U.S. Weather Bureau
Arctic activities, summer of 1946. Installation of Thule weather station

DECLASSIFIED - Mr. E. E. Goodale by phone 15 Jy 55

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National Oceanic and Atmospheric Administration

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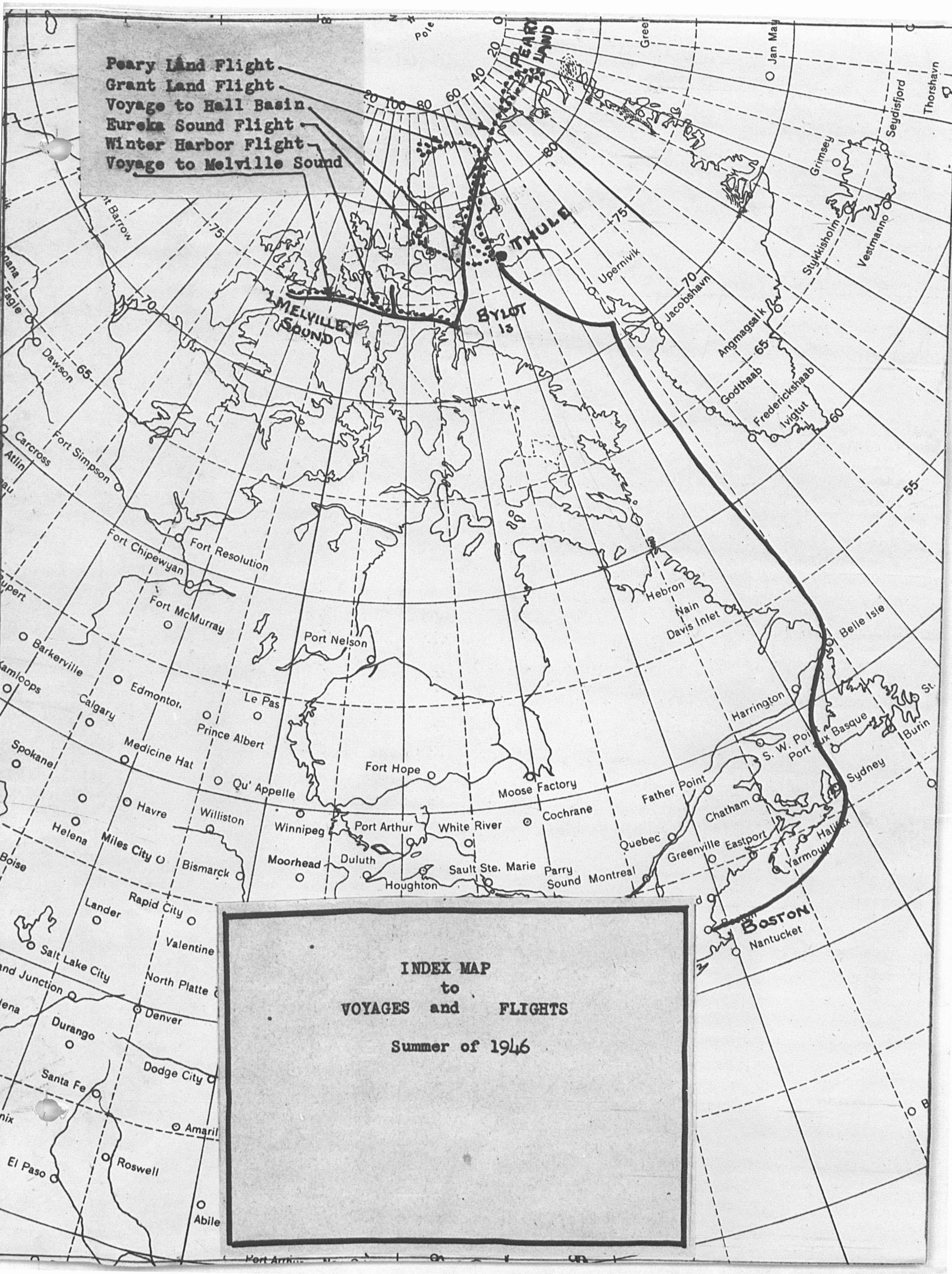
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FOREWORD

The following report by U.S. Weather Bureau observer covers operations during 1946 for the establishment of a weather station at Thule, Greenland, and for the investigation of general conditions in other parts of the Arctic.

During these operations transportation was provided by the U.S. Navy through the activities of Task Force 68 under Command of Captain R.H. Cruzen U.S.N. It should be emphasized that the very generous support provided by the Navy was principally responsible for the success of the Weather Bureau's 1946 program. Weather station supplies and personnel were handled by the Navy from Boston, Mass. to Thule, Greenland, and expeditiously discharged to the beach of destination. Navy personnel provided material assistance in the erection of weather station buildings and other structures. Gratifying consideration was given to all Weather Bureau requirements.

During the reconnaissance activities a maximum opportunity was afforded by the Commander of Task Force 68 for investigation of all areas and conditions related to future Weather Bureau plans, and which were within reach of facilities available. U.S. Navy support exceeded any strict interpretation of prior committments and thus permitted observations of great value.

The U.S. Coast Guard ice-breaker "Northwind", commanded by Captain R.M. Hoyle U.S.C.G. was attached to Task Force 68, and clearly demonstrated the remarkable ability of a vessel of this type in arctic waters.

Equal credit is due the U.S. Army, especially for the procurement and delivery of a large proportion of weather station supplies during the very brief period available between authorization of this project and the sailing date of Navy ships. Without the full cooperation of the Strategic Air Command, and the energy of Brig. General F.W. Smith, Chief of Staff, adequate supplies could not have been procured. Furthermore U.S. Army engineer personnel attached to the Navy Task Force 68 provided equipment and completed an emergency airstrip for the Weather Bureau at Thule under pressure of haste and limited facilities. This airstrip at Thule will be a major asset in the operation of the weather station, and the Air Force has already provided air transportation and inaugurated an air mail service.

The planning and establishment of radio facilities at Thule was accomplished through the cooperation of the U.S. Civil Aeronautics Administration with the loan of Mr. John Lewis, and by recruitment of CAA radio operators on transfer to the Weather Bureau.

The U.S. Department of State conducted successful negotiations with the Danish Government to permit the Weather Bureau to enter Greenland and to arrange for international cooperation in the management of the Thule station. Whereas the principal benefit from upper air investigation and weather research at Thule will accrue to the United States a gratifying response was returned to proposal of the U.S. Weather Bureau by the Danish Government. Eleven Danish personnel, a number equal to the American staff, were assigned to participate in the activities at Thule and suitable housing and supplies were provided. Danish shipping and other facilities represented a large contribution to the project. The establishment was visited during the summer by Mr. Knud Oldendow, Director of Greenland

Affairs of the Danish Government, who expressed the cordial policy of joint international participation under which the Thule station is built and will be operated.

Although the Canadian Government did not feel that it was wise to under take the establishment of stations in Canadian territory during 1946 nevertheless the generous allowance for Navy exercises in both ships and aircraft permitted U.S. Weather Bureau observers to examine various Canadian locations where stations may be contemplated in the future. The information gained is of great value to planning for the development of the arctic project. Canadian observers present during the 1946 activities were in every way cooperative, and supported a hope that satisfactory participative arrangements can be found to permit the extension of an arctic weather station network on Canadian territory in the future.

SUMMARY OF 1946 ACTIVITIES

As finally activated the 1946 arctic program of the U.S. Weather Bureau comprised two principal objectives. The first was to establish, in participation with Danish personnel, a weather observatory at Thule, Greenland. The second was to examine local conditions and transportation problems at other weather stations sites proposed for future establishments in Canadian territory.

The U.S. Navy provided surface and air transportation for the accomplishment of these objectives as part of its exercise "Nanook", under Task Force 68. Exercise Nanook provided two cargo vessels carrying supplies to Thule, and there was included among the facilities for survey an aircraft tender and three long range flying boats together with one ice-breaker and one ice strengthened survey ship.

The U.S. Navy landed all cargo on the beach head at Thule and likewise provided generous assistance in the construction of the Weather Bureau camp.

The U.S. Army assistance included aerial parachute delivery of certain short supplies, activities in the construction of an emergency airstrip for support of the Thule station, and the inauguration of an air mail service.

Thule Station

Cargo ships arrived at Thule on July 27th and remained until Sept. 9th. Good anchorage was found in North Star Bay just off the unloading beach.

Building site was selected in the valley on the south side of the bay which provided good exposure for meteorological observation, adequate space for both camp and airstrip, and separation from local habitation in the Danish village of Thule.

Supplies were discharged on the beach using LCM's and were deposited in primary storage near the shore. Supplies as needed were hauled by Athey wagon train to the camp site where five main buildings were constructed, together with rawin instrument shelter, storage huts, garage, radio antennaes etc.

Upon deparure from Thule the station had established radio communications with BW8, and was prepared to take the following meteorological observations daily:

6 hourly
3 hourly surface observations
2 pibals
2 rawinsondes

In addition to weather observation the station is prepared to made measurements of earth magnetism with apparatus provided by the Naval Ordnance Laboratory, conduct test of radio propagation, observe aurora and various special phenomena, and test equipment.

Station personnel consists of 11 American and 11 Danes, all civilian. The Danes did arrive on September 5th, bringing their own housing and supplies, but no meteorological instruments. The station is to be operated as a joint enterprise under the U.S. Official in Charge.

Supplies are adequate for at least a full year. An emergency airstrip was adequate for C-54 aircraft, and monthly air mail vists are scheduled.

Survey Flight From Thule

A flight was completed on July 25th to the north coast of Greenland, affording an opportunity for examination of Peary Land and Independence Fjord area. Ice conditions in the polar sea were examined.

On July 27th a flight was made to the Grant Land Coast of northwestern Ellesmere Island and photographic coverage is available. The flight indicated unfavorable conditions in this area for weather station establishment at this time.

A flight was accomplished in the Eureka Sound area which discovered favorable weather station sites, and suggested the desirability of changing the proposed location of the Thule satellite station from its original proposed location on Grant Land to this latter area. Open water was found in Eureka Sound.

Exploration By Ice-breaker

During late August and early September a successful voyage was made in the U.S.C.G.S. "Northwind" to Winter Harbor, Melville Island, and beyond to Cape Hay in the entrance to McClure Strait where further progress was blocked by very heavy pack ice. A course was followed without difficulty through Lancaster Sound, Barrow Strait and along the north side of Melville Sound.

It was found that in this year, in spite of discouraging ice conditions prevailing in mid-August, it would have been quite possible, and not unduly hazardous, to have taken a standard cargo vessel to Winter Harbor, Melville Island. This substantiates all previous experience of the accessibility of this location. Although it is not intended thereby to draw a conclusion that every season will be found similar it is believed to have been demonstrated that the establishment of a weather station at Winter Harbor by ship is a wholly reasonable objective.

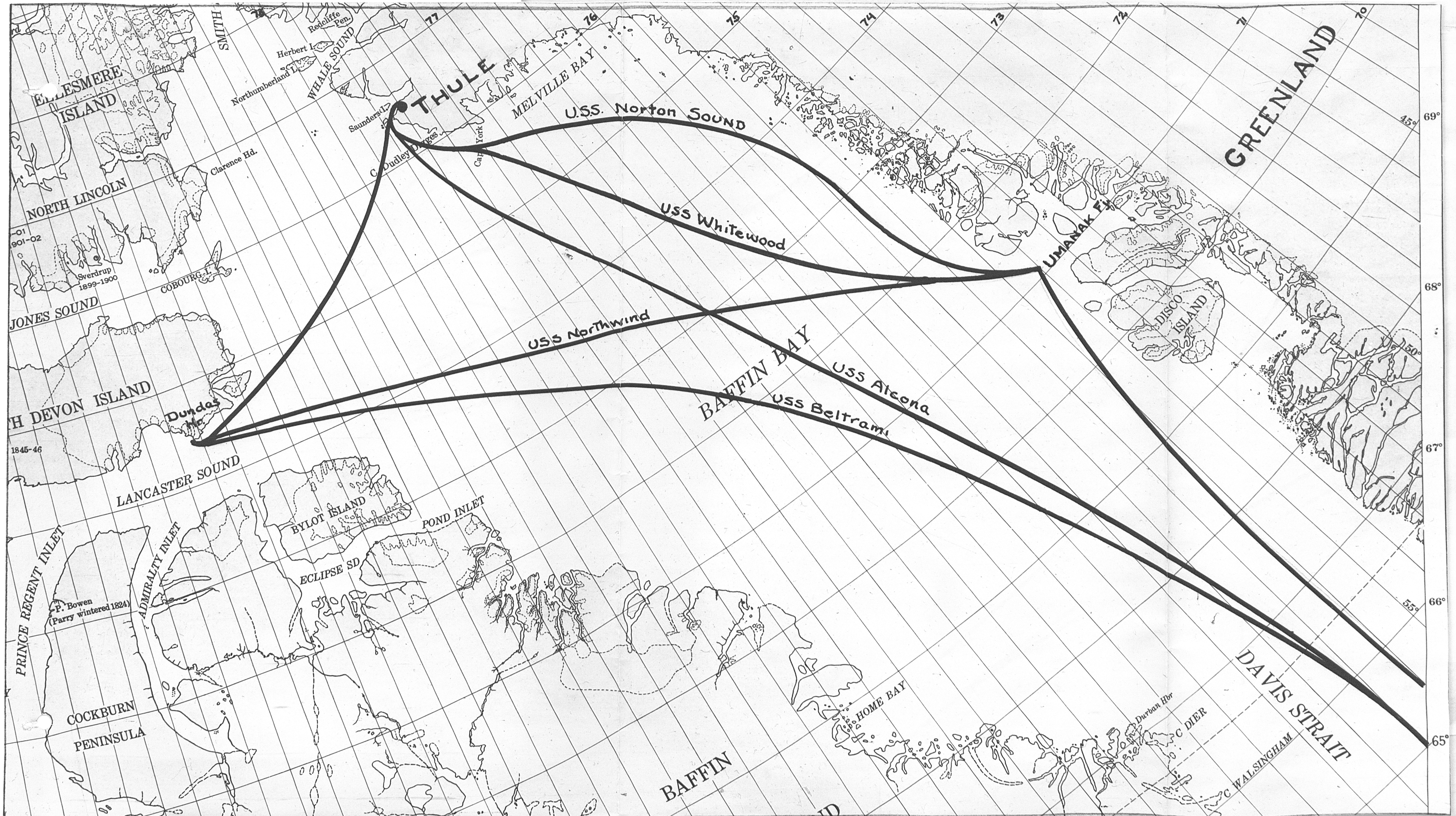
Also in confirmation of previous experience it was found that the waters of northern Melville Sound did not become navigable until the end of August. Date of freeze up was not observed but it is reported by Parry as September 20, in 1819. It is likely that the period during which a ship may safely remain at Winter Harbor approximates only 14 to 20 days.

Local conditions at Winter Harbor were found exceptionally favorable for establishment of a weather station and construction of emergency flight strip.

Observation of local conditions at previously contemplated advance base locations (Banks Island, Prince Patrick Island) could not be completed in this season, but a sufficient knowledge of typical arctic condtions was obtained to justify the presumption of satisfactory weather station sites.

During return voyage Wellington Channel was penetrated north to Pioneer Bay. No significant features were discovered except observation of continuing open ice conditions northward into Queens Channel, suggesting the possible use of this route for access to the open waters found in Eureka Sound.

Clear demonstration was provided of the ability of ice-breakers of the "Wind" class to navigate in summer ice in the arctic, except that progress cannot be maintained in close heavy polar pack. In addition to voyages outlined above the "Northwind" was taken to latitude 81° 50'N through Kennedy Channel and Hall Basin. The possibility of access by surface ship for cargo deliveries to these high latitudes was investigated.


THULE
GREENLAND
U.S.S. Norton Sound
USS Whitewood
USS Northwind
USS Alcona
USS Beltrami
UMANAK Fj.
Dundas Hr.
BAFFIN BAY
DAVIS STRAIT
DISCO ISLAND
MELVILLE BAY
WHALE SOUND
SMITH
Redcliffe Pen.
Herbert I.
Northumberland I.
Saunders I.
C. Dudley Digges
Cape York
Clarence Hd.
ELLESMERE ISLAND
NORTH LINCOLN
Sverdrup 1899-1900
1901-02
COBOURG I.
JONES SOUND
TH DEVON ISLAND
1845-46
LANCASTER SOUND
BYLOT ISLAND
POND INLET
ECLIPSE SD
PRINCE REGENT INLET
ADMIRALTY INLET
P. Bowen (Parry wintered 1824)
COCKBURN PENINSULA
BAFFIN
HOME BAY
Durban Hbr
C DIER
C WALSINGHAM
77
76
75
74
73
72
71
70
69°
68°
67°
66°
65°
45°
50°
55°

GREENLAND PHASE

Intinerary

July 14 – Left Washington, D.C. – Naval Air Transport
July 19 – Left Goose Bay, Laborador – TCF 68 – PBM
Rendezvous with USS Norton Sound–Umunak Fj–Greenland
July 20 – Transferred to USS Whitewood
July 22 – Arrived Thule, Greenland
Lay in Thule until August 5th
July 25 – Flight into Peary Land
Aug. 5 – Departed Thule for Canadian Phase
Aug. 15-18 – Returned Thule to meet official Danish party.
Sept. 9 – Returned Thule and left immediately for United States

THULE STATION

Navigation to Thule

In the 1946 season there was very little pack ice anywhere in Baffin Bay. The USS Whitewood followed a course about 50 to 100 miles off shore across Melville Bay and saw no pack ice at all. The Norton Sound, and later the Sigrid were closer inshore and reported light ice accumulations near the land, probably common by reason of current eddies and local glaciation. The Alcona, coming up the east center of Baffin Bay encountered only one small string of ice in the middle of the bay.

There seems to be little doubt from earlier records that considerable ice is present occasionally in northern Baffin Bay in summer and especially in a loose pack west and south of Cape York. However, it is believed that ordinary cargo vessels without escort can reach Thule annually after the 15th of July, although they may be required to avoid packs, and to search for open passage. It is unlikely that they would be subject to dangerous ice action if skillfully handled.

Station Site

North Star Bay is formed by a hooked sand spit terminated by Mt. Dundus. It appears to form a backwash in the current pattern (or for some reason) so that very little ice invades the harbor proper even when westerly winds drive considerable accumulations into Wolstenholme Sound. There is good anchorage in 15-25 fathoms.

Thule Village is on the sand spit. It is a favorable location because of protecting hills to the east and south from which direction the prevailing winds blow off the ice cap. The disadvantages of the Thule sand spit for purposes of our weather station were (1) that it was considered desirable to be further moved from the local people. (2) that no fresh water was readily available (3) that the area was not satisfactory for an airstrip.

To the southeast the harbor is a flat valley some two miles wide and reaching back nine miles to the ice cap. The surface consists of glacial drift and alluvial plains of sand and gravel. In this valley are several nearly flat stretches of alluvial beds, satisfactory for airstrip construction. Two rivers, ponds, and streams, afford adequate fresh water. The valley is separated from Thule village by a large hill with cliffs to the water. At extreme low tide it is possible to follow a narrow beach at the base of the cliffs, a walk of 1 1/2 mile to the village. Otherwise contact is usually by water (or ice), or over the hill.

There is an excellent landing beach of clear sand with sufficient water for access by LCM at all tides. The single disadvantage of the valley is the general exposure to prevailing winds from the ice. Extensive examination was made for a camp site with some measure of protection. A site was selected in the lee of a low hill in the center of the valley. This site offers excellent opportunity for meteorological observations and for radio antennae lay out, although the protection afforded is not as much as might be desired. There are three benches on which are level building sites. The surface is peat moss which, by comparison with the bare sand-grvel of the open flats, indicates enough protection to accumulate silt and to permit growth. When cutting into this material the frost line is found at 12" depth. The site is 1/2 mile from the landing beach over flat terrain easily crossed by tractors and even wheeled vehicles. Seclection of this site was confirmed by Goodale after his arrival. One operations building (Quonset Hut) was staked out near the top of the hill where an uninterrupted horizon could be obtained for weather observations and rawinsonde, and close to a favorable flat for radio antennaes. The remaining buildings are lower and more protected.

A nearby stream affords water. There is adequate space for several more buildings and for storage. It is 1/2 mile across flat land to the site selected for the airstrip.

Conditions are favorable for directional radio. The direction of Fairbanks (and Melville Island) faces out across the bay, and that of BW8 is back through the broad opening of the valley.

Miscellaneous supplies, and especially the fuel will probably remain in storage on the flat just above the beach, to be brought to the camp as required.

Unloading

A beach about 100 yards long was available having sufficient water to permit the approach of LCM's (draft approximately 5') except for minor difficulty at dead low tide. A few isolated boulders were removed. The beach surface was clean sand and hard enough to carry the tractors.

A bank of sand and gravel rises some 10-15 feet immediately behind the beach. A spot was used where a small stream cut down through the bank and presented a gradual shoulder for hauling up onto the flat plains behind the bank where unlimited space for storage was available.

Two methods were used for the removal of general cargo from the LCM's. For the most part large cases, or pallets, or clusters of oil drums were hoisted out of the lighters by crane and loaded onto Athey wagons. One four wagon train could handle one LCM full of drums (average 64). The second method was to load sleds placed in the bottom of a lighter, and to haul the sleds over the LCM ramp directly onto the beach by tractor.

For future reference it should be noted that the sled method is much faster than using a crane. It is extremely important to provide sleds properly suited to the work.

It is probable that a sled can be designed to carry a half load of an LCM, or 5 to 10 tons. (Navy sleds as provided fitted two to a lighter in tandem), and still be hauled by a single D7 tractor. Certain features of the available sleds could have been improved, such as provision for towing point at bottom level of the runners to lift the front, omission of full steel shield across the front, possible use of two runners instead of three, and provision of stake body sides. The sleds themselves could have been lighter. A combination of these factors would undoubtedly have increased the efficiency of the sled operation. It is believed that a wide steel shoe under the runner, instead of wood, would improve sliding and the timbers of the stringers could be narrower (12" x 12" stringers used). An improved sled should give reasonable efficiency for hauling 5 tons per load at least. It is important to provide some method for hauling back into the LCM, probably with a snatch block at the rear of the lighter and a back hauling wire. It would be even better if a drum could be rigged in the lighter engine room.

The desirability of the use of larger tractors is a question of economy. The D7 is adequate for general hauling.

Every effort should be made to use the sled technique not only because it avoids the serious breakage that results from a second lift operation by mobile crane, but because it is faster as well.

On the Thule operation it developed that the tractors became a bottle neck. With four lighters working from the ships both tractors were required on the beach (the third tractor was considered engineer property for the airstrip) one of which was used on the Athey wagon train, and the other hauling sleds. But since the camp site was an additional 1/2 mile beyond the beach all building materials had to be reloaded for a second haul. Furthermore no tractors were available for work at the camp while cargo unloading was in process. This situation was met by working the beach and ships only during a day shift, and using a night shift for camp construction when the tractors were available.

This bottle neck would not have applied if the camp site had been closer and materials hauled directly from lighter to building area, which will be the case at Winter Harbor.

Operations, general

Adequate time was available and all conditions most favorable at Thule so that there was no need for great pressure on the cargo handling or camp construction. It was most interesting, however, to estimate the progress of the same operation if it had been conducted under the conditions anticipated at Melville Island.

It is estimated that the cargo could have been discharged from one fully loaded ship with two lighters in less than two weeks, working two long shifts-day and night. The camp would necessarily have to be within reasonable reach of a continuous haul from the beach head. If two weeks were the whole time available then camp construction would necessarily have to go on simultaneously with the cargo handling. Personnel approximately as follows would be required.

Ships discharge	10
Lighter crews	4
Beach	6
Tractor crews	4
Beach head & storage	6
Building construction	6
Radio construction	6
	42 men, 1 shift - 84 total, 2 shifts

By the use of 1 1/2 complements of suitable sleds per lighter, and two tractors, this operation could be brought to a satisfactory point in two weeks. The crane and Athey wagons could be omitted if the sleds were sufficiently reliable, and if a camp site were accepted close to the discharge beach.

If the camp were moved back from the beach more than approximately 1500 yds then the Athey wagons, crane, and an additional tractor would be required.

The above estimates do not take into account the problems of building an airstrip simultaneously.

It should be noted as of first importancethat for a coordinated operation it is necessary to have some single superintendent on the job. At Thule there was willing cooperation but divided control on the ships, beach, camp, and airstrip. Each group wanted things a little different with resultant inefficiency which could have been very serious, if rapid accomplishment had been vital.

Camp

In general it should be realized that the Thule station developed a good many short comings over what might be considered ideal, and for four principal reasons, (a) that it was so hastily assembled (b) that the shortage of goods was acute during procurement (c) that larger quantities of military materials were used because of availability, economy, and Army interest (d) that the construction effort was not well organized and the workers inexperienced.

The most serious effect of the time stortage was that 90% of all the supplies arrived for shipment in Boston within 48 hours of the dead line date. Many packages were improperly marked or not marked at all. In the resultant confusion it was impossible to check accurately the supplies received against the list ordered, except for large critical items. Nor could much be done anyway if supplies were missing since time was not available for tracing and expediting. It was necessary to take what was available and hope for the best. Several shortages developed later including all rockwool, window glass, stove jacks and a number of lesser items, which will affect the comfort of the camp [illegible] but do not jeopardize its security. Substitutions were devised on the field to meet urgent necessity, and critical items will be supplied by airmail.

The shortage of goods in the United States at the time of procurement for this project necessitated heavy reliance on military sources of supplies. The shortage of both time and materials necessitated acceptance of available military housing. Both the Navy 'Quonset Huts' and the Army 'Precut' barracks were provided although neither is well suited to Arctic housing. The Quonset huts will frost, and sweat. The barracks require extensive modification on a frame which is basically poor originally. In both types the floors are weak and the windows crude. It is recommended that plans be made to replace these buildings as living quarters at the earliest opportunity, and to convert them for storage.

Military supplies, other than consumable stores, are not well adapted to small installations since military requirements are almost invariably large. This was especially obvious with reference to the kitchen equipment for the Thule station where, for instance, the kitchen sink provided could not be used because not enough water can be obtained in winter to fill it. The same difficulties of over size apply to the bread racks, mixers, some of the cooking utensil, etc.

A view from the top of a small hill beside the rawin shelter looking across the "operation" quonset hut and one of the barracks to North Star Bay and Mount Dundus.

Looking along road from the storage dump to the camp site. Buildings were placed on natural terraces in the shelter of a small hill which will break the sweep of the wind from the ice cap which over-hangs this whole valley nine miles to the south.

Across the valley from the camp site to the emergency flight strip. Tractors can be seen working on the strip just behind the storage area of aviation gasoline.

It should be possible to maintain this emergency strip in satisfactory condition without additional surfacing. Runway is 4,000 feet long and 150 feet wide. Lengthening of the runway involves cutting down some of the small ridge visible at the distant end.

Radio

During the Greenland phase there was experienced an example of radio blackout. This came on July 29th and persisted steadily for three days, and interruptedly for a week. During this period no HF could be transmitted or received. The only reception was occasionally from the very low frequency, high powered stations at Washington and San Francisco.

The Danish radio, OZZ (HF on 100 watts) was out, even with Egedesminde at 500 miles.

It is probable that these blackouts will put our station off the air occasionally in spite of 3 KW low frequency.

The radio layout at Thule is as good as can be expected. A counterpoise ground system has been laid and the steel towers put up to 78 ft. Prospects in the direction of BW8 and Fairbanks are wide open. All the necessary equipment seems to be on hand for both the high and low frequency channel.

The station went on the air on Sept. 8, 1946.

A detailed report on Communication by Mr. John Lewis, CAA radio engineer assigned to Weather Bureau for this program is made a part of this paper. It is not intended to duplicate herewith, except to note that Mr. Lewis agrees with the undersigned in finding a tendency toward excess in planning of the radio equipment. This excess is excused by the argument that spare equipment is an assurance of continuous operations and that the communications are vital to the success of an Arctic operation. Nevertheless, more radio equipment was delivered at Thule than is required in the immediate future. It is believed that considerable economies can be effected on any future operations of this nature.

Personnel

All the Weather Bureau personnel seemed to be in good physical and mental condition.

Mr. Goodale displayed reassuring experience with Arctic camp construction and also a diplomatic manner in his contacts with the Danes. Mr. Chappell assumed his position of second in command with vigor and assurance. Mr. Stoen, who is expected to assume charge of any advanced station set out from Thule next spring proved exceptionally capable and well adapted to activities of this nature.

As noted above Mr. Goodale was authorized to reduce the Weather Bureau staff to parity with the Danes i.e. to eleven. The disposition of personnel is therefore as follows:

1946 Thule Staff -

Official in Charge	Edward E. Goodale
Meteorologist	William B. Chappell
Advance Station Official	Per Stoen
Observer	Earl A. Johnson
Radio Operator	John M. Ciganek

Radio Technician	Eldon S. Moberg
Cook	Tom H. Sheret
General (Cook)	Michael J. Bregenzer
" (Diesel Operator)	Alfred N. Wallace
" (Carpenter)	Charles J. Clifton
" (Mechanic)	Donald E. Wiggen

Returned to United States

Radio Operator	Edmund Becker
Observer	Leo V. Corbett
Observer	William D. Beal Jr.
Mechanic	Raymond R. Roszek

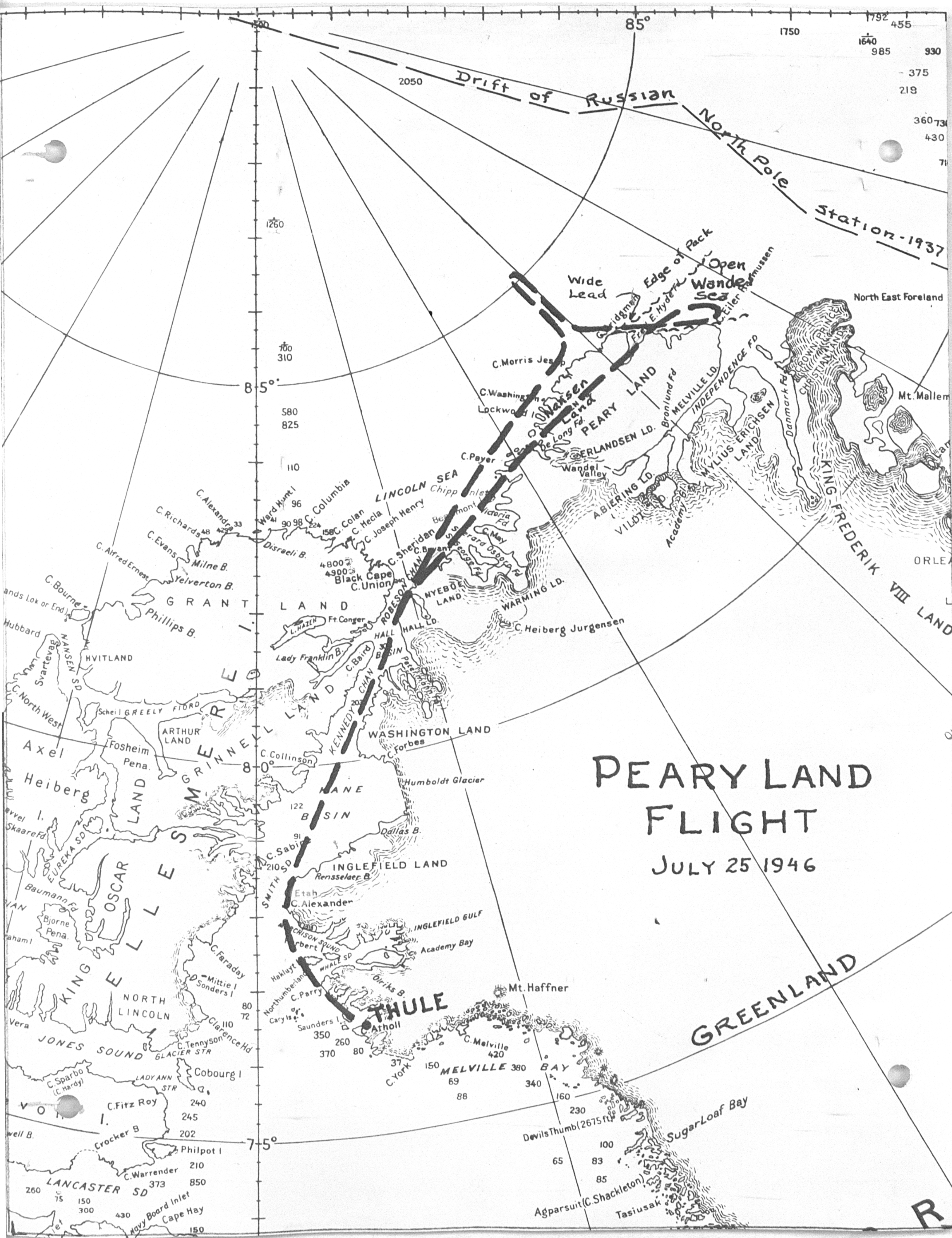
As of this date it is too early to comment on the characteristics of individuals.

Airstrip
The airstrip site was selected for maxium level and least required grading. It's headings are approximately 74° - 154° which is somewhat across the prevailing winds. According to analysis of 12 months records at Thule (plus local advice and natural signs) the prevailing wind is approximately 120° - 200°. Also the location is a little close to the southern cliffs which may cause some uncomfortable turbulence. However, the grades were excellent and a better location would be hard to find. A strip 4000' was staked out, with the possibility of extension to 5000' with additional grading.

Test holes on the strip showed a sandy gravel for approximately 12 inches and glacial silt beneath. Frost was found at 36'.

The area was rooted up and filled over with new materials from the shoulders. This was compacted by tractors. In spite of some early doubts it was demonstrated that the surface thus formed was hard enough to carry a C-54 airplane of approximately 60,000 lbs. It is probable that the surface will freeze perfectly hard for winter operations. A sample of soil taken on ship board and frozen gave satisfactory hardness.

It should be noted, in spite of the construction of the emergency land airstrip, that the original Weather Bureau plan of flight operations on harbor ice is fully substantiated by local descriptions of the ice surface. There seems to be no doubt that at Thule the ice will be smooth and strong, and the presumption that this will be so in other Arctic harbors is well reinforced. The problem of snow removal is minor, although it should be observed that the grader as supplied at Thule for snow removal was enormously large compared to its job, weighing 32,000 lbs. Some lighter equipment should be found and experiments made on ice runways at Thule this winter for practice on advance station techniques.


PEARY LAND
FLIGHT
JULY 25 1946
Drift of Russian North Pole Station-1937
85°
80°
75°
Wide Lead
Edge of Pack
Open
Wande Sea
North East Foreland
C. Morris Jesup
C. Washington
Lockwood I.
Nansen Land
PEARY LAND
De Long Fd.
ERLANDSEN LD.
Bronlund Fd
MELVILLE LD.
INDEPENDENCE FD
Danmark Fd
CHRISTIAN LAND
Mt. Mallem
KING FREDERIK VIII LAND
Wandel Valley
MYLIUS-ERICHSEN LAND
A. BIERING LD.
VILDT LD
Academy Fd
C. Payer
LINCOLN SEA
Chipp Inlet
Victoria Fd
C. Bryant
C. May
C. Columbia
C. Alexandra
Ward Hunt I
C. Richards
C. Colan
C. Hecla
C. Joseph Henry
Disraeli B.
C. Evans
Milne B.
C. Alfred Ernest
Yelverton B.
C. Sheridan
Black Cape
C. Union
ROBESON CHAN
NYEBOE LAND
WARMING LD.
C. Bourne
GRANT LAND
Phillips B.
L. HAZEN
Ft. Conger
HALL LD.
HALL BASIN
C. Heiberg Jurgensen
Lady Franklin B.
C. Baird
Hubbard
HVITLAND
NANSEN SD
Svartevag
C. North West
GREELY FIORD
ARTHUR LAND
GRINNELL LAND
KENNEDY CHAN
WASHINGTON LAND
C. Forbes
Axel Heiberg I.
Fosheim Pena.
C. Collinson
Humboldt Glacier
ELLESMERE I.
KANE BASIN
EUREKA SD
Skaare Fd
OSCAR LAND
C. Sabine
Dallas B.
SMITH SD
INGLEFIELD LAND
Rensselaer B
Baumann Fd
Etah
C. Alexander
Bjorne Pena.
INGLEFIELD GULF
Academy Bay
KING
C. Faraday
Mittie I
Sonders I
WHALE SD
Hakluyt
Northumberland
C. Parry
Olriks B.
Mt. Haffner
NORTH LINCOLN
Clarence Hd
THULE
Atholl
Saunders I.
Carey Is
C. Tennyson
JONES SOUND
GLACIER STR
C. Melville
C. York
MELVILLE BAY
GREENLAND
C. Sparbo (C. Hardy)
LADY ANN STR
Cobourg I
C. Fitz Roy
Crocker B
Philpot I
Devils Thumb (2675 ft)
Sugar Loaf Bay
C. Warrender
LANCASTER SD
Navy Board Inlet
Cape Hay
Agparsuit (C. Shackleton)
Tasiusak
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PEARY LAND FLIGHT

North Greenland (Peary Land)

On July 25, 1946 a flight was made from Thule by Navy seaplane (PBM) carrying besides the crew (Lt. Commander Branowski, pilot) the following observers, Captain R.H. Cruzen U.S.N., Comdr. C.M.Campbell U.S.N., Charles J. Hubbard U.S.Weather Bureau.

The flight followed a track north along the middle of Smith Sound, Kennedy, and Robeson Channels, turning eastward to follow the north coast of Greenland to its most northerly point at Cape Morris Jessup, then south easterly to Cape Eiler Rasmussen as turning point. The returned followed Frederick E. Hyde Fjord, thence overland to Cape Dan (Victoria Fjord) and then by previous track to Thule.

Weather was remarkably favorable north of Smith Sound. Patches of low stratus formed over high land, but these were intermittent and a clear view of almost every area except the overland pass westward from Hyde Fjord was afforded on either the outward or return flight. Flight altitudes varied from an average of 4,000' to 11,000', and down to 200' over the ice of Kane Basin on the return (see flight track record). The track was generally 10 to 15 miles off shore. The intervening distances were too great for observation of detail although general characteristics of the area were clearly discernable.

During the first part of the flight my observation was made from the nose turret, and subsequently from the waist doors of the aircraft. The flight lasted 11 1/2 hours.

The principal areas of observation may be considered:

1. Smith Sound through Robeson Channel.

Smith Sound was found free of sea ice other than scattered growlers and occasional bergs. Stratus prevented observation of most of the shore line other than islands and high headlands. In general the coast is bold with the same stratified geologic formations found at Thule. Etah was observed as readily accessible by ship and offering good shelter although surrounded by high land unfavorable for local flying or for meteorological observation.

The first pack ice was found stretching across Kane Basin approximately from the north side of Bache Peninsula (Ellesmere Island) to the vicinity of Cape Russell (Englefield Land). This ice appeared impenetrable to shipping unless it could be broken by ice-breakers. The southern edge was composed of a narrow belt of loose broken fragments and stringers. Beyond it seemed to consist of large unbroken floes of new ice, some a mile or more in extent, each of which had moved or turned so slightly that they might have been readjusted to their originial positions forming a continuous sheet. There were no continuous leads. Pools of clear water existed where floes had turned and left an opening. The ice surface was mottled by small patches of snow all of quite uniform size (perhaps 50' x 100') and regularly spaced, giving the appearance of a standard pattern. Between the snow patches the color was greyish green. Low altitude observation on the return flight revealed that the greyish green patches consisted of shallow water melted on the ice surface. In many places the ice had rotted, with round holes developing through it to the water beneath. Where these holes were closely grouped the surface took on a rusty yellowish color, apparently having some relation to the thinness of the ice at these places. At the edges of these ice sheets where freshly broken and exposed in a pool of open water the thickness seemed uniformly about 4'. (Such observation from aircraft maybe in error.) Where ice sheets had been driven together pressure ridges, consisting of a line of tumbled ice blocks some four to ten feet high, or perhaps up to 15', were observed.

It is interesting to note here two other examinations of this ice. The submarine Atule penetrated some 1,000 yards beneath it. Surface examination in advance revealed apparently smooth ice except for a low wall at a distance, estimated some 2' to 3' high. It is my belief that this wall could only have been a pressure ridge, where the loose ice of the marginal zone was driven against solid sheet. It was probably higher than estimated, since distances are deceptive, and observation was from the low submarine bridge. A course was plotted to avoid scattered ice bergs embedded in the pack. Diving beneath the ice, the submarine came under a sudden downward projection and grazed against ice overhead which was estimated 40' below the surface. Diving further, the submarine's vertical fathometer registered an irregular under surface of the ice with an ice depth reaching 80 feet. It is believed that these figures may be somewhat in error since no such thicknesses of ice were observed by any subsequent surface examinations even much further north. The depths of the downward projections of the ice must be due to pressure lines which drive blocks of ice downward and under adjacent floes. It is easier to submerge a block of ice than to raise it bodily from the water, and it therefore seems logical that in the formation of a pressure ridge which may be 15' above the surface the same action will form a downward ridge several times that dimension - 40' to 50' or more.

An examination of this same area by the USS Whitewood indicated that the vessel could not penetrate or break the ice. The Whitewood was a sheathed wooden ship of some 1,200 tons, but not an ice-breaker. On the other hand the USS Northwind, being a true ice-breaker of 10,000 H.P. did later demonstrate that she could maintain progress in ice of this general type and thickness (see return voyage to Hall Basin).

It is believed that most of the ice observed in the Kane Basin was formed in place during the previous winter, being protected from invasions of polar ice from the north by congestion in Kennedy Channel, and not being subject to excessive current action due to the width of the basin.

In Kennedy Channel old polar ice was encountered. This ice was closely packed but did not fill the passage, leaving considerable areas of open water usually near the land, and first on one side of the channel then the other although mostly on the Ellesmere side. This open water (land water) was fairly continuous and it appeared possible for a ship to work north, even at this early date as was done in August, and by Nares, Greeley and Peary. Conditions were very much as they described with grounded bergs along the beach, and the pack occasionally in contact with the land.

From a high altitude the most marked characteristic of the polar ice was the clear light blue color of the water pools on the ice. This is believed to be the result of the great thickness of the ice itself, and possibly also of the freshening of the ice with age. The blue pools were wholly irregular and scattered. Low altitude observation revealed the massive character of this ice and the great irregularity of its surface. Pressure ridges between floes could be distinguished by the rough appearance of the new ice blocks thrown up, but the surface of the floes themselves consisted of a continuous and intermeshed series of older pressure ridges solidified into miniature mountain ranges by the accumulations of snow and weathering. It was clear that the descriptions of the great difficulties of traveling over this ice are not exaggerated.

It is believed that a suitable vessel could deliver supplies for a weather station to the northern entrance of Robeson Channel and return the same year provided ice conditions were not worse than the 1946 season, and provided she were given aerial observation cover. It is not believed that any cargo vessel can safely attempt this passage unless specially constructed for this purpose.

North Coast of Greenland

Certainly at the time of this flight it would not be possible to take any ships along this coast. And it is probable that ice conditions do not materially improve throughout the season since the vast ice fields of the Polar Seas press against the shore without even a narrow belt of land water. There does not appear to be much opportunity for off-shore winds to press back the ice since there is little slackness in the polar pack.

The polar pack extended to the horizon. It consisted of floes in a nearly continuous sheet, but slightly opened forming narrow leads and cracks running in every direction. It would be difficult to cross on the surface because of these cracks. Our altitude of 7,000' was too high to permit observation of the ice details.

Since access to this general area would be confined either to air transport, or to sled transport (perhaps by tractor) across land ice, the best possibilities for weather stations would probably be found back in the fjords where there should be flat new ice surfaces in winter for flying, and shorter overland distances. Unfortunately the off-shore track of this reconnaissance did not permit observation of areas back from the coast. There is little doubt, however, that many sites exist which would be satisfactory for station construction. Flat areas and favorable shore approaches were seen near Cape Bryant, Dragon Pt, and around Victoria Fjord.

It is interesting to note that open water was observed at a distance in the heads of the fjords. It is probable that open water will be found similar to the occurrences in Peary Land, and that flying boats could be used intermittently in summer as hereinafter discussed in reference to Peary Land.

Across the entrance of each fjord there could be observed a line of demarcation between the fast fjord ice and the moving pack of the polar sea. The outer fjord areas were still frozen, although in an advanced state of deterioration with mixed water and snow in the surface. The character of the winter ice surface should be quite smooth although numerous old floes were seen imbedded. The invasions of heavy pack into these fjords are, however, not believed to be sufficiently dense to present a hazard to ice flight strips, especially near the heads of the fjords.

In summary it is concluded that camps could be established in many of the North Greenland fjords by the use of air transport with frozen ice surfaces for landing. It is also probable that access could be had occasionally in summer (August) with flying boats on open water. However, it is considered improbable that locations in this area would be favorable for meteorological work, because of surrounding high land, nor is it believed likely that any satisfactory sites would be found for airstrips or year-around flight facilities.

Peary Land

The flight continued around the coast, turning Cape Morris Jessup and following down the south easterly trend as far as Cape Eiler Rasmussen at the entrance to Independence Fjord. The return flight tracked back to Fredrick E. Hyde Fjord, which was then followed to its head and a course projected to Cape May where our previous route was joined.

The most striking feature of this land area was the advanced stage of summer. The land was bare of snow, rivers flowed, fjord heads were open with numerous water landing prossibilities, and much bay ice was beginning to move. Peary's description of the comparative abundance in this country appears justified. The interesting question is why such conditions prevail in this latitude when they do not in comparable latitudes of north Ellesmere Island some 300 miles westward. An answer may have been discovered on this flight.

Open sea was found to exist immediately to the eastward of Peary Land.

This water is shown on some maps as Wandels Sea although records so far examined do not reveal whether it has previously ever been known to be ice free. The fast ice of the fjords ended with a clean break line sweeping Capes Bridgman, John Flagler, Eiler Rasmussen, Prinsesse Margretes Island, and presumably to Northeast Foreland. At these capes the water lapped to the shore with no ice foot. Boats could have been landed directly on the beach. In the open sea beyond the fast ice were scattered ice fragments but water stretched to the horizen from east to southeast. The aircraft was then at 7,000 ft. and visibility excellent. From this altitude the horizon would be distant 110 miles and it is considered certain that open water extended the majority of this distance.

It is a question of great interest whether this open water was accessible to shipping via the Norwegian Sea. There was every appearance that it would have been possible to sail a ship across from Spitsbergen (400 miles) without encountering any pack.

The fringe of the polar pack forming the northern boundary of this open sea ran approximately east and west, closing with the land near the northern tip of Greenland and developing a tapering lead reaching nearly to Cape Bridgman where tha polar pack touched the land ice.

It is probable that this lead is parallel to the lead encountered by Peary in his track north from Morris Jessup. Peary considered that a

The most northern land in the world at the northern tip of Greenland in the vicinity of Cape Morris Jesup. The coastal fringe is here beginning to flatten out. Polar pack in the foreground is very heavy and continuous.

On the north coast of Greenland and beginning in the vicinity of Cape Bridgman there was found a broad lead of water (open) separated from the shore by a belt of land fast ice. This lead gradually widened as we flew southeast along the shore until it assumed the proportion of an open sea known as Wandel Sea.

Looking into the entrance of Frederick E. Hyde Fjord open ocean is in the foreground just outside the ice of the fjord. Flight altitude at this time was 7,000 feet and the open ocean extended to the southeast horizon at a distance of approximately 100 miles. Area around the entrance to this fjord is particularly favorable for weather station site.

The small indentation on the north side of Frederick E. Hyde Fjord approximately 60 miles inland from the mouth. Open country is prominent. Running fresh water has melted ice at head of bay. Highlands surrounding this location are unfavorable for weather observation and there is no level ground for flight strip construction, but the site is excessible and might be used as a base for explorations.

large open lead was usual in this vicinity and he therefore transferred his base for polar operations to Ellesmere Island. If such a lead is usual it may perhaps be taken as an indication that open water in Wandels Sea is at least not unusual.

The only reference I have so far been able to find to substantiate previous observations of a body of open water is in Peary's "Nearest the Pole" on page 328. On May 20, 1900, being then at latitude 83° on the northeast coast of Peary Land (Clarence Wyckoff Island) some twenty miles south of Frederick Hyde Fjord, he wrote "Open water was clearly visible a few miles off the coast, while not far out dark water clouds reached away to the southeast."

A further indication that open sea can be expected east of Peary Land is the snow free character of the land itself, which can best be explained by the moderating influence of an adjacent large large body of water.

At first glance it may seem contradictory that we have a record of heavy polar pack in this region from the drift of the Russian North Pole party under Papanin. This was in mid-winter (January) of 1937. And the line of drift was some hundred miles off shore from Cape Eiler Rasmussen, parallel to the coast. It is taken as a fact that a strong southerly current exists in this off shore position. It should perhaps then be assumed that this current will persist in summer as well as in winter, and tend to carry the polar pack southward off this section of Greenland. However, many influences can change characteristics enormously between January and July, or there may have been a marked difference between 1937 and 1946. Furthermore the observed open water was inside a drift line plotted a hundred miles off shore, and it may be possible that a south-reaching tongue of pack did exist outside our range of vision in July 1946. This raises the question whether open water off Peary Land may be only a small local phenomena embayed within surrounding pack, similar to the Russian "polynias". This question can only be answered by further observation.

The fact remains that Wandels Sea was open for 100 miles on July 25, 1946. Nor does it seem improbable that this sea would occur frequently under the influence of an easterly current in the polar ocean sweeping across north Greenland turning southward after confluence with the main current from the north as plotted by the drifts of the Fram and Cedor. Such a current pattern would tend to create an eddy under the protection of the northeast shoulder of Greenland.

In any event the possibility of getting a ship to north Greenland is sufficiently interesting to justify considerable investigation. The most important feature of such an attempt would be aerial reconnaissance. It is to be hoped that someday the facilities may be found to send a suitable ship, together with aircraft, to Spitsbergen from which point reconnaissance may be flown across the 400 miles to north Greenland, the ship being held in readiness for a rapid passage if open water is present.

In connection with the possibility of sea access it was observed that the coasts of northeast Greenland from the vicinity of Cape Bridgman down to Independence Fjord consist of broad flat plains, presumably of sand

and gravel, and offering numerous possibilities for the construction of air fields and weather stations. Quoting again from "Nearest the North Pole" page 328, Peary describes Clarence Wyckoff Island as a "low point composed entirely of fine glacial drift." These plains were completely snow free and intersected by many rivers draining from the mountains of the interior of Peary Land. The country appears barren from aerial observation, as all arctic lands appear barren, but it is believed that Peary's and Rasmussen's descriptions of abundant arctic flora and fauna can be accepted. Favorable conditions were also reported by L. Kock.

The possibility of landing an exploratory aircraft on these flat coastal plains is a matter of conjecture. During the frozen spring period it is probably possible to land on protected salt water ice, or on the ice foot, or on the land itself, on skiis. During the summer it is possible to land on open water in the vicinity as it is believed the fjords will be mostly open.

Access by glider onto the coastal plains should be relatively easy (except for the towing distance involved) in either summer or winter. The most propitious location would appear to be on the north side of Independence Fjord or around the bay south of Cape Flagler. The latter site seems to offer the best possibilities of all, as observed on this flight, although it is probable that the south side of Independence Fjord offers equal opportunities and further reconnaissance may disclose new features.

On the return through Frederick E. Hyde Fjord, the ice in the outer part appeared to be rotting rapidly and had moved slightly as shown by widening cracks. Shortly there were signs of opening of the ice, and water was found in the bay on the north side on longitude 34° W. A sufficient area was ice free to have permitted landing and taking off our PBM aircraft. This introduces the interesting possibility of summer exploration by seaplane. Further open water was found on the south side, and in both branches at the head of the fjord. These early (July 25) openings were apparently caused by fresh water pouring onto the ice.

It is considered quite certain that the greater part of Frederick E. Hyde Fjord (and probably Independence Fjord) will open in summer. This assumption is based on the advanced deterioration of the ice in July, and on the fact that the ice surface which we observed seemed only seasonal, showing little sign of carry over from year to year. No active glaciers were observed to feed into this fjord.

Beyond the head of Frederick E. Hyde Fjord stratus cloud covered the land until we rejoined Victoria Fjord at the north coast. In general the maps and heights of the land are remarkably accurate.

In summary it may be said that the establishment of a weather station in Peary Land appears wholly practical. Furthermore the possibility of building and supplying an airfield of substantial proportions is sufficiently interesting to justify careful examination.

Compared to Ellesmere Island, and to other parts of Greenland, Peary Land is distinctly friendly in the summer. Temperatures must be well above the freezing point almost continuously for two months or more. Land exploration has revealed abundant flora and fauna. Land ice is not extensive. There are numerous extensive plains and flat areas. There is open water in summer.

It is possible that Peary Land may be accessible by sea.

Peary Land Flight Log -- July 25, 1946

Time	Lat.	Long.	Cut	Grid Wind	True Wind	Temp.	
1652Z							
1800	76-51	71-50	7000	290	SW	-5	
1900	79-10	71-00	7000	255	SSE	-5	
2000	82-15	60-30	7C00	255	SSE	-5	
2100	83-05	47-00	9000	0	NW	-8	
2200	83-29	25-50	5-6000	0		-12	-16
2300	83-15	26-20	10000			-1	
2400	82-52	42-35	11000	255	SSW	-4	
0100	82-19	55-50	8000	270		-6	
0200	80-50	66-45	7000	280			
0300	79-04	72-20	500	250	S	-13	

GRANT LAND FLIGHT

Unfortunately I was not able to accompany this flight, made July 28, 1946. Observers carried were Captain Dufek, Lt. Dowd, Fl/Lt. Bishop (RCAF). Material hereafter is derived from conversation with these persons and from photographs.

The flight first attempted to cross to western Ellesmere via the pass between the head of Princess Marie Bay and Eureka Sound. This pass is reported by McMillan to be less than 500 ft. above sea level. Clouds were heavy against the Ellesmere mountains and presented a hazard even in the pass so that the flight turned back. This is of interest because it has been hoped that the pass into Eureka Sound could be used for air transport operations to West Ellesmere and Axel Heiberg Island. However, clouds were observed in this area on several occasions during July and August and suggest a serious obstacle to flight in the summer. Probably the cloud concentrations will not be so serious during the cold months of early spring (see report of Eureka Sound Flight for the observation on the very narrow character of this Princess Marie Bay pass).

After abandoning the attempt to cross at Princess Marie Bay flight proceeded north via Kennedy and Robeson Channels and turned westward along the north coast of Ellesmere Island.

Opinion was expressed that locations could be found within reach of ice-breaker navigation on the north coast of Ellesmere Island, where land airstrip construction would be possible. Broad areas of glacial drift were frequent, and there appeared to be occasional flat areas. It was further reported that open ocean was present in southern Lincoln Sea, at the entrance of Robeson Channel as far north as Cape Rawson, and a workable lead followed the Ellesmere coast as far as Cape Belknap.

For notes on surface navigation to this area see subsequent section herewith on voyage to Hall Basin. It is possible that an ice-breaker similar to the Northwind could reach Cape Belknap and return annually without great difficulty. It is doubtful, however, whether a cargo ship can be escorted through the heavy pack of these waters. A combined effort by aircraft based at Thule with surface transport by ice-breaker might establish an advance station on the north coast.

From examination of photographs it appears that the most propitious area on the north Ellesmere coast would be in the vicinity of Cape Belknap, which is a low and comparatively level plain of what seems to be glacial drift. It would not by any means be easy to build a land airstrip on this terrain but it should be possible with adequate machinery. On the west side of the point is Black Cliffs Bay, and the inner reach of Hilgard Bay which latter is sufficiently enclosed to offer substantial promise of smooth ice for an ice landing strip. There is abundant fresh water in the vicinity and favorable camp sites are numerous.

Advancing westward to Cape Columbia and to the vicinity of Ward Hunt Island the coast as seen from photographs is rough and forbidding. No glaciers or permanent land ice appear in the coastal mountains of this section. Sea ice was found heavily packed against a narrow ice foot although numerous cracks and small water pools indicated motion. The bays were all frozen, showing a distinct line of division between the fast ice and the moving pack.

Beyond McClintock Bay and Cape Richards, as the trend turns southwestward, the coast becomes increasingly heavily glaciated and with large snow accumulations. It is unfortunate that characteristics of this nature are so difficult to interpret from aerial observation or photography. Perhaps the best interpretation can be gained from aerial data compared with the descriptions of previous explorations. Peary examined this coast in 1906 between June 15th and July 15th as described in the book "Nearest the Pole".

The coast is mountainous and bold. That there is persistence of clouds against the land is attested not only by our single aerial observation but by Peary's record wherein he speaks constantly of fog, snow and reduced visibility in the early summer. Fog and snow are practically synonomous in this region since the condensation usually freezes. It is presumed that the evidence indicates a prevailing westerly or north westerly wind which gives condensation when being raised against the mountains. This also accounts for the large glaciation and accumulations of snow.

Peary describes the coast as a 'glacial fringe'. He states that the broad icefoot is indeed a glacial shelf having a downward grade away from the land, and further that the so-called "low sloping spits" shown on Hydrographic Office Chart 275 are in fact true glaciers. The surface of this glacial fringe is undulating and in general covered by deep snow in June and later turns into a morass of slush and water pools.

From the photographs it appears probable that the 'low sloping spits' off the headlands, as charted, are ice or perhaps compacted snow resting on the land underneath. The pictures show no signs of activity or movement however, and it is probable that this formation is a permanent ice or snow bed rather than a proper glacier. Where bays let back into the mountains the shore becomes bold and the 'glacial fringe' is interrupted.

It is unfortunate that Peary travelled off shore along the edge of the icefoot and could not see clearly nor describe the bays which he passed.

He says of Yelverton Bay simply that "it is full of glaciers", and of Phillips Bay "we passed the mouth of a black precipitous-walled bay, some ten miles wide at the mouth and with apparently several interior ramifications."

Nowhere along this coast does there appear to be any possibility of airstrip construction on land. If any weather stations are to be established here it must be wholly by air, since surface navigation even by powerful ice-breakers appears quite impossible. Operations are therefore confined to flying on ice surfaces (unless parachutes are used).

Photographs show apparently undisrupted ice surface in McCormick Bay. The details of the ice surface are not clear although there seems to be little embedded or pressurized ice and it is reasonable to conclude that (a) a light airplane on skiis could find a safe landing on this surface and (b) an airstrip for wheels could be prepared quite easily with the aid of a tractor. This same condition appears to exist in the inner arms of Ayles Bay. At this latter location the junction of the fast ice and the broken pack penetrates more deeply into the mouth of the bay than as shown at McClintock, but the line of demarcation is definite and smooth ice appears inside.

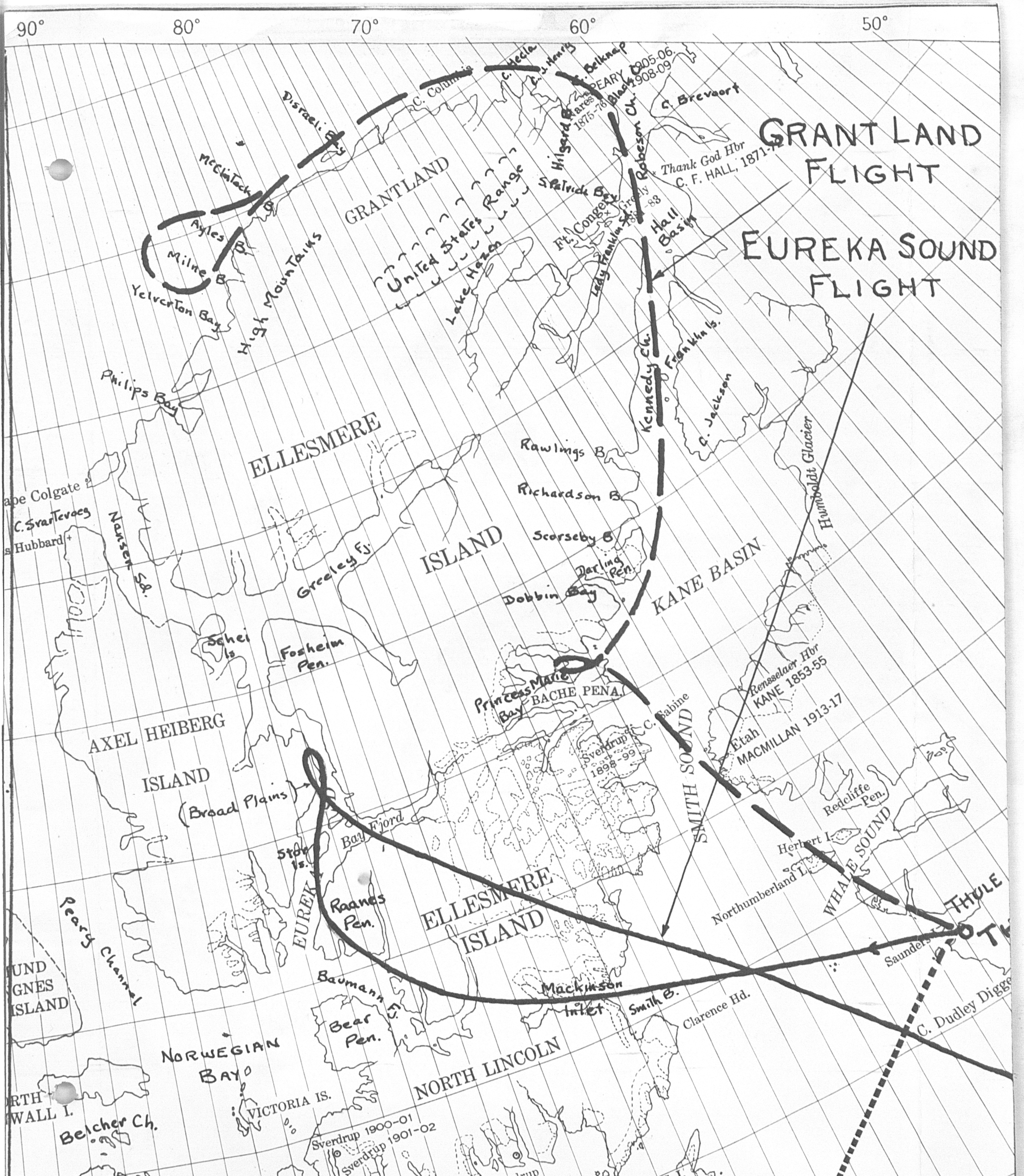
Milne Bay is more difficult to analyze from the pictures. A smooth stretch of ice appears just inside the line of the pack but beyond is rough ice and what appears to be a large glacier at the head.

Yelverton Bay apparently offers large areas of fairly smooth ice similar to that observed in McClintock Bay, but at least one of the glaciers referred to by Peary can be seen in our photographs.

It is unfortunate that no observation could be made on this flight beyond the northern part of Yelverton Bay. A heavy fog bank prohibited further flight to the southwestward and the aircraft turned back along substantially the same track as its outbound flight.

In considering further the problems of establishing a station in this area the most serious hazards appear to be the weather and the distance from any accessible base of operations. All available weather data indicate a high percentage of fog, low cloud, and snow during the favorable periods of the arctic summer. The seriousness of this condition is aggravated by the flight distances involved which approximate 700 miles from Thule by the track through Robeson Channel. Furthermore the high mountains of the interior of Ellesmere, and the persistence of cloud over these packs render a direct flight route across Ellesmere extremely hazardous.

In conclusion it appears that the establishment of a weather station on the northwest coast of Grant Land must be both difficult and dangerous. It is not recommended that this venture be attempted as an initial operation in the transportation of an advanced station by air. On the other hand the above facts should not be interpreted as excluding the southern portion of Grant Land, or the Nansen Sound-Greely Fjord area, since these were not observed. (see section, Eureka Sound Flight)



GRANT LAND FLIGHT
EUREKA SOUND FLIGHT
90°
80°
70°
60°
50°
C. Columbia
C. Hecla
C. Henry
C. Belknap
PEARY 1905-06. 1908-09
NARES 1875-76
C. Brevoort
Disraeli B.
McClintock B.
Ayles B.
Milne B.
Yelverton Bay
High Mountains
GRANTLAND
United States Range
Lake Hazen
St. Patrick Bay
Ft. Conger
Greely 1881-83
Lady Franklin B.
Robeson Ch.
Thank God Hbr
C. F. HALL, 1871-72
Hall Basin
Kennedy Ch.
Franklin Is.
C. Jackson
Humboldt Glacier
Philips Bay
ELLESMERE
ISLAND
Rawlings B.
Richardson B.
Scorseby B.
Darling Pen.
Dobbin Bay
KANE BASIN
Cape Colgate
C. Svartevoeg
Hubbard
Nansen Sd.
Greeley Fj.
Schei Is.
Fosheim Pen.
Princess Marie Bay
BACHE PENA.
C. Sabine
Rensselaer Hbr
KANE 1853-55
Etah
MACMILLAN 1913-17
Sverdrup 1898-99
SMITH SOUND
AXEL HEIBERG
ISLAND
(Broad Plains)
Bay Fjord
Stor Is.
EUREKA
Raanes Pen.
ELLESMERE
ISLAND
Redcliffe Pen.
Herbert I.
Northumberland I.
WHALE SOUND
THULE
Saunders I.
Peary Channel
Baumann Fj.
Mackinson Inlet
Smith B.
Clarence Hd.
C. Dudley Digges
Bear Pen.
NORWEGIAN BAY
NORTH LINCOLN
VICTORIA IS.
Belcher Ch.
GRINNELL
Sverdrup 1900-01
Sverdrup 1901-02
Sverdrup 1899-1900
COBOURG I.

Eureka Sound

A successful crossing of Ellesmere Island by air was made in the vicinity of Mackinson Inlet. This inlet is almost due west from Thule and offers a fairly direct route into the Eureka Sound area, with crossing of the Ellesmere mountain chain at moderate elevations.

The day of flight was remarkably clear with ceiling unlimited and only occasional low cloud patches as an obstruction to visibility. Aircraft maintained 9,000 altitude. From this experience it is difficult to assess those characteristics of the flight route which might be a hazard under less favorable weather conditions. It is estimated, however, that a route exists between Mackinson Inlet and Baumann Fjord with land elevations not over 2,000 feet, although this low level route is probably too tortuous and narrow for use by aircraft under a cloud deck except in emergencies. On the other hand it did appear probable that an ample and straight flight track could here be flown across Ellesmere Island at 4,000 feet and perhaps less. This is believed to be the only place at which a crossing can be flown under 6,000 feet to 7,000 feet.

It will be found elsewhere that an attempt was previously made to fly under cloud deck through the pass shown on maps at the head of Princess Marie Bay, in Kane Basin. This attempt did not discover any openings. This same Princess Marie Bay pass was examined during the flight here reported from a position some ten miles south but at 9,000 feet. No significant breach of the Ellesmere mountain chain could be seen at all. It is likely that this northern pass is merely a narrow valley, suitable for dog sleds but of little value to aircraft. Existing charts of the area are believed to be misleading. In the fact the mountains of that area, viewed from a little distance, appeared to rise to approximately 7,000 to 8,000 feet.

Southeastern Ellesmere Island is actually covered by a true ice cap although its main body is not extensive and soon divides into glaciers, especially on the east side. On the west side of the mountain chain a great sheet of land ice forms the approach to the mountains which then rise through this sheet. The belt of ice cap and heavy glaciation averages some fifty miles in width from the coasts of Smith Sound and Kane Basin. This belt marks the extent of the mountainous country. To the west of it the land is compartively low and does not support more than a few minor glaciers until the peaks of Axel Hieberg Island present another mountain range.

The low area between the Ellesmere mountains and the Heiberg mountains contains the channels known as Eureka Sound, Greeley Fjord, and Nansen Sound. To the south Eureka Sound opens into Norwegian Bay and connects with Jones Sound and Belcher Channel. To the north Nansen Sound opens to the polar sea.

A flight at 9,000 feet over terrain of this nature does not permit more than general observation, although the distribution of sea ice can be accurately estimated. Furthermore, a fairly reliable estimate of the character of the ice can be made from the pattern of snow and the colors. Elsewhere in this report will be found descriptions of the relationship between snow patterns and ice type, and between color and thickness.

It is of primary interest that Eureka Sound itself was open.

Baumann Fjord, crossed on our flight track prior to reaching Eureka Sound proper, was not open. In fact the inner reaches of this fjord where first seen in the vicinity of Stenkut Bay, were covered by an unbroken sheet as of that date. The ice itself was nonpressurized, having the characteristics (evenly-distributed snow pattern) of a perfectly flat surface. The color would indicate that this ice averaged some 4' to 6' of uniform sheet. It is therefore presumed that the ice of Baumann Fjord is rarely distrubed and simply melts down during the summer and builds up to thickness again during the winter. There can be very little current action. It can be presumed that this dead-end fjord, does not have much tide (characteristic of these arctic waters) and being surrounded by land of 1,000 feet to 2,000 feet high is protected from storms.

In proceeding west the ice sheet of Baumann Fjord was seen to be cracked into large pans and slightly moved. The Fjord is here becoming wide and more open to Eureka Sound. Nevertheless there was not much evidence of ice actually moving out of this fjord until very close to its entrance.

Eureka Sound was reached by crossing Rannes Peninsula north of the point called Hare Nose. Eureka Sound was immediately seen to be open and practically ice free.

It was unfortuna te that little could be defined in a south westerly direction because the sun at that time opposed our line of sight. There was an impression of mixed floes and open water extending into Norwegian Bay. It is here presumed that a substantial current flows southward through Eureka Sound into Norwegian Bay. The presumption is based on the southerly and westerly current tendencies of Baffin Bay, Lancaster Sound, and probably of all the inter-action island passages. It is borne out by the argument since the ice of Eureka Sound must have moved out, and since it could not well move northward into the pack of the polar sea, it must have moved south. An extremely interesting possibility is immediately raised as to the chance of reaching this open water by surface ship.

The shortest approach would be through Jones Sound, and either Hell's Gate or Cardigan Strait. However, it is not believed that this will be found practical. Applying the conditions of Lancaster Sound to Norwegian Bay it must be presumed that a heavy ice concentration will be held in the southern portion of this bay. And both Hell's Gate and Cardigan Strait are much too small to offer ice drainage. It is more probable that they will themselves be blocked and choked with pack. Probably the western end of Jones Sound is then relatively unaffected by the fact that there is a further opening west, and Jones Sound itself will have little tendency to clear. This latter condition was found to be true in late August 1946 within the limits of surface ship observation.

It is more likely that Eureka Sound could be reached through Wellington Queen's, and Belcher Channels, and across Norwegian Bay. Sailing ships have passed through Queen's Channel to the northwest corner of Grinnell Peninsula. If Belcher Channel could then be traversed to reach the northern side of Norwegian Bay it is extremely probable that a majority of open water would be found along the south coast of Axel Hieberg Island. Some additional notes on this subject will be found in the section on "Wellington Channel".

It is recommended that aerial reconnaissance be flown to determine the possibilities of this passage. It can probably not be attempted until late August or September.

Reconnaissance in Eureka Sound was carried north to approximate latitude 79° 40' N. The mountains of Axel Heiberg are not far back from the water but an area of low elevations reaches north and south, having an average width of some fifty miles. In general the land is rough and consists of rugged rounded hills and cliffs perhaps 1,000' to 1,500' in height. On date of flight a snow line existed which was estimated at 1,000 feet.

Along Eureka Sound there are several areas where comparatively flat gravel plains spread from the back ground of hills and stretch along the shore for several miles. The presumption of a gravel is based on the straightness of the water courses across these plains and on the appearance of small delta-like deposits at the mouths. It is suggested that on these gravel plains there may be found a suitable area for the construction of an airstrip. Details could not be observed from our flight altitude of 9,000feet but the impression was strong that in spite of numerous water courses and rolling undulations there would be very good air field sites and certainly many which could be leveled by limiting earth movement.

Flat plains of a nature as described above were observed on the north shore of Bjorne Peninsula, on Raanes Peninsula, at the north end of Stor Island, and especially on the shoulder of Axel Heiberg Island where Eureka Sound bears to the west. This latter position was the turning point of our flight. It is probable that the same general nature of the country persists farther north and probably up to Schei Island and to the peninsula forming the southern entrance of Nansen Sound. This latter location is recommended as the most desirable site for an advanced weather station provided plains* may be found there suitable for an emergency flight facility. Further reconnaissance will be necessary. However, if this ultimate location should not prove propitious we can still be quite confident that satisfactory conditions do exist only some 50 miles to the south. The question is then one of selection of the best site. The general area can be recommended with confidence.

Although presumptions as to the character of the surface for airstrip construction can be wholly misleading when based on long distance observations it is at least certain that many good locations exist along Eureka Sound for weather observation. Many places can be found with good exposures, adequate space, good orientation for radio antennaes etc, water supply etc. And it is still a near certainty that since the water of the sound opens so fully there must be extensive formations of smooth new ice which would permit the landing of aircraft almost anywhere.

* Grassy plains are reported on Schei Island and in the vicinity of Svarteveog Cape.

VOYAGE NORTH TO HALL BASIN

In view of the heavy ice observed in Melville Sound it was decided to delay the contemplated westward expedition, and to attempt instead a penetration northward by the ice-breaker 'Northwind' via Kane Basin and the American route to the pole. Personnel of the Nanook Task Force Staff transferred to the 'Northwind' and departed Tay Bay, Bylot Island 1900 August 20th, 1946.

August 21

About 20 miles off shore passed Coburg Island and the coast of North Lincoln Peninsula, Ellesmere Island, Coburg Island is mountainous and heavily glaciated. All along the southern Ellesmere coast very large glaciers stream down from the hills of the interior. Where the latest aeronautical chart of this area shows no ice cap on North Lincoln Peninsula there is apparently much land ice present.

Many large ice bergs in the sea but no pack.

In the evening stood in near Cape Faraday. The coast north of Smith Bay presents five or more large glaciers which join to form what must be very nearly an ice shelf along the coast for some 20 miles.

August 22

During the night we passed through Smith Sound and entered Kane Basin. Large glaciers fill every valley of the Ellesmere mountains. Off Pim Island, and Cape Sabine, at breakfast time. The contrast is striking when one thinks of Greeley's men starving on that flat desolate bit of rock. Just north of Cape Sabine we encountered the pack.

At first the ice was loose and fairly small. As we edged in it became denser and bigger. It was my impression from the previous flight over this area on July 25th that there were very large pans of young flat ice. It is probable that these pans had been broken up. There were numerous old rough floes with much broken ice, but few large stretches of young sheet remaining.

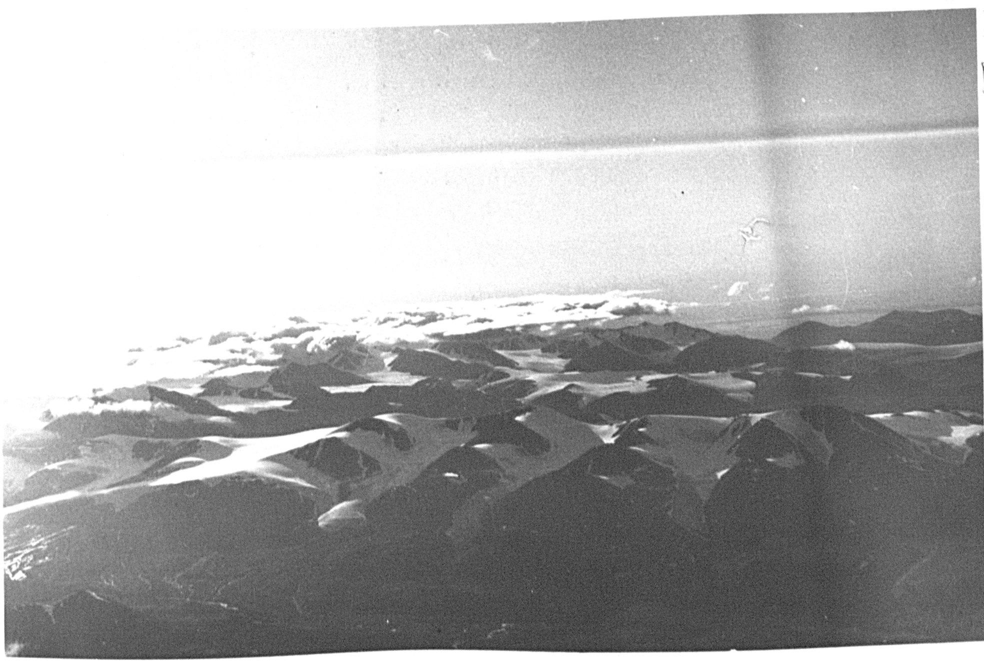
There seem to be two principal types of ice. There is young ice which is quite level and of relatively uniform thickness. This may be from 2 to 6 or 7 feet thick. It seems clear that this ice is formed during a previous winter either from open water or with some previous ice sheet incorporated in it as might occur where a residual sheet remained over from one year to the next in a sheltered location. The pans of young ice had been reduced to a size not exceeding some 100 yds across, and fragments around their edges were a sign that they had been working against each other. Some of these pans had small pressure ridges across them probably produced in cases where this ice had formed in the open sea and been subject to some pressure during the previous winter. Occasional small pans were perfectly flat with an unbroken snow surface. The great majority of this ice had a surface of intermingled water pools and snow patches. The pools were some 10 to 20 feet across. On this date they were mostly skimmed over with 1/2 inch of fresh freezing.

The pools on this ice were depressed into the snow surface with the water surface as much as a foot to 18 inches below the snow. All around the pools

A small pressure ridge. This flow is obviously more than a year old since the pressure ridge could not have been consolidated during the melting period of the current summer.

Heavy old polar ice in Kennedy Channel. Under the lines of pressure this ice might be as much as fifteen feet thick. At our farthest north in Hall Basin floes were found to be bigger and rougher than here shown, reaching a thickness of approximately thirty feet. The Northwind was finally stopped in very heavy ice of this nature.

Probably Cape Alexander on the Greenland side in the entrance to Kane Basin. Ice was still heavy in Kane Basin.



Looking back (westward) along the north coast of Greenland. Sheets of stratus clouds were formed over the rising land mass.

the snow banks were under cut and sharp. It would be impossible to land an aircraft across this surface if it were again frozen in this condition.

The pools on sea ice are the most characteristic feature, principally due to the color which seems to be a good measure of the thickness beneath. On young ice as here discussed the color of the pools varies from steel gray blue for sheets some 6 feet thick, through gray green for 3 to 4 feet thickness, to brownish green for thinner stuff.

Pools in old thick ice are clear blue. Solid sea ice itself is blue, and it is probable that the color of the pools on thick ice is imparted by the blue beneath. As the ice becomes thinner the greatest reflection from below partakes of the dark grey green of the ocean water. Also the ice itself loses it blue color when thin. Sheets broken by the ship and turned on edge showed the pure blue only in heavy ice, while the lighter sheet was white.

The brown tinge of thin soft ice gives a distinct impression of rotting, as differentiated from melting. The pools vary from grey green to brownish yellow and seem to give off a sour odor when disrupted. The ice under the pools is speckled with brown material when exposed, which might be dirt, and which would in turn cause rotting by absorption of heat. This theory does not seem too probable however, because it does not explain the concentration in small patches. Nor does it explain the odor (if any). It seems more probable that the brown deposit is marine life trapped in the pools, or worked up into the pools from below through the pores of the thin sheet underneath.

Apparently ice has a tendency to melt under water not by disappearance of a whole surface area but by drilling great number of holes into the solid mass. Often the sub-surface portion of heavy masses turned up by the ship was honey-combed by masses of parallel holes from 1" to 6" in diameter and any depth up to through penetration. As melting progresses the holes grown together leaving a frothy formation of the fringes of heavy ice bodies. This same characteristic can be observed in the bottom of pools as a number of small holes developing downward, like a pattern of shot. As the holes deepen and grow together the whole bottom of a pool will drop out leaving one big hole through the floe. The brown pools of rotten ice become dark like the sea water when melted all the way through. When striking a pan with the ice-breaker the cracking generally occurs through the line of weakness of the brownest pools. Around a big hole the ice splits like breaking a doughnut.

Intermingled with the young ice in Kane Basin were numerous floes of old thick ice. (It will be noted that in higher latitudes the old ice is in predominance.) Some of the old floes were very large, one being more than a mile across.

On the old ice the water pools are mostly light aquamarine blue. The pools are not so numerous nor in regular pattern with the snow patches but are irregularly scattered. The surface of this old ice is almost always rough from numerous pressure ridges running in every direction. Heights of pressure ridges are not as great as appear from aerial observation but may rise as much as 10 to 15 feet above the general floe surface. The ridges are consolidated with snow and are worn down so they resemble a series of miniature alpine mountain ranges as much as anything. The thickness of these floes may be judged by the heights built up above the water. Total thicknesses of about 30 feet were observed and it is believed that greater dimensions may be found immediately beneath the heaviest ridges. The snow on this old ice has a more granular appearance and looks harder. The floes are white above water except for the blue pools. The moment the ice begins to crack under the impact of the ship the blue color is disclosed beneath a very few inches of white upper surface, which is probably mostly snow. The underbody of the ice is blue when turned over. Looking at the floes from the ship's deck the underbody appears pale green through the water.

It is probable that the color of the pools on the ice has a relationship to the freshness of the water and of the ice. It is well known that the pools on old ice are potable, and this source of water has often been used for fresh water on ships. This may be partly explained by the melting of the snow. However, it is also true that the ice itself freshens with age. New sea ice when melted makes salt water but old ice water is drinkable. It is therefore logical that the blueness which is apparent only in ice having every appearance of age may derive from the freshening process. This probability is further illustrated by the fact that the same blue is present in icebergs (glacier ice) which is of fresh water origin.

August 23

The experience of the previous day in working the "Northwind" through leads and loose ice of the lower Kane Basin developed a great confidence in the ship. She did not seem to be bothered materially by ice less than 4' thick, and could maintain substantial headway through close pack varying from 6 to 8 feet thick. On one occasion she was driven onto an old blue floe some 20 feet thick and although she was almost stopped momentarily she crushed it apart and drove through. During most of this time she operated on only two of six possible motors (total power available 10,000 HP).

Although it might have been possible to crush through the pack it would have been slow. It was therefore desirable to find the most propitious leads. The ship was therefore stopped in a pool of open water in the pack and the SOC airplane put overboard. This was a test of our ability to operate such a plane for reconnaissance from the pack. It was most successful. The plane made a flight of three hours, covering fifty miles all around. Navigable water was found close to the Ellesmere Island shore, from Allman Bay north to Kennedy Channel. Confused leads ran in that general direction and the ship worked ice easily to a point where she could maintain 10 knots northward. The Ellesmere coast becomes increasingly bold and mountainous and without glaciers. Any large land ice of the interior is not visible from sea level. Visibility was excellent although in general with overcast. Stratus layers and streamers of dark cloud lay against the coast.

In the evening we approached the Kennedy channel and crossed over to the Greenland side. Here there was a greater predominance of heavy old ice and stretches of pack were encountered requiring substantial effort from the ice-breaker. The ship would be laid into the ice slowly and then with full power applied she would crush through. At all times she gave the impression of having still greater power in reserve, and she won the admiration and complete confidence of all hands.

In Kennedy Channel there were some extremely rough and very large floes. The surface of this ice was a jumble of irregular ice blocks from a few feet to twenty feet in diameter. It is probable that these were thrown up during the last winter under the pressures of the polar sea. Peary describes ice of this nature resulting from the pressures of the great lead north of the Lincoln sea. The ice is all crushed together and then frozen in a homogenous sheet which later breaks into pans. If these pans remain over one or more summers in the polar sea the jumbled blocks are filled over with snow and somewhat melted, forming the pressure ridge surface which has been described as a miniature alpine mountain system.

Just south of Crozier Island ice became sufficiently heavy to suggest further air reconnaissance. A pool was found and the SOC airplane launched successfully. A brief flight reported open ocean north of Franklin Island.

At this same time the helicopter was also flown. The machine is extraordinarily well adapted to ice reconnaissance except for the very limited range of this model (R4 Sikorsky) which is approximately 50 miles with 2 passengers. It has the advantage over the airplane of not requiring any open water or stopping of the ship.

With report of good conditions ahead the Northwind drove through strings of heavy ice to Franklin Island and emerged in ice free water. Strong southerly wind came up at this time. To take advantage of conditions full power of six motors was applied and the ship driven to 16 knots into Hall Basin.

August 24

Drove across lower Hall Basin still in ice free ocean and with strong southerly breezes. At 0400 came up with the pack which had been blown into the entrance of Kennedy Channel. We were nearer the Greenland side, southwest of Cape Lupton. Put the ship into the ice and tried to work across toward the Ellesmere coast. This ice was very heavy, consisting of thick old floes closely packed. The ship behaved marvellously, working through and breaking one floe as thick as 30' of blue ice. But the strain was great and progress very slow. No open water or loosening of the pack was found. We put back into Hall Basin with the intention of making reconnaissance flight in the SOC.

Attempted to find sufficient shelter from the heavy breeze in the lee of Cape Baird. All this time it was darkening in the south under heavy overcast. We did not find sufficient lee for flying and shortly it began to snow and become foggy.

Examining with binoculars the area of St. Patrick Bay and eastern entrance of Discovery Harbor could discern no remains of Ft. Conger activities. Only a musk ox was grazing on the slope north of St. Patrick.

It was apparent that further northward progress depended on a change of wind and slackening of the ice. And since we still had the intention to undertake activities in the Lancaster Sound region it was decided to turn south. Ran down Kennedy Channel with practically no ice.

August 25

Day with flat calm and fog. Ran on slowly south, navigation by radar. still very little ice. We had assumed that the ice of Kane Basin would be packed into lower Kennedy Channel by the recent southerly wind, but this was not so. It was a strong indication that the fresh wind we had experienced further north had not blown in the Kane Basin. Furthermore it was quite clear that the southern wind had blown strong in upper Kennedy Channel for a considerable period before we had arrived, and had thus cleared the water and packed upper Hall Basin. It seemed that the wind had been local and that we ran in and out again.

Crossing Kennedy Channel there was considerably less ice than was present two days before. At no time were we bothered by any close pack. A large floe of heavy consolidated rough ice hung in the west central basin, but skirting this pan, we ran free with only scattered pieces to avoid.

It is always a mystery how the ice disappears so quickly. In this case the whole Kane Basin has been surveyed by air and found full of ice. Two days later there was much less, and many square miles of pack seemed to have vanished. It may be that greater consolidation had occured in the eastern basin which we did not see. Much ice must have melted, although it is difficult to believe that this can account for the whole phenomena, in two days of 40° temperatures. Considerable pack may have gone out south through Smith Sound. The latter solution would seem to require a northerly blow, while we were experiencing a strong southerly wind only 100 miles north.

August 26

At least partial answer to the lessening of the ice was observed while passing through Smith Sound. Here there were quite extensive fields of ice but all soft and mushy. Apparently the melting near the end of the season is much more rapid than one would suppose for we had seen no signs of such rapid deterioration three days earlier.

Abreast of Cape Sabine we ran out into the open sea with brilliant sunshine and cloudless sky.

WINTER HARBOR FLIGHT

The report below was written immediately after the flight described. It will be noted that some of the conclusions were invalidated by observations made later during the voyage to Melville Sound in the Northwind. The whole report is included, however, to show the difference between aerial reconnaissance and surface exploration, and to preserve in original form some of the detailed observations made on this flight. The flight afforded striking evidence of the great changes to be expected from week to week in the Arctic. Whereas ice conditions as observed on the 13th of August appeared to preclude the possibility of surface navigation to Winter Harbor, nevertheless 20 days later a channel of open-water was found to exist all the way to the south of Melville Island.

Took off from Tay Bay, Bylot Island, just before midnight of August 12th.

The central portion of Lancaster Sound was blanketed by low cloud below us but the cloud dissipated as we reached the south and west coasts of Devon Island. The mountains of this island become lower west of approximately longitude 88°W and the land ice and glaciers disappear.

Strings of loose ice were observed between Maxwell Bay and Prince Regeant Inlet and from our distance the Inlet appeared choked. Between Devon and North Somerset Islands there was less ice until approaching Wellington Channel. Loose ice pressed around Beechey Island, enough to threaten a thin-plated cargo ship although there was still sufficient open water to permit a passage. Radstock, Union, and Erebus Bay were filled with pack and could not have been entered at that date without forcing. There is no propitious location for an airstrip and weather station along the south coast of Devon. The shore is bold with cliffs 600 to 800 feet high.

The time of day for this flight was unfortunate. All during the westward passage the sun stood just above the northern horizon. There was high but dense overcast appearing above the sun which seemed to increase the glare and darken the land. Since we were flying south of the land and looking north it was extremely difficult to discern the character of the surface at any distance, nor could we tell much of conditions in the north-leading water channels. By the time of return flight the sun had risen several degrees and although still shining in our face it illuminated the surface better. All photographs on the flight were taken during the return leg.

The southern portion of Wellington Channel carried large quantities of loose ice but with sufficient through water passage to permit tortuous navigation without ice breaking. The northern portion of Wellington Channel was not open. Conditions did not permit observation of the character of ice beyond latitude 75° N.

Along the south shore of Cornwallis Island the pack was still penetrable, though becoming increasingly close, up to Griffiths Island. At first there seemed to be a passage between Griffiths and Cornwallis but this was later found to be practically closed at the west end. From a distance the pack appeared to be looser and perhaps navigable to the south in the middle of Barrow Strait. This open condition, however, did not seem to lead anywhere.

Between Cornwallis and Bathurst the ice below our flight route was very close. It consisted of large pans cracked apart but moved only slightly from the original position. There were small water spaces between but no continuous leads. The ice gave every appearance of having been one continuous sheet very recently. There was practically no evidence of pressure or working. The ice surface was quite smooth with a speckled pattern of snow patches and water. There was no indication of deterioration at all in deep water and it was presumed to be still near the winter thickness (perhaps 6 ft.). Occasionally old worn low pressure ridges could be seen. It is probable that the ice of this general area usually persists from year to year, simply melting down in the summer and building up again in winter. It is conjecture that the surface becomes smooth before it begins to freeze again. Probably often it is reduced to a continuous surface of slush. Old pressure ridges left over from one season are gradually absorbed during the next.

The bay between Cornwallis and Bathurst seemed to be covered by a solid unbroken sheet of ice. A narrow lead followed the edge of this sheet where the broken pack began. Between Lowther Island and Bathurst it was nearly solid again, and impenetrable except by direct breaking of a channel through the sheet. Beyond Bathurst, past Byam Martin, both north and south across Melville Sound as far as we could see the ice was practically one unbroken sheet. A single long crack reached across Melville Sound bearing southwest and extending perhaps 20 miles or more.

It was clear that as of this date no ship could be expected to reach beyond Bathurst Island unless a very powerful ice-breaker could keep headway through the solid sheet. For a cargo ship even to reach Bathurst would involve serious hazard and expert navigation with escorting ice-breaker.

As an alternate to Melville Island for a weather station location Bathurst appeared satisfactory. It is mainly low land, consisting of low rolling hills. Distance did not permit observation of surface details but it is presumed that the gravel plains clearly observed on Lowther Island and Melville are characteristic on Bathurst also. Suitable camp locations could be found almost anywhere and it is probable that a favorable location of an airstrip could be discovered without great difficulty. An impediment to air field construction is present in the form of many small ponds and pools of water on most flat stretches of land. In the larger ponds ice remains. But there seemed to be raised benches of gravel with sufficient drainage to afford some dry level surface.

There are sheltered harbors on the Bathurst coastline. Of course we could tell nothing of their depth but it is probable that anchorage could be found providing ice conditions permit entry. As of date of observation all these harbors were blocked. Nevertheless it is recorded by other explorations in previous years and later in the season that the waters have been found open.

The change from broken to practically solid sheet ice occurred roughly along the line of Garrett, Davy, and Young Island which group probably hinder any tendency for eastward movement of ice out of Melville Sound.

Byam Martin Island is quite low and flat and offers no harbor for protection of a ship. It was completely surrounded by solid ice except for a few breaks along the south shore. Byam Channel was solid.

Along the south coast of Melville Island there was a very narrow lane of open water. From the color of the water it appeared to be shallow and it is likely that this lane corresponded with the tide break. At a few places the lane widened and reached outside of a line of ice fragments which were obviously grounded just off the beach.

Skene Bay is much as shown on the charts except that it seemed more completely landlocked. There is a large side arm on the west. Certainly the inner bay is wholly protected from any pressure under any circumstances. It was presumed that the solid sheet of ice existing in the bay on date of this flight would probably not go out at all in the present season. The surface of this sheet consisted of intermingled pools of water and slush and patches of snow. Similar ice observed from ship in Kane Basin showed the same characteristics, with the pools frozen over and the snow patches rising 6" to a foot above the pool surface. If again frozen in this condition in Skene Bay the surface would present a rough but not impossible landing for a suitable ski aircraft. With the assistance of some machinery it should be fairly easy to prepare a flight strip for heavy aircraft on skiis and probably on wheels.

It can be presumed that in most years the ice leaves the bays of Melville Island and a new surface freezes which should be smoother than an old surface consolidated into the new. It may also be possible that even in this year the ice will still go even after August 13th. The ice in shore appeared rotten and with many holes through it.

The land around Skene Bay did not appear propiticus for an airstrip. Observation was at considerable distance but the surroundings were hilly and no flat area was discernable.

Bridport Inlet and vicinity seemed to offer the largest harbor on the Melville Island south coast for weather station construction. The inlet itself is very well protected. The ice of the inlet should offer favorable opportunity for an ice flight strip. And if it is possible to reach this area with surface ships there is anchorage in back of Dealey Island even if the inlet itself is not open. There is a second harbor some eight miles west formed by a point and an island before reaching Cape Bounty. The land to the west of Bridport Inlet was quite flat. Unfortunately light conditions at the time of this flight did not permit adequate observation for detail but it seemed very likely that a suitable strip area could be found.

Winter Harbor was more carefully reconnoitered than others on Melville Island. The harbor was still covered by an ice pan but there was open water all around the shore occasioned by the shoal beaches. Bottom could clearly be discerned under the open water. It would appear difficult to approach the shore with landing craft. The harbor ice pan was in advanced deterioration, all the poolshaving the dull brown color of rotted ice, and showing many holes through the sheet. It was almost certain that this harbor ice would either break and drift out, or melt away entirely. Even in this bad ice year it is to be presumed that open water will occur and a new smooth ice sheet form in the coming winter. An ice flight strip should be entirely practical although the area might be found a little small.

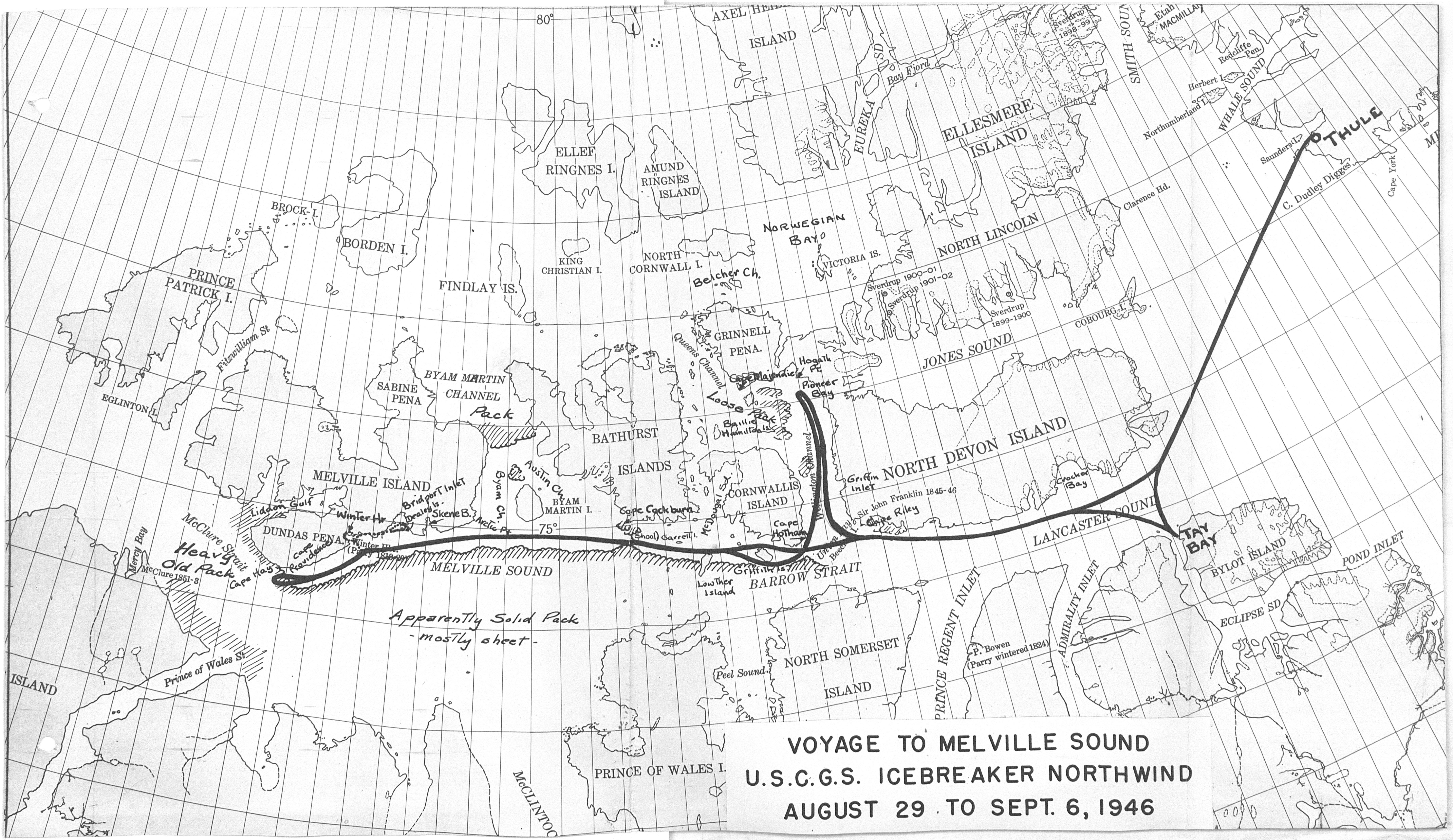
For landing operations on the beach the best place seemed to be on the west side with depths of water probably substantially as shown on Parry's and Bernier's charts. There are extensive flats behind Hearne Pt. but they are very wet with countless pools of standing water. It is probable that the permafrost is very close to the surface and a solid strip might be achieved by draining and filling but it would involve large amounts of earth moving.

The most favorable air strip site appeared to be on the east side of the bay in back of Fife Point. Here the land is higher and consists of gentle ridges some long enough for an airstrip. A dark overcast at that time obscured surface details in spite of the fact that observation was made at less than 1,000'. It was my opinion, however, that a strip location could be found. It is believed that the low gravel mound and bench type of terrain as found at Winter Harbor is also found west of Bridport Inlet

The house erected by Bernier on the beach at Winter Harbor was apparently in good condition. Outside the harbor the ice sheet of Melville Sound was solid as ever.

Flight was continued westward from Winter Harbor along the coast to the vicinity of Cape Dundas. The land becomes more hilly with cliffs rising behind a narrow beach. The narrow lead of water against the shore petered out in the vicinity of Cape Providence, and from here west the ice sheet of the Sound rested directly against the land. Liddon Gulf was clearly visible across Dundas Peninsula with Hooper Island as a pronounced landmark. Looking on west from our turning point all of McClure Strait and Melville Sound to the horizon (75 miles) was solid ice. Banks Island could not be defined because of low clouds although on the return flight we could see Prince of Wales Island at similar or greater distance.

Return flight was made along the same track as followed westward. Light conditions were much improved and photography was undertaken. Many of the characteristics as described above with east bound chronology were observed on the return. Arrival back to the Norton Sound at Tay Bay-Bylot Island was at 0845.



VOYAGE TO MELVILLE SOUND
U.S.C.G.S. ICEBREAKER NORTHWIND
AUGUST 29 TO SEPT. 6, 1946

VOYAGE TO MELVILLE SOUND

It is a striking example of the unpredictability of ice conditions that whereas air reconnaissance of Melville Sound found continuous solid heavy pack on August 13th, and again on August 27th showed nearly unbroken pack west of Bathurst Island, nevertheless our voyage by ship passing Wellington Channel on August 30th proceeded to Winter Harbor on September 1st in a channel of open water without the necessity of passing through any ice at all.

Some scattered ice was seen along the south side of Barrow Strait and pack sighted south and a little west of Cape Hotham, Cornwallis Island. The wind which had been blowing SW in Lancaster Sound went back to NW with velocity of about 20 MPH. This helped to hold the pack to the southward. Approaching Griffiths Island light ice pushed us north of this island, then south of Sommerville and Brown Islands, and again north of Lowther and Garrett. Deep water averaging 100 fathoms was carried on this course but shoaled off Cape Cockburn to 15 fath. where the pack held us within 10 miles of land.

After passing Cape Cockburn (SW Cornwallis Island) a straight course along the north side of Melville Sound, and 15 to 20 miles off the land was held, encounter- deep water and no hazards to navigation.

Course was held along the northern edge of the main pack which apparently filled the southern portion of Melville Sound completely. Occasional pools could be observed to the south but no leads or openings offered passage in that direction.

The channels to the north-Wellington, MacDougall, Austin and Byam Martin were all ice free as far as we could see, although subsequent aerial reconnaissance found heavy pack in the nothern reaches.

The main pack of Melville Sound differed from the ice encountered in Hall Basin through the absence, or great scarcity, of massive pressurized floes. At no time, even in the heavy solid pack of McClure Strait, was ice found thicker than perhaps fifteen feet in isolated places. Most of the Melville Sound ice was from two to four feet thick with some rough old floes six to eight feet and occasionally deeper.

The pack was bounded by a belt of loose small pans and fragments. Beyond were large unbroken floes sometimes a mile or two across, with extensive areas of small floes and crush ice filling all the space between. Occasional water pools and short leads could be seen in the pack.

Of the large floes there were two main types. A first type was apparently young and formed on open water without evidence of pressure. This type of ice was later found to be of quite uniform thickness at 2' to 3'. It is presumed this ice may be 5' to 6' in winter, reduced by melting during the summer. The surface was lest than a foot out of water, being very smooth with alternate patches of snow about 3" deep and spaces of grey green slush, or exposed bare ice surface. There were occasional small pressure ridges, but these floes, when refrozen in the coming winter, would generally be quite safe for landing aircraft on wheels.

This young ice must be formed in the open water of the northern channels and along the north side of Melville Sound. It is believed that those floes were the same ice observed during earlier air reconnaissance as almost continuous sheet in the area which had later cleared.

It is interesting to note the smooth surface of this young (one year) ice compared to the surface of what appeared to be also young ice in Kane Basin. On Melville Sound ice the snow was shallow patches clinging to the ice surface and scoured smooth by the wind. On Kane Basin ice, however, the snow predominated and ice pools were exposed by melting a hole down in the snow leaving a pocket 1 to 2 feet deep, with a brupt under-cut edges. Presumably this difference comes from a greater snow depth accumulated on the ice in the latter case. It may be evidence of more precipitation in Kane Basin. On the other hand it may be that the mountainous country of the latter location promotes snow accumulation locally whereas the flat country of the west permits more direct wind scouring. In any event there were very few ice floes in Kane Basin suitable for flying whereas there were many in Melville Sound.

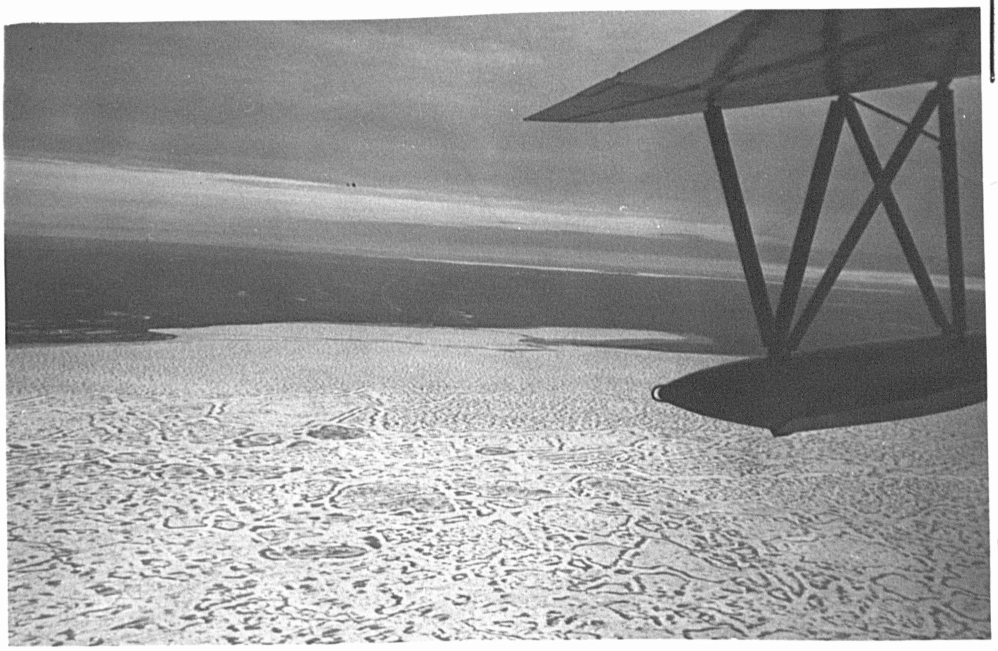
The second type of ice consisted of large rough floes. It should be observed that as freezing takes place in Melville Sound there are two kinds of exposed surface to start with, namely open water and pack ice. It is believed that our first ice type above comes from the water and the second type from refrozen pack. Occasionally a smooth one year floe may persist over the summer as an integral piece and be refrozen without material change of form. However, the majority of the young thin ice is broken up in the summer pack and the fragments piled together by the wind to be refrozen as an irregular mass. This rough surface holds the snow and is thus consolidated into a continuous sheet of tumbled blocks and ridges. On the average these rough floes do not reach more than 6 to 8 feet heights above the water level, averaging perhaps 3 feet above and 10 to 15 feet thickness.

The fact that the rough old floes of Melville Sound were still not as thick and heavy as the true polar ice found in Hall Basin is probably due to the limited area in the sound exposed to northerly wind storms, and consequent less application of pressure. It also indicates less moving current action. It is obvious that when a field of ice is driven together the greater the driving force the more the contraction in horizontal dimension and the thicker the resulting floe. It is probable that the heavier ice will be found in the southern portions of Melville Sound after the wide ice fields receive force from a sweep of wind. The great thickness of polar ice is thus due both to the broad exposures of the polar sea where wind develops great force acting on hundreds of thousands of square miles of surface, and to strong ocean currents.

The same characteristics of color prevailed in MelvilleSound as in the higher latitudes. Water pools and ice of thick floes were pure blue. Thinner floes showed grey green, and when rotten turned brownish. There were numerous dirty floes carrying earth and piles of gravel.

The edge of the pack ran nearly east and west parallel to the islands. Occasional strings of loose ice reached out, or small bights formed, but usually the ship could run within 100 yards of the pack in clear water.

Cornwallis and Bathust Islands are both some 800 feet high and quite bold and rugged. The southeastern corner of Cornwallis continues the horizontally



Solid ice south of Winter Harbor on August 13th. From the air this ice appears thick and blue even in mid-August although the ice in the Harbor has deteriorated with numerous holes rotted through the ice surface.

The ice-breaker Northwind working in solid sheet. This ice was approximately 3 feet thick and the ship could maintain headway at approximately 6 knots. She broke ice by crushing downward. Normally cracks in the sheet would open at a 45° angle from her bow.

The building left at Winter Harbor by Bernier in 1909, as a cache. The building is in excellent condition although the contents have been destroyed by animals and time. Most favorable landing beach is almost directly in front of the building. Weather station site would probably be selected in the foreground of this photograph.

A possible airstrip site adjacent to the weather station location. This site offers only about three thousand feet to the rising ground in the background, but the soil here has been subject to more recent alluvial action, by the nearby river, and is more firm and sandy than other arias around Winter Harbor.

stratified formations of Devon Island, but to the west (and to the north as observed later in Wellington Channel), the stratification is lost as the limestone character of the western islands becomes predominant.

Cape Cockburn on Bathurst Island, is a rounded hill. Large flat plains appear behind the cape and along the west side of the island.

Byam Martin Island is low and flat, apparently composed of undulating mounds of silt and gravel.

Melville Island at Arctic Point is quite bold, and some hundreds of feet high, but the hills are weathered and rounded. Along the south coast the land becomes low and flat at Winter Harbor, then bold again along the Dundas Peninsula.

Arrived off Winter Harbor September 2nd, without incident.

A flight was made over Winter Harbor itself but landing was prevented by loose ice drifting in the sheltered water. A second flight visited Dealey Island. The characteristics of these two places will be found described elsewhere. It was then decided to examine the ice to the westward, by ice breaker.

Proceeding westward the pack gradually closed with the land. Off Cape Providence, with still some 5 miles of open water inshore, the Northwind tried the ice on a course SW roughly parallel with the coast of Dundas Peninsula and in the direction of Prince of Wales Strait. At first the leads were followed, and patches of loose small ice from pool to pool. In these conditions the Northwind can maintain almost full speel except for the difficulty of sharp changes of direction. Large floes of young ice became increasingly numerous, and after some 5 miles were sufficiently close to force the ship to break this ice. The floes proved to be from 2' to 3' thick. With four generators in operation (2/3 total power, or 6,600 HP) the Northwind could maintain headway through these floes at a speed averaging perhaps 4 knots. She would split even very large floes often with cracks running off 45° from the heading, gradually separating the pieces and finally developing a crack straight ahead. As she progressed the ice was crushed under the bow in irregular slabs 10' to 15' across which turned on edge against the side as she slid past, and closed again in the wake. In solid floes, before starting a crack to follow, progress was slow but picked up rapidly as any opening developed. It was apparent that she could maintain way even in continuous sheet ice of this thickness, although very slowly.

Occasional rough old floes were at first sufficiently small to be avoided or pushed aside, but with progress west large old floes constituted the majority of the pack. Still it was possible to navigate around the largest floes. Pieces of this ice up to 100 to 200 yds across could be split by a single crushing blow and slowly separated to allow passage. Fragments turned on edge showed thickness of 6' to 8'. The roughness of the surface seemed to be reflected on a larger scale in the under surface of the ice and in its thickness. Fracture occurred at the thinnest and weakest section. Thicknesses would therefore be expected considerably greater than the 6' to 8' actually exposed. Observation of the underbody of the ice still in the water seemed to indicate thicknesses of 15' - 20' in places. Twice, in large heavy floes, the Northwind was stopped under power and required to back up and strike again before starting a crack in the ice.

Progress became increasingly difficult and slow. The two remaining generators were placed in operation. Even with the full 10,000 HP a condition was finally reached where progress was so slow that further effort was not justified. In fact if the ice should have closed under pressure and prevent backing the ship, it might have resulted in temporary besetment. A 'farthest west' was reached south of Cape Hay in longitude 113° 50'W.

On the return trip to Winter Harbor, in an area somewhat north of previous course, heavy ice was more persistent, and full power maintained only slow progress until the outbound track was recovered. The old track consisted of a line of loose pieces and had not closed. No difficulty was encountered thereafter except for steering to follow the rather tortuous passage where the ship had previously worked through the ice. Open water was regained after 11 hours. Proceeded to Winter Harbor and anchored two miles of Hearne Pt. on September 4th. Observation parties were put ashore by motor launch.

That night, and over September 5th, proceeded eastward on substantially the same course as had been previously taken westward, except to hold south of Griffiths Island. The edge of the main pack had not changed appreciably. A north reaching tongue lay up close to the SE coast of Cornwallis Island which was crossed through ice, although some 5 miles of open water could be seen under the land. Rounded Cape Hotham 1700Q, September 5th.

<u>EXAMINATION OF WELLINGTON CHANNEL</u> (See later section on Winter Harbor)

A course was pursued approximately along the middle of Wellington Channel northward to a position some ten miles off Pioneer Bay. This voyage was disappointing so far as observation of the land was concerned since the Northwind remained well off shore throughout, and much of the time visibility was reduced by fog and snow.

In the main part of the channel, that is with Corwallis Island on the west, both shores appear bold and unpromising. The Devon Island side shows the same conspicuous stratification as is characteristic on the sough coast of that island. Only glimpses at long distance were obtained of Griffin Inlet and nothing could be seen to add to the information from Sir Edward Belcher's exploration. Corwallis Island is conspicuously stratified in the vicinity of Cape Hotham but becomes rounded, though equally high and rough, as one proceeds north.

From a position ten miles off shore at Pioneer Bay the coast was examined with binoculars. The high, horizontally ribbed cliffs of Devon are here lost. Instead, behind the bay, is a broad plain which appears to rise steadily and smoothly away from the sea. Drainage water courses are almost straight, parallel lines at right angles to the beach. Foothills in the distance were lost under low stratus. The slope of this plain could not be determined, nor its character. Probably it is a gravel or glacial silt, and it is likely that a level area could be formed satisfactory for construction of an emergency airstrip. However, the general character of this area was unfriendly compared to Winter Harbor. The impression was undoutedly strengthened by fresh snow driven across the land and generally gloomy aspect under a dark low ceiling during most of our visit.

The coast of Grinnell Peninsula could be seen as far as Cape Majendie. North and west of Pioneer Bay the coast again becomes bold and rough with mountains rising into the overcast beyond. Prince Alfred Bay could be only roughly identified and no other harbors were observed.

The most interesting feature of Wellington Channel was the state of the ice. The channel was clear in the lower part but farther north there were patches and small fields of loose pack. The Northwind was not bothered by this ice and in fact any ship could have worked it. Conditions were probably very similar to those confronting Penny's and Belcher's sailing ships. Hazard was present in the amount of ice, which covered some fifty percent of the surface, but adequate open water remained for manoeuvers, provided care and foresight were exercised. It may be said that Wellington Channel was open. Furthermore there was evidence that Queen's Channel was also open since leads showed in that direction and it appeared that ice was moving through the channel from the north. It is probable that this passage could have been used to penetrate toward the north just as Franklin continued on around Cornwallis Island, and Belcher reached Northumberland Harbor with three ships in sail. It is interesting to speculate what might be the possibilities of navigation beyond and to the north through Belcher Channel and Norwegian Bay into the waters of Eureka Sound which were subsequently found to be open. Ice was apparently moving through Queens Channel, which would indicate slack ice beyond. Furthermore, it is likely that the barrier of the Ringnes, and Axel Heiberg Islands to the northwest prevent much invasion of polar pack to Norwegian Bay. If there is a majority of only local ice to contend with, and if this tends to slacken by movement southward, it appears probable that an ice-breaker similar to the Northwind could make substantial progress northward and very likely reach Eureka Sound.

It is recognized that theories and suppositions about ice are apt to be mis-leading or even dangerous. It is therefore proposed that if occasion warrents an aerial ice reconnaissance should be flown of Queens and Belcher Channels and Norwegian Bay.

Return voyage down Wellington Channel was uneventul except that considerable changes had taken place during 48 elasped hours. If anything there appeared to be more ice, or at least it was more heavily concentrated in the middle of the channel. On again entering Lancaster Sound, steaming east, an extensive ice field was encountered off the south coast of Devon which had been completely absent a week previous. This is probably evidence of an easterly movement of ice from Lancaster Sound during the late summer, or this new ice might have been blown across the straits from the south.

WINTER HARBOR - PHYSICAL CHARACTERISTICS

Although there are three or four alternates along the south and east coast of Melville Island, Winter Harbor (within the limits of our present knowledge) seems to offer the best all around combination of facilities for a weather station.

Anchorage

There will be some difficulty managing a ship in such a small harbor, but no real danger should be encountered getting a single vessel of 20' - 25' draft into a protected anchorage in eight fathoms of water. There is probably not room for more than one ship inside. The outer approaches should be surveyed for possible uncharted shoals (Northwind had 20 fathoms 2 miles southeast of Hearne Pt). Entry should be made on a low tide (tide range 2 1/2 ft) and on a calm day. Details of the harbor shown on HO 261 are believed to be quite accurate, although further check is desirable. Leading marks as established by Bernier are clear and provide good reference marks. If held closely to course a ship should be able to come to anchor on a planted bouy with just sufficient swinging room. For better security she might be turned by the aid of launches and anchored bow and stern, head to sea.

There is apparently excellent holding ground in clay.

The harbor is open to the southeast. There is very little danger of sea action, however, because of the persistence of ice fields just off shore. Ground tackle would have to be adequate to hold against winds. Even from the north the land affords little protection from wind, being low and flat. During our experience in Melville Sound (August 30 to September 5th) no winds were encountered above 30 mph although one should be prepared for storms. All available data indicatex prevalence of N to NW winds. From the east the anchorage is protected by a shoal point, or bar, having 1 1/2 fathoms.

The greatest danger to a ship in this harbor is in the possibility of a strong or prolonged southerly wind, which could drive the pack ice of the Sound onto the Melville shore. However, no very large pans can invade the narrow entrance between Hearne Pt. and the eastern shoal, and ice field pressures would tend to bridge across this opening. It is believed that this occurence would not result in anything more serious than the hazard of loose ice floating about. Also, strong southerly winds are rare.

Cargo Discharge

Approaches to the beach all around this harbor are shoal. At the head and on the east side, also down toward Hearne Pt., a mud clay flat is exposed at low tide to a width of approximately 50 yards. Lighters of 3' draft could therefore not approach even at high tide. The beach is better on the west side and best for a length of some 100 yards, abreast of Bernier's cache building.

At this landing place the beach is only some 12' wide and 20' - 30' at low tide. Probably a landing craft like the LCM could not come close enough to drop its ramp on dry beach at either tide. It would therefore be desirable to build a small jetty which could be done temporarily merely by pushing out an earth bank.

WINTER HARBOR

SKETCH FROM BERNIER CHART

The earth is soft, however, and it would be wise either to provide some rock (which can be found in the adjacent river bed) around the sides or to crib with timbers. A jetty 25' long and averaging 3' deep should serve the purpose.

The beach itself is fairly hard sandsand should support a D7 tractor.

Immediately behind the beach a bank rises some 6' to the general level of the land. The material here is earth (clay and sand) with perhaps 25% of small gravel. The bank could be broken down by bulldozer and used to build the jetty. Frost may be found at 18", and some difficulty will probably be experienced with soft traction after continuous operations.

In line with other experience it would be recommended that sleds be used for hauling from lighter to shore and in this case a long traveling wire or bridle might be used to keep the tractors on the top of the bank. A windlass could be used for the straight haul. Plans should not contemplate heavy equipment on the beach itself since the sand area is too narrow and the tide flat is mostly clay.

Camp Site

It has been observed, especially at Thule, that a great deal of extra labor is involved if the camp is placed too far from the beach for a single continuous haul from the lighter to final storage or deposit position. At Winter Harbor where any summer operaton must be very rapid, this point is important. It is fortunate that a construction close to the beach at Winter Harbor should be entirely satisfactory. No marked advantages of camp sites are obtained by moving inland in any direction.

It would be recommended that the camp be constructed in the close vicinity of the Bernier cache building where it now stands. This building, some 15' square, is in good repair and could be used as a construction office and tool shed.

The area suggested is almost perfectly flat and is of clayey earth with scattered small stones with a thin growth of moss and lichen on the surface.

The only disadvantage of the site near the present cache is that the bearing of the great circle course to Thule, on which a long Beveridge type low frequency antenna might be built, lies across the harbor. To construct a Beveridge antenna on Thule it would be necessary to originate about a mile north of the Bernier cache, and string the wire around the head of the harbor in the general direction of Northeast Hill. Rather than to move the whole camp however, it should be possible to provide remote control transmitters and not to plan on using the Beveridge antenna for receiving. A possible alternative which might be studied would be the use of a pontoon landing dock to reach across the tide flats and allow cargo discharge directly at the head of the harbor.

As a meteorological station any location near Winter Harbor is excellent. Exposures are unobstructed in all directions for upper air soundings, and weather conditions should be as representative as can be expected anywhere.

There is adequate storage space in all directions and large flat areas for antennae layout. Buildings should be designed to rest on sills since the 18" of soft earth over the frost is hardly adequate to hold foundation posts securely.

Fresh water for the camp may present a problem. The stream just behind the proposed camp site was running on occasion of our visit but it is probable this was due to rain on the day before and that this stream is often dry during the latter part of the summer.

Behind the camp the stream runs in a bed some 100 feet wide and 4 feet deep. A shallow pond could easily be impounded here and it is probable that there would be enough seepage to maintain the supply. If a pond could be held to freezing it would provide fresh ice in winter which would otherwise be difficult to procure. For ice purposes a second and deeper pond might be built farther up the stream where it narrows in a small ravine. For other sources of fresh water there are numerous shallow pools but these are so slight as to be practically useless. No lakes of any depth were seen within 5 miles of the harbor.

Water in winter will present something of a problem unless the stream can be impounded, since there are no ice bergs available. However, sea ice will probably be found of sufficient age to have freshened. Deep snowbanks will accumulate rapidly in the sheltered ravines. One has persisted all summer in considerable size. It might represent a saving of labor, however, to provide a small evaporator, and to use salt water which could be procured all winter by keeping an open hole.

Airstrip Possibilities

Around Winter Harbor the earth seems to be too soft for construction of an all-season airstrip without importation of surfacing material. However, a strip adequate for the frozen period of approximately nine months, can be provided with practically no effort.

For Weather Bureau purposes the use of a frozen strip is indicated since the cost of an all season surface must be large. The land all around the harbor is extremely flat and the hills as shown on Bernier's survey are scarcely more than low gravel mounds. The most convenient location, if the camp is built at site of the present cache building, is immediately in back of this site running NNW toward North Hill. The prevailing wind is apparently NNW to NW. The strip is restricted to some 3,000 feet length unless considerable earth moving is undertaken in which case it can be extended to 3,500 feet. (difference in grade is 8'). Surface of this area is at present cut here and there by small water ditches and has some standing water pools 3 to 4 inches deep. The ditches can be filled with little trouble. The pools will freeze solid and offer no hazard. There is a rise of some 2 feet to a second bench level about midway of the strip which requires grading off. A few rocks should be moved or broken. One bulldozer in three or four days should be able to level off a surface which when allowed to freeze would provide a flight surface. The length may prove to be a little less than 3,000 feet. Approach from the south is over water. Take off to the north is against gradually rising land.

It would not be recommended that this site be worked with any intention of improving it with all-season surface. It is too small. However, within the limits of our brief examination, the soil in this area appeared considerably better for building than any other in the vicinity. It will be noted that a stream cuts around in back of this location and it is probable that the area has been subjected to some alluvial action. The soil is a mixture of sand and clay but with substantial consistency. Perhaps 15% of small gravel is mixed with it. As above, it is not believed that this soil can be compacted to carry aircraft loads. Permanent frost was found at 18 inches down.

Except at the area above described the soil all around Winter Harbor seems to be a brownish clay with a little admixture of sand and pebbles. The surface is stickly under foot and one sinks in 1/2 to 1 inch when walking on bare ground. Musk ox tracks everywhere are depressed about 1 1/2" in it. In general the vegetation is only a thin growth of moss and lichen giving a bumpy blackish surface, but more firm underfoot. Around the head of the harbor and in the valleys to the east are soft meadows with shallow pools and grass.

In this gently undulating country there are many long level areas. I inspected one in particular forming the top of a low ridge parallel to the east side of the harbor. This is properly oriented to the prevailing wind-about NW. It was estimated to give a surface some 5,000' by 150' without a change in grade anywhere of more than 6". Not even riverlet ditches were observed. The only obstruction to aircraft consisted of scattered stones the largest of which projected 12" to 18". The surface, as described above, was soft brownish clay and practically devoid of vegetation. It should be noted however that this surface would be frozen as hard as concrete after October, and remain so probably well into June. At this place a winter landing area adequate even for heavy aircraft such as a C-54 on wheels could be prepared in a day or two simply by removing scattered rocks without any earth moving at all.

A similar area was reported by Captain Adams (Army Engineers) on a bench or low mound to the west of the harbor and some 1 1/2 miles back. From his description this area is perhaps not quite as extensive or level but can presumably easily be worked to form an adequate strip. It is somewhat more accessible to the camp site.

In summary of the above situation it would seem that a temporary winter landing strip could readily be prepared at any of several places while work progressed on all-season strip as desired.

It should be noted that a winter strip on land will here probably be preferable to use of harbor ice surface, and especially if a southerly wind should drive quantities of loose ice into the harbor at time of freezing. If flight to an advanced base requires use of skii aircraft because of advance base conditions it may be necessary to use the ice at Winter Harbor. It is not believed that a land strip will have enough snow unless artificially accumulated. However, it should be possible to collect snow by the use of snow fences and to distribute it on the strip. If then compacted a good surface for either wheels or skiis could be maintained.

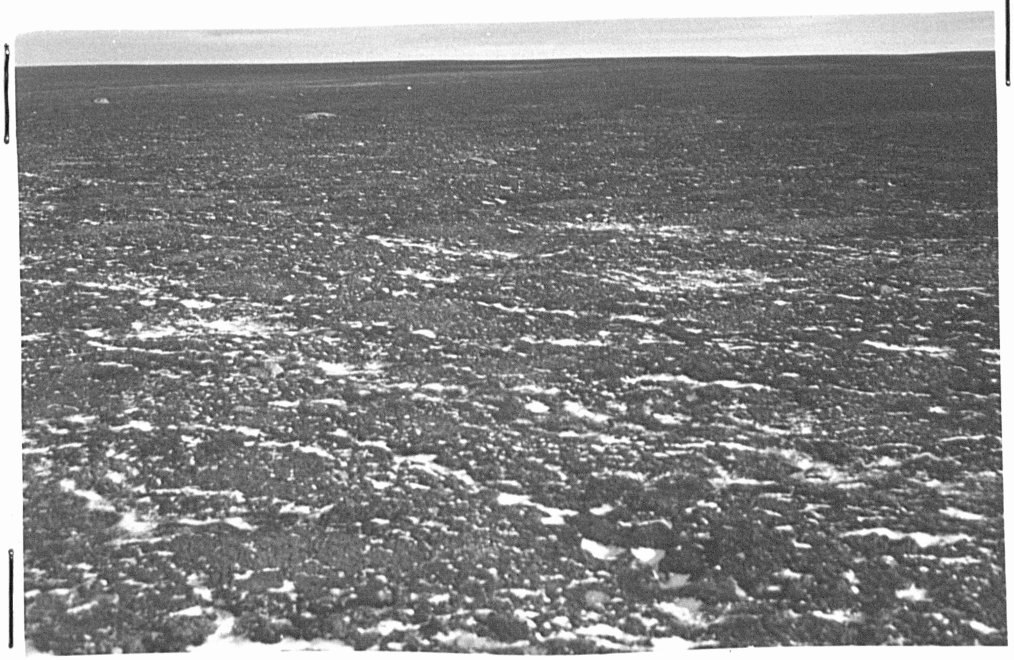
With reference to construction of an all-season flight surface it would probably be satisfactory to use steel plank or mat. This involves considerable expense however, and represents a large cargo problem. Furthermore it is temporary.

It is believed probable that enough rock can be procured around Winter Harbor to ballast a flight strip. Although time did not permit careful examination of this possibility it is presumed that bed rock will be found in the ravine of the adjacent brook, since there are already considerable accumulations of broken stone. This is a sandy limestone, but probably hard enough for ballast.

Large outcroppings of bed rock form the ridge of Fife Point, 4 miles to the east.

Crushed rock placed directly on the clay soil and rolled down to bear on the permanent frost should give a firm surface. This suggestion presumes the provision of a crusher, shovel, and probably track and cars for transportation.

The landing beach at Winter Harbor. The beach is firm sand and the grades are excellent for hauling from a lighter. The drop of the beach is a little shallow and will probably require the construction of a small jetty in order to bring LCM's to shore at all times. An adequate jetty can be constructed by pushing earth into the water with a tractor. The boat was part of Bernier's cache.



A view along a ridge, about two hundred yards east of Winter Harbor and running northwest and southeast. Visual observation indicated that this surface did not have a variation of over a few inches in a length of approximately five thousand feet. A few stones are scattered on the surface. If these are removed the surface is frozen and hardened. In its summer condition the soil of the area consists of a clayey limestone silt mixed with sand.

A musk ox on part of the level ground surrounding Winter Harbor. Hills are seen rising a mile or two in the background.

Looking along the west side of Winter Harbor. These plains are not continuous, being cut by small river beds and requiring considerable earth moving if used as a place for an emergency flight strip.

ALTERNATE SITES ON MELVILLE ISLAND

Alternates to Winter Harbor were examined by air only.

There is a harbor about half way between Winter Harbor and Cape Bountry which may have enough water for anchorage of a ship, although Sir E.W.Parry considered it shallow. It has poor protection from the south but would serve under favorable conditions. The beach looks a little wider than at Winter Harbor. Adjacent land is greatly undulating and substantially as described elsewhere.

There is also a small but well protected anchorage behind two low islands just east of Cape Bounty. This may be uncomfortably shallow. There are two deep water lakes just behind the cape, each some 3/4 mile long. About half the fresh water ice remained on September 2, 1946.

Dealey Island -- Bridport Inlet

Anchorage at Dealey Island is between the island and the long narrow spit of land enclosing Bridport Inlet. The anchorage is useful only for an establishment on the island itself, which is too small and rough for a flight strip. It would be difficult to reach the mainland since the adjacent spit is an outcropping ridge of rock with steep talus slopes and no beach.

It is apparently possible to enter Bridport Inlet over a bar between the east and west spits. Depth of water over the bar is not known but looked quite deep from the air. The inlet is not favorable however because of large amounts of persistent ice which do not escape through the narrow entrance. In this year 1946 it is not believed the inlet will clear.

There is flat land suitable for airfield construction both east and west of Bridport Inlet, but in general the country is more bold and rough than in the vicinity of Winter Harbor.

Skene Bay

This was observed by Captain Cruzen who reports good anchorage in clear water. The inner part known as Beverly Inlet had not cleared of ice on Sept. 4, 1946. Captain Cruzen reports flat land available in the vicinity suitable for an airstrip but in general Melville Island becomes increasingly high (to 500 feet approximately) and more bold toward the east. Skene Bay probably represents the best alternate to Winter Harbor if the latter were blocked off by ice.

East Coast of Melville Island

It is reported by air observation that along the east coast, which is shown bold on the charts, there are two or three deep harbors. Very heavy pack was found across the northern part of Byam Martin Channel.

APPENDIX I

To - Mr. Charles J. Hubbard - Chief, Arctic Section

From - Mr. John Lewis -- CAA Radio Engineer

Subject-- Report on Radio Installation at Weather Bureau Station, Thule Greenland. This report will cover the ordering, transportation, and installation of radio equipment with suggestions for future installations.

1. Ordering - In ordering radio equipment for stations to be established in the far Arctic - north of Arctic Circle - it was believed the problems to be encountered were the same as those in the Sub Arctic - southern Alaska, Hudson Bay, etc., that is, it was believed that high frequency transmissions would be broken up by auroral interference. This interference sometimes lasts for several days. Therefore, it was thought necessary to parallel high frequency circuits with low frequency circuits. The aurora does not often interfere with low frequency transmissions to the extent that they are broken up. So, for the main stations, Thule and Melville Island, both low frequency and high frequency equipment was ordered.

It was planned to install the point to point transmitters and the receiving equipment in the main operations building. The air to ground transmitters were to be installed in a separate building, for security reasons in case of fire. Separate power plants were to be provided.

High frequency transmitters T4/FRC 400 W output, one each for the following point to point frequencies were ordered 3390 KC, 5597.5 KC, 10645 KC plus one spare.

The point to point transmitters were to work into sloping V antennas, the air ground transmitters into doublet antennas. A low frequency transmitter, Wilcox 96 200 C, 3 KW output, was ordered for point to point on 170.5 KC. This was to work into a beveridge antenna.

A low frequency transmitters, T5/FRC was ordered for a homing beacon on 398KC. It was to be installed in the air ground building and work into a flat top antenna.

Two dual modulators, MD 1/FRC, were ordered. One for point to point and one for air ground. One rectifier, Wilcox 36A, was ordered for supplying power to the Wilcox 96 200 C transmitter. Remote control equipment CS 212 was ordered for the 96 200 C transmitter.

Remote control equipment CY 161/FRC was ordered for the T-4 and T-5/FRC equipment. One VHF transmitter, 624B was ordered for airport control service.

Eight Hammerlund Super Pro Receivers BC779 were ordered.

Twelve antenna towers were ordered. These were of triangular, sectional steel construction. They were shipped completely knocked down. Each tower was packed in four boxes. It was planned to use five towers, but the risk of losing parts thru the boxes being broken open was considered great enough to warrant ordering twelve towers.

Maintenance kits containing nuts, bolts, washers, screws etc. were ordered. Construction kits containing tools were ordered. Wire, insulators, spacers etc, for antennaand transmission lines were ordered.

Three 207B 15KW, three phase, 240 volt power units were ordered. It was planned to have a main and stand-by units in the regular power shed. The third unit was to be an emergency unit installed in the air ground building.

2. Transportation - Practically all of the radio equipment was furnished by the Army. There was so little time between the date of ordering and our scheduled shipping date, that the utmost haste was necessary. The equipment was received in such large lots that the Weather Bureau checkers at the warehouse in Boston were swamped. It was not possible to segregate similar equipment for checking purposes.

By the time I arrived in Boston, the Thule radio equipment was about half loaded in the number two hold of the USS Alcona. I attempted to identify all the major items. Sometimes all I could do was measure the visible, unmarked end of a box and compare it with a similar box in the Melville pile. The loading was hastily and carelessly done. Little attention was paid to the manufacturers marks on the boxes such as "This Side Up", "Handle With Care", "Top", "Fragile".

I had asked, and it was agreed to, in our meetings in Washington, that the antenna equipment be loaded last so that it might be unloaded first. This would give me a chance to assemble and erect the towers while the unloading of the ship and construction of the buildings were taking place. When I noticed that the equipment was being placed in the hold without regard to the unloading sequence, I was assured that the number two hold would be unloaded first, and the radio equipment would be among the first to come out. Unfortunately this action was not fully accomplished resulting in delays in subsequent assembly of the radio units.

3. Installation - Installtion first of all involved selecting a site. This had to be a compromise between a hillside that would afford protection from the wind for the buildings and a flat area that would have been most suitable for our proposed antenna layout. A compromise site was finally selected. The antenna layout was limited by a steep slop on one side, a hill on another and a creek on a third.

In laying out a Beveridge antenna directed on Army Station BW8 it was found that 3,500 feet was as far as we could go in that direction. Here a sloping rise that terminated in a 1,000 foot cliff began. We had planned to erect a 6,000 foot, two wire Beveridge supported on 4 x 4^s with cross arms. The 4 x 4^s failed to arrive, so we put up a single wire supported on 2 x 4^s embedded in the permafrost.

Three steel antenna towers were erected. The bases and guy rods were put about four feet below the surface of the ground. This means that they are 2 1/2 to 3 feet in the permafrost. The holes were dug with an air hammer and liberal use of small charges of TNT. And at that it was a pretty tough job. The holes were filled in with heavy rocks and dirt.

Practically every box of antenna material was broken open due to rough handling. This resulted in about fifty percent of the nuts and bolts, and numerous small pieces being lost. It was necessary to open nine sets of boxes to secure enough small parts to assemble four towers. It is suggested that on future jobs the ends of the boxes containing antenna material to ruggedly reinforced by using iron bonds or heavy iron wire well secured.

Erecting the steel towers, with the inexperienced help available, proved to be quite hazardous. One tower was completely wrecked due to carelessness on the part of a crane operator. Luckily no one was injured. An experienced rigger should be available for such work. Inexperienced people don't realize the risk to temselves and the equipment.

It was found the tower parts were not carefully punched. It was necessary to file out or re-drill too many holes.

Two sloping V antennas were instaled. The legs were of No 8 hard drawn copper wire, 1,200 feet long and enclosed a 33° angle. The apex was 70 feet above ground. A 600 ohm, open wire transmission line to the transmitters was used. One V was directed on BW8, the other on Fairbanks, Alaska.

Four half wave doublet antennas were installed. They were cut to 3452.5 KC, and 6355 KC for air ground, and 10645 KC and 15000 KC for comparison with V antennas on point to point at these frequencies. All were connected to the transmitters on 600 ohm, open wire transmission lines using a delta Y match at the antenna connection.

One vertical antenna, 70 feet high, having a 230 foot T type flat top was installed for a homing beacon at 398 KC. It was connected to the transmitter on a 600 ohm open wire transmission line.

The Beveridge antenna also was connedted to its transmitter on a 600 ohm open wire transmission line. When it came to installing the transmitters and power units our original plans were not adhered to. It was found that the Jamesway Huts were not suitable for housing transmitters or power units. It was decided not to house the air ground transmitters in a separate building. It was decided to partition off twelve feet of the operations hut and install the regular and stand-by 207B power units here. A double wall partitions was built and the noise and vibration in the operations end of the hut were negligible. The third 207B power unit was not removed from its crate being held as an emergency unit.

One of the two power rectifier units PP 1/FRC was damaged beyond repair in shipment. Since each power rectifier supplies power for all T-4/FRC and T-5/FRC channels in an FRC transmitter unit it was necessary to give up the idea of having a separate unit for air ground service.

One complete FRC equipment consists of four T-4/FRC high frequency channels, one T-5/FRC low frequency channel, one dual modulator capable of voice modulating any two channels and one PP 1/FRC power rectifier which supplies power to all channels. Any four channels can be operated at the same time. This is so each of four operators can control and work one channel at the same time or any one operator can work one to four channels simultaneously. For the volume of work at our stations it is believed one FRC transmitter (4 High RF Channels and one Low RF Channel, any two of which can be modulated) will be sufficient. At any time one operator on point to point can have one modulated and one unmodulated channel available, and another operator on air ground can have a modulated and an unmodulated channel available. If a frequency shift is necessary it can be easily and quickly done in this type equipment by changing coils and crystals and returning. Therefore it is not deemed necessary to have an exclusive channel for each frequency available. On future jobs it is suggested that only one FRC transmitter with one spare high RF channel be provided.

It was found that the sloping V antennas worked very well with T-4/FRC channels. The loaded up very easily and nicely. I had the opportunity of observing only a few days operation but the results seemed very gratifying.

Operation on the low frequencies was not tried. No fuses had been furnished with the Wilcox 96 200 C transmitter. However, some experiences that we had with the radios in the Naval ships and the experience of the Danes who had been operating a small radio station at Thule for several years, also experiences of pilots who have flown over the area, indicate that we can predict what our experiences will be. In the sub Arctic the breaking up of high frequency signals by auroral interference is accompanied by excessive hissing and crackling noises. The low frequencies come thru pretty well at these times. Therefore it has been found advisable to have parallel high and low frequency circuits.

In the far north, a different kind of interference is encountered. Here a complete blank out of radio signals occurs. Both high and low frequencies are affected. It is as if the power were turned off. The receivers are silent, no carrier, no scratching, no squeals, nothing but silence. According to a Danish operator, who had logged these interferences for two years, they occur about every twenty seven days. Generally they last for only a few minutes or a few hours, but sometimes for several days, and in one instance for three weeks.

Going north on the Alcona, as we neared the Arctic Circle, we lost radio contact with the ships ahead of us. We were the last to leave Boston. All European and American stations, as well as ships at sea to the south of us were receiving normally. This condition lasted about a day. Then we entered the blank out area and were completely out of contact with all stations regardless of location, frequency or power. This lasted for several days. Then we contacted the ships to the north and finally normal conditions were resumed. While the interference lasted ships to the north of us were unable to hear us though we constantly tried to contact them. They were only a couple of hundred miles away from us. The ships to the north of the interference were able to communicate between themselves, but all stations in and south of the interference were blanked out for them also. There were five Navy ships north of us at this time. Also some Navy airplanes were in the area north of us. Most of them had good radio equipment. One ship reported hearing stations from Honolulu and California during the interference. Probably coming over the top. About a month later another blank out occurred. It lasted only a few minutes.

From the Danes experience, communications can be maintained better than eighty percent of the time on high frequencies. When the blank-outs occur low frequencies are affected as much as the high. Therefore it seems ill advised to have heavy bulky low frequency equipment at places that are hard to reach knowing before hand that it will probably be of little use.

By eliminating low frequency equipment the number of towers necessary can be reduced. Also the size of the power equipment can be reduced. Less space in the operations room will be required, and the installation generally can be reduced. Thule will serve as a proving ground for testing low and high frequencies this winter. Our men there are alerted and anxious to make the comparisons.

A shortage of tools at first slowed down the job. As unloading progressed more tools were available. It would be a good plan to load all tools where they would be among the first things off the boat. Also a tent or two should be erected to house all tools with a man in charge at all times who is accountable for the tools.

Nuts, bolts, screws, washers should also be issued out. Great waste of these things occurs when every one goes about opeing boxes looking for what he wants.

Tents should be set up for shelter and for eating lunches. The antenna layout and the layout of the equipment in the operations hut as finally installed is shown on the attached sketches.

John Lewis
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