Keynote Address and Notes on Newfoundland Botanists

Contributions from the 15th Annual Meeting, St. John's, August, 1978

Edited by Guy Brassard

Canadian Botanical Association/L'Association Botanique du Canada

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KEYNOTE ADDRESS

AND

NOTES ON NEWFOUNDLAND BOTANISTS

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CANADIAN BOTANICAL ASSOCIATION

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Cover: Sarracenia purpurea L. (Pitcher-plant) - the provincial flower of Newfoundland. Drawn by A. Glen Ryan.

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INTRODUCTION

by

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CBA/ABC 78

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The 1978 Annual Meeting of the Canadian Botanical Association/l'Association Botanique du Canada, held from 13 to 17 August at Memorial University of Newfoundland, St. John's, had as its theme "The Subarctic". The plenary session took the form of a symposium on this theme, with the keynote address given by Dr. Teuvo Ahti, Department of Botany, University of Helsinki, Finland.

As his topic Dr. Ahti chose "Definition and Subdivision of the Subarctic: a Circumpolar View", and he presented a general review of the several conflicting definitions of "subarctic", concisely summarizing the various opinions, and giving the audience his own preference. Subsequently, we were presented with his reasons and given a thorough introduction to the vast region under consideration. It is important that this be done, as Dr. Ahti did, from a circumpolar point of view; too often in the past, insularity or parochiality has led to inconsistencies in definition of terms subsequently used widely both in the scientific and popular literature.

Thus, CBA/ABC-78 was privileged to hear first hand the views of one of the scientists most knowledgeable about the subarctic, no matter how it is defined. Dr. Ahti's previous experience in Newfoundland, which he first visited in 1956, and in other parts of Canada, and his extensive personal contacts with Canadian botanists, added an extra dimension to the meeting, both scientifically and socially. The CBA/ABC is pleased to publish here the text of Dr. Ahti's presentation so that it may benefit all who have an interest in the subarctic.

Several other aspects of the subarctic theme were developed by the three other participants in the symposium: Dr. A.W.H. Damman, University of Connecticut; Dr. H.C. Duthie, University of Waterloo; and Dr. J.C. Ritchie, University of Toronto. Their contributions have been or are being published elsewhere.

Those present at the plenary session will long remember the incidental comment near the close of the discussion that it might be difficult or impossible to rigidly define "subarctic" but one defintiely knows when one is standing on it!

Also included in this publication are contributions based on three informal talks presented during a visit by CBA/ABC-78 to Memorial University's Oxen Pond Botanic Park. These deal with the life and contributions to botany of three of Newfoundland's early botantists. It is interesting to note that the first, A.J.M. Bachelot de la Pylaie, only visited Newfoundland, the second, A.C. Waghorne, was born elsewhere but spent most of his adult life in Newfoundland, and the third, Agnes M. Ayre, was born and spent all her life in Newfoundland. All three have been rather poorly known, for a variety of reasons, and it is hoped that the short biographies presented here will help to rectify this.

DEFINITION AND SUBDIVISION OF THE SUBARCTIC:

A CIRCUMPOLAR VIEW

by

Teuvo Ahti

Botanical Museum

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Introduction

I am certainly not the first speaker in scientific meetings to discuss the definition and subdivision of the region on the globe called the Subarctic. For instance, in a UNESCO Symposium on the ecology of the subarctic regions in Helsinki in 1966 the West German geographer Joachim Blüthgen gave a summary of this problem (Blüthgen 1970), and more recently in the Circumpolar Conference on Northern Ecology in Ottawa in 1975 my countryman Ilmari Hustich outlined his concept of the Subarctic. In fact, the Subarctic is a word that is commonly applied especially in botanical, zoological, geographical and climatological research articles and textbooks, and even defined in many of them. In 1970 Doris Löve published a review of the history and use of the terms subarctic and subalpine, aiming at their international standard definition.

What is then the problem? It is in the application of the word Subarctic; it is still not consistently used with the same meaning all over the northern countries. To a very large extent the study of the definiton of the Subarctic is sheer nomenclature or semantics. But I am not going to confine myself to semantics but also outline some characteristic phytogeographical features of the terrestrial Subarctic.

The circumpolar boreal bioclimatic zonation in relation to vegetation geography is being actively studied by Sakari Tuhkanen, a Ph.D. student in the Dept. of Geography, University of Helsinki. He is actually my wife's student and I have received useful material for this paper from his unpublished manuscripts - as well as from my wife.

Our principal method has been to define the boreal and arctic zonation in North Europe (Ahti et al. 1968) and then try to test its validity in northern Asia and North America (HämetAhti et al. 1974, HämetAhti 1976). In Finland, A. Kalela (1958) originally distinguished seven zones between the Gulf of Finland and the Arctic Ocean, but we think that only five of them are circumpolar, the rest being caused by local topography. We feel that the same zones form a workable circumpolar pattern, but the indicator species and other diagnostic characters have not been clarified sufficiently yet.

Main delimitations of the Subarctic

The meaning of the word subarctic is, of course, 'almost arctic' or something which is 'below the Arctic'. I do not know who first used this term and it is not important in this connection. The term 'Arctic' is quite old and was known to Linnaeus, for instance. The Subarctic was probably first used by some geographer or climatologist, and it gained wide acceptance early in the 20th century.

We may start with this rough scheme of the major zones in the North: the arctic, boreal and temperate zones. Such units may be called biotic zones, vegetation zones, biomes, bioclimatic, ecogeographic, landscape zones, etc. What is the position of subarctic in this system? Let us now examine the commonest delimitations found in the literature.

1) Subarctic = boreal

This usage derives from the early zonation system of the European Alps, where below the treeless alpine zone a subalpine zone of coniferous forests was distinguished (and that was followed by a montane zone of broadleaved deciduous forests, etc.). The analogous formation (or actually an almost homologous formation) between the treeless arctic and the temperate deciduous forest was then called subarctic.

Especially A. Engler and other German students of floristic elements applied this term. In the sense of boreal the term is actually used e.g. in the American manual Geography of the Northlands edited by Kimble and Good (1955), and in the same sense it has been used by some Canadian botanists as well.

I think that most authors who have really worked in the boreal and arctic areas prefer a narrower definition, since especially the southern parts of the boreal zone have little in common with the arctic, at least in summertime.

2) Subarctic = forest-tundra

This usage has been advocated especially in Scandinavia, because there is a special kind of mountain birch forest formation at timberline traditionally called a subalpine zone, which is a narrow ecotone of the coniferous forest and the treeless alpine zone. Similarly, the ecotone of the boreal and arctic, the forest-tundra, with its mosaic of forest and tundra or very open woodland has been called subarctic (Hustich 1966). This is also the meaning that Löve (1970) wanted to standardize. The bad side of this definition is that expressions like 'a subarctic species' find no use, simply because there are then hardly any species which are essentially subarctic, i.e. confined to this ecotone. When this ecotone requires an adjectival term, I would rather recommend the term hemiarctic that was proposed for this purpose by Rousseau (1952), who worked on the Ungava-Labrador Peninsula. Incidentally, Rousseau was perhaps not quite orthodox in his practical application of the concept subarctic - neither were Marr (1948) Hare (1950) and others who worked in Labrador. Rousseau included some vertical zonation (patches of alpine outliers) in his horizontal zone hemiarctic in Labrador, which is due to the hilly terrain of that region.

3) Subarctic = the northern part of the boreal zone (south of the forest-tundra)

This usage has been adopted by some phytogeographers, e.g. Rousseau (1952), who thus distinguished a subarctic zone south of his hemiarctic zone. Another example is Sjörs (1963), who compared eastern Canada and northern Europe. However, the subarctic zone may be limited in two principal ways: if the boreal zone is divided into 4 subzones south of the hemiarctic forest-tundra, the Subarctic could be defined either as

a) = northern boreal subzone (like Sjörs 1963)
b) = northern + middle boreal subzone (= 'taiga' in the sense of Hustich 1949).

Both delimitations have advantages. For instance, in Northern Europe the arctic lichen Nephroma arcticum has its limit of abundance at the limit of the northern boreal zone, while another indicator-plant, Empetrum nigrum ssp. hermaphroditum, has its main front at the limit of the middle boreal forest (Kujala 1964).

I would prefer the limit of the northern boreal forest, which is a southern boundary of numerous arctic features and features which are very commonly called subarctic. Hare and Ritchie (1972) called it the Northern Forest Line.

4) Subarctic = hemiarctic + northern boreal

In Rousseau's scheme there is the disadvantage that forest-tundra, the hemiarctic, is not subarctic. If we combine the forest-tundra ecotone and the northern boreal zone, we get an entity which is just below the arctic, which is not too narrow an ecotone and which in fact seems closest to what almost all botanists want to include in the Subarctic, especially when they are not delimiting any ecological zone but are applying the term more loosely to some special plant species, plant community type or an ecological feature.

5) Subarctic = hemiarctic + southern arctic (low-arctic)

Have you ever come across the expression 'subarctic tundra'? You will if you read Russian literature. This is because it is a widespread practice in the Soviet Union to call the low-arctic tundras - those with continuous vegetation carpet - subarctic, while the real arctic is only what could be called middle and northern or high-arctic tundras. A well-known geographic handbook in the Soviet Union by Grigorev (1956) titled 'Subarktika' has this delimitation and it was also used by Aleksandrova (1977) in her recent summary of the Soviet Arctic phytogeography. Surprisingly, Blüthgen (1970) prefers that kind of delimitation, too. In accordance with Grigorev he adopts the term paraboreal for the forest-tundra and pararctic for the low-arctic.

In my articles I have avoided using the term subarctic because it has been adopted in so many different ways in different areas. However, I have used it to some extent with a very loose meaning. Now, if the term Subarctic is adopted, I find it most useful in the sense number 4, i.e. subarctic = hemiarctic + northern boreal or forest-tundra ecotone + open boreal forest, to use Hare's (1950) denominations. A subarctic feature is then one which is essentially concentrated in this particular geographic, circumpolar region, though may be found, to a lesser degree, even outside of it.

Some characteristic features of the Subarctic

How does one recognize the Subarctic? There are numerous methods and indicators which can be applied. It is uncertain, however, whether we can use any single indicator. If we find a useful one, especially a climatic value, we are usually restricted by the fact that there are extremely few meteorological stations in operation in the Subarctic. In mountainous regions in particular, where substantial variations occur within a few kilometers, the existing meteorological records may be of little help.

1) General physiognomy

When a layman enters the Subarctic from the north or down a mountain, he can easily recognize the limit of the Subarctic, because of the woodland that is absent from the true Arctic, except in the exceptional cases when the Subarctic is completely or essentially treeless, which I will treat later. But when he enters the Subarctic coming from the next zone in the south, the middle boreal zone or the main boreal forest or the close-forest zone or whatever it is called, he may find it more difficult to recognize the boundary. An experienced geobotanist, however, usually does notice the change.

In general physiognomy it is the openness of the Subarctic forest that is emphasized in the Canadian literature (e.g. Hare 1950). The open forest particularly means lichen woodland, i.e. woodlands where lichens of the genus Cladina (or Cladonia subgenus Cladina) or Stereocaulon are dominant in the ground layer. However, such woodlands may also be extensive south of the Subarctic, especially on sandy glacial drifts and Precambrian rock outcrops. The immense drift-covered Lake Plateau of Labrador-Ungava is usually regarded as a typical example of the open subarctic woodland zone (Hare 1959). It is true that similar abundance of open lichen woodlands occur elsewhere in the Subarctic, but I would still rather emphasize how exceptional Labrador-Ungava is from a circumpolar view. The dominance of lichen woodlands there must be due essentially to appropriate soil conditions.

I would rather point out the following characters in this respect:

- The relative openness of the mesic (moist) forest in the Subarctic in addition to the dry forests. From a Finnish point of view the subarctic forest is excellent terrain for sports such as cross-country skiing and orienteering, even in Canada, where the boreal forest trees generally grow more densely than in Eurasia.
- The subarctic lichen woodlands are dominated by spruce trees, in Canada either the black spruce or - more rarely - the white spruce. This seems to be a real subarctic feature. I have no definite data on the occurrence of extensive and well-developed, permanent spruce-lichen woodlands in the more southern boreal forests. In Scandinavia and Finland and most of the European Russia there are no real spruce-lichen woodlands at all, only pine-lichen woodlands. In subarctic Russia and Siberia spruce-lichen woodlands do occur, and larch-lichen woodlands are also common. Other trees found in the subarctic lichen woodlands of Canada include larch as well as the jack pine, of course, and more locally the lodgepole pine the northwest.
- The lichen woodlands in the subarctic zone may develop even on unsorted till in addition to pure sands; this hardly happens south of the Subarctic. The abundance of lichens on thinly wooded outcrops, on hummocks of raised bogs, on burnt peatlands (open or wooded) etc. is not a special subarctic feature but also occurs elsewhere in the boreal zone if the humidity and soil conditions permit.

2) Indicator species of the Subarctic

The limits of the ranges of plant species are commonly applied as indicators of zonal boundaries. The southern boundary of the Subarctic may be characterized with numerous species (Table 1):

- species whose southern limit coincides with the limit of the Subarctic (phanerogams, lichens, mosses); hypoarctic species of Yurtzev (1966)
- species whose northern limit coincides with the limit of the Subarctic (boreal-temperate species, including many weedy aliens, widespread in Eurasia and North America).

The first list includes many circumpolar taxa, while in the latter list there are mainly species with more restricted ranges or they have been brought to North America by man.

3) Climatic features

I have gathered some climatic features which show the variation found within the Subarctic. It would be nice to have some threshold values to indicate when a locality is biologically in the Subarctic. It is possible in a rough way, but it is necessary to observe bioindicators in addition to meteorological indicators. Certain climatic values, e.g. those of the winter time, are much less important than others. Ritchie (1962) defined his subarctic zone in Manitoba very clearly: "That area in Manitoba characterized by a climate whose growing season does not exceed 650 degree-days°C and whose mean July temperature does not exceed 14°C and by a vegetation which is primarily an open coniferous forest or a mixture of forest and tundra".

This definition is actually very close to what I would like to call subarctic. These threshold values presumably also work well within large areas of slightly continental areas of subarctic North America and Eurasia.

Instead of dealing with the degree-days, I would like you to consider a rough table (Table 2) of the variation of the effective temperature where degrees of temperature above a monthly mean of 5°C have been calculated. It shows that different threshold values must be used in oceanic and continental regions of the boreal zone. The values also show considerable geographical overlap.

Another table (Table 3) shows the variation of the length of the growing season in the various boreal subzones. It shows the same kind of overlapping.

There are many sources of error in the interpretation of these figures based on meteorological records. Incidentally, a good rule of thumb for the minimum growing season required for trees is 100 days (80 days recorded for Larix gmelinii for Siberia is exceptional).

Another known rule of thumb is that the 10°C isotherm of the warmest month indicates the timberline. In fact, in eastern Canada 11°C is closer, in the interior of Canada 12°C and in parts of Siberia 12.5°C, but locally also values slightly less than 10°C have been recorded. All this variation is easily explained by the existence of different tree species at timberline. Not even all populations of one tree species can have the same ecological requirements.

I would also like to show you the average threshold values of the potential evapotranspiration (PE; Table 4). Annual potential evapotranspiration proved to be in our circumpolar analysis the most reliable indicator of the vegetation zones. It even seems to work well in Alaska, which was regarded as problematic by Hare and Ritchie (1972). They adopted the values of mean annual net radiation, which seems to work well in most of Canada but not in Alaska.

4) Ecological responses of the plant species and communities

One of the simplest indicators is the habitat-choice of common forest plants. In northern Europe it is well known that certain species which are confined to bogs and other peatlands in the middle and southern parts of the boreal zone are also commonly present in non-paludified forests in the Subarctic. Good examples are the dwarf shrubs Ledum palustre and Vaccinium uliginosum and the mosses Dicranum undulatum (syn. D. bergeri) and Polytrichum strictum. The moss species certainly behave in the same way in North America, but I am not quite sure if Ledum groenlandicum or Vaccinium uliginosum s. lat. have the same habitat shift at the same boundary. This shift may actually be due to humidity differences rather than to strictly zonal, viz. thermal, differences.

The productivity of the subarctic forests has been especially studied in forestry. One example is the zonal decline of the growth of the Scots pine (Pinus sylvestris) in Finnish Lapland (Koivisto 1970). The zonal differences on the productivity of natural vegetation are roughly summarized by Bazilevich and Rodin (1971), and the IBP projects have produced numerous studies of similar nature.

In North America the subarctic forests are commonly called a zone of non-productive forest, which has commercial interest only locally. In northern Europe the subarctic forests have been utilized to a great extent, because better forests have not been available in sufficient amounts. Much of the subarctic forest does not produce saw timber at all, but can only provide pulp-wood and fuel, and because of poor stock-

TABLE 1

Arctic-subarctic plant species whose southern boundary closely follows the southern limit of the Subarctic (the northern boreal zone) in northern Europe

Agrostis mertensii
Phleum alpinum
Eriophorum scheuchzeri
E. russeolum
Luzula multiflora ssp. frigida
Salix glauca ssp. glauca
S. hastata
S. myrsinites
S. xerophila
Stellaria calycantha

Solorina crocea
Nephroma arcticum

Dicranum elongatum

Ranunculus lapponicus
R. hyperboreus
Epilobium hornemannii
E. alsinifolium
E. davuricum
Bartsia alpina
Pinguicula villosa
Saussurea alpina
Lycopodium calvatum ssp. monost.
Alnus incana ssp. kolaënsis

Baeomyces placophyllus
Cladonia stricta

Boreal-temperate plant species whose northern boundary closely follows the southern limit of the Subarctic (the northern boreal zone) in northern Europe

Dryopteris carthusiana
Calla palustris
Convallaria majalis
Platanthera bifolia
Salix aurita
S. cinerea
Alnus glutinosa
A. incana ssp. incana
Actaea spicata
Polygonum lapathifolium
Raphanus raphanistrum
Turritis glabra
Trifolium hybridum
T. spadiceum
Frangula alnus
Viola riviniana
Epilobium collinum
E. montanum

Physconia pulverulenta
Physcia tenella
Pseudevernia furfuracea

Circaea alpina
Pimpinella saxifraga
Peucedanum palustre
Pyrola chlorantha
Lysimachia vulgaris
Myosotis scorpioides
Mentha arvensis
Veronica officinalis
V. chamaedrys
Viburnum opulus
Knautia arvensis
Campanula patula
Lobelia dortmanna
Senecio vulgaris
Cirsium arvense
Sonchus arvensis

Xanthoparmelia conspersa
X. taractica
Bryoria simplicior

TABLE 2

Effective temperature (accumulation of degrees of temperature above a monthly mean of 5°C) in the subzones of the boreal zone (after Tuhkanen 1977).

Zone	North America		Eurasia		Range
	oceanic	contin.	oceanic	contin.	
Hemiboreal	40–48	43–55	34–40	50–60	40–55
Southern boreal	17–40	37–52	30–34	34–50	17–52
Middle boreal	(21)	28–38	15–30	28–40	15–41
Northern boreal (incl. hemiarctic)	10–20	16–30	14–24	12–30	10–30

TABLE 3

Duration of growing season (days above 5°C) in the subzones of the boreal zone (after Tuhkanen 1977).

Zone	North America		Eurasia		Range
	oceanic	contin.	oceanic	contin.	
Hemiboreal	220–236	165–178	200–230	162–175	160–236
Southern boreal	142–220	150–173	130–200	135–162	140–220
Middle boreal	130–142	123–150	120–170	120–140	115–170
Northern boreal (incl. hemiarctic)	120–130	92–136	120–142	82–122	82–142

TABLE 4

Potential evapotranspiration (PE)

Approximate circumpolar limiting values (after Tuhkanen 1977)

Zonal limit	PE mm
northern temperate/hemiboreal	560 mm
hemiboreal/southern boreal	510 mm
southern boreal/middle boreal	465 mm
middle boreal/northern boreal	420 mm
northern boreal/hemiarctic	350 mm
hemiarctic/arctic	320 mm

TABLE 5

Conrad's (1946) continentality index

$$C = \frac{1.7\ A}{\sin\ (\phi + 10°C)} - 14$$

A = annual temperature amplitude

ϕ = latitude

ing even clear-cutting yields little timber per area unit. In recent times, use has been made of more and more remote subarctic forest areas, and at the same time technical development has made possible logging operations and timber transportation under more difficult conditions. In northern Finland, for instance, subarctic forest stands are even fertilized and drained, and excessive regeneration of birch is killed with herbicides from aircraft. The profitability of such investments in the north is questioned by some economists, however, and their use is more restricted in the Subarctic than in the main boreal zone. The quality of the subarctic forests of much of northern Europe, however, may be better than over most of the Subarctic, because of the tree species and the long tradition of silvicultural measures. It may also be because northern Europe falls in the climatically optimal area in the Subarctic, that is, the climate is neither highly oceanic nor clearly continental.

5) Subarctic agriculture

A few words about subarctic agriculture. In North America there is very little true subarctic agriculture, though the Ontario-Quebec Clay Belt, the Peace River Country, the Mackenzie Valley and the Matanuska Valley in Alaska, for instance, are sometimes cited as examples of subarctic areas where farming is carried out. All of these areas are rather southern to middle boreal regions according to my present definition. However, in northern Scandinavia and Finland and perhaps in parts of the Soviet Union fairly extensive agriculture is widespread in subarctic conditions.

Because of poor climate and high production costs agriculture in Finnish Lapland, for instance, has a very narrow basis: almost the only source of farm income is milk. Therefore, mainly grasses are grown to produce hay - the main crop is timothy grass, since clover cannot be grown commercially in the Subarctic. The only grain crop is barley and the third important crop is potatoes. It must be added that in northern Europe farming is usually combined with forestry, fishing or the reindeer industry - unlike in Canada. Thus, although the agricultural potential of the Subarctic is actually very restricted, through careful and rational utilization it is still considerable. But immediately south of the Subarctic numerous crops, like rye, oats, red and alsike clover, and even wheat and strawberries, give commercially acceptable yields.

6) Soil conditions

The common subarctic soils include humo-ferric podzols, more locally brunisolic and commonly gleysolic soils. A very characteristic feature of the Subarctic is the occurrence of permafrost. It is present almost everywhere in the Subarctic, except in some coastal regions, but it is usually discontinuous. The southern limit of the discontinuous permafrost is often, but not always, close to the southern limit of the Subarctic. Central Siberia is a major exception to this rule, since there, permafrost extends far into the main boreal zone.

7) Phytosociological criteria

Phytosociology or the study of plant communities or actually their classification is a highly controversial subject. To those who believe that a rational classification of plant communities is possible I want to tell what we have found in Finland to be the most useful means of delimiting vegetation regions and the southern limit of the Subarctic in particular.

In the 1950's and 1960's especially, Aarno Kalela and his pupils made numerous vegetation records (relevés) of representative stands of mature forests of the main site types and peatlands throughout Finland and also in Norway (Kalela 1958). The sample plots were generally 100 m^2 in size and all the plants were carefully analyzed, especially including the mosses and lichens. Environmental parameters, including some chemical soil analyses, were also taken into account. A floristic-ecological site-type classification was made and the relevés were plotted on a map. After some 2000 forest plots were analyzed it turned out that the transitional areas between each region were surprisingly narrow, perhaps up to 50 km in completely flat country, but often only 25-30 km in width. In hilly or mountainous areas very detailed maps could be made, and elevation differences as small as 50-100 m proved to be surprisingly important, especially in borderline situations of the regions. Unfortunately most of the material remains unpublished, and the main leaders of the projects, A. Kalela and V. Kujala, both died in 1977, and there seems to be no active person to continue their work. La Roi (1967) has made similar studies of vegetation geography in Canada and also in North Europe.

Sectorial division of the Subarctic

I have talked mainly about the latitudinal boundaries of the ecogeographic zone which could be called subarctic. Of course, this zone cannot be homogeneous throughout its circumpolar range. If it is divided into areal units I propose to call them sectors or sections. In principle, such divisions resemble those recognized as forest sections by Rowe (1972).

There are various diagnostic criteria for such a subdivision. If we think of the climatic criteria, I may first quote Hare (1950), who stated that in Labrador wide variations in moisture index occur within the open boreal woodland, without any apparent effect on the vegetation. However, he notes that in the drier west of Canada there may be distinct differences.

According to my field observations the moisture conditions may be used for a regional division of the subarctic and the boreal zone in general, but real large-scale field studies are very few. It is true that especially in Europe oceanic influences in plant distribution and vegetation geography have been much discussed, but very little of that really concerns the boreal zone.

The Subarctic is mostly humid or at least subhumid. It is almost never so arid that forest development is limited by drought. However, even if the steppes and prairies in North America and Eurasia are largely in the temperate zone, there are also steppes in what I would like to call the boreal zone. Such boreal steppes, even subarctic steppes, occur locally on the south-exposed slopes in the Yukon and the District of Mackenzie, for instance, and much more widely in Yakutia, East Siberia. But even if the arid boreal zone is forested, the botanical composition of such forests is rather different from that in humid conditions, I believe. A well-known feature of somewhat arid boreal forests in Canada is the tremendous abundance of aspen, Populus tremuloides. The so-called Aspen Parkland Zone, which seems to be mainly hemiboreal in my system, is so different botanically that many people are not willing to include it in the boreal zone.

Another criterion for divisions along the oceanity-continentality gradient is the thermal continentality. Numerous indices have been proposed to indicate this character. Most of them are not satisfactory in defining the vegetational sectors from a circumpolar view. Tuhkanen (1977) regarded Conrad's (1946) continentality index (Table 5) as the most useful one in the boreal zone. With this index as related to vegetational changes he proposed a preliminary scheme of 21 major sectors in the circumpolar boreal zone, from Newfoundland through the Bering Straits and Scandinavia to Iceland. There are actually only seven classes, from highly oceanic to highly continental, which are repeated in the coastal and interior areas respectively (cf. the schemes in Hämet-Ahti 1976, 1977). Of course, the correspondence of each continentality class on the two continents is only approximate and in vegetation it may be marked to a great extent by other factors, such as floristic and edaphic differences.

As I noted before, the extremely continental, arid boreal areas may be quite treeless. The same is true with the extremely oceanic boreal sectors. In coastal areas the main factors restricting tree growth are cold winds coupled with poor snow shelter, low summer temperatures and often destructive human activities. There are many problematic subarctic areas which are referred to as arctic by some and as boreal by others and frequently are separated as special regions, not assigned to any of the main zones. Such areas include the Newfoundland coastal heaths, Iceland, the Faeroes, Orkney and Shetland Islands, much of northern Norway, the Kuril Islands, the Commander Islands, the Aleutian Islands and the southeastern Alaskan mainland with adjacent islands.

I have advocated (Ahti et al. 1968) the adoption of the concept of boreal maritime heaths or grasslands, admitting that the line of demarcation of the real arctic maritime heaths (and especially hemiarctic heaths) remains to be clarified. I have tried to say that absence or structure of tree layer may be a very poor indicator of arctic or subarctic in coastal areas and that the zone corresponding to the forest tundra or the Hemiarctic is always treeless in highly oceanic conditions. I have come to these conclusions as a cryptogamist. I tend to look at the bryophytes and lichens first and only then at the higher plants. For instance, on the southern Avalon Peninsula of Newfoundland, in the vast treeless barrens there, when I see the mosses Hypnum imponens, Leucobryum glaucum, Dicranum spurium, and Sphagnum imbricatum (in bog very abundant) or the lichen Cladonia ciliata var. tenuis, C. terrae-novae or C. cristatella I immediately feel: Oh no, this cannot be arctic! - in spite of the simultaneous presence of a number of species common in the arctic.

An important factor in the differentiation of sectors in the circumpolar subarctic zone is the floristic diversity. The subarctic zone is exceptionally homogeneous as to its flora - including numerous circumpolar species; in lichens (Ahti 1977), bryophytes and many agaric groups the circumpolar species amount to about 80-90 per cent.

The coastal regions deviate the most, reflecting differences in floristic history as well as ecology. Some easily recognized floristic differences in dominant tree species are traditionally regarded as more important than ecological similarities. For instance, Betula pubescens ssp. tortuosa is not often included in the boreal zone in Europe, because it is not a conifer. There it is the dominant tree in the oceanic subarctic. In eastern Asia, Pinus pumila is not usually included in the boreal zone because of its small size, although it seems to be a real subarctic (-subalpine) plant, apparently corresponding to trees in other subarctic areas rather than to arctic shrubs. In western North America trees like Picea sitchensis, Tsuga heterophylla, and Abies lasiocarpa are not generally regarded as boreal trees but representatives of special Pacific forests. In my opinion, these forests could be interpreted as belonging to the oceanic sectors of the boreal zone in Alaska and British Columbia. The same is true with the extensions of the boreal zone or outliers of the boreal zone in the mountain ranges (including the 'altitudinal subarctic' or orosubarctic) further south, which topic I here leave without any further comments.

Many speakers in former congresses have made a plea for establishing a more unified phytogeographic terminology to be used in the northern regions, especially including the term subarctic. Some progress in these matters has perhaps taken place in recent times, although I am afraid that ecologically the most satisfactory answer to the question of the delimitation of the Subarctic is not as obvious as would be desirable. In any case I am sure that my contribution here is not the last word on this question!

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NOTES ON NEWFOUNDLAND BOTANISTS

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A.J.M. BACHELOT DE LA PYLAIE

(1786-1856)

by

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Newfoundland and the French islands of St. Pierre and Miquelon occupy a prominent although not always well recognized position in the history of North American marine botany, largely due to the extensive explorations and prolific writings of the French naturalist, explorer and archaeologist, Auguste-Jean-Marie Bachelot de la Pylaie (1786-1856) who visited Newfoundland in 1816 and 1819-1820. Although the scientific contributions of this clever and, at times, enigmatic man were not restricted to the field of marine botany, and included works on other cryptogamic plants, on conchology, zoology, geology and archaeology, his 1829 "Flore de Terre-Neuve..." represents the first major work describing seaweeds from any part of North America. A man of unusual brilliance and ability in several related disciplines, the early works of de la Pylaie are well known, his later contributions are largely unknown and probably lost for ever, and the second part of his life is mysterious, marred by accusations of possible misdeeds.

Bachelot de la Pylaie was born in the northwest corner of France at Fougères, Ile-et-Vilaine on 25 May 1786. His father was a nobleman by the name of René-Roch-Pierre Bachelot de la Pilaie (sic), his mother Claire-Renée-Geneviève Vigeon, dame de Plessix. The orthography of de la Pylaie's name has been a matter of some controversy, largely due to variations made in the spelling by the scientist himself. Although the family name was spelled with an 'i', a rendering actually used in the entry of the birth to be found in the register of St. Léonard's parish church, de la Pylaie usually spelled his name with a 'y'. The 'y' spelling is known to originate from 1810, when de la Pylaie was a lithographer and this pseudonym has remained throughout history. Further orthographic variants are also known, these stemming from de la Pylaie himself. The orthographic variants have at times posed problems to experts in plant nomenclature, since a certain seaweed dedicated to de la Pylaie was, until quite recent times, known as Pylaiella; it has since been correctly argued that the real name of the seaweed should be Pilayella.

Little is known of de la Pylaie's young days, although he undoubtedly developed an early interest in natural history, particularly botany. He first trained as a lithographer, a skill later to be put to considerable use. His interests in natural history soon became uppermost in de la Pylaie's activities and in 1815, at the age of 29, he produced his first manuscript in the form of a sixteen-page unfinished article describing studies on the cryptogamic plants, more particularly the mosses, from the vicinity of Fougères.

In 1816 he began his first historic voyage to Newfoundland. De la Pylaie embarked on the frigate "La Cybele" commanded by M. de Kergariou and M. de Bougainville. The vessel was commissioned on a three-month tour of inspection of Newfoundland, St. Pierre and Miquelon. Various letters written by de la Pylaie and now in the possession of the Muséum d'Histoire Naturelle, Paris, describe vividly his impressions of Newfoundland and the French Islands at that time. He wrote of the inhospitable nature of the terrain and the difficulties of making plant collections. In addition to plants, de la Pylaie was to take diverse geological and biological specimens back to France. This first visit to Newfoundland was beset with some misfortune, not the least of which was the loss of some of his valuable papers and specimens when they were damaged by water.

Following his return from the first trip to Newfoundland de la Pylaie worked principally in Brittany. In 1818 he spent some time on the island of Ouessant (known also as Ushant Island), just north of Brest, Finistère. His attentions were still directed toward the sea, and in the autumn of that year appeared an article "Essai sur l'Ichthyographie marine de l'Ile d'Ouessant et du Finistère..." It was not long after his sojourn in Brittany, however, that de la Pylaie was once more drawn back to Newfoundland. He departed in 1819 on the warship "l'Esperance" and was not destined to return to France until 1820. During his second voyage of much longer duration he was to amass much of the information for his "Flore".

The results of de la Pylaie's extensive studies in Newfoundland were to appear with

characteristic speed in a monumental manuscript "Essai sur la Flore de Terre-Neuve et des iles St. Pierre et Miclon (sic)..." Started on August 1, 1819, the work was finished in 1820. Written on both sides of the page in neat handwriting, the style was readable and highly informative, with attention to the smallest of detail. The manuscript, still housed in the Paris Museum (MS. 444-445) consists of two large folios of 484 and 501 pages. Accompanying the manuscript were originally many drawings which indicated a high degree of technical skill and accuracy. Not all of these remain to the present day, although those that do give full justice to the abilities of their executor.

De la Pylaie prepared other manuscripts after his return from Newfoundland in 1820. In addition to the "Essai" he wrote two journal accounts of his travels (MS. 1800 and 1801 in the Paris Museum), the second of these entitled "Second voyage à l'Ile de Terre-Neuve, 1819-1820, corvette "l'Esperance", cahier de 1820". (96 pages).

Some of his preliminary observations on the marine plants of Newfoundland first appeared in published form in 1824 in the Annales des Sciences Naturelles (Vol. 4, p. 174-184) as "Quelques observations sur les productions de l'Ile de Terre-Neuve, et sur quelques algues de la côte de France appartenant au genre Laminaire". In this article he was to describe for the first time certain brown seaweeds of the genus Laminaria, descriptions which remain important to present day students. The diversity of de la Pylaie's interests is clear from the opening sentences of the 1824 paper, where he lists among his collections 1000 specimens of plants, 24 mammals, 66 birds, 34 fish, 46 molluscs, 14 annelid worms, 60 insects, 34 "Zoophytes et Acalephes" and 21 "Polypes" and "Polypiers". Among remarks on geology are descriptions of his finding of Labrador feldspar, conglomerate rocks from certain parts of the coast, granite, gneiss and siliceous rocks in abundance and fossil-bearing rocks containing Ammonites in some localities.

A further publication appeared in 1825 in the Mémoires de la Société Linnéene as "Voyage a l'Ile de Terre-Neuve, a 131-page article from which one can gain considerable insight into the meticulous observations of its author. Included are descriptions of terrain, vegetation and individual plants. He talks of the remarkable Sarracenia purpurea, our provincial flower, and describes with much admiration our orchids. Interspersed with his biological observations are more general items which are, nonetheless, of equal interest.

In 1826 de la Pyalie spent a month on the island of Houat, where he found shelter with the local priest. He was greatly moved by the extreme conditions of hardship in which the local people were living, particularly by their struggle for existence during the cold winter months. It was during this year that he developed a further interest, this time in shells. A result of this interest was a large publication "Manuel de Conchyologie..." dedicated to Charles de Lamarack and printed by H. de Balzac, 17 rue des Marias, Paris, in 1826. Extending to 464 pages, the book still remains an important reference.

It was not until 1829 that de la Pylaie was able to begin publication of his "Flore". He placed this task in the hands of the publishing house of Firmin Didot, 24 rue Jacob, Paris. The first part of the work appeared as " "Flore de Terre-Neuve et des iles St. Pierre et Miclon avec figures dessinées par l'auteur sur les plantes vivantes..."

The first part dealt with the algae, principally Laminaria and Fucus, and ran to 128 pages. Despite the title, however, the illustrations referred to throughout the text were not produced. In fact, by a lamentable lack of money, this first portion of the great work was to be the only part of the monumental manuscript ever to be published. De la Pylaie had originally intended that the "Flore" would be in two parts, each with accompanying illustrations. The reason why the rest of the book was never published was for some time rather obscure although Broyer, writing in 1938[1] stated that it was largely due to the lack of sufficient subscribers.

Although only the first portion of de la Pylaie's "Flore" was published, it was still to occupy an important position in the history of North American marine botany. It was the first major work to be produced dealing exclusively with marine plants from any part of North America although it has, perhaps unjustifiably, not always been given the credit merited. Its obscurity to many may simply have been a reflection of its limited edition and incompleteness. A further contributing factor to the relevant obscurity of this important work was the later work of the famous marine botanist Professor William Henry Harvey of Dublin (1811-1866). In 1849-50 Professor Harvey toured widely in North America, ranging from Nova Scotia to Florida. During his travels he gathered a wealth of information and specimens of seaweeds and his extensive researches culminated in the publication of a three volume work entitled "Nereis Boreali-Americana" (1852-1858). The "Nereis", which remains an important reference to the present day, included reference to de la Pylaie's writings and specimens and, by its large scope, immediately replaced the "Flore" as the most important reference available on North American seaweeds. Harvey did not visit Newfoundland, however, and studies of our seaweeds were to be neglected for more than a century following publication of de la Pylaie's "Flore". A comprehensive and modern treatment of the seaweeds of Newfoundland and Labrador is still lacking.

It is fortunate that de la Pylaie's manuscripts are preserved in the Paris Museum to this day, together with certain of his excellent drawings. Copies of his book are extremely rare and there is not a single one in Newfoundland. There may only be a single copy in Canada, housed in the library of McGill University.

After publication of the first and only part of the "Flore" de la Pylaie turned his interests to archaeology and was to become well

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[1]Broyer, C. 1938. Bachelot de la Pylaie, naturaliste et archéologue. (1786-1856). Bull. Soc. not. archéol. Ain. 52, 277-285.

known in French academic circles of that time for his attendance and addresses at learned meetings, particularly at the Société des Antiquaires de France. Until at least 1836 his researches in this field are known, but it was very suddenly after that de la Pylaie was to disappear into complete obscurity; the second part of his life was to remain shrouded in mystery to the present day.

So obscure did de la Pylaie become, it has been something of a controversy as to where and when he died. It is known that he spent a period in a house on the Ile d'Yeu, where he lived as something of a recluse and acquired the nick-name "Le Père Goémon",translated as "Old Father Seaweed"! Originally his death was recorded as at Marseille on 28 September 1856, although it was later discovered that he actually died on 8 November of the same year, in Paris. He certainly spent the later days of his life in extreme poverty and probably in distress although the full details will never be known.

It seems hardly fitting that a man of such diverse interest and potentially brilliant achievement should have perished in such degrading and obscure circumstances. In Newfoundland and, more generally, in North America, he should be remembered for his original and first contributions to marine botany.

Footnote:-

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REV. ARTHUR C. WAGHORNE

(1851-1900)

by

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The Rev. Arthur Charles Waghorne (1851-1900) made substantial contributions to the botany of Newfoundland and Labrador in the late 19th century, yet remains a poorly-known figure.

Waghorne was born in London, England, in 1851, and educated at St. Augustin's College, Canterbury. On graduating he immediately left for Newfoundland, and arrived in St. John's in February 1875. As a result of theological studies in Canterbury, Waghorne was ordained into the Church of England at Queen's College, St. John's, as deacon in 1875 and as priest in 1878. Waghorne came to Newfoundland as a missionary for the Society for the Propagation of the Gospel (S.P.G.).

Rev. Waghorne spent 25 years as a mission priest in Newfoundland and Labrador. His official charges, or 'home' parishes, were as follows: Ferryland (1875), St. Pierre and Miquelon (1875), New Harbour (1878-1893), Bay of Islands (1894-1899). However, Waghorne travelled widely to numerous small settlements near his charges, and spent periods of several months conducting or assisting missionary work in outlying parts of Newfoundland and Labrador. The most noteworthy of these were his stay at Harbour Breton (May-October 1888), his trips to the coast of Labrador (June-September 1891; late June-September 1892; late July-September 1893; July-September 1894), his winter at Exploits, Notre Dame Bay (October 1893-June 1894), and his winter in St. John's (1894-1895). In late 1899 Waghorne, whose health had deteriorated rapidly, retired to Jamaica, where he died a few months later (April 1900).

Waghorne's interest in botany surfaced after his arrival in Newfoundland, and he quickly became the leading voice of botany there. He was Newfoundland's first resident botanist, although he had no such illusions about himself, preferring to think of himself only as a cataloguer of the local flora. His main, and perhaps only, botanical ambition was to prepare and publish complete 'lists' of all Newfoundland and Labrador plants, based on previous reports and on his own massive collections.

Because Waghorne was entirely self-taught in botany, and had no personal contacts with any botanists (other than through correspondence) his knowledge of the plants was, in general, poor (at least for the cryptogams) and he relied heavily on the specialists of the day for identifications. He considered all his 'identifiers' equally competent, and was confused when the same plant sent to two different botanists came back with two different names. He was careful to request clarification about synonymy, but seemed truly perplexed when his experts considered some of his specimens different species. Waghorne had the novice's idea that a specimen could be named, and named correctly, not allowing room for differences in taxonomic judgements.

Although Waghorne was scrupulously fair to those who identified plants for him, he did expect results, and complained regularly when the names did not arrive quickly enough. He sent plants to the leading specialists of the time, e.g., Salices to Bebb, Sphagna to Warnstorf, fungi to Ellis. Despite the fact that Waghorne's botany was done more or less in his spare time, he collected perhaps close to 10,000 specimens in Newfoundland and Labrador, which eventually made their way to most major herbaria in Europe and North America.

If his specimens were often scrappy or poorly prepared, one must remember that Waghorne worked in botanical isolation. He had a few of the major reference books, but there was no plant collection in Newfoundland. In a letter to B.L. Robinson, written in 1895, Waghorne, late in his botanical 'career', mentions that the plants which Robinson had sent to the Geological Museum in St. John's that year were the first properly mounted specimens he had ever seen!

However, Waghorne's correspondence was voluminous. He wrote very fast in an artistically pleasant script, but one which many found illegible, thus creating difficulties for his correspondents and identifiers.

One can only surmise on how he collected

plants, but many of his specimens were, no doubt, collected hurriedly and under very difficult conditions. He was precise about the locality and date of collection, but only rarely included habitat data. It is obvious that he had a good eye for detecting different plants in the field (even if he did not know what they were) and some of his finds are most remarkable, particularly in the mosses, which became his main specialty. He had some inklings of differences in phytogeography, and was careful to separate specimens from different localities in Newfoundland. He kept separate lists for Newfoundland (the island) and for Labrador.

Waghorne published the first three parts of his phanerogamic lists in the Nova Scotia Institute of Science, and occasional lists of specimens for sale, etc. However, many of his specimens were included in publications by other botanists, in particular Macoun's Catalogue of Canadian Plants. The information which he accumulated thus became available to others, and the specimens he sent freely are today an important part of his legacy to Newfoundland botany. Unfortunately, none of Waghorne's specimens remained in Newfoundland. After his death his personal collection was stored in a warehouse, and had been discarded by the time Agnes Marion Ayre tried to locate it.

Footnote:- *The author is preparing a more complete 'botanical' biography of Arthur C. Waghorne, which will document in more detail his life and work in Newfoundland, as well as provide references, and other sources of information.*

AGNES MARION AYRE

(1890-1940)

by

Peter J. Scott

Curator of the Agnes Marion Ayre Herbarium

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Mrs. Ayre was born on February 2, 1890 in St. John's, Newfoundland to Lewis and Mary Miller. She was educated in St. John's and married Harold C. Ayre in 1913. She had two sons and a daughter.

She lived a comparatively short life but in addition to running a household and raising a family she accomplished a great deal.

Her main hobby was drawing and painting, mainly landscape. She was often found perched on a rock with a host of children, dogs, goats, adults, and others gathered about to watch her. She was a founding member of the Newfoundland Art Society which was particularly active during the twenties and thirties and helped promote an appreciation for art by holding regular art exhibitions.

Mrs. Ayre was an avid gardener and grew many perennials and annuals as well as a good variety of herbs and small fruit. She studied folklore as it applied to natural history and told her children why the various trees were grown--Dogberries (Sorbus spp.) for good luck, Ash (Fraxinus spp.) to keep the fairies away, and Shivery 'apse (Populus tremuloides) which has always trembled because the cross was made from its wood.

She was fascinated by history and had an extensive collection of Newfoundland books. She corresponded with people all over the world about folklore, ancestors, placenames, etc.

Books filled many hours and she particularly enjoyed poetry. In addition to this she sewed and was very active in St. John's' society and involved herself completely in everything.

Mrs. Ayre's passion for many years was wildfowers, and the Agnes Marion Ayre Herbarium is founded upon her collection of watercolours and pressed specimens. She initially became interested in painting the local species in the 1920s. Mrs. Philip Knowling came out from Wales and saw the need for a list of Newfoundland wildflowers. She asked Mrs. Ayre to paint the specimens that she collected. Mrs. Knowling did not continue with the project very long but Mrs. Ayre continued on. She enjoyed learning about the plants and worked very hard with the Latin, identifications and paintings. After assembling enought material she took it to Dr. Fernald and he is reported to have been quite impressed with what he saw. He apparently considered Mrs. Ayre to be quite competent in identification.

Her family learned to cope with her study of plants. She developed the sharp botanist's eye and her family had an unlimited supply of four-leaf clovers which she would spy while sitting on the lawn. They also had many lurching halts while motoring as she exclaimed "Stop the car, I see a ....". She did other things that were a bit inconvenient such as leave meat locked in her car at the railway station for a weekend while she went to Clarenville to botanize.

Her grandson wrote: "She was a continual whirlwind of activity--painting, making dresses, illustrating and writing family cartoons, organizing parties, and then disappearing. Her disappearances became a fact of life. My grandfather would be called at 10 o'clock at night to be told she was stuck on some back road where she had gone hunting for flowers. At one point she called my grandfather to say she was leaving for St. Anthony on the next boat which happened to be departing in 30 minutes. He later found her car on the dock with the engine still running."

Mrs. Ayre published "Wildflowers of Newfoundland, Part III". It had a sad history. Colour was too expensive at the time and so the water-colour was washed off each painting. They were then photographed in black and white by Miss Elsie Holloway of St. John's. Miss Worral typed the descriptions in the evenings after work. The work received quite a set back when thieves, looking for something more valuable, tipped out the typing and left it torn and crumpled. Only part three was published in 1935. An application for a grant from the Guggenheim Foundation to complete the work was being favourably considered at the time of her death from cancer.

Her collection of 2,440 specimens and 1,890 paintings form the foundation of the Agnes Marion Ayre Herbarium--an outstanding contribution to botany. But she left her mark in other ways. There are still people who remember Mrs. Ayre identifying the flower collection that they made as a child and these people have a real appreciation of the flora.

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