WILLIAM C. WONDERS

CANADA'S CHANGING NORTH

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CANADA'S CHANGING NORTH

EDITED AND WITH AN INTRODUCTION BY
WILLIAM C. WONDERS

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Introduction

Geography has stamped a northern imprint upon Canada. Though the total area of its northern regions may be rather less than those of the U.S.S.R., it still bulks larger in its relative size within the natural boundaries than it does in the latter nation. Over two-thirds of Canada may be regarded as northern including a third which lies north of tree-line. Within our Arctic Archipelago some islands are larger than several European countries. Snow is as common an element of our winter landscape as is its rarity in many other nations of the world.

In the face of these realities it is remarkable how limited accurate knowledge most Canadians have of the North. Though there was no population pressure from longer occupied southern regions pushing man northwards, as in Scandinavia or in Russia, European explorers did penetrate at least part of the North relatively early and its fur resources were tapped along with more southern parts of the country. Except in some southern marginal sectors, however, the settler and the resource developer have not swept over the area. It is still essentially an "empty" country. For most Canadians it remains a remote area. They know more about their southern neighbouring nation than they do about the largest portion of their own.

The Canadian is not unaware of the North. He knows that it is there, at his back door, and that it stretches away for thousands of miles. He takes pride in the fact that he shares the distinction of being a "northerner" with citizens of a relatively small group of other nations, but he is content to look east, west, or south rather than north. The North is for him an ill-defined area of long severe winters, dark, limitless forests or monotonous tundra, inhabited by a few Indians or Eskimos who make their living from trapping. It is a romantic area but not particularly one in which he wants to live.

Within the past twenty-five years, however, such changes have occurred in the North that vague generalities must be discarded. World War Two and the increased technical capabilities of the aircraft thrust Canada into a new military and political role because of its North and because of its world geographic setting. The advantages offered by northern Canadian skies for great circle tracks, for both peaceful and military

purposes, in a world of shrunken distances are obvious. Now that the era of ICBM has replaced that of the aircraft such distances are measured in minutes rather than in hours.

Social change, though longer delayed in the North than elsewhere in Canada, has been particularly marked in the years since World War Two. It brings with it not only hope for an improved future for northern residents, but also difficult and troubled times in the transitional period. It also involves considerable cost financially which must be borne by the southern taxpayers now and in the foreseeable future.

Economic change in the same time period not only has contributed to social change but has cast the North in an entirely new role in recent years. Previously, its remoteness has isolated the area from the rest of the nation and the world. Only the highest value resources could be exploited because of high transportation and development costs. Thus furs, and later precious minerals, have been the only northern resources utilized, until recently.

So great has been the growth in demand for industrial resources, especially by the United States in the postwar years, that remoteness is no longer the deterrent it once was. If size of resources is sufficiently encouraging, transportation means will be provided, particularly with the new technological improvements which have been taking place. The vast new mineral developments have changed the North and are changing the North. They also not only are changing the national economic structure of Canada, but are tying the nation increasingly closely to foreign markets. Water and fuels now are facing comparable pressures from external demand.

More than anything else in the recent history of Canada, the discovery of oil on the North Slope of Alaska and the voyage of the *Manhattan* through Canadian Arctic waters has brought the Canadian North forcibly to the attention of the southern citizen. Complacency about the remote, unchanging Canadian North has been jolted by the challenge of the extent of our political ownership itself. Linked with this has been a belated but increasing awareness of the sensitivity of the northern environmental balance, particularly in the Arctic.

This book is presented with two aims. First, it must be clear to all that the Canadian North will be playing an increasingly important role in the life of the nation. It is essential, therefore, that much more be known about the area. It is hoped that this book will assist in making accurate information more readily available. Second, the focus is upon the *changing* nature of

Canada's North – change in our understanding of the area and its characteristics, change in the conditions prevailing within the area itself. We have accepted change as a feature of life in other parts of Canada, and must appreciate that the same holds true of the North as well. It is hoped that this book may help others understand the Canadian North better, and assist in directing that change for the optimum benefit of the North and of Canada.

There is a large amount of written material dealing with the Canadian North. Much of it is of a very specialized nature, however, while much also is not particularly informative and in many cases perpetuates misinformation about the area. It was decided initially that the readings would be drawn only from journals rather than from hardback books. The only departure from this has been where an essential article in the overall "balance" of the book was not otherwise available, or was overly long for inclusion.

The book is intended primarily for students and the general reading public. Accordingly, an attempt has been made to steer a middle course in making the selections, between the narrowly specialized articles of the professional scholar and the extremely generalized accounts of the popular writer. The diversity of disciplines with an interest in the North adds to the complexity of the problem. It may well be that the book seeks an impossible goal, but it is hoped that it will prove interesting as well as informative.

Two previous volumes in the Carleton Library series contain much material closely related, though more specialized, and should also be consulted by those interested in the Canadian North. Warkentin's *The Western Interior of Canada* includes several accounts of important exploration and survey expeditions which covered parts of the North as well as the Western Interior. Valentine and Vallee's *Eskimo of the Canadian Arctic* gives an excellent picture of this indigenous resident of the North.

It is important first of all to define the North, since few other geographic regions are subject to such widely differing interpretations. Louis-Edmond Hamelin has devised a new system for this purpose and applies it on a circumpolar scale, which provides a most interesting basis of comparison between Canada and other northern nations. John E. Sater sets out the fundamental duality of the North long recognized by geographers and other scientists, with its division into Arctic and Subarctic components.

The second chapter attempts a survey of some of the historical perspectives of the Canadian North, beginning with the arrival of the first Europeans. The Northwest Passage has been a persistent theme in the area from the earliest explorations down to the present. Much of the early exploration of the North and its first settlements were linked with the fur trade. Though many played important roles in the North, Albert Peter Low was particularly noteworthy. As a late explorer he provided us with accurate knowledge of the vast Labrador area and laid the base for the great post-war iron ore developments in it. He also symbolized the increasing official concern with the Arctic in heading up the Canadian government expedition of the *Neptune* in 1903. How great has been the technological change from the earliest days of dangerous exploration is suggested in the articles covering the post-war discovery of our last Arctic islands by the R.C.A.F., and the attainment of the North Pole by power toboggan. Finally, W. L. Morton suggests that our northern experience has given Canada a distinctive identity in which we should take greater pride.

It was considered appropriate to begin the chapter on the physical nature of the North with an Indian legend of the origin of the Mackenzie River, our great river of the North. In this we not only have a point of contrast for our increasing scientific knowledge of the North, but, equally important, have an indication of the imagination and beauty of expression of our indigenous peoples which we should not submerge in this technological age. The articles outline the diversity of landforms in the Arctic and how these may be shaped in ways different from those operating elsewhere, the very appreciable variety of the northern forest in contrast to the popular stereotype, and the muskeg phenomenon. Permafrost now is fairly widely known as a term in Canada yet twenty-five years ago it was almost unheard of and the condition itself scarcely recognized. While several climatic characteristics typify the North, wind chill is perhaps a particularly significant if unpleasant element, since many Canadians have had personal experience of it. Our increasing knowledge of the North even extends to snow itself, but simetimes it may be too late as may well be the case with the caribou for instance.

Through careful scientific research we are constantly expanding our knowledge of how man first came into the North. Our indigenous peoples, both Indian and Eskimo, are finding themselves in a rapidly changing North, however, which is

taking on a very different nature to that in which their forefathers lived.

The increasing attention being paid the North in the post-war years is largely the result of the unprecedented demand, still swelling, for raw materials elsewhere. Chapter five suggests that the North can provide such resources, though it cautions they do have limitations. The Montferré region of Labrador is shown just as the huge iron ore developments were about to take place which had been experienced in the Schefferville area, and is typical of other massive mining projects in the North. Regrettably, again we note that even when indigenous people seem to have established a viable economic base in this new North, they may be disastrously affected by the outside world.

Development in Canada's North as elsewhere, is dependent upon improvement in transportation and communications, but nowhere else are these as critical. The North brings unique problems to these services as well. Some of these considerations, their characteristics, improvements and repercussions are set out in the next chapter.

The sum total of the foregoing characteristics is reflected in the regional variations within the North. Moreover, the North like the rest of Canada, is increasingly becoming an urban-centred area. The fact that these centres are small by southern standards in no way reduces their importance. In an area where such structures are relatively youthful it offers opportunities for new and better concepts, but regrettably to date there is not too much evidence of these despite good intentions.

Finally, the book concludes with a series of articles pointing up some of the major problems confronting the Canadian North today. The problem of the place of the indigenous people in the North still remains despite vigorous government educational programs, etc., and Abe Okpik poignantly conveys the sense of bewilderment of many of them. The Polar Continental Shelf Project is the most impressive scientific program in the North by the Canadian government and reflects the increasing research interests in the area in the post-war years by both governments and institutions. Much still remains to be done in scientific enquiry. International political problems, considered by Canadians to have been long since settled insofar as their North is concerned, have arisen in connection with resource development in the area. All this increasing focus on the North

is forcing the Canadian government to devote more attention to their policy on the area and to lay down firm guide-lines for the future. Even so the North will continue to present challenges and problems in the political sphere to a degree unprecedented in the past. In a finite world the North also presents challenges and problems to demonstrate that man is finally prepared to assume a broader responsibility for the maintenance and improvement of his natural environment.

I wish to acknowledge the permission of the original authors and publishers of the journals and books from which these selections have been made. For economy I have omitted most of the footnotes in the original texts except for explanatory notes and direct quotations. For the same reason original maps and diagrams have been reduced to an absolute minimum. In this regard I am particularly indebted to my wife, Lillian, for her professional cartographic advice and skills, and to the draftsmen and technicians of the Department of Geography, of the University of Alberta. Colleagues both within and outside the Department have provided valuable suggestions including Professors C. S. Brant, D. A. Gill, W. A. Fuller, I. L. Head, R. W. Longley, C. S. MacKinnon and G. D. Williams. In a few cases there have been changes (chiefly economic) since the original articles were written but they have not reduced their importance in the overall picture. Very brief factual notes have been appended where it was felt absolutely necessary.

It gives me pleasure also to acknowledge the assistance of Mrs. B. Horton and Mrs. E. Colyer, Librarians of the Boreal Institute, University of Alberta, and of a grant from the University Research Committee, University of Alberta. Gordon Merrill of Carleton University has given me continuing encouragement, and as Geography Editor of the series has been helpful and understanding even while obliging me to reduce the number of readings originally proposed. Finally I wish to express my thanks to the many northerners who have assisted me over the years and who invariably demonstrated that hospitality and love of their area traditional to the North.

WILLIAM C. WONDERS
University of Alberta
April, 1970.

1.
A Circumpolar Index*

Louis-Edmond Hamelin

SOURCE: *Annles de Géographie*, 422, LXXVII, Juillet-Août, 1968, pp. 414-430. Reprinted by permission of the author and publisher.

The problem of establishing and defining the outer boundaries and internal subdivisions of any very large region continues to be extremely complex, perhaps even insoluble. Indeed, no matter what type of region we are concerned with, whether temperate, mountain, or desert, the available criteria and existing boundaries rarely provide satisfactory answers for further research workers, even when they are of the same discipline. This fact is all the more indicative of the inherent difficulties in this subject, since very often the parameters in question are purely physical. Moreover, when we consider the far more subjective human criteria, our task is greatly complicated, and any reservations as to their real value are all the more justified. This dilemma no doubt accounts for the relatively small number of works of this nature. Such, however, is the aim of this paper, taking as our example the cold countries of the northern latitudes.

1. Terminology

The geography of cold countries suffers from much confusion, especially regarding the terms of reference; these fall into four main groups, which have been decided on by various writers. The word "polar" adopted by the Scott Polar Institute of Cambridge, the American Geographical Society, the French Polar Expeditions and the Deutschen Gesellschaft für Polarfor-

* The author made full use of comments from various people present at the reading of this paper in 1964 in Liege and Paris in Quebec and Vancouver, and in 1967 in Stuttgart. In addition he would like to thank J. E. Armstrong and Mrs. H. Richardson of Cambridge, Jean Gottmann of The Arctic Institute of North America, Alan Cooke and Jacques Rousseau of Quebec for providing him with some interesting observations. However, these people and institutions can in no way be held responsible for the ideas put forward in this text.

schung, remains extremely imprecise – sometimes being applied only to glaciated areas, sometimes to all the territory inside the Arctic and Antarctic circles, and sometimes to all cold lands (people have spoken of "polar soil" in mountains no farther north than the 45th parallel). Circumpolar suggests, more than anything else, a latitudinal position, as does peri-arctic. However, polar is the only one of the four terms discussed which can be applied to either hemisphere.

Similarly, the word "Arctic" has a long and involved history. At the beginning of its scientific career only one factor, the mean temperature of the summer months, was necessary for the definition of a given region. The Arctic has been subdivided in many different ways: "Inner," "Outer" (O. A. Nordenskjold), "Low," "Middle," "High" (N. Polunin). Between the traditional Arctic and Subarctic, a "hemi-arctic" belt has been inserted (Jacques Rousseau). Other writers have defined a hydrographic subarctic (M. J. Dunbar) which does not necessarily coincide with the terrestrial subarctic. J. Bluthgen makes a distinction between a para-arctic subzone and a para-boreal subzone, including in this oceanic and continental sub-divisions. In short, the way in which the word arctic is used – sometimes in a narrow sense (corresponding more or less to the tundra), sometimes in a broad sense (even including an area not otherwise defined as the Subarctic) – remains very vague. On the other hand, in the southern hemisphere a hydrographic subantarctic surrounds a continental Antarctic.

"Boreal" essentially expresses the opposite of austral, when associated with hemispheres, poles and auroras. Thus, it would be "wrong to qualify only the forests at the northern limits of the temperate zone as boreal" (J. Rousseau); in fact, all the others in the same hemisphere would be equally entitled to this qualification. Further, boreal has acquired certain connotations in connection with botany and moderate, cold climates. H. Sjors subdivides it into three belts (meridional, central and subarctic) and places it between the Nemoral (a temperate region) and the Arctic. "Borean" is derived from the name given to the inhabitants of the area. Thus in Canada the Eskimos would be "hyperboreans" (P. del Perugis).

In the boreal hemisphere a fourth term, "north," competes more and more with the preceding ones. Originally used to express an idea of relative place (for example the Northwest – found in Europe as early as the eighteenth century), it now tends to mean a whole region (the word "Orient" evolved in a similar fashion). In the literature of exploration and dis-

covery, the expression "Far North" occurred frequently, not only in America, but also in the U.S.S.R. (the second expedition to Kanchatka in 1733). It vaguely signified something far off – something vast, hostile, dangerous, unknown, almost unimaginable. Gradually some of the mysteries of the Far North were replaced by more objective data. According to Elisée Reclus, the far northern territories of Canada are made up of the area drained towards the Arctic Ocean, clearly an unsatisfactory argument in view of the local drainage conditions. Gradually the idea of the North as a regional entity became established and "Northlands" appeared as a title in 1954. Since the First World War the term "Norden" has generally been taken to mean the whole area of the Fenno Scandian islands and peninsulas (from Iceland to Finland). The School of Advanced Practical Studies in Paris published a review on the cold countries of the boreal hemisphere entitled "Inter-Nord." On the other hand, Stone used the term "Nornam" to describe the whole of the American North. In short, a nordic terminology has become accepted for the different zones in the countries of cold latitudes; from south to north: "Pre-North" or "Near North" ("Proche-Nord"); "Mid-North" ("Moyen-Nord") of J. W. Watson; "Middle North" of The Institute on Current World Affairs in New York; "High North" ("Grand Nord") and "North." These divisions recall those used for many years for Asia (Middle East, Far East); for the United States (Middle West, Far West); and for Morocco (Middle Atlas, Upper Atlas). This practice of differentiating between separate nordic zones is found as much in the U.S.S.R. as in America (the work of Slavin). A whole new technical vocabulary is developing around the word "north": first, there is the adjective "nordic" used in the sense of circumpolar (Hamelin, 1956), and not simply north-European as at the end of the nineteenth century; later, we encounter nordic criteria, nordic index, nordic values or units, the "nordicity" of a place, isonords (lines joining points of the same value, for example, the isonord of 500 units), nordic gradient, nordic front, a mean annual north, the nordic world (bounded in the South by the isonord 200), and nordists (inhabitants of the North).

2. Single Criteria

Most writers who have considered the problem of fixing boundaries for the countries of high latitudes have arrived at a single

criterion, but not always the same one. Thus in Canada, since jurisdiction is shared with the provinces, the federal government for most matters uses the 60 degree north latitude as the southern limit to its northern activities. The U.S.S.R. uses the 62nd, while the "Tromsö Museum" has established the southern limit of northern Norway at the 65th parallel.

In theory bio-climatic factors are preferable by far to the more artificial element of latitude, and yet their use has not led to very satisfactory results. In countries where the temperatures are characterized by large seasonal variations and great differences from year to year, the mean annual temperature has little value. In this way the July isotherm or even those of the three warmest months would deceive the observer. The wind-chill factor (temperature × wind velocity), like the negative thermal index (day degrees above 32 degrees Farenheit) would only invoke other extreme conditions: indeed, at the same latitude, the degree of nordicity is far lower in summer than in winter. Another criterion often used, vegetation, also presents major drawbacks, for not only is it not applicable to marine areas but it is descriptive of conditions beyond the present and also tells us little about the severity of the full winter, of the permafrost (especially if the ceiling of this is low), the accessibility of the region, the number of inhabitants, or the exploitation of resources other than of the vegetation. This standard is therefore more useful for botany than for world geography.

Still other writers have preferred to consider economic and human criteria in trying to delimit the North. First, their use of commercial agriculture (the northern fringe of which would correspond to the southern limit of the North) is disputable, since the farthest limits of cultivated land throughout the world depend on numerous circumstances, some of which have no direct connection with latitude: ancient soils, agricultural techniques, international markets, rate of settlement and population increase. Furthermore, in the northern countries agriculture is only one of many ways of pioneer life, including forestry, fishing, mining, hunting and even military and scientific operations. Among the other single criteria let us mention the means of communication; the distribution (R. Gadja), rate of increase and ethnic characteristics of the population; the influence of the cities in the "base regions" – in Canada, the mining and finance centres of Montreal, Edmonton, Toronto; and the administration centres of Winnipeg and Ottawa. In the U.S.S.R., Slavin divided the North according to the cost

of exploitation. K. H. Stone, after considering the idea of the degree of habitability of the "Norden" countries, has just established a "measures of isolation" for Alaska.

In total, at least twenty criteria have been used provisionally to delineate the cold regions of the high latitudes. The result of these independent investigations has not provided world-wide frontiers for the North, but instead as many different boundaries as there are criteria. Nevertheless, this brief account will have served to both demonstrate the absolute complexity of the problem and to help single out the elements worth retaining in the creation of a more comprehensive index.

3. A Global Nordic Index

Jacques Rousseau has established a "latitudinal division of Quebec-Labrador," taking into account various factors, both physical (botanical and zoological regions), and human (civilization of the natives). We intend to use this same approach of combining different factors, but for the whole boreal hemisphere.

In order to interpret the nordic situation in its entirety, we propose to consider a group of ten criteria which will attempt to express the idea of a total geography. First there is an identifiable variable – latitude; and since our aim is to define the cold countries of high latitudes it is necesary to establish a standard minimum limit to the region: arbitrarily, we set this at the 45th parallel. Among the other nine criteria, the natural elements clearly predominate, for example, temperature; but though the main characteristic of the high latitudes (the cold) is well represented, we are not dealing with a purely climatic index. On the other hand, our calculations of nordicity do not include psychological conditions as such, owing to the difficulties in measuring heroism, suffering – objective and subjective – the taste for adventure or for solitude. In spite of this limitation, the four human elements provide a more complete structural picture than if it were founded solely on the tundra-taiga fringe, on the line of continuous permafrost, or the July 50° F. isotherm (10° C.). In particular, the fact that we have incorporated an air transport criterion modifies the conditions of what was once, at a certain stage of technical development, called the "pole of inaccessibility" (W. Stefansson). The polar index (or simply, northern, in the boreal hemisphere) is thus based on a broad geographic conception.

Second, the index should be representative of the situation

Map 1

throughout the year. Therefore, with regard to the boreal hemisphere we are no longer concerned with a seasonal north. The former suggestions of a "summer North" and a "winter North" are displaced by the new idea of a mean annual North. This corrects the views sometimes held about particular places, for example about the polar conditions in Verkhoyansk; this station has been noted for its low winter temperatures, whereas its total nordicity is no higher than 631, a high but by no means extreme figure.

Besides this, the index enables us to define the nordicity of marine areas – previously an impossible task with the purely terrestrial criteria such as vegetation and permafrost. In fact, eight out of ten of the factors proposed can be applied to ocean regions. To be sure of a fair comparison with the results of continental stations the values originally calculated out of 800 are adjusted to a value out of 1,000.

Using the index is very simple. Since each criterion represents a certain degree of polar conditions, by adding up all the individual units we arrive at the total nordicity. For each criterion there is a scale of points from zero to 100; for example, in the case of floating ice, the permanent pack ice in the centre of the Arctic Ocean would equal 100 VAPO (polar values). Hence in this calculation, which is linear, the maximum of 1,000 units should in theory be the Pole itself.

The intermediate levels have been established in order to reflect the situation in the whole of the nordic world, and to allow valid comparisons not only between places of different latitude but also between places widely spaced longitudinally (for example, central Alaska and nordic Ontario). Thus it enables us to make objective comparisons at any point in the Arctic Ocean, especially as we know the individual factors making up the total for each locality: the nordicity of Norilsk is equivalent to that of Churchill; Novosibirsk and Reykjavik to that of Edmonton. On the other hand, the nordicity of the Russian islands of Franz Josef Land is scarcely higher than that of Winter Harbour, of Melville Island (a Canadian Arctic archipelago). In this introduction to the methodology we do not intend to take any further the comparative study of the north of different nations, though this is undoubtedly an interesting field.

The quantification of the North not only serves to determine the maximum nordic hinterland, but is perhaps still more useful in identifying the degrees of regional nordicity. First, the index enables us to demonstrate the increase in nordic

characteristics as we move away from the "base regions." However, this increase is by no means uniform as the variation is not strictly latitudinal, but also climatic. The isolines are not always the same distance apart. In Canada the highest nordic gradient is in the North-West – in the space of a few hundred miles the forests of the lower Mackenzie give way to permanent polar pack ice. Although not so marked, the nordicity of Norway also rapidly increases from the coastline to the mountains inland. This transformation in a short distance is even more rapid in Southern Greenland from the coastline to the ice cap inland. Seen on a large scale, nordicity is very variable; thus local deviations of as much as 100 units (the exact difference can even exceed 200) occur frequently. These spacial variations create certain enclaves outside the main zone, such as the south-west Yukon, an extremely mountainous area, which is situated however in a region of only moderate nordicity. As an example of a reverse anomaly, Alert, near the coast, has a less severe nordicity than that of the glaciated mass, Ellesmere, to its south. These local variations do not prevent us from roughly dividing the North into regions. The main isoline plateaux are found around 200 units (south of the Middle North), 500 (north of the Middle North and south of the High North), and 800 (south of the Far North). These zones are not divided by thin, straight lines but rather by fringe areas tens of miles wide.

Given the choice of criteria the total nordicity of places and regions is modified by bioclimatic changes, technical discoveries and the general state of the country's development. This mobility is reflected in the life of each region. It is an indisputable fact that the exploitation of iron ore in central Quebec-Labrador has reduced the nordicity of this region, which was previously very isolated. Periodic calculations of the indexes would enable us to follow this geographic dynamism, an evolution which does not take in only the Taiga-tundra zone with its slow evolution.

TABLE 1

Nordic Index: criteria, classes, score.

CRITERIA	CLASSES	SCORE
1. Latitude	90 degrees	100
	80 degrees	77
	70 degrees	55
	60 degrees	33
	50 degrees	11
	45 degrees	0
2. Summer heat	0 days above 42 degrees F. (5.6 C)	100
	40 days above 42 degrees F. (5.6 C)	80
	60 days above 42 degrees F. (5.6 C)	70
	80 days above 42 degrees F. (5.6 C)	60
	100 days above 42 degrees F. (5.6 C)	45
	120 days above 42 degrees F. (5.6 C)	30
	135 days above 42 degrees F. (5.6 C)	20
	more than 150 days above 42 degrees F. (5.6 C)	0
3. Annual cold	more than 12,000 day-degrees F. above 32 degrees F. (0 C)	100
	10,000 day-degrees F. above 32 degrees F. (0 C)	85
	8,500 day-degrees F. above 32 degrees F. (0 C)	75
	7,000 day-degrees F. above 32 degrees F. (0 C)	65
	5,250 day-degrees F. above 32 degrees F. (0 C)	45
	3,500 day-degrees F. above 32 degrees F. (0 C)	30
	2,250 day-degrees F. above 32 degrees F. (0 C)	15
	less than 1,000 day-degrees F. above 32 degrees F. (0 C)	0
4. Types of ice		
4a. Permafrost	Permafrost, continuous and 1,500 ft. thick (457 m)	100
	Permafrost, discontinuous	60
	Semi-permafrost, for 9 months	50
	Semi-permafrost, for 4 months	20
	Semi-permafrost, for less than one month	0
or 4b. Floating ice	Permanent pack ice in the Arctic ocean	100
	Pack ice in the peri-Arctic (Baffin)	90
	Pack ice for 6 months	40
	Pack ice for 4 months	20
	Pack ice for less than one month	0
or 4c. Glaciers	Ice cap – 5,000 ft. thick (1,524 m) and more	100
	Ice sheet – about 1,000 ft. (304 m)	60
	Névé	20
	Covering of Névé for less than 11 months	0

CRITERIA	CLASSES	SCORE
5. Total precipitation	less than	
	4 inches (100 mm)	100
	8 inches (200 mm)	80
	12 inches (300 mm)	60
	16 inches (400 mm)	30
	more than	
	20 inches (500 mm)	0
6. Vegetation	Stony desert	100
	Thin tundra	80
	Thick, shrub tundra	60
	Open forest (subarctic, parkland)	40
	Continuous forest (coniferous)	0
7. Accessibility other than by air (heavy transport)	No service	100
	Seasonal service:	
	once a year	80
	for 2 months	60
	for 6 months,or 2 "seasons"	40
	Service throughout the year:	
	one form only	20
	more than one form	0
8. Air service	Nearest airfield – approx. 1,000 miles (1,600 km)	100
	Nearest airfield – approx. 300 miles (480 km)	80
	Nearest airfield – approx. 30 miles (48 km)	60
	Regular service, twice a month	40
	Regular service, twice a week	15
	More than one service a day	0
9. Population	None	100
	from 20 to 30	90
9a. Number of inhabitants in a settlement	approx. 500	75
	approx. 1,000	60
	approx. 3,000	20
	more than 5,000	0
or		
9b. Population density of the region (100,000 square miles, or 256,000 km²)	Uninhabited	100
	0.01 persons per square mile (0.004 per km²)	90
	1 person per square mile (0.4 per km²)	70
	2.5 persons per square mile (1 per km²)	50
	5 persons per square mile (2 per km²)	25
	10 persons per square mile (4 per km²)	0
10. Degree of economic activity	No production and none foreseeable	100
	Prospecting, but not yet exploited	80
	Gathering, or extractive industries or crafts	50
	Large ore deposits, entrepot, or terminus	30
	Large "secondary" industries	15
	Interregional centre for multiple services	0

TABLE II

Canadian examples of local and regional nordicity, by the criteria of VAPO

CRITERIA	1. SETTLEMENTS				2. REGIONS
	Shefferville (Quebec)	Dawson (Yukon)	Resolute (N.W. Territories)	Centre of Hudson Bay	Interior of Keewatin
Latitude	21	42	65	31	42
Summer heat	37	24	90	71	60
Annual cold	42	50	80	54	75
Ice:					
Permafrost	60	60	92	—	75
Floating ice	—	—	—	65	—
Precipitation	0	52	95	52	90
Vegetation	40	40	100	—	80
Accessibility other than by air	20	20	70	40	100
Air service	20	30	25	100	100
Population:					
Number of persons	20	67	78	—	—
Regional density	—	—	—	—	90
Economic Activity	35	50	80	85	100
Nordicity total	295	435	775	622*	812

* The original total out of 800 has been adjusted to out of 1000, for comparison with the landbased stations.

TABLE III

Comparisons of nordicity by the criteria of VAPO

CRITERIA	FAIRBANKS (Alaska)	VERKHOYANSK (U.S.S.R.)	ALESUND (Svalbard)
Latitude	42	44	75
Summer heat	10	62	70
Annual cold	65	100	85
Ice	50	90	90
Precipitation	65	90	60
Vegetation	15	40	80
Accessibility by land	25	50	50
Air service	35	40	75
Population	0	50	60
Economic activity	30	65	92
Nordicity total	337	631	737

4. Nordicity in the Boreal Hemisphere

Continuing on from the preceding index, we now have some other examples of values taken in different countries.

TABLE IV

Global values of the American and Eurasian Norths, in VAPO.

CANADA	
Melville Island (Franklin)	865
Alert (Franklin)	854
Barnes Ice Cap (Baffin)	804
Cambridge (Franklin)	690
Coral Harbour (Southampton)	662
Frobisher (Baffin)	609
Aklavik (Mackenzie)	511
Povungnituk (Quebec)	502
Chimo (Quebec)	459
Churchill (Manitoba)	450
Churchill Falls (Labrador, 1927)	432
Fort Smith (North-West Territories)	423
Yellowknife (Mackenzie)	405
Long Range (Newfoundland)	350

La Ronge (Saskatchewan)	340
Whitehorse (Yukon)	283
Gagnon (Quebec)	277
Moosonee (Ontario)	270
North-East of the Gulf of St. Lawrence	238
Grand Prairie (Alberta)	211
Chibougamau (Quebec)	183

ALASKA

Barrow	799
Anchorage	204

GREENLAND

Ice Cap (on the Arctic Circle)	830
Scoresby	635
Thule (base)	603
Upernivik	584

NORDEN

Kirkenes (Norway)	278
Lulea (Sweden)	153
Tromsö (Norway)	145

U.S.S.R.

Franz Josef Land	875
Wrangel	800
Vilyuiski	766
Tiksi	653
Chukotskiy Mountains	650
Khatanga	634
Nizhniye Kresty	605
Diomede Island	599
Anadyr	579
Tura	539
Norilsk	473
Yakutsk	392
Vorkuta	365
Khanty-Mansiysk	361
Kirensk	343
Magadan	340
Murmansk	247
Ust'-Kamchatsk	238
Arkhangelsk	231
Siktyakh	213
Okha	209

By way of comparison there follows the nordicity in VAPO, or polar values, of some settlements in the southern zone of nordic countries – the nordicity still being calculated with the same index (this zone in the south of the North serves as a support to the development of the polar world and we qualify it as a "base" region).

In the "base" regions of the U.S.S.R.

Moscow	48
Leningrad	61
Novosibirsk	125

In the "base" regions of Canada

Montreal	45
Edmonton	125
Sept Iles	133
Winnipeg	142

In the Norden countries, to the south of the Middle North

Copenhagen	29
Stockholm	56
Tampere (Finland)	67
Narvik (Norway)	112
Reykjavik (Iceland)	127

These and many other values help us establish objective southern boundaries to the northern regions. The only value-limit worth keeping is not the isonord zero VAPO, the farthest frontier, which nordicly speaking is of little significance, and in America almost completely avoids Canada; but the isonord of about 200 units which seems, in the present state of development, to provide an acceptable frontier for the nordic world. This limit, which synthesizes the region, North, corresponds to the southern limit of the Middle North, and is situated a little this side of the former southern limit of the Subarctic. The main nordic areas thus delineated are the Arctic Ocean, the Soviet North and the Canadian North. Within this area there are scarcely more than seven million inhabitants, of whom almost half live in the European part of the Russian North. This statistic is well short of the many millions living in the Subarctic, a number which seemed excessive, considering that settlement is limited in cold countries.

The regional nordicity which appears the most difficult to determine is the line of transition from the Near North in the

northern fringe of the base regions, immediately to the south of the Middle North. These marginal areas are characterized by a low level of nordicity, such as in Lulea in Sweden (153 VAPO) and Murdochville in Quebec (125), and may be found equally well on the Norwegian coast, in Baikal (U.S.S.R.) or in Abitibi (Canada). The section still least known to us is the nordic Pacific (the Okhotsk Sea, the Kuril Islands, the Bering Sea and the Aleutian Islands), and nothing could be less certain than the 168 VAPO of Sovetskaya Gavan in the north of the Sea of Japan.

The nordic index enables us to determine that the major part of the Arctic Ocean and Greenland are in the Far North, whereas about two-thirds of Alaska and the U.S.S.R., as well as almost the whole of the nordic section of Scandinavia, are in the Middle North. Relatively speaking Canada seems to be at a disadvantage, possessing more territory in the High North and the Far North put together than in the Middle North alone. Generally the score for the nordic index can be seen as the inverse value of the areas of habitability.*

* These calculations have been made for the boreal hemisphere only, but providing we made some minor corrections, they could equally well be applied to the high Austral latitudes. The "nordic" vocabulary would become a polar vocabulary: polar criterion, world, index, value, gradient, and polar front; polaricity (the equivalent of boreal nordicity); polarians for the inhabitants. In the order of progressive polaricity, the terms designating the zonal regions would be prepolar, mesopolar, megapolar and superpolar.

2.
The Arctic Basin and the Arctic: Some Definitions

John E. Sater

SOURCE: John E. Sater, *The Arctic Basin* (rev. ed., Washington: Arctic Institute of North America, 1969), pp. 1-4. Reprinted by permission of the author and publisher.

Considerable misunderstanding still exists about the portion of the earth that we call the Arctic. If some of this misunderstanding stems from an imprecise terminology, the reason is that the well-known terms from the past do not suffice to express the subtleties that are now known to characterize the region. Certain terms that are commonly used are unhesitatingly translated by many into a few, rather limited – and sometimes wrong – ideas. Among these terms now rendered inexplicit by an increase in knowledge is the word "arctic" itself.

Within a particular discipline, its use as an adjective allows the delineation of a precise boundary concerning that subject, but to define it as a noun, or as an adjective for more general application, by conglomerating the various boundaries of the many disciplines would only be an exercise in confusion. Consequently the reader of these pages will find it more meaningful if he views the term "arctic" as a group of concepts and attributes that is not yet closed to amendment – as a word in the process of being redefined, and certainly not as a territory with precise boundaries.

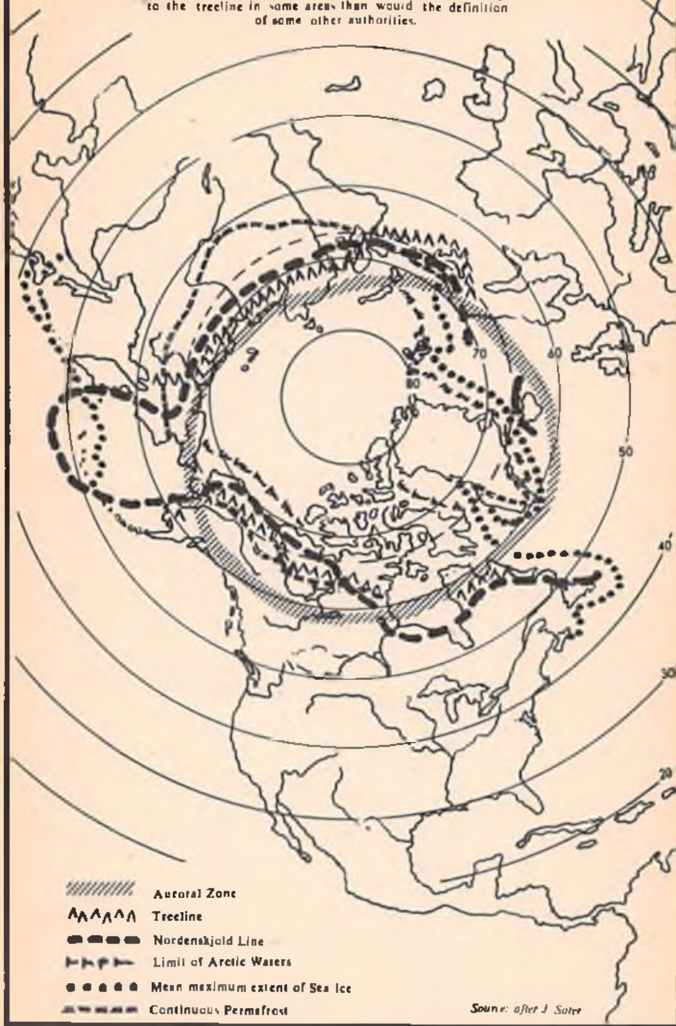
Wherever its boundaries, the Arctic is partly obscured by its distance from us, but more by its inhospitable environment that has limited the numbers of those who could experience it. Only within the past few decades have there been concerted efforts to learn exactly the processes and elements that make the region what it is. These efforts have had a depth and success not previously achieved primarily because modern technology and geopolitical interests have offered a technical capacity and stimulus that had been lacking before.

As with many other areas of inquiry, the Arctic is a subject in which the more that is learned, the more, it is realized, there

is to learn. When first encountered by Western man, a single simple term sufficed to describe it. The Greek word for bear – *arktos* – was an ample designation for the region in a period when men were conscious of the constellations, and the Great Bear, or Big Dipper, was a well-known sign in the northern sky. The early visits were probably limited to distant views of glaciers and snow-covered mountains or cautious probings of the southern edges of the ice-filled seas, but their accomplishment became part of our history and the memory remained. Gradually more people penetrated more deeply into the region, some even settling there, but their contacts were still few and served to illuminate only small areas or locales. The rise of astronomy and cartography eventually led to the defining of an Arctic Circle: the line above which the sun would not rise on the winter solstice nor set on the summer solstice. The definition is valid under most circumstances, and at the North Pole the sun does not appear for nearly three months at midwinter. However, because of the manner in which the atmosphere refracts light, the sun may be seen even when it is slightly below the horizon, and on some occasions, overcast excluded, will not be visible even when it is above the horizon.

Usually three expressions are intertwined – arctic, polar, and high latitude. They have come to be used interchangeably in conversations about the northern portion of our globe, but always with a lack of precision. Literally, the Arctic is the area north of 66°30′N, but the inappropriateness of the terms of definition weakens its utility. Furthermore, the area is not best known for the variation of the hours of daylight and darkness but for climatic conditions that are little related to the precision of an astronomic definition. "Polar" is less exact, therefore more mutable, but it may be related to many locations. The geographic, geomagnetic, dip, and cold poles and the pole of inaccessibility are all facets of the north polar region but each has its counterpart in the Southern Hemisphere. "High latitude" is convenient, because of its inexactness, but presumably supplements middle and low latitude while retaining the inflexibility of all mathematical divisions of the earth's surface. Assuming that it denotes the area north (or south) of 60°N (or S), it does not add or include sufficient distinction to warrant differentiating it from arctic. All these expressions apply to the same approximate area and help to convey meaning to an idea, but each is unsuited or inadequate to serve as an all-inclusive definition, or designation. . . .

Oceanographers and marine biologists are concerned with



MAP 2

the seas and the life therein, and their definition of arctic is therefore limited and applicable only to the seas. They define arctic water as having a temperature at or near 0°C and a salinity of approximately 30 $^{\circ}/_{oo}$. The surface water of the Arctic Ocean exhibits these characteristics as do portions of the adjacent seas. These quantities may be established with accuracy and their limits drawn on a map. The Arctic Basin itself may be drawn on a map, for it is a structural feature of the earth's crust that is filled with a portion of the world ocean. . . .

On the land, the occurrence of permafrost gives the geologists, and others, a significant and definite means of establishing an arctic limit. This phenomenon is characterized by the presence of perennially frozen ground a decimeter to a meter or so below the surface, which may extend to depths of hundreds of meters. In more northerly locations, this phenomenon occurs beneath virtually all the land surface, while farther south it is interrupted by areas of unfrozen ground until a southern limit is reached beyond which it is not found. Permafrost is of interest to botanists because the roots of plants that grow in the ground above it cannot penetrate into it, nor can water. As a result, the root systems of plants are restricted in size and the ground may become very moist in summer. It is of interest and concern to engineers because it has tremendous significance to anything constructed above or in it.

As a result of the behavior of the earth's magnetic field, the aurora borealis is seen as a colorful and unique attribute of the northern regions. The field also creates problems in the use of magnetic compasses in the region and may severely disrupt radio communications. Physicists therefore may delineate an arctic region in which there are severe magnetic disturbances, auroral displays, and significant and prolonged radio blackouts.

The most useful definitions of arctic, in terms of their meaningfulness to man, are those based on climatic factors. The weakness of these definitions is their number and the fact that no one of them has been accepted by all concerned. The 50°F isotherm, the 43° isotherm, the mean winter temperature in relation to summer means, and other parameters have been suggested but not agreed to. Further, the condition most widely associated with the term arctic – cold – is most applicable in terms of its duration rather than its intensity. Thus while the Arctic is cold longer than the lower-latitude regions, the areas of extreme cold in the Northern Hemisphere are located in the Subarctic.

Treeline is probably the most useful definition of arctic for it is related to the climate and adds a clear visual element that all can see. As a result of the climatic, and soil, conditions there is a northern limit of trees, and treeless mountains and tundra are the lands that are usually thought of as "the Arctic." Unfortunately there are disadvantages, too, in using treeline as the basis of a definition. Not only is it liable to change in time, but also it must be subdivided in a manner similar to the oceanographer's high-, mean-, and low-tide lines. Thus there is a northern limit of continuous forest, a northern limit of erect trees, and a northern limit of species.

A concept as complex and extreme as the Arctic necessitates establishing another region wherein the various circumstances are mitigated and grade into those of the temperate regions. Thus has come into use the term and concept Subarctic: a vast forested area of climatic transition. But definitions require limits or boundaries and boundaries separate those things that are distinct. The profusion of conditions that are not coincident with each other but which have arctic aspects virtually precludes the meaningful defining of an "Arctic." However, it is useful to list the factors that in sum make the Arctic the distinct region that it is, for it is these factors that give meaning to the concept and the word.

The Arctic:

is located in the higher latitudes of the Northern Hemisphere;
receives less solar radiation and, hence, surface warming because of the oblique angle of incident solar radiation;
is cold longer than temperate regions;
is distinguished by the absence of trees;
is characterized by the occurrence of permafrost under its land surface;
consists mainly of an ice-covered ocean;
experiences a wide range in the duration of daylight and darkness;
receives no more precipitation than most deserts but has many lakes and rivers that may freeze solid;
is very sparsely settled;
lies at considerable distance from the centers of population;
lies between the major population centers of the present day;
is not now of economic importance because its resources have only just become economically exploitable.

3. The Identification of Vinland

by Alan Cooke

SOURCE: *The Polar Record*, Vol. XII, No. 80, pp. 583-87. Reprinted by permission of the author and publisher.

During the past two hundred years, few informed persons have doubted that about A.D. 1000 the Norse attempted to colonize a part of the New World that they called Vinland. But the location of Vinland and the meaning of the word itself have long been subjects of dispute among scholars, and the lack of incontrovertible evidence of Norse occupation has permitted a proliferation of hypotheses. Among the earliest speculators in this matter were Torfæus (1705) and Forster (1784), but the initiation of spirited controversy may be credited to Rafn (1837), who first forcibly drew public attention to the fact that it was the Norse who, some five hundred years before Columbus, discovered the New World.

Excavation has now revealed house sites in northernmost Newfoundland that, to competent judges, appear neither Indian nor Eskimo, but typically Norse. This immensely satisfying discovery is the achievement of the Norwegian explorer, scholar, and writer, Helge Ingstad, and his archaeologist wife, Anne Stine Ingstad. Ingstad began his search for Vinland by a careful study of the voluminous literature. The evidence is derived chiefly from Adam of Bremen, an ecclesiastical historian, who wrote about 1075; from Icelandic sagas written during the thirteenth and fourteenth centuries; from certain early maps, especially the late sixteenth century delineation of the northern regions by Bishop Sigurdur Stefansson; and from modern knowledge of weather and ice conditions, ocean currents, and the techniques of navigation of a thousand years ago.

The sagas that mention Vinland are not consistent in all details, but that is not surprising in accounts written two centuries or more after the event. The *Grænlendinga saga* gives the fullest account of the voyages to Vinland which began about 986, when Bjarni Herjolfsson was driven off course during a

voyage from Iceland to Greenland and came in sight of new land. An accident prevented Erik the Red, first colonizer of Greenland, from leading an expedition of land-hungry Greenlanders to explore the new land, and the honour fell to Erik's son, Leif the Lucky. Following Bjarni's course in reverse, Leif sighted first a land of flat stones, which he named Helluland; further south, he found a well-timbered coast, which he named Markland; and to the south-east, he came upon a pleasant country, where his expedition passed the winter. This he named Vinland.

The next summer, Leif returned to Greenland. A year later, his brother Thorvald led a second expedition to colonize Vinland. Using the houses built by Leif as base, he made in the first summer a long exploration westward; in the second summer, he explored east and north, probably along the coast of Markland. Here the Norse met natives for the first time, whom they called Skrælings, and by a Skræling arrow Thorvald died. After passing a second winter in Vinland, his party returned, with their sad news, to Greenland. Another of Erik the Red's sons, Thorstein, set out to retrieve Thorvald's body from its Markland burial, but he was obliged to give up the plan after a storm-tossed summer at sea, and he died the next winter in Greenland. His widow, Gudrid, married Thorfinn Karlsefni, who followed the course of his wife's brothers-in-law, taking with him to Vinland three ships, 160 men, some with families, and livestock. But, after further explorations and a battle with the Skrælings, they, too, withdrew. A son, Snorri, was born to Gudrid in Vinland, the first American of European parents, so far as record tells. Leif's half-sister, Freydis, made another attempt to settle Vinland, but her venture ended in civil discord and murder.

The sagas do not dwell on later voyages to Vinland and Markland, perhaps because they had become commonplace and lacked the epic quality of those made by Erik's vigorous and bold children. In other Icelandic records, there is mention of the departure of a missionary bishop to Vinland in 1121 and of a wood-gathering trip from Greenland to Markland in 1347. Nicolo Zeno quotes a fisherman's story that seems to show the presence of Norsemen in Vinland or Markland as late as 1354.

But where was Vinland? There is good reason to suppose that Helluland was some part of present-day Baffin Island and that Markland was some part of the coast of Labrador, perhaps the handsomely forested region of Lake Melville and Hamilton Inlet. Ingstad has assumed that the saga directions and the descriptions of time-distance relations mean what they say – an

assumption that few of his predecessors in the Vinland search have cared to make – and that, therefore, Vinland must lie fairly far north in Newfoundland; within two days of Markland and a short summer's sail from Greenland. He has accepted, as a few recent scholars have, the suggestion made by the Swedish philologist Soderburg in 1888 that *vin* may be taken to mean pasture, and that Vinland was remarkable in Leif's eyes, not for its wines or vines, as Adam of Bremen and the saga-writers after him supposed, but for its grazing potential. This theory Ingstad has elaborated in a massive study, *Landet under leidarstjernen* (1959).

In 1960, Ingstad began a survey, by boat and airplane, of the coast from Rhode Island north to Newfoundland. In northern Newfoundland, a resident of L'Anse-aux-Meadows gave him news of nearby ruins, which, during the summer of 1961, Fru Ingstad began to excavate. From the beginning, their close resemblance to Norse remains in Greenland was promising. The Ingstads continued excavation during the summers of 1962, 1963, and 1964, assisted by scientists from Norway, Sweden, Iceland, Canada, and the United States. Their labours revealed several house sites. One of them measures about 20 by 15 metres, and is composed of a great hall and four connecting rooms. Near by, they found a smithy with a stone anvil and many hundred pieces of slag, bits of iron and bog iron; they found, also, a pit for the manufacture of charcoal and, in the neighbourhood, a rich deposit of bog iron. The techniques evidently used for making charcoal and for hot-forging iron were unknown to primitive Indians and Eskimos, and to post-Columbian occupants of the region they would probably have been obsolete. A dozen Carbon-14 dates from the site cluster around 1000. The first and, so far, the only recognizably Norse artifact, a soapstone spindle whorl, was uncovered just at the end of the 1964 season. The scarcity of Norse artifacts is disappointing but not surprising, for most will have decayed long since in the wet and acid soil. Over the diggings, the Government of Newfoundland has erected shelters, and it has declared the site an historical monument.

It cannot be asserted positively that L'Anse-aux-Meadows was the New World home of Leif Erikson himself, but the geography of the region so nearly matches the saga descriptions of Vinland that identity seems very likely. How much farther south the Vikings sailed, or how far westward into the continent they penetrated cannot yet be stated with any confidence. There is no reason to suppose they did not explore far, both south and

west, and there is reason to hope that the interest generated by the Ingstads' discovery may lead to new revelations of Norse occupation of the New World.

In the United States, heightened public interest in Norse knowledge of the New World has led to the declaration of Leif Erikson Day. In August 1964, Congress passed a joint resolution (H.J. Res. 393, introduced into the Senate by then Senator Humphrey) that authorized the President to proclaim the day each year on October 9. It was thought appropriate, in naming this commemorative date, to accord Leif a three-day precedence over Columbus, whose discovery of the New World is celebrated on October 12.

The posthumous publication of Vilhjalmur Stefansson's autobiography (1964) is a reminder that the discovery of the New World was completed by the Norse race that, by following a westward course from Norway to Ireland, Iceland, Greenland, and Vinland, had begun it. In 1915 and 1916, Stefansson, a Canadian-born Icelander, added the last major land masses to the map of the Canadian Arctic Archipelago. The kinship-conscious Norsemen of the eleventh century would, no doubt, have taken satisfaction in the knowledge that Stefansson, in common with many other Icelanders, could trace his family back through the wonderfully complete records of Icelandic history to include Snorri, the first son of Vinland.

4.

Early Geographical Concepts of the Northwest Passage

Theodore E. Layng

SOURCE: *North*, Vol. XIII, No. 4 (July-Aug., 1966). Reprinted by permission of the author and publisher.

The venerable Adam of Bremen in his great ecclesiastical history of northern Europe, written about 1075, recorded for the first time the existence of Iceland, Greenland, and "islands" bearing farther away in the same direction. He was in fact giving to an uninterested Europe the highlights of the Norse odyssey to America. Do not number him however amongst the early proponents of a northwest passage. He advises that beyond Greenland "there the ocean, shrouded in mist, forms the boundary."

There is a paradox here. The "islands" west of Greenland – the Helluland, Markland, and Vinland of the Norsemen – could scarcely be out-of-bounds. Unhappy Adam. He accepted in principle the disconcerting concept of a globular world, but his thoughts still generated within that very practical image that the mapmakers of his day were wont to present. The awful ocean flowed all round, corsetting the tripartite world of Europe, Asia and Africa, and it was scarcely within the scheme of things to bulge the tight little cartographical circle to accommodate lands not mentioned in the Bible, and therefore beyond the decent regard of man.

Meanwhile the Scandinavians were ranging far and wide across the top of the globe from the White Sea to the Canadian Archipelago. Amongst their kind it is certain that navigating to the west along a northerly Atlantic route was a frequent occurrence. For the mediaeval sailor it was surely a more reassuring thought to sail the top of the world than to risk sailing through fiery equatorial regions to the bottom, where God alone knew how a man could avoid orbitting into space.

During the fourteenth and fifteenth centuries the old Norse route became less and less frequented. The Scandinavian people seem to have lost their zest for the sea. Interest in maintaining