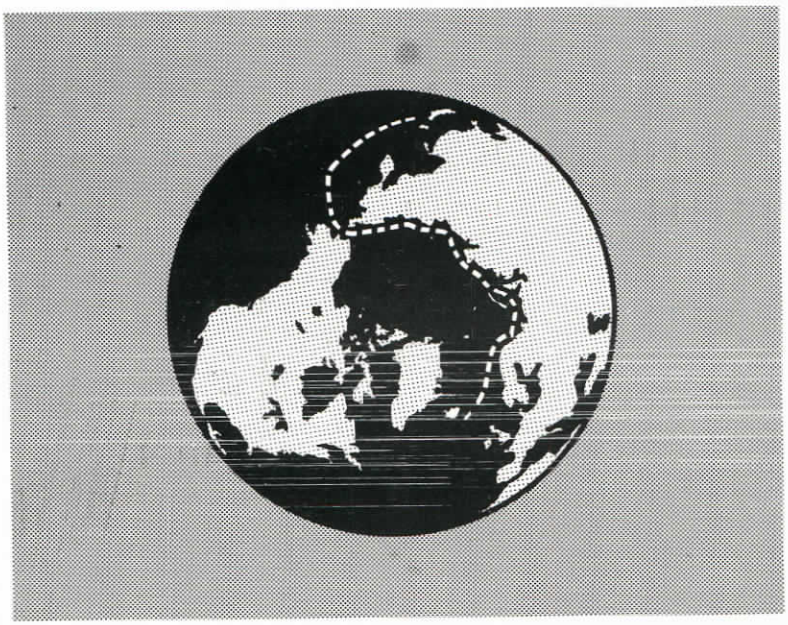

The Arctic Sea Route

The Association of Municipalities
in the Capital Area

The Arctic Sea Route

A SEMINAR HELD IN HALLARGARÐURINN,
HÚSI VERSLUNARINNAR
IN REYKJAVÍK, ICELAND, OCTOBER 8, 1987

The Association of Municipalities
in the Capital Area
ICELAND

THE ARCTIC SEA ROUTE

A seminar held in Hallargarðurinn, Húsi Verslunarinnar in Reykjavík, Iceland, October 8, 1987.

09.00 COFFEE.

Chairman: Mr. Jóhann J. Ólafsson, Chairman of the Icelandic Chamber of Commerce.

09.20 **OPENING ADDRESS**: Mrs. Jóna Gróa Sigurðardóttir, Chairman, The Industrial Development Committee for the Capital Area.

09.30 **ADDRESS**: Matthías Á. Matthiesen, Minister of Transportation.

09.40 **INTRODUCTION.**

Mr. Gestur Ólafsson, Managing Director, The Planning Office of the Capital Area:

"The Purpose of the Conference."

Dr. Thor Jakobsson, Meteorologist:

"The Trans-Arctic Sea Route - Recent Developments."

Mr. Haraldur Ólafsson, Senior Lecturer, University of Iceland:

"The People of the Arctic".

10.30 COFFEE BREAK.

10.45 **ENVIRONMENT AND TECHNOLOGY.**

Dr. Vilhjálmur Lúðvíksson, Managing Director, The National Research Council:

"Cooperation in Scientific Research in the Arctic".

Mr. Thomas W. Möller, Industrial Engineer:

"The Icelandic Shipping Industry - An Overview".

Mr. Gísli Viggósson, Civil Engineer, Icelandic Harbour Authority:

"Port and Ocean Engineering under Arctic Conditions (POAC)."

Mr. Einar Hermannsson, Marine Engineer:

"Icebreakers and Cargo Ships in the North."

12.00 LUNCH.

13.00 **THE INTERNATIONAL CONTEXT.**

Chairman: Dr. Gunnar G. Schram, professor.

Mr. Vladimir Maslov, Engineer, The Russian Embassy, Iceland.
"The Polar Ocean Route".
Ms. Gulnur Aybet, M.Sc., England:
"An Investigation on the Feasibility of an Arctic Trade Route between Iceland and Japan."
Mr. Frederic Seibold, Manager, The Arctic Marine Technology, R & D Program:
"Progress towards Trans-Polar Shipping Route."
Mr. Eyjólfur Konráð Jónsson, MP, Chairman of the Foreign Affairs Committee:
"War or Peace in the Arctic."

15.00 COFFEE.

15.15 **DISCUSSION.** Chairman: Mr. Gunnlaugur Sigmundsson, Managing Director, The Icelandic Finance and Investment PLC.

16.00 **SUMMING UP.** Mr. Róbert Trausti Árnason, Councillor, The Ministry of Foreign Affairs.

16.30 - 18.00 **Reception by the Mayor of Reykjavík, Mr. Davíð Oddsson, in Höfði, Reykjavík.**

Jóna Gróa Sigurðardóttir, Chairman,
The Industrial Development Committee
for the Capital Area.

OPENING ADDRESS

Ladies and Gentlemen,

On behalf of the Industrial Development Committee of the Association of Municipalities in the Capital Area, I should like to welcome you to this seminar on the polar ocean route between the two great oceans, the Atlantic and the Pacific, via the Bering Strait. I would like to extend an especially warm welcome to our guests from abroad, who have travelled so far to be with us.

The object of the seminar is primarily to learn more about this shipping route, and to encourage more discussion of it from the viewpoint of various experts, politicians and businessmen.

Meteorologist Dr. Þór Jakobsson has for some time proposed the prospect that the polar ocean route might, at some future time, become one of the world's major shipping routes. If so, it would prove vital to create entrepots at both ends of the Arctic route, where goods would be transshipped and sent onward to the markets.

Iceland lies on the sea route between the polar ocean and the North Atlantic and also has easy access both to the east coast of America and to western Europe. Iceland would thus be an ideal location for such an entrepot, and the capital is particularly well-equipped to provide the necessary services.

In this environment we must envision a totally different economic base from the one we now know. An entrepot would attract various different activities, banking and services of many kinds would boom, trade and commerce would flourish. In this new business environment, one can easily imagine a World Trade Center being formed, and this possibility has been considered by the Association. Enourmous interests are bound up in this vision of the future.

For decades, varied programmes of scientific research have been carried out in the polar regions. Both superpowers, and other countries which border on the Polar Ocean, or make use of adjacent land, aim for greater research and collaboration than hitherto. The Icelandic National Research Council has closely monitored this move toward collaboration.

Over the past quarter century, the Polar Ocean has been opening up, primarily due to technological developments. Icebreakers, and vessels able to withstand sea ice are growing ever more powerful, and remote monitoring of sea ice, for instance, by satellite, provides greater understanding of ice drift, and

improves the safety of those who travel the polar sea. As a result, it has proved possible to extend the shipping season to four months.

In 1985 it was estimated that there were 16 icebreakers and about 400 freight vessels in the area, which transported a total of 6 million tons of goods. As a matter of interest, Iceland's total freight transportation that year amounted to 1.4 million tons.

A question to be considered is whether it might prove worthwhile to extend the shipping route in both directions, for the shortest route from Europe to the Far East is supposed to be via the Pole. These prospects have been considered, and the Japanese even went so far as to call Iceland the Hong Kong of the north. Technically, it is a possibility, but the economic side has yet to be assessed.

Much work is being done to evaluate the potential profitability of such freight shipping, without which investors would be unlikely to put their money into in this shipping route.

It is quite clear to all of us that these ideas are still only a distant prospect, and that the realisation of any plans depends heavily upon successful collaboration between the nations most closely involved.

I am sure, ladies and gentlemen, that the addresses we are about to hear will leave us far better informed upon current developments in this area.

It is with pleasure that I declare this seminar open.

TO LINK CONTINENTS

Mr. Gestur Ólafsson, Managing Director,
The Planning Office of the Capital Area,
Kópavogur.

A few years ago, the Association of Municipalities in the Capital Area of Iceland coined the slogan "We Link Continents". In trying to live up to this statement the Association decided, on recommendations by its Industrieal Development Committee, to look into the development possibilities that a sea route between the Atlantic and the Pacific Ocean, to the north of Siberia, might open up for the Capital Area of Iceland.

This idea of a sea route north of Siberia is not a recent one. The voyage was first made the Russian ship Alexander Sibiryakov more than half a century ago, in 1932. This was by no means an easy passage, through the Arctic ice and fog, but the breakthrough had been made and it had been shown that such a sea route was possible.

The ice in the Arctic has not thawed a great deal since this voyage was made, but technological advances in shipbuilding, navigation, and especially the recent thaw in relations between the Superpowers have made this sea route much more feasible now than it was only a few years ago, both for transportation and tourism.

Navigating the Northern Seas is nothing new to the Icelanders and it is therefore only natural that we should approach the idea of a sea route north of Siberia with enthusiasm and be prepared to contribute towards the realization of that idea in cooperation with other nations. It is to manifest their will to cooperate on this project that the Association of Municipalities in the Capital Area has decided to organize this seminar.

The Capital Area is however, by no means the only part of Iceland that could have something to offer in this context, but this area has nonetheless traditionally been the center of the shipping industry and communications in Iceland and contains about 54% of Iceland's population. In addition the best seaport facilities in Iceland are in this area, with an international airport only 30 miles away.

The organizers of this seminar do not necessarily expect us to solve many problems in connection with this sea route today. They do however hope that we will help them to answer the following three questions:

1) Is the operation of this sea route a realistic possibility today, or should we perhaps wait for yet another half a century?
2) If the operation of this sea route is feasible today, in what areas do we need additional research to make it economically viable?
3) How can we best cooperate internationally to realize the possibilities that this passage may open up?

To link continents is no easy task. To link the Atlantic and the Pacific Ocean by a sea route north of Siberia seems no less massive a task for us today than it was for the Vikings to discover Iceland, Greenland and America a thousand years ago, despite all technological advance. The Association of Municipalities here in the Capital Area has however decided to give this matter some priority for the time being. The idea has also been put forward that, if the outcome of this seminar is positive, we should host a truly international conference of all parties interested in this sea route here in Reykjavík in a year's time. The intervening time could then be used to answer important questions that may be highlighted at this seminar.

It has long been acknowledged that the greatest power on this earth is the power of a good idea. Coupled with the will to pool resources, share ideas and knowledge and to work together, we may not be able to work miracles, but it is possible that we can open up the sea route between the Atlantic and the Pacific Ocean, north of Siberia.

THE TRANS-ARCTIC OCEAN SEA ROUTE

Dr. Thor Jakobsson,
Meteorologist,
Reykjavík.

Modern technology is opening up new possibilities all the time, causing rapid progress in many areas of human activities. In the opinion of the late historian-philosopher Arnold Toynbee there are two basic facts characterizing our age, having a profound effect on our world views: First, vastly increasing knowledge of mankind's history, say, during the last 35 thousand years and, second, the speed or frequency of new scientific discoveries. Modern man has to struggle to keep the balance between his own nature and the new technical environment he is himself creating.

We are gathering here today to consider new possibilities due to scientific progress, but at the same time, to look into economic and cultural benefits our nations may gain by these new developments.

The trans-Arctic sea route between the Atlantic Ocean and the Pacific Ocean is a challenge in many respects, both from technical and commerical point of view and it may eventually have interesting sociological implications.

I would like to express my gratitude to the Planning Office of the Capital Area for organizing this meeting on behalf of the Association of the Municipalities in the Capital Area of Iceland. This conference will hopefully be a turning point in the process of recognizing the possibility of building a grand international forwarding harbour in Iceland that would be linked to a future sea route across the Polar Ocean. I am happy to experience so many able persons contributing to this subject at the present conference by attending, writing in the proceedings, giving talks or discussing the pros and cons later today.

In the attached inerview by Bernard Scudder reproduced from the Iceland '87 - Yearbook of Trade & Industry - I described how I came to learn about this idea, "the dream" of Iceland becoming "the Hong Kong of the North". I should not spend time repeating the winding story, but I cannot resist pointing at its multi-nationality if I may say so.

It begins with my participation in a Soviet-Icelandic sea ice expedition on the Russian icebreaker Otto Schmidt. Somewhat later I wrote a short account on the trip, published by the Research Institute Nedri Ás, Hveragerði, Iceland. Among the responses, received by the director of Nedri Ás, Mr. Gísli Sigurbjörnsson, acknowledging the receipt of the report, there was a letter from a German meteorologist, dr. T. Endo, where he mentions the interest of Japanese scientists in a future Polar Ocean sea route with Iceland playing a main role due to its location.

Even though I had been for 20 years, either myself involved in Arctic reseearch or close to others, occupied with studies of the Polar atmosphere and sea ice, I had never thought of such a possibility. After some hesitation and reading I became convinced of the enormous potential latent in the idea. Since then I have encountered a slowly growing interest and lately an encouraging reaction to my rather sporadic articles but more numerous discussions on the Arctic sea route.

However, a couple of events have in my opinion, signified distinct advances during these two years. First of all I would like to mention an introduction made by BBC Television followed by the BBC-News a year ago, resulting in valuable contacts, one of those being with a Dutch-English shipping company. A few months ago their office in London initiated an investigation into the viability of trans-Arctic transport. Today we will enjoy the presence of Ms. Gulnur Aybet, M.Sc., who made this study and we look forward to hearing about her findings in a few hours.

The second advantageous event happened about the same time, when the largest newspaper in Iceland, Morgunblaðið, put forth on October 10, 1986 one of my articles on trans-Arctic transport despite busy times and plenty of news as these were the days of the Reagan-Gorbachev summit meeting in Reykjavík. The article featured a large picture of my former host icebreaker Otto Schmidt and a map of the Northern Hemisphere north of 60°N. In the article I described the northern sea route and recent developments in the Soviet northern areas, concluding by stating that the basic condition for the realization of the trans-Arctic sea route, and Iceland enjoying her geographical location accordingly, would be that peace would last between the two super-powers. The Reykjavík summit meeting would hopefully promote such a condition.

After the appearance of this article I received phone calls and letters from interested people here in Iceland, some of whom are with us here today.

The third event is then the interest shown in organizing and taking part in this meeting. Besides attending fellow-Icelanders and Ms. Gulnur Aybet from England it is particularly enjoyable to have at the meeting representatives from the United States and the Soviet Embassy in Iceland.

According to the organizers of this symposium this may just be a preliminary meeting. The purpose is to find out if the subject warrants a larger international conference next year. Interestingly, I think that we suddenly have a different perspective now, recalling last week's statement by the most recent enthusiast in the Arctic Ocean sea-route club, Mr. Mikhail Gorbachev. From now on, no-one should doubt the soundness of the idea. The question now is rather: In what way should our countries take part and how should we cooperate - or compete peacefully for that matter.

On October 4, 1957 - thirty years ago - our Earth acquired its first artificial satellite in the Russian Sputnik 1. The Space Age began. One of the results obtained by the new Earth monitor technology is the much easier access to the ice covered Arctic Ocean. In addition to progress in icebreaker, ship and submarine construction it could open a path between distant peoples and amplify their interaction, commercially and culturally.

In my presentation I will show a couple of Arctic Ocean maps, displaying distribution of sea ice, and comment on remote sensing of northern areas by satellite sensors.

Haraldur Ólafsson, dósent

PEOPLE OF THE ARCTIC

The anthropologist and explorer Vilhjálmur Stefánsson once wrote a book, which he called The Friendly Arctic. There he describes the high north as a land of plenty. In many ways he was a pioneer in travels in the Arctic. He learned to live from the land, and could therefore go to some of the most inhospitable regions of the globe without cumbersome baggage. A gun and knives were all he needed to get all the food necessary. This he didnot learn from books or in universities, but from the people living in the Arctic, the Eskimos, now called the Inuits. Century after century the Europeans had tried hard to find their way through the icemasses in the north, hoping to find a new route to the mysterious and rich countries in the East. For centuries had fishermen and whalers from Europe hunted in the dangerous waters where the Atlantic Ocean meets the Arctic Ocean. The boreal regions of the earth were mysterious, dangerous, full of monsters in the sea and on land. The weather was unpredictable, and the ice could in few hours change a strong ship into a total wreck.

But Vilhjálmur Stefánsson saw all this from a different angel. He saw the abundance of life in the sea. The protein in fish and sea-mammals, an inexhaustible source of food for man and beast. And he saw more: the possibilities of safer and more convenient travel over the Polar-regions. The aeroplanes where changes the modes of travel , and also the thinking of man. The majority of the population lives in the northern hemisphere of the earth. The international trade is to a great extent between the big industrial nations in east and west. The Arctic is therefore playing a pivotal role in global trade. The North is well suited for air-travel. After all the Arctic was not so unfriendly as most people believed, and Vilhjálmur Stefánsson was right in many of his predictions concerning the future role of the Arctic regions in communication between nations.

He was not only interested in trade routes, but also, and even more, in the people living in the far North, the people that tought him how to live on what the land had to offer. The inuit groups that lived on the arctic islands of Canada , in Greenland and in Alaska were specialized in surviving under harsh conditions . What they tought Vilhjálmur Stefánsson was how to live in the Arctic. Their experience is to this day a valuable example of how man has adapted to nature.

It is of course not necessary to talk about the people of the Arctic when discussing the opening upp the North-East Passage for ocean-going ships, but it is interesting to get to know the population still living along the coastline in the Arctic. The people there has lived there for many centuries and as said before, adapted to the arctic conditions. We don´t have much exact information about some of the groups that will be mentioned here, and many of the old cultural traditions have disappeared.

For most of his time as a cultural animal the man has been a hunter, and for thousands of years has he been living as a ice-age hunter, chasing reindeer and moose, mammouth and elk, seal and whale, fox and wolverine. The Arctic people are the last representatives of the great ice-ages in the last one million years.

We know now that man has lived for thousands og years at the coast of the Arctic Ocean. The first inhabitants in Scandinavia were most probably hunters in the norwegians fjords in Troms. To those hunters, the sea mammals and fish in the sea and rivers the Arctic has been friendly and generous. But let us not believe for a moment that life there has ever been easy. It is a hard life that demands much of the people. You have to adapt or go under. You have to accept its terms ,- you have no chance if you defy the nature.

The boreal regions inhabited by people are mostly a tundra near the ice-filled sea. The tundra ecozone is charcterized by scanty vegetation, if any. The nirthern hemisphere, i.e. the northernmost landmasses of Eurasia and America, is tundra and taiga. The trees vanish where the taiga merges into the tundra. These two zones are characterized by permafrost,where the mean temperature is always under 0°C, that the temperature on the ground. The permafrost can reach considerable depths, even 1000 feet down. The various chapters on human ecology demonstrate that natural production of foodstuffs for livestock kept and game hunted by circumpolar peoples and of direct sources of human food such as sea mammals, land mammals, fish and edible vegetation is low compared to most other areas of the world. The natural production of land is low but the sea rich in plankton and differs little from other marine areas.

The limitations of natural production in the circumpolar area are evident from the small human population living there. It is possible, that the population has been constant for a very long time. The nature in this part of the earth sets limits to the growth of the population. It is known that the coastline from Nordkapp to the Bering Strait has been inhabited over thousands of years. The earliest known habitat in Scandinavia is in Altafjord,where hunters, probably of Same-origin, lived over eight thousand years ago.

In the northern part of Russia lived the Netsy, often callaed Samoyeds in the litterature and travelbooks.They, as the Same, kept reindeer, but depended also upon the sea and fishing in streams and rivers. They were often met by explorers trying to find their way over the dangerous Kara-sea, which often was the most difficult hindrance on the way along the eurasian northcoast. Nordenskjöld met often the Nentsy on the successful Vega voyage, and he and his men gathered much invaluable etnographic material and knowledge on that trip. Amundsen got also help from them when forcing Maud to the east.

East of the Nentsy are the Evenks, or Tungus. Most of them live between the great rivers Lena and Yenissey. They are reindeer-breeders and hunters, also depending upon catch from the esturaies of the rivers. Farther to the east ar the Yakuts, one of the biggest culture groups in Northern Siberia. They are originated farther south, but moved north, bringing with them horses and cattle.

On the tundra surounded by the great mountain range called Verkhoyansk live the Yukagirs. They are reindeer hunters and gatherers. They They occupy the country north of Verkhoyansk which is draines northwards to the arctic Ocean by the tributaries of the Kolyma river. In this country all water is frozen for seven or eight months of the year. The winter temperature is the lowest there of any inhabited place on earth, often down to 60 centigrades below zero.

yukagir

Very few of the original people is still living there. The Yukagirs have been living at the frontier of the possible.

Farthest to to the east on the siberian coast live the Chukchi near the Bering Strait. In many ways they are on the same cultural level as the Inuit were, and have many things in common with them. They are seal-hunters but they also hunt caribou and fish. At both sides of Bering Strait are Inuits or Eskimos, an interesting group of people both from a geographic and ethnographic point of view. The Inuit come from Siberia, but it has been impossible to find their original home. Many and contradictory theories have been advanced concerning their roots, but the eskimo culture begins when the Inuits take up the double activity of hunting caribou inland and sea mammals at the shore or on the ice in winter. Coming into Alaska at least some twenty thousand years ago they followed the coastline over to the canadian arctic islands and to Greenland, never to mix with the Indians.

What we have told here about the people living near the coast of the Arctic Ocean is only to remind ourselves that hunters have been living at this coast for a long time. They have lived under some of the most difficult conditions on earth, extreme cold in winter, and very short summer, where the melting snow makes the earth soaked with water for the few warm weeks of the year. Everywhere is life and everywhere is people trying to live on what the nature has to offer.

The hunters of the northern Eurasia are perhaps disappearing. The only thing they can offer are pelts from the wild fur-animals. But the furs are now more and more coming from animal farms.

It is impossible to predict what will happen to the eurasian people in the future. Greenland is now an autonomous country, and the Inuits in Alaska and Canada have taken up new occupations, although still many of them hunt both caribou and salmon in the rivers.

The friendly arctic, said Vilhjálmur Stefánsson, land of abundance and plenty ! Maybe.But also a land of extreme condition, where blizzards and frosts make live dangerous and difficult.

The people in the far North have extended the human habitat to the absolut limits of what is possible. They have been teacher to those that had the necessary imagination to learn from their experience and a thousand years struggle with nature, that only gives if you are able to combine flexibility and strong will. Then the North will open its door.

Haraldur Ólafsson

INTERNATIONAL RESEARCH COOPERATION IN THE ARCTIC
- ICELANDIC INTEREST -

Conference on the "Northeast Searoute"
Reykjavík, October 8, 1987

by
Dr. Vilhjálmur Lúðvíksson, Director
The National Research Council
Reykjavík, Iceland

1. The Rising Arctic Interest

The discovery and exploitation of oil and gas in northern Alaska and its adjacent Arctic Ocean shelf area in the sixties and seventies created a wave of interest in the Arctic which is still on the rise. There are number of reasons for this continued interest, such as the following:

1. The continued exploration for oil and gas in other areas of the Arctic and the discovery of vast resources of coal, lead, zink and other minerals.

2. The importance of the polar regions in the global circulation and regeneration of the atmosphere and the oceans, which have enormous influence on weather and climate world wide.

3. The military significance of the Arctic as the common frontier between the superpowers and their alliances, who reportedly maintain a considerable part of their destructive power in nuclear weapons on board submarines under the arctic ice at any one time.

4. Recent technical advances in remote sensing from aircraft and satellites and greatly increased computer

capacity to store and process large quantities of da which have opened up totally new possibilities for relating and understanding and eventually respond to large scale physical processes in the region. Satell technology has also facilitated commercial activity, such as fishing in far northern areas affected by ic

5. The greatly increased human activity in the arctic region, which has drawn attention to the problems of the indigenous peoples of the north as well as the immigrants to the Arctic, who are affected by or re upon the exploitation of resources, reasearch or military activity in this region.

2. Competition and Confrontation

The Arctic was for a long time the playground of bold explorers, who sought fame for themselves and made terri torial claims for their countries. The resulting competi spirit over the Arctic together with the confrontation between the superpowers after the war, has, however, prevented cooperation between countries in the region. T contrasts sharply with the situation in the Antarctic, w an international treaty insures cooperation on researc and prevents conflicts over exploitation.

The Soviet Union has for security reasons always blocked international shipping in the arctic coastal seas north the Eurasian Continent, although these routes are free o ice during a part of the year and are kept open at other times by large icebreakers. The Soviet Union has also un this year shunned all overtures for research cooperation the Arctic, preferring, it seems, to do it all on her ow

This was regrettable, not the least because of the large scientific potential of the Soviet Union in this area. T U.S. has, however, to a certain extent taken the lead by

encouraging their University research establishments as well as their Office of Naval Research to promote international cooperation. Many nations have responded favorably, including the Nordic countries. The Soviets have declined until this year, when there seems to be a policy change on this.

In February the Norwegian Institute for Polar Research invited to a consultative meeting between all countries on the arctic rim. The Soviet Union sent a representative for the first time. Last week the Soviet leader Gorbachev during his visit in Murmansk confirmed this policy change by calling for international cooperation in the exploration and exploitation of arctic resources and declared that the Soviet Union was willing to open the searoute north of the Soviet Union to international shipping. If these policy-changes can be realized and are as far reaching as the statements indicate, it will open a totally new epoch in the relations between the countries in the Arctic region.

3. The U.S. initiative

Sofar the U.S. has in many ways taken the lead role in arctic research. Due to the multitude of technical, environmental and socio-economic problems associated with exploitation of arctic resources, the political leaders of the State of Alaska convinced President Reagan to prepare the socalled Arctic Research and Policy Act and present it to the Congress. It was approved in the early part of 1984. The Act sets the goals and organisational framework for research in the Arctic. It creates the Arctic Research Commission to coordinate the efforts in arctic research by various federal government departments.

At its request a report on National Requirements for Research and Priorities in the Arctic (ref. 2) was prepared and published in 1985. This is a very concise but comprehensive overview over arctic research problems. The

findings in that report have been subject to hearings and debates in various circles. On that basis a long-term plan for Arctic Research was drawn up and published this last summer (ref. 2).

The plan calls for about 90-100 M.US$ per year to be spent in the various departments for arctic research. The largest part or 26-28 M.US$ comes through the Department of the Interior. Approximately 20 M.US$ go through each of the Department of the Interior, The National Science Foundation and NASA.

The guiding recommendations for the U.S. Arctic Research Plan are as follows:

Atmosphere and oceans

- Ice dynamics
- Weather and climate
- Air/ice/ocean interaction
- Upper atmosphere
- Marine ecosystems - incl. fisheries

Land

- Energy and mineral resources
- Land environments and ecosystems
- Interaction between land and atmosphere
- Coastal processes and engineering

People

- Health
- Social science
- Health culture - socio-economic

Support activities

- Communication
- Data and information handling
- Platforms and logistics
- International cooperation

4. Existing International Cooperation

An excellent review of the history of the present situation has recently been given by Dr. E.F. Roots, Science Advisor of the Canadian Department of Environment (see ref. 4). Although no political agreements exists between arctic nations on research cooperation, a number of nongovernment bodies exist, which promote cooperation in this area. These include among others:

Comité Arctique (Icelandic members)
Arctic Ocean Science Board (NRC is the Icelandic member)
International Permafrost Association
International Union of Circumpolar Health (Icelandic members)
UNESCO MAB Northern Science Network (Iceland participates)
International Geosphere/Biosphere Program
Inuit Circumpolar Conference

The Nordic Council of Ministers (financial) agreed in 1985 to provide some 2 M.DKR annually for arctic research and development cooperation.

Last February the Norwegian Institute for Polar Research invited representatives from all countries around the arctic rim, including Iceland, to a meeting in Oslo. All countries, including the Soviet Union, sent its representative. This was considered a significant breakthrough in Arctic relations. At this meeting a proposal was introduced for the creation of an Arctic Science Committee with representatives from all arctic countries to coordinate the arctic research efforts of these countries and to create a vehicle for cooperation in other areas. A team of three experts from Norway, Denmark and Canada was appointed to prepare a

concrete proposal for this purpose to be presented to the next meeting of these national experts in Sweden later in the year. I think the prospects for creating an Arctic Science Committee with participation of all arctic countries should be welcomed (see ref. 5).

Thus, it appears likely that arctic research and research cooperation will increase considerably in the years to come. The question is to what extent and how will Icelandic scientists participate in this field.

5. Icelandic Interest in Arctic Research

Iceland has until very recently not expressed much interest in arctic research, perhaps for two major reasons:

1. Traditionally arctic research referred to a rather exotic and exploration oriented endeavour, outside the means and interest of the day-to-day Icelandic R & D effort.

2. The generally mundane objectives of the Icelandic science effort were not seen in the context of "arctic science", although to a high degree they are in fact influenced by forces that have their origin in arctic regions. The weather and ocean conditions thus determine to a very large extent our economic outcome and ameneties of our life.

However, with the expansion of the overall R & D effort in Iceland in recent years and after having come to grips with many of the short-term problems of our nation'industries, such as fisheries, agriculture and energy supply, we are now turning our attention to more long-term problems and are interested in participating in global research projects that relate to climate and environmental changes with the view of understanding better their effects on our everyday national

life, such as the productivity of our fishing grounds and farmlands, abundance of hydrological resources, etc. In this context we have decided to participate in the activities of the Arctic Ocean Sciences Board, in particular the socalled Greenland Sea Project (see ref. 3), and in the ice-core drilling project in Greenland in cooperation with Denmark. Both of these projects are concerned with studying the atmospheric and oceanographic processes that determine the state of the climate and ocean conditions in the area. The Icelandic contribution relates both to physical and biological aspects. Iceland is also participating, although on a small scale, in the world climate program, in studies on ocean absorption of CO_2. In the future we expect our participation to grow considerably.

Another motivation for our increasing interest is that some countries, such as the United States, have formulated an arctic research policy, which involves greatly increased attention to applied problems of the Arctic that relate to fisheries, agriculture, health, construction and social objectives, all of which have great relevance to the work of our research institutions in this country. If the Soviet Union now decides to open its doors and make available its vast experience and scientific resources in cold weather technology, a very bright prospect would appear for cooperation on subjects of interest to us.

The previously mentioned Arctic Science Committee could play a key role in fostering such cooperation. From an Icelandic standpoint it would be particularly valuable to have such a forum, because we do not have the manpower and capacity to organize participation in the many different organizations that are active today, many of which are self-appointed or established without any reference to national policies in the area.

There is no question that the prospects for increased peaceful activity in northern regions could greatly benefit

Iceland in many ways. Increased knowledge about the arctic and subarctic environment improves the possibility for economic exploitation of resources and for responding to the challenges offered by the harsh climate of the North. A new international searoute through the Northeast passage could bring various economic benefits and Iceland would certainly move closer to the mainstream of international trade traffic. A major concern will of course be that the sensitive arctic environment must be adequately protected from pollution and ecological disturbances as a result of intensified economic activity in the region. Research and development will of course be the strategic tools most useful to guide us in balanced economically profitable and environmentally viable progress in this region.

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Reykjavík,
06.10.87
TMÖ/SJ/389

THOMAS MÖLLER

THE ICELANDIC SHIPPING INDUSTRY - AN OVERVIEW.

One of the most famous quotations is one dating from the year 56 BC, told by a Roman general during wartime, saying;

"NAVIGARE NECESSE EST"

which in plain english could read: "Sailing is important" Today we would rather say: "Transportation is vital to the world economy".

Today most of us realize that a high standard of living depends highly on the international specialization which again is unthinkable without reliable transport and logistics systems.

For ICELAND, transport is even more important than for most other countries. Economic activities and production for export is spread over the whole coastline. Our most important markets are in Europe and the USA 1200 to 2500 seamiles away. We export around 45% of our GNP and the import is well over 44% of GNP (based on 1986 figures).

My paper will touch the development of ocean transportation in Iceland. I will talk about the major characteristics of this industry today how it is organized, what companies are involved the technology used and the service offered, including the total transport concept which is the key to economic and efficient export of commodities to markets in Europe, America and the far East as well the import of general cargo from these same markets to Iceland.

First a few words about the early days of shipping in Iceland. The sailings of the first settlers in the ninth century are proof of the unbelievable navigation skills these men had. After the settlement of our country we had to tolerate 10 centuries of irregular and totally inadequate shipping, controlled by foreigners. This situation was a major contributing factor to the extreme poverty that existed here. Around the turn of the last century, danish (DFDS) and norwegian (BERGENSKA) shipping companies started regular sailings to and from Iceland. The foundation of the Iceland Steamship Company Ltd. in 1914 signalized a new era in transportation in Iceland, shipping was finally in icelandic hands, designed to meet the needs of the national economy. Since then, we have vitnessed a steady growth of the Shipping industry.

Vessels for all types of cargo, appeared in icelandic waters; general cargo vessels, ships for frozen and chilled cargo, bulk vessels and lately container and roll on/roll off ships, equipped with modern transportation and navigation technology.

Today the icelandic shipping industry is offering Transport services which are characterized by the following:

1. Containerized, regular weekly or bi-weekly sailings to major market areas in Europe and North-America with Reykjavik as load center for the whole country.

2. Feeder services on the coastal line to and from Reykjavik.

3. Multi-modal transport systems, linking Iceland with markets far behind the ports of call in Europe and N-America, enabling trouble-free and efficient containerized transport to and from markets in Southern Europe, Japan, S-America and Africa.

4. Bulk-transport systems for the export of aluminium, ferrocilicium, pumice, fishmeal and salted fish in bulk as well as the import of raw materials for the aluminium and ferrocilicum plants.

These transport systems are organized in 3 different ways:

1. Liner-shipping
2. Tramp-shipping
3. Contract shipping.

The main characteristics of the Liner shipping market are:

1. Regular sailings
2. Containerized transport
3. Extensive marketing and agency activities
4. Comprehensive logistic services
5. Fast, efficient and flexible vessels (150-450 TEU)
6. Many customers

The Liner shipping sector is dominated by two shipping companies, EIMSKIP and Samband-Line, the two carrying about 90% of the general cargo shipped to and from Iceland, the rest being carried by small companies often offering "shoestring" service. Both EIMSKIP and Samband offer a total transport package with storage, distribution, cargo handling as well as consulting and forwarding operations.

The contract shipping and the tramp shipping sectors are characterized by the following factors:

1. Irregular sailings
2. Both specialized and Multi purpose vessels (500-7600 TONS DWAT)
3. Few customers with large transport volumes
4. Short-term contracts
5. Fierce competition

Around 10 icelandic companies are competing in this sector with foreign companies carrying the bulk of the transport of petroleum-products and raw materials for the aluminium plant in Straumsvik.

The state coastal Line is offering regular and irregular sailings around the costline using Reykjavik as base port.

This paper has should give you, the delegates of this seminar an idea about the importance and the scale of the icelandic shipping industry. This industry which employs about 1% of the total workforce in Iceland is a vital link in the icelandic economy, adding value to our exports and serving the import trade with transport solutions.

PORT AND OCEAN ENGINEERING UNDER ARCTIC CONDITIONS

Gísli Viggósson, civil engineer,
Icelandic Harbour Authority.

The title of this presentation **"Port and Ocean Engineering under Arctic Conditions"** or **"POAC"** is the name of an international conference dealing with various theoritical and practical aspects of Arctic technology. The first conference was held in 1971 and since then every second year.

The **POAC** conference have focused mainly on the following topics:

- Sea Ice Properties
- Sea Ice Dynamics and Morphology
- Marine Geology, Soil Mechanics, and Geotechnical Engineering
- Oceanography and Meteorology
- Coastal and Offshore Structures
- Ice Breaking Technology
- Offshore Operations and the Environment
- Materials and Underwater Technologies
- Navigation in Cold Regions
- Planning for Developments in Arctic Coastal Regions

The first conference was held in Trondheim in 1971 and the subsequent conferences were held in Reykjavík 1973, Fairbanks, Alaska in 1975, St. John's, New Foundland in 1977, a second time in Trondheim in 1979, Quebec in 1981, Helsinki in 1983, Narssarssuaq in 1985, and a second time in Fairbanks this year. It has been considered that the tenth **POAC** conference will be held in Luleå in Sweden in 1989 and why not for the second time in Reykjavík in 1991?

I was personally involved with the team preparing the first conference and since 1985 a member of the **POAC International Committee.**

When professor Per Bruun, my friend and a great friend of Iceland, took the initiative, Arctic technology was not in focus and it was with great foresight that he called for a conference on the new challenging Arctic technology, which developed into a major industry after the discovery of oil and gas in the high Arctics. No one, however, had the imagination to predict this fantastic development as for instance in the Beaufort Sea, in the Barent Sea and both east and west of Greenland.

When Dr. Thor Jakobsson told me about his ideas of the **"Northern Sea Route"** I realized the similarity of the spirit of Dr. Thor and Dr. Bruun. Just look back upon these last sixteen years. In my mind the ideas of Dr. Thor will be realized to some extent in the near future.

ENVIRONMENTAL DATA

Arctic Basin Large areas of the polar oceans are covered with thin, variable thickness layer of ice formed from freezing seawater - the permanent polar ice. The growth, drift and decay of this ice cover are intrinsically related to both the dynamic and thermodynamic variations in the atmosphere and ocean.

During winter, the landfast ice - the fast ice - will expand from shore line seawards to reach the 20-25 meter depth contour.

Between the coastal fast ice and the permanent polar ice there lies a 60 to 100 km wide transition zone (Beaufort Sea) of mostly first-year ice which is open water in summer - with multi-year ice interspersed.

Ice in the transition zone occurs as flows (100 to 500 m across or more) in drifting pack of a concentration that varies and changes.

New sea ice in the southern Beaufort Sea grows at a rate of approximately one centimeter per day beginning in early October and a maximum thickness of about 180 centimeters is reached by late May.

The main ice thickness of the permanent polar ice increased gradually from the Northern Sea Route north of Siberia to the Northwest Sea Route north of Cananda. The main ice thickness increases from about 2 meters to a maximum of 6.5 meters north of the Ellesmere Island (figure 1).For navigational purposes the transition zone is the most important.

The overall findings of environmental data is that the open water conditions in the transition zone are less severe than those found in the North Atlantic, except for the Barent Sea which can be regarded as an extension of the Norwegian Sea.Following environmental data is provided from the Beaufort Sea, which is expected to be the most severe area in the Arctic:

Wind: Storms have two predominant directions and generally come from the east or the west. A typical wind speed exceedence for speeds above 20-25 knots is 4%. The corresponding figures for Reykjavik are 8%.

Waves: Waves follow the same pattern as the wind and have therefore similar predominant directions. The significant wave height of 6 meters will be expected for only 3 hours every 100 years compared to 14-15 meters south of Iceland.

VESSELS

Ice-strengthened freighters: Today enthusiastic opinions continue to be expressed on the quality and performance of the SA-15 class, built in Finland. Two more were delivered in 1985, leaving three to come by this year, when the total will be 19.

It is claimed that ice breaker tankers (crude carriers) that can reach Beaufort Sea from the east, year-round, can now be designed and built.

IHI in Japan and Wärtsilä in Finland published a paper In **POAC '85**: "Study on 100.000 DWT icebreaking Tanker". Following are some highlights of the paper.

"The service route is assumed to be from the Beaufort Sea either to Japan or Europe. To navigate this route on a year-round basis, the vessel has the icebreaking capacity corresponding to the Canadian ASPPR Arctic Class 8. The bunker capacity is decided assuming the vessel to refuel at an unloading port only and assuming the cruising distance to total about 8,000 sea miles including 3,000 sea miles of ice covered sea.
The designed speed is about 14 knots in open water and the vessel can navigate in continuous mode in 2.4 m thick level ice.

As the required transport capacity depends on the productivity of the oil field and demand of oil, it is virtually impossible to determine the most economical size for the ship. The deadweight of 100,000 tons is thus chosen arbitrarily. The draft is determined to be 16.5 meters to have a wide selection of loading ports and service routes. The length/breath is selected keeping in mind stability criteria, trim condition and the most effective loading capacity.

The required engine power is determined from the results of model tests in the ice model basin. The navigation bridge is positioned afore to keep good visibility. The design particulars are given in Table 1 and the general arrangement sketch is shown in Fig. 2.

Three propulsion units, each consisting of two medium-speed diesel engine sets, one reduction gear and one propeller are provided. The center unit has smaller power than the wing units. This combination gives the necessary power level. The principal machinery arrangement is shown in Fig. 3. Several more Tests were undertaken as Towing Tests in Level Ice.
The level ice tests were performed in ice thickness corresponding to 0.9 m, 1.8 m and 2.4 m, in full scale and at ship speeds corresponding to 1.5 kn, 3 kn and 6 kn. The resistance extrapolated to full scale is shown in Fig. 4.

In conclusion the authors have designed an 100,000 DWT tanker for the purpose of studying the problems relating to its building and operation and giving a rough sketch of the vessel to those who are interested in the arctic exploitation project.

Although there may be still unknowns in the actual navigation of such a big icebreaking vessel in the Arctic Ocean, the authors have found no serious impediment in building this vessel from a technical viewpoint and have bright prospects in realizing this vessel in the near future."

Next I will mention another paper from **POAC '85**: - "A shipboard ice navitation system".

"The experience gained by INTERA, Canarctic, Dome and other organizations enganged in Arctic sea operations has shown that real-time ice information which is available from sources like airborne radars (SAR, SLAR) marine radars, and satellites (IR/visual) can be used for better route planning and tactical navigation by ships in transit. With a knowledge of the ice conditions in an operational region, a ship's Master can optimize his route and avoid areas where the risk of contact with ice or heavy ice is great. The resulting savings in ship operating costs, vessel damage, and delivery schedules have proven to be very substantial.

One of the key concepts to emerge from this research is that of an "ice navigation chart". Typically, navigators have charts of the worlds oceans; however, what is required for operations in the Arctic is a similar chart showing detailed ice conditions. This requires superior information to what has been available in the past. Features such as old ice and icebergs with sizes of the order of 10 metres should be shown on the chart. Areas of ice rubble, ice build up and ice compression also need to be shown. Because ice condtions change rapidly this information must also be available in real-time".

Table 2 shows sources of ice information ice navigation.

One of the main criteria for the size of container vessels has been the maximum beam of 106 ft that the Panama Canal can accommodate. This is also true for the container cranes used worldwide.

In 1985 the American President Lines passed this criteria by taking into service 5 new vessels with their 129 ft beam on the Trans-Pacific Route.

By using computer simulation to optimize size, speed and operational efficiency, they determined that a vessel with a 129 ft beam and overall length of 902 ft with a large fuel efficient slow speed diesel engine of 57.000 Hp, can attain a cruising speed of 24.4 knots with a capacity of 3900 TEUs, the vessel is 41.250 DWT and the 57.000 Hp engine is the most powerful diesel engine ever built for seagoing vessels.

Table 3.

Comparison of a proposed 100.000 DWT icebreaking tanker and a new 41.250 DWT non-Panama vessel:

	100.000 DWT ice-tanker	41.250 DTW container vessel
Length	307.00 m	274.7 m
Beam	45.5 m	39.3 m
Draft	16.5 m	12.5 m
Engine		
Center units	42.000 Hp	
Wing units	48.000 Hp	
TOTAL	138.000 Hp	57.000 Hp
Design speed	14.0 kt	24.4 kt
HP/DWT ratio	1.38	1.38

It is remarkable that the ratio between the horsepower and deadweight is exactly the same.

It should be noticed that some of the largest ports in Europe have taken container cranes larger than for Panmax vessel into service the last two years.

TERMINAL ENGINEERING

A terminal is a loading/unloading station for vessels serving bulk, unit transports or passenger traffic. A terminal may have one or serveral berths. One usually distinguishes between terminals for oil products, dry bulk terminals for ores, coal, grains et cetera, LO/LO and RO/RO terminals for container transports and ferry or similar passenger terminals including RO/RO. Such terminals are not identical with conventional ports of the old days, but present a diversification of normal port activities to serve particular purposes.

The development of a terminal as any port facility may be seen from the land as well as the seaside. Popular vessel-sizes vary according to Table 4:

Table 4.

	DWT	Draft in m.
Tankers for crude oil	Up to 350.000 DWT	-24
	Normal 20.000-220.000 DWT	11-20
Tankers for oil products	Up to 150.000 DWT	-18
	Normal 10.000-120.000 DWT	8-17
Mineral Bulk and Ore	25.000 - 200.000 DWT	12-20
LNG/LPG (Liquified natural gas & Liquid Petroleum gas)	20.000 - 80.000 DWT	11-15
Container	10.000 - 50.000 DWT	8-13
Break Bulk	10.000 - 30.000 DWT	8-12

Each of these types of vessels require terminals with special handling facilities for loading/unloading, transportation, storage, passenger handling or for specific requirements by industrial development. No general rules are applicable but considerable experience is available, e.g. in fields like oil storage, handling of coal and ores, LO/LO, RO/RO transports and from the rapid development in the LNG and LPG transport fields.

That raises the question of site selection. Site selection seen from the landside is to find a location which has plenty of area for development, adequate transportation links or possibilities for the establishment of same and all kinds of auxiliary facilities near by including supplies and accomodations forpeople to operate the new facilities or expand existing.

Site selection seen from the seaside is to find a place with adequate depth, relatively mild exposure to environmental forces and soil conditions of needed capacity. Depth and exposure usually present a trade off. If you want more depth you will have to live with more exposure. So it is in Iceland too. Transportation on deeper keels means lower costs assuming bulk quantities but it usually also means more expensive piers and could also require more elaborate protective works. With respect to natural protection geotechnical could however play a decisive role as inland fiords are often plagued by thick and soft sedimentary deposits.

Regarding protection a development has taken place during recent years by which protective work is replaced by more practical and safer mooring/fendering systems. This improves economy tremendously. From the physical point of view a terminal for deeper draft vessels should not necessarily be placed in protective waters but rather where optimum economy of transportation, all aspects included on land and at the sea, offers the best opportunities.

This is not necessarily at an already existing port where depths are limited but it rather refers to any open coast with acceptable exposure located relatively close to transportational arteries, sites for mining operations, power production or areas which are particularly suitable for the establishment of industries. In the choice of such, national economy is the main factor to be considered. In 1987 no nation can afford to ignore economical considerations, which means the highest performances and yields at lowest costs.

CONCLUSION

In this paper I have described the activities of POAC in the last one and a half decade. It is evident that a substantial progress has been made and now by the turn of the century we can see the beginning fo a new era in inter-continental transportation. It has been stated that it is technically possible to sail the Arctic.

In the future we will have to watch progress in this field and therefore we should perhaps call for the POAC conference in 1991 in Iceland.

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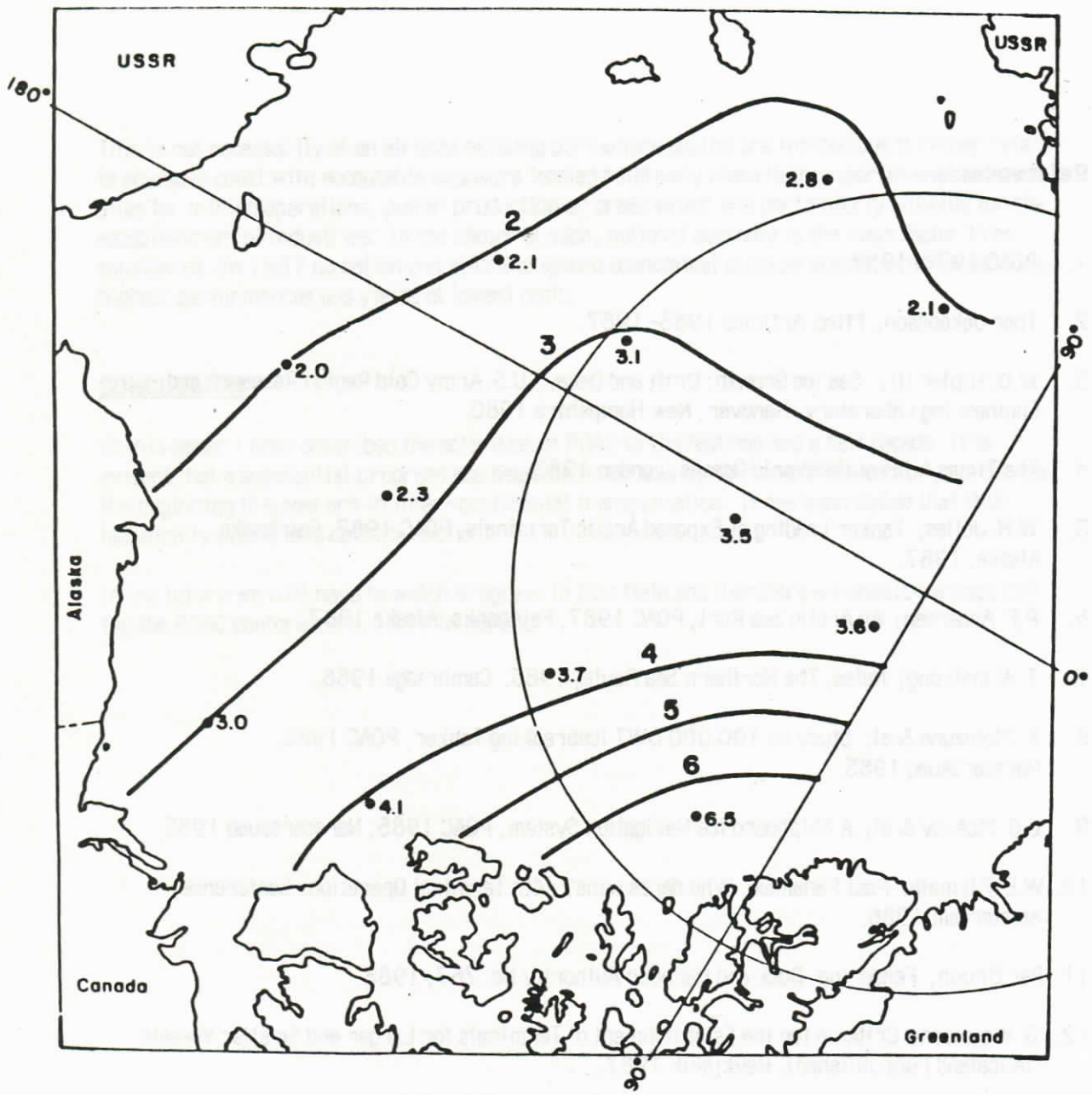

Fig. 1. Contours (in meters) of observed mean ice thickness values estimated from submarine sonar data. [LeShack (private communication).]

STRATEGIC (100 - 1000 km)	TACTICAL (25 - 200 km)	CLOSE RANGE (0.5 - 50 km)
- Interpreted ice charts - Weather forecasts - Satellite; NOAA LANDSAT METEOR - Passive Microwave - SLAR airborne & - SAR spaceborne	- SLAR (airborne) - SAR (airborne) - Marine Radar	Marine Radar Sonar Codar (H.F.)

Table 2 Sources of ice information for ice navigation.

Table 1 PRINCIPAL PARTICULARS

Length (o.a.)		307.00 M
Length (b.p.)		284.00 M
Breadth (Max.)		45.48 M
Breadth (W.L.)		44.00 M
Depth (Mld.)		31.00 M
Draft (Mld.)	Designed	16.50 M
Deadweight		100,000 MT
Main engine	IHI-Pielstick 16PC4-2V x 4 sets	
	IHI-Pielstick 14PC4-2V x 2 sets	
Output	Total	138,000 PS
	Center units	42,000 PS x 98 RPM
	Wing units	48,000 PS x 70 RPM

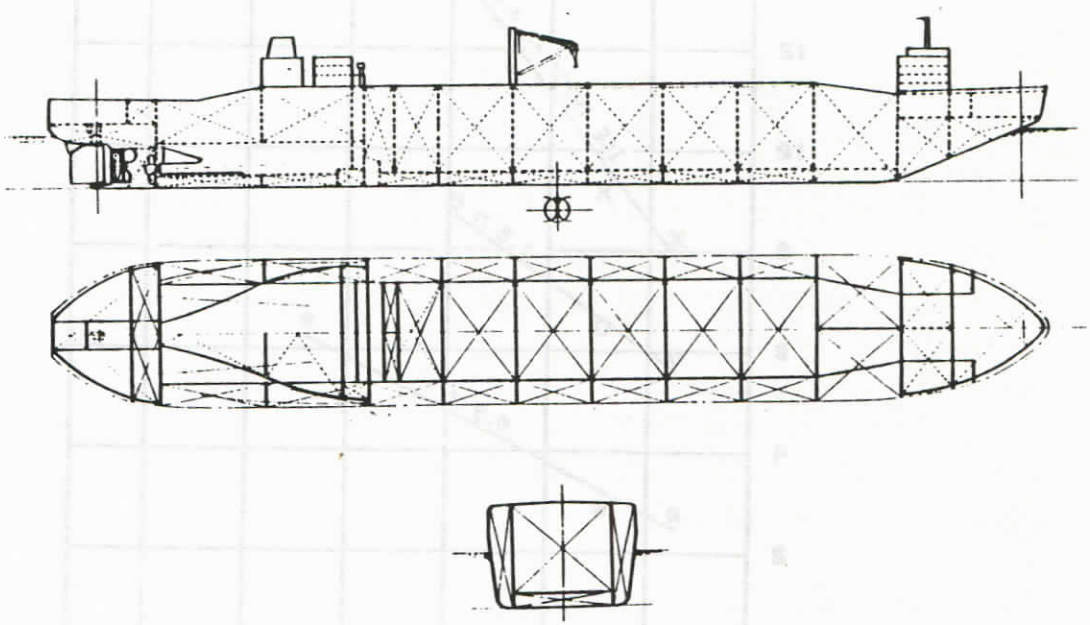

Fig. 2 General arrangement

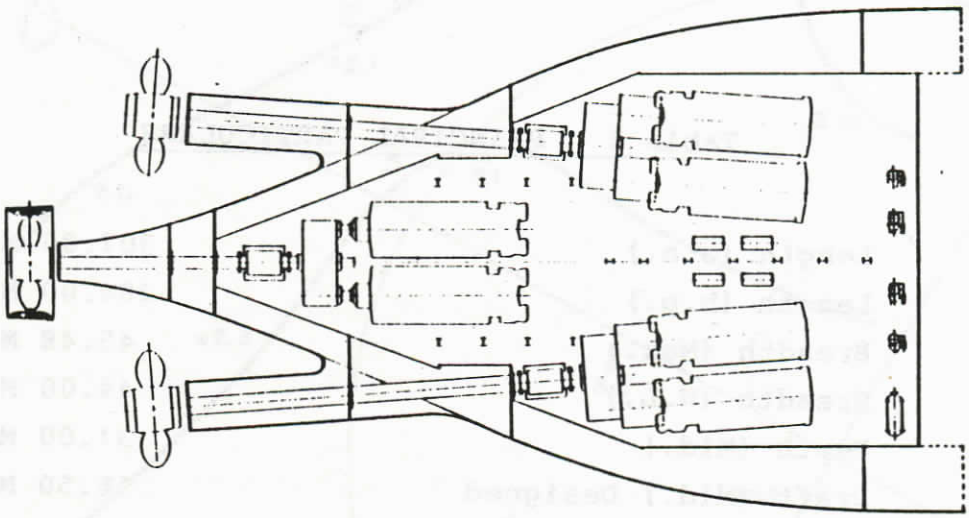

Fig. 3 Machinery arrangement (bottom plan)

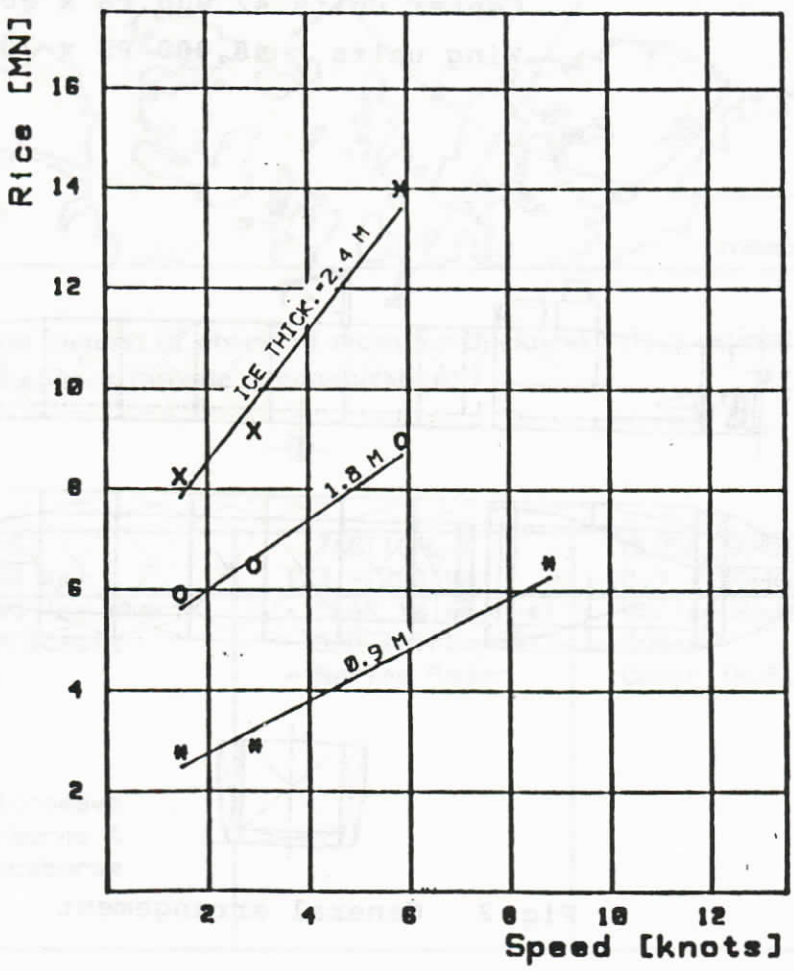

Fig. 4 Resistance in level ice
(Ice flexural strength = 600 kPa)

Einar Hermannsson,

Marine Engineer.

ICEBREAKERS AND CARGO SHIPS IN THE NORTH

Reykjavík, 5 October, 1987

Mr. Chairman, ladies and gentlemen,

quite frankly it is rather difficult to discuss the topic of this paper in the context of merchant shipping in and around Iceland. In spite of the northern latitude of Iceland, surface ice is a minimal problem and hazard to navigation around Iceland and arises only at very long intervals. This is borne out by the fact that icelandic merchant vessels are generally not ice-strengthened, or carry the lowest grade of ice-strengthening. Only a very few vessels have higher grades of ice-strengthening and this is more incidental, than purpose built into the ships by their owners.

GENERAL.

In general terms it may be stated that commercial shipping ventures in icebound enviroments exist on regular basis in three areas in northern latitudes, i.e. in the North-East Passage that this conference deals with, on the so called North Slope of Alaska and in the Baltic in season.

Unfortunately two of the three areas mentioned, are very much national and specified operations, where general shipping economics do not apply at this time. Although the technology of shipping and ice-breaking operations in the North-East Passage are fairly well known, the economics of these operations are very much unknown and doubtlessly deal with development of new frontiers and resources, that have little relation to commercial shipping. Similarily the shipping operations in Prudhoe Bay on the Beaufort Sea, are exclusively oil exploration and production operations that have limited number of factors common to deep sea commercial shipping.

THE BALTIC

The area that we are left with, where there is an abundance of information and known economical factors, is

the Baltic. Incidentally the Baltic countries of Finland and Sweden have been at the forefront of the technology and research on navigation in ice and have developed their own rules for the requirements of ships to trade in the Baltic during winter, the "Finnish-Swedish Ice Class Rules". To further demonstrate the role of these countries in navigation in ice, abt. 70% of all existing ice-breakers in the world were built in Finland.

TRADITIONAL ICE-STRENGTHENING

Traditionally the ice-strengthening of commercial vessels has been the decision of the owner, with certain assistance by the classification societies. The associations of underwriters of commercial ships established quite early trading limits. so called "Institute Warranty Limits", within which the insurance for ships would remain valid. These trading limits naturally excluded areas of high risk such as war zones etc., as well as areas that are considered to expose the ships to possible damages, such as icebound waters. In many instances shipowners can trade their vessels into areas outside Warranty Limits, but only against paying additional insurance premiums as deemed appropiate by the underwriters. As navigation in seasonally and intermittently icebound areas are a frequent necessity to shipowners, the classification societies developed optional ice-strengthening requirements for ships, to standardize and assist the underwriters and owners in the determination of appropiate additional premiums and to minimize the possibilities of damages to ships traversing such known icebound areas.

The ice-strengthening requirements of the classification societies are generally divided into four catagories, designated by AA, A, B and C type ice-strengthening, in descending order of how extensive the strengthening is.

Type C ice-strengthening, the lowest catagory of ice-strengthening, involves primarily a strengthening of the area in contact with the ice, i.e. an area extending from 0.5 meters above the deepest waterline to 0.5 meters below the lowest waterline and the shell plating in this area is required to be 25% thicker than in a conventional vessel. Such ice-belt

is to extend from the bow aft, to where the vessel reaches it´s full beam.Additionally the above reinforced area is to have intermediate frames and stringers, in addition to the frames as required for an unreinforced vessel.

Type AA ice-strengthening, the maximum classification ice-strengthening, requires shell plating in an area from 0.75 meters above the deepest waterline to 0.60 meters below the lowest waterline to be 80% thicker from the bow to the full beam of the vessel, 40% thicker in the parallel midbody and 25% greater in the after taper, than for conventional vessels. In addition the vessels frames are to be abt. 50% stronger than in a conventional vessels and intermediate frame between conventional frames are to be fitted for full length of the vessel, with specially reinforced frames and stringers in the bow and stern. It is compulsary for Class AA ships to have ice-breaking bows, i.e. a reinforced raked bow at between 22° and 35° and heavily reinforced bow and stern frames. It should be borne in mind that heavily ice-strengthened vessels, due to their ice-breaking bow, can not take advantage of the substantial fuel-savings inherent in a bulbous bow. Additionally Class AA ships require 50% stronger rudder, 20% greater diameter tail-shafts, 12% greater diameter intermediate shafts; 150% stronger gears and very much stronger propellers than conventional ships. Finally Class AA ships are required to be equipped with propulsion units that are substantially larger than in a conventional vessel, however very much depending on the type of trade that the vessel is intended for.

THE FINNISH-SWEDISH ICE STRENGTHENING RULES

The administrations of Sweden and Finland have found the ice-strengthening requirements of the classification societies inadequate for their purposes, as regards their Baltic ports. As a matter of fact, the evolution of rules and operational procedures for navigation in ice developed in the Baltic, are doubtlessly a valuable indicator to the possible development of the North-East Passage. The Swedish and Finnish administrations were early confronted with the economic necessity of keeping their Baltic ports open during

winter to permit the export of valuable raw materials produced in their Baltic regions, but at the same time their efforts by way of operating ice-breakers to keep shipping channels open and assist individual vessels, had to be economically feasible. Thus the adminstrations developed the Finnish-Swedish Ice Rules and decreed that given certain ice conditions only vessels complying with these rules would be entitled to ice-breaker assistance and their safety guaranteed.

The Finnish-Swedish Ice Rules are more logical in their approach to ice-strengthening than the classification rules, and lay down definite forces from the ice that have to be taken into consideration. The net result is that these Rules fall somewhere within the Class A and Class AA requirements of the classification societies at the lower end, up to considerable more ice-strengthening for the highest Finnish-Swedish Ice Class. The Finnish-Swedish Ice Rules touch upon, but do not deal conclusively with a major problem in artic navigation, i.e. the very much deteriorated characteristics of conventional shipbuilding materials at lower temperatures and the unsuitability of all exposed machinery, such as deck machinery at sub-zero temperatures.

Quite a number of North-European merchant vessels have been built to meet the Finnish Swedish Ice Rules, naturally the national fleet of Finland and to some degree of Sweden, but also a high number of West German, Norwegian and Dutch vessels. However most of these ships, apart from the Finnish national fleet, are relatively small ships engaged in feeder traffic in and from the Baltic and therefore not directly comparable to the much larger vessels required for plying the North-East Passage as an inter-ocean shipping route.

ARTIC VESSELS

In the past many individual merchant ships have been built or converted for artic operations with varying degree of success. However the state of the art merchant vessels for artic operations, apart from oil service vessels operating in the Bering and Barents Seas, are the SR15 type dry cargo

vessels built for the Soviet Union by Wartsila of Finland and the Polar Tankers built by Rauma-Repola of Finland for the same owner.

Apart from the ice-breaking ability that is common to vessels operating in the Baltic, the added consideration of material characteristics at very low temperatures weigh heavily in the construction of these ships. As is well known, the impact properties of conventional shipbuilding steels are drasticly reduced at lower temperatures and steel structures become extremely brittle, not the least structures subjected to shock-forces such as forcing and breaking ice. Thus the Finnish shipbuilders have developed new alloy steels that retain their impact strengths at lower temperatures. However these steels are obviously considerably more expensive than conventional steels and do pose some difficult problems in production, in particular heat control in welding.

The SR15 type cargo vessels are highly specialized vessels and although no official price is known, they are likely to have cost several times the price of a conventional ship of comparable capacity. The SR15 type is a combination general cargo/container and ro-ro vessels of abt. 20.000 tons deadweight, powered by four 14 cylinder main engines for combined 21.000 bhp. In addition they carry four 800 KW diesel powered generators. The ships have a length of 177 meters on a beam of 24.5 meters and a loaded draft of 10.50 meters. The vessels have a 576 TEU capacity and a service speed of 17 knots. Approximately 20 SR15 have been built by Wartsila, for the Soviet Union. The Polar Tankers built by Rauma Repola are somewhat smaller vessels than the SR15, or abt. 14.400 tons dwt. Both types of vessels have advanced deck machinery that is operational at artic temperatures, but conventional hydraulic and electrical machinery is inoperable at artic temperatures.

ICE-BREAKERS

As previously stated about 70% of the world ice-breaker fleet has been designed and built in Finland. Other countries that are leaders in ice-breaker construction are the Soviet Union, West Germany through the firm of Thyssen/Wass,

U.S.A. and Canada. The vast experience built up in Finland has made them the forerunner in ice-breaker construction and related research, in co-operation with their prime customer the Soiviet Union. Effectiveness of ice-breakers for many years has been primarily based on sheer size/weight of these vessels combined with enormous horsepower. Naturally other factors have been important, such as hullform and bow construction etc. One factor that has led to these ships being very expensive to build and operate, has been the need for direct astern propulsion to enable the vessels to break free in ice-breaking operations and to have maximum torque at any revolutions. Thus ice-breakers have been fitted with diesel-electric or in the case of the Soviet Union, nuclear electric propulsion systems and equipped with a seperate ahead and astern propellers and propulsion motors. The principles involved in this type of power generation are the same as emplyed on offshore drilling units for drilling and propulsion operations. Recent breakthroughs in ice-breaker technology have been the use of air-bubble generation in the bow instead of bow propellers, the employment of stainless steel super smooth compound alloy in the ice contact area, as well as special epoxy paints on the hull. The combination of these factors has reportedly led to between 15% and 30% less power required for ice-breaking operation, as compared to older ice-breakers. The air-bubble system greatly reduces friction with the ice and the removal of the bow propellers substantially reduces drag.

The sheer size of the modern ice-breakers gives an idea of the enormous power of these ships. The largest ice-breakers presently in service are the Soviet built "Rossyia" type vessels with 75.000 shp nuclear propulsion plants. For comparison a bulk carrier of 40.000 tons dwt. will have abt. 7 - 8000 shp propulsion plant to give a loaded speed of abt. 14 knots. Wartsila is presently constructing two super shallow draft ice-breakers of length of 150 meters and beam of 29 meters. These vessels will be subsequently refitted with nuclear propulsion of 52.000 shp in the Soviet Union. As is evident from the extreme dimensions, these vessels are comparable in size to abt. 20.000 tons dwt. cargo vessels.

CONCLUSIONS

In view of the ice-breakers and ice-strengthened merchant ships already in service, particularily in the Soviet Union, and the voyages already made by these vessels through the North-East Passage, it is already proven that it is technically possible to use the route for merchant ships on a seasonal basis and given unlimited expenditure in new vessels and breakers on a year around basis. Whether the North-East Passage will ever be a commercially viable inter-ocean shipping route is a totally different matter associated more with economics and security, rather than present day technology. In the opinion of this speaker, the only possibilities for the North-East Passage to become a commercially viable inter-ocean shipping route, in spite of vastly improved ice information data through satellite observations, are unprecedented technological breakthroughs in navigation in ice. The lessons learned from the "Manhattan" experiment in the late sixties, would tend to indicate that the North-East and North-West Passages will become commercially viable at about the same time, if ever.

BORING ECONOMICS.

This speakers immediate response, upon hearing of the idea of using the North-East Passage as a commercial inter-ocean shipping route, was to check the charts for the equidistance point in the Far-East for the route versus traversing the Suez Canal. With respect to Rotterdam, Europes principal port and the world´s largest port, the equidistance point lies somewhere just south of Hong Kong, which incidentally has cropped up in these discussions. In other words the countries that would enjoy a purely distance advantage using the North-East Passage viz. Northern-Europe ports (Mediterranean is closer by Suez, but marginal advantage viz. American East Coast), would be Japan, the Koreas and Northern China.

Seaborne cargoes moving between these regions and North Europe and the American east coast may roughly be

divided into two catagories, i.e. low value bulk cargoes and raw materials moved in large low powered and economical vessels on the one hand and high value consumer and industrial goods moved in high speed container and specialized vessels on the other hand. It is very difficult to envisage that the low value cargoes will ever be moved through the North-East Passage for commercial reasons, as the shipborne cost of these cargoes is minimal in it´s present form.

Possible cargoes through the North-East Passage are therefore the latter of the above catagories. Economics of scale have played an ever greater role in the construction of deep sea container vessels and the "state of the art" vessels have a capacity of abt. 3000 TEUs, with a service speed of abt. 22 knots. These vessels have a length of abt. 220 meters, a beam in excess of 30 meters and a loaded draught of almost 20 meters. Their size is obviously not compatible with even the largest ice-breakers of today, and smaller container vessels are already proven to be less economical. On the route Yokohama to Rotterdam the North-East Passage offers a time saving of abt. 8 days viz. traversing the Suez Canal. However bearing in mind technological gains in navigation in ice in the last two decades, it is likely that such ice navigation will be subject to drastic speed reduction for a long time to come and the the distance advantage thus eroded, not to mention delays because of convoy arrangements, cost for ice-breaker assistance etc.. Additionally the high value cargoes of the latter catagory can not be exposed to longer transit time than presently employed, for economical reasons.

Thus it appears that for economical reasons, the North-East Passage is not likely to be commercially viable as an inter-ocean commercial shipping route, until technology makes it possible to traverse the route in cost effective merchant ships on a year around basis without speed impedements.

THE POLAR OCEAN ROUTE

Mr. Vladimir Maslov,
Third Secretary of
the Embassy of the USSR,
Reykjavík.

The polar ocean route is a shipping route which stretches along the northern coast of the USSR via the seas of the Arctic Ocean (Barents Sea, Karsk Sea, Laptev Sea, East Siberian Sea, Chukotka Sea and Bering Strait), linking Soviet ports in Europe and on the east coast, as well as the estuaries of the navigable rivers of Siberia, into a single communications network for the entire country. This is the most extensive oceanic communications route in the Arctic.

The sea ice on the polar ocean route extends over a distance of 5610 km from the strait of Novaja Zemlja to the harbour of Providenje. The most difficult conditions arise in areas where there is a large build-up of ice, which does not melt even in the warmest months (Taimir and Ajonski ice fields). It is only possible to travel through these ice fields by icebreaker. Specialized services, such as shipping lines, sea harbours, river harbours, airfields, water observation stations, industrial and transport companies, scientific institutions, as well as a network of weather stations, operate in these areas.

In 1932 an expedition on the icebreaker A. Sibiryakov, led by O.J. Schmidt, made the first journey from Archangel to the Bering Strait without a winter stop, thus proving the potential of the polar ocean route.

In the 1930s and 1940s Arctic ports such as Igarka, Dikson, Pevek, Providenja and others were built.

Since 1954 two Soviet drift stations have been operating in the Arctic area each year.

New and powerful icebreaking vessels such as the nuclear-powered icebreakers Lenin and Arktika, conventional icebreakers Moskva and Leningrad, and other similar ships, together with the development of modern technology in the Arctic ports, the increase in the number of Arctic stations (over 100) and astronomic stations, and scientific advances, have all worked together to make the use of the polar ocean route a practicable possibility for the inhabitants of these areas.

In 1970 a Polar Ocean Route Department was established within the Ministry of the Fleet, with the principal role of monitoring on behalf of the State the good use of the route. It is responsible for planning of shipping services on the route, security and safety at sea, and for the prevention of pollution of the ocean in this area.

The Soviet authorities have shown great interest in this route over the past few years, General Secretary Gorbachev said recently in a speech at Murmansk, capital of the USSR north of the Arctic Circle:

"Depending on how the process of normalizing international relations proceeds, the USSR could open the northern sea route, the shortest route from Europe to the Far East, to foreign ships, with the Soviet Union providing icebreaker-assisted pilotage."

AN INVESTIGATION ON THE FEASIBILITY OF AN ARCTIC TRADE ROUTE BETWEEN ICELAND AND JAPAN

BY

GULNUR AYBET

FOR

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INTRODUCTION AND SUMMARY

This report is an investigation on the possibility of operating an Arctic trade route linking Europe and North America to Japan in order to save fuel costs and time.

There are 2 main improvements in technology which makes travelling through ice more feasible than before.

Firstly, an accurate satellite reconnaissance system can not only show the ice edges, but also map information regarding the thickness and the type of ice and identify cracks in the ice sheets. This can track lines of weakness right around the polar ice cap. The information is immediately passed on to the travelling ships, thus, enabling them to avoid areas where the ice is unbreakable. Obviously, it does not seem feasible for the route to be operating all year round, at this stage. But even if such a route were to operate 6 months a year, one could take great advantage from this short-cut and save on fuel costs.

Extensive satellite reconnaissance programmes regarding ice information have been undertaken by the Icelandic Meteorological Institute, the German Meteorolgical Institute, and Intera Technologies Limited of Canada. The work of these organisations will be revealed in more detail in the following report.

Secondly new improvements have been made on Arctic transportation vehicles. Finland, being a leading builder in icebreakers, are now building a new generation of nuclear powered icebreakers which are capable of punching through thicker ice better than before. The Finnish company Wartsila have extensive experience in Arctic transportation and have been supplying nuclear powered icebreakers to the Russians for some time.

These two technologies enabled Dr. Thor Jacobsson of the Icelandic Meteorological Institute to conceive the idea of an Arctic trade route linking Iceland to Japan, and transforming Reykjavik into an international port where ships travelling from Japan through the Arctic can load and unload to leave for Europe and America.

The original idea for this route was to have a high powered ice breaking ship making way for a convoy of conventional merchant ships. But, during my investigation, I came across the possibility of operating large air cushion platforms that can be attached to the bow of a conventional merchant ship. Large air cushion platforms have an ability to go over ice up to 2m of thickness. They can go through ice continuously, without having to pull back and move forwards again to break the ice, like an icebreaker ship that has to rely solely on its propulsion force to break the ice. The air pressure of the air cushion platform which pushes the ice under means the ships use less propulsion power. Also if each ship was accommodated with its own platform, then this would allow companies wishing to use this route more flexibility, as a convoy, headed by one icebreaker would not be necessary. Of course, there may be problems. Companies may not wish to invest in large air cushion platforms to save fuelling costs. But, this would be a one time only investment, and over time it should pay-off its initial capital investment and bring profit in fuel saving.

Another problem is the pessimism over the ability of an air cushion platform to survive Arctic conditions. The current existing air cushion platforms operate in short distances over level ice, leaving ridges and thicker ice a problem to encounter. But, design paper studies show that large air cushion platforms around 1,000 tons can go over ice up to 2m thickness, and if there are difficult ridges, icebergs and thicker ice, these areas can be avoided using the information from the Satellite reconnaissance indicating distribution, thickness and the type of ice.

The concluding findings of this report are:

1) The use of large air cushion platforms attached to the bow of individual conventional ships, is a test study that needs to be carried out in the Arctic.

2) Intera Technologies of Canada, do undertake tests and mission flights regarding ice information and have extensive experience in the field. A merger of their methods and those of the Northern Meteorological Institutes including the Icelandic Meteorological Institutes would provide very accurate, infallible ice information.

A test study must be carried out initially to draw the attention of other companies who may wish to use this route. A study may be carried out by DF Dickins Associates Limited of Vancouver Canada, who are a company involved in Arctic Transport Studies, and they provide route evaluation, conceptual design and testing for Arctic air cushion vehicles and their recent project includes studies on large 1,000 ton Air Cushion platforms, capable of breaking obstacles over 2.5m in height.

A further test study on specific ice patterns all thoughout the route can be undertaken by Intera Technologies who are currently pursuing a programme called Radar-Sat which is run by a consortium of companies and is sponsored by the Canadian and British governments. This programme means Intera will be working with the Russians on this in the near future and the main aim of the programme will be to licence ice patterns to companies who are interested in obtaining such information.

It is essential that these tests be carried out to receive accurate data on the route. For this, investment is necessary, but without such tests, it is impossible to receive an accurate feed back from the market on the commercial side of shipping, with respect to the conventional trade routes. As George Lassados of the Hambros Bank commented, at such an early stage, one cannot receive any feedback from the shipping market with regard to this route. Also, at this stage, it is impossible to draw a comparison between this proposed Arctic trade route and the current existing conventional trade routes, as companies are not willing to release information which may be used against their interests.

However, as a preliminary paper study this report concludes that with the above mentioned technologies the operation of such a route is feasible in the future.

TRANSPORT IN THE ARCTIC IN THE PAST

The current proposed route stretches from Iceland across the Northern coast of Russia with the stopping ports being Murmansk, Dudinka, Khatanga, Tiksi and Pevek, through the Bering Strait down to the Bering Sea to Japan. In the past, the Northern sea route has operated shipping lanes between the Novaya Zemlaya straits in the west and the Bering strait in the east. Throughout the period of 1887-98 there were a number of voyages carried out from Europe to the Kara Sea. Among those who shipped on this route was Joseph Wiggins, an English Sea Captain. The cargoes carried were mainly manufactured goods to Siberia, and on the return trip, local products such as grain, flour and graphite.

In 1912, a Norwegian businessman, Jonas Leid used the route to import cement, coal and manufactured goods into Siberia and exporting agricultural products. Thus a viability of a route through the Kara Sea had been clearly shown.

Vice Admiral Makarov of the Russian Navy, around this time, came up with the idea of building a ship with the Arctic specifically in mind and the first polar icebreaker 'Yermak' was built. 'Yermak' operated in the Arctic until final withdrawal from services in 1963. The pressures of the first world war led the Russian government in 1916 to create the port which is known today as Murmansk. Murmansk is close to the Norwegian frontier and is the only port free of ice all year round. The port became the main base of the route.

Afterwards a sea route for trade between the Pacific and North East Siberia was developed by the Russians and starting in 1911 an annual voyage was made from Vladivostok to the Kolyma and back. This area is part of the currently proposed route.

A series of hydrographic expeditions between 1910 and 1915 were undertaken by the icebreaking ships Tamyr and Vaygach. These laid the foundation for the practical exploitation of the Northern Sea Route.

This followed in 1913, with the discovery of the Severnaya Zemlaya.

In 1920 a Russian government Committee of the Northern Sea Route was established to get ships moving between Siberian producers and the White Sea, where food was scarce. With a convoy of icebreakers and freighters this route successfully operated.

In 1924 the Kara Sea route from the Yenisey basin to Western Europe was used for the export of timber.

In 1932 at the second International Polar year, the suggestion was made for a scientific voyage which would traverse the whole of the waterway from the Atlantic to the Pacific. So an expedition was planned by the Arctic Institute in Leningrad with the recruitment of a carefully selected scientific staff. The icebreaking ship to make the journey was the Alexander Sibiryakov, which was built as the Bellaventure in Glasgow in 1909.

The voyage started from Arkhangelsk on 28 July. There were no problems going through the Kara Sea and the second stopping port was Dikson. The next call was the island of Domashniy, where there was a base of an exploring expedition. It was decided to go round the most northerly island of the Severnaya Zemlaya archipelago, a thing no ship had yet done. There were some difficulties when a propeller blade was lost in the ice, but a week later the ship reached the Laptev Sea, thus completing the challenge to go round the Severnaya Zemlaya successfully. The next stopping port was Tiksi, and after that, the mouth of the Kolyma river. Cape Schmidt on the north coast of Chukotka was reached without difficulty, but there, within 400km of the Bering Strait problems started. The propeller blades and the propeller shaft were severly damaged with ice. The crew rigged sails made of tarpaulin hatch covers as the ship drifted. But a fortnight later, the Bering Strait was reached. It was the first time ever that the Northern Sea Route had beed traversed in one season. After repairs had been carried out in Japan, the Sibiryakov returned to Murmansk by southern seas.

All this goes to show that, if such a voyage was made in 1932, without satellite reconnaissance ice information and without the new technology in icebreakers and air cushion platforms, there is no reason why such a voyage cannot be possible today.

During the second world war a number of Red Navy units were transferred between the Atlantic and Pacific by way of the Northern Sea Route. Lend-Lease goods were shipped out of North American West coast ports through the Bering Strait to destinations along the route.

In 1941 the Soviet icebreaker 'Krasin' crossed the Northern Sea Route and went across the Pacific to Seattle. In 1942, she crossed to Britain and thence proceeded by way of Iceland back to Murmansk, which she reached in May.

During this time, many attempts were made by German U Boats to intercept and seriouly damage the Northern Sea Route used by the Russians. Certain Russian convoys saw some damage but the main German aim to halt or seriously interfere with shipping on the Northern Sea Route was not achieved.

In the post war period many voyages were made from the ports of Igarka and Dudinka in the Yensisey region to the West. The purpose was the transfer of timber from Igarka, and the transfer of supplies to Dundinka which was situated near a mining centre. According to Terrence Armstrong of the Scott Polar Research Institute, the port facilities in Dudinka must now be quite extensive.

Coastwise shipping centered on Tiksi which makes use of the early melting of the southern Laptev Sea brought about by the massive outflow of relatively warm water in the summer.

In 1961 the nuclear icebreaker 'Lenin' completed an assignment to set up a new drifting station on the ice north of Wrangel Island and deposited automatic meteorological stations at fifteen points in the Central Arctic Basin. Some of the regions traversed by the Lenin at this voyage had never been navigated by a ship under its own power at any season and most of the regions had not been navigated in October and November before. The 'Lenin' was the first surface ship to have nuclear power. Another pioneering voyage was made by the nuclear ice breaker 'Arktika ' in August 1977. She travelled a triangular course from Murmansk, the Laptev Sea to the North Pole and back to Murmansk. It was the first time a surface vessel had ever reached the Pole. The 'Arktika' completed this 3,850 nautical mile voyage in 14 days at an average speed of 11.5 knots. In 1978 the icebreaker 'Sibir' escorted a freighter across a similar route to a more southerly latitude.

Information gathered from E.A Gibson shipbrokers revealed that the tanker Manhattan, from 1976 onwards, made several journeys to transfer Alaskan oil from Alaska via the Bering Sea down through the Pacific to Los Angeles. The tanker was accommodated with an icebreaking bow. After the pipeline from Alaska was built for the purpose of carrying oil, there was no further need for these voyages. But even after the construction of the pipeline, when certain unexpected oil came up, the Manhattan had also to repeat a few trips down the same route for this purpose. No satellite reconnaissance ice information was used and the tanker made its way through the ice by using its propulsion power to break the ice by force. However the main problem which the Manhattan encountered was port stopping. As the tanker continuously moved, it was easier to break the ice. But once it stopped and became surrounded by ice it was very difficult for the tanker to start again and acquire enough propulsion power to break the ice which had settled around it.

Travelling within ice the average speed of the Manhattan was 3.4 knots and would have burned 20% to 50% more fuel than if it were going full speed. (The Manhattan has a maximum speed of 16½ knots and a consumption of 220 tons bunkers a day). The Manhattan is still in operation and sailed from San Fransisco to Vancouver at the end of June, this year.

During 1983, in the Northern Sea Route the year round navigation into Dundinka continued, also the export of timber from Igarka continued. In late February, within the same year, the icebreaker, Admiral Makarov, took a freighter to Egvekinot and Provideniya on the South coast of Chukotka. The voyage was repeated on early May by Nizhneyank, one of the new SA15 ships. But it was difficult for ships to reach the North Coast of Chukotka and the Chukchi Sea before July because of the heavy ice.

In 1984, the southwest Kara Sea was again the major centre for freight traffic. But during this season it was shown that there was a clear intention to open up new possibilities in Artic navigation when the icebreaker Leonid Brezhnev escorted the Monchegorsk out of Murmansk in early June, bound for Pevek. They reached Pevek on 25 June. The Monchegorsk continued its voyage to Japan where she took on board the cargo of pipes. During this season five other freighters, four of them SA15s unloaded at Tiksi or Pevek and continued on to Vancouver where grain was loaded.

In 1985 a through voyage from Murmansk to Pevek traversing the Laptev sea was made for the first time by the Soviet ice breaker 'Sibir' and the SA15 'Kola'. They passed by the north of the Novasibirskiye Ostrova.

A set of voyages from Vancouver through the Nothern Sea Route to the west were planned for 1985 by the Russians. This was known as the trans Arctic experiment. Three SA 15s made the voyage to Arkhangelsk. They were the 'Kola', 'Arkhangelsk' and the 'Tiksi'.

In August 1985 there was a well publicized and controversial voyage through the Northwest Passage by the US Coast Guard Icebreaker 'Polar Sea'. Canada objected to the voyage claiming the waters of the Passage as internal waters. The Soviet comment also sided with Canada and made the point that the Northern Sea Route was an internal waterway.

Of course the most important aspect of the Northern Sea Route are the seasonal variations across all the regions of the route. Most of the information in this report regarding the history of the route and the seasonal changes within it were obtained from Terrence Armstong of the Scott Polar Research Institute in Cambridge, who is an expert on the Northern Sea Route. The ice situation along the route varies from year to year and place to place. Reports from the period of 1984 - 70 show that the Ob and Yenisey regions (near stopping port Dudinka) would be accessible from the west between early July and early November. Then Kolyma and Pevek would be accessible from the east between mid July and late October. The Lena (near stopping port Tiksi) would be accessible from either end between early August and mid October. Thus the ports close to each end of the route may have had a season of up to 4½ months, while the through route itself would have around 2½ months. Of course this seasonal accessibility is drawn on the assumption that an ice strengthened ship with an experienced captain has the availability of an icebreaker support on call and regular access to reports and forecasts of the ice situation.

According to Terrence Armstrong, if this route were to become attractive to international trade, there would be nothing to stop the shipping interest of any country attempting to make use of it.

Since the second world war, there has been non-Soviet use of the route until the mid-60s, a number of Norwegian, British and other ships were chartered by the Soviet government to carry timber from Igarka. In 1967 the Soviet government offered to open a through route to foreign shippers who would not be on charter to Soviet organisations. A certain fee would have to be charged, and for this the necessary icebreaker and information services would be provided. No one took up the offer, because perhaps they calculated that the fee, the additional insurance premium and the unforeseen possibilities of delay would off set the gain in time, which was expected to be up to 13 days on a voyage between western Europe and Yokohama. Although the offer was tacitly withdrawn soon after, in order not to offend the Arabs by posing an alternative to the recently closed Suez Canal, between 1962-67, the US Coast guard icebreakers made a series of oceanographic cruises to the seas north of the USSR. During this time, no attempt was made to stop them until 1967 when they were about to enter Soviet territorial seas near the Vil 'kitskiy Strait, and then they were stopped only because they were thought to be warships. From these illustrative examples, Terrence Armstrong draws the assumption that the USSR regards the high seas north of the USSR as essentially the same as the high seas anywhere else. Thus he concludes that the route can become attractive to international trade through technological advances. Regarding the current proposed trade route, Terrence Armstrong said there were "possibilties of zooming ahead".

ARCTIC TRANSPORTATION VEHICLES

Through the Arctic, so far the main mode of transportation has been ice stengthened ships and icebreakers. Already the most extensive ventures in the Arctic have been carried out by Soviet icebreakers as previously illustrated.

The modernisation of the Soviet icebreaking fleet which is the largest in the world came about with the addition of a number of Finnish-built icebreakers in the post war era. The firm principally concerned, OY Wartsila AB, soon became the worlds leading ship yard for ice going vessels. Wartsila has several production plants outside Finland, in Sweden, France, the USA and Singapore. The shipbuilding Division in the Helsinki shipyard specialises in icebreakers. By July 1986 it had delivered 54 icebreakers. The yards research and development department is continuously engaged in feasibility studies and research on the development of ice-going tonnage and future transport needs in the Arctic and Antarctic areas.

The Wartsila Arctic Research Centre (WARC) has an ice model basin in which it is possible to test the behaviour of ships and other structures in several different kinds of simulated ice fields. Research is also carried out for outside interests. In addition, the Diesel Division of Wartsila is one of the worlds leading manufacturers of medium speed diesel engines.

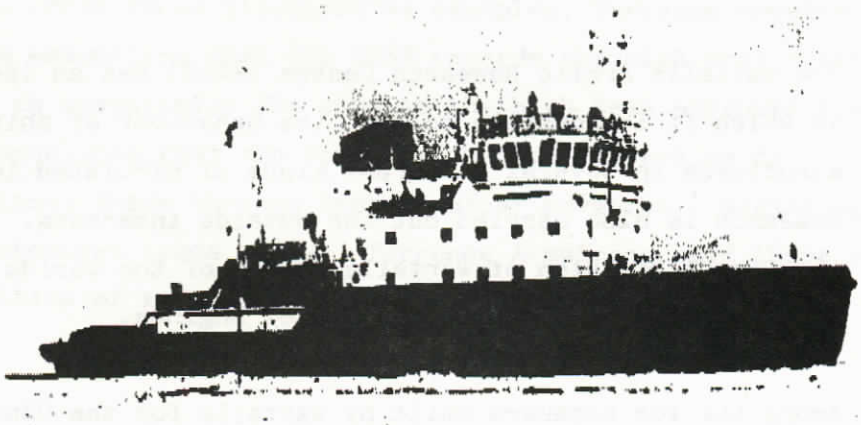
Among the ice breakers built by Wartsila for the USSR have been the new Yermak, a 36000hp icebreaker delivered in 1976, the Kapitan Sorokin, and the Kapitan Izmaylov, equipped with the Wartsila air bubbling system.

15.2.5 FINNISH BUILT RIVER ICEBREAKERS, KAPITAN CHECHKIN TYPE

Kapitan Bukayev. These shallow draught icebreakers are fitted with the Wartsila air bubbling systems.

Built: Helsinki by Oy Wartsila A/B
Tons: 2240 displ
Dimensions: 254.5 x 53.5 m (255 x 54 ft)
Engines: 3 x 12 cyl Wartsila (6330 bhp) driving generators connected to electric motors (1496 shp each) and 3 shafts 14 knots
Delivered: 1977 *Kapitan Chechkin* *Kapitan Plahin*
1978 *Kapitan Bukayev* *Kapitan Chadayev*
Kapitan Krutov *Kapitan Zarubin*

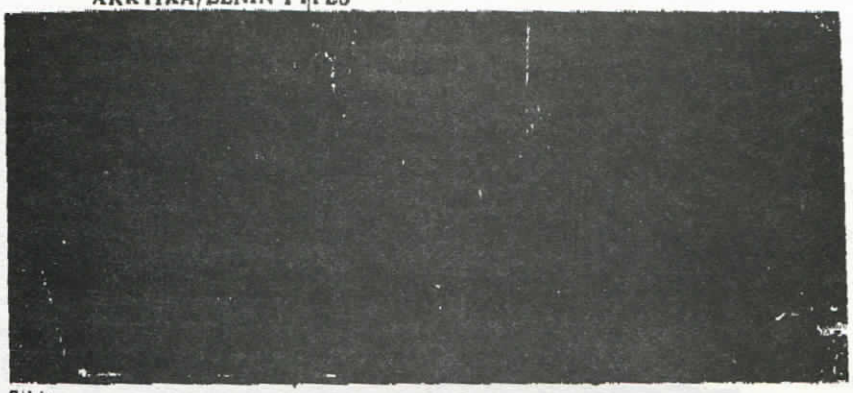
15.2.6 FINNISH BUILT INLAND SEA ICEBREAKERS KAPITAN IZMAYLOV TYPE



Kapitan M. Izmaylov. These 3 ships are equipped for fire fighting and salvage duties and have the Wartsila air bubbling system

Built: Helsinki and Vasa*, by Oy Wartsila A/B
Tons: 3540 dwt, 1362 gross
Dimensions: 56.29 x 16.03 m (185 x 53 ft)
Engines: 4 x 8 cyl Wartsila (5360 bhp) driving 4 generators connected to 2 electric motors (1700 shp each) and 2 shafts 13 knots
Delivered: 1976 *Kapitan A. Radzabov**
Kapitan Kosolapov
Kapitan M. Izmaylov

15.1.1 RUSSIAN BUILT NUCLEAR POLAR ICEBREAKERS ARKTIKA/LENIN TYPES

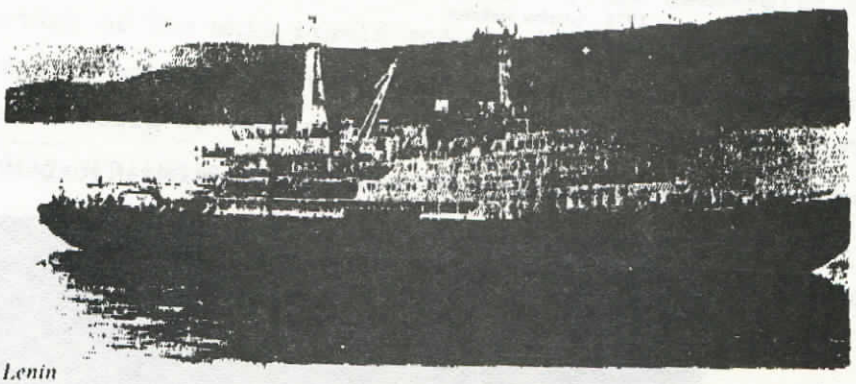


Sibir

Built: Leningrad by Admiralty Shipyard

A.

Tons: 4096 dwt, 18172 gross, 3018 net
Dimensions: 147.99 x 30.00 m (485 x 98 ft)
Engines: 2 nuclear reactors 4 Kirov steam turbines (75000 shp) driving 3 generators connected to 3 shafts 21 knots
Delivered: 1974 *Arktika*
1977 *Sibir*

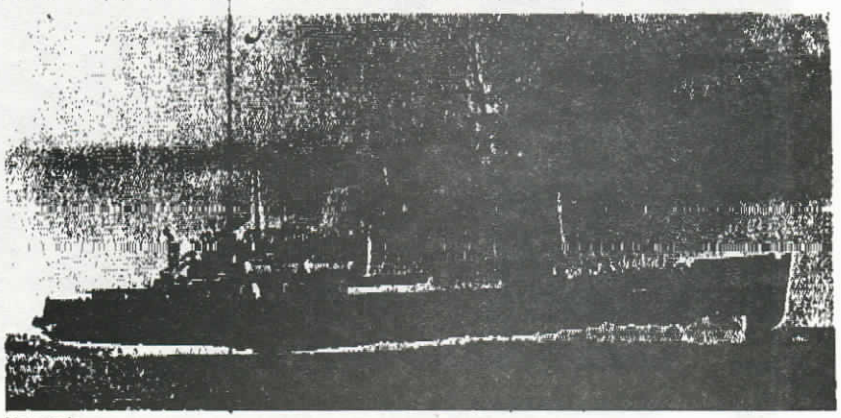


Lenin

B.

Tons: 3849 dwt, 14067 gross, 2820 net
Dimensions: 134.02 x 27.64 m (440 x 91 ft)
Engines: 3 nuclear reactors: 4 steam turbines (44000 shp) driving 4 generators connected to 3 electric motors and 3 shafts 18 knots
Delivered: 1959 *Lenin*

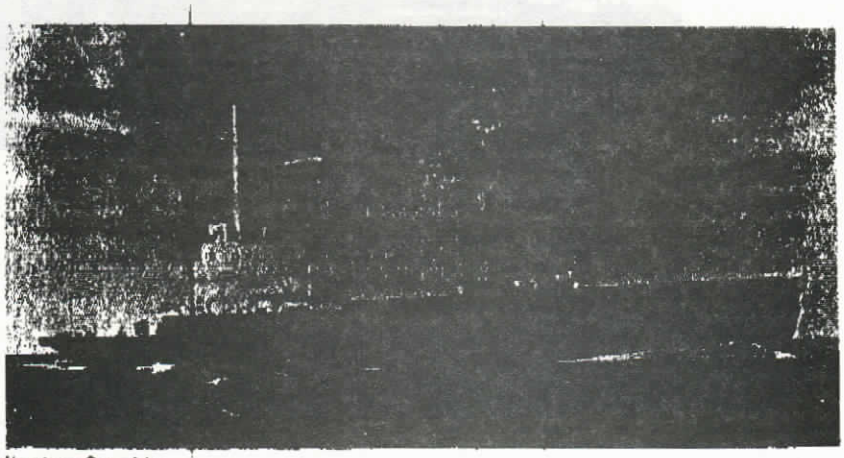
15.2.1 FINNISH BUILT POLAR ICEBREAKERS, YERMAK TYPE



Yermak

Built:	Helsinki, by Oy Wartsila A/B
Tons:	7560 dwt, 12231 gross
Dimensions:	135.01 x 26.07 m (443 x 86 ft)
Engines:	9 x 12 cyl Wartsila/Sulzer (41,400 bhp) driving 9 generators connected to electric motors (12000 shp each) and 3 shafts 19 knots
Delivered:	1973 *Yermak*
	1975 *Admiral Makarov*
	1976 *Krasin*

15.2.2 FINNISH BUILT POLAR ICEBREAKERS, KAPITAN SOROKIN TYPE



Kapitan Sorokin

Built:	Helsinki by Oy Wartsila A/B
Tons:	4225 dwt, 10609 gross, 2668 net
Dimensions:	131.88 x 26.70 m (433 x 88 ft)
Engines:	6 x 9 cyl Wartsila/Sulzer (24840 bhp) driving 6 generators connected to 3 electric motors 6666 shp each) and 3 shafts 19 knots
Delivered:	1977 *Kapitan Sorokin*
	1978 *Kapitan Nikolayev*
	1980 *Kapitan Gronitsin*
	1981 *Kapitan Klebnikov*

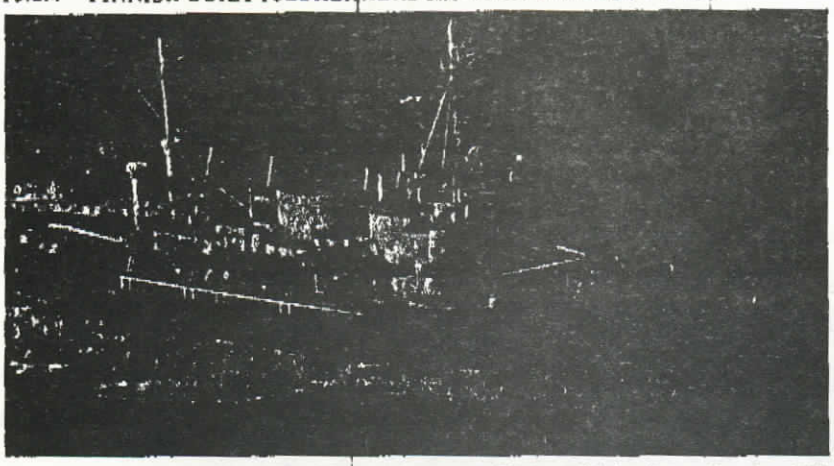
In December 1983 a new Soviet built nuclear powered icebreaker of 75,000shp entered Arctic service. She was built primarily for the route across the Kara Sea to the Yenisey which is kept navigable virtually all year round. In 1984 Wartsila started construction on the 52,000shp nuclear powered icebreaker Tamyr, a shallow-draft vessel designed particularly for estuary work.

Two further SA15 class ice-strengthened freighters built in Finland were delivered in 1985 and a further three to have been delivered this year would have brought the total up to nineteen.

Mr Yoran Wilkman of the Arctic Transportation Division in Wartsila said that the nuclear part of the icebreakers supplied to the USSR was fitted at the USSR and that Wartsila mainly dealt with the construction of the ship itself and constructed icebreakers mainly with electric motors. He said that of course nuclear powered icebreakers would be very good for Arctic conditions where fuel is not readily available, but said that although Wartsila did not at present possess the facilities to build nuclear reators into their icebreakers, this was not a complicated process and if the demand for this rose, Wartsila would take it up.

When asked about the average speed of icebreakers operation in the Arctic, Mr Wilkman said that it mainly depended on the type of ice. From Murmansk to Dikson, an icebreaking ship could sometimes go up to 10 knots and sometimes be completely stuck. The 22,000hp 'Sorokin' class icebreakers could break ½m of ice in 2 knots. Mr Wilkman also gave information about the air bubbler system which operates beneath the hull on most of Wartsila icebreakers for the past 18 years. This proves a reduction of 15-30% in propulsion power used to break the ice. The pressure pulls the water up beneath the ice so that the water comes in between the ice and the hull and pushes the ice to the bottom of the sea where it disintegrates from the pressure and is forced to go down.

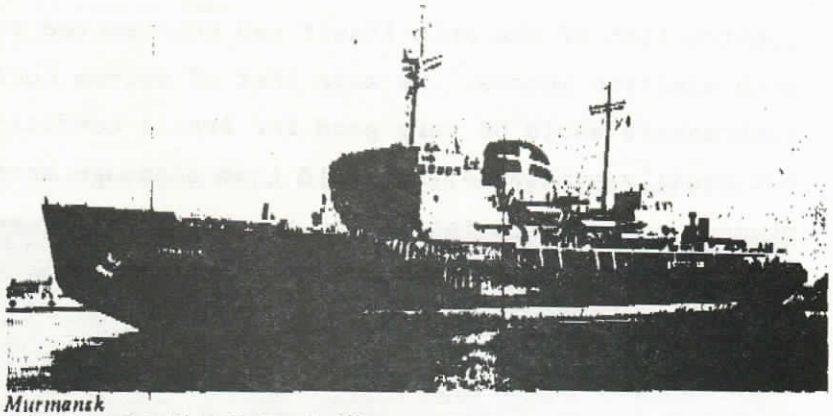
15.2.4 FINNISH BUILT ICEBREAKERS KAPITAN BELOUSOV TYPE



Kapitan Melekhov. Similar ships were delivered to Finland (*Voima*) and Sweden (*Oden*).

Built:	Helsinki, by Wartsila – Koncernen A/B
Tons:	1446 dwt, 3710 grss. 1050 net
Dimensions:	83.17 x 19.41 m (273 x 64 ft)
Engines:	6 x 8 cyl Polar (10500 bhp) driving 6 generators connected to electric motors and geared to 4 shafts (2 forward and 2 aft) 16.5 knots
Delivered:	1955 *Kapitan Belousov* *Kapitan Voronin*
	1956 *Kapitan Melekhov*

15.2.3 FINNISH BUILT POLAR ICEBREAKERS MOSKVA TYPE



Murmansk

Built:	Helsinki, by Oy Wartsila A/B
Tons:	5609 dwt, 9427 gross, 1142 net
Dimensions:	122.23 x 24.59 m (401 x 81 ft)
Engines:	8 x 9 cyl Wartsila/Sulzer (26000 bhp) driving 8 generators connected to four electric motors (5500 shp each) and 3 shafts 18.25 knots
Delivered:	1960 *Moskva*
	1961 *Leningrad*
	1965 *Kiev*
	1968 *Murmansk* *Vladivostok*

Wartsila also builds icebreakers for the Norwegian and Swedish governments where they are used mainly to escort vessles.

The construction cost of nuclear ships so far is of course much above diesel electric or gas turbine craft, but falling into account the rising cost of organic fuel, nuclear powered ships of greater engine capacity become competitive.

Since 1976, Wartsila's Helsinki shipyard has been applying the experience gained in its construction of icebreakers to the development of air cushion craft capable of negotiating the physical conditions encountered in the cold regions.

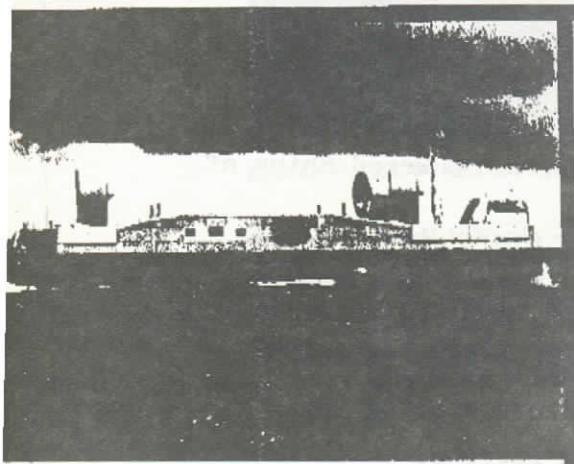
The prototype of the Polar Utility Craft 22 is the Larus, which has a 30 tonne capacity and is an amphibious mixed traffic ferry. It was delivered by the Helsinki shipyard in December 1981. The Larus was designed and constructed, specifically for Arctic conditions. It can operate in temperature as low as 50c. The Larus is propelled by 4 650kw diesel engines which drive integral lift fans and thrust propellers. The thrust is provided by 4 controllable pitch propellers in nozzles located upon pylons. The pylons rotate 240 providing the craft with excellent manouvering capability.

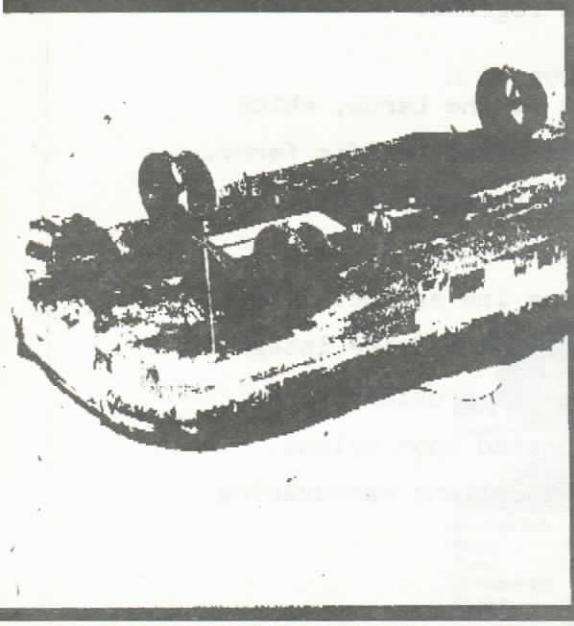
After operating as a ferry, transporting vehicles and passengers to offshore islands within the Baltic Sea, the Larus, has operated for Arctic Transportation Limited, Calgary, Canada, since 1985. It has been used in a number of operations including the transport of cargo and passengers to offshore islands and structures in the Beaufort sea and transport of cargoes and passengers along the shallow waters in the western Arctic.

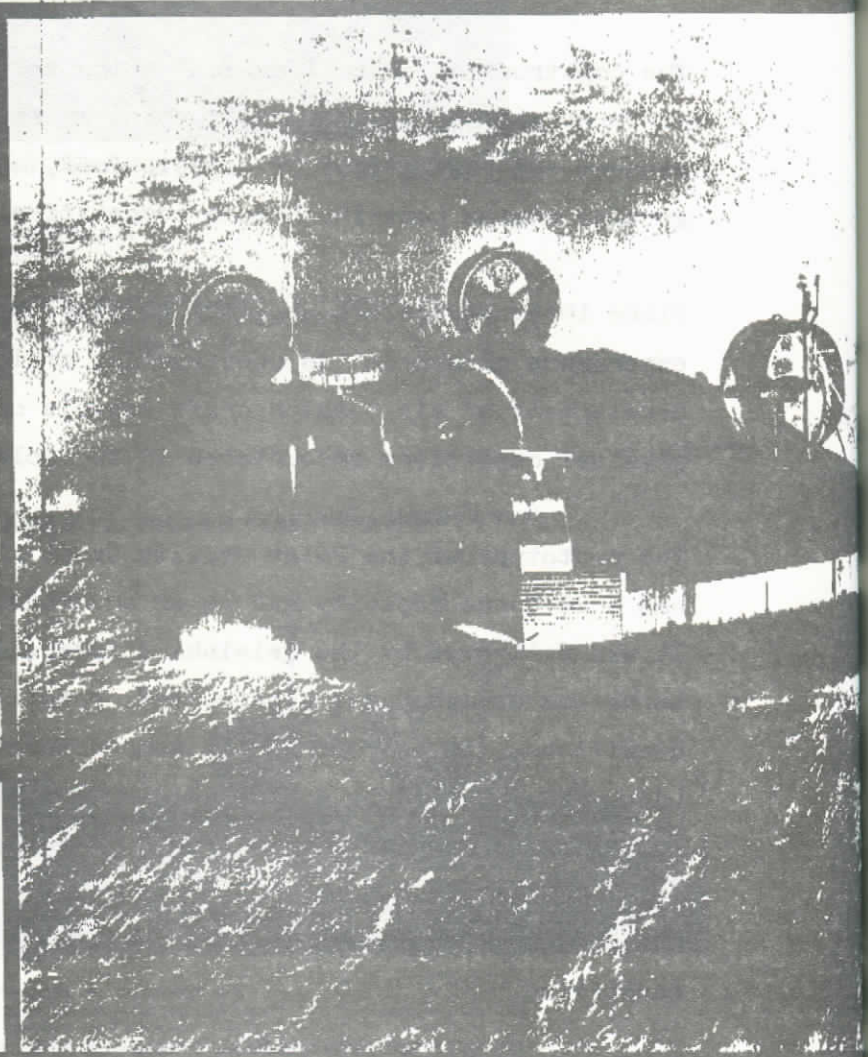
The crew of the Larus consists of three, a pilot-in-command, a navigator and a loadmaster.

The Air Cushion Vehicle "Larus"

AHI
ARCTIC HOVERTRANS
Suite 1900, Esso Plaza, Eas
425 - 1st Stre
Calgary, Alberta







The Arctic Alternative

The air cushion vehicle "Larus" is the Arctic alternative providing the capability of transporting cargoes and passengers along most terrain and virtually any water depth, ice, wind and weather condition experienced in the North American Arctic. The "Larus" is aluminum constructed and capable of carrying approximately 25 tonnes cargo at a cruising speed of 20 knots. The craft may also accommodate 46 passengers in comfortable individual seats within the two hull superstructures.

The vehicle was designed and constructed s pecifically for Arctic conditions, by Oy Wartsila Ab Helsinki, Finland. The "Larus" has recently been refurbished to insure reliable operation in temp tures as low as -50°C. The machinery and mate of the craft have been selected with Arctic condi in mind, from the main propulsion diesels to the re-inforced Arctic grade rubber skirt.

The "Larus" is propelled by four 650 KW diesel engines which drive integral lift fans and thrust propellers. The cushion is provided by six doubl centrifugal aluminum fans. The thrust is provided by four controllable pitch propellers in nozzles loca upon pylons. The pylons rotate 240° providing th craft with excellent manoeuvering capability.

Among the many features of the "Larus" are mechanically operated ramps bow and stern to facilitate the handling of cargoes.

Wartsila has also built nine TAV 40s, the towable air cushion vehicles for the USSR to operate in conjuction with the 14 SA-15 type 20,000 tonne icebreaking multi-purpose cargo ships designed by Wartsila. Other air cushion vehicles derived from the TAV 40s built by Wartsila have been the Vector 200 designs.

The main purpose of these vehicles is to transfer goods from ship to shore and to be used in specific circumstances where the waters are shallow and the ships cannot go. Since being built for this reason, these air cushion platforms are small in size and have not been built to be attached to the bow of a ship to lead it through the ice. Bearing this in mind, Mr Wilkman of Wartsila said rather than an air cushion vehicle, an icebreaker ship would be the cheapest and the most feasible mode of transport to operate in the Arctic. Mr Wilkman also pointed out that air cushion vehicles operated well only in level ice, but where there were ridges and rubble, their operation would not be so easy.

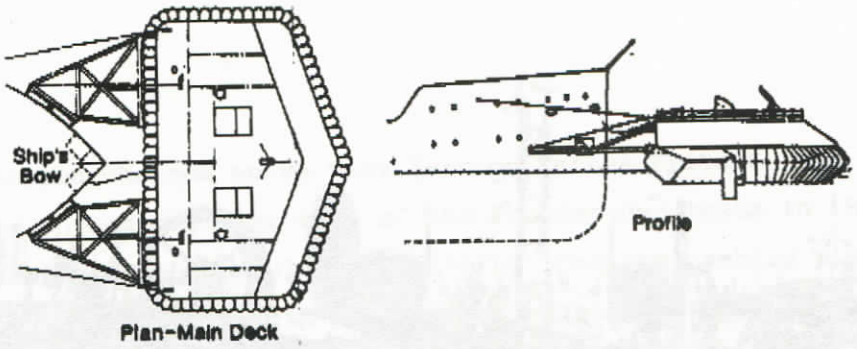
However at the point of the conversation with Mr Wilkman the possibilities of building a large ACV platform specifically designed to be attached to the bow of a conventional ship, based on the Arctic strengthened structure of these small preliminary vessels, was not discussed. But in Canada, certain paper studies had already proved that the building of a large 1,000 ton ACV to assist ships through ice could break ice up to 2.5m thick.

In 1971 the Canadian built ACT-100 air cushion transporter was completed. It operated mainly as a transporter of drill rig supplies and equipment between artificial islands. (The ACT-100 has a 100 ton payload capability) DF Dickins Associates and the Sohio Alaska Petroleum company provided information on certain tests that were run on the ACT-100 at Prudhoe Bay, Alaska.

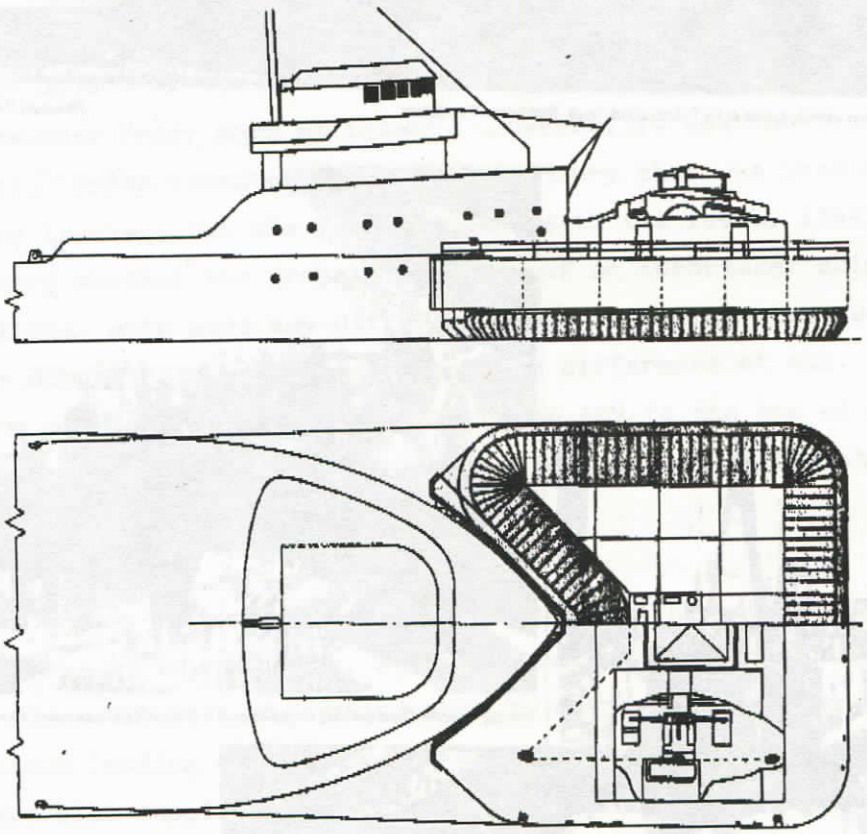
In 1981 the ACT-100 was pushed by an ice strengthened tug in 36cm level ice sheet. The tug hoverbarge system traversed a distance of about 25 miles over a 4 day span through areas of level ice, rafted ice and refrozen tracks. Speeds of up to 3 knots were obtained.

The icebreaking characteristics of the ACT-100, led to the development of a new vehicle designed specifically to aid the passage of a conventional ship through ice bound waters. This craft is attached to the bow of the ship. On making contact with the ice sheet, the skirt rises up over the ice while continuing to maintain its air seal. The ice sheet then penetrates the zone of pressurised air beneath the craft, where the water level within the skirt area is depressed to a lower level than the bottom of the ice layer. The ice has now become a cantilevered ledge without water support beneath. When the cantilevered section reaches its critical length, failure occurs and the overhanging section breaks off and falls into the depressed water below.

Under the sponsorship of transport Canada, the ACT-100 was modified into an icebreaking system and named Iceater 1. It was first demonstrated during the 1975-76 winter season at Thunder Bay, Ontario. It maintained a continuous headway through ice up to 32 inches in 9 knots. The ACT-100 had a deep V notch cut into its stern to accommodate the bow of the 'Alexander Henry', a Canadian Coast Guard ice strengthened ship. The Thunder Bay tests began on 15 January 1976 in temperatures -30c. They continued for 3½ months. The Iceater did not have its own propulsion. It was pushed by the Alexander Henry, but it had 3 diesel engines which provided the air pressure of 600hp each.



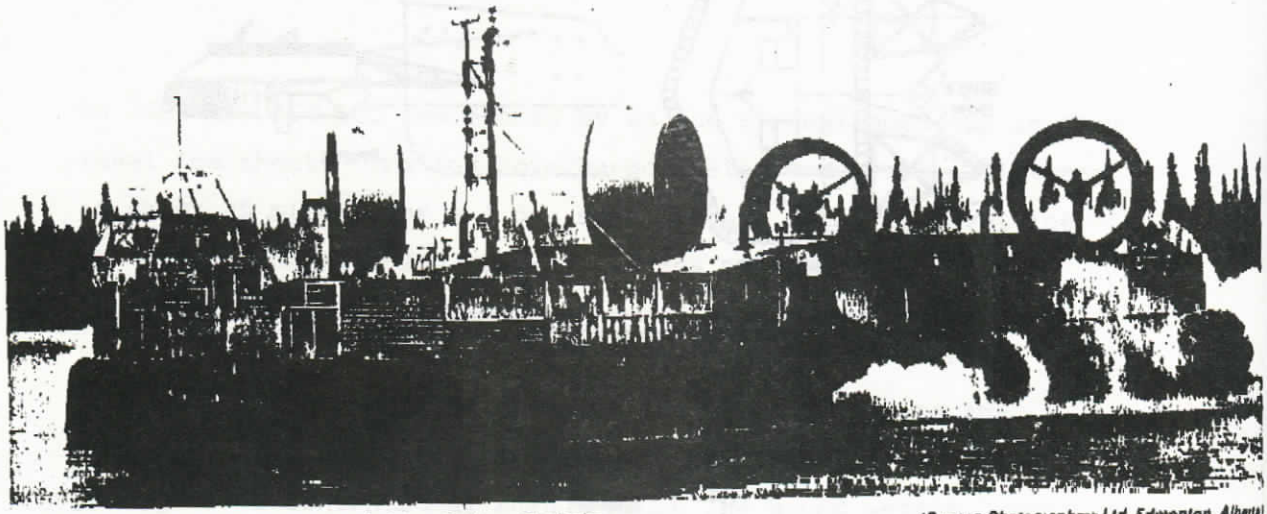
Early VIBAC air-cushion ice-breaker concept designed for attachment to conventional ships travelling through Arctic waters. The unit was an outcome of experience with the ACT-100 on the Great Slave Lake, where it continuously broke ice as thick as 0·685m (27in)



Iceater I—general arrangement

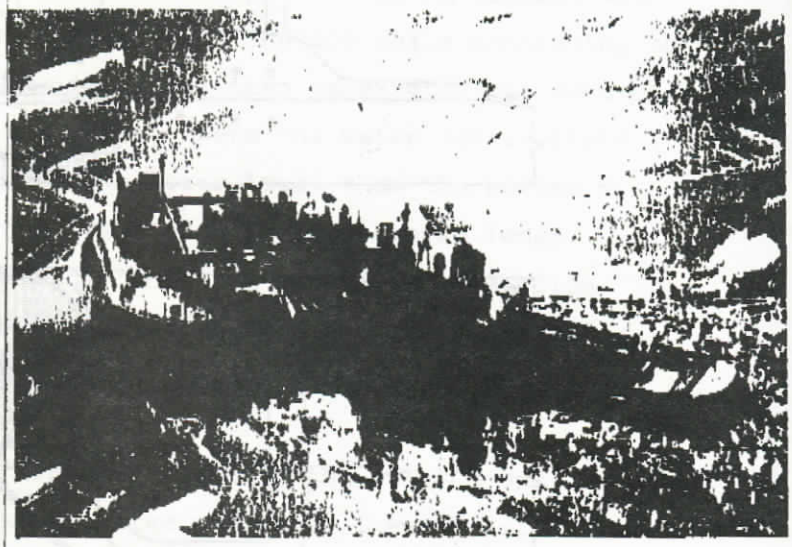
ASL Iceater-1 has now operated with four different vessels:-

	Length	Beam	Displacement	Horsepower
Thunder Cape, harbour tug	32m (105ft)	8·11m (26ft 7in)	600 tons	1,440shp
CCGS Alexander Henry	57·91m (190ft)	13·2m (43ft 6in)	2,240 tons	3,550shp
CCGS Griffon	65·22m (214ft)	14·93m (49ft)	2,793 tons	4,250shp
MV Imperial St Clair	122·49m (415ft)	22·55m (74ft)	16,450 tons	6,500 shp

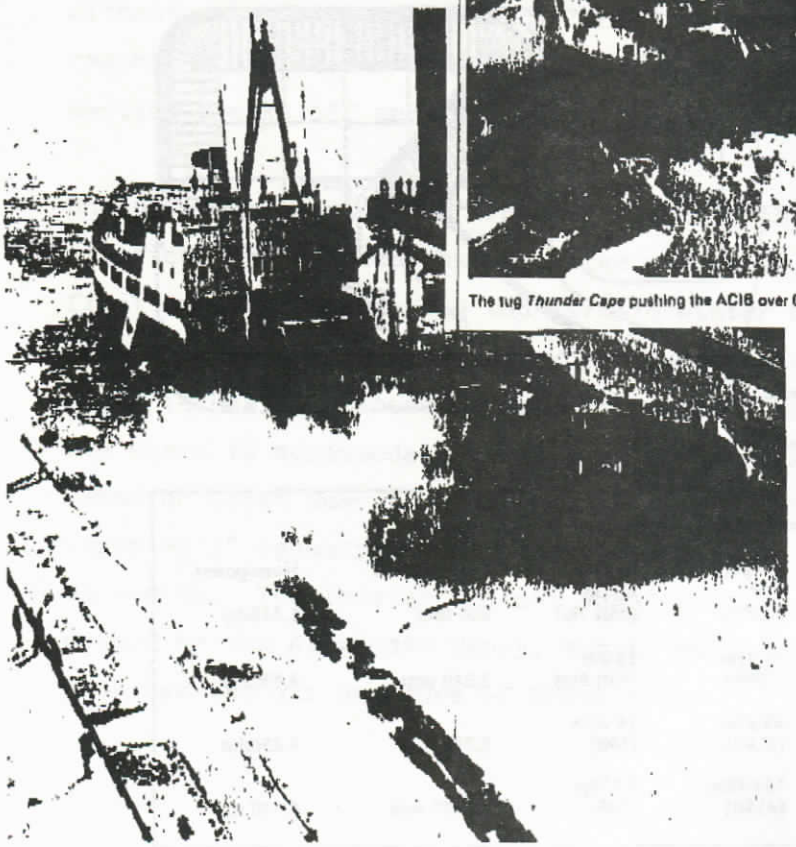


Wärtsilä air cushion vehicle *Larus* at its Tuktoyaktuk base, Northwest Territories

(Ranson Photographers Ltd, Edmonton, Alberta)



The tug *Thunder Cape* pushing the ACIB over 0·60m of ice at a speed of 4 knots



The CCG *Alexander Henry* using the ACIB to open a slipway, March 1984

Tony Simpson who now works with Textron Marine Systems, was the engineer on board at the time of the Thunder Bay tests in 1976. Mr Simpson said one should bear in mind that air cushion platforms operate continuously, with the current existing models operating continuously in 30 inch ice. Whereas icebreakers in order to break the ice need to charge and recharge and this would mean a larger consumption of fuel.

The main object of the Iceater was to make the icebreaking ship the Alexander Henry more efficient. However, it was the propulsion power alone of the Alexander Henry that was used to push the Iceater, but the Iceater dealt with the ice by itself. When asked whether the propulsion power of an icebreaker ship or a conventional ship made any difference when operating with such an ACV, Mr Simpson replied it would make no difference at all. So it would be possible to attach an icebreaker ACV to the bow of a conventional ship and it would operate just as well under the same conditions.

Textron Marine Systems of New Orleans, have built a Landing Craft Air Cushion for the US Navy, within a contract which started in 1981. The LCAC is a high speed ship to shore and over the bench amphibious landing craft, capable of carring a 60 ton payload. TMS have also supplied the US Navy with the LACV-30 (lighter air cushion vehicle 30 short tons payload) The LACV 30 is employed primarily by the US army as an amphibious lighter for efficient cargo removal from ship to shore and inland where no port facilities exist. These designs are similar to the Wartsila Larus.

The transportation Development centre which is the research and development group within Transport Canada, had a contract to carry out ice management tasks with the ACIB (Air Cushion Ice Breaking Bow) and the Alexander Henry in 1984. These ice management operations were carried out by the Canadian Coast Guard.

Jacque Laframboise who is the senior development officer of TDC said that in 1977 the ACIB was attached to the bow of a conventional ship and was successful in ice up to 1m thickness in the Great Lakes. In the Arctic, he agreed that a bigger machine would have to be built to tackle ice over 2m thickness, but maintained that it would still be cheaper to operate than an icebreaker. Mr Laframboise said that an ACV of at least 1,000 tons could probably tackle Arctic conditions but this would be a new thing as it has never been done before. He also pointed out the problem of ridges in the North West passage as opposed to the flat ice in Thunder Bay. However, he agreed that with the aid of satellite reconnaissance on ice information, it ought to be possible to avoid dangerous areas such as ridges and multi year ice, and with a large ACV attached to the bow of a conventional ship capable of breaking ice over 2m, he saw this a likely possibility in the future, although such a large ACV platform does not as yet exist.

Hover Craft Consultancy Lmtd of Southampton, carried out a design study for a 1,000 ton icebreaker to go over ice up to 2m thickness in the North West Passage for German and Mill of Ottowa. This was a paper study carried out 3 years ago. The study was carried out by HCL acting out for German and Mill who had the contract from TDC. This design study was intended as a follow up to the ACIB to break ice up to 2m. There were two distinct parts to the study.

First, to carry out a smaller, circular design, second, to carry out a rectangular design with strong rigid side walls. Mr Rapson of HCL said that a test work was definitely needed as a follow up to the paper study. He agreed that for the Arctic route a final design would be a very large ACV, but he said it would be worthwhile to carry out tests on smaller versions. Mr Rapson said that ACV platforms according to the paper study can go over ridges and the ice does not necessarily have to be flat. In fact a large ACV could go over ridges of 2.4m. This was indicated on the study carried out by HCL. HCL mainly carry out model tests and designs. Recently a design for a 1,000 ton ACV platform was near completion for BP until BP dropped the project.

George Onega of the Research and Development section of Textron Marine Systems said that TDC would definitely be interested to pursue the construction of an ACV platform built specifically for the proposed Arctic trade route. However, if such a contract were to come about in the future, a test study would first have to take place.

DF Dickins Associates Lmtd of Canada are actively involved in Arctic marine transportation studies. This company provides route evaluation, conceptual design and testing for Arctic air cushion vehicles. If a heavy ACV is to be built specifically for this route in the future, DF Dickins Associates seem qualified to carry out a test study on this. From 1981 to 1984, DF Dickins Associates provided technical direction of Sohio Petroleum Company's hovercraft research. This involved the co-ordination of an international design team to develop the concept for a 1,000 ton ACV. Thus, the company have already completed a study on a large ACV.

As it stands there are three possibilities for Arctic transportation vehicles on this route. Firstly, there can be the operation of icebreaking cargo ships, such as the SA-15 series built by Wartsila for the Russians. Secondly, there can be the operation of a convoy of ice strengthened cargo carrier ships headed by a high powered icebreaker. Such an icebreaker could be based on the US Coast Guard's high powered icebreaker the 'Polar Star'.

The Polar Star was built by Lockhead shipbuilding and construction of Seattle. It possesses diesel and gas turbine engines which gives it operational flexibility and for navigation it has a glass enclosed heated conning station and 2 helicopters housed on the flight deck and hangar. On the other hand the leader of the convoy could be a nuclear icebreaker such as the Lenin, Arktika or Sibir. But then arrangements would have to be made as to who would provide the leading icebreaker and how it would be paid for. Arrangements would also have to be made about the time of departure for the voyage, as travelling within a convoy would not give the operators of the ships much flexibility.

The third alternative for Arctic transportation would be a large ACV platform to be attached to the bow of a conventional ship. The ship would use its propulsion power to push the ACV and the ACV would use its power to push the ice to the bottom of the sea, and satellite reconaissance ice information would provide the facts about which areas of strengthened ice to avoid.

Although such an ACV does not as yet exist, at least three leading specialists have agreed that it is feasible as a possibility in the future.

SATELLITE RECONAISSANCE SYSTEMS ON ICE INFORMATION

Ice information today is better than it ever was before. The Russians who have used the Northern Sea Route extensively have their own information system, operating with their own weather satellites, continuously sending out weather maps to ships. Such information was sent from the Soviet meteorological offices to the Soviet Icelandic Sea Ice expedition in 1982.

The Icelandic Meteorological Department keeps a close watch on ice movements within 600m radius of the country. Ice information is collected by reports from ships in the area, from satellite pictures, radars, and special ice watching flights run by coastguards. The information comes into the forcasting room where they draw up maps where the numbers indicate concentration of ice and the dots indicate icebergs. The maps are directly facsimiled to the ships themselves. Dr Jacobsson of the Sea Ice Research Divison in Iceland said that the pictures obtained in infrared can show what type of ice there is and can identify cracks in the ice sheet and the thickness of ice, too. Therefore it is possible to pinpoint track lines of weakness right around the polar ice cap.

Captain Borthwick, who is on the sea ice bench of the Meteorological Office in Bracknell which gives an ice edge around the area of Greenland and Spitsbergen, said that the photographs they received on the Northern areas were not satisfactory. He said the quality was bad because of the low sun and effect of cloud and most of the time the ice did not show up. However, he did mention that the German Meteorological office had produced good quality photographs on ice.

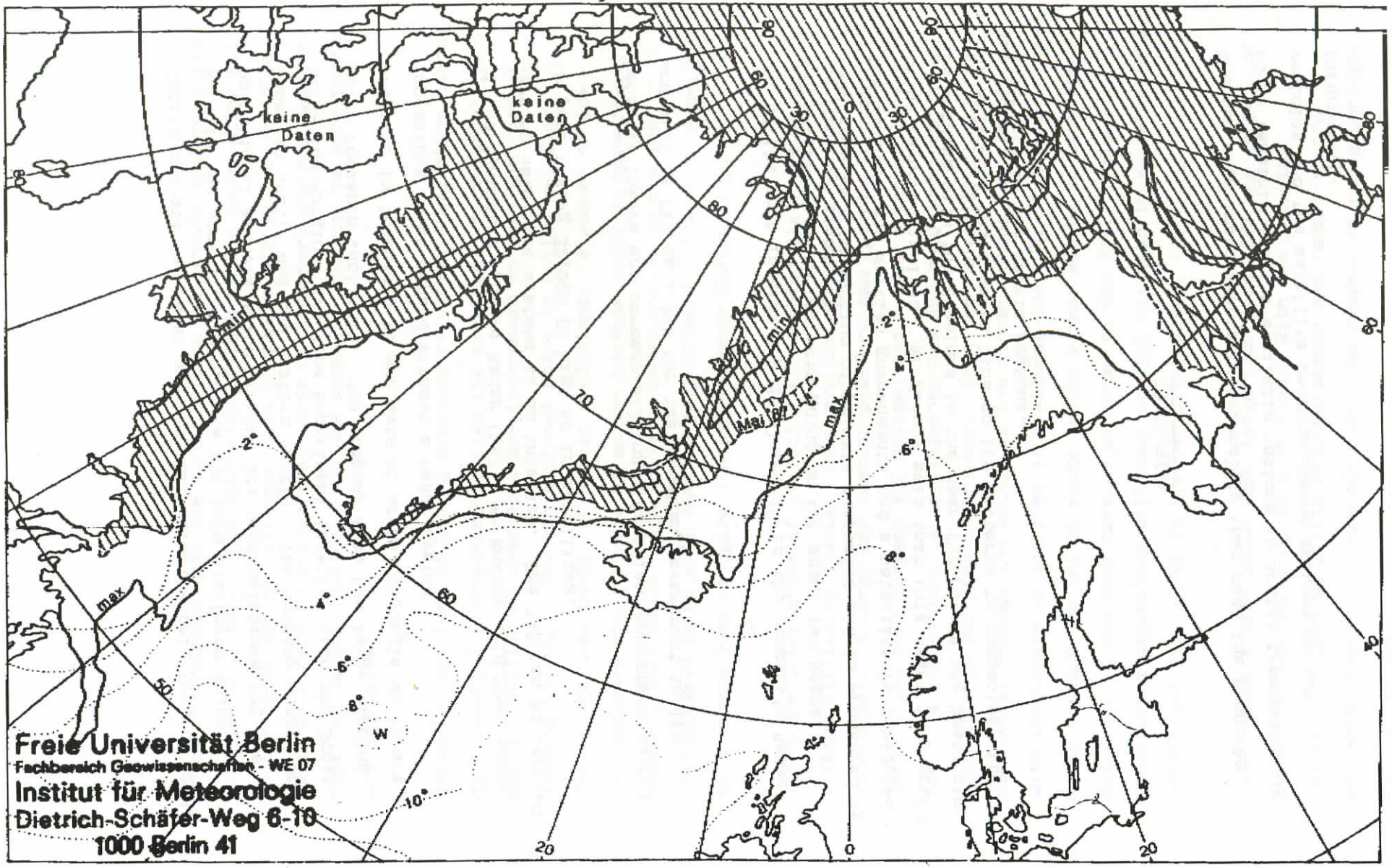
The German Meteorological Institute in Berlin have analysed circumpolar ice distribution between 0+90 degrees since 1966 from AVHRR data to give monthly mean distributions. The results are presented in maps. (Please see enclosed map of ice distribution for May 1987) I believe the AVHRR data used in this map operates with a microwave satellite system which records passive energy from the ground. This records the temperature of the ice. This is very useful in recording the ice edge.

At the Transportation Development Centre, Canada, Mr Audette who had worked with Intera Technologies of Calgary, provided information on their work regarding satellite reconnaissance. He told me of the Synthetic Apeture Radar system which gives very detailed imagery of ice with resolutions down to 8-10m and this shows where the ridges are where the ice is freshly frozen or whether it is multi year ice. The navigation information is plugged in a computer which has recorded a soft copy display of imagery.

Mr Greg McAvoy, an expert on the satellite systems of Intera Technologies Lmtd, talked about the company's work in general. Intera is a commercial operator specialised in ice reconnaissance. The optical photographs taken at radar gives out ice types. The company in the past has helped offshore drilling companies like Gulf Oil by giving coverage of areas around the drilling.

Intera have done mission flights around the Canadian Arctic and the North West Passage on the Eastern Arctic. The company carried out a number of research programmes with Can-Arctic shipping. These took the form of excursions in aircraft to reduce subsequent damage to the vessels.

Sample



Mai '87

Intera operate two radar systems which are the only type of their kind in the world. They operate air born platforms which are operational systems which provide ice reconnaissance for the Canadian Arctic and the Eastern Arctic. The company worked on MIZEX the Marginal Ice Zone Experiment together with the Scott Polar Research Institute. The company also has large mapping projects in Indonesia to map data of areas of jungle which are impossible to be mapped without a radar system.

Of the Synthetic Aperture Radar (SAR), Mr McAvoy said that there were no satellite systems to do this job. The SAR can be carried in jets flying 32,000 ft high or in satellites.

Recently Intera are commercialising a Canadian Government agency and will be flying a SAR for the Canadian government in the Arctic.

One of the most interesting developments is the company's Radar Sat programme which has been going on for about two years. Radar-Sat is a consortium of private companies and is sponsored by the Canadian and British governments and a satellite is scheduled to be launched in 1992. Mr McAvoy said that this meant they would be working with the Russians in the near future and the basic aim of Radar-Sat would be to licence ice patterns to companies with interests in the Arctic regions.

CONCLUSION

The two main improvements in technology that make the proposed route feasible are the available options in Arctic transportation vehicles and the satellite reconnaissance systems on ice information.

It can be touched upon the three options for Arctic transportation vehicles once more. The operation of icebreaking cargo ships such as the SA-15 series will mean that companies wishing to use this route will have to change their mode of transport and purchase new types of vessels suitable for the voyage. This may be undesirable and expensive.

Secondly, the idea of having a convoy of conventional ships headed by a powerful icebreaker has also its problems. First of all it may not suffice to have just one icebreaker to take the task of leading the way. The conventional ships to follow may find themselves unsuitable for Arctic conditions. A convoy of ice strengthened ships headed by an ice breaker would be more feasible however, this would again prove to be expensive as new ice strengthened ships will have to be purchased. Also the operation of a convoy does not give its participants flexibility.

The third alternative of operating air cushion platforms is not without difficulty itself. However, the advantages must not be overlooked. A large air cushion platform can operate in much thicker ice than current ACV designs can. When attached to the bow of a conventional ship, together the ACV-ship combination can form a cargo carrying icebreaker. When the conventional ship need not travel through the Arctic in the winter months, it can proceed with its voyage in ice free seas without the ACV. But when it has to go through the Arctic route in the summer months to save time and fuel, it can once more be attached to the ACV. Its own icebreaking capability will mean it will not need to travel with a convoy and this gives it further flexibility.

Paper studies have shown that large 1,000 ton ACVs are capable of overcoming obstacles up to 2.4m high. With the incoming information from satellite reconnaissance and radars on ice patterns, areas where the ACV cannot be capable of going through, can be avoided.

However, feasibility tests must be carried out to discover the operational qualities of this proposal. As mentioned earlier DF Dickins and Associates Lmtd have extensive experience in Arctic marine transportation and especially in the areas of route evaluation, conceptual design and testing for Arctic air cushion vehicles. A 1,000 ton ACV with Arctic capabilities will be a new venture, but one worth pursuing.

As for obtaining infallible accurate ice information the technologies of Intera could be merged with that of the meteorological institutes. In addition, it may be valuable to carry out a research programme on the overall ice situation throughout the route to aid the building of the Arctic transportation vehicle most suited for this purpose. Intera Technologies Lmtd are experienced in carrying out such research programmes and they fly their own mission flights equipped with SAR technology.

If accurate data is to be received before proceeding with the future of this route, it is essential that these tests be carried out. For this, investment is needed but without these tests and the data to be derived from them, it is impossible to receive an accurate feedback from the market on the commercial side of shipping. Companies will want to know the facts before venturing in a new route that they may have never tried before. To obtain these facts, somebody has to make the investment for these tests. At this stage, it is impossible to draw a comparison between the existing conventional trade routes and the proposed Arctic trade route. The necessary data to draw such a comparison is not available. Firstly, because feasibility tests have not been carried out, and secondly, because at this early stage, companies are not willing to give out information that can be used against their interests.

However, as a preliminary paper study this report concludes that with the mentioned technologies the operation of such a route is feasible in the future.

PROGRESS TOWARD A TRANSPOLAR SHIPPING ROUTE

by Frederick Seibold

Marine transportation in the Arctic has been of interest to the U.S. Government and industry for many years. This paper briefly describes the results from two successful field programs which were directed toward demonstrating the feasibility of arctic transportation. Based on this experience, it outlines one possible approach which we would consider in evaluating the commercial feasibility of a transpolar route.

First, the current status of U.S. arctic transportation will be discussed, including some of the U.S. research over the past few years. Second, based on what we've learned, some suggestions are offered as to how the commercial feasibility of a transpolar route might be assessed. And finally, a method that can be used to reduce technical and economic risk is presented.

U.S. National Policy and the Arctic

The national policy of the United States concerning the Arctic has historically focused on a number of key objectives. Among them are:

1. A commitment that support be provided for resource and energy development in arctic regions; and that this be done without damaging the environment. The Maritime Administration has been active in the development of safe and efficient marine transportation systems for ice covered regions. Both in the United States and Canada, there are government and citizen groups concerned with the effect of such operations on the environment; these issues are taken seriously.

2. There also are a number of U.S. government agencies interested in the promotion of scientific research for the purpose of increasing the body of knowledge on the arctic environment.

3. Thirdly our national policy calls for the maintenance of essential national security. Of course such issues include the arctic as well as other regions.

4. Finally, the U.S. has sought the advancement of mutually beneficial international cooperation. With regard to marine transportation, the U.S. has long had a cooperative relationship with the Canadian Ministry of Transport for arctic research.

Two U.S. Demonstration Programs

The U.S. Maritime Administration has the responsibility to promote the development of the U.S. merchant marine. As part of its charter, studies were initiated during the late 1960's and 1970's to examine the potential for commercial arctic marine transportation, particularly for moving oil that might be discovered in the Alaskan Arctic. These studies concluded that there was considerable risk associated with arctic transportation because U.S. commercial ship operators had very little operational experience in the ice-covered northern latitudes.

It appeared that the best method to reduce the risk was to demonstrate the feasibility of ship operations in ice covered waters. Two demonstration programs were carried out:

1. the voyages of the icebreaking tanker "MANHATTAN" through the northwest passage, and

2. the voyages of the U.S. Coast Guard POLAR Class icebreakers in the Alaskan waters.

Voyages of the USS Manhattan

The SS MANHATTAN program was financed by a group of U.S. oil companies; there was no government assistance involved. The purpose of the program was to evaluate the commercial feasibility of moving Prudhoe Bay crude oil to the U.S. east coast through the Northwest Passage. The decision that eventually had to be made was whether to move oil by ship or by pipeline. At the time the program cost $50 million. In today's dollars, that same program would cost over $250 million.

The SS MANHATTAN is a 1005 foot tanker with a displacement of 106,000 tons. She was fitted with a new icebreaking bow and made two trips to the arctic, one in 1969 and the other in 1970. Although the program was successful in demonstrating the technical and economic feasibility, the risk was considered to be too great and a decision was therefore made for these and other reasons by the petroleum industry to construct the pipeline. All data and reports from the SS MANHATTAN project are now archived with the U.S. Maritime Administration. They have been used in technical data exchange agreements with other countries.

The Arctic Marine Transportation Program

In 1979 the U.S. Maritime Administration initiated another program to examine the feasibility of year-round commercial marine transportation along Alaska's coastline. This program had three primary objectives:

1. First, to define the environmental conditions in the Bering, Chukchi, and Beaufort Seas. This had to be done at different times of the year and at different locations.

2. Second, to obtain data to improve design criteria for ice-worthy ships and offshore structures.

3. And third, to demonstrate that commercial ship operations were feasible along possible future arctic marine routes.

All three objectives would also have the effect of reducing the risk associated with arctic marine transportation.

This research was performed using the United States' two POLAR Class icebreakers. At the time the research program began, these ships had just been constructed. They are presently the world's most powerful non-nuclear icebreakers and the only U.S. ships capable mid-winter trips to the northern Chukchi and Beaufort Seas.

During the eight years of the program, a total of 13 POLAR Class icebreaker deployments occurred. Winter data collection occurred in the Bering Sea, and the Chukchi Sea. Summer data collection took place in Beaufort Sea just north of Alaska.

During the program, we successfully operated the POLAR Class icebreakers during the middle of winter in the Bering and Chukchi Seas and in the early winter in the Beaufort Sea.

Some of the program activities are described below:

A. Friction Tests

The POLAR Class icebreakers are equipped with a special low friction hull coating. One of the earlier technical projects was to demonstrate the benefits of the coating and to measure the coefficient of friction. The low friction hull coating does reduce the frequency that the ship became stuck in heavy ice, and reduces the horsepower required to break ice. Our research recommended that all ice-transiting ships have a low-friction coating applied to their hull.

B. Structural Loads Tests

One of the large unknowns that existed at the start of the program was the severity of ice loads on the hull. We decided to instrument the bow of the icebreaker with strain gages. Measurements were made during numerous trips in new first year and multiyear ice.

The lowest of the loads were measured in the relatively light ice of the South Bering Sea. Farther north, the loads were more

severe with the highest loads shown here in pink recorded during the winter in the North Chukchi Sea. This data was used by the American Bureau of Shipping in developing their new ice structural rules. Good agreement was shown between this data and the A.B.S. rules.

C. Profiling Ice Features

Ice conditions vary greatly along the marine routes in offshore Alaska as they do along the transpolar route. One of our project objectives was to profile these ice features to better understand the environment. Standard surveying techniques were used to profile the top surface of the ice.

Power augers were used to determine ice thickness and underside profile. With this method, we physically measured ice thickness; we would also drop a sonar unit through the holes to profile the underside of the surrounding ice.

We also determined thickness measurements electronically using an EM-31 sensor. The sensor was not very effective in irregular arctic ice; it was much more effective in the level ice of the Antarctic and was used most often there.

During 1985, we used a remotely operated vehicle to profile the underside of the ice and to measure ice thickness. Controlled from the icebreaker, this unmanned submarine moved under the ice in a regular pattern and used sonar to determine the distance between itself and the bottom surface of the ice. This method was very successful.

To properly evaluate ship performance in ice, it is necessary to know the strength as well as the thickness of the ice. This slide shows data being collected from an ice core from which the strength of sea ice can be determined.

Operational Achievements

Our achievements during the eight year program are shown in the next two slides. This one relates to the operational experience gained.

1. First, the POLAR Class icebreakers were the first U.S. ships able to make mid-winter transits in offshore Alaska.

2. In addition, we were able to demonstrate ship performance in a wide range of ice conditions. From this we were able to determine that commercial year-round transportation was feasible in the Bering Sea.

3. We also concluded that good ice navigation and ice piloting are critical to any future operations in ice covered waters. They are at least as important as any technical ship design considerations. The most capable icebreaking ship will have great difficulty moving through arctic ice without good ice pilots and good navigational support.

Technical Achievements

There were also a number of technical achievements:

1. We learned much about the environment and the ice conditions in the waters off the coast of Alaska and to some extent through the Northwest Passage.

2. The various engineering studies resulted in the development of new design criteria and standards for ship construction. The measurement of structural loads discussed above is one example.

3. The voyages themselves gave us an improved understanding of the importance of ice navigation and ice piloting and we were able to make recommendations for improvements in these areas.

Feasibility of a Transpolar Shipping Route

This section presents some thoughts concerning a transpolar shipping route. There are three key elements to be considered. The shipping system must be technically achievable. The economic return for choosing such a route must be attractive, and the risks associated with such a route must be acceptable.

The approach that we would suggest is one that we have been able to use effectively in our Arctic Marine Transportation Program. First of all, there are certain technical criteria which must be considered:

1. One must know the nature of the ice and its movement. That includes such things as ice thickness, drift, pressure, rafting, ridging and formation of rubble. All of these conditions vary by location and by month. We also know from experience that the growth of ice and the severity of ice conditions will differ from year to year. In the U.S., we have been collecting such data on each deployment from 1979 through 1976 and have a fairly good idea of how ice conditions vary in the Bering and the Chukchi Seas. We don't know to what extent such information is available along your suggested route, but the data is necessary in order to determine how late into the season a ship can operate.

2. When this paper was prepared, we did not know whether the intended transpolar shipping system would involve the independent operation of icebreaking cargo ships or whether an icebreaker escort was to be utilized. Among the U.S. oil companies, there is a difference of opinion on this question. Some companies, such as Exxon, believe a high powered tanker can operate independently. Other companies such as Arco, believe that a shipping system can best be operated with icebreaker escort. Making this decision requires careful study. Whichever way is chosen, several cautions should be remembered. We've experienced broken ice paths close up tightly directly behind the ship in heavily pressured ice. We would be fearful of designing any ship to operate in the Arctic without full icebreaking capability. At the same time, if someone is going to design a marine transportation system with several cargo ships depending upon a single escort icebreaker, the investors would most likely want some firm commitment that the escort icebreaker will indeed be available at all times. From a technical point of view, the icebreaker becomes a critical link in the system. If the icebreaker sustains a casualty, the entire system comes to a stop. Again, from a technical point of view, the capability probably exists today to properly design a ship to operate in Arctic ice-covered waters either independently or with escort.

3. Finally, when environmental data and the ship performance data have been obtained, the ship transit time must be determined. Since ice conditions vary considerable from month to month, and from location to location, there will also be significant differences in transit time from month to month.

There are also economic criteria to be considered:

1. First, there is an entirely different set of costs associated with seasonal operation versus year-round operation. A shipping system can probably be designed to operate as late into the season as desired, but there will be dramatic differences in cost.

2. Second, it will be desirable to compare the total costs of the alternate open-water route, and finally...

3. the availability of investment capital needs to be considered.

Even with technical and economic data, there is still the element of risk that needs to be addressed.

Conclusions

One of the principal reasons we began our Arctic Marine Transportation Program with demonstration and data collection programs on the U.S. Coast Guard POLAR Class icebreakers was to reduce the element of risk. We have found this method to be very successful.

We also believe that international cooperation in the demonstration program is very desirable. International cooperation is especially important wherever the proposed shipping route takes the operator into or near the territorial waters of another nation.

Eyjólfur Konráð Jónsson, MP,
Chairman of the Foreign Affairs
Committee.

WAR AND PEACE IN THE ARCTIC

Modern technology has made such enormous advances that most of the older generation, apart from those directly engaged in scientific work in these fields, really have little knowledge of what is going on any more. Voyages to the moon would have been unthinkable a few decades ago. Now they are already a thing of the past which people hardly care to mention any longer, let alone go in for.

Sailing through, under and even over ice, however, is an old enough idea for laymen such as us to understand and even feel ourselves qualified to discuss. For my part, I was immediately gripped by the ideas under discussion here, and agreed to take part in this conference. The moment I did so I was allocated the task of discussing war and peace in the northern regions of the globe.

There is no need to dwell upon the enormous military buildup which has taken place in the seas of the northern part of the world. The nations on the northern seas now fear an increase, rather than a decrease, in the pressure brought to bear upon them if tension is reduced in Central Europe. No one would attempt to cover up the fact, either, that one of the largest arsenals ever built up in the history of mankind is situated on the very ocean route which, it has been suggested, should be opened up.

This fact inevitably affects the subject under discussion here, and numerous questions arise -- military and political, economic and environmental. It is impossible to answer them in a few words -- nor in many words either. Such questions have to be raised rather than answered.

The first and most obvious fact is that the greater part of the planned sailing route would lie through the "Mare Sovetica," which the Kremlin could close immediately if any conflict took place. So what would the Soviet Union gain by opening itself towards

international cooperation, for example by significantly reducing its military activity in the area?

A clear result would be vast economic benefits which the Soviet Union now needs above all else. But are the Soviets prepared, on political and military grounds, to open their harbours and even overland communication routes to the south and west? They alone can answer this question -- and perhaps not even collectively, but only as individuals. But at least the issue has been raised.

As before, the two superpowers will continue to exert the strongest influence upon geopolitical and military developments, not least around the North Pole. However, a third economic giant is now awakening and will, along with Japan, undoubtedly involve itself in such issues.

After returning recently from a visit which Iceland's Parliamentary Committee for Foreign Affairs made to the European Community and European Parliament, I am now convinced that national boundaries in Western Europe will undoubtedly be abolished and independent cultures numbering 320 million people will merge into a single economic entity. An end will finally be put to centuries of bloody conflicts among these nations, and progress will be made on an unparalleled scale.

Naturally, the Soviet authorities are keeping a close watch upon this development -- or perhaps I should say near-revolution -- as shown by the contact already established between the EC and Comecon bloc. The Soviet Union cannot help realizing the need to take part in some form of economic competition if it is not to be left still further behind. But how?

It will have to consider this question for itself, and will hopefully arrive at the right conclusion. The Russians also ought to be aware that the longstanding threat to their national security,

which has so often been posed by disputes, power struggles and nationalism -- even chauvinism -- in Western Europe, no longer exists. It has been removed by the European Community.

World affairs have developed over the past decade-and-a-half at such an incredible pace that it is not surprising if people are still rather stunned. The most familiar example to the Icelanders is naturally in the sphere of the Law of the Sea, which is directly connected with what we are discussing here now. Between 1972 and 1976, Iceland's jurisdiction over the marine resources around the country was extended from 12 to 200 nautical miles.

An economic zone of this size had already become de facto international law, due to action taken by coastal states and the agreement reached at the Third UN Conference on the Law of the Sea. The latter has since been widely described as one of the most remarkable international conferences in history. It ended with an agreement upon jurisdiction over two-thirds of the Earth's surface, without any serious conflicts taking place or even any vote on the matter until its final day.

Iceland and Norway also reached two remarkable agreements in 1980 and 1981, regarding joint rights to resources and their exploitation in the 200-mile economic zone around Jan Mayen. The seabed rights of Iceland and the Faroe Islands (represented by Denmark) in the Hatton-Rockall area are now the subject of negotiations in which the UK will hopefully come to play a greater part than it has done so far.

Iceland, Norway and Denmark (on behalf of Greenland) have also decided to begin cooperating towards securing their seabed rights in the area west of Norway and east of Greenland and Iceland. Finally, Iceland has announced its claim to a 350-mile area of seabed jurisdiction along the Reykjanes Ridge.

No one would have dreamt of such a development a decade and a half ago. You might be amused to learn that when the debate on seabed rights beyond the 200-mile economic zone was at its height towards the end of the UN Conference, the Soviet and Icelandic delegations happened to meet several times. They agreed between themselves that, in the case of submarine ridges, seabed rights along the natural prolongation of a country's continental shelf could not exceed 350 miles. This clause was later adopted unopposed into the Draft Convention on the Law of the Sea, and is now international law.

The Soviet delegation bared its teeth rather fiercely at first, convinced that we had dreams of becoming a kind of superpower by wanting to extend our seabed rights southwards along the entire Atlantic Ocean. But when we put on our best blue-eyed, innocent expressions, said nothing could be further from the truth and asked how far they would allow us to go, we suddenly found ourselves on the best of terms.

Even though this is rather a light-hearted example, it does go to show what can happen when people talk things over. The Arctic passage will hardly become an international shipping route in the near future unless a comprehensive international agreement is reached, directly or indirectly connected with economic interests and national security.

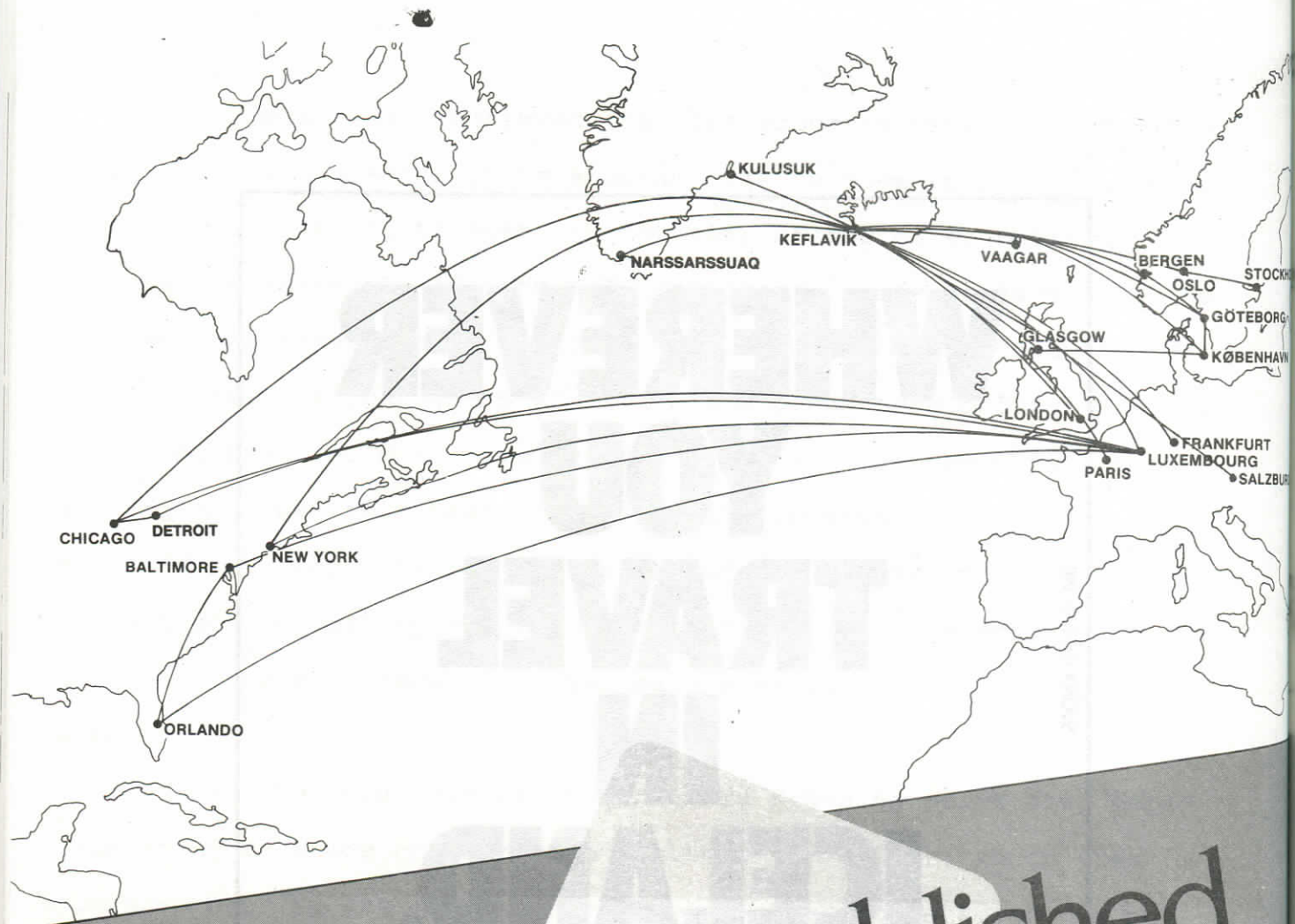
And in mentioning the UN Conference on the Law of the Sea, I would like to raise the idea that the question of the Arctic cargo route ought to be discussed at another conference, using the same procedures which proved so successful in that earlier instance. The number of participants could be much smaller, but would probably include most of the individual nations or groups of nations in the northern part of the globe who would be interested in taking part.

I have already mentioned the vast economic benefits which the Soviet Union would enjoy if this dream were to come true. Undoubtedly this would also apply to most, if not all, of the other nations concerned -- certainly all the NATO countries, while Iceland would be involved on a considerable scale as well, as you have already heard.

I believe that improved living standards throughout the world and a more favourable climate for education and culture offer us one way to guarantee world peace. Another path towards this goal is improved communications and extensive contact between nations. Of course there is nothing new about this. There would be nothing new, either, if the superpowers themselves opened talks on the Arctic route.

Even when the Cold War had reached freezing point they began cooperating on space programmes and missions -- which, so to speak, brings me back to the moon, where I began. This cooperation was no less sensitive from the point of view of security than the present discussion on the Arctic route, and helped contribute to detente.

I feel that the idea we have been discussing is an equally feasible way to establish greatly increased and more open economic relations. At least, I cannot see any immediate reason why it should encourage militarism more than the spirit of peace, if the Soviet people simply wish to improve their living standards through international cooperation to develop their resources in Siberia as rapidly as possible.



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ICELANDAIR

APPENDIX

Arctic Short Cut to Japan Could Mean New Cargo Role

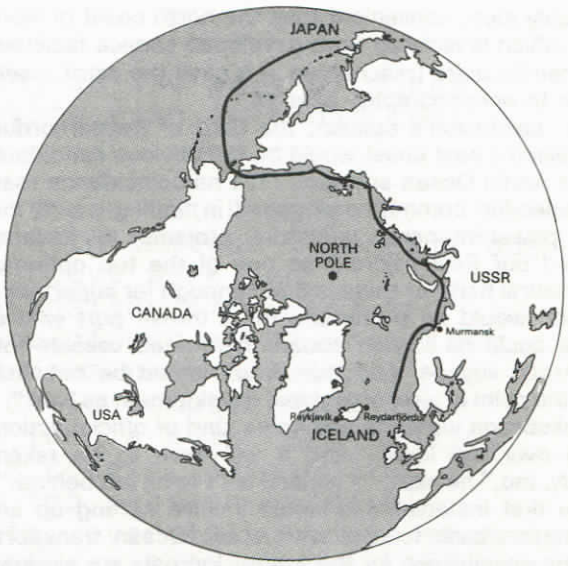
One of the many interesting ideas for future developments in Iceland which were raised on the BBC's popular *Tomorrow's World* science programme in September 1986 could put Iceland at the centre of another trade route than the familiar North Atlantic sea path. Technology, says meteorologist Thór Jakobsson, now makes it possible to bridge the Atlantic and Pacific across the once-impenetrable Arctic Ocean, offering Iceland the chance to become a major port of call on a new trade route which would more than halve sailing distances between the West and the East. If Iceland acts quickly to take up the challenge, Dr. Jakobsson claims, it could become "the Hong Kong of the North."

As head of the sea ice research division at Iceland's meteorological service, Dr. Jakobsson was invited in 1982 to join 80 Soviet scientists and crew members on an expedition along the east coast of Greenland on board an icebreaker. The report he later published attracted the interest of a West German colleague, who drew his attention to ideas put forward by Japanese scientists for making Iceland into "the Hong Kong of the North," an entrepot for vessels sailing along the north of Siberia to Japan.

Satellite-aided sea ice reconnaissance and advances in shipbuilding now mean that the "Arctic Ocean route" is open for three to four months a year, and some kind of systematic northern coastal shipping service has already been established in the Soviet Union. Substantial levels of freight — some six million tons annually — are already carried along the northern coast of the USSR, much of it timber from the traditional industry in the region, where oil exploration is now under way as well. The northern route between the Atlantic and the Pacific has already been crossed for the purposes of international trade, when Soviet icebreakers have fetched wheat and other goods by travelling from Leningrad around Scandinavia, across the Arctic Ocean to Vancouver and back. Not only does the predicted rise in world temperatures around the turn of the century offer even better chances of taking advantage of the Arctic route: Dr. Jakobsson expects that the present political climate should increase the likelihood of the Soviet Union opening up for greater trade and freight forwarding.

"What makes the Arctic cargo route particularly attractive is the much shorter distances involved, even though sailing speeds are slower," says Dr. Jakobsson. The route from London to Tokyo measures 12,400 nautical miles through the Panama Canal, 14,700 nm around the Cape of Good Hope and 11,100 nm via Suez. Across the Arctic Ocean, it is only 7,000 nautical miles. "Savings like this mean that the possibility is well worth considering seriously, despite the obstacles and practical difficulties that are entailed.

"The route can definitely be opened for part of the year," continues Dr. Jakobsson. "This has been proved by what the Soviet vessels have achieved. Icebreakers will not necessarily have to be used for the actual freighting, since reinforced cargo vessels could simply follow in the channels which are cleared. From a practical point of view, the scheme will stand or fall on business considerations — my primary interest is as a natural scientist, and I leave evaluating the commercial possibilities up to other people. But scientists have a contribution to make of course — technology can probably help us lengthen the season which the route can be kept open. Data from satellites now shows us channels through the polar ice-cap that shorten sailing distances even further, and can be used to measure changes in the ice concentration. A full-scale study really needs to be made, taking everything into consideration: marine conditions, the weather, the Arctic ecosystem and environmental factors, including pollution hazards and safeguards against them."



Reaching Japan "the short way" via the Arctic Ocean is well possible for 3-4 months of the year, says Dr. Thór Jakobsson.

Bringing Iceland into the Picture

"Tomorrow's World" with its Arctic sailings moved a step closer to becoming today's after Dr. Jakobsson appeared on British TV. He was contacted by an established Anglo-Dutch shipping firm which is studying the feasibility of the idea from a strictly business point of view. Another forum for the plan has been a Nordic Council of Ministers committee established to examine potential Arctic and sub-Arctic projects for the Nordic countries to undertake as a group; Thór Jakobsson is Iceland's representative. Naturally this raises the question why Iceland should champion the scheme, instead of the other Nordic countries on the Scandinavian mainland. And Dr. Jakobsson admits that the interests of the entire area, not just of Iceland, are involved in the plan. "Iceland's main advantage is that it is more central for a large North Atlantic freight forwarding harbour, and offers possibilities for opening the Arctic route to traffic from Northeast America. It is

probably more convenient than the north coast of Norway, which is isolated from developed service facilities and can be quite treacherous — it gave the word *maelström* to oceanography, after all."

In Dr. Jakobsson's opinion, the fjord of Reydarfjördur on Iceland's east coast would be the obvious candidate for an Arctic Ocean entrepot. "It's no coincidence that the selection committee engaged in finding a site for new power-intensive industrial projects in Iceland pointed out Reydarfjördur as one of the top options. The natural harbour there is deep enough for supertankers and would be a fine site for a transit port where goods could be loaded aboard reinforced vessels for the Arctic voyage. And then there would be benefits from the point of view of regional development as well."

Dr. Jakobsson wants to see some kind of official action taken over the idea. "And it will have to be taken quickly, too," he says, "if Iceland isn't to be left behind." In the first instance this would involve setting up an information bank to deal with Arctic Ocean transport and the possibilities for the future. Journals are already being regularly published on Arctic activities, some containing articles and columns on shipping in the area.

"The idea of crossing the Arctic to reach Japan struck me as a very way-out suggestion when it was first made," Dr. Jakobsson admits. "But when I looked into it more deeply it took on another aspect. There's nothing particularly new about these suggestions either, in fact they link up with Iceland in a rather curious way. We find the Canadian explorer Vilhjalmur Stefansson, who was of Icelandic descent, talking about submarine travel under the Arctic Ocean sea-ice cover as early as 1920. Today this has become a highly developed means of transport, admittedly only for military purposes so far. But I foresee massive submarine cargo becoming a reality within a couple of hundred years. After all, more unlikely things have been done. Many ideas only seem strange until they're actually put into practice."

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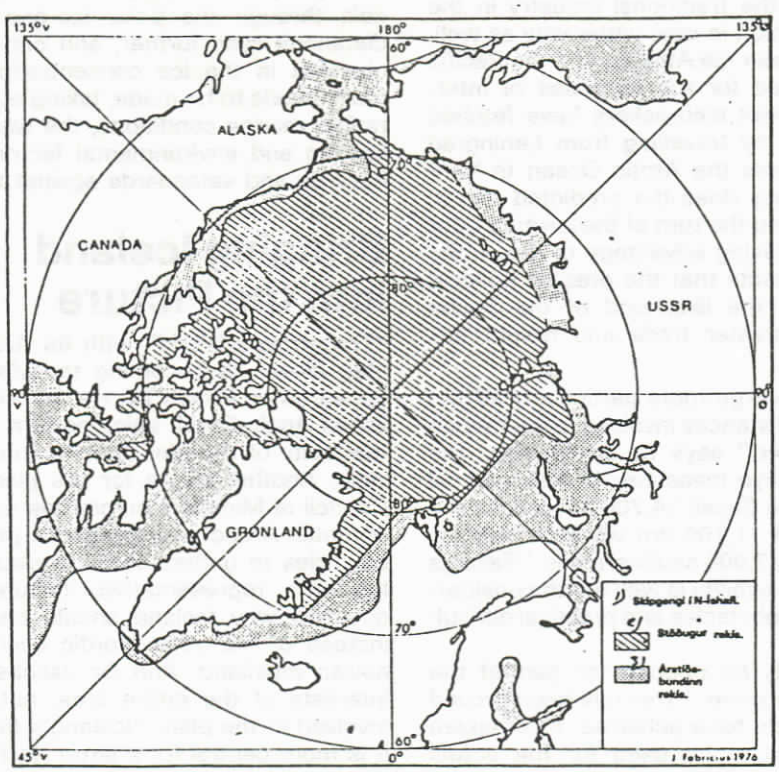

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murmansk october 1 tass - following is the part of mikhail gorbachyov's speech in murmansk, dealing with international affairs:

millions of people around the world are watching the restructuring process in our country with immense interest. our bold embarking on large-scale constructive work and revolutionary change demanding consolidation of all of the country's might is convincing evidence of our confidence that peace can be preserved, that mankind does have a future.

indeed, the international situation is complicated. the dangers to which we have no right to turn a blind eye remain. still, there has been some change. of course, judging the situation only from speeches made by top western leaders, including their +programme+ statements, everything would seem to be as it has been before: the same anti-soviet attacks, the same demands on us to show our commitment to peace by giving up our orders and principles, the same confrontational language: +totalitarianism,+ +communist expansion,+ and so on.

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a few days afterwards, however, these speeches are often ignored, and, in any case, theses other than those contained in them figure in business political negotiations and contacts. and this is a very interesting moment, an interesting phenomenon. this confirms the fact that we are dealing with yesterday's rhetoric, while real-life processes have been set into motion. this means that something is indeed changing. one of the elements of the change is that it is now hard to convince people that our foreign policy, the policy of the soviet union, our initiatives, our nuclear-free world programme are mere +propaganda.+

a new, democratic philosophy of international relations, of world politics is breaking through. the new mode of thinking with its humane, universal criteria and values is penetrating inside diverse strata. its strength is in being concordant with people's common sense.

considering that world public opinion, the peoples of the world are very concerned about the situation in the world, our policy is an invitation to dialogue, to a search, to a better world, to normalized international relations. this is why despite all attempts to besmirch and belittle our foreign policy initiatives, they are making their way in the world because they are consonant with the mood among the broad masses of working people and with the mood in realistic political circles in the west.

favourable trends are gaining in strength in inter-state relations as well. the substantive and frank east-west dialogue, far from being without result for both sides, has become a characteristic trait of contemporary world politics. quite recently the entire world welcomed the agreement reached at the talks in washington, to draft an accord on medium- and shorter-range missiles within the briefest possible time to be then signed at the highest level. thus, we are close to a major step in the field of real nuclear disarmament.

if it is made, it will be a first such step for the post-war years. as yet the arms race has proceeded either unimpeded or with some limitations, but no concrete move has as yet been made towards disarmament, towards eliminating nuclear weapons.

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the road towards the mutual soviet-american decision was hard. reykjavik was a pivotal event along that path. life has confirmed the correctness of our assessment of the meeting in the icelandic capital. contrary to panic wavering of all sorts, sceptical declarations and propaganda tooting about the +failure,+ developments have started moving in the direction blazed by reykjavik.

and they have borne out the correctness of the judgement we expressed, as you remember, just 40 minutes after the dramatic end to the meeting.

reykjavik indeed became a turning-point in world history, it showed a possibility of improving the international situation. a different situation has emerged and none could act after reykjavik as if nothing had happened. it was for us an event that confirmed the correctness of our course, the need for and constructiveness of new political thinking.

full use of the potential created in reykjavik is yet to be made. gleams have emerged, however, not only in the field of medium- and shorter-range missiles. movement has become apparent on the question of banning nuclear testing. full-scale talks on these problems will soon be started. it is obvious that our moratorium was not in vain. this was not an easy step for us either. it engendered and intensified worldwide demands for an end to the tests.

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i can't undertake to predict the course of events. far from everything depends on us. there is no doubt that the first results achieved in washington recently and the forthcoming meeting with the president of the united states may cause a kind of peaceful +chain reaction+ in the field of strategic offensive arms and non-launching of weapons into outer space as well as in many other issues which insistently ask to be put on the agenda of international dialogue.

so, there are signs of an improvement of the international situation but, i repeat, there are also disquieting aspects which are fraught with a sharp aggravation of the situation in the world.

it would be irresponsible on our part to underestimate the forces of resistance to changes. those are influential and very aggressive forces blinded by hatred for everything progressive. they exist in various quarters of the western world but the largest concentration of them is observed among those who directly cater for the military-industrial complex ideologically and politically and live on it.

here is a recent meaningful example. a series of hearings on the subject +the economic reforms of gorbachyov+ began at the joint economic committee of the u.s. congress on september 10, with senators and congressmen participating.

the hearings are both open and closed-door ones. speakers include representatives of the administration and analysts-sovietologists from the central intelligence agency, the u.s. department of defence and from various scientific centres.

this in general is quite normal and even good that in america officials at such level want to gain a thorough understanding of what takes place in the soviet union and what our reorganization means for the rest of the world and for the united states itself.

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various views are expressed, including diametrically opposite ones. there is a good deal of sensible and objective in them. some of them can be debated in earnest. there would be no harm in listening to some things in them. the committee members also heard an opinion that the united states +should welcome the reorganization+ because it would lead to a reduced risk of nuclear clash. all this is taking place at these hearings and discussions.

but different kind of recommendations are also being offered at these hearings to the administration and to the congress. here is one of such recommendations nearly word for word: if the soviet union attains the targets planned by the 27th congress of the cpsu, that would, first of all, enhance its prestige in the international arena, and heighten the cpsu's authority inside the country and abroad and -- thereby increase the threat to u.s. national security.

another recommendation runs as follows: success of the reorganization may weaken the political and economic unity of western europe, for the ussr would reach its market. the ussr's political influence in the developing countries would gain in scope, since soviet military and other aid to them may be increased, and some of them would want to adopt the model of the soviet economy if it proves competitive with regard to the u.s. economy.

and yet another recommendation: the reorganization is dangerous because it would strengthen the soviet union's positions in international financial and economic organizations.

those analysts perceive a particular threat in the soviet union's increased influence in the world arena connected with its initiatives in the field of arms control as well as with the prospect of signing a treaty on medium- and shorter-range missiles.

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just listen what conclusion is drawn as a result: a failure of the socio-economic policy being pursued by the soviet union under the leadership of the cpsu and the soviet government would accord with u.s. national interests.

in order to +facilitate+ such a failure it is recommended as follows: to speed up the programmes of costly abm systems under sdi and draw the ussr into the arms race in order to hinder its restructuring, to allocate still more funds for the development of expensive high-accuracy weapons and space-based military systems for the same purpose, to increase the amount of military and other aid to groups and regimes which actively fight against the governments of the countries supported by the soviet union, to counteract the establishment of economic and trade contacts by the ussr with other countries and international organizations, fully to rule out a possibility of transfer of advanced technology to the ussr and other socialist countries, and to toughen control over the activities of cocom and of its member-countries.

such are the views expressed overtly and cynically. we cannot but take into account such stance. they are also backed by forces, above all by the military-industrial complex. the more so as assurances of peaceableness which we often hear from u.s. officials are immediately accompanied, at one go, so to speak, with praise of +power politics+ and with arguments very similar to those being used by the authors of the recommendations which i just mentioned.

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militarist and anti-soviet forces are clearly concerned lest the interest among the people and political quarters of the west in what is happening in the soviet union today and the growing understanding of its foreign policy erase the artificially created +image of the enemy+ -- an image which they have been exploiting unabashedly for scores of years. well, it's their *business after all. but we shall firmly follow the road of* restructuring and new thinking.

comrades, speaking in murmansk, the capital of the soviet transpolar region, it is appropriate to have a look at the idea of cooperation between all people also from the standpoint of the situation in the northern part of this planet. in our opinion, there are several weighty reasons for that.

the arctic is not only the arctic ocean, but also the northern tips of three continents: europe, asia and america. it is the point where the euroasian, north american and asian-pacific regions meet, where the frontiers come close to one another and the interests of states, both belonging to the opposing military alliances and not parties to them, overlap.

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the north is also a problem of security of the soviet union, of its northern frontiers. in this respect we have some historical experience which cost us dearly. residents of murmansk remember well the years 1918-1919 and 1941-1945.

the wars fought during this century proved to be a grave trial for the countries of northern europe proper. and, it seems to us, they have drawn some serious conclusions for themselves. evidently this is the reason why the public climate in those countries is more receptive to the new political thinking.

it is significant that the historic conference on security and cooperataion in europe was held in one of the northern capitals -- helsinki. it is significant that another major step in the development of that process -- the first ever accord on confidence-building measures reached in principle -- was made in another northern capital -- stockholm. reykjavik has become a symbol of hope that nuclear weapons are not an eternal evil and that mankind is not doomed to live under that sword of damocles.

major initiatives in the sphere of international security and disarmament are linked with the names of famous political figures of northern europe. one is urho kekkonen. another is olof palme whose death at the hands of a vile assassin left soviet people shocked. one more is kalevi sorsa who has headed the consultative council of the socialist international for many years now. we hail the activities of the authoritative world commission on environment and development headed by prime minister gro harlem brundtland of norway.

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the soviet union duly appraises the fact that denmark and norway, while being members of nato, unilaterally refused to locate foreign military bases and deploy nuclear weapons on their territory in peacetime. this stance, if consistently adhered to, is important for lessening tensions in europe.

however, this is only part of the picture.

the community and interrelationship of the interests of our entire world can be felt better in the northern part of the earth, in the arctic perhaps than anywhere else. for the arctic and the northern atlantic are not only the 'weather kitchen', the point where cyclones and anticyclones are born to influence the climate in europe, the u.s. and canada, even in south asia and africa. at the same time one can feel here an ice-cold breath of the 'polar strategy' of the pentagon. an immense potential of nuclear destruction concentrated aboard submarines and surface ships affects the political climate of the entire world and can, in its turn, detonate from an accidental politico-military shock in any other region of the world.

the militarization of that part of the world is acquiring a threatening character. one cannot but feel concern over the fact that nato, in case of an agreement on medium- and shorter-range missiles, is getting ready to train for using sea- and air-based cruise missiles from the northern atlantic. this would mean an additional threat both to us and to all the countries of northern europe.

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a new radar, one of the elements of the +star wars+ programme, has been made operational in greenland in violation of the abm treaty. u.s. cruise missiles are tested in the north of canada. the canadian government itself has recently worked out a large programme of forces build up in the arctic. the united states' and nato's military activity in districts adjoining the soviet arctic areas is enhanced. the level of nato military presence in norway and denmark is built up.

therefore, staying in murmansk, on the threshold of the arctic and the north atlantic, i would like to invite, above all, countries of the region to the discussion of security questions long ripe here.

how do we visualize this? it is possible to take simultaneously the roads of bilateral and multilateral cooperation. i had an opportunity to speak on the subject of +our common european home+ more than once. the potential of contemporary civilization enables to make the arctic habitable to the benefit of interests of the national economy and other interests of humanity and near-arctic states, to the benefit of europe and the entire international community. and security problems that have accumulated in the area should above all be resolved for this purpose.

the soviet union is for a radical lowering of the level of military confrontation in the region. let the north of the globe, the arctic, become a zone of peace. let the north pole be a pole of peace. we suggest that all countries concerned should embark on talks on the limitation and scaling down of military activity in the north as a whole, in both the eastern and the western hemispheres.

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what, specifically, do we mean?

first. on a nuclear weapon-free zone in northern europe. if such a decision were adopted, the soviet union, as it has been already declared, would be prepared to act as a guarantor. it would depend on the participating countries as to how this guarantee should be formalized: by multilateral or bilateral agreements, governmental statements, or in some other way.

the soviet union simultaneously reaffirms its readiness to discuss with each of the countries concerned or a group of countries all the problems related to the creation of a nuclear-free zone, including possible measures applicable to the soviet territory. we could go sufficiently far, for instance, remove submarines equipped with ballistic missiles from the soviet baltic fleet.

as is known, the soviet union had earlier unilaterally dismantled launchers of medium-range missiles in the kola peninsula and the greater part of launchers of such missiles on the remaining territory of the leningrad and baltic military districts. a considerable number of shorter-range missiles was removed from those districts. the holding of military exercises was restricted in areas close to the borders of scandinavian countries. additional opportunities for military detente in the area will open up after the conclusion of the agreement on +global double zero+.

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second. we welcome the initiative of finland's president mauno koivisto about restricting naval activity in the seas washing northern europe. on its part, the soviet union proposes consultations between the warsaw treaty organisation and nato on the restriction of military activity and scaling down of the naval and airforce activities in the baltic, north, norwegian and greenland seas and the spread of confidence-building measures to these areas.

these measures could include arrangements on the limitation of rivalry in anti-submarine weapons, notification of large naval and airforce exercises, invitation of observers from all countries participating in the european process to large naval and airforce exercises.

this could be an inittep to the spread of confidence-building measures to the entire arctic, to northern areas in both hemispheres.

at the same time we propose to consider the question of banning naval activity in mutually agreed-upon zones of international straits and in intensive shipping lanes in general. a meeting of representatives of countries concerned could be held for this purpose, for instance, in leningrad.

the following thought suggests itself in connection with the idea of a nuclear-free zone. at present nordic countries, that is iceland, denmark, norway, sweden and finland have no nuclear weapons. we are aware of their concern over the fact that we have a testing range for nuclear explosions on novaya zemlya.

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we are thinking how to solve this problem, which is a difficult one for us because so much money has been invested in the testing range. but frankly speaking, the problem could be solved once and for all if the united states agreed to stop nuclear tests or, as a beginning, to reduce to the barest minimum their number and yield.

third. the soviet union attaches much importance to peaceful cooperation in developing the resources of the north, the arctic. here an exchange of experience and knowledge is extremely important. through joint efforts it could be possible to work out an overall concept of rationally developing northern areas. we propose, for instanceh agreement on the working out of a single energy programme for the north of europe. according to existing data, the reserves there of such energy carriers as oil and gas are truly boundless. but their extraction entails immense difficulties and the need to create unique technical installations capable of standing up to the polar elements. and it would be more reasonable to pool forces in this endeavour, this helping to cut both material and other outlays. we have an interest in drawing, for instance, canada and norway into the creation of mixed firms and enterprises for extracting oil and gas on the shelf of our northern seas. we are prepared for relevant talks with other states as well.

wwe are also prepared for joint work to utilise the resources of the kola peninsula, to carry out other major business projects in most diverse forms, including joint enterprises.

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fourth. the scientific study of the arctic is of immense importance for the whole of mankind. we have a wealth of experience here and are prepared to share it. in turn, we are interested in the studies conducted in other sub-arctic and northern countries. we already have a programme of scientific exchanges with canada.

we propose to hold in 1988 a conference of sub-arctic states to coordinate research in the arctic. the conference could study the question of setting up a joint arctic scientific council. should the partners agree, murmansk could serve as the venue for the conference.

questions connected with the interests of the indigenous population of the north, the study of its ethnic specificities and the development of cultural ties between northern peoples require special attention.

fifth. we attach special importance to the cooperation of nordic countries in environmental protection. the urgency of this is obvious. it would be worthwhile to apply the experience of joint measures to protect the marine environment of the baltic, now carried out by a commission of seven littoral states, to the entire oceanic and sea surface of our planet's north.

the soviet union proposes jointly to work out a single comprehensive plan of protecting the nature of the north. the north european countries could set an example to others by reaching agreement on the establishment of a system to monitor the state of the natural environment and radiation safety in the region. we must hasten to protect the nature of the tundra and forest tundra, of the northern forest areas.

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sixth. the shortest sea route from europe to the far east and the pacific ocean passes through the arctic. i think that depending on progress in the normalisation of international relations we could open the north sea route to foreign ships with us providing the services of ice-breakers.

such are our proposals. such is the concrete content of soviet foreign policy in the northern direction. such are our intentions and plans for the future. of course, safeguarding security and developing cooperation in the north is an international matter and depends by far not on us alone. we are ready to discuss any counter proposals and ideas. the main thing is to strive for the climate here to be determined by the warm gulfstream of the csce process and not by the polar chill of accumulated suspicions and prejudices.

what everybody can be absolutely certain about is the soviet union's profound and definite interest in preventing the north of the planet, its polar and sub-polar regions and all nordic countries from ever again becoming an arena of war and in forming there a genuine zone of peace and fruitful interaction.

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