amber-embedded fossils that date from the Miocene and include Parmelia saxatilis, Hypogymnia physodes, Graphis scripta, and Cornicularia aculeata (although there is the suggestion that the determinations are not reliable, since they are based on thallus fragments). She noted that the "great antiquity of lichens ... has been adduced from physiological rather than the phytogeographical evidence". Scott (1973) stated that the "great-

est misfortune for the study of symbiotic evolution is the paucity of fossilized remains that can be clearly categorized as symbiotic". Kurokawa (1972) admitted that "the fossil record is of little help since fossil lichen remains are too few to permit generalizations about their former occurrences". He also admitted that "while chromosome studies have been giving suggestions on evolution and differentiation as well as distribution of higher plants, in comparison we know little about chromosome numbers, chromosome morphology, or other cytological aspects of lichen fungi or lichen algae". A discussion of the sexual process in lichens is usually discussed in terms of the knowledge of non-lichenized fungi. "The steps leading to formation of ascocarps and spores in lichens ... are very poorly known compared with other fungi" (Hale, 1967b).

Because of the lack of substantiating evidence concerning former distributions, the hypothesizing of the factors that brought about current lichen distributions are all conjectural. The linking of phanerogamic explanations to similarly distributed lichens is, at the best, only circumstantial. As Lindsay (1977) noted "in the absence of any fossil record for lichens from the polar regions, any remarks on past distribution patterns and their transformation into modern types may be considered speculative". With that warning made he then proceeds to discuss some of the possible explanations. On the other hand, other lichenologists regard this speculation as unfeasible. For example Hale (1965a) stated, concerning Parmelia subgenus Amphygmnia,

"Phytogeography of lichens is actually no more than a presentation of known distribution patterns interpreted with reference to patterns already established for phanerogams and ferns. Higher plants have a fossil record, and there is a more or less coherent link between modern and fossil forms. Lichens have no fossil record and we know nothing of their evolution in geological ages. We will therefore confine our discussions here to a summary of the distribution patterns."

This conservatism is in agreement with one basic principle of phytogeography, namely that "coincidence in range distribution, <u>although certainly</u> <u>suggestive</u> (my emphasis) does not mean that two taxa have similar dispersal histories - the same form can be produced by different processes" (Stott, 1981).

Some comments will be made here concerning the possible historical phytogeography of the local lichen flora. As long as the speculative nature of these remarks is fully understood then the hypotheses involved can be of interest, but not treated as facts. In order to remind the reader of the speculative nature, all sources are carefully cited.

C. Difficulties with adequate distribution mapping of lichens

While the difficulty caused by the absence of adequate fossil data and genetical information in lichens has hampered lichen phytogeography, the problems encountered in determining present day lichen distributions has also caused it to lag far behind that of phanerogams. Culberson (1972) noted "reliable distribution maps have been published for very few (only hundreds) of the approximately 20,000 recognized species of lichen fungi". Reliable species distributions result from a sound taxonomic basis as well as adequate collecting and subsequent publishing of the records. As Lindsay (1977) remarked "a sound taxonomic basis is an absolute necessity before any meaningful discussion can proceed upon biogeographical problems". Rogers (1977), in a discussion of desert lichens, reminded that "until consistent studies have been completed embracing taxa across the world, biogeographic findings must be treated as tentative".

i) Lichen taxonomy; name changes

A sound taxonomic basis is slowly evolving in lichenology although difficulties still exist in this morphologically simplistic group. A comparative paucity of morphological characters as well as wide plasticity

has placed emphasis in recent years on the more qualitative chemical characters. Differences of opinion have resulted on the validity of "chemical species" with currently a return to a more conservative view. Once again a difference of one or more secondary metabolites does not automatically result in a new species unless correlated with at least a geographic separation of the two strains or, preferably, some morphological difference as well, even if only slight. However, the same conservatism that moderates the emphasis of chemical characters has also made it difficult to reduce long-accepted species to subspecies rank. Thus what constitutes a 'good' lichen species is still rather open to individual interpretation among lichenologists.

The process of establishing a sound taxonomic basis has produced a plethora of name changes in recent years. Keeping up-to-date with the nomenclature is often very difficult. In some cases, large genera have been split into numerous segregate genera. This is usually only an inconvenience to the phytogeographer. However, for a variety of reasons, changes of the species epithet are often necessary resulting in difficulties in equating taxon names between floras published in different years.

ii) <u>Difficulties</u> using monographs

Ideally both a sound taxonomic basis and adequate collecting and publication could be met in modern monographic treatments (Wetmore, 1968). However, even among the macrolichens very few genera have been monographed, and among those treated many, except for the very smallest genera, are not world treatments but typically of single continents or portions of continents. Some monographers work with only the type specimens or a very limited number of specimens, thereby not accurately reflecting the distribution of taxa. Some monographers while studying many specimens only report sites

in very generalized or abbreviated fashion which also gives a false impression of distributions. And, unfortunately, their recent taxonomic treatment reduces the chances of a recently monographed group having a complete distribution-analysis done in the immediate future.

iii) Difficulties using floras

When recent monographs are not available, then distributions must be interpolated utilizing regional floras. Many areas lack recent treatments or have only partial treatments, i.e. of the macrolichens. One problem, of course, is language difficulties, e.g. with Russian publications which often are not readily available and even when available not easily utilized. Even after accepting the identifications of so many different workers through a very wide range of time periods there is the major difficulty of using floras to estimate distributions because of the problem of equating the taxonomies. What is considered a species by one lichenologist is not necessarily considered at that rank by another. Whether a worker was a 'lumper' or a 'splitter' is not readily apparent when skimming species It is remarkable that there is a fairly high degree of conformity lists. regarding which taxa deserve recognition at the species level; some of this undoubtedly results from conservative inertia. A very outstanding exception to the general uniformity of species concept, is shown in the "Lichen flora of the Antarctic continent and adjacent islands" (Dodge, 1973) which proposes an extraordinary number of new species and includes very few that are widespread. Lindsay (1977) maintained that this "poor taxonomy, especially of the Antarctic species, has hampered discussion of the biogeography of cold desert lichens". Similarly, the treatment of the Mongolian lichen flora (Magnusson, 1940, 1944c) consists, according to Rogers (1977), of "very narrowly circumscribed species" and "probably has greatly inflated

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the lichen flora of the area".

iv) Insufficient collecting; poorly known regions

Inadequate collecting and tardy publication of the data has also suppressed the knowledge of lichen distributions. Lichens are a comparatively 'low interest' plant group that has been overlooked or ignored by many general collectors. Thus lichens have not been as intensively collected as many other groups. However, it should be noted that Lindsay (1977) considered collections made by non-lichenologists as "often unrepresentative and poor taxonomic material". Most world monographs mention regions that are inadequately explored with respect to their particular interest. Even in the Northern Hemisphere, which is 'lichenologically advanced' compared to the Southern Hemisphere, very few regions have been intensively collect-In discussing the boreal lichen flora, Ahti (1977) noted that many ed. areas were still "very sporadically and superficially explored" including northwestern Russia, Siberia and the Far East, Yukon, northern British Columbia, northern Alberta, Saskatchewan, Manitoba, and the Northwest Territories. He also noted that even in northern Europe, where the boreal macrolichens are well known, that the microlichen flora is incompletely understood.

The incomplete knowledge has been used to explain some currently known lichen distributions as only fragments of their actual distributions, e.g. Lindsay (1977) explained an unusual Arctic distribution in Thomson (1972) as possibly an artifact of undercollecting. In bryophytes, however, disjunctive distributions are considered not to be the product of inadequate collecting (Schofield & Crum, 1972).

Culberson (1972) suggested that the best lichens to examine phytogeographically were those that were well-known systematically, recently studied, common in at least part of their range, and large enough to be conspicuous and therefore collected. Very few species meet many of these requirements. Even monographic treatments are characterized by the restrictions that undercollecting imposes. For example, Hale (1976b) stated, regarding Bulbothrix, that" "statements made on species abundance and distribution will be tempered by the results of other workers in the future". Accordingly, it is not surprising that even the range of the well-known arctic macrolichen Dactylina ramulosa has been altered significantly with the study of poorly collected areas. Lynge (1933) presented and discussed the known distribution of D. ramulosa of which only the North American portion is reproduced here (see Figure 47). Its apparent absence in most of northwestern North America with additional isolated outliers further south is Although Lynge (op. cit.) was not certain that the low suggestive. intensity of collecting did not preclude its presence in the alpine regions of the Rocky Mountains to the north of the known disjunction he did believe the intensity of collecting to the south was sufficient to rule out its occurrence in Utah or Colorado. Lynge did emphasize this disjunction by comparing it with the phanerogam Lloydia serotina and quoting Fernald as remarking that,

"The isolation from the Arctic and Subarctic region in the Cordilleran region far to the south is a very general one, this showing in so large a proportion of cases that I take it to be a natural isolation".

However, in the case of <u>Dactylina</u> <u>ramulosa</u> the disjunction was unquestionably an artifact of undercollecting as illustrated by comparison with a more recent map of its distribution in North America by Thomson and Bird (1978). The same is true today with the less well-known or less common macrolichens as well as for most of the microlichens. Several well-known macrolichens, including <u>Peltigera collina</u> (Ahti, 1964; Ahti & Vitikainen, 1977), Umbilicaria polyphylla (Ahti, 1964), Cavernularia hultenii (Ahti



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Figure 47. Comparison of older and recent known distribution of <u>Dactylina</u> <u>ramulosa</u> in North America. A. After Lynge (1933). B. After Thomson and Bird (1978).

& Henssen, 1965), formerly considered to be western North America-Europe disjuncts, are now known to be present although rare in eastern North America. The currently known distributions for many lichen species will be altered radically with future knowledge. In discussing the boreal lichen flora, Ahti (1977) stated that "the lack of adequate distribution maps has resulted in contradictory statements about the ranges of many boreal lichens" noting the dissimilarities between the distribution lists of Makarevich (1963), Brodo (1968), and Krog (1968). He went on to suggest that "hence many statistics of lichen elements are almost worthless".

D. The value of phytogeographic discussion in lichens

In light of these general difficulties with lichen phytogeography, which have been recounted at some length here, it is argued that such a discussion and statistics are not worthless as long as the limitations are fully understood. It is also suggested that although many of the specifics (= statistics) will undoubtedly be altered with time, the generalizations may well remain true. This has already happened in the phytogeography of phanerogams. For example, the hypothesis of Asa Gray concerning the close ties of eastern North America with Japan was originally based upon the disjunction of many of the same species between the two areas. Although most of these are now regarded as separated species in each of the areas of disjunction the generalization has remained true; the disjunction is now based on numerous vicarious species. Fernald's hypothesis concerning disjuncts in eastern and western North America has also been altered with increasing knowledge over the years. Although the number of disjunctive taxa has been reduced greatly, the disjunction persists and the generalization is still accepted that arose from the original data.

Similarly, the statistics given in the following treatment of the local lichen flora will undoubtedly alter with time. As further data be-

comes available, species will be transferred from one group to another. Some will have their distributions expanded with reports from new areas. In the last few years Cetraria merrillii and Thelomma mammosum (as Cypheliopsis bolanderi), both previously considered to be western North American endemics, were reported from Europe (Tibell, 1976; Kärnefelt, 1980) and so are currently interpretated as western North American-Europe disjuncts. Many other local endemics will undoubtedly be shown to be amphi-Pacific as increasing knowledge of eastern Asia becomes available. The suspicion that Pilophorus acicularis was amphi-Pacific was confirmed in Jahns (1981). P. clavatus, originally also considered a western North American endemic. is known now to exhibit this distribution. The currently broad distributions of other species will be reduced when taxonomic treatments recognize portions of them as distinct species separating these from the very polymorphic, commonly widespread, 'conglomerate' species. Lecanactis megaspora, a west coast endemic, was recently separated from the more widespread L. amylacea (Brodo, 1976). Thus future research will expose both reductions and increases in lichen distributions. It is unlikely that the two flows will be equal. The exact percentages of the different phytogeographical elements will undoubtedly also change with time. But these data are not as worthless as Ahti (1977) suggested since the generalizations that are derived from these statistics are considerably more stable than the statistics on which they are based.
II. Floristic Elements Composing the Lichen Flora of the CDFD Subzone

The phytogeographic elements composing a flora can be analyzed in several ways. Different criteria can be selected to separate and group elements based on the desired emphasis. Here the first criterion used is an elimination of the Southern Hemisphere and a consideration of a species distribution in the Northern Hemisphere only. Presence in the Southern Hemisphere is considered later, but to a lesser extent. This emphasis on distributions in the Northern Hemisphere follows, to a large extent, the greater knowledge of lichens in this hemisphere. The second criterion for analyzing the elements is a separation of continuous and discontinuous distributions in the Northern Hemisphere. It is the large discontinuities that are of interest here with the smaller discontinuities, for phytogeographic purposes, considered continuous, particularly when thought to be within the normal range of dispersal for that species.

Of the 448 species included in the local flora only 385 (86%) are classified satisfactorily into elements. Sixty-three species were excluded from the analysis, 22 species because they are not actually known from the CDFD subzone but from adjacent areas and 41 species that do occur in the CDFD subzone but could not be assigned satisfactorily to an element either because of contradictory information or inadequate information.

For the purposes of the present classification the distributions of individual species were extensively but not exhaustively researched. World distributions were available from modern monographs for a few species, but most were not. The latter group was interpolated from regional floras or partial monographs, often with previous worker's distributional assessments taken into consideration, i.e. from Krog (1968), Ahti (1964, 1977), Wetmore (1968), Brodo (1968), and Thomson (1979). The world distributions of these individual species are mentioned within the body of the flora. As explained in the introduction to lichen phytogeography these distributions should be considered as tentative to a large extent. Some will be altered by future work.

The results of the phytogeographic analysis of the CDFD subzone are presented in Table III. Each element is discussed in detail. Representative distributions have been mapped where the information was available. The broader distributions were extracted directly from the literature or were derived from several different sources. The more local, narrower distributions were constructed from both available literature and specimens in the UBC herbarium. A geological time scale is available in Table I.

WITHIN THE NORTHERN HEMISPHERE ONLY (excluding occurrences in the Southern Hemisphere)

A. CONTINUOUS DISTRIBUTIONS (69%)

As stated earlier, continuity and discontinuity are very relative terms. While keeping in mind that all distributions are actually discontinuous, within the premise that they can be considered continuous within the dispersal distance of each species (which is unknown for lichens), then most species composing the local lichen flora have continuous distributions. Species that show continuous distributions may be further divided into those that completely encircle the north pole and those that are not completely circumpolar. Most of the latter group, that are represented in the study area, are North American endemics, and are predominantly western North American endemics. In lichens, continuous distributions are either large and extensive (circumpolar) or considerably smaller and restricted (endemics). Distributions of intermediate extent such as the "'circumboreal' but missing in eastern Asia" as noted in 10% of the hepatics of

Table III. Floristic elements composing the lichen flora of the CDFD subzone including their relative percentages based on the 385 species classified. I. Within the Northern Hemisphere (excluding occurrences in the Southern Hemisphere) II. Within both the Northern and Southern Hemispheres.

I. <u>Within the Northern Hemisphere</u> (excluding occurrences in the Southern Hemisphere)	
A. CONTINUOUS DISTRIBUTIONS	
1. Circumpolar (49%)	
a. Arctic-alpine or Arctic with boreal-oceanic extensions	4 %
b. Boreal	31 %
c. Temperate	12 %
d. Tropical with temperate-oceanic extensions	2 %
2. Not circumpolar (20%)	
a. Amphi-Pacific	2 %
b. North American, primarily endemics	18 %
B. DISCONTINUOUS DISTRIBUTIONS (31%)	
1. North America	
a. western NA - eastern NA	3 %
2. North America - Europe	
a. western NA - Europe	11 %
b. western NA - eastern NA - Europe	7 %
3. North America - Asia	
a. western NA - eastern NA - eastern Asia	12%
b. western NA - eastern Asia (included in Amphi-Pacific)	· _
4. North America - Europe - Asia	
a. western NA - Europe - eastern Asia	112%
b. western NA - eastern NA - Europe - eastern Asia	8 %

II. Within both the Northern and Southern Hemispheres

A. Unknown, as yet, in the SH	62%	
B. Continuous in NH plus occurrence(s) in SH		
1. Circumpolar in NH	31% *	63% **
2. North America only in NH	1%	6 %
C. Discontinuous in the NH with occurrence(s) in SH	6%	19%

* Percentage of total species (385) classified
** Percentage within that element, i.e. number circumpolar in NH and also occuring in SH / number circumpolar in NH X 100%

southwestern British Columbia (Godfrey, 1977b) is not displayed in lichens, although <u>Platismatia glauca</u> approaches this pattern.

1. Circumpolar

Of the local lichen species, 49% have circumpolar distributions. Within the circumpolar subdivision, most species exhibit a latitudinal preference, although this is typically very broad among lichens. For example, a species is not usually strictly boreal, but is present often also in the (low)arctic or the (north)temperate zone (or both). A species appears be more characteristic of the boreal because of its common occurrence, abundance, or luxuriance there.

Most species in the local flora that exhibit continuous circumpolar distributions have boreal affinities, some have temperate affinities, while only a few have tropical or arctic affinities.

a. <u>Circumarctic-alpine or circumarctic with boreal-oceanic extensions</u>

Only 4% of the local CDFD subzone flora have circumarctic distributions. Species with this distribution are found north of the tree line, i.e. in northern Canada (Arctic islands and continental fringe), U.S.A. (Alaska), U.S.S.R. (Siberia, Novaya Zemlya, northern European Russia), Fennoscandia, Spitsbergen, Iceland, and Greenland. Species showing circumarctic distributions in the Northern Hemisphere occur south of the tree line, but at increasingly higher altitudes in the mountains at more southern latitudes in boreal, temperate, or even tropical regions. In North America these species show extensions south in the alpine zones of the Appalachians in the east and the Cordillera (Rocky Mountains, Coastal Mountains, Cascades, etc.) in the west occasionally as far south as Mexico. According to Thomson (1972), alpine stations in the Rocky Mountains are often absent between southern Alberta and Colorado. Examples of lichens with an arcticalpine distribution include Thamnolia vermicularis and Haematomma lapponicum. The latter is found as far south as Mexico at high elevations (see Figure 48). Occasionally, charcteristic arctic-alpine species are found even locally at low elevations in edaphically suitable sites.

The distribution of other circumarctic lichens that occur also south of arctic latitudes does not fit strictly into an arctic-alpine designation but is better described as circumarctic with southern extensions in oceanic areas typically only as far as boreal latitudes. Occasionally these species are alpine too. Species showing this distribution are sometimes characteristically coastal species in both the arctic and in their southern extensions. Examples of lichen species with this distribution are the saxicolous Lecanora straminea and Caloplaca verruculifera. Their known distributions are extremely fragmentary but both appear to be distributed southwards from arctic latitudes in Europe as far as Scandinavia and Great Britain and in western North America as far south as southern British Columbia and probably Washington (Ryan, pers. comm.) and Oregon. Other species that are typically circumarctic and occur southward, not just in the alpine but also oceanic-boreal areas, are Placopsis gelida (see Figure 49), Sphaerophorus globosus, and Lopadium pezizoideum. The last two examples change their substratum being terricolous or muscicolous in the arctic but corticolous in the boreal-oceanic regions (It should be mentioned that S. globosus is sometimes treated as only an arctic species, with the name S. tuckermanii being applied to collections from oceanic-boreal regions). Lamb (1947) described the distribution of Placopsis gelida in the Northern Hemisphere as predominantly oceanic although not strictly so. Outside the arctic it is found at sea level in Ireland as it is also, luxuriantly, on the west coast of Vancouver Island. Continental stations of P. gelida in Europe are all at higher elevations. Although also at higher elevations in the coastal mountains of western North America, it is absent from the con-



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tinental, inland chains of the Cordillera.

Thomson (1972) has suggested that arctic lichens are "of very, ancient origin, pre-Pleistocene" on the basis that (1) the majority of arctic lichens are circumpolar, (2) there is such a large number of species (2,000+), and (3) since "evolution in lichens proceeds very slowly it scarcely seems possible that this number has originated in the Pleistocene or the post Pleistocene". Lindsay (1977) also believed that circumarctic lichens of Northern Hemisphere are very ancient (see bipolar discussion following).

Brassard (1971) pointed out that bryophytes endemic to the High Nearctic and occurring in the Canadian High Arctic are composed of "very well differentiated taxa, suggesting old age rather than recent evolution" while, in comparison, several vascular plants belong to very plastic genera and may have evolved more recently since Pleistocene times.

Like the bryophytes, many arctic lichen species are morphologically very distinct and often lack many or any, close relatives. Some are restricted to the arctic while others are also alpine in their distribution. <u>Masonhalea</u> and <u>Thamnolia</u> are both monotypic genera. <u>Pseudephebe</u>, <u>Asahinea</u>, and <u>Dactylina</u> are other examples of genera which have two or only a few species.

In contrast to the apparent ancient age of the arctic flora is the knowledge that the arctic biome could not have existed in its present location before the early Tertiary since fossil records from the Eocene show a very well developed forest flora, containing genera now character-istic of more temperate climates, existing at northerly locations. Fossils of <u>Taxodium</u> have been collected near 81° N in the Canadian Arctic and <u>Sequoia</u> near 78° N in Spitzbergen (Seddon, 1973). It is theorized that the prevalence of this "Arcto-Tertiary Geoflora" was coincident with



Figure 49. World distribution of <u>Placopsis gelida</u>, an example of circumarcticalpine with oceanic-boreal extensions. After Lamb (1947), Thomson (1972), and various smaller papers. \blacktriangle = known alpine sites.

Laurasia, the ancestral continent that broke into North America and Eurasia, once being situated at more southerly latitudes. Laurasia 'rafted' slowly northward which caused a gradual displacement of the mesophytic Arcto-Tertiary flora southward, eventually into temperate latitudes, allowing for the development of more cold tolerant floras, e.g. conifers, in northern locations. Hadnač (1963) suggested that since taiga covered parts of Siberia in the Miocene-Pliocene, tundra could have been present north of this. Indeed, it is usually accepted that by the Pliocene, or before glaciation in the Pleistocene, an arctic tundra was present in a form and position approximating the modern arctic biome.

Individual species are thought to have attained circumpolar distributions before the Pleistocene. Glaciers would have dissected these continuous distributions into the discontinuous, relict disjunctions observed in some species today.

Thomson (1972) suggested, following Packer (1971) for phanerogams, that arctic lichens may have "originated in montane tundras" produced by the tectonic uplifts of the Miocene in the Rocky Mountains or the mountains of eastern Siberia. He envisioned the attainment of circumpolar distributions as a later development, originating during the glacial advances and retreats of the Pleistocene when the montane species could have invaded the low elevation tundra of the arctic.

Löve and Löve (1974)envisioned a similar montane origin of phanerogams but place its development as earlier. They suggested that although the lowlands of Laurasia were vegetated by tropical or temperate species, some mountainous terrain was undoubtedly present. This permitted the selection and evolution of cold-enduring plants in small and perhaps isolated locations at higher elevations. The increasingly colder climate at the lower elevations associated with Laurasia drifting northwards could have permitted these montane-derived species to spread downslope and eventually over the northern portions of the continents.

During the Pleistocene, although the northern half of North America and Eurasia were extensively glaciated, not all northerly locations were under ice simultaneously during every one of the four or more glaciations, nor during the entire time. In western North America unglaciated refugia existed in the Alaska-Yukon region, the Queen Charlotte Islands, and probably the Brooks Peninsula on western Vancouver Island (Godfrey, 1977b). Many arctic species thus persisted north of the maximum extent of glaciation and spread out from these locaions when the glaciers finally receded. Other arctic species may well have persisted south of the glacier front. Just as it is theorized in Thomson (1972) and Packer (1971) that arctic lichens as a general group evolved at higher elevations at more southerly latitudes and subsequently moved northwards with cooling during the Pliocene, the opposite situation is commonly used to explain arctic lichens occurring south of arctic latitudes. Arctic lichens are thought to have moved southward during the glacial advances of the Pleistocene and subsequently to higher elevations where available (Rocky Mountains and northern Appalachians in North America) in those southerly latitudes as the glaciers retreated and the climate ameliorated at the low elevations. This places emphasis on stepwise migration rather than the chance occurrence of long-distance dispersal.

b. <u>Circumboreal in the Northern Hemisphre</u> (31%)

Lichens of the CDFD subzone with a circumboreal distribution compose 31% of the total flora. This is both the largest circumpolar group as well as the largest phytogeographical element in the local flora despite the fact that the local study area does not fall within the boreal biome in the strict sense. While the boreal zone forms an almost continuous band,

about 1,000 km wide across northern North America and Eurasia, in North America this zone extends much further south in eastern Canada including Newfoundland and all but southern Quebec, Ontario, and Manitoba and then gradually further north in the Prairie provinces until it only touches the more northerly (especially northeast) parts of British Columbia (see Figure 2 in Larsen, 1980). However, the mountainous nature of western North America coincides with a vegetational domination of conifers south to northern California just as the true boreal is also dominated by conifers. Ahti (1977), in considering boreal lichens, showed a much more southerly boundary at approximately 49° N and included western and northern Vancouver Island but excluded the present study area. Examples of lichen species with a circumboreal distribution in the Northern Hemisphere include many of the larger terricolous macrolichens such as Cladonia (C. gracilis, C. squamosa, C. pyxidata, C. phyllophora), Cladina (C. rangiferina, see Figure 50), Peltigera (P. aphthosa, P. canina, P. spuria) and corticolous macrolichens such as Melanelia exasperatula (see Figure 51). Also included are crustose species such as Polysporina simplex, Psoroma hypnorum, Rhizocarpon obscuratum, Lecanora atra, and Huilia crustulata.

Like circumarctic species, the circumboreal species occur southward in the mountainous regions, their elevation of occurrence increasing with decreasing latitude. In North America this includes the Appalachians in the east and the Cordillera in the west.

The origins of the boreal lichen flora are unknown although since the boreal zone corresponds almost exactly to the region covered by ice during the glaciation it is obvious it did not evolve recently <u>in situ</u>. Larsen (1980) stated that the boreal floras as a whole (= vascular plants) probably developed throughout the Tertiary, although the fossil record is far from clear, from various elements present in the Arcto-Tertiary Geoflora





Figure 51. World distribution of <u>Melanelia</u> <u>exasperatula</u>, an example of circumboreal. in the Northern Hemisphere. After Esslinger (1977) with additions from Krog (1968), Thomson (1979), Alstrup (1982).

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consisting of both deciduous trees and conifers that flourished in the warmer climate of the circumpolar arctic region. The climatic deterioration that occurred in the late Tertiary, especially the Pliocene, and the subsequent climatic reversals that produced several glaciations caused a sifting out of the various species that could tolerate the harsher environment, and the eventual arrangement into what we are familiar with as the boreal flora. Larsen (1980) suggested that most boreal species "weathered out" the glaciations to the south of the maximum extent of the glaciers while most arctic species survived in northern, unglaciated refugia. Since the last glacial retreat began only 13,000 years ago and some northern regions became available for colonization as recent as about 7,000 years ago, the invasion of flora has been very rapid.

Another theory postulated a much longer association of boreal-type Daubenmire (1978) noted that, on the very northern continental vegetation. fringe of the Northern Hemisphere and some arctic islands, a very depauperate flora existed even in the Eocene which, although made up of taxa also present in the adjacent Arcto-Tertiary Geoflora, was segregated as the "Subarctic Forest" (on the basis of its present location). More commonly, a boreal-type conifer forest is thought to have been present further south in montane regions. It consisted, in part, of species from the surrounding Arcto-Tertiary Geoflora of the lowlands at least by Miocene times (Kornaś, 1972). However, the presence of a broad, northern boreal zone (more distinct than the above-mentioned Subarctic Forest) is not believed to have been present until the Pliocene when continental cooling forced a southward displacement of most members, especially the broad-leafed, heatrequiring taxa in the Arcto-Tertiary Geoflora. The boreal zone was circumpolar preceding the Pleistocene and although following displacement, dissection, and local extinction by glaciation of some members and being

somewhat regionally isolated today, many taxa are again circumpolar. The comparatively high number of circumboreal taxa compared to circumtemperate taxa is in part a direct result of the recent and current circumpolar connections of the circumboreal taxa compared to the connections of the circumtemperate taxa which were severed some time ago.

Ahti (1977) pointed out that apomictic species were very common among the boreal lichens, especially the foliose macrolichens. They are very uniform morphologically, lack much ecotypic differentiation, and are usually considered secondarily evolved species with the primary species interpreted as Tertiary relics now confined to (oceanic) temperate regions. Their success in the boreal zone is perhaps chiefly a result of the short time since glaciations and their quick mode of reproduction.

c. Circumtemperate in the Northern Hemisphere (12%)

Lichens with a circumtemperate distribution compose 12% of the local flora. Within the temperate latitudes in the Northern Hemisphere there is not as continuous an environmental zone around the pole as exists in the boreal and the arctic. Species with circumtemperate distributions require very broad ecological tolerances. Most species, even when apparently circumtemperate, actually may exhibit a preference, especially an oceanic preference, such that their presence within the North American continent is often very sporadic. Other species with a more pronounced absence from these continental areas are grouped under discontinuous distributions, in particular the western North America-eastern North America-Europe-eastern Asia (wNA-eNA-E-eA) disjunction. Extensions further north into oceanic boreal regions are fairly common, otherwise the northern boundary of the temperate zone in North America corresponds roughly with the U.S.A.-Canada border.

Examples of lichens that show a circumtemperate distribution in the Northern Hemisphere include Lecidea fuscoatra, Candelaria concolor, Lecanora muralis (see Figure 52), Arthonia radiata, and Arthopyrenia biformis. A large number of the species classified as circumtemperate are crustose species. Correspondingly, a large number of the discontinuous wNA-eNA-E-eA species are foliose or fruticose species. This suggests that microlichens either have wider tolerances than macrolichens in the temperate zone or that the wider distributions result from too generous an interpretation of incomplete distributional data. This applies especially to microlichens.

Circumtemperate species often have their distributions described as cosmopolitan especially if they infringe upon the tropical latitudes at higher elevations or boreal latitudes in oceanic regions. No lichen species (in spite of very wide tolerances) are able to tolerate the wide extremes that occur throughout the world. The term cosmopolitan has sometimes been applied to taxa actually found on all continents, but as Daubenmire (1978) pointed out, except possibly for some bacteria, "no higher organism has sufficient ecologic amplitude to be cosmopolitan".

Circumtemperate species are probably derived from the warm-preferring (or perhaps frost-intolerant) members of the Arcto-Tertiary Geoflora. (See Discontinuous Distributions for a discussion of these affinities.)

d. <u>Circumtropical with temperate-oceanic extensions in the</u> Northern Hemisphere (2%)

Only a very small portion of the local lichen flora displays a circumtropical distribution with temperate-oceanic extensions (2%). For the most part, the actual distributions of the species involved are only partially known and there are some indications that these may not be truly



tropical in distribution since occurrences are often at higher elevations in the tropics, descending to sea level only at oceanic regions in the temperate zone. Examples of lichen species that appear to have mainly circumtropical distributions are <u>Hypotrachyna sinuosa</u>, <u>Pseudocyphellaria crocata</u>, and <u>Sticta weigelii</u>

Derivation of this element may be from the Neo-Tropical Geoflora that in Tertiary times extended coastally as far north as Alaska in western North America. This is probably true for genera like <u>Hypotrachyna</u> which is concentrated today in tropical regions, albeit typically at montane localities. <u>Pseudocyphellaria</u> and <u>Sticta</u>, however, are both genera concentrated in the Southern Hemisphere and their presence in the Northern Hemisphere is possibly more recent.

Direct exchange between (sub-tropical) Asia, India, and Africa was possible until the late Tertiary when the desert environment of Asia Minor developed. South America had separated earlier from Africa in the early Cretaceous. Raven (1972) considered many phanerogam genera common to South America and Africa to be younger than the Cretaceous and younger than the period immediately following "when the two continents were relatively near and partially connected by islands". Some genera, at least, are believed to have evolved in South America and then spread to Africa by recent long-distance dispersal.

2. Not Completely Circumpolar, But Continuous

a. Amphi-Pacific (2%)

Species with amphi-Pacific distributions compose only 2% of the local flora. This low proportion results in part from ignorance of the lichen flora of eastern Asia and western North America. Some of the species now considered to be western North American endemics, especially those

that extend north into Alaska, will be found ultimately in eastern Asia. For example, <u>Psora</u> novomexicana was originally thought to be a southwestern North American endemic but recently it has proven to be synonymous with P. nipponica (which has priority). The amphi-Pacific element, as treated here, may contain some disjunct species (those that are absent in the northern part of the Pacific but present in British Columbia or Washington and again in Japan.). Knowledge of these species is so fragmentary that this separation cannot be attempted at this time. Pilophorus acicularis originally appeared to have a discontinuous distribution on either side of the Pacific Ocean, but recently it has proven to be amphi-Pacific. It occurs from California north to Alaska including the Aleutian Islands, Japan, and China (Jahns, 1981). The previously mentioned Psora nipponica currently appears to have a disjunct distribution. It occurs extensively throughout the southwestern United States and north into southern British Columbia and then in Japan; it is not yet known from northern British Columbia or Alaska. Stereocaulon sterile has a continuous amphi-Pacific distribution. It ranges widely in western North America and occurs in eastern Asia only in Kamchatka (see Figure 53).

In a report on the bryophytes common to both Japan and British Columbia Schofield (1965) listed many mosses as well as some hepatics and phanerogams that have a continuous or fragmented amphi-Pacific distribution. The hepatic flora of southwestern British Columbia has a much larger percentage (9%) of its species with eastern Asian affinities (Godfrey, 1977b). It is suggested that species currently showing amphi-Pacific distributions (continuous or fragmented) have heterogenous origins that resulted from a temperate amphi-Pacific Tertiary flora or the remnants of a circumboreal Tertiary flora. There is also the possibility that their pre-Pleistocene distributions may have been only eastern Asia or only western North Amer-





ica, especially those with just northern encroachments on the opposite continent, e.g. <u>Stereocaulon sterile</u>. Many amphi-Pacific species survived the glaciation in Pacific North America south of the maximum extent of the glaciers while others may have persisted in unglaciated portions of Alaska (or the Yukon) or in refugia scattered at high elevations or coastal regions of British Columbia and Alaska (Schofield, op. cit.) such as the coastal headlands on the western side of the Queen Charlotte Islands.

Species with continuous amphi-Pacific distributions that once had circumboreal Tertiary distributions are closely related to some species which now have disjunct distributions, especially those which are western North America-eastern North America-eastern Asia (wNA-eNA-eA) disjuncts. Reduction of the ranges of the former was just more complete than those of the latter although lichens with a wNA-eNA-eA disjunct distribution are quite often rare and/or are restricted in eastern North America.

Iwatsuki (1972) has suggested that bryophytes with wNA-eA distributions (with the eastern Asia locality being Japan) differ both in origins and age from the classical eastern North America-Japan disjunction. The amphi-Pacific group probably arose from boreal, perhaps circumpolar elements while the eastern North America-Japan group arose from temperate or tropical elements. Additionally, the larger number of vicariad pairs with the eNA-Japan distribution indicate its "older relationship" or correspondingly a younger age for the amphi-Pacific group.

Although eastern Asia and North America are separated by the Bering Sea, this is not necessarily the barrier to amphi-Pacific distributions it might seem. A drop of about 50 m in sea level can, and has in the past, exposed a connecting land bridge. This region, Beringia, was above sea level throughout most of the early and middle Tertiary and part of the late Tertiary. Again in the Pleistocene " a series of major worldwide climatic

fluctuations that repeatedly produced large glaciers in land areas and concomitant fluctuations in sea level" exposed the bridge on several occasions (Hopkins, 1967). It has been suggested also that the strictly oceanic amphi-Pacific species did not use the Bering land bridge to achieve their distributions but instead spread east (or west) stepwise along the Aleutian Island archipeligo, further to the south (Schofield, 1969).

b. North America, primarily endemics (18%)

Most species in the local flora that show continuous distributions within the Northern Hemisphere and are found in North America are western North American endemics. (The three species that are not endemics are disjunct to South America in the Southern Hemisphere).

Western North American endemics form a heterogenous assemblage. At least three groups are distinguishable by their slightly different distributions within western North America although there are many intergradations and, indeed, the groups are not sharply separated. In some respects the groupings are ecological with the overall distributions being very similar, but regions of highest concentrations different.

i) California Group

One group, with perhaps the most restricted distribution, is distinctly more southern, being concentrated in the warm, dry coastal areas of California and ranging northward on the west side of the Cascades by passing inland in the Willamette Valley of Oregon to the Puget Sound region of Washington and finally reaching their most northerly extension in southwestern British Columbia, especially eastern Vancouver Island and the Gulf Islands. Some, however, do extend as far north as southern coastal Alaska. Localities in California can be inland and at moderate elevations or coastal, but in British Columbia or Alaska they are restricted typically to maritime sites or at least low elevations near the sea. Examples of species which appear to be at their northern limit in the study area include <u>Ramalina subleptocarpha</u> (see Figure 54), <u>Caloplaca laeta</u>, and <u>C. bolacina</u>. However, knowledge of western North American endemics is very incomplete and these species may well range further north or at least further north in Georgia Strait. <u>Ramalina menziesii</u> (see Figure 56), which probably belongs in this group, although it has been collected on the west side of Vancouver Island, occurs as far north as Juneau, Alaska (Krog, 1968) and <u>Arthopyrenia plumbaria</u> (see Figure 55) as far north as the Queen Charlotte Islands.

In a discussion of the phytogeography of the bryophytes and vascular plants of northwestern North America Schofield (1969) named this group "Californian" and described it as very distinctive, occupying...

"the so-called 'Mediterranean' climatic portion of Southern Vancouver Island, the islands of the southern Strait of Georgia and the headlands of the adjacent mainland. The species occupy sites that are edaphically similar to those occupied by the same taxa further south to California in more conspicuously Mediterranean climates, and where they are more widespread. All species are restricted to west of the Cascade Mountains, occupy drier sites, but are not maritime".

Schofield pointed out that other elements besides western North American endemics have this California distribution pattern in western North America, specificially species that are found in other regions with Mediterranean climates. Among the lichens this is known only among species disjunct to the Mediterranean region of Europe.

Some species previously considered to be western North American endemics, including some from this California group, are now known also from Europe. (See wNA-E disjuncts for additional comments.)

The unusual lichen flora of California has long been recognized and commented on (Herre, 1910b; Weber, 1967). Indeed, California has been



Figure 54. World distribution of <u>Ramalina subleptocarpha</u>, an example of western North American endemic. After Rundel and Bowler (1976) with additions.



Figure 55. World distribution of <u>Arthopyrenia plumbaria</u>, an example of western North American endemic. From Harris (1975).



Figure 56. World distribution of <u>Ramalina menziesii</u>, an example of western North American endemic. After UBC herbarium, Krog (1968), Howard (1950).



Figure 57. World distribution of <u>Pertusaria glaucomela</u>, an example of western North American endemic. After Dibben (1980) with additions. O = exact locality unknown

noted as possessing an extraordinary number of endemic species among all plant groups. Endemics among the phanerograms have been extensively studied and shown to be both paleoendemics and neoendemics. The relicts are substantiated by widespread fossil finds showing previously more extensive distributions and are also suggested by morphologically isolated taxa lacking close local relatives. Relatively young endemics have been demonstrated from cytogenetic evidence and again suggested by taxa with small distributions with "ecological and morphological relationships to similar species in the area" (Lewis, 1972). Lewis (op. cit.) stated that the diversity of the California flora is "associated with extreme differences in topography and climate, differences that frequently occur within very short distances". A detailed study of phanerogam endemics in California by Stebbins and Major (1965) indicated that...

> "...in regions with ample moisture, as well as regions with a marked deficiency of moisture, floras are likely to be relatively stable, and most of the endemic species are ancient or at least not recent. This is due to the fact that most of the climatic shifts which occur during geological periods of time and which affect moisture availability will keep the climate within the range of tolerance of the resident species, and will allow them to persist in the same area with little or no change in their genetic make-up..."

Lewis (1972) has pointed out that the diverse phanerogam flora in California as a whole, not just the endemics, "is associated with extreme differences in topography and climate, differences that frequently occur within very short distances" resulting in very steep ecological gradients.

The whole of western North America is characterized by its mountainous terrain composed of many separate series of chains varying in age, height, and parent materials. These include the Sierra Nevada, Cascades, Olympics, Purcells, Selkirks, and others. In considering the mountains of West Africa in particular, but also others in general, Morton (1972) remarked that in mountainous environments competition is at a minimum, open habitats are often abundant, and environmental extremes often occur over a short spatial distance. This resulted in "evolutionary forces" being "concentrated and focused on a smaller number of biota in simpler communities" and hence the "origin and survival of new biotypes is encouraged" (Morton, 1972)

The time of the origin of this lichen Californian group is unknown. Weber (1967) noted that "the pattern of North American endemism" suggested that these species were at least of Tertiary age. The origins of many of the phanerogams of the Californian group may lie with the "Madro-Tertiary Georflora" that arose in uplands in the Tertiary or even the late Cretaceous in the southern Rocky Mountains and nearby Mexico between a "broad-leaf, evergreen Neotropical Tertiary Geoflora" in the southern half of the North American continent and a "temperate, mixed deciduous-conifer Arcto-Tertiary Geoflora" in the northern half of the continent (Tidwell et al., 1972). The Madro-Tertiary Geoflora evolved from a warm-temperate to subtropical flora related primarily to the "shifting climatic conditions (specifically increasing aridity)...resulting from the many orogenies that occurred in the American west". Some of these drought resistant taxa would have been able to survive the summer-dry and winter-wet regime of a Meditarranean climate present in the zone between the humid subtropical climate and temperate climate to the west along the coast. Madro-Tertiary populations are thought to have been present in Baja California (as well as more northerly but continentally) in pre-Eocene times (Tidwell et al., op. cit.). As the ocean retreated which then covered much of western California, Oregon, and Washington, they may have moved north (or west from the continental locations). By the Miocene these taxa were spread extensively throughout southern California. Raven (1971) suggested that although...

"Mediterranean climates have been more or less restricted to their present areas for as long as the continents have been in their present positions... they were presumably displaced poleward when the tropics occupied a larger area than they do at present in the Cretaceous and early Tertiary".

Presumably this would have placed the California group much closer to its current northern extension in the study area. Yet these Madro-Tertiary elements were evolving at that time in the highlands of the southwestern United States and Mexico. They would have been confined in the interior until after the humid tropical climate present then on the western coast was displaced southward and replaced by the current Mediterranean climate. The Madro-Tertiary species could then have moved to the coast.

It must be mentioned that Wolfe (1969) disputed the "so-called Madro-Tertiary element" as well as the generalized concept and timing of Geofloras in general and the Arcto-Tertiary Geoflora in particular. He pointed out that although many genera typical of the Madro-Tertiary element were an important part of the flora and were restricted to Nevada in the late Miocene, they could not have had a southern origin since many show early Miocene fossils in northwestern North America which indicates that they were "derived from a mesic forest of the Pacific Northwest". As the summer-dry climate again began to prevail at the close of the Miocene in the northwest, the "Madro-Tertiary" species may have re-entered the area at that time.

Therefore, this Californian group may or may not have been present locally before the Pleistocene. The California group was undoubtedly present in the warmer regions found in the southern part of their range before glaciation. However, even in California the group may have temporarily left the more coastal areas during the Pleistocene since it is postulated that rainfall was much more abundant then

and distributed throughout the year at that time while the intermountain region was still "somewhat semi-arid" (Tidwell et al., 1972). Expansion into the study area, the northernmost location for many of the species, followed glaciation with extension "northward from California or Oregon to southern British Columbia during the Hypsithermal Interval" in a continuous distribution with the subsequent cooling of the climate, leaving only scattered fragments in suitable microenvironments (Schofield, 1969). The occurrence of the warmer Hypsithermal Interval, however, has been questioned at least for coast British Columbia (Mathewes, 1973). Alternatively, the northerly extension of the California group may have been achieved by radical or stepwise long-distance dispersal, producing isolated outliers in "edaphically suitable sites" as in the rainshadow of the Olympic Mountains (Schofield, op. cit.).

ii) Pacific Northwest Group (Wet and Dry Subgroups)

A second group of endemics appear to be composed of lowland species but those that possess a much more northerly and easterly maximum range and are not concentrated in or typically penetrate as far into California as the California group. Their area of concentration occurs further north in southern British Columbia and Washington. Their distibution may be described roughly as a bulge in the Pacific Northwest region passing as far east as Montana and Idaho and then thinning out as two narrow bands with one band going south coastally and/or as two narrow bands with one going south coastally and/or on the west side of the Cascades to California and the other occurring north into Alaska along the coast. Their range is typically continuous from California north to Alaska while the more eastern localities are often disjunct (but treated here as continuous since the disjunctions are comparatively small). The central bulge coincides latitudinally with the upper atmosphere's westerly-flowing jetstream pushing the precipitationproducing cyclones much farther inland here and producing "oceanic influences as far as the divide of the Rockies" (Daubenmire, 1978).

Similar to the California group, it has been suggested that this Pacific Northwest group is of very ancient origin and with its evolution connected to orogenous activity in western North America but, with direct affinities to the Arcto-Tertiary Geoflora. This temperate, mixed deciduousconifer forest had earlier been confined to the northern half of the North American continent, but by the Oligocene a cooling climate was displacing it southward, although the Neotropical Geoflora continued to persist further north along the west coast. The rise of the Rocky Mountains during the Oligocene and Miocene reduced rainfall to the interior of the continent so much that trees could not survive and the Arcto-Tertiary Geoflora was divided into two areas. Daubenmire (1975) has suggested that the phanerogamic flora of eastern Washington and Idaho:

"...contains a substantial remnant of the mid-Cenozoic temperate forest flora, consisting of residual lowland trees joined by species which probably descended from the upper slopes of low mountains and by immigrants from the northeast, with the group as a whole expanding toward the Pacific coast (my emphasis) as the tropical wedge of forest receded..."

during the Miocene. With the building up of the Cascade Mountains during the Pliocene and into the Pleistocene and the concomitant rainshadow formed on their easterly side, much of the easternmost section (eastern British Columbia, eastern Washington, Idaho, Montana) of their range became unsuitable and their distribution now consists of only scattered fragments there.

Apparently hundreds of phanerogam species can be matched to a sequence of distributons that begin with (A) those still widely distributed in the interior and connected with populations found centrally along the coast (e.g. Pseudotsuga menziesii), through (B) those that have large disjunct

populations in the interior and continuous distributions from Alaska to California mainly along the coast (e.g. <u>Tsuga heterophylla</u>), and (C) those with only a few or small disjunct populations in the interior but continuous coastally (e.g. <u>Alnus rubra</u>, <u>Cornus nuttallii</u>), to finally (D) those not present in the interior at all and now only found coastally (e.g. <u>Fraxinus</u> <u>latifolia</u>). Daubenmire (1975) belived that these 'equiform recessive' ranges confirm the "reality of the mass exodus which resulted from changes in inland climates".

Thus, this Pacific Northwest group was probably present locally prior to the Pleistocene. These species would have survived glaciation south of the ice sheet (or in isolated west coast refugia) and expanded northwards again as the glacier retreated.

Two slightly different subgroups differentiated out of this early western forest, one thriving in slightly wetter regions, and the other in the drier parts. The distribution of the first subgroup typically extends as a very narrow coastal strip (on the very outer coast east to the first mountain range) from northern California to central Alaska plus sometimes scattered relicts inland in the "central bulge" under the oceanic influences. Among the phanerogams <u>Tsuga</u> <u>heterophylla</u> is an example of the Pacific Northwest Wet subgroup. Among the lichen species, examples probably include Pseudocyphellaria anomala, P. anthraspis (see Figure 58), and Lecanactis megaspora. This subgroup just infringes on the study area. In the vicinity of the study area all these species are much more common and luxuriant on the west coast of Vancouver Island, especially in the Fog/Spruce subzone of the Coastal Hemlock zone. It should be noted that other groupings and explanations are possible for this wet subgroup, suggesting that it has heterogeneous origins. For example Cavernularia lophyrea may be a west coast, hyperoceanic boreal species that perhaps survived in coastal refugia during

the Pleistocene rather than retreating southward. Species like <u>Bacidia</u> <u>alaskensis</u>, which are distinctly maritime now, would appear to have a different origin despite having a similar outer coast distribution like the Pacific Northwest Wet subgroup.

The other subgroup that differentiated from the early Miocene forest, which preferred drier regions, is more richly represented in the interior in the central bulge as well as west of the Cascades further south into California, but often much more coastal and often not as far north as the wet group at the northern extent of its range. This group is well represented and abundant throughout the study area. Among the phanerogams, <u>Pseudotsuga menziesii</u>, is an example of this Pacific Northwest Dry subgroup. Examples of lichens with this distribution are <u>Pertusaria subambigens, Cladonia verruculosa, Platismatia herrei</u> (see Figure 60), <u>P. stenophylla</u> (see Figure 61), <u>Buellia penichra</u> (see Figure 59), and <u>Bryoria tortuosa</u>. (Note: The last species has been reported from the Caucasus in Motyka (1958) but it is treated here as a North American endemic since the specimen on which the report was based requires confirmation (Brodo & Hawksworth, 1977),)

iii) Montane-continental Group

A third group of western North American endemics just infringes on the study area as does the Pacific Northwest Wet subgroup. This is composed of essentially montane species, that while technically reaching the ocean on the western edge of their distribution, actually are concentrated much more continentally in western North America. They are present from California (usually the interior) northwards through central British Columbia (or Alberta) sometimes as far north as the Yukon. Examples of species with this sort of distribution are <u>Bryoria oregana</u>, Cetraria canadensis (see



Figure 58. World distribution of <u>Pseudocyphellaria</u> <u>anthraspis</u>, an example of western North American endemic. After UBC herbarium, Schroeder and Schroeder (1972), Krog (1968), Hasse (1913).



Figure 59. World distribution of <u>Buellia penichra</u>, an example of western North American endemic. From Imshaug (1951).



Figure 60. World distribution of <u>Platismatia herrei</u>, an example of western North American endemic. After Culberson and Culberson (1968), Krog (1968), Miller and Shushan (1964), Pike (1973), and UBC herbarium.



Figure 61. World distribution of <u>Platismatia stenophylla</u>, an example of western North American endemic. After Culberson and Culberson (1968), Tucker and Jordan (1978), UBC herbarium. Figure 62), <u>Umbilicaria phaea</u>, <u>Melanelia multispora</u> (see Figure 63), and <u>Cetraria platyphylla</u>. The first two species are best developed in the dry regions of the interior of the province. In the study area they are found inland, often at higher elevations or associated with open stands of <u>Pinus</u> <u>contorta</u> on dry, gravelly soils and are never abundant or luxuriant in this area.

Some of the phanerogams that are associated with the dry interior plateaux and valleys of western North America, such as <u>Pinus ponderosa</u>, are considered to have affinities with the Madro-Tertiary Geoflora (Daubenmire, 1978), as does the California group. This Dry Interior group is also drought resistant, but unlike the latter probably does not tolerate well the moist, drier, very cold winters of the interior. It is suggested that many of the phanerogam species that belong to this dryland group did not enter from the south until comparatively recently, during the Pliocene, when the Cascades had uplifted sufficiently to cause a drying of the interior climate and the exodus of the Pacific Northwest (Wet and Dry) Group (Daubenmire, 1975).

This implies that the Dry Interior group originally migrated into the province along the eastern side of the Cascades rather than the western side, as did the other group with Madro-Tertiary affinities, the California group. Like most of the other groups, the Dry Interior group would have been displaced southward during the ensuing Pleistocene and returned with varying success following the glacial retreat. Most of the species have been able to range as far north as central British Columbia, some as far as the Yukon. Others have been able to spread to the coast although, as mentioned above, they are very restricted here in their success.

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Figure 62. World distribution of <u>Cetraria canadensis</u>, an example of western North American endemic. After UBC herbarium, R#S#nen (1933), Tucker (1973), EssLinger (1973b), Howard (1950), Herre (1910a), Bird (1972).



Figure 63. World distribution of <u>Melanelia multispora</u>, an example of western North American endemic. After Ahti (1966), Esslinger (1977b), Case (1977), Bird et al. (1980). **O** = exact locality unknown
B. DISCONTINUOUS DISTRIBUTIONS (31%)

Discontinuous distributions are displayed by 31% of species composing the local lichen flora. Disjunctions occur primarily in species occupying portions of the temperate zone, especially the oceanic, lowland part of the temperate zone although some disjuncts occur also in montane or subalpine species. There are also some boreal hyperoceanic species that show disjunct distributions; these just infringe on the CDFD subzone and are much more common on western Vancouver Island. For the temperate species, the CDFD subzone is often the northernmost location in western North America, in a range that commonly extends from Baja California or California, northward. (Oceanic-)temperate regions also occur at roughtly the same latitudes in Europe, eastern North America, and eastern Asia. It is with these regions, especially Europe, that disjunctions occur. As explained in the introduction these disjunctions occur in lichens within the same species; very few are even recognized as separate varieties.

In summarizing bryophyte disjunctions Schofield and Crum (1972)stated that no single hypothesis can explain all disjunctions and note that each hypothesis raises a number of serious questions. The plausible reciprocal is that the hypotheses of (1) continental drift, (2) long-distance dispersal, and especially (3) ancient, previously large and continuous distributions now persisting as variously dissected remnants, together offer a reasonable explanation.

Schofield and Crum (op. cit.) also observed that the regions richest in disjunctive bryophytes are largely those with hyperoceanic climates including such areas as "Britain and Norway, the Faeroes, the Alps, the Himalayas, higher mountains of Japan and Taiwan, North Pacific North America, and Hawaiian Islands" (= western North America-Europe-eastern Asia). Species with a western North America-Europe disjunction, eastern Asia-eastern North America disjunction, and amphi-Pacific distribution are "also largely of oceanic climates". Schofield and Crum (1972) believed the hypothesis of long-distance dispersal (although obviously effective in vegetating isolated islands) is handicapped in hyperoceanic climates where precipitation and the general humidity decrease chances of disseminules becoming air-borne. Most disjunct distributions are interpreted as examples of fragments of formerly continuous distributions.

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Since plants display "almost any conceivable sort of disjunct range", Raven (1972) believed it is only important "in looking for some collective reason...when considerable numbers of ranges coincide in their disjunctions". He noted a disjunction "shows that there is some similarity between the habitats in the two (or more) disjunct areas. There is always some probability of additional plants achieving the disjunction regardless of its original historical basis".

These currently temperate species are thought to have affinities primarily with the mixed deciduous-conifer Arcto-Tertiary Geoflora that was mentioned previously with respect to some western North American endemics. In early Cenozoic times this Arcto-Tertiary Geoflora was situated much further north in the Northern Hemisphere because of a considerably warmer climate. It has a southern boundary then of approximately 49° N latitude which is now the northern border of the temperate zone. At these higher latitudes this ancestral flora was continuous (or almost so) around the pole. By the middle of the Cenozoic a continental cooling displaced this Geoflora southward, which, although initially still continuous by more northerly, oceanic extensions (amphi-Pacific, amphi-Atlantic), was split eventually also into eastern and western sections by aridity in the center of each continent. In the smaller North American continent this was accent-

uated by the build-up of the Cordillera at right angles to the prevailing westerly winds. This left four separate oceanic regions in the northern temperate zone.

The climate currently prevalent in these areas, while temperate and oceanic, shows a segregation into two types. The western portions of the continents (western North America and Europe) have mild winters and warm summers while the eastern sides of the continents (eastern North America and eastern Asia) share cold winters and hot summers. Species that were once part of the continuous Arcto-Tertiary Geoflora had the potential of producing a four-centered disjunct distribution if possessing a very wide ecological amplitude. However, many are found now in only two or three of the four areas as the result of a variety of reasons. These reasons include extinction from the stresses caused by the many glaciations of the Pleistocene and climatic preferences.

1. North American Disjuncts

a. Western North America-eastern North America (3%)

This is a small group of species which composes only 3% of the local lichen flora. It is made up of North American endemic species that are found in western North America (California to British Columbia or coastal Alaska) and also in eastern North America (especially around the Great Lakes). Some, including <u>Bryoria pikei, B. friabilis</u> (see Figure 64), and <u>Pertusaria borealis</u>, are much more common in the west while a few, like <u>Xanthoparmelia culberlandii</u> and <u>Cetraria orbata</u> (see Figure 65), are abundant in both the west and the east. <u>X. cumberlandii</u> is better described perhaps as pantemperate in North America.

This disjunction has been discussed extensively for phanerogams. Some explanations offered include the premise that the species evolved in west-





ern North America and subsequently migrated eastward during the maximum extent of glaciation or during the glacial retreat. They were isolated in the east by the increasing aridity in the center of the continent. Others envisioned a more northern and earlier origin for these species in the Arcto-Tertiary Geoflora as mentioned above. The differences in the climate of eastern and western North America partially explains the varying success in the two regions. However, why the species were totally exterminated in Eurasia (if part of the Arcto-Tertiary Geoflora) is not yet explained except by chance. The two explanations can be combined: although originally part of the Arcto-Tertiary Geoflora these species were either not continuouscircumpolar when the flora was displaced southward, or, if continuouscircumpolar then they were able to survive in only one of the four regions (western or eastern North America). During the Pleistocene these species were then able to spread east (or west).

Assuming a high degree of genetic homogeneity, resulting from the proponderance of vegetative reproduction, it would appear that the differing climate has produced the differing abundance in the east and west populations.

2. North America-Europe Disjuncts (18%)

a. Western North America-Europe (wNA-E)

The largest discontinuous element is the disjunction occurring between western North America and Europe. It composes 11% of the local lichen flora. This agrees with the large number of bryophytes that also share this disjunction. In the lichens there is a good possibility that this disjunction, or at least a portion of it, results from Europe being the cradle of lichenology and still continuing to play a dominant role. Most of the modern floras (e.g. Poelt, 1969; Poelt & Vézda, 1977, 1981; Duncan, 1970; Ozenda & Clauzade, 1970) as well as many of the continental monographs available are European. These serve as a basis for determination of extra-European specimens, and thus probably place a heavy bias on this disjunction. Many of these species may eventually be found elsewhere.

The western North America-Europe disjuction is heterogeneous, being made up of at least three separate groups, and perhaps more. One group shows a more southern and coastal distribution in western North America, being concentrated in California and sometimes occurring northward in a narrow belt as far north as southern British Columbia. It has many similarities with the California group of the western North American endemics. In Europe this element is found concentrated around the Mediterranean Sea, sometimes quite extensively or occasionally restricted especially to its western edge. Examples of species that show this distribution are <u>Leptogium</u> <u>furfuraceum</u>, <u>Lecidella subincongrua</u> var. <u>elaeochromoides</u> (see Figure 66), <u>Thelomma mammosum</u> (see Figure 67), and <u>Koerberia sonomensis</u>. The first two are abundant in both North America and Europe while the last two are common in North America but rare and restricted in their distribution in Europe.

Stebbins and Day (1967) have theorized in a study of phanerogams with similar disjunctions that in at least one case a common ancestor "spread from the Old World to the New by means of a Bering Strait 'land bridge' sometime not more recent than the beiginning of the Miocene" (Stott, 1981). with subsequent evolution of the species pair and loss of intervening populations with climatic deterioration. On the other hand, Kärnefelt (1980), following Axelrod (1975), has suggested lichen species that occur in western North America and again in Macaronesia or West Mediterranea are "part of an older and much larger continuously distributed Madrean-Tethyan element" that was part of an ancient sclerophyllous phanerogam flora that existed around the forerunner of the Mediterranean Sea (= Tethyan Sea) and



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across southern North America when the continents were much closer.

Raven (1971) did not accept that direct migration between Mediterranean regions, especially via the Bering Strait, was ever possible, since arid and semi-arid regions are thought to currently be at their maximum extent, and indeed, such migrations have never occurred since the regions involved have a proponderantly different flora. Raven (op. cit.) preferred to explain Meditarranean disjuncts by long-distance chance dispersal although also pointing out that many Mediterranean disjuncts are actually accidental human introductions. This included the phanerogam Plantago ovata-P. fastigiata species pair used as an example in Stebbins and Day (1967) which some authors consider as synonymous. It is not difficult to see how lichens may have been introduced accidentally between two regions with such close historical ties during trading or supplying of agricultural stocks, food, specialty building supplies, etc. Examples of accidental lichen introductions between other regions include Physcia millegrana which was probably introduced into California from the eastern United States on shade tree stock in the 1800's (Thomson, 1963), Leprocaulon microscopicum into Australia from Europe on ballast rock of ships (Lamb & Ward, 1974), and some eighteen different species into Greenland from Denmark on timber (Alstrup, 1977). Ahti (1977), although noting lichens do not have "the weedy flora" developed as well as in phanerogams, reported several anthropochorous lichen species in boreal Fennoscandia.

A second group that shares the western North America-Europe disjunction includes species that are much more widespread in western North America than the first group, best described perhaps as montane, being well developed in the mountains away from the coast and penetrating further north and further east than the last group. In Europe this montane group is typically widespread and continental although it can also be rare and restricted to southwestern regions as in the last group. Examples of lichen species with this distribution are <u>Letharia vulpina</u>, <u>Cetraria merrilli</u>, <u>Bryoria fremontii</u>, and Neofuscelia verruculifera (see Figure 68).

This group is currently associated with western North American endemics of the interior-dry or montane subgroup which are theorized to have evolved from the Madro-Tertiary Geoflora in the southern part of North America. These species may, therefore, have a migrational history similar to the Mediterranean group which also has Madro-Tertiary Geoflora affinities. There is the possibility that, although currently associated with many species that have strong Madro-Tertiary ties, this montane group originated elsewhere , (montane sections of the Arcto-Tertiary Geoflora) and eventually became associated with the former.

A third group of western North America-Europe disjuncts are oceanicboreal species that occur in North America, in the very humid coastal strip extending from northern California to southern Alaska or sometimes extending along the Aleutian Islands. In Europe these species occur throughout much of coastal Scandinavia and oceanic parts of central Europe, but avoid the Mediterranean region. It is not a large group because the hyperoceanic element does not grow well in the rain-shadow of the study area, and because there are very close connections of this element with eastern North America. Since these connections are expressed in lichens usually at the same species level, a wNA-eNA-E disjunction is much more common among distinctly oceanicboreal subgroups. A good example of this western North America-Europe disjunction among lichens is <u>Cladina portentosa</u>. The very closely related species <u>C. terrae-novae</u> is present in eastern North America. This group of wNA-E disjuncts appear to have arisen from the selection of climate on remnants of the Arcto-Tertiary Geoflora.



Figure 68. World distribution of <u>Neofuscelia verruculifera</u>, an example of western North America-Europe (plus North Africa-Asia Minor) disjunction. From Esslinger (1977) with additions from Kopaczevskaja et al. (1971). **O** = exact locality unknown

b. Western North America-eastern North America-Europe (wNA-eNA-E)

A strong relationship exists between lichens from western North America, eastern North America, and Europe. It constitutes 7% of the local lichen flora. Some species, including Melanelia glabratula and Platismatia glauca, are abundant in all three regions and in the first case is almost panboreal-temperate in North America. Others, like Alectoria sarmentosa subsp. sarmentosa, while being well represented in all areas, is decidedly oceanic. Several species are rare in eastern North America but common in western North America and fairly common in Europe. Some of these taxa were formerly considered absent in eastern North America and therefore interpreted as part of the wNA-E disjunction. Sticta limbata, Lecanora carpinea, Pertusaria stenhammari, and Umbilicaria polyrrhiza are rare in eastern North America and appear confined primarily to the southern part of the current boreal zone. Other species showing this disjunction have their eastern North American localities much further north in Greenland and are often rare in Europe, being found only in Scandinavia. Examples of lichen species with a wNA-eNA(Greenland)-E distribution include Rhizocarpon bolanderi, Lobaria hallii (see Figure 69), Leptochidium albociliatum, and Parmelia stictica.

Like the wNA-E disjunction, this element also arose from Arcto-Tertiary Geoflora stock, which, however, unlike the last was able to survive with varying success in eastern North America. Western North America is, climatically, much more similar to Europe than is eastern North America. If a species has a narrow ecological amplitude and thrives in western North America, it is likely to thrive in Europe, but not necessarily in eastern North America. The Greenland locality of eastern North America appears to represent a relictual population and in two of the four examples noted the species are relict also in unglaciated portions of Scandinavia, suggesting



Figure 69. World distribution of <u>Lobaria hallii</u>, an example of western North America-eastern North America-Europe disjunction. After Jordan (1973), Ahlner (1948), and Dahl (1950).

that these species survived the Pleistocene in these refugia and have not been able to expand their ranges in Europe or eastern North America since retreat of the glaciers, despite their apparent success in western North America. In western North America the distribution of <u>Rhizocarpon</u> <u>bolanderi</u> has its northern limit very close to the southern maximum of the glaciers.

3. North America-Asia Disjuncts

a. <u>Western North America-eastern North America-eastern Asia</u> (wNA-eNA-eA)

The disjunctions involving western North America and Asia which have been documented are few. Currently there are few species in the CDFD subzone lichen flora that show a disjunct distribution between western North America and Asia (and sometimes easterne North America). Just as the richer representation of the western North America-Europe disjunction results from extensive lichenological knowledge of Europe, undoubtedly some of the poor representation of western North America-eastern Asia disjuncts results from a lesser understanding of the lichens in both of these regions. Indeed, since the number is seemingly quite small, disjunctions involving just western North America and eastern Asia have been included in the continuous amphi-Pacific element. In the western North America-eastern North America-eastern Asia disjunction there are only two species (0.5% of the local flora). Both of these are relatively continuous between eastern Asia and western North America (essentially amphi-Pacific), and their presence in eastern North America is rare and restricted. Stereocaulon intermedium is known only from Newfoundland in the east and S. sasakii is known only from Minnesota and Michigan. (Possibly Pilophorus acicularis belongs in this element, since there is one anomalous collection from Ontario which, however, Jahns (1981) believed needs substantiation.)

4. North America-Europe-Asia Disjuncts

Most disjunctions that occur between the two northern continental areas occur between all four oceanic regions (western North Americaeastern North America-Europe-eastern Asia) rather than just the minimum three (western North America-Europe-eastern Asia).

a) Western North America-Europe-eastern Asia (wNA-E-eA)

The wNA-E-eA disjunction accounts for only 1.5% of the local flora. Although these tend to be restricted in Europe to Scandinavia or central to northern Europe, occurrences in eastern Asia are very scattered, from Siberia, Japan, and in one case Nepal. Locally some of the species displaying this disjunction are restricted to maritime sites (e.g...<u>liecania</u> <u>aipospila</u>, <u>Lecidea sulphurea</u>) but another is more typical of alpine environments (e.g. <u>Cornicularia normoerica</u>).

b) <u>Western North America-eastern North America-Europe-eastern Asia</u> (wNA-eNA-E-eA)

Species that occur in all four oceanic regions on either side of the northern continents make up 8% of the local flora. As stated earlier most of these species usually are not found in the interior, continental regions of North America or Asia although some have sporadic occurrences and are almost circumpolar. Some species are restricted to maritime locations and are sometimes treated as circumpolar, e.g. <u>Arthopyrenia halodytes</u> (see Figure 70). Others are not closely tied to the marine environment and actually penetrate very deeply into the continents, e.g. <u>Parmotrema</u> <u>arnoldii</u>, <u>Nephroma laevigatum</u>, <u>Menegazzia terebrata</u>, <u>Phylliscum demangeonii</u> and are fairly abundant in all their centers. Others are rare or restricted in some part of their range, especially eastern North America. For example, Peltigera membranacea is rare in eastern North America, Microcalicium sub-



Figure 70. World distribution of <u>Arthopyrenia halodytes</u>, an example of wNA-eNA-E-eA disjunction in the Northern Hemisphere due to maritime requirement, also described as "cosmopolitan, but absent in the tropics" (Harris, 1975). After Santesson (1939) and Harris (1975) with additions.

pedicellatum appears rare everywhere except for Europe, and <u>Cetraria</u> <u>chlorophylla</u> is rare in eastern North America and may be restricted to Greenland.

II. WITHIN BOTH THE NORTHERN AND SOUTHERN HEMISPHERE

A consideration of the local flora in light of their total world distribution shows that while most are confined to the Northern Hemisphere (62%) a remarkable proportion (38%) are found in both hemispheres. As this proportion results from only a cursory survey it could be much higher. Furthermore, many of the distributions of microlichens are poorly known in the Northern Hemisphere as well as the Southern Hemisphere. Species that are circumpolar in the Northern Hemisphere (circumarctic-alpine, circumboreal, circumtemperate, circumtropical) account for most (31%) of the 38%. Chances are high (63%) that if a species is circumpolar in the Northern Hemisphere, it occurs also in the Southern Hemisphere. On the other hand, species with discontinuous occurrences in the Northern Hemisphere make up only 6% of the 38%. Chances are much lower (19%) that a species disjunct in the Northern Hemisphere will occur also in the Southern Hemisphere.

Except for the circumtropical species, most species of this pattern in the Southern Hemisphere are absent in the tropics and hence have disjunct distributions between the two hemispheres. The species with bipolar distributions typically occur in New Zealand, Australia, South America (Chile and Argentina) but not in the southern tip of Africa. Occurrences in Africa are infrequent and when present are more likely to occur in the mountains of the east-central part of the continent (e.g. <u>Parmelia stictica</u>, <u>Trapelia involuta</u>, <u>Xanthoria fallax</u>, and Parmelia flaventior).

Examples of lichens with bipolar distributions may be seen in some of the maps given in Section I (see Figures 49, 50, 52, 70).

One bipolar lichen disjunction is postulated to have an anthropogenic cause. Lamb and Ward (1974) suggest that the saxicolous <u>Leprocaulon microscopicum</u> was introduced into Australia from Europe on the ballast rock of ships. Most bipolar distributions, however, do not appear to have been caused by man.

Among the bipolar cryptogams, the Northern Hemisphere is typically assumed to be the source region of most species with subsequent spread to the Southern Hemisphere. Species are typically circumpolar in the Northern Hemisphere (or with several disjunct regions) with one or more occurrences in the Southern Hemisphere. Within one group of hepatics, locations in the Southern Hemisphere are few and scattered and therefore "are clearly holarctic-derived" (Schuster, 1969).

Schofield (1974) believed the New Zealand disjunction involving bipolar bryophytes is difficult to explain by anything but long-distance dispersal despite the very long distances involved. Since the species involved are morphologically and ecologically more or less identical with the Northern Hemisphere's populations he suggested the disjunction may be of quite recent origin, since or during the Pleistocene. Du Rietz (1940) disputed that long-distance dispersal can be used to explain most instances of bipolar distributions. In connection with bipolar South American disjuncts Schofield (op. cit.) has pointed out that, as most bipolar bryophytes have achieved a circumpolar distribution in the Northern Hemisphere, which is the bulk of their present distribution, "since the final retreat of the Pleistocene glaciers, it is reasonable to speculate that they could have expanded their ranges southward in mountains during

the glaciations as well as immediately following them". A continuation southward is possible by 'mountain hopping' through Central America and then along the Andean axis to the southern regions of South America.

Schuster (1969) pointed out that bipolar ranges were not common in the Hepaticae and that the few that occurred, being at the species level, suggested that the disjunctions were relatively recent. He believed that the "Cordilleran and Australasian axes seem to have been of major and general significance as migration routes, both north and south, for relatively modern (and relatively motile taxa)".

In phanerogams the generic and species level ties with the Southern Hemisphere are higher than among the Hepaticae. Moore (1972) pointed out that there is also a difference between bipolar and disjunctions of East and West Hemispheres at the generic level, or below. New Zealand was noted as having less than 10% of its genera found in the Northern Hemisphere while Tierra del Fuego has 35% of its genera in common with the Northern Hemisphere.

As well as discounting long-distance dispersal to explain most bipolar disjunctions, Du Rietz also discounted the obvious and current mountain chains along the western edge of the New World and eastern edge of the Old World. Du Rietz (1940) stated:

"The present transtropical highland bridges are not continuous enough to account for the actual facts of bipolar plant distribution and of other phytogeographical connections between the temperate floras of tropical mountains and those of boreal and austral regions, neither in Central America nor in Africa, nor in Malaysia...".

Instead Du Rietz favoured the idea of "a more continuous distribution of temperate vegetation across the tropics during some earlier period in the history of the globe" which he suggested could have been on "epeirogenetic transtropical highland bridges older than the mountain chains of the

Alpine Orogen. Such highland bridges may have existed not only in Africa, but also bordering the transtropical Alpine geosynclines (i.e. the Andean and Malaysian geosynclines), partly passing over present deep sea bottom".

On the other hand, it has been suggested that the distributions of most bipolar lichen species, and definitely the genera, are not the result of migration from the Northern Hemisphere to the Southern Hemisphere in most cases since the "basic similarities between the polar floras are too great" (Lindsay, 1977). Instead Lindsay (op. cit.) suggested that at least many of the generic units were present in Panagaean times and were present on each new continent that resulted when the mother continent broke up. Genera that arose after the split of Panagaea are much more prevalent in the hemipshere of their origin. Thus <u>Pseudocyphellaria</u> and <u>Placopsis</u> are richly represented and widespread in the Southern Hemiesphere while <u>Platismatia</u> and <u>Pilophorus</u> are predominantly. Northern Hemisphere genera These 'younger' genera are theorized to have utilized the "Andean mountain chain or the Malaysian-Papual link" (Lindsay, op. cit.) to spread to the opposite hemisphere where they are still poorly represented.

Among the phanerogams it is also suggested that the high degree of similarity of the flora of the Southern Hemisphere and the Northern Hemisphere at the family level points to a common derivation (perhaps in the tropics of southeast Asia). Their dissimilarity at the genus and species level indicates the separation of the two floras by the middle of the Cretaceous. There also have been more recent exchanges especially between North and South America although these continents were separated in the late Triassic and reconnected by perhaps only the Eocene. Since the Cordillera were not uplifted until the beginning of the Miocene (with maximum height attained in the Pliocene) earlier exchanges would have to be via long-distance dispersal or "transtropical Tertiary uplands for which

there is little evidence" (Moore, 1972). Despite gaps in the mountain chains in the area of Central America, exchanges would have been favoured in the Pleistocene with the cooling temperatures and compression of vegetation zones despite the relatively short period of time and its recentness.

Raven (1963) believed that a number of vegetational groups show this North America-South America disjunction. He stated that the disjunction was relatively recent and probably arose exclusively from long-distance dispersal. Solbrig (1972b), on the other hand, in an examination of desert disjuncts, believed the bipolar disjunction has "been established over a long period of time" with "no one single explanation" possible.

CONCLUSIONS

The lichen flora of the Coastal Douglas-fir Dry Subzone, treated here, is based primarily on recent collections made throughout the area. A few collections also were made in the adjacent Wet Subzone and Coastal Western Hemlock Zone for comparative purposes. This resulted in a catalogued flora of 448 species in 114 genera, 422 of which are definitely known from the Dry Subzone. Keys are provided first to the genus level and then to the species level. Additionally, detailed and concise descriptions are presented plus information on substratum preferences, abundance within the subzone, and taxonomic problems are noted where applicable. Spore diagrams are provided for many of the crustose species, especially those with septate or muriform spores.

As a result of the present study one species new to science has already been published, <u>Gyalideopsis alnicola</u> Noble & Vězda, and several others are to be described in future publications. One new combination has already been made, <u>Catillaria columbiana</u> (Merr.) Noble, and two others <u>Lecanora ochrococca</u> (Nyl.) Noble and <u>Arthothelium macounii</u> (Merr.) Noble, are to be published in a forthcoming checklist of the lichens of the province. <u>Lecanora phaeobaea</u> Tuck. has proved to be synonymous with <u>Lecanora ochrococca</u>, and <u>Solenospora</u> hassei (Zahlbr.) Zahlbr. with <u>Lecania dudleyi</u> Herre.

Specimens were also submitted to specialists that resulted in, or contributed to, the publication of two new species, <u>Collema fecundum</u> Degel. and <u>Pannaria maritima</u> P. M. Jørg., and two new combinations, <u>Cladonia verruculosa</u> (Vain.) Ahti and <u>Pyrenula occidentalis</u> (Harris) Harris ex Noble, ined. Several other species are still in the process of being described.

Ninety-six species new to Biritsh Columbia were encountered, primarily among the microlichens. Furthermore, several species listed in Otto and Ahti (1967) on the basis of voucherless reports have been confirmed as present in the province. Several of the species that are new to the province also appear to be new to North America. However, it is not practical to make an exact count of the number involved since the North American checklist (Hale & Culberson, 1970) is very outdated. Ten genera were added to the provincial checklist; these included <u>Gyalecta</u>, <u>Gyalidea</u>, <u>Gyalideopsis</u>, <u>Koerberia</u>, <u>Lichenothelia</u>, <u>Micarea</u>, <u>Phylliscum</u>, <u>Scoliciosporum</u>, <u>Staurothele</u>, and <u>Trapeliopsis</u>.

A first assessment of many taxonomic problems was made and others noted. Many genera contain small taxonomic problems and an attempt was made to resolve some of these difficulties. Leptogium californicum has been reported by many authors from the study area. However, examination of collections determined as this species and their comparison with <u>L</u>. <u>lichenoides</u> showed no distinct differences. Indeed a comparison of thallus size, lobe width and thickness, lobe surface and margins, and spore size and septation of the two taxa revealed a very broad overlap that is best characterized as a continuum. Although it is strongly felt that the two taxa are the same, further study of <u>L</u>. californicum from throughout its range is required before it can be reduced to synonymy. At the other extreme it was noted that the three species of <u>Buellia (B. punctata, B. turgescens</u>, and <u>B. badia</u>) that are sometimes considered as a single species with increasing thallus development are, indeed, very sharply delimited taxa.

Additional study was spent on several genera in which relatively limited numbers of species in temperate regions suggested that solutions of taxonomic problems would be possible. Examination of type specimens, i.e. in <u>Arthonia</u> and <u>Lecania</u>, yielded some refinements concerning the identity of the local taxa. However, since recent worldwide treatments in these genera are lacking, such solutions are only temporary. Of special interest were western North American endemics, species which were often poorly understood. Those described through the work of Herre and Hasse from California at the turn of the century and by Magnusson, particularly from Oregon and Washington, were of special interest. An examination of the types of Dermatocarpon heppioides, Caloplaca laeta, C. Bolacina, Lecania fructigena, L. dudleyi, and Arthonia polygramma confirmed the presence of these species in the study area. This extended their known ranges some 600 to 1,000 km northward. In the reverse direction, an examination of the type of Bacidia alaskensis, extended that species known distribution some 900 km to the south. Also of interest were five species described from material collected in the study area in the early 1900's by John Macoun and then, for the most part, completely overlooked by lichenologists. One of these, Catillaria columbiana, was found to be relatively widespread, occurring south to California; Caloplaca atrosanguinia and Phlyctis speiria are known also from Washington; Arthothelium macounii and Xylographa micrographa, however, are not known yet from outside the study area. The last species requires further study.

Often it was more expedient to confirm the identity of the local species through comparative material obtained on loan rather than to search for the type. In this manner <u>Bacidia herrei</u>, <u>Pertusaria chiodectonoides</u>, <u>Lecidella</u> <u>subincongrua var. elaeochromoides</u>, <u>Koerberia sonomensis</u>, <u>Arthonia intexta</u>, <u>Caloplaca arenaria</u>, <u>Leptogium platynum</u>, <u>Micarea peliocarpa</u>, and <u>Xantho</u>-<u>parmelia mougeotii</u> all were confirmed as present in the study area. Many of these records are extensions from California. Confirmation of still other species is required.

Several obviously distinctive taxa could not be determined to the species level. These are included in the flora as 'unknown' species, a category which also contains several unpublished species. Several genera, including <u>Aspicilia</u>, <u>Caloplaca</u>, <u>Lecidea</u>, <u>Usnea</u>, and <u>Verrucaria</u>, require major revisions on a world scale before the local species will be understood. Furthermore, chemical analyses of the local species will undoubtedly turn up further points of interest.

One of the difficulties continually faced in this study was the elusiveness of defining what constitutes a 'good' lichen species. Many of the taxa are capable of apparently endless gross variation and are commonly treated as falling within the bounds of a single species while, in other cases, very subtle variation is treated instead as the basis for delimiting two or more taxa. Indeed, the criteria used to designate taxonomic levels differs from genus to genus and sometimes even within a genus. Just as the characteristic morphology and anatomy must be learned separately for each genus, so also must the taxonomic criteria for evaluating and separating individual species be re-assessed.

Local distributions, inferred from collection site maps, are presented for representative species. Despite limiting the study to a single subzone, there are a number of patterns that can be recognized that reflect and the second frequency, < climate constraints, substratum restrictions, or human influences. Eight patterns were noted and discussed. Many species were widespread. These were distributed either throughout the CDFD subzone plus adjacent zones or were confined to the CDFD subzone. Oceanic distributions made up several very distinctive patterns including marine oceanic, strictly oceanic (non-marine), and hyperoceanic. Species with hyperoceanic distribution patterns penetrated the study area on its northern fringe, at higher elevations along its western boundary, and in high humidity microenvironments, again, primarily along its western boundary. Calcicoles exhibited a distribution pattern related to the presence or absence of the substratum to which they are restricted. An urban distribution pattern was

noted despite the near exclusion of this habitat from the present study.

An analysis of the world distributions of the species composing the local flora showed that the majority were very widespread with an essentially continuous range. In the Northern Hemisphere twelve different elements are recognized. The circumboreal element makes up the largest single element with 31% of the total assignable species. Other important elements include the western North American endemic element (18%), the circumtemperate element (12%), the western North America-Europe disjunct element (11%), and the western North America-eastern North America-Europe disjunct element (8%). Despite its relative proximity, eastern Asia has only minor affinities with the local flora although it is quite possible that this results from poor lichenological knowledge of both areas. A separate analysis showed that 38% of the species composing the local flora were also present in the Southern Hemisphere. The majority of bipolar species were found among species that showed circumpolar distributions in the Northern Hemisphere.

On the basis of what is theorized and known about other plant groups, it is suggested that the modern lichen flora of the CDFD subzone was present in western North America before the Pleistocene some 1,000,000 years ago. Many of these species were very widespread, probably with circumpolar distributions and probably of very ancient origins. Since the study area was totally covered by ice during the maximum extension of the glaciers, these species probably survived locally in Washington, south of the ice sheet, or for some species, even further south. It is also quite possible that hyperoceanic species persisted through the Pleistocene in coastal refugia in British Columbia, perhaps on the west coast of Vancouver Island. Following the retreat of the glaciers beginning about 13,000 years ago these species were able to expand northward into the study area again. Some continued to expand very aggressively from their many refugia and eventually re-established circumpolar distributions. Others, however, were not so successful. These species were left with fragments of their pre-glacial ranges and today are disjunct in two or several centers in the Northern Hemisphere, typically the temperate-oceanic margins of North America and Eurasia. During the Pleistocene the Cascade Mountains were formed and these apparently became an important pathway on their windward side for the movement of many species into the study area, including the Mediterranean-California types. For these groups the study area, with its summer-dry climate, is now their most northerly location in North America. At the same time the leeward side of the Cascades was an important pathway for xeric continental-montane species to first range northward and eventually enter the study area.

This treatment of the lichen flora of the Coastal Douglas-fir Dry Subzone, despite being lengthy, is not exhaustive. It is a preliminary flora that provides the foundation for future work and encourages others to look at these poorly known cryptogams.

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PART IV:

APPENDICES

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Appendix A. A checklist of the Lichens of the Coastal Douglas-fir Dry Subzone. Some species from the adjacent (sub-)zones on Vancouver Island that are included in the flora are also listed here; these are marked by an asterisk (*). Besides the 424 species listed below there are an additional 24 taxa identified only to genus.

Acarospora cfr. asahinae H. Magn.

<u>Acarospora fuscata</u> (Nyl.) Arn.

Acarospora macrospora (Hepp) Th. Fr.

<u>Alectoria sarmentosa</u> (Ach.) subsp. sarmentosa

Alectoria vancouverensis (Gyeln.) Gyeln. ex Brodo & D. Hawksw.

*Arthonia aspersa Leight.

Arthonia carneorufa Will.

Arthonia dispersa (Schrad.) Nyl.

*Arthonia intexta Almqu.

Arthonia lapidicola (Tayl.) Branth & Rostr.

Arthonia phaeobaea (Norm.) Norm.

Arthonia polygramma Nyl.

Arthonia radiata (Pers.) Ach.

Arthopyrenia antecellans (Nyl.) Arn.

Arthopyrenia biformis (Borr.) Mass.

Arthopyrenia cfr. carinthiaca J. Stein

Arthopyrenia halodytes (Nyl.) Arn.

Arthopyrenia padi Rabenh.

Arthopyrenia plumbaria (Stizenb.) R. C. Harris, ined.

Arthothelium ilicinum (Tayl.) P. James

Arthothelium macounii (Merr.) Noble, ined.

Arthothelium cfr. spectabile (Flot.) Mass.

Aspicilia caesioceinerea (Nyl. ex Malbr.) Arn.

Aspicilia cinerea (L.) Koerb.

<u>Aspicilia contorta</u> (Hoffm.) Kremp.

Aspicilia leprosescens (Sandst.) Hav.

Aspicilia melanaspis (Ach.) Poelt & Leuck.

[Lecanora cfr. sipeana H. Magn.]

Bacidia alaskensis (Nyl.) Zahlbr.

Bacidia arceutina (Ach.) Rehm & Arn.

Bacidia herrei Zahlbr.

Bacidia igniarii (Nyl.) Oxn. Bacidia inundata (Fr.) Koerb. Bacidia laurocerasi (Del. ex Duby) Zahlbr. Bacidia naegelii (Hepp) Zahlbr. Bacidia scopulicola (Nyl.) A. L. Sm. Bacidia sphaeroides auct. Baeomyces rufus (Huds.) Rebent. Bryoria capillaris (Ach.) Brodo & D. Hawksw. Bryoria fremontii (Tuck.) Brodo & D. Hawksw. Bryoria friabilis Brodo & D. Hawksw. Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw. Bryoria glabra (Mot.) Brodo & D. Hawksw. Bryoria oregana (Tuck. ex Nyl.) Brodo & D. Hawksw. Bryoria pikei Brodo & D. Hawksw. Bryoria tortuosa (Merr.) Brodo & D. Hawksw. Buellia alboatra (Hoffm.) Branth & Rostr. Buellia badia (Fr.) Mass. Buellia chlorophaea (Hepp ex Muell. Arg.) Lett. Buellia cfr. disciformis (Fr.) Mudd Buellia fosteri Imsh., nom. nud. Buellia lepidastroidea Imsh., nom. nud. Buellia penichra (Tuck.) Hasse. Buellia punctata (Hoffm.) Mass. Buellia stellulata (Tayl.) Mudd. Buellia turgescens Tuck. Buellia verruculosa (Sm.) Mudd Calicium abietinum Pers. *Calicium adaequatum Nyl. Calicium adspersum Pers. Calicium glaucellum Ach. *Calicium subquercinum Asah. Calicium viride Pers. Caloplaca arenaria (Pers.) Muell. Arg., non auct. Caloplaca atroflava (Turn.) Mong. Caloplaca atrosanguinia (Merr.) Lamb. Caloplaca bolacina (Tuck.) Herre

Caloplaca cerina (Ehrh. ex Hedw.) Th. Fr. Caloplaca chrysophthalma Degel. Caloplaca citrina (Hoffm.) Th. Fr. Caloplaca feracissima H. Magn. Caloplaca ferruginea (Huds.) Th. Fr. Caloplaca flavorubescens (Huds.) Laund. Caloplaca holocarpa (Hoffm.) Wade Caloplaca irrubescens (Nyl.) Zahlbr. Caloplaca laeta H. Magn. Caloplaca marina (Wedd.) Zahlbr. Caloplaca cfr. obliterans (Nyl.) Blomb. & Forss. Caloplaca oregona H. Magn. Caloplaca litoricola Brodo, ined. Caloplaca teicholyta (Ach.) J. Stein. Caloplaca verruculifera (Vain.) Zahlbr. Caloplaca vicaria H. Magn. Candelaria concolor (Dicks.) B. Stein Candelariella aurella (Hoffm.) Zahlbr. Candelariella cfr. efflorescens Harris & Buck Candelariella rosulans (Muell. Arg.) Zahlbr. Candelariella vitellina (Hoffm.) Muell. Arg. Catillaria chalybeia (Borr.) Mass. Catillaria columbiana (Merr.) Noble Catillaria graniformis (Hag.) Vain. Catillaria griffithii (Sm.) Malme *Cavernularia hultenii Degel. *Cavernularia lophyrea (Ach.) Degel. Cetraria canadensis (Räs.) Räs. Cetraria chlorophylla (Willd.) Vain. Cetraria hepatizon (Ach.) Vain. Cetraria merrillii Du Rietz Cetraria orbata (Nyl.) Fink Cetraria platyphylla Tuck. Cetrelia cetrarioides (Del. ex Duby) Culb. & C. Culb. *Chaenotheca brunneola (Ach.) Muell. Arg. *Chaenotheca chrysocephala (Turn. ex Ach.) Th. Fr.

Chaenotheca ferruginea (Turn. ex Sm.) Mig. Chrysothrix candelaris (L.) Laund. Chrysothrix chlorina (Ach.) Laund. <u>Cladina arbu</u>scula (Wallr.) Hale & Culb. <u>Cladina ciliata</u> (Stirt) Trass var. ciliata <u>Cladina ciliata</u> (Stirt.) Trass var. <u>tenui</u>s (Floerke) Ahti & Lai Cladina mitis (Sandst.) Hale & Culb. Cladina portentosa (Duf.) Follm. Cladina rangiferina (L.) Nyl. Cladonia asahinae Thoms. Cladonia bellidiflora (Ach.) Schaer. Cladonia carassensis Vain. Cladonia cariosa (Ach.) Spreng. Cladonia carneola (Fr.) Fr. <u>Cladonia cervicornis</u> (Ach.) Flot. subsp. <u>verticillata</u> (Hoffm.) Ahti. Cladonia coccifera (L.) Willd. Cladonia coniocraea (Floerke) Spreng. s. lat. Cladonia cornuta (L.) Hoffm. Cladonia ecmocyna Leight. Cladonia fimbriata (L.) Fr. <u>Cladonia gracilis</u> (L.) Willd. Cladonia herrei Fink ex Hedrick Cladonia macilenta Hoffm. Cladonia phyllophora Ehrh. ex Hoffm. Cladonia pyxidata (L.) Hoffm. Cladonia squamosa (Scop.) Hoffm. Cladonia subulata (L.) Wigg. Cladonia transcendens (Vain.) Vain. Cladonia uncialis (L.) Wigg. Cladonia verruculosa (Vain.) Ahti Collema fecundum Degel. Collema furfuraceum (Arn.) Du Rietz Collema nigrescens (Huds.) DC. Collema tuniforme (Ach.) Ach. Coniocybe furfuracea (L.) Ach.

Cornicularia aculeata (Schreb.) Ach. Cornicularia normoerica (Gunn.) Du Rietz Cyphelium inquinans (Sm.) Trev. Dermatocarpon heppioides Zahlbr. Dermatocarpon miniatum (L.) Mann Dermatocarpon reticulatum H. Magn. Dimerella lutea (Dicks.) Trev. Diploschistes bisporus (Bagl.) J. Stein. Diploschistes scruposus (Schreb.) Norm. Evernia prunastri (L.) Ach. Graphis scripta (L.) Ach. *Gyalecta jenensis (Batsch) Zahlbr. *Gyalidea hyalinescens (Nyl.) Vézda Gyalideopsis alnicola Noble & Vézda Haematomma lapponicum Ras. Huilia crustulata (Ach.) Hertel Huilia nigrocruenta (Anzi) Hertel Huilia soredizodes (Lamy) Hertel Huilia tuberculosa (Sm.) P. James Hypocenomyce anthracophila (Nyl.) P. James & G. Schneider Hypocenomyce friesii (Ach.) P. James & G. Schneider Hypocenomyce scalaris (Ach. ex Liljebl.) Choisy Hypogymnia imshaugii Krog Hypogymnia inactiva (Krog) Ohlsson Hypogymnia physodes (L.) Nyl. Hypogymnia tubulosa (Schaer.) Hav. Hypotrachyna sinuosa (Sm.) Hale Icmadophila ericetorum (L.) Zahlbr. Ionaspis odora (Ach.) Th. Fr. Koerberia sonomensis (Tuck.) Henss. Lecanactis megaspora (Merr.) Brodo *Lecanactis patellarioides (Nyl.) Vain. Lecania cfr. aipospila Th. Fr. Lecania cyrtella (Ach.) Th. Fr. Lecania dudleyi Herre Lecania erysibe (Ach.) Mudd

Lecania fructigena Zahlbr. Lecania nylanderiana Mass. Lecanora albescens (Hoffm.) Branth & Rostr. Lecanora atra (Huds.) Ach. Lecanora badia (Hoffm.) Ach. Lecanora cfr. campestris (Schaer.) Hue Lecanora carpinea (L.) Vain. Lecanora demissa (Flot.) Zahlbr. Lecanora dispersa (Pers.) Somm. Lecanora expallens Ach. Lecanora grantii H. Magn. *Lecanora intricata (Ach.) Ach. Lecanora muralis (Schreb.) Rabenh. Lecanora ochrococca (Nyl.) Noble, ined. Lecanora pacifica Tuck. Lecanora polytropa (Ehrh.) Rabenh. Lecanora rupicola (L.) Zahlbr. [Lecidea scotopholis Tuck.] Lecanora straminea (Wahlenb.) Ach. Lecanora symmicta (Ach.) Ach. *Lecidea albofuscescens Nyl. Lecidea berengeriana (Mass.) Th. Fr. Lecidea botryosa (Fr.) Th. Fr. Lecidea cruciaria Tuck. Lecidea elabens Fr. Lecidea fusca (Schaer.) Th. Fr. Lecidea fuscoatra (L.) Ach. Lecidea granulosa (Hoffm.) Ach. Lecidea lapicida (Ach.) Ach. Lecidea mannii Tuck. Lecidea monticola Ach. Lecidea phaeops Nyl. Lecidea plana (Lahm.) Nyl. Lecidea cfr. protabacina Nyl. Lecidea sulphurea (Hoffm.) Wahlenb. Lecidea tessellata (Sm.) Floerke
Lecidea tessellata (Sm.) Floerke Lecidea uliginosa (Schrad.) Ach. Lecidella elaeochroma (Ach.) Choisy Lecidella scabra (Tayl.) Hertel & Leuck. Lecidella cfr. spitsbergensis (Lynge) Hertel & Leuck. Lecidella stigmatea (Ach.) Hertel & Leuck. Lecidella subincongrua Nyl. var. elaeochromoides (Nyl.) Hertel & Leuck. Lepraria incana (L.) Ach. Lepraria neglecta auct. Leprocaulon microscopicum (Vill. Gams ex D. Hawksw. Leprocaulon subalbicans (Lamb ex Imsh.) Lamb & Ward Leptochidium albociliatum (Desm.) Choisy Leptogium furfuraceum (Harm.) Sierk Leptogium lichenoides (L.) Zahlbr. Leptogium palmatum (Hedw.) Mont. Leptogium platynum (Tuck.) Herre Leptogium saturninum (Dicks.) Herre Leptogium sinuatum (Huds.) Mass. Leptogium tenuissimum (Dicks.) Fr. Leptogium teretiusculum (Floerke) Arn. Letharia vulpina (L.) Hue Lobaria hallii (Tuck.) Zahlbr. *Lobaria linita (Ach.) Rabenh. Lobaria oregana (Tuck.) Muell. Ar. Lobaria pulmonaria (L.) Hoffm. Lobaria scrobiculata (Scop.) DC. Lopadium pezizoideum (Ach.) Koerb. Massalongia carnosa (Dicks.) Koerb. Melanelia disjuncta (Erichs.) Essl. Melanelia exasperatula (Nyl.) Essl. Melanelia glabratula (Lamy) Essl. Melanelia panniformis (Nyl.) Essl. Melanelia multispora (Schneid.) Essl. Melanelia subolivacea (Nyl.) Essl. Menegazzia terebrata (Hoffm.) Mass. Micarea denigrata (Fr.) Hedl. Micarea globularis (Ach. ex Nyl.) Hedl.

Micarea cfr. lithinella (Nyl.) Hedl. Micarea peliocarpa (Anzi) Coppins & R. Sant. Micarea prasina Fr. Micarea sylvicola (Flot.) Vezda & V. Wirth Microcalicium subpedicellatum (Schaer.) Tibell Mycoblastus affinis (Schaer.) Schauer Mycoblastus sanguinarius (L.) Norm. Mycoblastus tornoensis (Nyl.) R. Anderson Neofuscelia verruculifera (Nyl.) Essl. Nephroma helveticum Ach. Nephroma laevigatum Ach. Nephroma resupinatum (L.) Ach. Normandina pulchella (Borr.) Nyl. Ochrolechia androgyna (Hoffm.) Arn. Ochrolechia farinacea Howard Ochrolechia laevigata (Räs.) Vers. Ochrolechia oregonensis H. Magn. Ochrolechia pallescens (L.) Mass. Ochrolechia tartarea (L.) Mass. Ochrolechia upsaliensis (L.) Mass. Opegrapha herbarum Mont. Opegrapha ochrocheila Nyl. Opegrapha pulicaris (Hoffm.) Schrad. Pannaria leucostictoides Ohlss. Pannaria maritima P. M. Jørg. Pannaria mediterranea C. Tav. Pannaria pezizoides (G. H. Web.) Trevis Pannaria saubinetii (Mont.) Nyl. Parmelia flaventior Stirt. Parmelia pseudosulcata Gyeln. Parmelia saxatilis (L.) Ach. Parmelia stictica (Duby) Nyl. Parmelia subrudecta Nyl. Parmelia sulcata Tayl. Parmeliopsis ambigua (Wulf.) Nyl. Parmeliopsis hyperopta (Ach.) Arn.

<u>Parmotrema arnoldii</u> (Du Rietz) Hale Peltigera aphthosa (L.) Willd.

Peltigera canina (L.) Willd.

Peltigera collina (Ach.) Schrad.

Peltigera degenii Gyeln.

Peltigera leucophlebia (Nyl.) Gyeln.

Peltigera membranacea (Ach.) Nyl.

Peltigera pacifica Vitik., ined.

Peltigera polydactyla (Neck.) Hoffm.

Peltigera rufescens (Weis.) Humb.

Peltigera spuria (Ach.) DC.

<u>Peltigera</u> <u>venosa</u> (L.) Baumg.

Pertusaria amara (Ach.) Nyl.

Pertusaria borealis Ericks.

Pertuaria chiodectonoides Bagl. ex Mass.

Pertusaria glaucomela (Tuck.) Nyl.

Pertusaria leucostoma (Bernh.) Mass.

Pertusaria ophthalmiza (Nyl.) Nyl.

Pertusaria stenhammari Helb.

Pertusaria subambigens Dibb.

*Phaeophyscia ciliata (Hoffm.) Moberg

Phaeophyscia orbicularis (Neck.) Moberg

Phylliscum demangeonii (Moug. & Mont.) Nyl.

Phlyctis argena (Ach.) Flot.

Phlyctis speirea Merr.

Physcia adscendens (Fr.) Oliv.

Physcia aipolia (Ehrh. ex Humb.) Fürnr.

Physcia caesia (Hoffm.) Fürnr.

Physcia cascadensis H. Magn.

Physcia dubia (Hoffm.) Lettau

Physcia tenella (Scop.) DC.

Physcia vainio Räs.

Physconia enteroxantha (Nyl.) Poelt

Physconia perisidiosa (Erichs.) Moberg

Pilophorous acicularis (Ach.) Th. Fr.

Placopsis gelida (L.) Lindsay

Placynthium nigrum (Huds.) Gray Platismatia glauca (L.) Culb. & C. Culb. Platismatia herrei (Imsh.) Culb. & C. Culb. *Platismatia lacunosa (Ach.) Culb. & C. Culb. *Platismatia norvegica (Lynge) Culb. & C. Culb. Platismatia stenophylla (Tuck.) Culb. & C. Culb. Polychidium muscicola (Sw.) Gray Polysporina simplex (Davies) Vezda Porina aenea (Wallr.) Zahlbr. Porina chlorotica (Ach.) Muell. Arg. *Porina guentheri (Flot.) Zahlbr. *<u>Protoblastenia in</u>crustans (DC.) J. Stein. Protoblastenia quernea (Dicks.) Clauz. ex Vězda Protoblastenia russula (Ach.) Rås. Pseudephebe pubescens (L.) Choisy Pseudocyphellaria anomala (Merr.) H. Magn, nom. nud. Pseudocyphellaria anthraspis (Ach.) H. Magn. Pseudocyphellaria crocata (L.) Vain. Psora nipponica (Zahlbr.) G. Schneider Psoroma hypnorum (Vahl) Gray Pyrenula occidentalis (Harris) Harris ex Noble <u>Ramalina</u> <u>dilace</u>rata (Hoffm.) Hoffm. Ramalina farinacea (L.) Ach. Ramalina menziesii Tayl. Ramalina subleptocarpha Rundel & Bowler Ramalina thrausta (Ach.) Nyl. Rhizocarpon bolanderi (Tuck.) Herre Rhizocarpon disporum (Naeg. ex Hepp) Muell. Arg. Rhizocarpon distinctum Th. Fr. *Rhizocarpon geographicum (L.) DC. Rhizocarpon grande (Floerke) Arn. Rhizocarpon hochstetteri (Koerb.) Vain. Rhizocarpon cfr. jemtlandicum Malme Rhizocarpon obscuratum (Ach.) Mass. *Rhizocarpon perlatum (Nyl.) Zahlbr. *Rhizocarpon riparium Räs.

Rhizocarpon sphaerosporum Räs.

Rhizocarpon viridiatrum (Wulf.) Koerb.

Rinodina archaea (Ach.) Arn.

Rinodina bolanderi H. Magn.

Rinodina confragosa (Ach.) Koerb.

Rinodina conradii Koerb.

Rinodina exigua (Ach.) Gray

Rinodina gennarii Bagl.

Rinodina hallii Tuck.

Rinodina marysvillensis H. Magn.

Rinodina verrucosa (Merr.) Shear, ined.

Rinodina willeyii Sheard, ined.

Sarcogyne regularis Koerb.

Scoliciosporum cfr. perpusillum Lahm ex Koerb.

Sphaerophorus globosus (Huds.) Vain.

Spilonema revertens Nyl.

Staurothele hazslinszkyi (Koerb.) J. Stein.

Stenocybe major Nyl. ex Koerb.

Stereocaulon intermedium (Sav.) H. Magn.

Stereocaulon sasakii Zahlbr.

Stereocaulon sterile (Sav.) Lamb ex Krog

Sticta fuliginosa (Dicks.) Ach.

Sticta limbata (Sm.) Ach.

<u>Sticta weigelii</u> (Isert ex Ach.) Vain.

Strangospora moriformis (Ach.) B. Stein

Thamnolia vermicularis (Sw.) Ach. ex Schaer. var. vermicularis

Thelomma mammosum (Hepp) Mass.

Thelomma occidentale (Harre) Tibell

Thelotrema lepadinum Ach.

Toninia ruginosa (Tuck.) Herre

Trapelia involuta (Tayl.) Hertel

<u>Trapeliopsis</u> <u>wallrothii</u> (Floerke ex Spreng) Hertel & G. Schneider Umbilicaria angulata Tuck.

ombritteatta angulada tack.

<u>Umbilicaria deusta</u> (L.) Baumg.

*<u>Umbilicaria havaasii</u> Llano

Umbilicaria phaea Tuck.

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Umbilicaria polyphylla (L.) Baumg.
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Umbilicaria polyrrhiza (L.) Ach.

Umbilicaria torrefacta (Lightf.) Schrad.

Usnea cavernosa Tuck.

Usnea filipendula Stirt.

Usnea florida (L.) Wigg.

Usnea fragilescens Hav. ex Lynge

Usnea fulvoreagens (Rås.) Mot. s. lat.

Usnea glabrata (Ach.) Vain.

Usnea glabrescens (Nyl. ex Vain.) Vain. s. lat.

Usnea inflata Del.

Usnea longissima Ach.

Usnea <u>scabiosa</u> Mot.

Usnea subfloridana Stirt.

Verrucaria cfr. floerkeana DT. & Sarnth.

Verrucaria fusconigrescens Nyl.

Verrucaria macrostoma Duf. ex DC.

*<u>Verrucaria margacea</u> (Wahlenb.) Wahlenb.

Verrucaria <u>maura</u> Wahlenb.

*Verrucaria cfr. <u>mucosa</u> Wahlenb.

*Verrucaria muralis Ach.

Verrucaria nigrescens Pers.

Verrucaria prominula Nyl.

Verrucaria tectorum (Mass.) Koerb.

Verrucaria viridula (Schrad.) Ach.

Xanthoparmelia cumberlandii (Gyeln.) Hale

Xanthoparmelia mougeotii (Schaer.) Hale

Xanthoria candelaria (L.) Th. Fr.

Xanthoria elegans (Link) Th. Fr.

Xanthoria fallax (Hepp) Arn.

Xanthoria polycarpa (Hoffm.) Rieb.

Xylographa abientina (Pers.) Zahlbr.

Xylographa vitiligo (Ach.) Laund.

Appendix B. Major collection sites with description, location, and specimen numbers.

Only major collection sites are listed. This includes sites where usually fifteen or more specimens were collected. For the most part presentation follows numerical order of the specimen numbers. Missing numbers are those of minor sites and collections taken from outside the study area. Out-of-sequence numbers represent later collections from the same site as earlier collections.

Lichens with calcareous substrata were collected from the following sites: 2, 3, 22, 32, 47, 51, 52, 54, 58, 59, 62, 65, 74, 106.



<u>SITE NO</u> .	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
1	1 - 16 915 - 957	48° 53'N 123° 20'W 15 m Whaler Bay, Galiano I. A. Open forest of <u>Pseudotsuga</u> B. Slightly sloped sandstone beach
2	17 - 37	48°52'N 123°21'W 10 m [°] Georgison Bay, Galiano I. <u>Alnus</u> thicket with <u>Acer</u> on higher ground; some outcrops
3	38 - 50 894 - 914	<pre>48° 54'N 123° 24'W 30-50 m Montague Harbour, Galiano I. A. Steep sandstone cliffs with Pseudotsuga; apple orchard at base B. Sandstone boulders beside ocean</pre>
4	101 - 135 137 - 141 142 - 221	 48° 46'N 123° 15'W 4-33 m N tip, South Pender I. A. <u>Thuja-Alnus</u> grove B. Rocks above ocean (conglomerate) C. <u>Acer</u> and <u>Salix</u> at base of hill passing into open <u>Pseudotsuga</u> forest with <u>Quercus</u> on exposed outcrops
5.	222 - 254	48° 45'N 123° 11'W 30 m SE tip, South Pender I., overlooking Camp Bay <u>Pseudotsuga</u> forest with many sandstone outcrops.
6A	255 - 291	48° 44'N 123° 11'W O-8 m Gowland Pt., South Pender I. Conglomerate beach; cliffs above covered in gorse and scrub <u>Quercus</u>
6B	292 - 310	48° 44' 30"N 123° 11'W 50 m Hill above Gowland Point, South Pender I. <u>Alnus</u> thicket at base; scattered <u>Quercus</u> and <u>Pseudotsuga</u> at top.
7A	311 - 339	48° 45'N 123° 12'W 60-80 m Hill above Bedwell Harbour, South Pender I. Disturbed hillsid-; <u>Pseudotsuga</u> regrowth
7B	340 - 387	48°45′30″N 123°13′W 100 m Spalding Rd. Hill, South Pender I. Rocky, reforested <u>Pseudotsuga</u> hillside
8A	388 - 412	48°46'N 123°16'W 6 m Murry Road, North Pender I. <u>Alnus</u> thicket

SITE NO.	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
8B	413 - 440	48° 46'N 123° 16'W 30 m Magic Lake, North Pender I. Rocky <u>Pseudotsuga</u> hillside
9	441 - 487	48°45'N 123°13'W 0-2 m Wallace Pt., North Pender I. Conglomerate-sandstone beach
10	488 - 512	48°46'30"N °123° 19'W 0-3 m Thieves Bay, North Pender I. Shore rock with <u>Alnus</u> and <u>Pseudotsuga</u> overhanging beach
11	513 - 545	48°46' 30"N 123°14'W 1-3 m Razor Pt., North Pender I. Conglomerate beach
12	546 - 604	48°17'30"N 123°16'W 40 m Bald Cone, North Pender I. Abandoned farm; reforested <u>Pseudotsuga</u> area with <u>Holodiscus</u>
13	605 - 640	48°48' 30"N 123°18'W 150 m Hill N of Hope Bay, North Pender I. Undisturbed stand of <u>Pseudotsuga</u>
14	641 - 674	48°48'N 123°18'30"W 0-5 m Otter Bay, North Pender I. Steep sandstone terrace beach
15	675 - 689	48°49'N 123°18'W 30 m Road into Clam Bay, North Pender I. Open stand of <u>Pseudotsug</u> a; <u>Alnus</u> thicket
16	690 - 714	48°'47' 30"N 123°17'W 100 m Between Hope and Otter Bay, North Pender I. Burnt hill with <u>Pseudotsuga</u> and <u>Arbutus</u> regrowth.
17	715 - 757	48°46'N 123°16'W 35 m Centennial Prior Prov. Park, North Pender I <u>Pseudotsuga-Arbutus</u> outcrop
18	761 - 819 6325 -6336	48° 52'N 123° 20'W 130 m Bluff Park, Galiano I. Steep, grassed hill with SE exposure
19	820 - 893	48°52'N 123°22'W 250-330 m Mt. Galiano, Galiano I. Scattered <u>Pseudotsuga-Quercus</u> groves, mostly grassed outcrops

<u>SITE NO</u> .	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
.	894 - 914	See Site 3
	915 - 957	See Site 1
20.	958 - 981	48° 56'N 123° 27'W 50 m 2 km S Quadra Hill, Galiano I. <u>Alnus</u> thicket
21	982 - 1007	48°56'N 123° 30'W 0-2 m Retreat Cove, Galiano I. Raised sandstone beach
22	1022 - 1035 1036 - 1067 1068 - 1082	48°58'N° 123°33'W O-40 m NE tip, Galiano I. A. Shaded dirt road B. Shoped, sandstone beach C. <u>Alnus</u> thicket
23	1083 - 1119	48°55'N 123°23'W O-5 m Galiano Way, Galiano I. Sloping sandstone beach with extensive moss mats leading up to <u>Pinus</u> above
24	1120 - 1144	48°53'N 123°23'W 130 m Hydro right-of-way, Galiano I. <u>Alnus</u> thicket leading up to sandstone cliffs
25	1145 -1201	48°49'N 123°23'W 10 m Glenthorne Pt., Prevost I. Conglomerate cliffs above ocean
26	1202 - 1248 1276 - 1285	48°50'N 123°22'W 30 m Central meadow, Prevost I. Farm meadow with scattered trees and small open cliff faces; <u>Crataegus</u> hedge, fenc- ing.
27	1249 - 1275	48°49'N 123° 21'W 1-2 m Divers Bay, Prevost I. Sandstone beach
	1276 - 1285	See Site 26
28	1286 - 1324	48°51'N 123°24'W O-10 m Peile Pt., Prevost I. Sandstone cliffs and beach
29	1325 - 1339	48°48'N 123°08'W 12 m Russell Beach area, Saturna I. Old apple orchard

<u>SITE NO.</u>	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
30	1340 - 1370	48° 47'N 123° 03'W 0-2 m East Pt., Saturna I. Sandstone beach with open forest of <u>Pseudotsuga</u> behind
31	1371 - 1401	48°49'N 123°11'W O-3 m Winter Pt., Saturna I. Sandstone beach
32	1402 - 1447	48° 48'N 123° 10'W 210 m Mt. David, Saturna I. Logged <u>Pseudotsuga</u> slope, scattered <u>Quercus</u>
33	1455 - 1484	48° 47'N 123° 12'W O-2 m Boat Cover, Saturna I. Mudflat beach with sandstone boulders; shaded
34	1485 - 1529 1583 - 1591 1607 - 1621	48°46'N 123°10'W 330 m Mt. Warburton Pike, Saturna I. A. Very steep SE facing grass-rock slope; scattered trees B. Ecological Reserve; <u>Tsuga</u> C. Grass-sandstone outcrops
35	1529 - 1550 1551 - 1582	48°46'N 123°07'W 0-80 m Narvaez Bay, Saturna I. A. Logged; <u>Pseudotsuga</u> on ground B. Sandstone boulders along beach
	1583 - 1591	See Site 34
	1607 - 1621	See Site 34
36	1650 - 1688	48°49'N 123°15'W 0-2 m Horton Bay Rd., Mayne I. Sandstone beach
37	1689 - 1749	48°50'N 123°18'W 270 m Mt. Parke, Mayne I. <u>Pseudotsuga-Arbutus</u> outcrop
38	1750 - 1775	48° 53'N 123° 18'W 0-2 m Georgina Pt., Mayne I. Sandstone beach
39	1776 - 1827	48°52'N 123°18'W 150 m Campbell Hill, Mayne I. <u>Alnus</u> thicket at base passing into <u>Pseudotsuga-Arbutus</u> outcrop

<u>SITE NO</u> .	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
40	1825 - 1850	48°50'N 123°15'W 0-2 m Campbell Pt., Mayne I. Sandstone cliff and boulder beach
41	1851 - 1907 1908 - 1917	48°50'N 123°18'W 160 m 2nd hill, W side, Mayne I. A. <u>Pseudotsuga</u> <u>outcrop</u> with open areas B. <u>Alnus</u> thicket at base
42	1918 - 1960 7276 - 7285	48°50'N 123°20'W O-3 m Dinner Pt., Mayne I. Shaded, conglomerate boulder beach with overhaning <u>Holodiscus</u>
43	1966 - 1993	48° 50'N 123° 16'W 100 m Fernhill Hill, Mayne I. Logged hillside covered in <u>Rubus</u> vines, some untouched <u>Pseudotsuga</u>
44	1994 - 2007	48° 51'N 123° 20'W 0-2 m Miner's Bay, Mayne I. <u>Pseudotsuga</u> and <u>Acer glabrum</u> overhanging
45	2008 - 2051	'48° 47' 30"N 123° 31'W 0-3 m Burgoyne Bay, Saltspring I. Granite/conglomerate beach bordered by grass and occasional <u>Quercus</u>
46	2052 - 2099 2130 - 2152	48°46'N 123°25'W 120 m Reginald Hill, Saltspring I. Granitic outcrops with scattered <u>Pseudo-</u> <u>tsuga</u> and <u>Quercus</u>
47	21 <u>0</u> 0 - 2129	48°53'N 123°35'W 0-2 m Vesuvius Bay, Satlspring I. Sloping shale/sandstone beach
	2130 - 2152	See Site 46
48	2153 - 2167	48°47'N 123°25'W 60 m Stewart Rd., Saltspring I. <u>Alnus</u> thicket
49	2168 - 2192 2196 - 2216 5467 - 5523 6422 - 6438 7355 - 7364	 48° 48'N 123° 31'W 430-630 m Mt. Maxwell Prov. Pk., Saltspring I. A. Outcrops beside road with <u>Pseudotsuga</u> B. SE exposed conglomerate outcrop at summit
	2217 - 2223	C. Alnus thicket

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<u>SITE NO</u> .	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
50	2224 - 2254	48° 55'N 123° 32'W 0-4 m Fernwood Pt., Saltspring I. Old wooden wharf; shale beach with over- handing shrubs and trees
51 ,	2256 - 2317	48°48'N 123°25'W 0-15 m Yeo Pt., Saltspring I. Steep cliff of open <u>Pseudotsuga</u> and <u>Holo-</u> <u>discus; Alnus</u> at base; also beach site
52	2400 - 2433 2437 - 2480	49°36'N 124°50'W 0-10 m N tip of Denman I. A. Open stand of <u>Pseudotsuga</u> B. Near Henry Bay; conglomerate beach
53	2481 - 2533	49°29'N 124°41'W 15 m SE side, Denman I. <u>Pseudotsuga</u> -moss forest
54	2543 - 2573	49°32'30"N 124°48'W 100 m Switchback of main road, Denman I. Moss-covered sandstone cliff and boulders
55	2574 - 2614	49°29'30" N 124°42'30"W 0-2 m Gravelly Bay, Denman I. Conglomerate beach
56	2615 - 2652	49°34'N 124°27'W 0-3 m Komas Bluff, Denman I. Sandy beach with overhanging trees
57	2653 - 2686	49°33'N 124°48'W 66 m Center of Denman I, near fire tower Young stand of <u>Pseudotsuga</u> ; logged.
58	2687 - 2707	49°31'N 124° 38'W 0-3 m Tribune Bay, Hornby I. Sandstone beach
59	2708 - 2761	49° 31' 30"N 124° 36'W 0-5 m Helliwell Prov. Park, Hornby I. Conglomerate cliff beach with extensive grass meadows beyond fading into <u>Quercus</u> groves and finally <u>Pseudotsuga</u> forest
60	2762 - 2809	49° 30' 30"N 124° 41'W 100-200 m Mt. Geoffrey, Hornby I. Dirt road bordered by <u>Alnus</u> at base; top recently logged, some <u>Pseudotsuga</u> left cliff edge

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<u>SITE NO</u> .	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
61	2810 - 2832	49°33'N 124°41'30"W O-2 m Callishaw Pt., Hornby I. Sandstone beach bordered by <u>Pseudotsuga</u>
62	2833 - 2867 2901 - 2923	49° 12'N 123° 52'W 0-2 m Tinson Pt., Gabriola I. Sandstone beach
63	2865 - 2900	49°09'N 123°51'W 130 m 'Cormorant Cliffs', Gabriola I. Shaded conglomerate rocks
	2901 - 2923	See Site 62
64	2924 - 2964	49°10'N 123°48'W 100 m South-central Gabriola I. Old logging road with second growth of <u>Pseudotsuga</u>
65	2965 - 3001 3020 - 3049	49°08'N 123°47'W 0-100 m Percy Anchorage, Gabriola I. A. Narrow sandstone, boulder beach B. Cliffs of open, mixed <u>Acer, Arbutus</u> , and <u>Pseudotsuga</u>
66	3002 - 3017	49°09'N 123°46'W 5 m False Narrows, Gabriola I. Meadow with <u>Quercus</u> grove
	3020 - 3049	See Site 65
67	3050 - 3088	49°09'N 123°11'30"W 0-2 m Law Pt., Gabriola I. Sheltered, sandstone boulders
68	3089 - 3096	49°09'N 123° 41'W 15 m 2 km S of Silva Bay, Gabriola I. Thick moss mats overgrowing sandstone
69	3097 - 3116 4655 - 4697	48°58'N 123°45'W 500-630 m Mt. Prevost, near Duncan <u>Pseudotsuga-Holodiscus</u> beside road; <u>Tsuga- Pseudotsuga</u> forest; <u>Alnus</u> in seepage areas; disturbed especially at summit
70	3117 - 3144 3186 - 3201	49°00'N 123°40'W 80-150 m Moore Hill, Thetis I. A. <u>Pseudotsuga-Arbutus</u> beside road B. <u>Alnus</u> thicket; base of hill

<u>SITE NO</u> .	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
71	3145 - 3185	49°01'N 123°41'W 0-3 m Pilkey Pt., Thetis I. Sandstone beach
	3186 - 3201	See Site 70
72	3203 - 3223	49°01'N 123°41'W 30 m Near North Cove, Thetis I. Open forest of <u>Pseudotsuga</u>
73	3224 - 3266	48°58'N 123°41'W 0-2 m Blue Pt., Thetis I. Sandstone beach with overhanging trees
74	3267 - 3296	48°29'N 123°18'W 0-4 m Ashley Bay, Victoria Exposed igneous headland
75	3605 - 3674	48° 30'N 123° 20'W 60-150 m Mt. Douglas Park, Victoria Open <u>Pseudotsuga</u> forest; <u>Quercus</u> groves; rock outcrops towards top
76	3675 - 3713	48° 32'N 123° 28'W 35 m 'Turner's Farm', N of Cordova Bay, Saanich Old farm; <u>Crataegus</u> hedge; outcrop area with open <u>Pseudotsuga</u> forest
77	3720 - 3747 3748 - 3759 3760 - 3778	48°41'N 123°25'W 100 m N end of Saanich Peninsula A. <u>Abies</u> forest B. <u>Alnus</u> thicket C. Shale outcrop beside road
78	3779 - 3806 3864 - 3881	48°36'N 123°29'W 0-3 m Henderson Pt., Saanich Peninsula Granitic beach with overhanging trees
79	3807 - 3863	48°31'N 123°25'W 200 m Observatory Hill, Saanich Peninsula NE slope of <u>Pseudotsuga, Quercus, Holo- discus</u> , and moss
	3864 - 3881	See Site 78
80	3882 - 3946	48°37'N 123°27'W 300 m Mt. Newton, Saanich Peninsula Open forest of <u>Pseudotsuga</u> ; <u>Quercus</u> out- crop
81	3947 - 3982	48°41' 30"N 123°24'W 0-3 m Swartz Head, Saanich Peninsula Shale beach

<u>SITE NO.</u>	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
82	3983 - 4022	48°31'N 123°29'W 165 m Partridge Hills, Highlands <u>Arbutus-Pseudotsuga</u> outcrop; previously logged
83	4023 - 4038	48° 31'N 123° 30'W 160 m Central part of Highlands <u>Alnus-Polystichum</u> thicket
84	4039 - 4061	48° 30'N 123° 30' 30"W 180 m Munns Rd. X Lone Tree Hill Rd., Highlands Open <u>Pseudotsuga</u> forest
85	4062 - 4122	48°31'N 123°31'W 360 m Lone Tree Hill, Highlands Mainly moss-rock outcrops, some groves of <u>Quercus</u> and <u>Pseudotsuga</u>
86	4123 - 4167	48° 29'N 123° 32'W 300 m Mt. Finlayson, Goldstream Prov. Park Lower slopes with <u>Alnus</u> , <u>Thuja</u> , <u>Acer</u> , passing into <u>Pseudotsuga</u> and finally open outcrops with some <u>Quercus</u>
87	4168 - 4193 4236 - 4256	48°23'N 123°30'W 0-3 m Cove at end of Pamir Rd., Albert Head, Metchosin Igneous beach
88	4194 - 4235	48°24'N 123°31'W 200 m Mt. Metchosin, Metchosin <u>Pseudotsuga-Quercus</u> outcrop
	4236 - 4256	See Site 87
89	4257 - 4331	48°20'N 123°41'W 0-100 m East Sooke Park, East Sooke Igneous beach through <u>Alnus</u> thickets to <u>Pseudotsuga</u> forest (some <u>Blechnum</u> <u>spicant</u>)
90	4332 - 4390	48°35'N 123°34'W 400 m Spectacle Lake Prov. Park, Malahat Mixed <u>Pinus-Pseudotsuga</u> forest, some outcrops
91	4391 - 4420	48°38'N 123°36'W 250 m Old Baldy Mt., Shawnigan Lake <u>Alnus</u> in drainage areas passing into <u>Arbutus-Pseudotsuga</u> forest

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<u>SITE NO.</u>	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
92 、	4421 - 4432	48°41'N 123°37'W 330 m Cobble Hill, S of Duncan Burned and logged area; some <u>Arbutus</u> , <u>Pseudotsuga</u> , abundant <u>Cytisus</u>
93	4433 - 4475	48°23'N 123°57'W 0-5 m Sheringham Pt., E of Jordan River <u>Picea sitchensis</u> fringed beach
94	4476 - 4535	49°01'N 123°50'W 150 m Woodley Range, near Ladysmith Cliffs with shaded and open forest
95	4536 - 4564	49°03'N 123°46'W 0-2 m Mermaid Cove, N of Ladysmith Sandstone beach
96	4565 - 4621	48°21'N 123°33'W 40 m Pedder Bay, William Head, Metchosin Hillside of <u>Pseudotsuga</u> passing into old <u>Quercus</u> outcrop; disturbed
97	4622 - 4654	48°55'N 123°42'W O-2 m Bare Pt., Chemainus Exposed conglomerate beach
	4655 - 4697	See Site 69
98	4698 - 4757	48°50'N 123°36'W 500 m Maple Mt., Maple Bay Disturbed by logging; also SE facing igneous outcrop with <u>Quercus</u>
99	4759 - 4804	48°46'N 123°37'W 150-200 m Skinner Bluffs, Mt. Tzuhalum, near Duncan Mixed forest of <u>Pseudotsuga</u> , <u>Arbutus</u> , <u>Holodiscus</u> , some <u>Quercus</u> ; burned at one time; top with rock slides
100	4805 - 4846	48°46'N 123°35'W 0-3 m Genoa Bay, S of Maple Bay Sandstone-conglomerate beach with over- hanging <u>Thuja</u>
101	4847 - 4895	48°26'3-"N 123°43'W 120 m Sooke Pot Holes, Sooke R. Open areas of <u>Pinus</u> , <u>Pseudotsuga</u> , also <u>Vaccinium ovatum</u> ; frequent moss-covered outcrops

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<u>SITE NO.</u>	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
102	4900 - 4922	49°17'N 124°16'W 30 m Englishman River at Craig Rd., near Parksville Mixed <u>Alnus, Pseudotsuga, Thuja</u> beside river.
103	2923 - 4991	49°17'N 124°09'W 200-260 m Nanoose Hill, N of Nanaimo Scattered <u>Pseudotsuga</u> plus well developed <u>Quercus-Arbutus</u> outcrops
104	4992 - 5001	49°17'N 124°11'W 0-3 m Nankivell Pt., S of Parksville Igneous ocean rocks
105	5002 - 5030	49°15'N 124°34'W 1070-1170 m Mt. Cokely, near Port Alberni Mixed <u>Thuja, Tsuga</u> , and <u>Abies</u> without shrub layer
106	5031 - 5087	49°15'N 124°21'W 180 m Englishman River Prov. Park Mixed sites throughout park; <u>Pseudotsuga</u> , <u>Tsuga, Taxus</u> mixed with <u>Gaultheria</u> , <u>Pachistima</u> , Adiatum, and <u>Oplopanax</u>
107	5088 - 5129	49°17'N 124°20'W 260 m Little Mt., Parksville Open <u>Pseudotsuga</u> below passing into <u>Pinus</u> and <u>Arctostaphylos</u> <u>columbiana</u> ; also ex- posed SW facing conglomerat cliffs
108	5130 - 5168	49°13'N 123°58'W 100-140 m Departure Bay, Nanaimo Igneous outcrop with <u>Cytisus, Quercus</u> , and <u>Arbutus</u>
109	5169 - 5204	49°14'N 123°58'W 0-3 m Neck Pt., Nanaimo Igneous rock beach
110	5205 - 5248	49°19'N 124°33'W 150 m Little Qualicum Falls Prov. Park Along railroad tracks with <u>Pinus</u> , Pseudotsuga, <u>Arctostaphylos</u> columbiana
111	5249 - 5264	49°21'N 124°35'W 100 m Horn Lake Public Rd. Young growth of <u>Pinus, Arctostaphylos</u> uva-ursi, <u>A. columbiana</u> , some <u>Pseudotsuga</u>

<u>SITE NO</u> .	SPECIMEN NO.	SITE LOCATION AND DESCRIPTION
112	5265 - 5303	49° 37'N 125° 05'W 330 m Comox Lake, near Cumberland Shaded forest of <u>Tsuga</u> , <u>Thuja, Pseudotsuga</u> , <u>Pinus</u> ; logged on top
113	5304 - 5359	48° 25'N 123° 14' 30"W O-3 m Discovery Island near Victoria Igneous beach with grass headland, some <u>Arbutus, Pinus</u> , and <u>Pseudotsuga</u>
114	5360 - 5398	48° 31' 30"N 124° 27'W 0-2 m Botanical Beach, near Port Renfrew Sandstone beach fringed by <u>Picea sitchensis</u>
115	5399 - 5431	48° 31'N 124° 22'W 0-3 m Sombrio Beach, 14 km E of Port Renfrew Beach lined by <u>Picea sitchensis</u>
116	5433 - 5442	48° 34'N 124° 13'W 10 m 'Harris Creek Y', 8 km E of Port Renfrew Shaded, steep shale cliff
117	5443 - 5453	48° 35'N 124° 11'W 30 m San Juan River Bridge, 20 km E of Port Renfrew Shaded, phyllite-shist cliff
	5467 - 5523	See Site 49
118	5524 - 5552	48° 44'N 123° 29'W 500 m Mt. Taum, Saltspring I. Scattered <u>Pseudotsuga</u> at base; slope of grass-moss- <u>Arctostaphylos</u> <u>uva-ursi</u>
119	6071 - 6091	48°44'N 125°38'30"W 150 m Koksilah R., near Shawnigan L. <u>Alnus, Acer, Thuja</u> along river
	6325 - 6336	See Site 18
	6395 - 6417	See Site 89
	6422 - 6438	See Site 49
120	6439 - 6445	48°46'N 123°22'W 0-2 m Beaver Pt., Saltspring I. Sanstone/igneous beach
	7276 - 7285	See Site 42
	7355 - 7364	See Site 49

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<u>SITE NO</u> .	SPECIMEN NO.	 SITE LOCATION AND DESCRIPTION
121	7365 - 7373	49° 19'N 124° 18'W 0-3 m Parksville Community Center Park, Parksville Grassed playground with scattered, old <u>Pseudotsuga</u>

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