ARCTIC HABITAT

Submitted in partial fulfillment of the requirements for the degree of Master of Architecture, at the Massachusetts Institute of Technology, June, 1958

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University of British Columbia 1952

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May 19, 1958.

Dean Pietro Belluschi
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Massachusetts Institute of Technology
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Dear Dean Belluschi:

I herewith submit my thesis entitled, "Arctic Habitat", in partial fulfillment of the requirements for the degree of Master of Architecture.

K. G. Terriss

A B S T R A C T

ARCTIC HABITAT

K.G. TERRISS

Submitted for the degree of Master of Architecture in the Department of Architecture on in June, 1958.

A study of the problems of providing the physical framework for amenable family living and community life at contemporary standards under Arctic conditions, and the application of these findings to a site in the Canadian Arctic.

Under both international and national pressures the Arctic is now in a stage of rapid development and settlement as one of the last frontiers of the world. One of the basic requirements for the successful development of these regions and the foundation of a stable economy is the establishment of contemporary communities.

This thesis investigates present and past settlements of the Arctic for lessons in the development of contemporary standards of Arctic living. The basic problems are:

socio-psychological	- barren, monochromatic landscape - isolation - winter night and summer day - individual and family privacy balanced with community life
physical	- permafrost in relation to utilities and foundations - low temperature in relation to insulation and condensation - wind and snow drifting - construction techniques and timing.

These are analyzed in their relation to the problems of contemporary family life.

The results of this study are synthesized into the physical plan for the housing and closely related community facilities for Frobisher Bay on Baffin Island in the Canadian Eastern Arctic. This small outpost is being rapidly transformed into a town of 4,000 people to support a vital re-fueling and stop-over airfield on commercial trans-polar flights. Within the framework of the general plan for the town the housing will be designed in terms of basic units for varying needs, and the relationship between the units and the other aspects of the community. The provision of high quality housing and community facilities will be considered in an

attempt to offset the inconvenience of Arctic life and thereby stabilize the community by reducing population turnover. The objective of the thesis will be to resolve the problems of the physical design of the units under the special circumstances of Arctic life.

A C K N O W L E D G E M E N T S

I wish to acknowledge the criticism and advice given during the preparation of this thesis by the members of the staff of the School of Architecture and City Planning, especially

Professor L.B. Anderson

Professor Roland Greeley

Professor Kevin Lynch,

I further thank, for their assistance, back ground material, and advice

D. D. Wallace, Voorhees, Walker, Smith and Smith
fellow 1955-56

The Architectural Division, Central Mortgage and Housing Corporation, Ottawa

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T A B L E O F C O N T E N T S

Abstract

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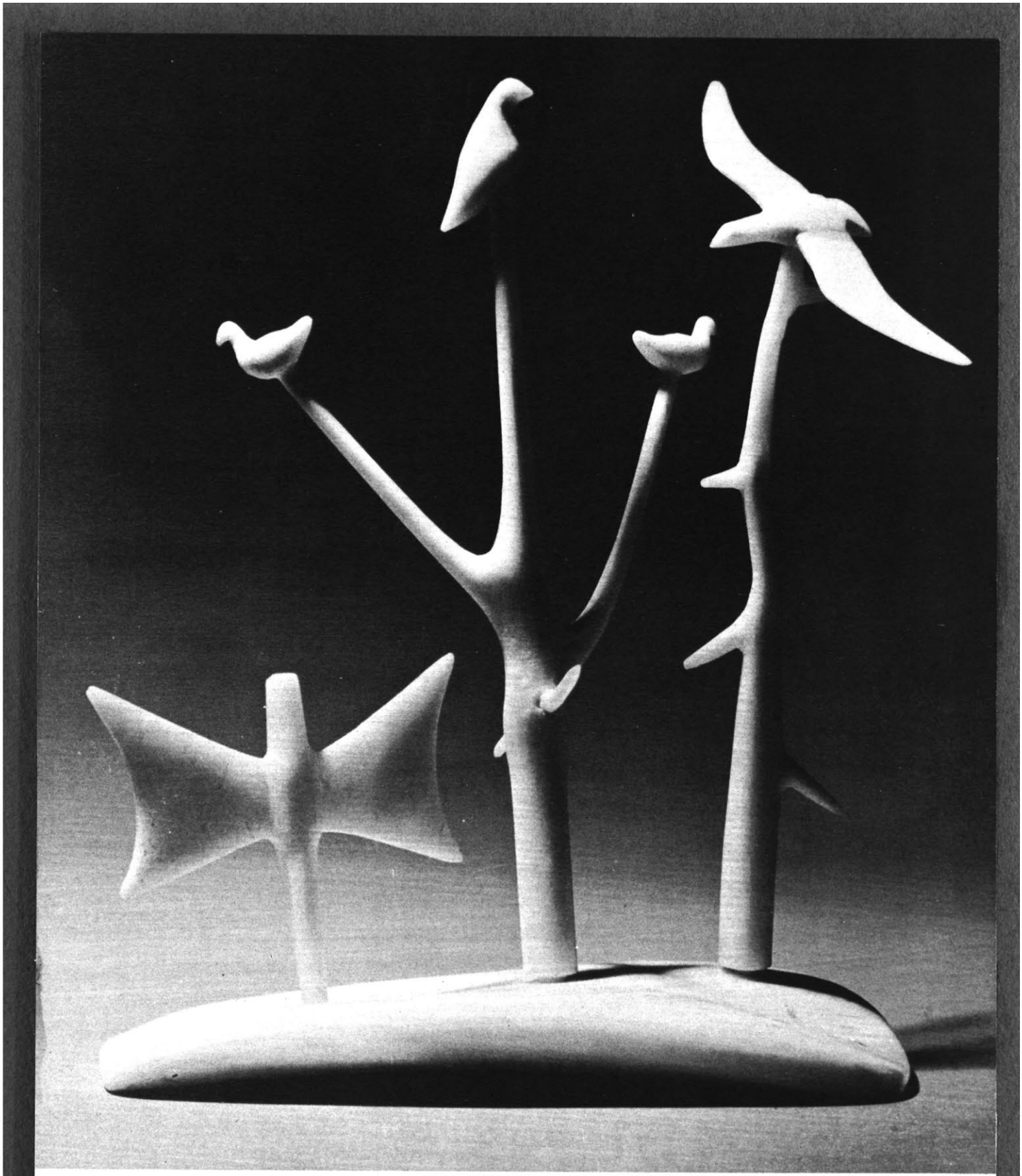


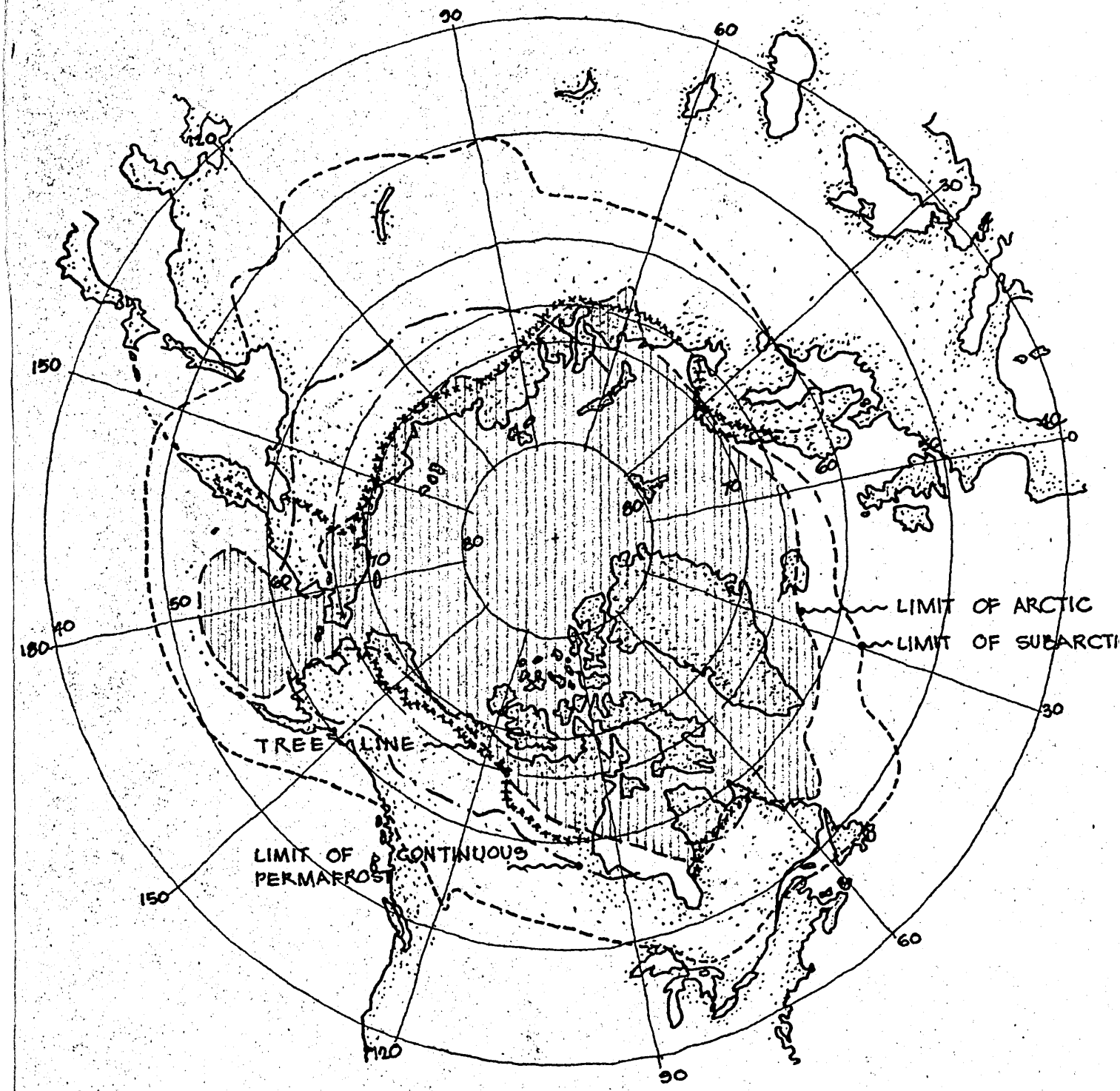
BIRDS IN A TREE—IMPRESSION OF CARVER WHO HAS NEVER SEEN A TREE—*ITTORCHIAK*, FROBISHER BAY, BAFFIN ISLAND

A space of awful, inhuman beauty, an unbelievably subtle undulation of colour and form,

R.A.J. Phillips

The Canadian north is one of the last great undeveloped regions on this globe. There are few other parts of the world of great size that have not been occupied - insofar as they are capable of it - and to a substantial degree exploited. In a large degree it is the tantalizing possibilities - the great uncertainties and obscurities - of this tremendous area at the top of our continent that leads us to wonder what the future has in store for this country as a whole. For much of the answer to the national riddle depends upon the prospects of the north.

R.G. Robertson



NORTH POLAR REGIONS

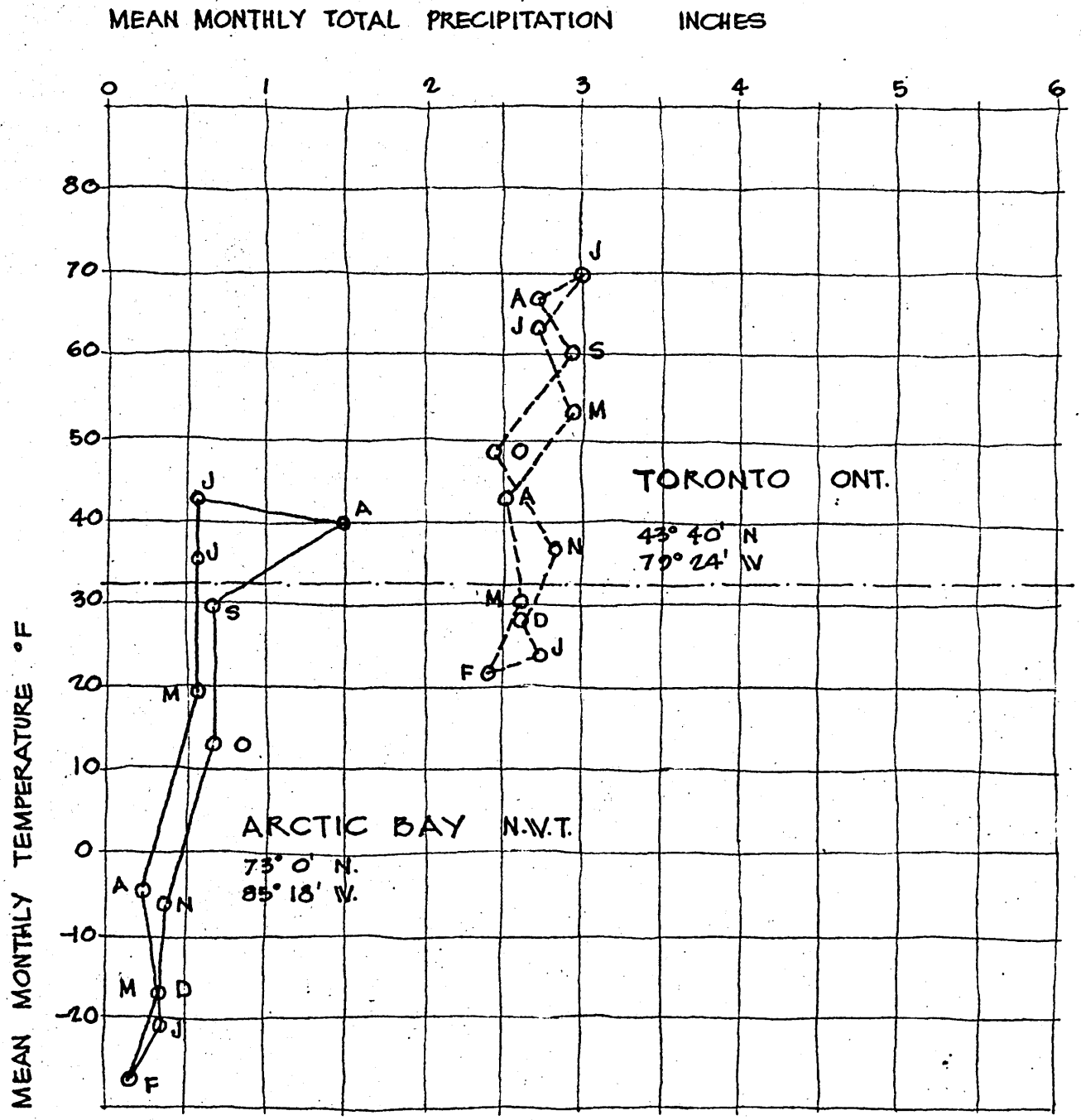
S U R V E Y

Historical

In order to state the limits of this thesis it is necessary to define the geographical area referred to as 'arctic'. Generally speaking the broad term can be subdivided into three zones; sub-arctic, arctic and polar. These are not divided by convenient lines of latitude but are usually defined by climatic conditions which vary with the geographical features. The distinction between polar and arctic is not rigidly set and is of less present importance than that between arctic and sub-arctic. This boundary is generally agreed to be the 50°F summer isotherm, that is a line north of which the mean temperature of the warmest month is less than 50°F; provided that the mean temperature for the coldest month is not more than 32°F.[1] This line has considerably more than a theoretical meaning since it roughly corresponds to the northern limit of trees and the southern limit of continuous permafrost. Older authorities also used it as the northern limit of possible cultivation. From the map it can be seen that the most extensive area is in the Canadian Arctic Archipelago and Hudson Bay regions. The mastery of this environment then is of proportionately greater importance to Canada than to any of the other arctic countries.

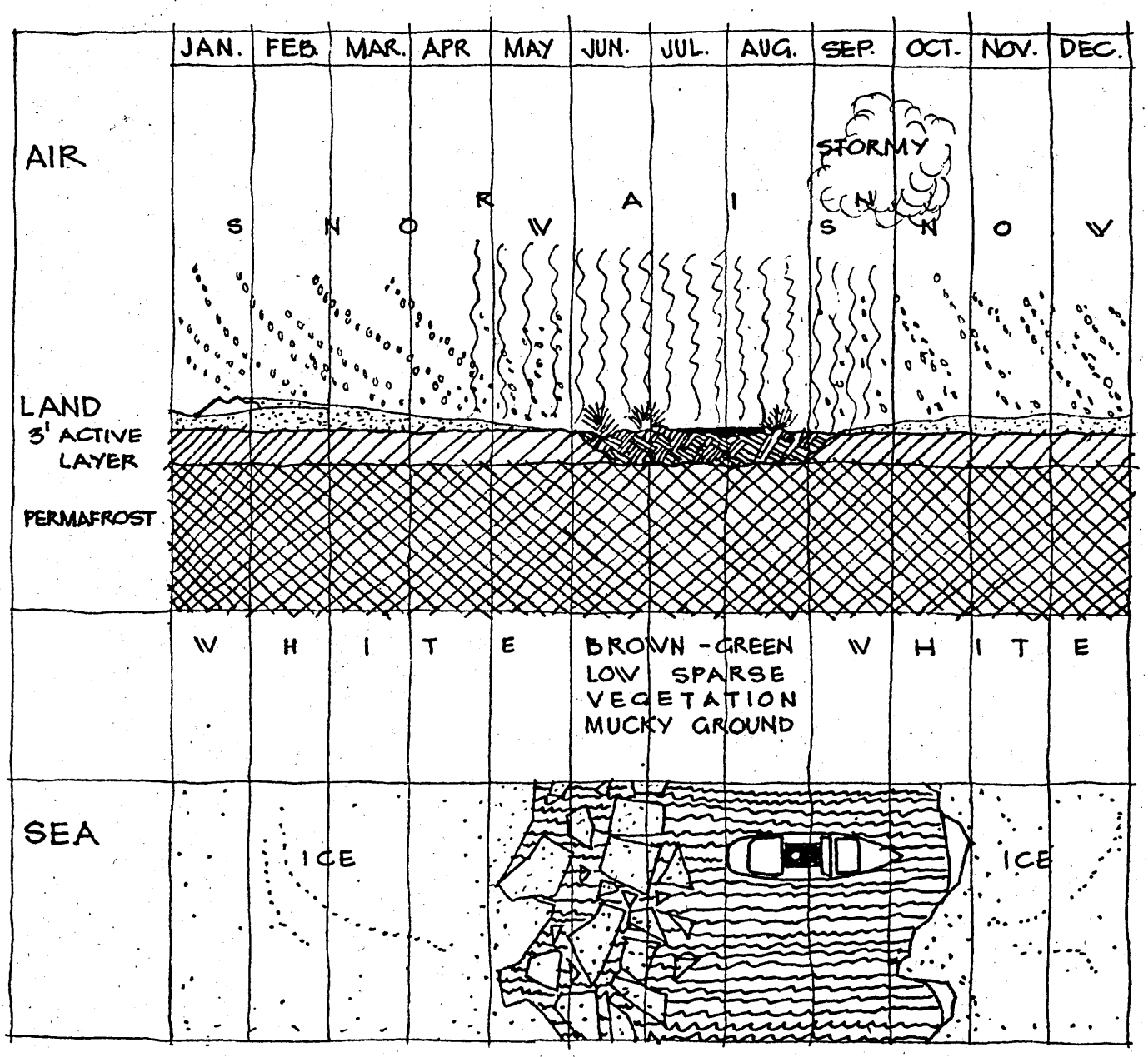
The environment assumes certain characteristics which can be generalized for the entire arctic area although there are many local variations. The principal climatic control is of course the latitude with its resulting

[1] Kimble, G.H.T., and Good T., edited, Geography of the Northlands, The American Geographical Society and John Wiley & Sons, Inc., New York, 1955. pp. 2-3.



HYTHERGRAPH
COMPARING ARCTIC AND TEMPERATE ZONES

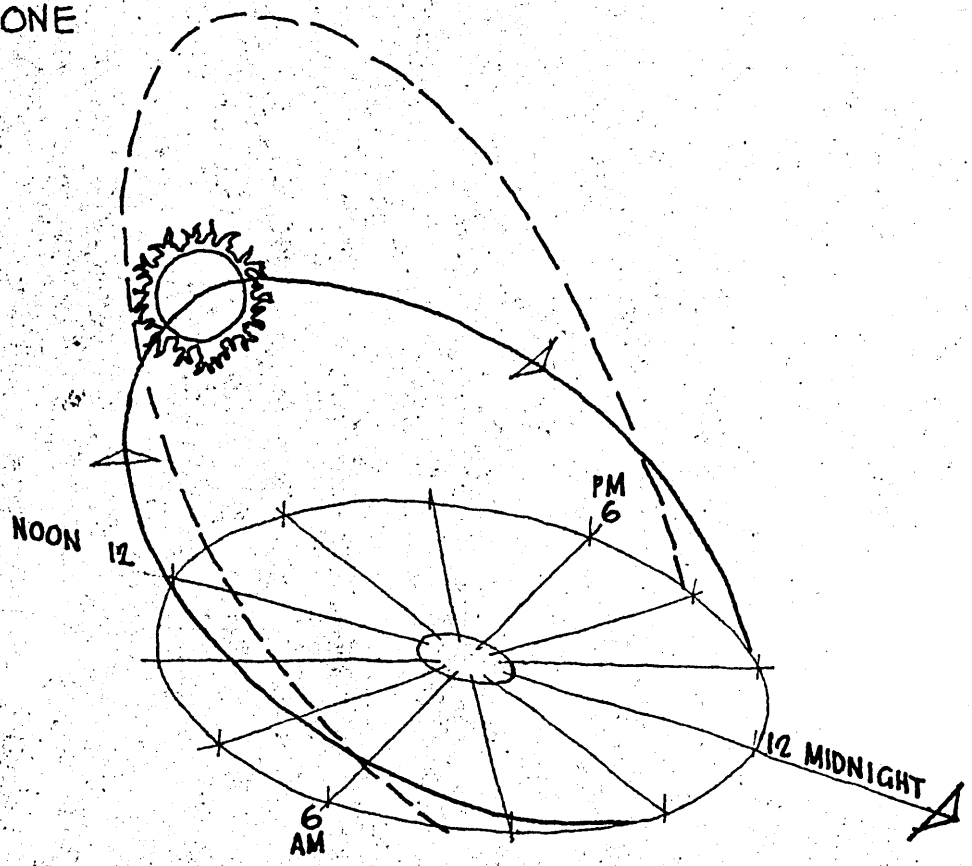
- LOW PRECIPITATION, BUT LITTLE EVAPORATION
- WINTER LOW NOT EXTREME, BUT FREEZING POSSIBLE ALL YEAR



ENVIRONMENTAL SUMMARY

TEMPERATE ZONE

ARCTIC ZONE

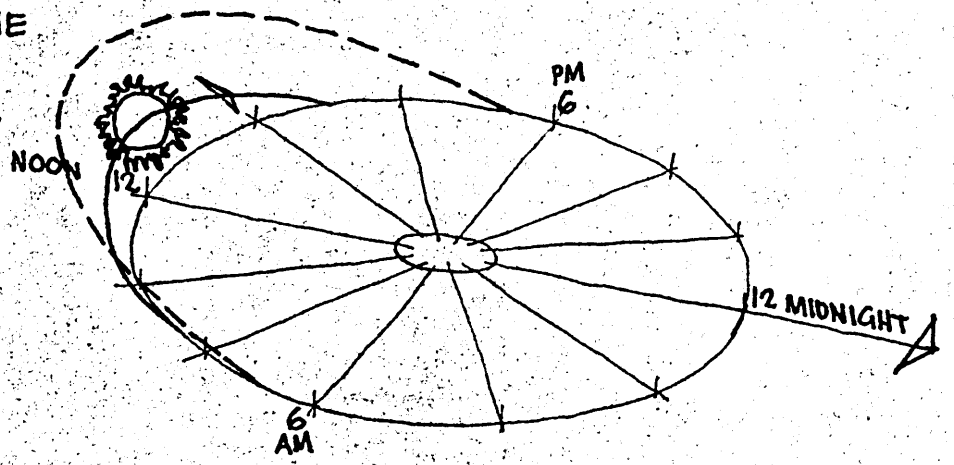


SUMMER SUN

- WIDE SWEEP
- RELATIVELY LOW ALTITUDE
- 24 HOURS DAYLIGHT POSSIBLE

TEMPERATE ZONE

ARCTIC ZONE



WINTER SUN

- SHORT SWEEP
- VERY LOW ALTITUDE
- 24 HOURS DARKNESS POSSIBLE

GREAT PSYCHOLOGICAL VALUE

solar conditions. At the Arctic Circle there is one day of continuous darkness at the winter solstice and one day of continuous daylight at the summer solstice, with correspondingly increasing contrasts toward the pole. This leads to the principal feature, that of little or no solar radiation during the winter and days of continuous radiation during the summer.

> "From the first week of June to the second week of July the earth receives from the sun more heat per square mile per day in the north polar regions than in the tropics."[2]

The summer heating effect is however reduced by the obliquity of the rays and the resultant thickness of the atmosphere they must penetrate. This low angle of the sun even in June is one of the most vital differences from temperate latitudes. The temperature is relatively constant over the entire area, especially during the summer, due to the large water areas. There is a general decrease of mean annual low temperature toward the pole due to the absence of winter solar radiation but the lowest recorded temperatures have all occurred in sub-arctic continental areas. The mean daily January temperature varies from -20°F to -30°F and the mean July temperature between 40°F to 50°F.[3] There is however the possibility of frost generally during any of the summer months. In terms of precipitation the arctic is a desert with from 10" to 15" per year. This is principally snow but even at the pole rain falls during the summer months. The snow is light and powdery and blows easily into drifts often exposing barren rock even in midwinter. This blowing snow often creates a phenomenon known as "white out" in which the horizon is lost and distance judgement is almost impossible.

[2]Stefansson, V., The Northward Course of Empire, Harcourt Brace & Co., New York, 1922, p.72
[3]Geography of the Northlands, op.cit., pp. 73-74.

The moon is the sky's only illumination from November to January when the whole Arctic turns midnight blue.

The pale winter sun, hidden for three months, emerges briefly at 2:30 p.m. on a violet afternoon late in January.

Perpetual midnight of November turns Arctic into dead world of Prussian blue.

Perpetual daylight in July turns sea fiery red as midnight sun hugs horizon.


Baffin Island: August


Barren Lands: February

LAWREN HARRIS

Mountain, Baffin Island

This austere painting on the left represents the last phase in Lawren Harris' development before he turned to abstract art. Critics feared Harris' early paintings would discourage immigration because they were so bleak.

THE SEA

In July, Ungava Bay shivers as its ice pack breaks up . . .

Above: The world goes upside down off Holman Island in June as the rays of the midnight sun are splashed across the candling ice and open leads of water seem to be reflected in the sky.


A. Y. JACKSON
Barren Lands

The Play of the Seasons in the North

SUMMER. Among the mountains and fjords of Baffin Island tents blossom out and boats dot the black surface of the sea.

WINTER. The whole world becomes a monochrome of white where snowhouses blend with frozen ocean and white hills.

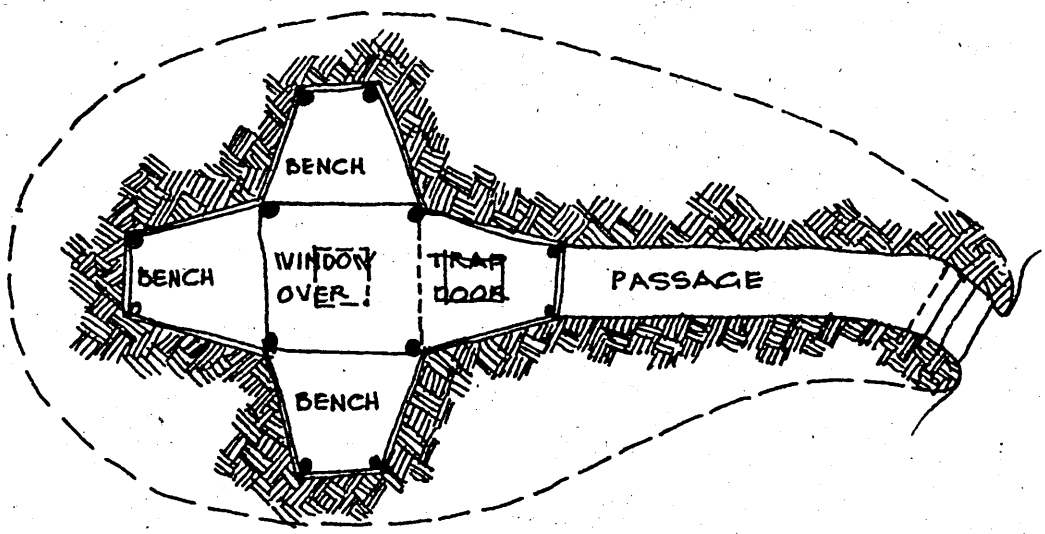
The visual landscape is bleak and barren varying from prairies to mountains with nothing growing more than about one foot above the ground. Although a greater part of the year it is a more or less continuous sea of white over the land and frozen water areas, in the brief summer there is a colourful burst of alpine flowers, mosses and sedges.[4] One of the principal characteristics of this plant life is its slow growth and precarious existence within the temperature cycle and ground conditions. This landscape is generally referred to as arctic tundra, and its extent follows quite closely the area defined as arctic. Another related characteristic is the presence of permafrost or permanently frozen ground. During the summer months the top layer, approximately 3 feet, thaws but the ground below remains perennially frozen to a tremendous depth. This condition creates an impervious layer which during the summer prevents the absorption of natural moisture creating a very wet and unstable ground condition. For this reason and the freezing of the sea, lakes and rivers allowing easy transportation the winter months are preferable to the damp, uncomfortable summer.[5] Insect life is not as prevalent as in the sub-arctic due to the longer winter but the extensive water areas create somewhat of a mosquito and fly problem. Animal life is, however, quite abundant ranging from migratory birds to silver fox, musk ox, caribou, and polar bears. The sea is rich in fish, seal, and walrus as well as the normal marine plant life at lower depths.[6] Although this may seem an austere region there is an encouraging sign in the recent rise of winter temperatures since 1885 and especially since 1920.[7] This has lead

[4] Geography of the Northlands, op.cit., Chapter 5
[5] Shelesnyak, M.C., Across the Top of the World, Navy Department, Washington, D.C., August, 1947
[6] Geography of the Northlands, op.cit., Chapter 6
[7] Ibid., p. 81

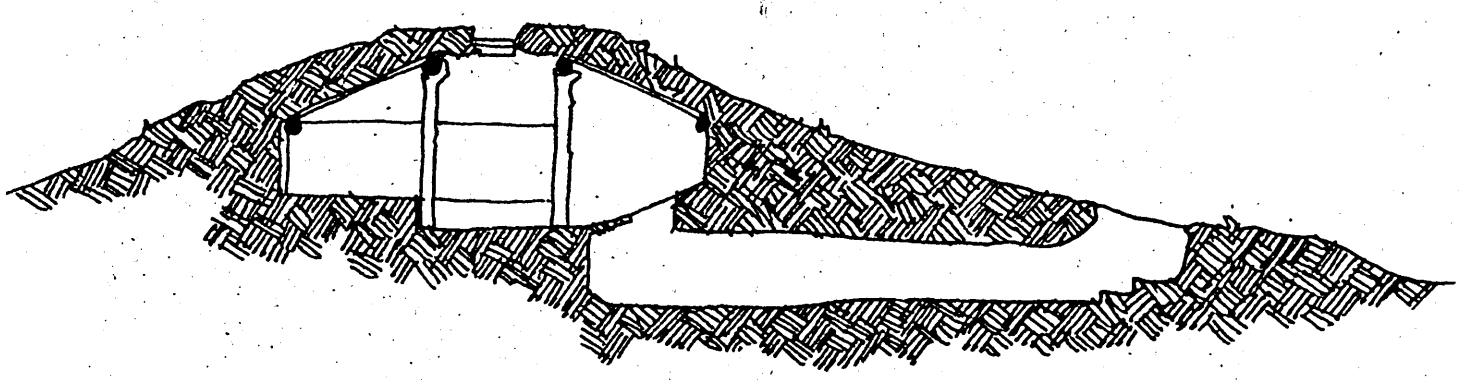
to the retreat of arctic sea ice and glaciers and the poleward migration of codfish and herring. Such a phenomenon holds encouragement since only a few degrees rise in temperature is very significant in the biological life and climatic conditions.

Within this region there has developed a circumpolar culture founded on common environmental problems and on cultural and ethnic mixture gaining momentum through modern communications and diffusion.[8] The earliest inhabitants of the North American Arctic are the Eskimos who migrated some 2,000 years ago from Central Asia, considerably after the main movements of the North American Indians. Contrary to what might be the first assumed, it is now felt that the Eskimo came into the arctic of his own volition because of the excellent conditions for hunting and herding. It was an inviting region to those who could master the techniques of living. The Eskimo in North America is really the only true arctic native since in Asia and Europe the arctic is really only a fringe of the sub-arctic and consequently not so clearly defined. Life was severely determined by climate, a limited supply of materials, enforced leisure time, and an economy based on hunting, fishing, and reindeer herding. In this nomadic existence the rigors of survivaly created an emininently suitable code of ethics and an attitude toward life which Christian civilisation from a kinder environment has often found strange. Culturally they stopped short of metals and agriculture but reached a high development in the arts. The degree to which the aboriginal culture was adapted to the environment may be gauged by the fact that no where else has modern civilisation been forced to abandon so many of its

[8] Ibid., p. 155



PLAN



SECTION

ESKIMO WINTER HOUSE

- SOD COVERED WOOD FRAME
- MINIMUM EXPOSURE
- AIR STRATIFICATION PRINCIPLE, ENTRY FROM BELOW, BENCHES FOR SEDENTARY ACTIVITIES
- LONG PASSAGE TO EXCLUDE WIND

own techniques in favour of the aboriginal.

Naturally under nomadic life little permanent habitation was created and only in the sub-arctic was any form of permanent community developed. Tents, of course, were the natural shelter during the summer. These were generally of skins or bark in a conical form over poles and sometimes were developed as a tent within a tent for colder conditions. During the winter the most common form of dwelling was the partly underground earthen hut. The well-known hemispherical snow house is common only to one region of Canadian Polar Eskimos and although seemingly complex was often only a relatively temporary structure. With the suitable snow conditions and two or three skilled men one could be erected in less than an hour. In areas with farily good hunting and fishing semi-permanent winter settlements were built, consisting of groups of ice houses. In one instance three ice houses, each containing two families, opened off a central "lobby" which was 12 feet in diameter. This allowed both a limited private and a communal life.[9] The two types of dwellings illustrate two of the fundamental techniques developed. The first is the reduction of exposure to the wind by either digging into the ground or by heaping earth or snow around the sides. Wind was also excluded by the careful placement of the entry and the use of a devious passageway. Secondly, is the principle of the entry from below, in these cases, by tunnelling, to prevent cold air from literally "falling in". Within the dwelling side benches for sedentary activities and sleeping further raised the occupants into the warmer air strata.[10] These extremely

[9]de Poncins, G., Kabloona, Reynal and Hitchcock Inc., New York, 1941
[10]Stefansson, V., Arctic Manual, The MacMillan Company, New York, 1944, p. 146

cramped quarters are also very easy to heat, especially the snow house, because its hemispherical shape reflects the heat. A small whale oil or blubber lamp was often sufficient.

Such was the state of the Eskimo before contact with the white man; a rugged but well adapted, advanced stone age civilisation. The more temperate civilisations have entered into the northern lands, sub-arctic and arctic, for various reasons.[11] Probably the primary being the early folk wanderings. These were the result of both population pressures and a general northward swing of the centers of world culture.[12] Western civilisation has steadily moved northward as the means of controlling winter climate, better buildings and better heating, have been perfected. This has made life under these more rigorous conditions possible with a surplus of energy over and above subsistence available for exploitation. The earliest such advances were probably before the birth of Christ as witnessed by the accounts of the Greek, Pytheas, who presumably sailed past Iceland to within sight of Greenland about 325 B.C. He was not credited since his findings did not support the Pythagorean concept of the world in which it would be impossible to live in that frozen zone. The next recorded ventures seemed to be those of the Irish to Iceland in the 6th century A.D., followed by the Norsemen around 850 A.D. By 930 A.D. Iceland was a republic and in the 10th and 12th centuries southwest Greenland was colonised. In the 13th century Greenland was a colony of Norway with a population of 8,000 to 10,000. The transition from the rugged coast of Norway would not have been too drastic and a very similar

[11] Geography of the Northlands, op.cit., Chapter 8
[12] Stefansson, V., The Northward Course of Empire, op.cit.

culture arose, generally based on fishing. The buildings were usually of stone or sod, in the native tradition with roofs of wood, either collected as driftwood or brought from Newfoundland. Early buildings were one large hall as big as 52' x 16' but later they were subdivided for ease of heating.[13] Undoubtedly many voyages were made onto the North American continent as far south as the Boston area and reportedly into Minnesota via the Hudson Bay and the Red River. However, due to circumstances in Scandinavia, this flourishing colony was cut off from all communication and when they tried to re-establish contact to bring the Reformation to them in the 1500's nobody was found. Presumably due to the lack of adoption to the native food and environment the colony either died off or was gradually absorbed into the Eskimo culture for survival. Consequently the inhabitants now are generally referred to as Greenlanders and not Eskimos. The colony, however, established the first link with southern progress and introduced iron and agriculture to the Eskimo.

The arctic fringe of Eurasia remained relatively untouched until around the 16th century when the Russians began some colonisation in the west. They gradually moved east and north to establish Tobolsk in 1590 and Iruktusk in 1673. Some trading developed and in 1648 there was trade between Europe and China through the Arctic Ocean and river routes although the northern coast was not completely mapped until about 1750.[14] The quest for furs brought Russia into the North American Arctic in Alaska around 1750. However, they were never very active and allowed the U.S.A. later to purchase Alaska.

[13]Stefansson, V., Greenland, Doubleday, Doran and Company, Inc., New York, 1942

[14]Smolka, H.P., 40,000 Against the Arctic, William Morrow and Company, New York, 1937

The archipelago of Svalbord, including Spitsbergen, although presumably known as early as 800 A.D. was rediscovered in 1590 when it became an important station for the whaling fleets. It was used by the Basques, Dutch, English, Scandinavians and Russians and had communities of several thousand people. More recently the mining of coal has become important and it remains the most northerly settlement in the world.

With the Spanish and Portugese preventing them from reaching the riches of the Orient via the southern route, the English made several attempts to discover the North West Passage. Although the voyages of such men as Frobisher, Hudson, and Baffin during the 16th and 17th centuries, were unsuccessful, their efforts did increase the knowledge of the North American Arctic. By land from the British North American colonies further explorations, such as Hearne's across to Coppermine and MacKenzie's to the mouth of the river bearing his name, further opened up the land area of the arctic. In 1845 Sir John Franklin lead a British expedition to try again for the North West Passage. After two years without a word, a large scale search was carried out which added greatly to the known area of the arctic archipelago. However, the news of the grisly fate of the expedition deterred commercial exploitation and the arctic remained relatively untouched. It was not until 1940 that the North West Passage was completed by Roald Amundsen.

The earliest modern scientific exploration was begun in the famous Russian Great Northern Expeditions, 1733-1742, but the first large scale project was the "International Polar Year", 1882-1883. A ring of correlated observation stations were set up around the arctic and sub-arctic to

provide comparative data. Fifty years later, 1932-1933 a second "International Polar Year" further increased the base of scientific observations. It was during this era that the arctic became the object of a number of daring exploration and international rivalries, climaxed by the conquest of the North Pole by Peary, 1909. After the major areas had been "discovered" the emphasis has been in terms of long-range and detailed research. More recently the need for accurate weather forecasting data has lead to the establishment of many weather stations since the arctic is the origin of many of the northern hemisphere climatic controls.

While the more official voyages and expeditions were advancing the frontier of knowledge, the commercial interest gradually moved into the arctic. Whalers and fur traders were the chief exploiters and it was the latter who pushed the frontier back in both Siberia and northern Canada. The Hudson's Bay Company established dominion over a considerable area of the Canadian Arctic with a huge fur trade monopoly. In Canada the true arctic fur resources were tapped only after 1900 and it was not until the 1920's that the most northerly islands were officially occupied to establish sovereignty. Although the earlier white man entering the arctic felt it somewhat "unsporting" to adopt too many of the indigenous techniques of arctic living, in the sense that it took the "glamour" and "adventure" out of the effort; it was soon discovered that in order to survive, the natives' habits would have to be studied more carefully. It was Stefansson who finally established the need for adapting the natives' techniques and in doing so was able to do a great deal of pioneer work in the arctic and dispel many of the misconceptions.

From earliest times contacts with the natives have been almost purely on the basis of commercial exploitation with the subsequent disruption of the traditional patterns of life and eventually dependence on the trader. Missionaries have always been active and although they have done much good work they have not always been successful in adapting the native to his new conditions.[15] This fundamental conflict of civilisation versus the stone age has been handled in different ways by different groups. In Eurasia the native has generally been absorbed by the expanding population from the south whereas in North America he has remained relatively free of the white civilisation physically but of course very deeply affected by its commercial interests. Through a well organised paternalistic approach the Greenlanders under Danish rule have probably been the best treated. They are almost 100% literate and Greenland has recently become a province of Denmark so that political and social equality are well advanced. Canada, just now awakening to the vast problem of the transition of stone age peoples to the twentieth century, has much ground to cover.

To protest the inequities of the contacts is academic since the damage has already been done. Romantic ideas of leaving the Canadian Eskimo to his traditional hunting and fishing nomadic life are unrealistic since with their increasing numbers the land will no longer support them even at their present deplorable living standards.[16] The transition of these 11,000 people to wage employment in competition with their fellow citizens is a difficult task, but it must be done. They have one advan-

[15] Geography of the Northlands, op.cit., p. 179

[16] Phillips, R.A.J., An Introduction to the Canadian North, Department of Northern Affairs and Natural Resources, Ottawa, October, 1957

NEED FINANCIAL EXPLOITATION

Canadian Arctic Islands Hold Vast Mineral Wealth

OTTAWA (BUP)—Petroleum, coal and other mineral possibilities in the Arctic islands of Canada need only financial exploitation to become a reality, Dr. Y. O. Fortier said here today after a 5½-month Geological survey of the Canadian Arctic.

"The Canadian Arctic abounds in a wealth of coal and oil deposits," he said in an interview. "The thing is, are they commercially possible to the nation?"

The gaunt, 40-year-old veteran Arctic explorer said his team of 11 senior geologists and 10 students mapped and surveyed 120,000 square miles of the polar region.

AIRBORNE SURVEY

"We discovered a lot of things during our exploration," he said. "One of them was that petroleum and mineral possibilities in the Arctic islands of Canada are almost astronomical. I think the government will finance another trip that will dwarf anything of the kind ever before attempted."

The entire operation was airborne. An advance party took off from Ottawa in a DC-3 and established bases along the route mapped out by the Ottawa geologist.

The main party left Ottawa for the Arctic later. A DC-3 landed the group and they travelled to within 600 miles of the pole, filed reports on coal outcroppings and surveyed the area by magnetometer for oil.

COAL DISCOVERED

The latter instrument was dragged across the skies from the belly of a plane, Fortier said. It showed the lows and highs of rock strata on both land and sea.

"We found substantial areas of coal," the Ottawa geologist said. "However, I cannot say just how good the coal is until we have put it to a series of tests. We also struck areas that presented very favorable conditions for the drilling of oil."

He said, however, that while coal and oil conditions were extremely favorable in the far north, he would not forecast their commercial values.

"We went into the north on a mapping expedition, and frankly, our coal and oil findings are something we were not given to consider at any length," he said. Just let us say that our tour of the Arctic has shown that Canada has very, very substantial reserves of oil and coal there."

HELICOPTERS USED

Fortier, a senior member of the geological survey of the Northern Affairs department, said the expedition cost $250,000. Two helicopters were used to ferry supplies to the party from caches, in addition to Eskimo-driven dog teams.

The geologists went into the polar regions early in April. The last of them return home early next week.

Fortier indicated that he had a tremendous amount of data about Canada's Arctic regions. "Eventually," he said, "all of it will be made known."

He said he did not find any Soviet geologist working in the same area. Earlier this year, a group of Russians ventured in to the approximate area recently covered by Fortier. It was reported they wanted to check on the possibility of establishing radar bases similar to those jointly operated by Canada and the United States.

Fortier said his expedition was solely for mapping the unexplored area. He said he was not sent there by the Canadian government to set up sites for air and radar bases.

Winter Still Challenge to Arctic Riches

Northern Canada Has Vast Buried Mineral Wealth

By EUGENE GRIFFIN

OTTAWA, (CTPS)—In the Canadian Arctic, rich in buried mineral treasure, winter still challenges man to tame this last North American frontier above the treeline.

A few nights ago it was 20 degrees below zero at Rankin Inlet on the west shore of Hudson Bay, where Eskimos worked 400 feet underground in a new nickel mine 300 miles north of Fort Churchill.

The ore must be stored until the ice goes out of Hudson Strait in mid-July for the short navigation season. Ice locked seaports, straits and rivers are a costly deterrent to exploitation of Arctic resources.

Lead, zinc, nickel, copper and other metals are ignored in many areas for lack of road, rail or water transport.

Fly Gold, Uranium

The two principal minerals exported from the Northwest Territories, gold and uranium, are so valuable that they are flown out.

Gold is air mailed in 70 pound bricks of rough bullion from Yellowknife, N. W. T., to the mint at Ottawa at a postal rate of 7 cents for the first ounce and 5 cents for every additional ounce. Each brick, worth nearly $30,000, is sent as registered mail valued at only $25.

There is not a mile of railroad in the Northwest Territories, which has a land area 22 times as large as Illinois. The Mackenzie River system, plied by paddle wheelers and barges, carries thousands of tons of freight north every summer but is closed for eight months or more each year.

In the Yukon, the Alaska Highway is the main stem of a skeleton road system in a small part of the Territory, and there is the short narrow gauge Whitepass and Yukon Railway from Whitehorse to the port of Skagway, Alaska.

In the Eastern Arctic, at Frobisher Bay on Baffin Islands, ships will have only 10 sure weeks of open water in which to lay down more that 50,000 tons of materials on the beach between tides this summer.

The government expects Frobisher, a village of Stone Age origin on the trans-polar route between Los Angeles and Paris, to grow within five years to a city of 4,500 population as a refueling stop and American Air Force base.

Save $172,000

The plane is the instrument of man's most spectacular advances in the tremendous distances of the north.

It was considered commonplace a few weeks ago when an Eskimo, Simonee, who grew up as a nomadic hunter, bought tickets at Frobisher to fly his wife Martha to a maternity hospital 1,400 miles away in Ottawa.

Simonee earns $1.63 an hour at Frobisher, six days a week and 10 hours a day in summer, as foreman of a crew of Eskimo carpenters building white clapboard Eskimo houses without kitchens.

Many Eskimos have struck it rich at American radar sites and air fields. A band of 11 families at Cambridge Bay, persuaded by a trading post manager to save half their pay for two years, is reported to have $172,000 in a Winnipeg bank.

Eskimo men in many cases have been introduced to mechanical work, using bulldozers and other equipment in the construction of United States installations, and have quickly picked up skill in their new crafts.

Built by U. S.

Frobisher air field was built by the United States in 1942-43 and given to Canada at the end of World War II. Then the American Air Force reactivated the field in 1952 for use in transporting supplies to the distant early warning (DEW) line built across far northern Canada by the United States.

From Baffin Island to the Alaska border, in an arc close to the Arctic Circle, the Americans built 21 air fields that have been identified by latitude and longitude in a Canadian government publication. The DEW line is given credit by many northern Canadians as the most beneficial project ever undertaken for opening the Arctic.

For years the north has lured Americans and Canadians, to make some wealthy and to break the hearts and purses of others. It gave Prime Minister John G. Diefenbaker a vision of Canadian development that he used to help win an election this year with a record majority. To most Canadians, the north is a promise of boundless prosperity that some day will be fulfilled.

tage in that they are best equipped to take over the operation of northern development as soon as they master the necessary skills.

> "Constitutionally, by nature and heritage the Eskimos are the logical human main stays in the utilization of all the resources of the arctic. If they are to be forever pigeonholed as hunters and trappers and nothing else, pressed into the missionary mold, they will be swept away with the tide of progress."[17]

It is Canadian policy that the Eskimo shall not become a second class citizen and already mixed communities with both races are living side by side and attending the same schools.[18]

The contemporary interest in the arctic stems from two principal sources, geography and resources. One might say that rather than changing his earlier concepts from a flat world to a spherical shape, man went through a stage of thinking in a cylindrical manner. The mercator projection had much to do with this approach and it is only recently that the concept of great circle travel has been realised with the advent of long range aircraft. A study of the world as a sphere reveals the Arctic Ocean as a large gulf off the North Atlantic Ocean around which the land mass of the Northern Hemisphere is strung. Considering that this land mass contains 90% of the world population the importance of communication over the arctic is evident. This also leads to other interesting conjectures, e.g. if oil is discovered in the north of the Canadian archipelago it might be more feasible to use an under-ice pipeline directly to the ice free ports of northern Europe rather than all the way to the populated areas of Canada. Submarine travel under the ice, which is

[17] Finnie, R., Canada Moves North, The MacMillan Co., New York, 1948, p.85
[18] Robertson, R.G., The Future of the North, Department of Northern Affairs and Natural Resources, Ottawa, November, 1957

generally only 7 to 8 feet thick, has often been speculated and may now be a reality. In the current international situation the arctic has assumed even greater strategic importance and its mastery is of vital concern. The Soviets capitalising on the geopolitical importance of the "Heartland" of Central Asia have made extensive use of their northern lands for both civilian and military purposes. One of the most important of their developments has been the establishment of a North East sea route across the top of Siberia with a series of re-fueling stations and a fleet of ice breakers. North America has no such dependable trans-arctic sea routes so vital for development. Similarly land transportation in Siberia is much farther advanced than in the Western Hemisphere.

Even disregarding international tensions the commercial development of the resources of the arctic is an inevitability. With the prodigous increase in world population already underway and gaining momentum there will be an ever increasing demand for the full utilisation of the world's resources. The arctic, especially in North America, remains as one of the last great undeveloped regions on the globe.[19] The principal asset of the arctic is its vast untapped mineral resources which are becoming ever more necessary. At present high costs prohibit extensive utilisation but the demand is already overcoming this limitation and extensive future development is predicted. The world population increase is also demanding further food supplies and although the true arctic holds little hope for agriculture, the raising of meat producing animals, reindeer and ovibos holds considerable promise. The vast grazing areas of the

[19] Ibid, p. 6

tundra have already been utilised for this purpoase and with the breaking of traditional eating habits it can be expanded.[20,21] The exploitation of these resources will of course require permanent settlements of various types and will form a further area for colonisation of the world population excess. The U.S.S.R. under this and political urgencies has already developed a population of 4,500,000 in its arctic and sub-arctic areas.[22] Therefore, the North American arctic, which is largely Canadian, by contrast lies relatively undeveloped. Transportation is the vital link required to open up these areas and plans have been made for the development of an extensive network.

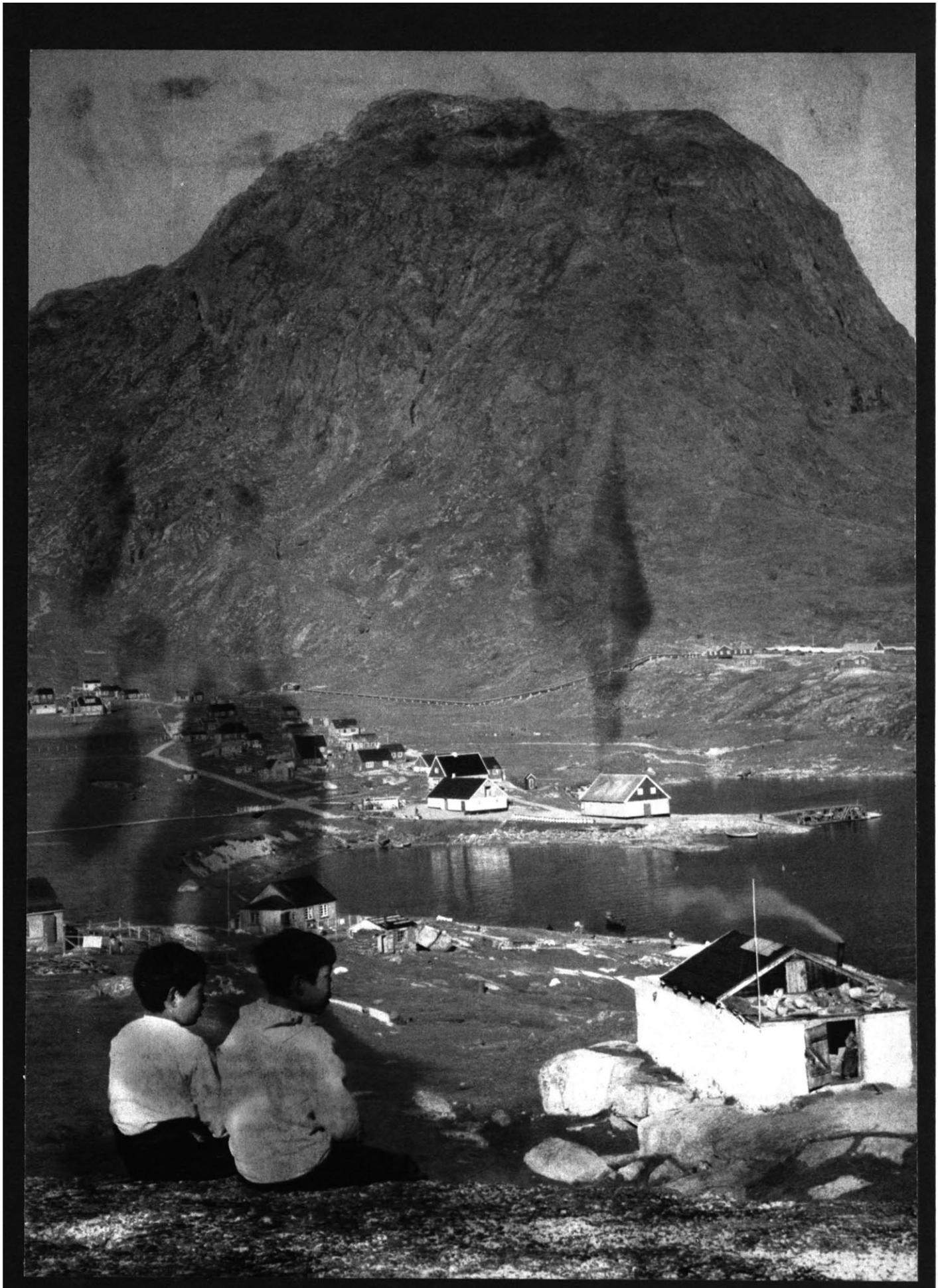
Contemporary Arctic Settlements

Although the sub-arctic, especially in Siberia and Scandinavia, has many examples of contemporary settlement there are few comparable developments in the true arctic. To some extent this is due to the more rigorous climate but much of it is the result of a lack of a clear idea of the problems.

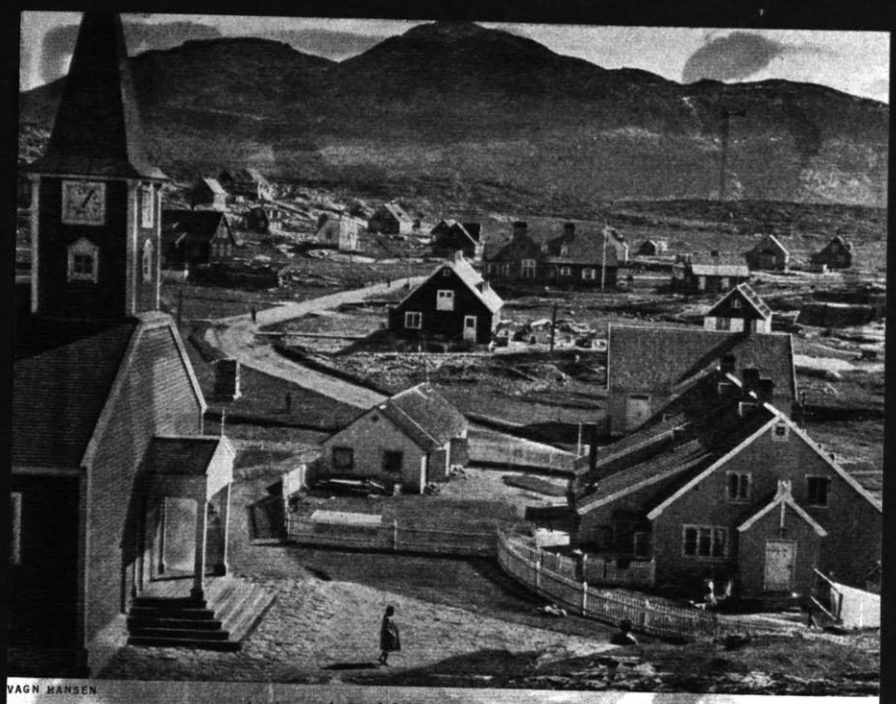
> "Man's ability to spread northward is, ... , either wholly or chiefly cultural and depends mainly on clothes, housing and the use of fire."[23]

While the use of suitable clothing is a very important aspect of arctic living,[24] housing and the associated community developments is the field in which the most effective work can be done.

[20] The Northward Course of Empire, op.cit.
[21] Teal, J.J. Jr., Golden Fleece of the Arctic, The Atlantic Monthly, Vol. 201, No. 3, March 1958, p. 76
[22] An Introduction to the Canadian North, op.cit., p. 4
[23] Stefansson, V., Colonisation of Northern Lands, Climate and Man, Year Book of Agriculture, United States Department of Agriculture, Washington, D.C., 1941, p.207
[24] Meier, R.L., Science and Economic Development, Technology Press M.I.T., 1956



(LEFT) *The old settlement of Narssaq. The winter water duct for the slaughterhouse creeps along the foot of the mountain like a centipede*



VAGN HANSEN

A view of Godthåb from Hans Egede Hill.
Godthåb is developing into a modern administrative centre.
Post-war enterprise and building activity have surpassed anything previously seen in Greenland.

VAGN HANSEN

Godthåb's mountain landmark, Hjortetakken ("The Antlers").
A new harbour road running behind the houses will be the future focal point of the capital. Modern development now taking place is changing the town beyond recognition.

> "The three great environmental protections contributing to health and longevity have been food, clothing and habitation, with every priority to highly developed habitation arts since these provide the context within which high levels of engineered food and clothing skills developed."[25]

Although it is common to speak of tremendous advances in Siberia the towns seem to be little different from conventional pioneer settlements. Perhaps a patriotic pioneering zeal has made up for some of the hardships. Spitsbergen, although far north, has a relatively mild climate and the housing has not seemed to take a form different from northern Norway or European Russia. Scandinavia, again not truly arctic but above the Arctic Circle, has made some notable advances. The environment is not nearly so rugged but there is still the long dark winter common to all arctic lands. In Lulea, Sweden, the architect, Ralph Erskine, has built an enclosed town centre containing, on several levels, shops, restaurants, cinema, and a public square. This has proven very successful and similar work is being done in Kiruna. Here the housing is also being re-considered in relation to winter sun and enclosed winter access. In Greenland town planning and housing has retained the character of single family wood houses, growing out of an improvement of the native sod hut. There is, however, a move to work with multiple dwellings in a denser development to create a more protective and rational town form. Their chief obstacle is the danger of fire amongst the wooden dwellings which at present forces a generous spacing. They are also being driven to a more concentrated form in order to supply all dwellings with utilities, a factor formerly not considered.[26]

[25]Herrington, L.P., The Physiological Engineering of Human Habitation, John B. Pierce Foundation, New Haven, Connecticut

[26]Andersen, H.L., Lyager, P., Boertmann, M., Teisen, F., Byplanforslag i Vestgronland, 1950-1951

Alaska, being almost entirely sub-arctic, has not yet had to cope with the problem.

Canada

Canadian Arctic town building is relatively new and has developed much like that of Greenland and although there are several projects under consideration for the development of new arctic settlements the only real example so far has been the re-location of the town of Aklavik from its former flood prone position.[27] This project illustrates several of the engineering problems of arctic town building. They concern principally permafrost and its relation to foundations and utilities and have dictated much of the building form and town layout. The buildings are principally of wood on traditional lots with the utilities carried above grade in 'utilidor' services ducts. The buildings are set above the ground on piles to allow free air movement beneath them in order not to allow building heat to escape to the ground and destroy the firm bearing of the permafrost.

The Canadian government is becoming increasingly aware of the importance of the establishment of balanced, amenable communities to ensure the proper development of Canada's most valuable asset. The following statements from the Department of Northern Affairs and Natural Resources reveal a clear idea of the problems.

> "If the north of the future does in fact turn into anything like I have suggested, how will it look? We can, I think, be fairly sure that there will not be large cities like those of the south.

[27]The Canadian North, The Canadian Architect, November, 1956

There will probably be a few centers of 50,000 or so in the Yukon and the Mackenzie Valley - the focal points of road and rail transportation. In these two regions there will be areas too of farming (mostly for the local market), of lumbering and commercial fishing. There will probably be ranching in the valley of the Slave River.

But over most of the north the future will probably appear much the way it now looks in our southern north - in the mining regions of Ontario. Scattered communities - some a thousand or two in population, others ten or fifteen thousand - grown up around mines of all kinds. They will be linked to the south or to seaboard by road or rail in most cases, but some will probably depend on large and efficient aircraft to carry in their supplies and carry out their mineral product.

The population of the communities will be a complete mixture - and the native inhabitants will not all be at the bottom.

But before that day comes, there is a tremendous amount to do, I have mentioned the need for transportation facilities, for education and for human adjustment. We have also a long way to go in technique.

Until just recently we had not really begun to think in any original fashion about the special problems of providing for life in the north. We know a bit about building in permafrost - but not, I suspect, as much as our friends the Russians. We have never so far as I am aware, in all of Canada, started from first principles and designed a house for Arctic living. It is not good enough to take a southern house and jam in more insulation. In the first place it costs too much - and in the second place the result is no good anyway. We have to work out a method to enclose more space than in the south (since much of life has to be lived inside in winter) - keep out the biting cold of a thirty mile an hour wind at 50 degrees below zero - and yet not spend a fortune in doing it. New materials, new methods, new concepts have to be applied.

How will we provide sewer and water service for a community of several thousand in a place where there are no lakes that do not freeze to the bottom in winter? How do you get the water to go in - and how do you dispose of the sewage that comes out? This is more or less the problem of Frobisher Bay, where a new town is going up. It may end up with purifiers and re-circulation of water; to reduce both the inflow and the outflow. The people may well live in reinforced, concrete apartments with enclosed play space for adults and children alike.

These are only possibilities. Just how things can best be done we do not know. What we all should know, however, is that the north has a future of very real promise - but that future will not be realized without the investment of a great deal more money and

WOMEN, ATOMIC ENERGY VITAL NEEDS IN ARCTIC

'Dynamic Forces' Lacking, Sun Writer Finds on D.E.W. Tour

Vancouver Sun writer Stanley Burke has completed the first tour of the Distant Early Warning radar line in the Far North.

By STANLEY BURKE
Vancouver Sun Ottawa Bureau

OTTAWA—Two dynamic forces are needed to complete the conquest of the Arctic started by D.E.W. line rada—atomic energy and women.

Atomic energy hasn't become a force in the Arctic yet although a lot of thought is being given the problem at research headquarters at Chalk River, Ont.

It is hoped a small, easily transportable atomic power unit which would revolutionize the under-developed areas of the world, can be developed.

Like most of the other under-developed areas, the Arctic lacks hydro potential.

Atomic energy promises to provide the power needed to unlock the treasure house of the north. This is one of the most richly mineralized areas in a world with almost insatiable needs for minerals.

Women Invade Arctic Areas

But while the atomic revolution is still in the future, the feminine revolution is under way.

The ladies have established bridgeheads across the Arctic as far as the north end of Baffin island. Usually these are the places where there's a mission or a Hudson's Bay post.

Further south the women have established themselves in force.

At Pangnirtung, on Baffin island, there's a hospital with women nurses.

There's a Hudson's Bay wife and a mission wife and a RCMP wife, the northernmost RCMP wife. Even the stern and rock-bound Mounties have succumbed. The women are "getting their men."

There are big concentrations at military bases like Goose Bay Labrador, and Churchill, Manitoba.

And there are waitresses at the Eldorado mines, a fact which has not gone unnoticed in the D.E.W. line camps whose mess halls have no attractions save $5 airlifted meals which can be bought for two bucks.

When the D.E.W. line was in the planning stage consideration was given to hiring young married couples, for example, technical men just out of university and their brides.

The northern affairs department has given the idea a good deal of thought.

It would be a wonderful opportunity for young couples. Pay for D.E.W. line operators will run between $500 and $800 a month. This would mean that young couples could put in a couple of years in the north and come out with a real stake, maybe $10,000.

Opportunities Opening Up

But so far the complications have seemed to outweigh the advantages. There's the cost of airlifting in supplies. There's the fact that space is at a premium.

Then there's the fact that women sometimes do inconvenient things—like having babies.

But the gentle, stabilizing influence of the ladies is needed—and it's coming.

. ingenuity than we have put into it so far."[28]

> "More difficult is the establishment of a social life in isolated settlements acceptable to modern standards. This involves a wide field of social studies including the relations between native and white populations, the provision of adequate educational and cultural facilities, the development of responsible local government and the fostering of interests to attract a permanent rather than a transient population."[29]

One of the most significat features of these new towns will be the provision of facilities for full family life. From experience gained in pioneer and isolated communities in other parts of Canada married men living with their families provide the most stable labour force,[30] and therefore community development will have to take on this added challenge. They will be considerably different from the traditional frontier town with its unbalanced sex ratio, transient workers, drunkeness, and gambling, but the added expense is necessary if the Canadian North is to become a stable part of the nation.

[28]The Future of the North, op.cit., p.22-24
[29]Rowley, D., edited, Arctic Research, Special Publication #2 of the Arctic Institute of North America, December, 1955, p.224 ff
[30]Crawford, K.G., Single Enterprise Communities in Canada, Central Mortgage and Housing Corporation report, Queens' University, 1953, p.27

A N A L Y S I S

The problems facing the establishment of stable communities in the arctic fall into two categories; socio-psychological and physical. Of these the latter has been met already in many developments especially those for military purposes. The socio-psychological aspect is however more complicated.

Socio-psychological

The prime consideration is that of the type of people who will inhabit these new communities. They fall into two groups. First, those in contact with the country and performing particular arctic tasks, The Royal Canadian Mounted Police, traders, missionaries, and administrators. They are generally happy but form a small portion of the incoming population. The second and largest group are those people performing tasks which are essentially the same as they would perform in more temperate areas except under more rigorous conditions. In the past, especially, they have been held by high wages and contracts but have generally been rather unhappy and transient.[1] It is with this segment of the population that the success or failure of the new communities lies. Good working conditions are, of course, a factor but are beyond this thesis. The point at which something can be done is in the community plan and the living accommodations. It is of little value to bring families into the arctic if they are to be ill-housed in a shack town and thus further aggravate the workers grievances.[2]

[1] Conversation with G.W. Rowley, Secretary, Advisory Committee on Northern Development, D.N.A.N.R. Ottawa, January, 1958

[2] Crawford, K.G.; Single Enterprise Communities in Canada, Central Mortgage and Housing Corporation report, Queens' University, 1955

The problem of providing amenable family living in the arctic generally boils down to the provision of adequate facilities for the housewife and the small child. Since the men spend most of their time at their work and older children are occupied with school and other group activities, their problems in relation to the habitat are not so demanding. They, of course, require certain spaces for family and personal activities but are not so wholly dependent on the environment of the habitat as the mother and child. In an area of such rigorous conditions and high costs the gains made in maintaining a happy and stable community will be well repaid in the efficiency of the employees. It is therefore an economic as well as a humane move to provide high quality housing.

For various reasons, perhaps the present high standard of living in the western world and the general materialistic leanings of people, there are few who wish to put up with much hardship or privation in the interests of advancing frontiers. Good pay will always be an incentive but families will expect reasonable accommodation especially if they plan to remain at all permanently. Within the dwelling there is little technical difficulty in providing a full range of utilities, heating and appliances, within a suitably large space. The provision of space is of course one of the most important aspects since with its increase comes increases in initial building cost, heating and extent of utilities, streets, etc. Therefore it is necessary to establish the scale of space required and to assess the possibility of using some communal space to free space within the home. Although some arbitrary standard such as Central Mortgage and Housing Corporation should be met, there will have to be provisions to cover the increased indoor times due to the environment. These will include such

T A B L E 1

SCHEDULE OF AREAS FOR THE DWELLING

Basic Activities	persons 2	3	4	5
sleeping and dressing	150	225	300	375
personal cleanliness and sanitation	35	35	70	70
food preparation and preservation	75	100	100	120
food service and dining	70	90	105	120
recreation and self improvement and extra familial	180	255	320	400
inactive storage	50	100	150	150
hobby and recreation	not privately	100	150	150
Totals	560	905	1195	1385

things as workshop, playroom and study areas, as well as private areas for the family members. A schedule of areas within the home has been prepared based on Planning the home for occupancy standards with certain revisions.

Within the community plan careful consideration must be given to the balance between individual privacy and opportunity for casual meetings and group activities. In a small isolated community nothing could be more irritating than a set of forced acquaintanceships which infringed on the family privacy. For this reason it is probably unwise to be too dependent on communal facilities, despite the economy of their use. Also arrangements should allow for considerable social mobility rather than setting too rigid a pattern of groupings.

The community plan should provide a protective feeling in contrast to the bleakness of the surrounding landscape. While it would be unrealistic to attempt to have the inhabitants ignore the environment completely, their daily activities should be internally focused. There will be sufficient natural chances in almost any scheme to be aware of its presence. In contrast to the almost formlessness of the landscape, especially during the winter, a well disciplined plan for the community will help to establish a sense of order within the immediate environment. Taken as a whole the community should form a defined element in the landscape and not peter out at its edges. Here again colour could be very effective as a foil for the monochromatic outlook.

Isolation will be a real problem in most arctic communities since there is little likelihood of road connection to the south due to construction

difficulties and the very short period for water navigation. Air will serve as the most important link with the outside world but even its service is very dependent on weather conditions. Radio will play a vital part in combatting isolation but its very presence may make the inhabitants more aware of what they are missing. Isolation can be relieved to some extent by taking advantage of all the suitable technical advances and by developing as lively a community as possible but certain inescapable factors will remain. These will be such things as the time involved and the necessity of making arrangements for trips 'out'; and the visual bleakness of the countryside. However these are not so vastly different from the problems faced by families in some of the mining, fishing, logging, or air base towns in other parts of North America. To some extent this is a factor which the people accept or if they cannot they seek other work. Holidays will be very important and families will presumably fly out to visit friends and relatives in more temperate climes, perhaps also shopping for major items. This break is generally felt to be very necessary to the morale of the wives especially. It is difficult to say whether even exceptional physical conditions can overcome the isolation but many families under similar conditions have come to love the life and have made permanent homes.

The need for recreational facilities will be strong especially since the average inhabitants will be relatively young and they generally will not have the diversions of home maintenance to occupy them.[3] Due to the rigorous climate during the winter and the muddy ground during the short

[3] Ibid.

summer most of the activity will be indoors. Ice skating and hockey will probably be very popular and will require an indoor rink to avoid the nuisances of uneven ice and snow removal. As well as the gymnasium there should also be a building like a field house for other sports. During the winter skiing will no doubt be popular at times when there is sufficient snow coverage. Although the countryside is often quite barren there is usually considerable animal, bird and fish life, and men and boys will no doubt find much diversion by hunting and fishing as the Eskimos have done traditionally. This will however be of little value to the women and younger children. For the women milder forms of relaxation such as bowling, will generally be provided as well as facilities for club meetings and social gatherings. Children will play outdoors during the winter as in any of the prairie towns but during severe weather and the 'gumbo' of the summer sheltered or indoor facilities will be required.

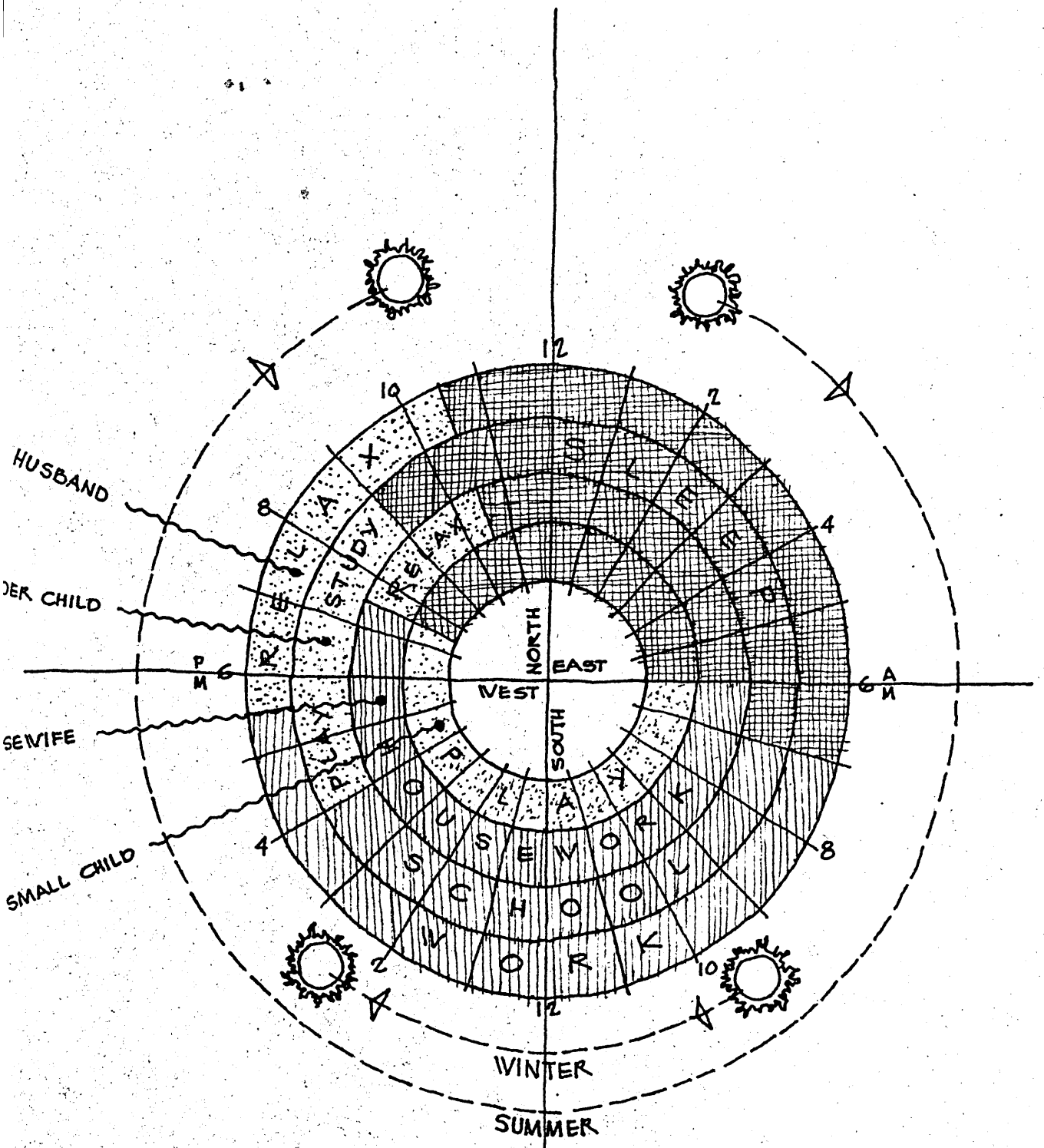
In general the approach to life in these areas has been to make it as 'normal' as possible. That is, by such practices as having a full range of shops, rather than a central supply depot or company store and allowing automobiles although their use may be restricted to a short road system. The town government and relations with the chief employer, if such is the case, are very important factors in the morale of the community. Somewhere between paternalism and complete disregard of legitimate needs of the people by the authorities lies a balanced arrangement. These and the problems of dwelling ownership are however beyond the scope of this thesis.

One of the most important features of life around the Arctic Circle is the

At Repulse Bay, HBC clerk and natives play football in forty-below weather. Eskimos completely ignore rules and regulations, play for fun, not to win.

However deep the snow, Eskimo children at Frobisher sally forth on their new tricycles which, with other modern toys, have replaced the traditional sleds.

Like children everywhere, Eskimo moppets slide on Baffin slopes. Sleds are often old gas drums.



DAILY FAMILY ACTIVITIES
IN RELATION TO THE SUN

DESIRABLE ORIENTATIONS

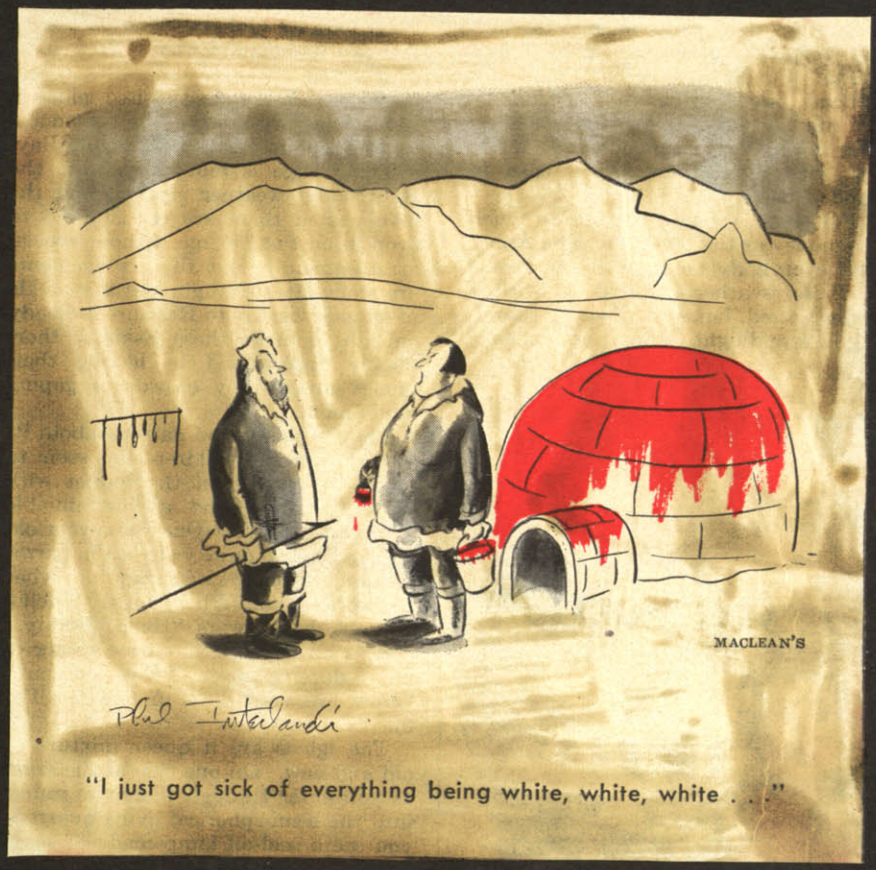
- HOUSE WIFE'S WORK AREA - SOUTH
- CHILDREN'S PLAY AREA - SOUTH — WINTER SUN VITAL
- ADULT RELAXATION - WEST AND NORTH
- SLEEPING - VARIABLE

sun. During the long winter when it is gone or almost so its brief appearances are tremendously important to the morale of the people. From the chart of the family's activities in relation to the sun it can be seen that during the crucial winter period the husband is at work and the older children are at school. It is therefore with the housewife and small children that the importance of orientation lies. When this is related to the areas they will use it is evident that the kitchen work space, children's play area require the most favourable orientation. On the other hand during the times of relaxation of the family during the evening there will be sun only from April to September at which time it will be in the north west. The sleeping areas are not as dependent on orientation except to the extent of requiring tight window coverings to keep the long summer sun out. From this we can arrive at a generalized orientation pattern.

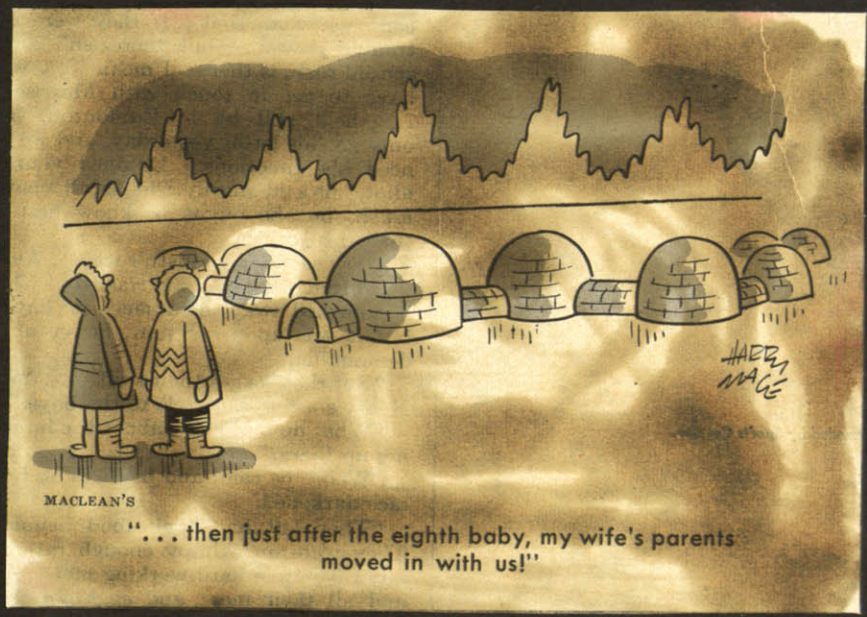
housewife's work areas	- south
children's play area	- south
relaxation	- west and north
sleeping	- variable

Another pertinent factor dealing with orientation is that during the crucial times of the year the sun angle is so low, 3° at noon December 21, that it is necessary to have a clear southern exposure to be of any value. North slopes are also to be avoided. It must be remembered that streets and public spaces will require good orientation if they are to form a pleasant community especially during the winter months. Although the dwelling should take preference it may be necessary to make some concessions to the total habitat.

One of the principal psychological reactions to the rigorous climate and dark winters, both in the northern Scandinavian countries and the North



"I just got sick of everything being white, white, white . . ."



". . . then just after the eighth baby, my wife's parents moved in with us!"

American Arctic and Sub-arctic is the raising of plants. Besides adding a touch of colour to a drab outlook they seem to symbolize at least a partial conquest of the environment. Therefore, some window box, or small hot house, probably related to the housewife's area seems desirable.

Physical

The most obvious problem in the arctic is the extremely low temperatures and their duration. Although the principal defence is in the perfection of suitable building techniques, e.g. tight construction, vapour barriers, good insulation; there are other approaches which can alleviate the situation. The most important of these is use of the principal of a stratification; that is that cold air falls and warm air rises. One of the worst problems is the entry into buildings through a normal door. With a temperature differential of perhaps 100° between inside and out a normal door opening allows a wall of cold air to literally fall into the building. This can be reduced by the use of a vestibule but it is best eliminated by entry from below, taking a cue from the natives. According to Viljhalmar Stefansson, noted arctic expert, even with an unsealed opening a quite large temperature difference can be maintained.

The problem of wind is rather difficult to assess because if a building is sheltered from wind it is in danger of becoming covered in drifting snow. Especially in relation to the community plan it would seem best to allow the wind to blow freely thus clearing the areas around the buildings; and to combat the heat loss due to wind by using compact structures.

Permafrost presents many difficulties in arctic construction.[4] Since below its three foot active layer it is a hard impervious surface which either must be thawed artificially or blasted, extensive excavation is prohibitive. In well drained ground, e.g. gravel, the thawing makes little difference to the properties of the soil, but with high moisture content soil thawing can turn the formerly solid ground into a liquid-like slurry. Rock is of course unaffected since it contains no moisture. These factors are strong determinants in both the location and form of buildings.[5] Sites in the arctic fall into two broad categories, those on well drained ground, often hillsides or rock, and those on poorly drained ground, generally flat. For each case the construction practice varies. In the first case standard construction techniques may be used since the thawing of this ground does not affect the foundations. In the second case the practice has been to use the passive method, i.e. not to disturb the permafrost level upon which it is possible to bear the structure. This is done by building a gravel pad 3 to 5 feet thick which insulates the unstable ground from the heat of the building. Bearing of permanent structures is often on piles which are steam jetted into the permafrost and allowed to freeze in solid. In this case the penetration of the pile should be sufficient to resist the heaving action of the thawing active layer during the summer. As a further insurance that the heat from the building does not reduce the permafrost level and cause foundation settling, buildings are raised a few feet above the ground to allow cold air to pass beneath them, or cold air ducts are placed in the

[4]Muller, S.W., Permafrost or Permanently Frozen Ground and Related Engineering Problems, Ann Arbor, 1947

[5]Pihlainen, J.A., Permafrost and Buildings - Better Building Bulletin #5, National Research Council of Canada, Division of Building Research, September, 1955, p. 9 and 15.

floors. The floors are also well insulated.[6]

The provision of utilities is also greatly affected by the permafrost since they cannot be laid in the ground due to construction difficulties. Therefore they are run above the ground generally in service mains which are insulated against the cold and sometimes heated.[7] This also allows for easy access in case of emergencies which would be impossible during the winter with buried lines in frozen soil.

The generally unstable ground conditions impose certain limitations on the use of sites. During the winter they are uniformly frozen hard with drifting snow on the surface. In summer the poorly drained areas of ground become quagmires of mud and small ponds. Outside of the sparse indigenous growth there is nothing that will grow. Even the native growth is so fragile as to be unable to withstand any abuse and would probably not survive extensive walking and certainly not children's play. Therefore site planning considerations must be revised from the traditional single lot and garden concept. If areas of stable ground during the summer do not exist they should be created and related to the recreational activities. With the use of gravel pads for building foundations and large scale earth moving machines this may be done very much in the manner of airport runway construction. Also in consideration of ground use the bad microclimatic effects in the north shadlow of buildings should be noted. Here the winter sun never penetrates, snow remains for a longer time and the permafrost level generally rises. About the best

[6]United States Army, Corps of Engineers, Arctic and Sub-arctic construction, Part XV, Chapter 1, October, 1954, pp. 11-14

[7]Hyland, W.L. and Mellish, M.H., Steam Heated Conduits, Utilidors, Protect Service Pipes from Freezing, Civil Engineering, Vol. 19, No. 1, January 1949 pp. 27-29

that can be done to relieve this situation is to build on a south slope and thereby minimize the shaded area. When the factors of a long, rigorous winter and short, wet summer at least at ground level, are considered, it seems very reasonable to think of some kind of enclosed paved access between the dwelling units and the other community facilities. This has already been used in arctic military establishments and coupled with the utilidor system seem like a very reasonable solution. It could be openable for warm weather use and in the winter enclosed but probably not heated. The addition of this element to the community grouping has certain shading and snow drifting problems which will effect other parts of the layout.

Outside of the special requirements to combat permafrost, construction techniques in the arctic differ mainly in degree rather than in kind from those in the north temperate and sub-arctic zones.[8] This probably is quite true as long as the building form is basically similar but if the form should change the construction techniques should be re-valuated. The primary requirements of wall construction of a heated dwelling to meet arctic conditions are:

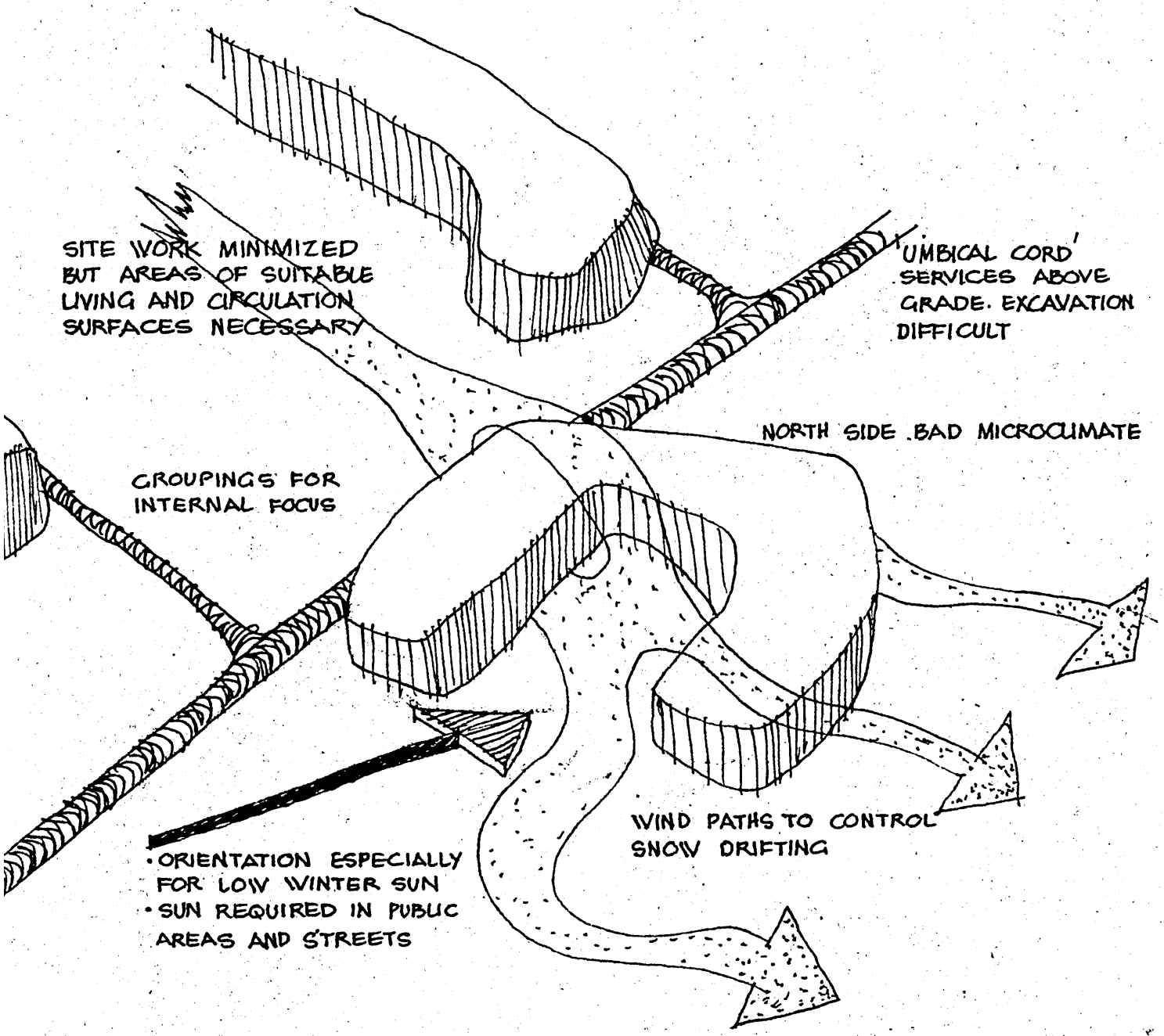
1. strength and rigidity
2. resistance to heat flow
3. resistance to water vapour flow
4. resistance to air flow and liquid water movement
5. resistance to fire.

The standard 2" x 4" @ 16" o.c. stud wall construction with sheathing, building paper, exterior finish, insulation between the studs, vapour barrier and interior finish has been recommended as fulfilling these

[8]Dickens, H.B., Buildings for the North, National Research Council of Canada, Division of Building Research, December, 1955

requirements.[9] Of special interest is the note that prefabricated panel construction has not proven satisfactory due to the joint problem which is accented by the rocking of the walls with foundation movement. Similar troubles were found with panels at Thule, U.S. Air Force Base, in northern Greenland.[10] The use of a structure other than of wood presents problems in the heat transmission through the wall and consequent condensation. Wood does however have the serious drawback of not being fireproof. At present this is overcome at least on the community level by the wide spacing of the buildings. However with the need for denser communities for economic as well as psychological reasons this is a serious handicap. The Swedish have been successful with the use of lightweight insulating concrete under almost as severe conditions, thereby defeating the fire problem. In the later buildings at Thule a system of reinforced concrete structure with precast concrete panels backed up with insulation has been used.[11] To further complicate the problem a system must be devised which can be enclosed quickly during the brief summer building season so that interior work may be carried on in the winter. Construction activities will have to be carefully coordinated with the importation of materials which will almost always be from the southern regions. A typical sequence of building would be the driving of piles one summer in order that they may freeze in over the winter and the construction of the exterior shells of the buildings during the next summer, with finishing being carried on the following winter.

[9] Ibid.
[10] Thule, Architectural Forum, February 1958, p. 117
[11] Ibid.



COMMUNITY PLAN CONSIDERATIONS

Summary

From the analysis certain recommendations can be made in regard to the design of a habitat for the arctic.

site selection

- preference for a south facing slope to take advantage of the low winter sun[12]
- build on rock or well drained soil if possible

general

- importance of the brief winter sun and its low angle
- orientation of the dwelling in respect to family activities
- importance of sun into the public spaces also
- need for a strong community form
- inward looking community
- visual significance of the above grade utilities
- protected access required

[12]this can be the equivalent of a several weeks earlier spring, a vital factor in the arctic

Flights to Europe Spotlight Arctic

By James Montagnes

Written for The Christian Science Monitor

A close look at several points in Canada's Far North is now a standard attraction for air travelers who use the polar air routes between Europe and the Pacific Coast. Four airlines now fly across Canada's Arctic regions between Los Angeles and Vancouver and points in western Europe.

Refueling stops are made by these airlines on their northern circle flights at Churchill and Frobisher, both well into the Arctic area. Churchill is located on the west coast of Hudson Bay, and is the site of a joint Canadian-United States defense base and missile testing range. Frobisher is on Baffin Island, opposite Greenland, and is becoming an important air base for commercial as well as military air services.

Stops Scheduled

These fueling stops in Canada's northland are not the only spots where air travelers can alight in the Canadian northland. Throughout Canada's sub-Arctic and Arctic areas are airfields where scheduled and charter air services from Canadian cities land passengers and stop to pick up passengers and goods. For Canada's northern regions are being rapidly developed and populated.

Passengers landing for a refueling stop at Frobisher find here a fur post, Royal Canadian Mounted Police station and a mission post which also handles the school for the Eskimo children of the small community. Two oil companies now have storage tanks at this remote point on the southern end of Baffin Island. The Canadian Government is building an airport terminal here to accommodate the growing number of airline passengers who stop here for a few hours.

Airlines Serve Area

Three airlines use Frobisher. They are Canadian Pacific, which flies from Vancouver to Amsterdam; Pan American, which operates from Los Angeles, San Francisco, Seattle, and Portland to London and Paris; and Trans-World, which runs from Los Angeles to London and Paris.

One other airline uses the north polar route, Scandinavian Airways System, which pioneered the routes between Copenhagen and Los Angeles, and from Copenhagen to Tokyo. This airline does not make stops in the Canadian Arctic, but stops at Winnipeg and at Anchorage, Alaska.

Those travelers who want to see Indians and Eskimos of Canada's northland at first hand, and who want to take a look at the mining developments in the northland, can take any of a number of Canadian airlines from principal cities into the Arctic regions. Many new communities have started in recent years in the Canadian Far North, and others are following suit.

Accommodation Limited

Accommodation is limited at most of these new mining towns, and is definitely not in the luxury class. There are small hotels at such mining towns as Yellowknife and Uranium City, close to the 60th parallel of latitude.

Fur posts along the Mackenzie River in the western Canadian Arctic receive a few visitors during the year, but the accommodation is usually a private home. At Aklavik, near the mouth of the Mackenzie River, the entire town is being moved to a new nearby site, and some arrangements are being made to put up tourist visitors.

Across the Arctic mainland area and on the islands of the Arctic there is no commercial lodging for tourists as yet. But traffic to these points is becoming heavier as new iron, copper, zinc, and uranium mines are being brought to production stages. There also has been a great deal of traffic to these and nearby points in connection with the construction of the Mid-Canada and Distant Early Warning radar lines by the Canadian and United States Governments.

Weather Stations Abound

There are many new weather stations spread across this vast Canadian Arctic area and operated jointly by the Canadian and United States Governments. Some of these stations are fairly close to the North Pole. Aircraft are the main means of contact with the men at these points.

The Canadian Arctic areas have never been used as a tourist region till now. The growing airline, military, and mining traffic into the area has opened up the possibilities and some lodges are planned in spots which provide good fishing as an added attraction to Arctic sightseeing.

The area is by no means desolate, but consists of numerous mountainous sections, with some ranges and peaks up to 10,000 feet high. While trees are seldom seen in the Arctic, the summer vegetation consists of numerous colorful flowers and lichens, with a wide variety of wild game to be seen, ranging from caribou to seals.

Soviet Union Opens Siberia to Tourists

By the Associated Press

London

The Soviet travel agency, Intourist, has announced that foreign tourists may now go to Siberia.

An announcement broadcast by Moscow Radio said a trip to the republic of Irkutsk is among three new routes being opened to foreign travelers. The others are to Soviet Latvia and Lvov, in the Ukraine.

Intourist said these routes will enable tourists to travel in their own cars through some of the most picturesque parts of the country.

D E S I G N

The results of these studies are synthesized in the design of the habitat for Frobisher Bay on Baffin Island in the Canadian Eastern Arctic. This project is intended to serve as a prototype design for other similar arctic communities so that an attempt has been made to resolve all aspects of the habitat problem on two typical site conditions.

Background

The basic reason for the community is in support of the stop-over airfield for trans-polar commercial flights and some military facilities. It also serves as an administrative centre for a large arctic area and as a rehabilitation centre for Eskimos returning from tuberculosis treatment in southern Canada. Although the need for the stop-over airfield will be gone with the use of longer range aircraft it is expected that Frobisher Bay will be an important centre in the Eastern Canadian Arctic for communication, administration, and perhaps new sources of employment such as mining and fishing.

The inhabitants will be principally employees of the various airlines or of the military establishment and will probably be on contract periods of from two to five years. However with good working conditions and family accommodation they may remain longer. There will also be a core of service personnel for the commerce in the town which will probably own or lease businesses and will be fairly permanent. Shift work will, of course, be

common since the airfield will be in use constantly and this should result in some staggering of commercial and recreational facilities although in other communities this has not been the case.[1] The noise problem for sleeping shift workers must be carefully considered both within the dwelling and within the town. During the two extremes of day and night, midsummer and midwinter shift work will seem little different than normal hours.

Arrangements for shopping facilities will be as normal as possible, i.e. no central supply depot but various shops with competition and a wide range of choice. The number of establishments and their respective stocks will have to account for the fact that there is no major centre nearby. People will probably take shopping trips by air to Montreal or perhaps western Europe but seldom more than once a year. Mail order buying through catalogues will probably be very popular as in other isolated areas. The commercial area will need large storage facilities since almost all supplies for the entire year will have to come in by ship during the few icefree months in the summer.

Generally speaking education will be carried out as in any other similar Canadian town with the Eskimo students fully integrated. The traditional church schools run by the Roman Catholic Church will probably appear and to this extent will duplicate facilities. Due to the widely scattered population the school will also serve a huge area of the Eastern Arctic by providing dormitory accommodation for students.

[1]Crawford, K.G., Single Enterprise Communities in Canada, Central Mortgage and Housing Corporation report, Queens' University, 1955,

Religion will be treated as normal with at least one Protestant and one Catholic Church.

Past experiences have shown that people living in the arctic have tended to keep fairly well to themselves by living in rather spread out communities. However, with the advent of larger communities with complete facilities and a full range of social and recreational activities there will probably be a stronger cohesive force amongst the people. There will still have to be opportunities for those desiring either personal or family privacy to do so. This choice may be even more necessary due to the extreme isolation and the dangers inherent in internal frictions.

As complete medical and health facilities as possible will be provided as well as the Eskimo rehabilitation centre.

The Department of Northern Affairs and Natural Resources has stated that the Eskimo will be integrated completely if he wishes to leave his traditional ways for the "advantages" of civilisation. With the education of the Eskimo children it is felt that they will be able to accept the responsibilities and benefits of contemporary life. Some difficulty may be encountered with the integration of present Eskimo families who wish it, into the community, especially with the tendency to gather neaby in slum-like shack towns. This could be avoided by providing some transitional form of dwelling between the sod hut and the fully equipped home. There is a danger however in creating a "native area" of lower quality which is distinctly against the government policy. Problems of inter-racial friction are hard to asses since the situation has rarely arisen previously with the

Eskimo but with a firm government policy of full integration from the beginning they can be solved.

Local government will advance as soon as possible to municipal status although initial development will almost certainly be through a Crown Corporation.

Although it is hoped that some people will be permanent and therefore likely to own their home, a large majority will be in rented accommodation. The Crown Corporation and later the municipality will probably own the buildings although it is possible that private building may operate also.

Isolation will be both a physical and a psychological problem since connections with the settled parts of Canada are very tenuous. There is no land connection since the Hudson Strait separates Baffin Island from continental North America, although during winter there is presumably a possibility of access by sled over the ice. This is however of little value since that part of Northern Quebec is equally as barren and uninhabited. There is sea connection only from late July to September and at that it is a several thousand mile journey from the nearest important port. The air service at present is twice weekly to Montreal, about 1200 miles to the south, as well as, of course, the frequent international airliners stopping over.

The external transportation pattern is principally related to the airfield with a brief flurry of summertime activity when the ships are able to bring in bulkier material. Ships are presently achored in Koojesse Bay and the supplies brought in to shore by lighter or landing barges. The internal transportation system will be principally between the dwellings and the working places at the airfield. While this would be most efficiently handled by a bus line, there will no doubt be a considerable number of private automobiles. In spite of the obvious difficulties and limited amount of road, people will generally wish to bring their car in if only for its prestige value. It might be possible to restrict the import of private automobiles but it is generally felt that allowing their use by those who wish to pay for it will be an important morale factor in "normalizing"the life. Within the community itself it is expected that most of the housewives' trips will be made on foot due to the relatively short distances. However, for such things as the "traditional" weekend shopping, the car will probably be used, and during bad weather. During winter the roads will generally be in good condition and since the snowfall is light they should be easy to keep clean. Problems will be met with snow drifting in lee conditions and during the summer thaw. Because of the ingrained use of the automobile and the lack of continuous deep snow such vehicles as snow mobiles do not seem to be practical.


CANADA
SCALE 1:15,840,000 OR ONE INCH TO 250 MILES
MILES 100 50 0 100 200 300 400 MILES
KILOMETRES 100 0 100 200 300 400 500 600 KILOMETRES
FRANKLIN
DISTRICT
FOXE BASIN
DAVIS STRAIT
BAFFIN ISLAND
HUDSON BAY
HUDSON STRAIT
LABRADOR SEA
ATLANTIC OCEAN
NEWFOUNDLAND
LABRADOR
QUEBEC
ONTARIO
JAMES BAY
Gulf of St. Lawrence
PRINCE EDWARD ISLAND
NOVA SCOTIA
NEW BRUNSWICK
ANTICOSTI ISLAND
SOUTHAMPTON ISLAND
MELVILLE PENINSULA
PRINCE CHARLES I.
COAST OF LABRADOR
GOOTHAAB
To Amsterdam
To United Kingdom
To Florida, Bermuda and Caribbean
To Chicago
To Mexico and South America
To Caribbean
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
TORONTO
OTTAWA
MONTREAL
QUEBEC
HALIFAX
SAINT JOHN
CHARLOTTETOWN
FREDERICTON
WINNIPEG
DETROIT
WINDSOR
BUFFALO
NEW YORK
BOSTON
HAMILTON
KINGSTON
SUDBURY
SAULT STE. MARIE
THUNDER BAY
PORT ARTHUR
FORT WILLIAM
SCHEFFERVILLE
GOOSE BAY
GANDER
ST. JOHN'S
CORNER BROOK
SYDNEY
HALIFAX
YARMOUTH
SABLE I.
ARCTIC CIRCLE
65°

FROBISHER BAY

NORTHWEST TERRITORIES

(PRELIMINARY MAP)

Scale 1:50,000

1.25 Inches to 1 Mile approximately

T A B L E 2

POPULATION DATA

Eskimo	625
White	3600
	4225

Family Structure

persons	Eskimo %	Eskimo No.	White %	White No.
1	15	96	30	1080
2	10	32	20	540
3	30	65	20	300
4	25	41	10	90
5	10	13	10	72
6	10	11		
		162 families		1002 families

ACCOMMODATION

Single Persons

	total	family lodgers	dormitory accommodation
Eskimo	96	50% (48)	48
White	1080	30% (324)	756
			904 (say 800 - some bachelor suites but mostly dormitory rooms)

Families

Eskimo	162
White	1002
	1164

Table 2 - continued

Space requirements

	1 br	2 br	3 br	4 br	total
Eskimo:					
2 persons	32				32
3 persons		65			65
4 persons		15	26		41
5 persons			16	8	24
	32	80	42	8	162
White:					
2 persons	540				540
3 persons		300			300
4 persons		30	60		90
5 persons			48	24	72
	540	330	108	24	1002

Assuming that the lodgers going families enter mainly the 3 and 4 person families we must increase the number of bedrooms alloted.

Increase for boarders

	Eskimo		White	
2 persons	5	10%	32	10%
3 persons	19	40%	200	60%
4 persons	19	40%	60	20%
5 persons	5	10%	32	10%
	48		324	

Revised space requirements with boarders
total number of families is the same but accommodation increased

	1 br	2 br	3 br	4 br	total
Eskimo:					
2 persons	27	5			32
3 persons		46	19		65
4 persons		9	19	13	41
5 persons			11	13	24
	26	60	49	26	162
White:					
2 persons	508	32			540
3 persons		100	200		300
4 persons		10	40	40	90
5 persons			16	56	72
	508	142	256	96	1002
Sum totals	535	202	305	122	1164 family units

Since total racial integration is the policy these housing figures can be added to obtain the net housing requirements.

TABLE 3

ENVIRONMENTAL DATA FROBISHER BAY NORTH WEST TERRITORIES CANADA[1]

63°45'N 68°33'W

	Precipitation Sun	Rain & Snow	Temperature Daily Max.	Daily Min.	Cloudiness	Days of Visibility 76 miles	Noon Sun Angle	Maximum Possible Daylight
Jan.	3.0"	.3"	-11°F	-24°F	36%	28 days	5°	5:02 hours
Feb.	5.8	.58	-12	-24	28	24	15	8:28
Mar.	4.6	.46	0	-18	36	27	25	11:40
April	4.0	.4	14	-2	39	26	37	15:11
May	5.7	.75	31	18	58	26	45	18:43
June	1.8	.94	43	32	61	25	49	21:53
July	-	1.38	53	39	56	29	45	20:15
Aug.	-	1.88	50	38	64	28	37	16:39
Sept.	5.4	2.37	40	31	65	26	25	13:07
Oct.	8.2	.91	29	19	56	26	15	9:46
Nov.	9.0	.91	18	7	55	24	5	6:16
Dec.	4.0	.4	5	-11	36	26	3	3:42
Year	51.5"	11.28"	21°F	9°F				

Frobisher Bay — Pangnirtung Comparable Location — 65°N Lat.

Winter Design Temperature	Frobisher Bay	Toronto	Summer Design Temperature	Frobisher Bay	Toronto
1 %	-50°F	-10°F	1 %	60%	85-90°F
2½	-45	- 5	2½	55	85-90
5	-40	0	5	55	80-85
10	-40	+10	10	55	80

Total hours of bright sun	Frobisher Bay	1200
	Toronto	2000
Degree Days 65°F base	Frobisher Bay	17500
	Toronto	7500

[1]Rae, R.W., Climate of the Canadian Arctic Archipelago, Meteorological Division, Department of Transport, Toronto, 1951
Thomas, M.K., Climatological Atlas of Canada, National Research Council, Ottawa, 1953

Site data

See Table 3.

The selection of the site, known as Apex Hill, is outside the scope of this thesis and has been accepted as the best within the immediate area of the airfield. The airfield has naturally taken the flattest land with reasonable access to the sea. When the present airfield was established in 1942 the Hudson's Bay Post was moved from the earlier site, 30 miles away, to Apex Hill. The most recent developments have taken place around the airfield but have been primarily of a service nature with a limited amount of housing. Although there appears to be some land available near the airstrip it seems wisest to keep the community away from the noise and danger of the aircraft and to allow for extension of the runways. Apex Hill is about 3 miles from the airfield or five miles by the recently built road.

The site is a fairly typical one of the arctic with about a $3\frac{1}{2}$ foot active layer above a continuous permafrost table. In the central trough area of the site there is rather poor drainage and bed rock is often not found until a depth of fifty feet. Water supply is presumably from the nearby stream from some distance back in the hills. The drainage pattern is quite clear in the rocky area but is slightly confused in the central trough which is somewhat of a basin. Local climatic observations are only very general. The wind is from the Southeast in summer and the Northwest in winter with gusts up to 120 miles per hour. Snow drifting is common with drifts of 6 to 8 feet in lee conditions, while bare rock is often exposed. The bay is of course iced over from about October to May and presents a flat stable area indistinguishable from the land surfaces.

Site development

The existing structures which have been erected on the basis of a much smaller community are generally small and easily moved. Therefore it is assumed that they will be re-located since to jeopardize the planning of a new and larger town by incorporating them would be unwise.

The town plan is intended as a framework for the study of the dwellings. However certain aspects must be noted. The land use is based on the use of the best oriented areas for housing with other activities taking the other areas. Therefore the north slope of Apex Hill is to be avoided and the south facing hillsides utilised. The town centre was located in the less desirable area north of Apex Hill with a westerly oriented slope for the evening sun. Here also it will be close to water access during the annual shipping period. It will also be possible to provide central community facilities on this relatively level area. This will include such things as the school, playfield, shopping centre, etc. In order to keep the housing within a reasonable walking distance, ¼ mile radius,[2] and to reduce the lengths of roads and utilities, it was decided to also utilise the flat central area of the site so that the town could be more compact.

The non-housing requirements of the town will have to be briefly considered. The principal element will be the commercial centre which should contain about 35,000 square feet[3] based on the needs of 1200 families with an additional area to compensate for the lack of a nearby larger centre.

[2]National Housing Agency, Public Housing Design, Federal Public Housing Authority, Washington, D.C., 1946, p. 11

[3]Moriyama, R. Urban Renewal, Planning the Neighbourhood, The R.A.I.C. Journal, January, 1958,

There will also be a movie theatre which will probably double as a school auditorium. These facilities along with certain administrative and professional offices will form the core of the centre and should be grouped around protected public spaces. Adjacent to the centre will be the service industries and the storage area. These will have to be sufficiently large to accommodate one year's supply since all bulk items will be brought in during the ten week long shipping season. For several reasons the school is also located in this complex. Principally because so many of its facilities will also be used for adult recreation during the evenings it should be related to the centre of town. This concentration will also serve to give the town a well developed focus. When considering recreational activities the ground conditions must be noted. During the warmer months when outdoor sports will be played, the normal ground will be too muddy for use and therefore it will have to be replaced with a gravel fill. Since it would be prohibitively expensive to attempt to build the total traditional recreation areas for a town of this size it has been decided to create a relatively small area of good ground for organised sports, both for adult recreation and for the school. An area of about 400 square feet would provide space for games such as soccer or baseball. During the winter the whole site will be available for outdoor activities such as skiing and sledding.

Other public and semi-public buildings should perhaps not be directly associated with the centre but will naturally not be too far away. This will include churches, hospital and rehabilitation centre, and hostel for the school children.

Transportation

The use of private automobiles although seemingly irrational will have to be accounted for but due to high transportation costs their numbers will be small. A figure of one per six households will be used, estimated from the experiences of other isolated communities. This will be supplemented by bus service to the airfield for the workers. Within the town walking distances should not be excessive and with adequate protection from the environment only a limited amount of roads will be required for servicing.

Housing

The housing can be broken down into several types. First, the single person accommodation which will be in dormitories containing communal facilities related to the town centre where their activities will be concentrated. Between this accommodation and that of families will be a group of one-bedroom apartments for families without children or single people of a more permanent nature. These will be divided amongst the housing areas in order to make each area relatively heterogenious and allow for choices of accommodation. The family accommodation then comprises the principal element of the housing.

It has been assumed that there will be relatively little home ownership since few families will remain more than five years. Therefore a scheme with a variety of accommodation within a standardised system is required. The principal controlling factor is the relation of the housewife and child to the environment. This implies first a close relation of the house to the small child's play areas,[4] and the relation to orientation. This leads

[4]Stein, C.S., Toward New Towns for America, Reinhold Publishing Corporation, New York, 1957

to the use of units which are directly connected to the ground level. Another element in this is the reaction of the inhabitants. In order to give a high degree of privacy as possible and a direct relation to the "street"; to avoid the psychological disadvantages of apartment living, row type dwellings will be used. These give each dwelling a "doorstep",[5] and avoid the acoustical problems of families one above another. In terms of developing a compact town pattern these will provide a balance between density and privacy.

The use of tall apartment buildings, besides the unfortunate mental attitude of North Americans toward them, is also rejected because of the high winds and the huge shadowed areas created to the north during the crucial winter months. With the low sun angle in winter tall buildings require extremely large spacing to avoid shading each other and thus create vast unuseable areas which further scatter the community. There is also the psychological problem of creating a series of long vistas which further accent the bleakness of the setting. Low dwellings looking inward with a scale related to the human being, in contrast to the vastness of the environment will provide a protective feeling.

Within a community of this size, really only a neighbourhood by definition yet a town, it is doubtful if there will be any significant adult subgrouping at a lower level.[6] In fact to allow for ease of varied social contacts "neighbourhoods" should not be rigidly created. Site conditions

[5]Smithson, A. and P., An Urban Project, Architects' Year Book #5, Elek Books Limited, London, 1953, pp. 49-55
[6]Taylor, R. The Social Basis of Town Planning, Architects' Year Book #4, Paul Elek, London, 1952, pp. 27-32

will probably give a degree of separate elements at any rate. There is however ample reason for a small unit based on the daily activities of the housewife and the small child. This could be related to the nursery school and play areas. At this level it would be desirable to provide a small convenience shop.[7] Although it is true that the town centre will be relatively close the establishment of a few smaller groups will help to create the feeling of a large complex and a limited degree of urbanity.

At the level immediately above the dwelling there is no significant grouping. A possibility would be use of communal laundries or storage space butthese it is felt would lead to the kinds of housewives' grievances so important to avoid in an isolated community. Therefore no particular figure can be set and the requirements of other aspects of the community plan will determine the physical shape of the dwelling groupings. Between each group there should be freedom of movement and generally the possibility of various ways to walk and play areas for children.

The family habitat is principally based on the recommended orientation pattern in conjunction with the desire to relate the dwelling to the "street" and child's play. The following standards form a basis for the program.

interior versus exterior

"a. is there reasonable protection from noise and invasion of public from street, particularly for living, dining, and play areas
b. is there easy access from living, dining, and play areas to similar space outdoors
c. is the kitchen as close as possible to service entrance
d. is the easy access from laundry to yard
e. is the outside space for children's play easily supervised from mother's work areas

[7]Tapiola Garden City, Arkkitehti, Suomen Arkkitehtiliitto, 1-2/1956

space for children inside

a. is there space for playpen easily supervised by mother when cooking, ironing, sewing, etc.
b. can play of very young and older children be separated
c. can adults sit in comfort away from noise of older children's play spaces
d. is there space in bedroom or elsewhere for older children to study with some privacy
e. is there a bath or toilet near young children's indoor play space (and entrance from outdoors)
f. if possible circulation of children between indoor and outdoor space should not be through "parlour" part of living space
g. does bathroom arrangement facilitate care of babies

adult indoor spaces for living

a. is there space for simultaneous separate adult entertainment and older children's play
b. is there space for workshop or other hobby for father
c. is there convenient, well lighted space for sewing and ironing."[8]

There are however certain modifications required for this particular climatic area. The principal element being that of outdoor space and yard. Combining this with the requirements of a weatherbreak between the weather and the heated interior spaces and additional hobby, play and storage space the concept of entry into a "yard" has been proposed. This area which would only be lightly heated would provide a stage between indoors and outdoors for small child's winter play; rough storage and place for outer garments and children's playthings.[9] It would be well oriented and related to the housewife's area directly. It could be developed by the tenants as they desired, e.g. greenhouse for plants, small workshop or just a semi-porch. By leaving this area less well finished and not fully heated it is felt that it can alleviate much of the disadvantages of arctic living at a relatively moderate cost.

[8]Philadelphia, The Development Authority of the City of, Eastwick, New House Study, August, 1957

[9]American Public Health Association, Committee on the Hygiene of Housing, Planning the Home for Occupancy, Public Administration Service, Chicago, Illinois, 1950, p. 41, 48 and 49

Within the community plan one of the principal elements will be the utilidor system combined with the means of covered access linking the dwelling groups. On land which is unstable, non-frost susceptible areas will be developed for play related to the family units and areas of sheltered play. These spaces will be shaped much in the manner of Japanese gardens since they will not be able to support any growth but will have to gain interest by sculptural form, paving areas and man made landscape elements. Family dwellings will be related to this type of area for an intimate friendly general outlook. Traffic will of course be limited by the conflict with the utilidor system and will require a careful separation with few crossings. Basically a series of super-block areas will be developed with roads on the periphery and utilidors and enclosed access ways forming the spine, or "central green area". Parking will be in groups at the edge with about 100 feet maximum distance to the farthest dwelling. For servicing, moving, etc., within the dwelling groups, small carts and dollies towed by electric cars will be used.

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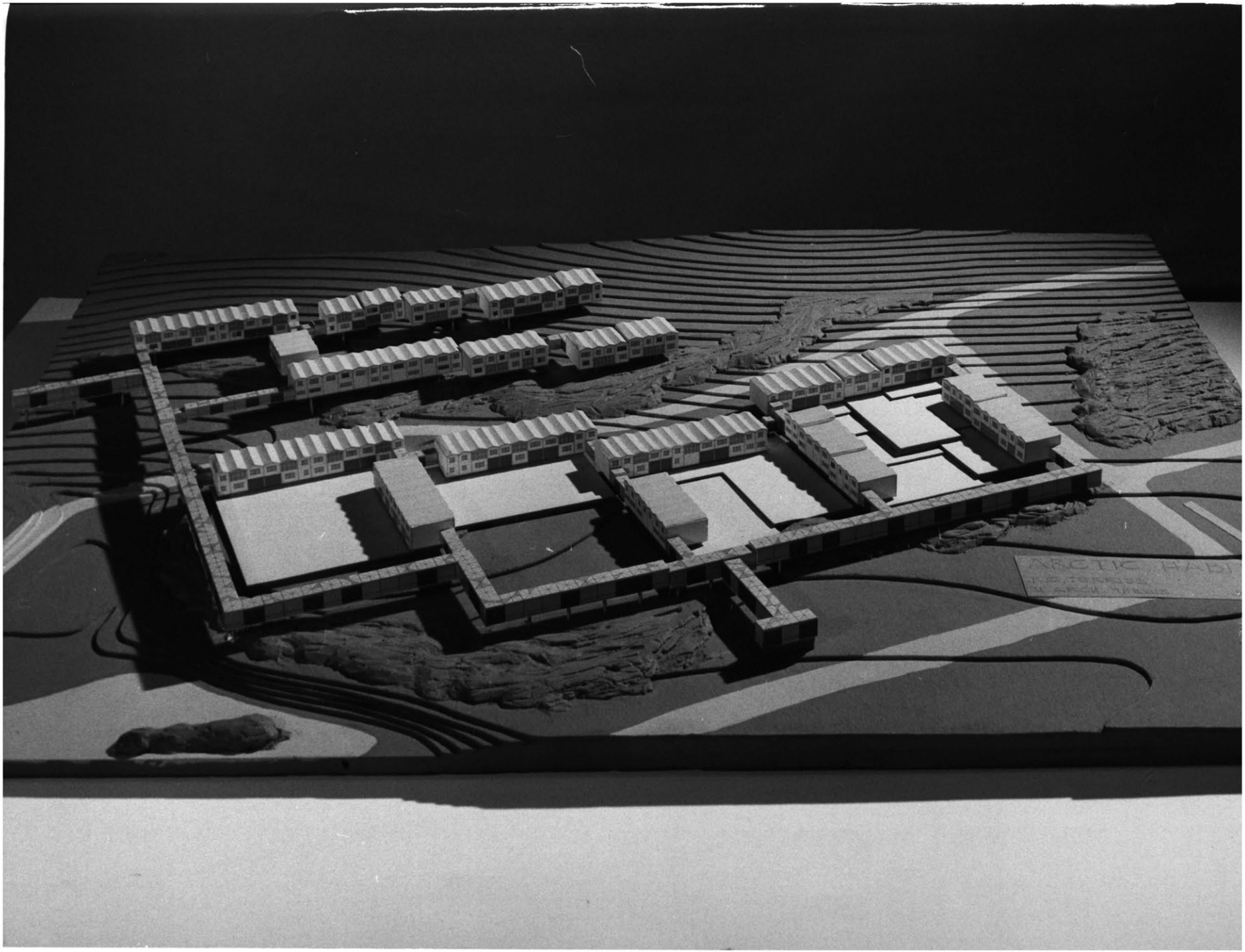
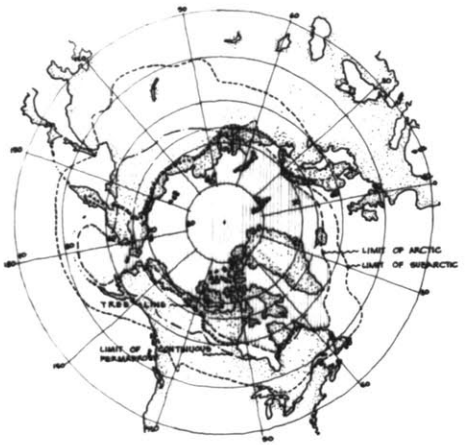
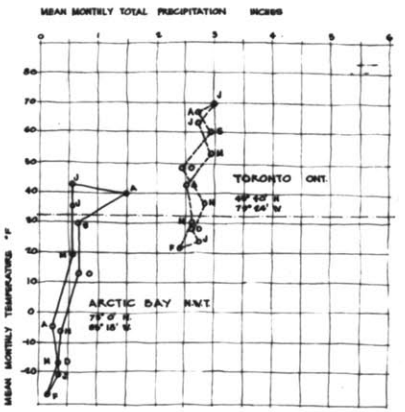
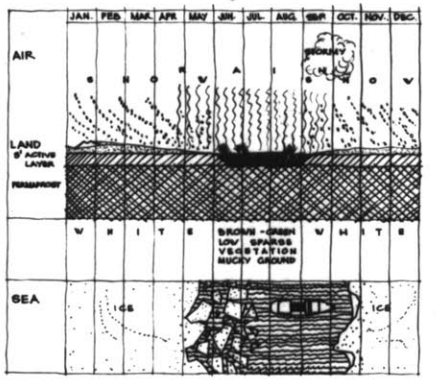




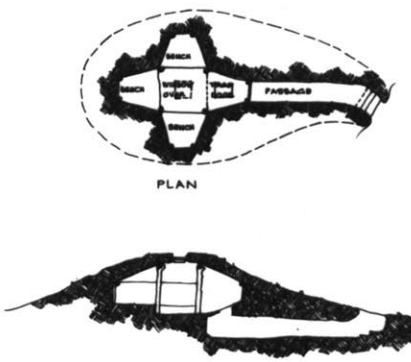
NORTH POLAR REGIONS



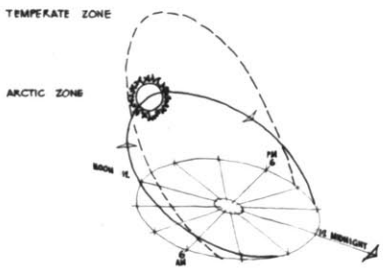
HYTHERGRAPH
COMPARING ARCTIC AND TEMPERATE ZONES
- LOW PRECIPITATION, BUT LITTLE EVAPORATION
- WINTER LOW NOT SEVERE, BUT FREEZING POSSIBLE ALL YEAR

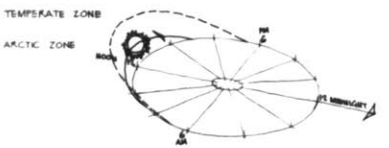


ENVIRONMENTAL SUMMARY

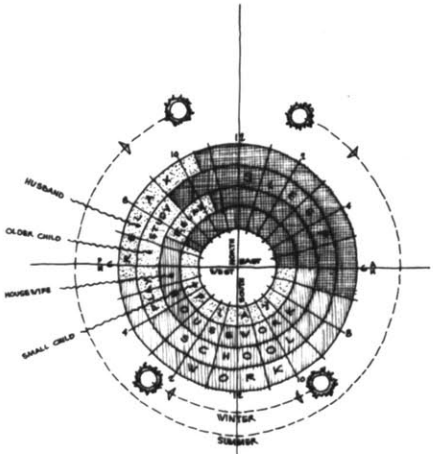


ESKIMO WINTER HOUSE
- SOD COVERED WOOD FRAME
- MINIMUM EXPOSURE
- AIR STRATIFICATION PRINCIPLE, ENTRY FROM BELOW, RAISED FOR SEDENTARY ACTIVITIES
- LONG PASSAGE TO EXCLUDE WIND





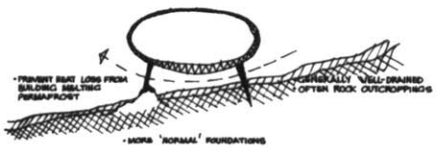
GREAT PSYCHOLOGICAL VALUE



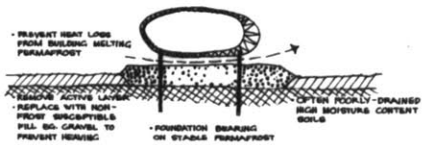
DAILY FAMILY ACTIVITIES IN RELATION TO THE SUN

DESIRABLE ORIENTATIONS

• HOUSE WIFE'S WORK AREA	- SOUTH
• CHILDREN'S PLAY AREA	- SOUTH WINTER SUN VITAL
• ADULT RELAXATION	- WEST AND NORTH
• SLEEPING	- VARIABLE

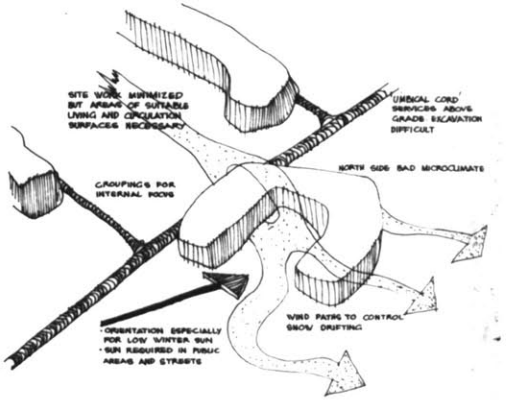


SLOPING SITE



FLAT SITE

TERRAIN CONDITIONS



COMMUNITY PLAN CONSIDERATIONS

ARCTIC HABITAT RESEARCH

K.G. TERRISS M.I.T.
M.ARCH THESIS JUNE 56

ACCOMMODATION

DORMITORIES

SINGLE ROOMS	800

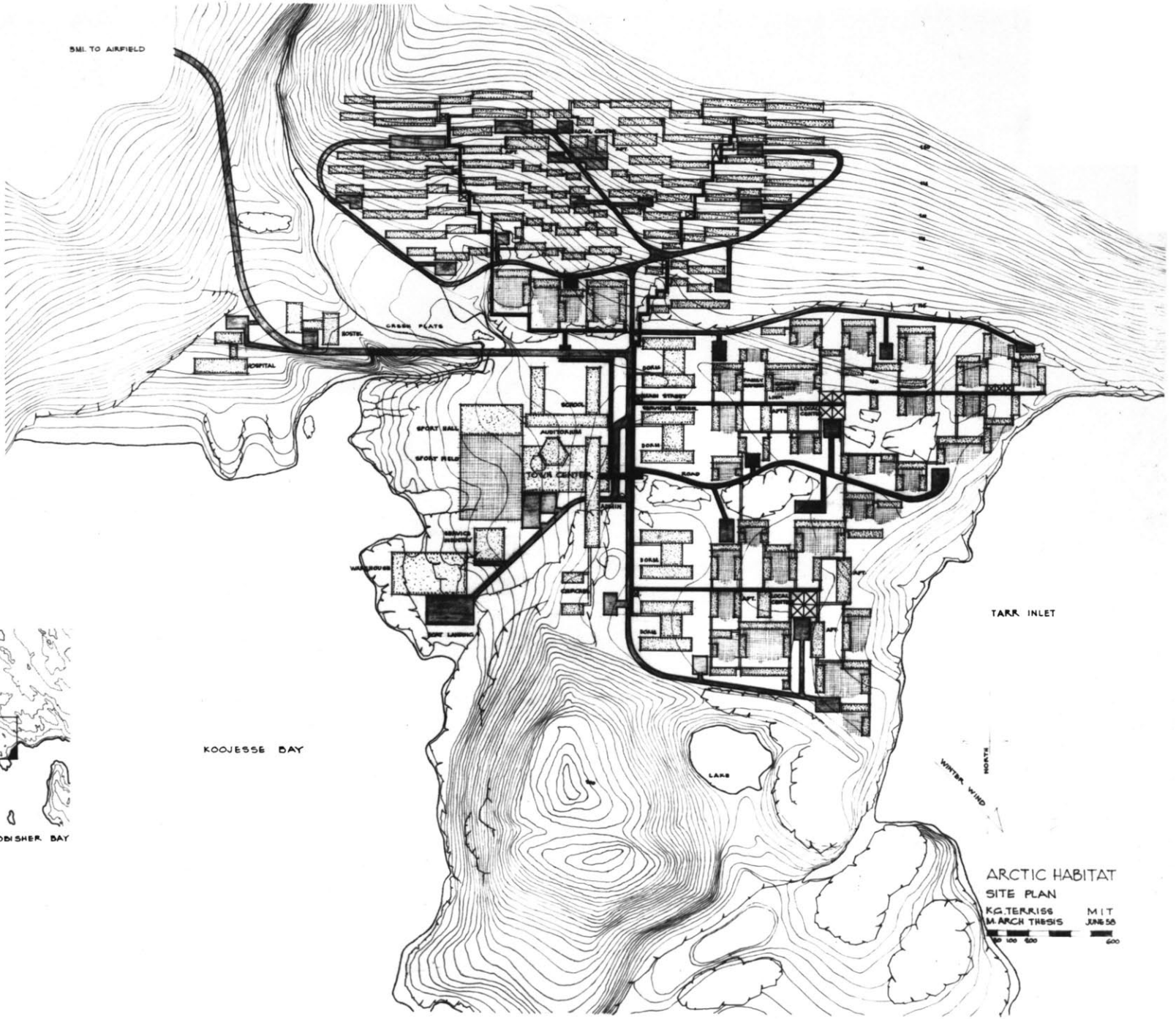
APARTMENTS

ONE AND TWO BEDROOM	500

FAMILY HOUSING

ONE BEDROOM	56
TWO BEDROOMS	202
THREE BEDROOMS	505
FOUR BEDROOMS	122

POPULATION 4125



LOCATION MAP 65°45'N 68°35'W FROBISHER BAY

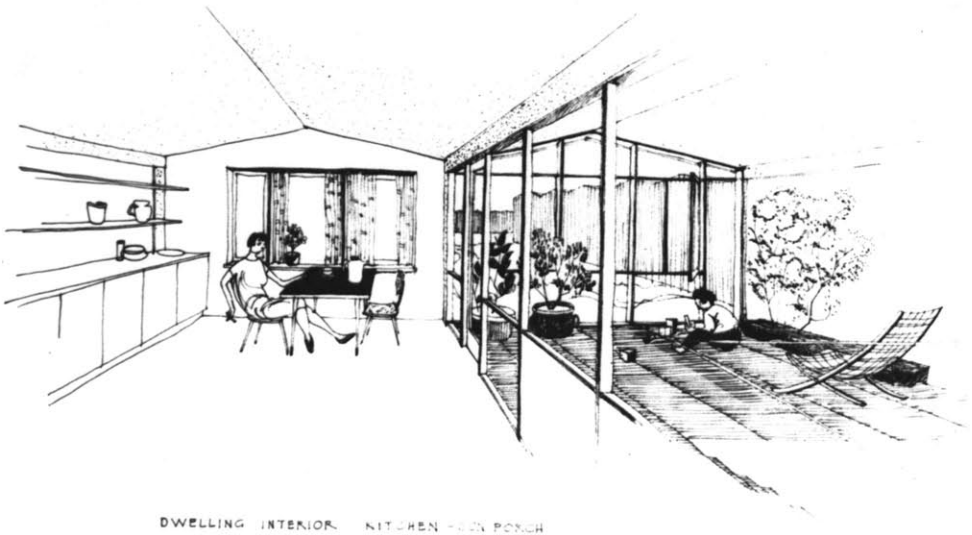
ARCTIC HABITAT

SITE PLAN

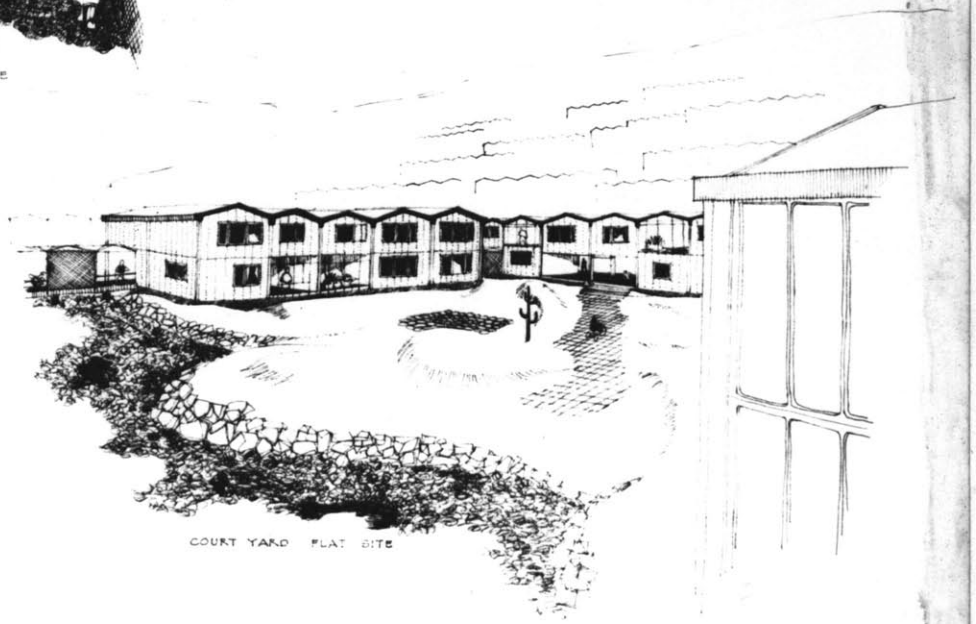
K.G. TERRISS M.I.T.
M. ARCH THESIS JUNE 58

50 100 300 600

CORRIDOR STREET SLOPING SITE



DWELLING INTERIOR KITCHEN-DEN PORCH

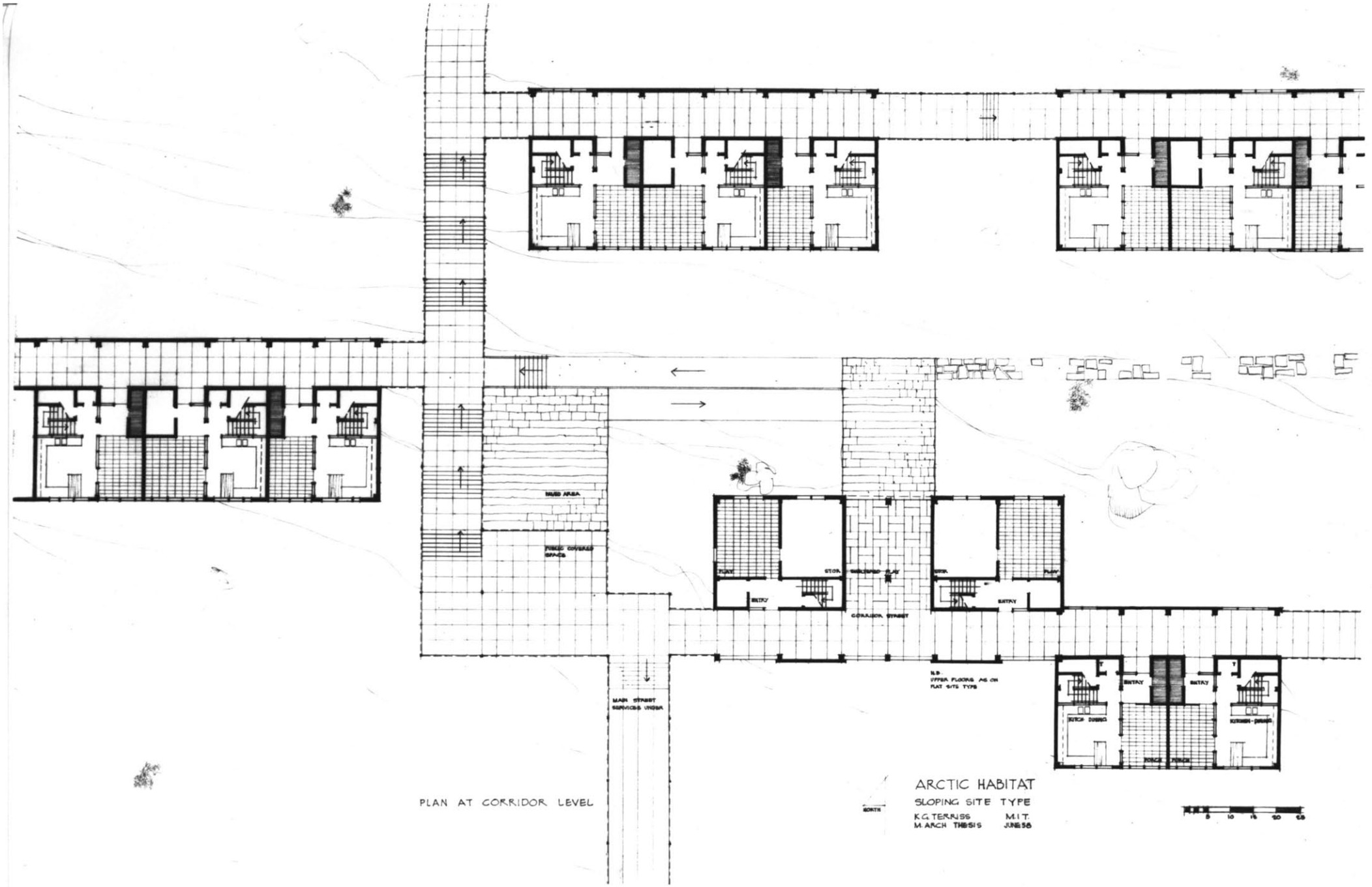


COURT YARD FLAT SITE

ARCTIC HABITAT

R.G. TERRISS M.I.T.

M.ARCH THESIS JUNE '58

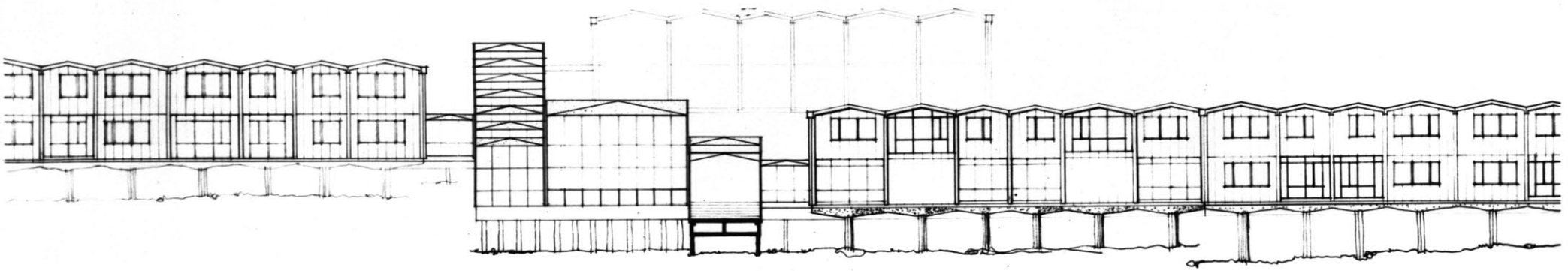


PLAN AT CORRIDOR LEVEL

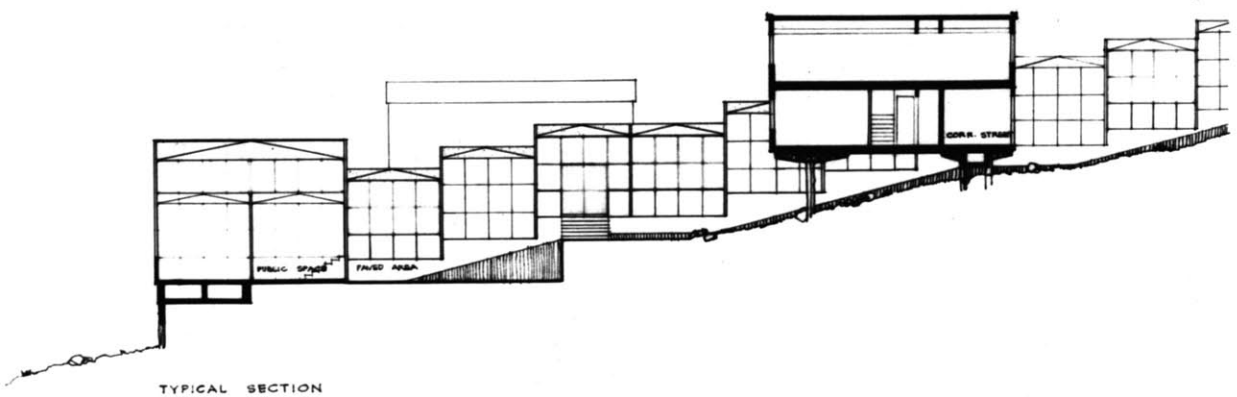
ARCTIC HABITAT

SLOPING SITE TYPE

K.G. TERRISS M.I.T.
M.ARCH THESIS JUNE 58



SOUTH ELEVATION



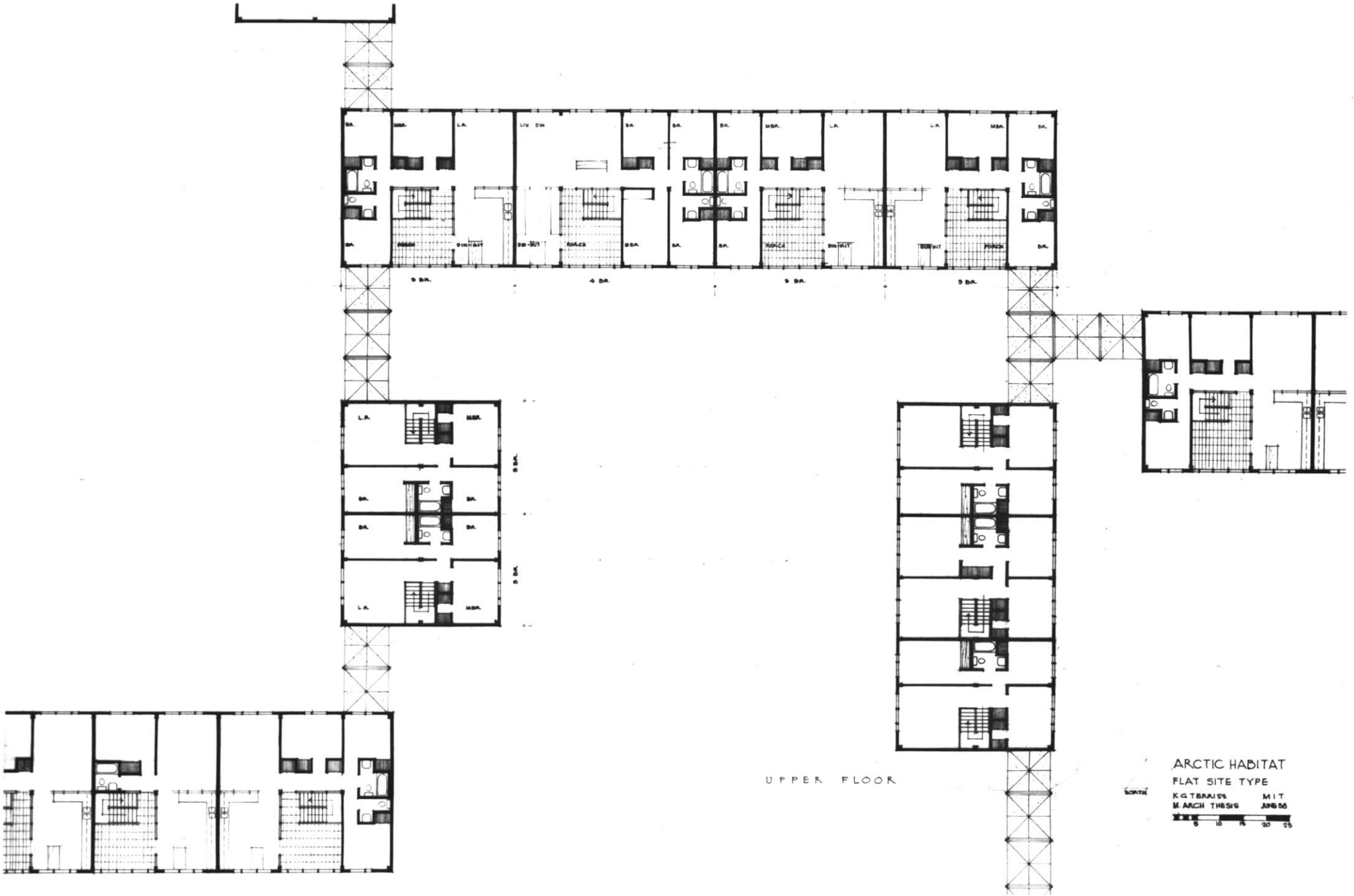
TYPICAL SECTION

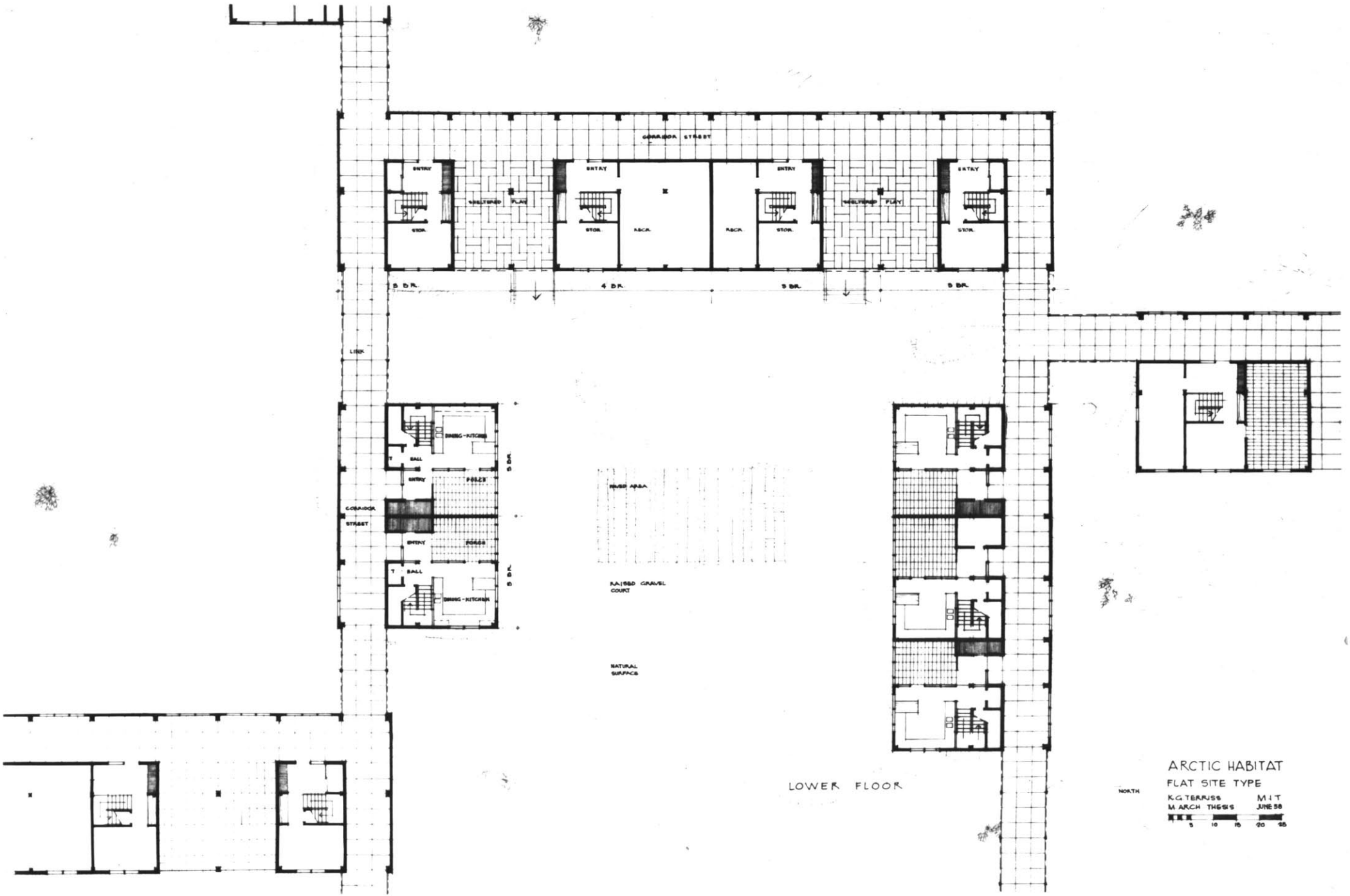
ARCTIC HABITAT

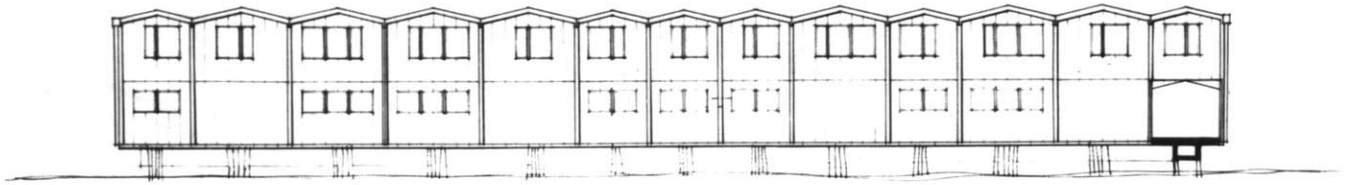
SLOPING SITE TYPE

K.G. TERRISS M.I.T.
M. ARCH THESIS JUNE 58

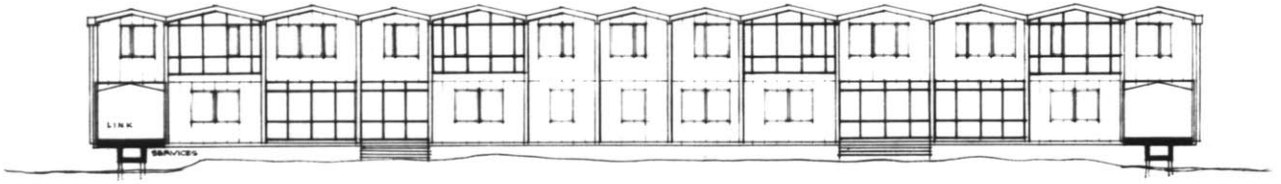
5 10 15 20 25


UPPER FLOOR
ARCTIC HABITAT
FLAT SITE TYPE
K.G. TERRISS
M. ARCH THESIS
MIT
JUNE 56
NORTH

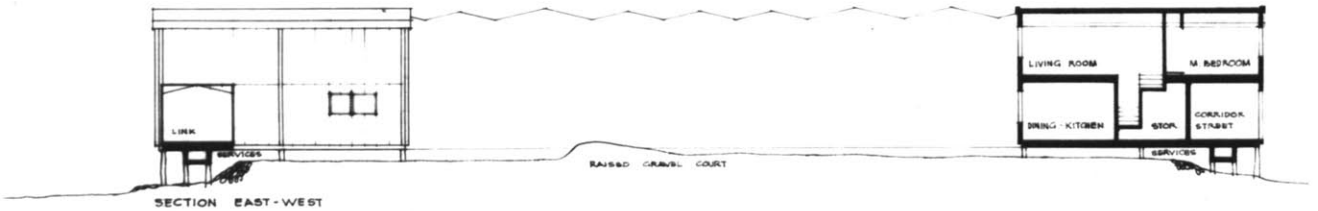

GORDADOK STREET
ENTRY
STOR.
SHELTERED PLAY
R&CR.
5 BR.
4 BR.
LINK
DINING-KITCHEN
HALL
POOLS
RAISED GRAVEL COURT
NATURAL SURFACE
LOWER FLOOR
NORTH
ARCTIC HABITAT
FLAT SITE TYPE
K.G.TERRISS
M.ARCH THESIS
M.I.T
JUNE 58



NORTH ELEVATION



SOUTH ELEVATION



SECTION EAST-WEST

SECTION NORTH-WEST

ARCTIC HABITAT

FLAT SITE TYPE

K.G.TERRISS M.I.T

M.ARCH THESIS JUNE 58

5 10 15 20 25