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JOINT CANADA/UNITED STATES

TOUR OF THE D.E.W. LINE

OCTOBER 3 - 10 1959

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I. MEMBERS OF THE PARTY

Canadian Group

The Honourable Raymond O'Hurley, Minister, Defence Production Department.

The Honourable Wm. J. Browne, Minister-without-Portfolio.

Mr. R. G. Johnson, President and General Manager, Defence Construction Limited.

Mr. G. W. Hunter, Assistant Deputy Minister, Defence Production Department.

Mr. B. G. Sivertz, Director, Northern Administration Branch, Department of Northern Affairs and National Resources.

Mr. J. K. Starnes, Chief, Defence Liaison (2) Division, Department of External Affairs.

Mr. V. F. Valentine, Acting Secretary, Advisory Committee on Northern Development, Department of Northern Affairs and National Resources.

United States Group

His Excellency Richard B. Wigglesworth, U.S. Ambassador.

The Honourable Allen W. Dulles, Director of the Central Intelligence Agency.

Major-General Robert Taylor, U.S.A.F. Commanding General Central Co-ordinating Staff (Canada).

Colonel Robert W. Witty, U.S.A.F. Air Attache.

Mr. G. B. McManus, Attache and Special Assistant to the Ambassador.

Colonel Andrew J. Reynolds, Commander, 4601 Support Group "DEW", Paramus, N.J.

Crews of the Aircraft

1. D.O.T. Viscount:

(a) From Ottawa, on Oct. 3

Captain H. R. Finley	-	Captain of the Aircraft
Captain W. M. Howes	-	First Officer
Mr. F. C. Jones	-	Flight Engineer
Mr. C. V. Dick	-	Flight Engineer

(b) From Elmendorf, on Oct. 8

Captain H. R. Finley	-	Captain of the Aircraft
Captain D. L. Button	-	First Officer
First Officer A. H. Lindop	-	Co-pilot
Mr. F. C. Jones	-	Flight Engineer
Mr. C. V. Dick	-	Flight Engineer

2. U.S.A.F. C-54:

(a) From Frobisher Bay, on Oct. 4

Major Robert H. Campbell	-	Aircraft Commander
Captain Garland E. Giles	-	Pilot
F/L J. E. Braidon RCAF	-	Navigator
F/O G. H. Wynnyk RCAF	-	Navigator
F/O N. A. Sissons RCAF	-	Radio Officer
T Sgt. M. Traylor	-	Flight Engineer
T Sgt. R. Sanford	-	Flight Engineer
S Sgt. M. Wyatt	-	Steward
S Sgt. Stone	-	Steward

II. ITINERARY OF THE TOUR

Saturday, 3 Oct 59 (Note pages 6 to 10)

0800 EDT Depart Ottawa via D.O.T. Viscount

1100 ADT Arrive Seven Islands, P.Q.
- Refuel

1130 ADT Depart Seven Islands for Frobisher Bay
- Lunch on aircraft

1400 EDT Arrive Frobisher Bay
- Tour of airport installations and townsite
- Dinner
- Remain over night

Sunday, 4 Oct 59 (Note pages 12 to 13)

0900 EDT Depart Frobisher Bay for Cape Dyer via U.S.A.F. C-54

1045 EDT Arrive Cape Dyer
- Tour of DEW Line installations
- Lunch

1445 EDT Depart Cape Dyer for Thule, Greenland

1820 EDT Arrive Thule Air Base
- Dinner
- Remain over night

Monday 5 Oct 59

- Briefing on Thule airbase activities by Commanding Officer and staff
- Lunch
- Tour of Thule installations
- Dinner
- Remain over night

Tuesday 6 Oct 59 (Note pages 14 to 28)

0700 EDT Depart Thule for North Pole via U.S.A.F. C-54
- Orbit North Pole for 10 minutes
- Lunch on aircraft

1600 MST Arrive Cambridge Bay
- Tour of DEW Line facilities
- Dinner
- Tour of townsite
- Remain over night

Wednesday 7 Oct 59 (Note pages 30 to 42)

0900 MST Depart Cambridge Bay via U.S.A.F. C-54 for Inuvik

1215 PST Arrive Inuvik
- Lunch
- Tour of Inuvik townsite facilities

1615 PST Depart Inuvik via U.S.A.F. C-54 for Elmendorf Air Force Base, Alaska

1800 AST Arrive Elmendorf Air Force Base
- Dinner
- Visit Anchorage
- Remain over night

Thursday, 8 Oct 59 (Note pages 43 to 47)

- Briefing by Commanding General and staff on Alaska Command activities
- Mr. Bernard Poirier, Executive Assistant to the Hon. R. O'Hurley joins party aboard D.O.T. Viscount

1100 AST Depart Elmendorf via D.O.T. Viscount for Prince George, B.C.
- Lunch on aircraft

1715 PST Arrive Prince George
- Hon. R. O'Hurley leaves party

1730 PST Depart Prince George via D.O.T. Viscount for R.C.A.F. Station, Cold Lake, Alberta

2015 MST Arrive Cold Lake
- Dinner
- Remain over night

Friday, 9 Oct 59 (Note pages 48 to 49)

- Tour of R.C.A.F. station installations

1200 MST Depart Cold Lake via D.O.T. Viscount for Churchill, Manitoba
- Lunch on aircraft

1535 CST Arrive Churchill
- Tour of townsite
- Dinner
- Remain over night

Saturday, 10 Oct 59

- Tour of base installations

1100 CST Depart Churchill via D.O.T. Viscount for Ottawa
- Lunch on aircraft

1700 EDT Arrive Ottawa

NOTE

Further details will be announced aboard aircraft.

SEVEN ISLANDS, QUE.

Seven Islands is a town in Saguenay County on a bay of the same name near the west end of the Gulf of St. Lawrence about 350 miles below Quebec City. The first map of Canada drawn in 1536 from data supplied by Cartier mentioned the "7 Yles". Actually there are only six islands, all near the entrance to the bay. The seventh island only appears to be such and is a part of the mainland. They are high and steep the highest reaching 730 ft. and have little vegetation. The bay is almost circular, about seven miles in diameter. It is so enclosed that it resembles a lake and makes a well protected harbour reached by three channels.

There has been a trading post and mission on the bay of Seven Islands since 1650 sometimes neglected but never abandoned. The first missionary was the Jesuit Jean de Quen in 1651. A chapel built in 1744 was in use more than one hundred years. The trading post was pillaged in 1759 but after the conquest it was operated by the Northwest Company and from 1821 to the present by the Hudson's Bay Company. A small settlement grew up about the post on the east side of the bay dependent upon hunting, fur trading, and fishing. The adjacent area was organized as the township of Letellier in 1866 and a resident priest was assigned to the Seven Islands mission in 1906.

The decision to mine the vast iron ore deposits of the Knob Lake-Schefferville area and build a 358-mile railway thence from Seven Islands began in 1950 to transform the settlement. The town was incorporated in 1951. Docks were built to handle ten million tons of ore during the June to November shipping season. The Quebec North Shore Labrador Railway came into operation in October 1954. Hydro-electric development on the Ste. Marguerite River came into production in 1954 to supply power for the railway terminal, the docks, and the community. The town has scheduled airline service. It is connected by coastal road with Moisie to the east and Clarke City to the west and is eventually to be reached by Highway 15 from Baie Comeau.

FORT CHIMO

The first discovery of Ungava Bay by Europeans is in some doubt. Presumably information from Portugese fishermen must have been responsible for a bay which appears on Mercator's map of 1569 and which is supposed to represent Ungava Bay. The first record of exploration in the vicinity is that of John Davis, who named Cape Chidley at the entrance to Hudson Strait but did not enter Ungava Bay. Weymouth visited the bay in 1602, and Henry Hudson, having read Weymouth's journals, entered Hudson Strait in 1610. Ungava Bay is not mentioned for a number of years after Hudson, but undoubtedly many of the exploring parties which entered Hudson Bay passed Ungava Bay, and some probably sailed into it. French fur traders penetrated far into the region, and a map published by Delisle in 1703 used the name "Baie du Sud" for Ungava Bay.

In 1811 two Moravian missionaries, Kohlmeister and Knoch, sailed from Labrador into Ungava Bay, mapping many of the features of the eastern and southern portions of the bay. They ascended the Koksoak River at least as far as the site of Fort Chimo, where they were well received by the natives. On their return to England they described the region in enthusiastic terms, for it seemed to them very pleasant compared to the barren coast of northern Labrador.

No notice appears to have been taken of this report except by the Hudson's Bay Company, which took steps to open trading negotiations at Chimo. A preliminary survey was made in 1828 by Dr. William Mendry (or Hendry), who approached Fort Chimo overland from Richmond Gulf in Hudson Bay. The post was established in 1830, but owing to difficulties in supplying it (the sea route being still largely unexplored), it was abandoned in 1843. In 1866 it was reopened and supplied by sea by the company's new vessel Labrador. Other trading posts were opened at Port Burwell, George River, Payne Bay, and Leaf River, but all except Payne Bay have since been closed.

The first scientific explorer in the area was L. M. Turner, who spent over two years, from August 1882 to September 1884, in and around Fort Chimo, keeping weather data and making ethnological investigations and collections of animals and plants for the Smithsonian Institution. Between 1892 and 1896 A. P. Low of the Geological Survey made explorations in the Ungava Peninsula, and in 1897 he explored the south coast of Hudson Strait, including Ungava Bay as far east as George River. From that date until quite recent years there was little work other than fur trading done in the area. Ungava remained one of the least travelled parts of Canada until the establishment of the air base at Fort Chimo, which, by easing the transportation problem, has enabled a number of scientists to increase the sum of knowledge of the interior and of the waters of the bay.

The old settlement of Fort Chimo lies on the right bank of the Koksoak River (Eskimo for "big river") about 25 miles from its mouth. It is the main Hudson's Bay Company trading post for the Ungava Bay district. Being situated on the tree line it is used by both forest Indians from the interior and the Eskimos who live 'round the coast of Ungava Bay.

The name "Chimo" is a native word. R. M. Ballantyne, who was a servant of the Hudson's Bay Company in the middle decade of the nineteenth century described it in Ungava, his adventure story for boys, as "An Esquimaux word of salutation....used by the natives when they meet with strangers. It signifies "are you friendly?" by those who speak first, and seems to imply "we are friendly" when returned as an

answer. So well-known was the word to the fur traders who trafficked with the natives of Hudson Strait that they frequently applied it to them as a name, and spoke of the Esquimaux as "Chimos". The Eskimos today use it as a greeting.

As well as the trading post there is a Department of Transport meteorological station, an R.C.M.P. post, a nursing station and school run by the departments of National Health and Welfare, and Northern Affairs and National Resources respectively, and Anglican and Catholic missions.

Seven miles further up the river, on the opposite bank, is the air base established by the U.S.A.F. and known during the war as Crystal I. The U.S.A.F. portion of the airstrip is now closed, but the Department of Transport have a meteorological station there and a small maintenance crew. The federal government agencies at the old settlement have now moved to this new location and only the native population, the Hudson's Bay Company and the Anglican mission will remain on the right bank.

Fort Chimo lies on the northern extension of the Labrador Trough (Iron Range) and the area is known to have deposits of speculated hematite. As a result of interest raised by the Labrador iron ore development, a number of private companies obtained concessions around 1950 to the north-west of Fort Chimo in the Payne Bay and Diana Bay areas. These properties have been examined and as a result serious development is dependent on the European market. It is the intent to ship the concentrated ore to Greenland during the short navigation season where it can be stockpiled for re-shipment throughout the year.

Very early geological reports by Dr. A. P. Low pointed out that the area north and west of Fort Chimo was favourable for base metal mineralization, and in the last few years a number of companies and individuals have been very active in the field prospecting, with some success. Unfortunately the isolated location does not allow its economic development at this time.

THE NEW QUEBEC CRATER

The New Quebec Crater, previously called the Ungava Crater and Chubb Crater, was first found on photographs taken by the U.S. Air Force in 1943 on which it was indicated by a lake of strikingly circular shape. The possibility of a meteoric origin was early suggested by several scientists. Dr. V. B. Meen, of the Royal Ontario Museum, led two expeditions to study the crater in 1950 and 1951, and became convinced of its meteoric origin. So far no better explanation of this interesting feature has been suggested.

In 1953, the Royal Canadian Air Force carried out a detailed aerial survey of the crater. From this it has been found that the crater profile is of a type corresponding to the other meteor craters on the earth and to the craters on the moon. The diameter of Crater Lake is 9,500 ft.; diameter of the rim, 11,500 ft.; depth of the lake, 825 ft.; and highest point on the rim above the lake, 530 ft. The crater lies in the granitic rocks of the Precambrian Shield and is one of the largest features of this type known on the earth. For example, the diameter of the well-known Arizona meteor crater is only 4,000 ft. The New Quebec Crater has been heavily glaciated and so was formed some time before the last ice age. Like the Arizona crater however it is recent in terms of the earth's history.

During the last few years several other possible meteor craters have been located in Canada. It is not surprising to find so many craters here since the rocks of northern Canada are some of the oldest on the earth and should therefore show unobscured records over a very long period.

FROBISHER BAY

Frobisher Bay is a great funnel-shaped bay over 200 miles long. The deep water and narrowing shores have the effect of increasing the tidal range and at the head of the bay the rise and fall at average spring tides is 44 ft., one of the greatest tidal ranges in the world. Towards the end of October the bay freezes and it does not break up sufficiently to allow ships to enter until mid-July.

The bay was named after Sir Martin Frobisher who entered it in 1576 in search of a northwest passage with two tiny ships, the "Gabriel" and "Michael", 20-30 tons. He sailed about two-thirds of the way up the bay but was distracted from his quest by the discovery of what he thought to be gold. In the two years following, he again visited Frobisher Bay and established a mine near the entrance to the bay, but the ore proved to be worthless.

The next person to visit Frobisher Bay was C. F. Hall, in the middle of the nineteenth century. He showed that it was a bay and not a strait as had been believed till that time. Here he was surprised to meet an Eskimo woman who spoke excellent English. It transpired that she and her husband had been to England on board a whaling vessel. The Prince Consort had met them and invited them to Buckingham Palace, where they had spent some time with Queen Victoria and got to know the little princes and princesses.

With the extension of fur trading to the Eastern Arctic, the Hudson's Bay Company established a trading post at Frobisher Bay in 1914. Walrus and seal are plentiful in Frobisher Bay and, although there are not many caribou or white fox, the Eskimos obtain a reasonably good supply of food along the shores of the bay.

In 1942, the U.S.A.F. built an airfield and a base for up to 500 men at the head of Frobisher Bay, some thirty miles from the Hudson's Bay Company's post. The field was one of the several built during the Second World War as part of the Crimson Air Staging Route. At the end of the war, the Canadian Government reimbursed the U.S. Government for the cost of these airfields and the R.C.A.F. took over the operation of the Frobisher airfield from the U.S.A.F. in September 1950. The R.C.A.F. in turn relinquished the operation of the airfield to the Department of Transport in September 1957. The present population approximates 1,500 including government staff, the R.C.M.P. detachment, Eskimos, contractors, and U.S.A.F. personnel. D.O.T. also has a weather and communication office. The Hudson's Bay Company's post has been moved to a site two or three miles from the air station.

Around 1954 the government decided that Frobisher Bay should be a centre for the Eastern Arctic, where there would be facilities for schooling, rehabilitation and medical care. A site was chosen for the new town some three miles from the air base near the Hudson's Bay Company's post, and the initial construction programme in 1955 was the erection of a school, a nursing station and garage-workshop, and seven Eskimo houses. The townsite now has a service road to the base, a school with a Department of Northern Affairs and National Resources teacher, a four-bed nursing station operated by a National Health and Welfare nurse, and a workshop-garage for mechanical repairs and training.

Mr. F. Delaute is the Area Administrator at Frobisher Bay in charge of the government projects and to represent the interests of the Department of Northern Affairs and National Resources in the area. These interests are numerous at the moment since Frobisher is

again sprouting new roots: A permanent townsite is being developed at a new site between the Apex Hill location of the original settlement and the D.O.T. airfield. The airfield itself is being improved to accommodate large civil and military aircraft. The additional facilities are aimed at making Frobisher Bay into a SAC tanker base. The runway is being lengthened to 9,000 feet for this purpose and the extension should be complete by this fall. This project is a major one, including taxiways, parking and refuelling aprons, high intensity lighting: the cost is approximately $6.3 million.

CAPE DYER

Cape Dyer, 800 nautical miles north of Goose Bay is the easternmost point of land on Baffin Island. It was first mapped in 1818 by Commander John Ross of the first British naval expedition for the discovery of the Northwest Passage.

Cumberland Peninsula on which Cape Dyer is located, is mainly alpine in character with sharp peaks and ridges, but in some sections they are table-topped. There are many glaciers, but the ice cover is not continuous except in the Penny Icecap. There are peaks of just over 7,000 feet in the centre of the peninsula and a ridge running northeastwards towards Cape Dyer has heights only a little less. The coastline in the vicinity of Cape Dyer is bald and high.

Cape Dyer has been in operation since 1957. The airfield is 1½ miles east-southeast of the landing beach on Exeter Bay. It has a gravel runway capable of handling DC4-type aircraft. Navigational aids include a radio beacon and air-ground communications. A terminal building has been completed in the fall of 1958.

THULE, GREENLAND

The base was operated from 1952 until 1957 by the North East Air Command (U.S.A.F.) and was transferred to the Strategic Air Force in mid-1957. The sea approaches are very favourable and relatively ice-free compared to Resolute Bay or similar sites in the Canadian Arctic. The climate is reasonable and, on the average, no worse than Churchill. These factors have naturally attracted to this location a number of the ancillary activities of the U.S. services.

The U.S. Army maintains some 14 miles to the south-east the Polar Research and Development Centre where the seven corps of the U.S. Army undertake arctic research. This is not confined to the land mass but is intensively prosecuted on the Greenland Ice Cap itself at two sites about 200 miles inland.

Thule is also the site for one of the BMEWS radars. The whole installation is under the protection of the U.S. Army Nike-Hercules Battery.

Resupply and port facilities are a responsibility of the Military Sea Transport Service (U.S.N.) and of the port companies of the Transportation Corps (U.S. Army).

LAKE HAZEN

About thirty miles inland from the Lady Franklin Bay system of fjords is the large Lake Hazen which has a length of about 50 miles in a northeasterly-southwesterly direction and a width varying from 2 to 10 miles. Mount Arthur, an isolated peak surrounded by low, round hills, rises to 4,500 feet about 25 miles south-southwestward of Lake Hazen. The Very River which has its source in the vicinity of Mount Arthur, empties into the south-western side of Lake Hazen. The lake discharges from its south-eastern side through the Ruggles River which empties into the head of Chandler Fjord.

The Defence Research Board's IGY base camp was situated on the north side of Lake Hazen opposite the westerly end of Johns Island. The camp area has good footing for any type of helicopter landing. The seaward approaches from Hall Basin through Lady Franklin Bay and thence to Conybeare Bay to Chandler Fjord, from the track of USCGC EASTWIND in 1957, showed deep soundings all the way to the anchorage at Chandler Fjord. To the south of Miller Island there is a reef extending from the south shore to within 1,000 yards of the southwest end of the island. At the eastern end, Miller Island rises to 1,500 feet and the western section to 950 feet high. The anchorage at Chandler Fjord is 30 fathoms with a mud and silt bottom, and it provides good shelter.

Operation Hazen was organized by the Defence Research Board as part of the Canadian International Geophysical Year programme to carry out meteorological, glaciological, geophysical and geological investigations in the Lake Hazen region of northern Ellesmere Island during two summers and one winter. Biological and archaeological studies were also made in 1958.

The winter party consisting of four graduates from McGill University, relieved the first summer party on 18 August, 1957, and remained throughout the following summer. The 1958 summer party was much larger, totalling about 20 persons.

The winter party successfully achieved their main objective: a complete record of synoptic meteorological observations. Studies were also made in micrometeorology, on ice growth and snow cover on the lake, ground temperatures and local wildlife. The same party maintained meteorological observations throughout the summer to complete a year's record - the first of its kind from an inland station north of the Canadian Arctic mainland. The living hut was an Attwell shelter, heated by an oil-burning stove, which was also used for cooking; a second Attwell shelter was used for stores. On 29 March, 1958, a C130A ("Hercules") aircraft of the United States Air Force, under the command of Major C. E. Fitzwater, U.S.A.F., landed on the lake from Thule Air Base with a load of 9 tons of fuel and the first visitors to the station since the previous August.

Thirteen members of the expedition were based on the lake during the summer. Gravity stations were established at Lake Hazen, and several other locations, which were tied in with the Canadian and Greenland network by observations at Fort Churchill, Resolute, and Alert. The geological reconnaissance started in 1957 was extended across the ice cap to Clements Markham Inlet, across the plateau to Alert, eastward to Fort Conger and southward to Judge Daly Promontory.

The aquatic life of the lake was studied, with special reference to the feeding habits and life cycle of the Arctic Char which abound in the lake; measurements on over 500 of these fish were recorded. About 100 species of flowering plants were found in the immediate vicinity of Lake Hazen; two full collections were made, and many of the species were photographed in colour.

Travel in the vicinity of the lake was by tractor, dog team, pack dog and motor-boat. Two Eliason motor toboggans and two dog teams were used on the glaciers and ice cap throughout the summer. Dogs were hired from Thule (Kanaq) by courtesy of the Danish authorities. During the first two weeks of August the operation was greatly assisted by Dr. Terris Moore who, in his float-equipped Piper Supercub aircraft, flew members of the party on a number of reconnaissance flights. This aircraft which he had flown up solo from the United States, proved to be extremely versatile.

ALERT

The site for the weather station at Alert was chosen as a result of reconnaissance carried out by the Sea Supply Mission of 1948. At the time some supplies were landed to establish the station. This was planned for the next summer but ice conditions in 1949 prevented the icebreakers from reaching Alert, and the station was therefore established by air in the spring of 1950. From the beginning, sea supply has only been carried out with great difficulty.

The problems encountered have been for the most part the result of heavy polar ice on the north coast of Ellesmere Island and at the north end of Robeson Channel. These difficult ice conditions were reported by the first ice recorders in the area and there is no reason to suppose that there will be any improvement in the future. It must be concluded therefore that supply of Alert by sea will continue to be undependable and will on many occasions lead to major damage to shipping.

The supply of the weather station at Alert by air alone is not in itself a difficult undertaking. Mould Bay and Isachsen, two similar stations, are supplied solely by air. There have been indications however that activities in north Ellesmere Island may expand. The development of a location which must be supplied entirely by air entails heavy expenditures and the commitment of considerable resources.

Since the difficulties of sea supply have usually occurred within the last few miles of the voyage to Alert, it has been suggested that they could be avoided if the station were established on the channel between Greenland and Ellesmere Island rather than on the exposed northern coast. On the other hand the Meteorological Division of the Department of Transport is reluctant to move for technical reasons.

The radio and meteorological station was established in 1950. It has an emergency landing strip operated jointly by Canada and the United States. It is the most northerly permanent human habitation in the world.

THE ARCTIC OCEAN

The Arctic Basin consists principally of two relatively deep areas (10,000 feet to 15,000 feet) separated by a submarine ridge extending from about the New Siberian Islands to Ellesmere Island. This ridge comes to within about 3,000 feet of the surface in places and divides the deep waters of the two main basins. The bottom topography of the Arctic Ocean is poorly charted but appears to be quite complicated. Along the Soviet Arctic coastline very shallow seas extend out several hundred miles from land and the coastal waters are divided by island chains into five shallow seas. On the American side the coastal waters are relatively deep.

Substantially all of the Arctic Ocean is covered by floating ice. The main pack recedes 50 to 100 miles from the coast of Alaska for a few months during the late summer and closes again on the land during November. Restricted on all sides by land and constantly churned by wind, tide and current, the pack ice resembles at first sight a giant jigsaw puzzle whose pieces are continually stirred by some unseen hand. Pressure ridges crisscross everywhere, new leads are constantly opening only to freeze again to form new ice. In winter the average thickness of the pack ice is probably 9 to 12 feet and in summer 6 to 9 feet, but the crushing force of the pack raises great hummocks and pressure ridges under which the thickness may be much greater.

The pack ice depends for its existence on the fact that during most of the year, a great deal more heat is lost by radiation than is gained from the sun. This heat budget is reversed during the summer months of constant sunlight.

This thermal cycle is a regular annual feature. During the brief summer season, melting occurs off the top. During the winter, the thickness increases by freezing on the bottom, but the thicker the ice the slower the freezing. The average thickness depends mainly upon the balance between summer melting and winter freezing.

Except near land, the ice is driven mainly by the wind. In general the ice moves at about 1/50 the speed of the wind and veers approximately 40° to the right due to the rotation of the earth. Since the surface wind over the ice blows about 40° to the left of the isobars (the lines of equal barometric pressure), it turns out that the ice drift is approximately parallel to the isobars. Thus, an area of surface convergence is an area of packing, and in an area of divergence the packing forces are relieved and more open water appears. As high and low pressure systems sweep across the Arctic Basin, the pack is churned into a chaotic maze of pressure ridges and open leads. In this competition for space the thicker and stronger floes survive the weaker ones. However, there are other processes which break up heavy floes as readily as thin ones. (Long continuous leads traversing widely differing floes are presumed to be caused by internal waves in the water below the ice).

NAVIGATION IN THE ARCTIC

Arctic navigation, contrary to popular belief is not an art in itself, but certain conditions exist in the Arctic that render the practice of Navigation more difficult. Conventional magnetic compasses are unreliable north of latitude 65 N., but the free gyro is quite a satisfactory substitute for the magnetic compass. Establishing a datum for direction is the biggest problem. To do this and to maintain a constant aircraft heading is always important to the Navigator: in the North this presents special difficulties. Convergence of meridians to the geographic north pole makes the definition of direction as used in middle latitudes impractical. The technique of "Grid Navigation" evolved from this need, and the technique of "Gyro Steering" emerged from the compass problem.

There are of course other problems of navigation in Canada's Arctic such as the long hours of twilight, daylight and darkness; and the scarcity of ground based navigation aids.

GRID NAVIGATION

"The Problem of Direction"

Navigation in middle latitudes consists of flying a track and measuring wind directions, bearings, azimuths, etc., in terms of degrees true using the nearest meridian as a reference datum. This is satisfactory near the equator and involves only minor difficulties at middle latitudes. It is hopeless however at polar latitudes because any line except a north south line cuts the meridians rapidly and at a changing angle.

Therefore a new datum is required and to overcome the directional problem a simple grid system was devised based on an "artificial north".

GYRO STEERING

The Problem of Maintaining Heading

The grid technique is the answer to the direction problem; the next step is to find a means to maintain the direction desired. As one proceeds north towards the magnetic pole the compass becomes unreliable.

If a freely suspended gyro is not influenced by external forces the direction of the spin axis will remain fixed in space. This "rigidity in space" is a property of gyros ideally suited for maintaining grid heading. Since gyros <u>are</u> influenced by external forces the Navigator must remember that the rotation of the earth causes apparent wander, and that friction causes precession in the gyro. Both of these factors are computed as the total drift of the instrument. Before precision gyros were developed it was not uncommon to have an instrument with a total drift rate of as much as 10 degrees every twenty minutes.

The Problem of Determining Heading

The final step is to determine the heading. In the air and on the ground one can observe a celestial body with an astro compass or a sextant: grid datum is used for a constant track and the gyro is used to "fly the heading".

TWILIGHT, DARKNESS AND DAYLIGHT

It is a well-known fact that there are uncommonly long periods of twilight, darkness and daylight at various seasons of the year in the Arctic. For example on 21 June continuous sunlight is experienced north of latitude 66 N; after 23 Sept. and until 9 Oct. continuous twilight prevails at the north pole; on 21 Dec. continuous darkness prevails north of latitude 73 N. These conditions must be taken into consideration when planning an operation in the north. These are factors that have added significance to the Navigator when he is "flight planning" his trip.

Of the three conditions the Navigator prefers darkness, for if weather permits he may use the stars both for checking heading and for fixing the position of the aircraft. Daylight is next in preference for if the sun is visible, it can be used to check heading and also to provide a single position line. During twilight however usually neither the sun nor stars may be used and often it is not possible to distinguish the terrain below. Map reading in the north is difficult even under ideal conditions. Twilight therefore is a condition to be avoided if possible. However, an instrument has been developed to provide heading checks under certain circumstances when twilight prevails. This instrument is not in common use as yet.

NAVIGATION AIDS

A good flight plan, a complete understanding of dead reckoning and celestial navigation are fundamental to navigation in the Arctic. Despite recent developments in the North, areas still exist where the Navigator may be quite isolated from any ground based aids and so must depend entirely upon his skill in dead reckoning, and celestial navigation.

W/C K. R. Greenaway stated, in his book "Arctic Air Navigation", published in 1951, "Practically nowhere else is the Navigator so completely on his own and nowhere else can he and his crew find themselves more isolated from help should he make a mistake." In the past seven years much has been done to ease the task of the Arctic Navigator. Ground based aids to navigation are becoming more numerous. Flights over the north pole are quite common and Grid navigation is an accepted and proven technique. Nevertheless, despite these advancements, there are areas of Canada's Arctic where W/C Greenaway's words still apply and navigation in the Arctic still demands a highly skilled craftsman.

ICE ISLANDS

The name "ice island" is used to describe a type of ice formation, rather like a very large tabular iceberg, found in the Arctic Ocean. The chief characteristics of ice islands are great massiveness and structural strength, which enable them to retain their shape over periods of many years, and a very distinctive surface pattern of more or less parallel rolls which show up very well from the air, although they are usually not so distinctive on the ground, having a long wave-length and only a few feet of amplitude. The "islands" are between 100 and 200 feet thick and radiocarbon dating suggests the ice is at least 2,000 years old.

The first sighting and photographs of an ice island were made in August 1946 by the crew of a U.S.A.F. aircraft flying over the Beaufort Sea. It was at first believed to be land and this gave rise to the name ice island. Soon after two other ice islands were found and the three were named T1, T2, and T3. They were tracked and plotted by the U.S.A.F. and R.C.A.F. for several years.

The source of these formations has been found to be an ice shelf which fringes the north coast of Ellesmere Island and shows characteristics very similar to the ice islands. Whether this shelf is of glacial origin, a relic from a time when the ice covered much more of north Ellesmere Island than it does today, or whether it has grown in situ mainly from the freezing sea water is not yet clear but the work of a joint Canadian/United States expedition in 1954, led by Mr. G. F. Hattersley-Smith of the Defence Research Board, suggests the latter. From Ellesmere Island the ice islands drift in an elliptical course west towards Alaska and then north to the vicinity of the North Pole and back to their source region. One, T2, has not returned to Ellesmere Island and may have grounded on the north coast of Greenland or drifted out by way of the Greenland Sea. T1 and T3 are now in the area north-west of the Canadian Archipelago. One other ice island photographed off the coast of Ellesmere Island has, like T2, disappeared, and there are not believed to be any other large ones in the Arctic Ocean at this time. This assumption is based partly on Russian information; the Russians while they claim to have seen the three "ts" before the Americans did, do not mention any others, and one of their leading authorities says definitely that no others have been seen by them. There are, however, a considerable number of smaller ones which have drifted south and are breaking up in the channels between the islands of the Canadian Arctic Archipelago.

In 1952 the United States established a weather and scientific station on T3 which was maintained for two years. It was reoccupied for six months in 1955 and during the International Geophysical Year as well.

RUSSIAN STATIONS ON THE POLAR PACK ICE

In the past twenty years the Russians have carried out a good deal of scientific work in the Central Arctic Basin from stations on the pack ice. In 1937 The Papanin North Pole Drift Expedition was established at the North Pole by the use of 4-engine aircraft, and in nine months their camp, now known as North Pole 1, drifted over a thousand miles south to a point off the east coast of Greenland. In 1941 an aircraft made three landings on the ice north of East Siberia in the vicinity of 80° N., the region called the "Pole of Relative Inaccessibility". In the short time the aircraft spent at each of these three places a number of scientific observations were made.

This type of work was interrupted by the Second World War, but it was resumed on an increased scale shortly after. Beginning in the spring of 1947 a large number of landings were made at different locations, including the North Pole. The most striking scientific result of this work was the discovery of the Lomonosov Range, a great submarine range extending across the Central Arctic Basin, from the new Siberian Islands to Greenland and Ellesmere Island, and dividing the basin into two distinct oceanographic regions.

In 1950 a semi-permanent station was established at 76° N. 106° W. It was occupied for a year during which it drifted to a position 400 miles further north and a little to the east. It is now known as North Pole 2. North Pole 3 and North Pole 4 were both established in 1954 at 86° N. 176° W. and 76° N. 175° W. respectively. North Pole 5 was set up at 82° N. 157° E. in April 1955, at which time North Pole 3 was abandoned. An additional station, North Pole 6 was occupied as part of the Russian International Geophysical Year programme.

These Russian stations were apparently large and well organized. They included living and working quarters for a scientific staff of from 10 to 20, and each station had a large helicopter, an AN2 aircraft, comparable to a Beaver, a tractor, and an automobile. They were well equipped apparently to a scale unequalled in similar conditions elsewhere. A photograph of a hut at North Pole 3 showed a piano, with a vase of cut flowers on it.

As well as these semi-permanent stations the Russians have occupied a number of temporary stations for short periods for scientific observations and they also make regular flights for meteorological and ice observation purposes. The announced results of all this work show that very important scientific information has been obtained, particularly in oceanography, terrestrial magnetism, and meteorology.

THE NORTH POLE

The first proposal for a north polar voyage was in 1527 when Robert Thorne, an English merchant, suggested a northern route to Cathay and India. During the early voyages in search of this northern route John Davis in 1588 sailed through Davis Strait as far as Lat. 72° 12' N. Between 1594 and 1597 William Barents made three voyages to the north during which he discovered Spitsbergen and reached 79° 49'. Henry Hudson circumnavigated Spitsbergen in 1607 and sailed to 80° 23'. This remained the furthest north voyage until 1773 when Captain Phipps, commanding a R.N. expedition in which Nelson was serving as a midshipman, penetrated 25 miles further north in the same region.

In 1827 Parry attempted to reach the North Pole by hauling sledges over the ice rather than sailing through it. His party set out from Spitsbergen but the ice drifted south almost as fast as they travelled north and they had to turn south at 82° 45'.

The expedition of 1875 commanded by Nares wintered in North Ellesmere Island and a sledge party under Markham managed to reach 82° 20' N. when an outbreak of scurvy prevented further progress. His record was beaten by four miles by one of Creely's parties in 1882.

In 1893 Nansen attempted to reach the North Pole by freezing his specially constructed vessel, the "Fram", into the ice and drifting with it. The drift did not follow the course he expected and when it became clear that the ship would not pass near the Pole, he and Johansen left the ship and travelled over the ice as far as 86° 12'.

In 1901 Cagni led a party from the Duke of the Abruzzi's expedition over the ice from Franz Josef Land and reached 86° 34'.

The next record 87° 6' was set in 1905 by Peary in a sledge journey from north Ellesmere Island. In 1909 he again set out by sledge from Cape Columbia with a number of supporting teams and on April 6 he with Henson, a negro, and four Eskimos reached the Pole. His claim has been generally, though not universally, accepted. Those who are not convinced base their views on the distance he must have travelled in so short a time (485 miles in 16 days over polar pack ice) and the lack of detail in his account.

The first flight to the North Pole and back was made by Byrd from Spitzbergen in 1926 and he was followed two days later by a flight by Amundsen and Ellsworth in a dirigible. In 1937 a Russian party landed by aircraft on the ice at the North Pole and Papanin established a scientific station which during the next eight months drifted well over 1,000 miles south to a point off the east coast of Greenland where the party was picked up by two icebreakers.

Since the Second World War there have been many flights to the Pole and for some time there were regular flights twice a week from Fairbanks for meteorological purposes. Russian and United States aircraft have landed at the Pole briefly and one of the Russian scientific stations on the ice of the Polar Basin (North Pole 3) has drifted to within a few miles of it.

RING STRUCTURES

When the air photography of the Arctic Islands was studied a few years ago a number of ring structures resembling craters in appearance were found. These caused great interest and many theories were suggested to account for them. They have now been investigated on the ground and have been shown to be piercement domes of gypsum. Pressure has developed in the underlying strata owing to the load of the overlying rocks or the squeezing effect of folding and this has forced the gypsum to flow up through the overlying sediments.

The significance of these domes lies in the fact that elsewhere in the world they have proved to be an excellent indication of oil. Normally there is salt beneath the gypsum but this has not yet been found in the Arctic. The domes do appear however to be very similar to the salt domes of Louisiana and Texas where great quantities of oil have accumulated in the strata which have been forced up by and plugged with the salt and the gypsum which caps it.

The domes in the Canadian Arctic occur in a wide belt lying approximately NE-SW across the Queen Elizabeth Islands. They were studied and mapped by the Geological Survey in 1955 during Operation Franklin, the largest field investigation ever carried out by the Geological Survey and one in which helicopters played a very important part.

OPERATION FRANKLIN

In 1955 the Geological Survey of Canada made an initial geological investigation of a large part of the Canadian Arctic Archipelago. This investigation called "Operation Franklin" was carried out from June 13 to September 15, 1955, and employed some thirty persons with the support of two heavy helicopters. The area involved was huge, remote and relatively inaccessible. Air photos revealed an almost unique display of stratigraphic and structural features, the so-called ring structures, or gypsum domes.

Essentially, the project was concerned with studying the stratigraphy of these ring structures in a network of selected localities. Trimetrogon air photographs served to organize the investigations and to map the regional distribution of formations.

This project had a specific aim and a special mode of implementation: hence its rate of progress and its cost per unit of area cannot be compared with that of other helicopter-supported methods tried by the Geological Survey of Canada. The operation greatly hastened the geological investigations of the central part of the Canadian Arctic Archipelago. Some 200,000 square miles, half land and half sea, were surveyed during that 1955 summer.

The prime task in planning the project was to select a method of operation that would meet both the aim of the project and its difficult conditions. The main factors were the insularity, topography and climate of the area, and the scarcity of permanent settlements. Simultaneous investigation of several areas with aircraft support seemed to be the most feasible approach.

The second step was to shape the geological program according to the potentialities of the method, since geographical conditions cannot be altered. In doing so full use was made of air photo interpretation: the same geographical conditions which handicap the travelling geologist may also expose features of bedrock geology which the investigating geologist can study on air photographs. Additional information was gathered for some areas from remarks of early explorers and from rare geological investigations.

Preliminary photo-geology maps were compiled incorporating all available information. Thus structural patterns were outlined and a stratigraphical sequence of indicated units was tentatively made. Field localities were then chosen to be studied in detail. The number and density of selected localities were related first to the minimum required to define the major stratigraphic elements, and second to the maximum physically permissible by the method of operation. Because the air photographs of the region contained valuable information, the selection of localities was most rewarding and led to a comprehensive preliminary survey of all major stratigraphic units of the region.

Many factors dictated the use of helicopters: there was only one year-round airfield for wheeled aircraft, the lakes were scarce and open sea water too unpredictable for hydroplanes, and sea ice in summer was unsuitable for ski-equipped aircraft. Moreover it was necessary to use light aircraft able to fly below the overcast and to land anywhere if the weather suddenly closed in.

The plan was for eight or nine geological teams to successively leap-frog by helicopter from one field station to another

within a radius of some 160 miles from a base of operation. Four such bases, some 220 miles apart, were occupied in a counter-clockwise manner in order to remain abreast of the disappearance of the sea ice. Two helicopters, capable of mutual support, placed teams at field stations and airlifted personnel and material. Everyone worked around the clock in the 24-hour daylight.

The versatility, ruggedness and capability of the helicopters enabled the members of Operation Franklin to overcome the difficult conditions of the task. The main handicaps were bad flying weather and the regulation restricting helicopters without floats to over-land (or over-ice) routes.

RESOLUTE - CORNWALLIS ISLAND

Cornwallis Island was discovered in 1819 by Parry on his first voyage in search of a northwest passage and named after Admiral the Honourable Sir William Cornwallis. Its insularity was proved by Franklin, who sailed around it in 1845 before heading southward to disappear forever.

Resolute Bay was named for H.M.S. "Resolute" (410 tons), one of the vessels of the Austin expedition in search of Franklin which spent the winter of 1850-51 at Griffiths Island, south-west of Resolute Bay. The bay to the east was called Assistance after "Resolute's" sister ship. The "Resolute" had an interesting subsequent history. She was in the same area under Belcher in the years 1852-4 and was abandoned by Belcher's order in the summer of 1854 along with three other sound ships. The "Resolute" drifted out into Davis Strait and was picked up by the U.S. whaler "George Henry" near Cap Mercy, Baffin Island, in September 1855. The Americans repaired the vessel and graciously returned her to Britain.

In 1947 the U.S. icebreaker "Edisto" escorted a cargo ship, the "Wyandot", to establish a joint U.S./Canadian weather station at Winter Harbour on Melville Island. Heavy ice made it impossible to reach Melville Island and Resolute Bay was selected as an alternative site. The name of the weather station has been officially shortened to Resolute.

The R.C.A.F. established a base at Resolute in 1949. This station is now one of the more important in the north, with an airstrip suitable for year-round operation and comfortable living quarters. There are scheduled North Star flights from Dorval via Fort Churchill. Resolute is an alternate for the U.S. base at Thule. The joint weather stations at Mould Bay (Prince Patrick Island), and at Isachsen, (Ellef Ringnes Island) are serviced by R.C.A.F. airlift from Resolute. Supplies for Resolute and for the stations serviced by air from Resolute were for some years taken in by the U.S. Navy, but the Department of Transport took over this task in 1954.

The weather station was at first two miles from the airstrip on the west shore of Resolute Bay but has now been moved to the R.C.A.F. station. Surface weather and upper air observations are taken and a 24-hour watch maintained on WT. A weather forecaster is stationed at Resolute. The weather and ionospheric stations have played host to a number of visiting scientific parties including geologists, geographers, and a drilling crew who drilled deep holes for a study of earth temperatures.

The Ionospheric Station at the old weather station site on the west shore of Resolute Bay is a D.O.T. installation which maintains a separate mess. Ionospheric, magnetic, seismograph, and Cosmic ray observations are recorded and transmitted on a 24-hour basis.

During the I.G.Y. the basic scientific and meterological programme was greatly expanded for a period of 18 months. This included the following: observation, for atmospheric ozone, soil temperatures, tidal measurements, auroral photo spectroscopy and very high level weather data. In 1959 some slight activity has developed at Resolute as the result of the recent increase in oil explorations in the Arctic Island.

THE NORTH MAGNETIC POLE

The North Magnetic Pole is the place on the earth's surface where the horizontal component of the earth's magnetic force becomes zero and a freely suspended magnet dips vertically with its north-seeking pole downward.

The present mean position of the North Magnetic Pole appears to be north of Prince of Wales Island at approximately 74° 15' N, 100° W. This position is based mainly on a study of continuous recordings of the magnetic field made at the Dominion Observatory station at Resolute Bay.

Changes inside the deep core of the earth are causing the mean position of the Magnetic Pole to drift about 4 miles a year slightly east of north at the present time. This rate is not constant in magnitude or direction. In 1831, according to Ross, the pole was near Cape Adelaide on the west coast of Boothia Peninsula and in 1904, according to Amundsen, about 40 miles northeast of Ross' position. Since 1904 the average motion has been approximately north-northwest.

Complicated daily and monthly changes in the position of the Magnetic Pole are produced by the Magnetic field of electric currents in the ionosphere. For example the daily track of the pole during a period of moderate magnetic disturbance is elliptical with the long axis of the ellipse north-south and the short axis east-west with distances of approximately 30 and 18 miles respectively. During magnetic storms the pole can be displaced as far as Bathurst Island.

The position of the peripatetic North Magnetic Pole has been calculated for each year since 1946 from observations made at Dominion Observatory magnetic stations on the arctic islands and the mailand surrounding the pole area, supplemented since 1948 by continuous records of the changes in magnitued and direction of the earth's magnetic filed at Resolute bay and baker Lake.

CAMBRIDGE BAY

During a journey of exploration in 1839 to delineate the north coast of the continent, Chief Factor Warren Dease and Thomas Simpson of the Hudson's Bay Company named Cambridge Bay after H.R.H. Adolphus Frederick, Sixth Duke of Cambridge. In 1851 Dr. John Rae, also of the Hudson's Bay Company, went to Cambridge Bay during a Franklin search expedition and his two boats sheltered in a creek at the head of the bay which was reported to swarm with salmon. Judging from the numerous caches he considered the area was a favourite resort of the Eskimos, though he saw none.

On a later Franklin Search, Captain Richard Collinson in H.M.S. Enterprise spent the winter of 1852-53 in Cambridge Bay. He saw two or three hundred Eskimos and was visited by them throughout the winter. He reported that the Eskimos spent much of the summer fishing there and then in the fall followed the caribou to the mainland. Cambridge Bay was also visited in 1905 by Amundsen in the Gjoa on his voyage through the North-west Passage.

Cambridge Bay appears to have continued to be an important Eskimo locality owing to the abundance of caribou, seal, fish, and wild fowl. Some Eskimos apparently lived on Victoria Island throughout the year but others wintered on the shores of Queen Maud Gulf and visited the island for the summer only. When they were first discovered, and indeed until trading posts were established early in the present century, the people in this part of the Western Arctic used native copper for very many purposes, and for this reason they are known as the Copper Eskimos.

The Hudson's Bay Company first established a post at Cambridge Bay in 1923 but it was closed when the caribou migration failed in 1925. In 1927 it was reopened on a new site and it was again moved in 1934. Another link with Amundsen is provided by the remains of the Baymaud, originally the Maud, the ship in which he made his famous trip through the Northeast Passage, (now known as the Northern Polar Route), and which now lies partially submerged at Cambridge Bay. She was bought as a supply ship by the Hudson's Bay Company and in 1927 took freight to Cambridge Bay where she was moored to serve as a warehouse, machine shop and wireless station. It was from the Baymaud that the first regular winter weather reports from the Canadian Arctic were transmitted and relayed to the south through the Royal Canadian Corps of Signals stations.

The R.C.M.P. schooner St. Roch often wintered at Cambridge Bay and the moving force of Exercise Musk-ox passed through the settlement in 1946. Both the Anglican and Roman Catholic churches have established missions at Cambridge Bay: the Anglican in the settlement itself, and the Roman Catholic across the bay.

In 1947 Cambridge Bay was chosen as the site of a low frequency Loran (long range navigation) slave station. This navigation system required a chain of three stations, one master and two slaves. The master station was at Kittigazuit near Tuktoyaktuk, the slaves at Cambridge Bay and Skull Cliff near Point Barrow. After being tested for some time the system proved unsatisfactory and was discontinued, but the 625-ft. tower remains as a prominent land mark. A similar tower at Kittigazuit was demolished in 1955 as a danger to air navigation. During the past few years Cambridge Bay has been used each winter by the R.C.A.F. for training air crew in Arctic

survival measures, and the Department of Transport has established a weather and radio station at the old Loran site.

The importance of Cambridge Bay has been increased owing to the construction of the D.E.W. Line. A nursing station with a resident nurse and a federal school have been established, and the D.O.T. is preparing to take over the operation of the airport. In 1956 the Department of Northern Affairs appointed a Northern Service Officer at Cambridge Bay because of the developments brought about by the construction of the D.E.W. Line. He is now the department's Area Administrator co-ordinating government activities in Cambridge Bay and vicinity and reporting through the Administrator of the Mackenzie at Fort Smith, N.W.T.

CAPE PARRY

Cape Parry, at the northernmost point of Parry Peninsula, separates Franklin Bay to the west from Darnley Bay to the east. The northern part of the peninsula is a low plain of flat-lying Silurian limestone and dolomite which increases in height toward the north. The limestone is overlain locally by thin deposits of glacial till which show unmistakable signs of east-west glacial fluting. The cape was named after Captain W.E. Parry by Richardson of Franklin's second expedition in 1826 when he made the first journey along this coast, travelling by whale boat.

Towards the end of the nineteenth century Cape Parry was the eastern limit of the waters frequented by the American whaling fleet from the Pacific. An American whaler, the "Alexander" was wrecked on the cape in the early years of this century.

Cape Parry itself is a conspicuous 500-ft. hill, from which two low points extend to the north. These points end in steep limestone cliffs on one of which an isolated colony of murres nests. A cairn containing a letter to Captain Parry was built by Richardson on the top of the high hill. Owing to strong currents off the cape there is a good deal of open water even in mid-winter. Eskimos no longer live at Cape Parry though they did so in the past.

THE SMOKING MOUNTAINS AND HORTON RIVER

In 1826 Richardson noted that the cliffs on the west coast of Franklin Bay increased in height as he travelled south. Near the mouth of a river, which he named the Horton River after the Under-Secretary of State for the Colonies at the time, the cliffs gave way to a ridge of low hills rising in a steep grassy and terraced slope to about 600 ft. within two miles of the coast. Richardson observed that the hills were made of shale "which was in a state of ignition in many places and the hot sulphurous airs from the land were strongly contrasted with the cold sea-breezes." Clouds of smoke and steam issued from the hillside and for this reason the hills have come to be known as the "Smoking Mountains".

The shale is bituminous and ignites spontaneously under certain conditions, smouldering underground close to the surface and giving off clouds of steam and smoke. Baked reddish clays are common where fires have burned. The Eskimos are said to have thought the fire was kept alive by spirits and they used to leave small offerings of food when passing by. The clouds of smoke and vapour are densest in spring and early summer and the smell is strongly sulphurous. The water in the streams is unpalatable. In many places on the slopes the shales have slumped or caved in where the underlying strata have burned.

Richardson also observed quantities of driftwood on the shoals at the mouth of the Horton River showing that it flowed through well-wooded country. It has since been found that trees grow in the Horton valley to within 60 miles of the Arctic coast, the most northerly trees in North America. In its lower course the river flows northward, roughly parallel to the Smoking Mountains to the east, across a low plain of shallow glacial till overlying westerly-dipping Cretaceous sediments. Its wide meandering valley has deeply incised the glacial deposits and the bedrock. From the air it is evident that the Horton, at an earlier period of its history, flowed into the head of Harrowby Bay to the west. In the comparatively recent past, possibly only a few years before the discovery of the river by Richardson, the Horton, where it approached closest to Franklin Bay, breached the Smoking Mountains and entered Franklin Bay at its present position through a narrow steep-sided gorge shortening its course by about 50 miles. It then began to deposit the deltaic sediments which are a feature of the river mouth. The abandoned course of the river to Harrowby Bay shows plainly from the air as a chain of ox-bow lakes occupying a deeply entrenched valley.

A drawing made by Lieutenant F.N. Kendall, Richardson's second in command, shows three prominent islets at the mouth of the Horton River, apparently composed of sand and gravel. These are no longer there and it seems likely that they have been removed by the action of ocean currents and the erosion of the river water.

TUKTOYAKTUK

Tuktoyaktuk is on the Arctic coast approximately 100 miles northeast of Aklavik. It is well north of the tree-line and the native population is almost exclusively Eskimo. The name is Eskimo meaning "Resembling a caribou". In the past Eskimos frequently camped near Tuktoyaktuk for fishing in the summer, and the whalers in the later nineteenth century knew of the harbour and probably made some use of it, although Herschel Island and Baillie Island were their normal headquarters. The first permanent settlement was not until 1934 when, as the result of a survey of the Mackenzie Bay region, the Hudson's Bay Company selected the harbour as the most suitable transshipment point for goods brought down the Mackenzie on barges to deeper-draft coastal vessels for distribution along the Arctic coast. The harbour is deep but the approaches limit vessels to a maximum draft of about 13 feet 6 inches. The original Hudson's Bay Company installation included a small trading post, warehouses, and a dock. The name Port Brabant was given to the settlement but local usage prevailed and the name was later officially changed back to Tuktoyaktuk. It is commonly abbreviated to Tuktuk or to Tuk.

Since its beginning in 1934 Tuktoyaktuk has grown steadily. Anglican and Roman Catholic missions have been established, a federal day school was opened in 1947, a Royal Canadian Mounted Police detachment in 1950, and a nursing station has recently been completed. An Eskimo population of about 250 (38 families) has been attracted to the settlement, some of these from the small settlement of Stanton to the east where a trading post was closed down about four years ago. Many of the Eskimos are immigrants from Alaska in comparatively recent years. There is some local employment at Tuktoyaktuk owing to the transshipment of supplies for the Western Arctic. Tuktoyaktuk lies within the Reindeer reserve and reindeer can often be seen from the settlement. Trapping is however the main activity, and fishing and white whaling are important to the Eskimos. There is a small boat building industry operated originally by the R.C. mission and now supervised by the Department of Northern Affairs and National Resources.

There is an auxiliary station of the D.E.W. Line at Tuktoyaktuk but the main effect of the D.E.W. line on the settlement lies in the development of transshipment facilities. D.E.W. supplies for the Western Arctic are brought down the river by barge and transshipped at Tuktoyaktuk. A wharf transshipment area and bulk oil storage have been built on the opposite side of the inlet from the settlement and D.E.W. station. Three tankers and three landing ships for D.E.W. supply operations winter at Tuktoyaktuk as well as one or two H.B.C. coasters. The D.E.W. Line has also led to the establishment of an airfield.

The local Anglican Minister, Thomas Umaok, is an Eskimo, the only ordained Eskimo Minister in Canada.

REINDEER DEPOT

The Reindeer Station lies at the foot of the Caribou Hills on the East Channel about 70 miles from the mouth of the Mackenzie River. Narrow bands of bright red "soil" are visible in the side of the Caribou Hills, which rise to heights of 600 feet. These are thought to be beds of burned-out lignite.

The station is the headquarters for the experiments in reindeer herding being carried out by the Federal Government. It is near the western boundary of the Reindeer Grazing Reserve which extends from the Mackenzie Delta eastward along the Arctic Coast to Liverpool Bay and includes the Eskimo Lakes.

Reindeer were introduced into Alaska from Siberia towards the end of the nineteenth century. Following a recommendation made in 1922 by a Royal Commission appointed to study the possibility of developing reindeer and musk-ox herding in Canada, the Government selected a reindeer range of some 6,000 square miles on the east side of the Mackenzie Delta. In 1929 arrangements were made with an Alaskan reindeer company to deliver a herd of 3,000 reindeer to this range. The drive began that December with Andrew Barr, a veteran Lapp herder, in charge. Many difficulties were encountered in crossing the mountains of northern Alaska and the bleak coastal plain to the Mackenzie Delta. Some of the reindeer broke away and returned to their home range. Blizzards, intense cold, and wolves delayed progress. A herd of 2,370 animals was finally delivered on March 6, 1935.

There are now two reindeer herds on the reserve. The larger is the government herd but some 1,500 out of a total of over 5,000 head are in a separate herd managed by Eskimos. Nikkel Pulk, the Lapp who took part in the drive from Alaska, is still employed at the Reindeer Station as Chief Herder. The reindeer are rounded up annually late in July or August. In the autumn the reindeer move to winter ranges some 50 miles inland from the coast, where reindeer moss, a lichen which forms their winter diet, is abundant. On completion of the spring fawning the herds move towards the coast to get relief from insects during the hot weather.

Reindeer meat finds a ready market in the Aklavik area; most of it is either sold through the local retailing agent or bought by the missions for their schools and hospitals. Local trappers occasionally purchase meat direct from the herd managers. Since the industry was established in 1935 some 15,000 reindeer have been slaughtered for meat and skins. Many of the skins have been distributed to needy Eskimos in the Western Arctic.

The original object of the reindeer experiment was to provide the Eskimos with a means of livelihood to supplement and conserve the game resources. In 1938 and 1940 Eskimo herding units were started but the industry received a serious set-back when the herders and their families were lost in a shipwreck in 1944. Recent attempts to interest the Eskimo in herding reindeer have not met with much success and it is intended to operate the herd in future as a business proposition to demonstrate that reindeer herding can be economically sound in the Mackenzie Delta area.

Though Cornwallis Island was undoubtedly inhabited in the past, no Eskimos had lived there for many generations. In the summer of 1953 four families, three from Port Harrison, P.Q., and one from Pond Inlet in Baffin Island, were voluntarily moved to Resolute Bay by the Department of Northern Affairs and National Resources to see whether they could make a living better there than in the south where the game resources were insufficient for the population. The project is entirely self-contained and the group obtains its supplies from a small store operated by one of the Eskimos with the aid of a government loan. The R.C.M.P. detachment supervises the project, which is proving very successful. The Eskimos have been able to obtain all the country food they need, and sufficient fur to purchase their other requirements. They have also been employed from time to time for moving supplies during the airlifts and at ship-time and for assisting scientific parties. They were sufficiently contented with conditions to request that some of their relatives join them. In the summer of 1955 six more families were moved to Resolute Bay including Idlouk, the central figure in the film "Land of the Long Day", and his family from Pond Inlet. The total Eskimo population is now 70 and it seems probable that other permanent colonies will be established gradually in the Queen Elizabeth Islands.

There are four old Eskimo village sites in the vicinity of Resolute Bay as well as numerous tent rings, stone-floored temporary house sites, stone caches and fox traps, indicating that some hundreds of years ago there must have been a considerable population. The site nearest to the airfield is about a quarter of a mile from the old weather station and half a mile from the shore. Archaeological investigations were begun in 1949 by a joint party from the Smithsonian Institution and the National Museum of Canada and have continued during several seasons. The upper layers yielded specimens from the whale-hunting Thule Culture, which spread over the greater part of the Canadian Arctic from Alaska within the past thousand years. Arrow heads, fish lures, harpoon heads, spears, knife handles, pendants, pottery, and ivory combs were among the objects found, many of which showed very strong Alaskan affinities. One extremely interesting find was a piece of whale bone snow-knife handle with an incised pictograph, typically Alaskan in concept and execution, of five men harpooning a whale from a skin boat. Animal bones showed that seals were the principal food, with bowhead whale and walrus next in importance. There were many polar bear, fox, and dog bones but few caribou or musk-ox. Underlying the Thule layers were a number of objects from the Dorset culture. This has been found throughout the Eastern Arctic and is probably a thousand or more years old. From these excavations it has been concluded that there have been at least three stages of occupation at Resolute Bay. The Dorset was the first, followed by an early phase of the Thule culture. These were probably both short periods of occupation possibly by only a few families. The last stage, a developed Thule culture, was of longer duration with a considerably larger population.

PINGOES

In the area to the east of the Mackenzie Delta there are a large number of small conical hills, varying in height to over 100 feet, and looking like miniature volcanoes. They are known as pingoes and are found in every stage of development from a low hump a few feet high with a small crack in the top to a high conical hill containing a crater. They are usually situated in partially dried-up lake bottoms. Their origin is uncertain but they are believed to be associated with permafrost and water under hydrostatic pressure pushing up the ground into mounds. A hole drilled in the bottom of one of the larger pingoes showed the top three feet to consist of a mixture of fine-grained soil and organic material, below which to a depth of at least thirty feet was clear massive ice. Pingoes are also found on the coastal plains of Alaska and Siberia. They are far better developed in the Tuktoyaktuk area than anywhere else in Canada.

INUVIK

The new site for Aklavik is on the East Channel of the Mackenzie River, 33 air miles due east of Aklavik. It was at first known as East Three but has now been officially named Inuvik which is Eskimo for Place of Man. When it was decided late in 1953 that the town of Aklavik had to be moved to a new site, a survey team was organized to examine possible new locations. Of these East Three best met the requirements which had been established by the Advisory Committee on Northern Development as a basis for site selection. The five essential requirements were:

(1) Suitability of the site from the economic and social point of view;

(2) Suitability of the ground for permanent sewer and water systems, foundations, and roads;

(3) Access to a navigable channel of the river;

(4) Availability of a suitable site for an airfield;

(5) A satisfactory supply of water.

The new site is on the edge of the delta on relatively high ground of glacial origin with elevations of 50 ft. to 150 ft., as compared to the deltaic silts at Aklavik and throughout the delta where maximum elevations are 30 ft. The ground is permanently frozen throughout the region and specific foundations will be required for efficient construction. A major advantage at the new site is the availability on the townsite of large quantities of gravel suitable for road construction and foundation pads. There is ample room for any future expansion of the settlement.

Work on the new site began immediately and good progress has been made. A public wharf, warehouses, and a large garage were built first. The school, the two government hostels, one to be operated by the Roman Catholic and the other by the Anglican mission, are now completed and in operation. The airstrip, which is connected by an 8-mile road to the settlement, is in use and there is a regular service from Edmonton using twin-engined aircraft. Most of the streets have been built and by the fall the utilities, including the laundry, should be completed. Commercial agencies have begun to establish themselves at Inuvik.

THE MACKENZIE RIVER

The Mackenzie River rises in the Rocky Mountains as the Athabasca River and flows into Lake Athabasca; it leaves as the Slave River and flows into Great Slave Lake; it then leaves as the Mackenzie River and flows to the Beaufort Sea. The total length of the river is 2,350 miles. From the head of steel at Waterways the river is navigable to Fort Fitzgerald, where there is a 16-mile portage to Fort Smith around a series of rapids, which include the Rapids of the Drowned and the Pelican Rapids and have a total drop of 120 feet. The river is continuously navigable from Fort Smith to the sea.

In 1789 Alexander Mackenzie of the North West Company discovered that part of the river which bears his name, when he travelled by canoe from Great Slave Lake to the Beaufort Sea and back. There were signs of Indians all along the river and the North West Company soon established a number of fur-trading posts, to which supplies were freighted by canoe. After the amalgamation of the Hudson's Bay Company and the North West Company the posts were supplied by York boat brigades from York Factory in Hudson Bay via Norway House and the Methye Portage, and later from Fort Edmonton by scow via Athabasca Landing. In 1883 the era of wood-burning, stern-wheeler river steamers, pushing wooden barges, began on the lower river. In recent years these have been replaced by diesel tugs and steel barges.

It is along the Mackenzie River and the waters draining into it that almost all the developed resources of the Northwest Territories are found, the gold of Yellowknife, the pitchblende of Port Radium, the oil of Norman Wells, and the commercial fisheries of Great Slave Lake. The river is playing an increasing important part as a transportation route for supplies from the south to settlements along it, for distribution of Norman Wells oil in the District of Mackenzie, and for supplies to defence and civilian establishments on the Arctic coast, which are transshipped to coastal vessels at Tuktoyaktuk. Over 200,000 tons now leave Waterways for the north in the shipping season. Most of this is for the upper river especially for Beaverlodge (for the uranium mine on Lake Athabasca) but a substantial part, including supplies for the D.E.W. Line, passes over the Fort Smith portage and on down the lower river. A good deal of additional freight for the lower river is sent down the Mackenzie Highway to Hay River, by-passing the upper river.

AKLAVIK

Aklavik is situated in the Mackenzie Delta on the West Channel of the river and about 70 miles from the Arctic coast. In 1912 the Hudson's Bay Company set up a trader at an Eskimo camp midway between Herschel Island and Fort McPherson on the Pokiak Channel of the river opposite the present settlement of Aklavik. This camp came to be called Pokiak. The Mackenzie Delta is rich fur country and with the arrival of other trading companies the settlement expanded in area and importance and spread across the river onto its present site, known as Aklavik. The name Aklavik is Eskimo and means "Place of the Barren Land Grizzly Bear".

Major developments after 1918, the true beginning of Aklavik at its present site, included the establishment of an Anglican mission in 1919, a Royal Canadian Mounted Police detachment in 1922, a Royal Canadian Corps of Signals station in 1925, and a Roman Catholic mission and the relocation of the Hudson's Bay Company from Pokiak in 1926. In this way Aklavik became the chief centre of the Delta and by 1931 the population of the settlement and the surrounding area had reached 411, 180 Indians, 140 Eskimos, and 91 whites, The Indians belong to the Loucheux tribe, a branch of the Athapaskan race. With the expansion of the Anglican and Roman Catholic hospitals and residential schools and the intensive trapping of the whole delta area, the population increased steadily. The concentration of activities led the federal government to open administrative offices in order to provide more efficient administration for the region.

By 1952 Aklavik and the surrounding region had a population of 1,556; 953 Eskimos, 176 Indians, and 427 whites and half-breeds. The settlement itself now has a permanent population of about 500, more than half white, but during the months of July and August visiting Indians and Eskimos increase it to approximately 700. The growth of Aklavik from a single trading post to by far the largest community in Canada north of the Arctic Circle has taken place in just over forty years.

The settlement at Aklavik now includes Anglican and Roman Catholic residential schools and hospitals, the office of the Area Administrator, and R.C.M. Police sub-district headquarters, a Royal Canadian Corps of Signals station, a National Health and Welfare doctor, a Department of Transport radiosonde station, a naval detachment, two hotels, several stores, an oil depot, a charter flying service, and an electric power company. Canadian Pacific Airways operate a twice-weekly scheduled service from Edmonton, though most freight is of course shipped to Aklavik by barge down the Mackenzie during the summer months.

The major economic activity in the Mackenzie Delta is fur trapping with muskrat being the chief catch. A large proportion of the annual catch is sold or traded to the various traders in Aklavik by both native and white trappers. Within the last five years, however, two factors have made it increasingly difficult for a trapper to make a living at trapping alone. With the whole of the delta divided into trap lines, the increased population over the years has resulted in an overcrowding of the productive trapping area as well as of individual trap lines. Secondly, while the price for furs has always fluctuated, the decline in prices during the past four years has considerably reduced the former good income of the inhabitants of the delta.

Owing to site limitations at Aklavik, the Canadian Government decided in late 1953 to relocate the growing settlement. Space requirements for a modern hospital and school, which will represent a larger investment in themselves than the value of the entire property of the present settlement, could not be met at Aklavik. An airport was required but it was not feasible to build one in the Delta. The low ground, only 30 feet above mean sea level at the highest point in Aklavik, is flooded at years of unusually high water at break-up. Public health requirements also called for a considerable investment in sewage and water supply plants. After study, a new location was selected and considerable site preparation, town planning and road construction has been carried out towards relocating the settlement where the facilities required can be established in a planned community. The new location is 33 air miles east of Aklavik on the East Channel of the Mackenzie River.

FAIRBANKS

Fairbanks, "Golden Heart of Alaska", always a substantial town since her gold-boom days, is today forging ahead with greater strides than ever. To cope with a growing population, Fairbanks has experienced in the last decade one of her greater building eras since the town was founded by prospectors in 1902. It was named in 1904 after Charles Warren Fairbanks, U.S. Senator from Indiana around the turn of the century, and Vice-President under President Theodore Roosevelt from 1905 to 1909.

After a period of quick expansion during the Alaska Gold Rush, Fairbanks declined until the second temporary boom brought about by the Second World War. The town then became the northern military defence centre. It has since developed into the Army and Air Force sub-arctic testing ground, at Ladd Air Force Base.

There are still signs of the gold-boom days in the numerous and unique log cabins spotted here and there among more pretentious homes. However, Fairbanks is now a modern city of approximately 10,000 people (in 1951) with up-to-date office buildings, theatres, shops, a lumber mill, railroad and freighting facilities. Gold mining is still the principal industry in the Koyakuk, Ruby, Wiseman, Tanana, and other districts, and all these are tributary to the city and add to its general prosperity.

Fairbanks is the commercial and transportation centre of the Alaskan interior. It is accessible from the coast by a highway from Valdez (370 miles), and by the Alaska Railroad from Seward (470 miles). Anchorage is 265 air miles away and scheduled airline service is available. Fairbanks can also be reached by direct flight from Seattle or with possible stop-overs at southeastern coastal towns. The development of trucking from the Fairbanks terminal over the Alaska Highway to and from Canada and U.S. commercial centres is adding to the importance of the area. There are two broadcasting stations and two newspapers, the daily News Miner and Jessen's Weekly.

The University of Alaska is located at College, five miles west of Fairbanks. Its grounds include an Agricultural Experiment Farm and the University Museum where the visitor may see restored prehistoric animals. While the season is short, bumper crops of potatoes, cabbage, grain and other produce are harvested. These products find a ready market in and around Fairbanks.

ELMENDORF AIR FORCE BASE, ALASKA

Elmendorf is located just outside of Anchorage, Alaska. It is the site of the Alaska Air Command Headquarters which has a three-fold mission: first to furnish early warning of attack by means of an extensive radar and communication system, second, to defend Alaska from the air, and third, to provide bases for retaliatory S.A.C. aircraft. Elmendorf field is a huge military airport set in a modern complex formed by the city of Anchorage itself, the Municipal Airport, Merrill Field, and the new International Airport in the Lake Spenard area.

ANCHORAGE, ALASKA

Anchorage is known in Alaska as "the air cross-roads of the world". Its population in 1958 was estimated at over 60,000 which makes it the largest population centre in Alaska. It was founded in 1914 to serve as a construction headquarters and survey camp for the building of the Alaska Railroad. Its name is derived from the fact that small boats used the mouth of Ship Creek as an anchorage.

Here is a modern city in the complete sense of the word: there are modern stores, office buildings, schools, multi-storied apartment houses, hospitals, churches, paved streets, and a new international airport completed in 1952. In addition to airline offices this airport has a fine dining room, coffee shop, cocktail lounge, and gift shop.

The Alaska Railroad still makes its headquarters there, operates streamlined passenger trains and handles a large amount of freight on the 470-mile railbelt between Seward on the coast and Fairbanks in the interior.

The landscape is remarkably beautiful. The town is on a low-lying level plain surrounded on all sides by mountains and dense forests of spruce, birch, and aspen. Because of its location on a broad peninsula at the head of Cook Inlet, there are magnificent marine and mountain panoramas from almost every point in the city.

The expenditure of government money has been the prevailing factor in the growth of Anchorage. It is by no means the only one and, notwithstanding defence spending, it is reasonable to expect that Anchorage will remain a substantial city. Aviation is the mainstay of this city and surrounding villages since merchants, miners, traders, trappers, fishermen, construction workers, in short, everyone uses planes for transportation just as their southern cousins use automobiles.

The climate can be said to be equable with an annual precipitation of about fifteen inches. This means a fairly dry summer, and moderate snowfall and freezing in the winter. January and July are the coldest and warmest months respectively.

THE INTERIOR OF NORTHERN BRITISH COLUMBIA

About the time that Captain James Cook (1778) and Captain George Vancouver (1792) were exploring the coast of British Columbia, the North West Company of Montreal was pushing its fur-trading posts or forts westward and northward from the interior plains. In 1792, Alexander Mackenzie left Fort Chipewyan, on Lake Athabasca, and in 1793, about one year later, reached the Pacific coast at Menzies Point, near the northern tip of Vancouver Island--the first white man to make such a journey overland.

The Fraser River, first traversed by Simon Fraser (1808), forms the natural thoroughfare between the southern interior and the ocean. The miners in the 1850's, panning the gold in the river bars as they went, travelled upstream to the gold fields of the Cariboo around Barkerville, and the Royal Engineers built the famous Cariboo Road along the banks of the Fraser. The Canadian Pacific Railway in 1886 and the Canadian National Railway in 1914 both follow the Fraser Valley as does the Trans-Canada Highway.

Prince George, originally Fort George, named for His Majesty George III, was founded in 1807 by the Northwest Company and was one of the first forts in the region. This company after thirty years of competition with the Hudson's Bay Company amalgamated with it in 1821. Forts of the interior such as Prince George were supplied through the Peace River route from Eastern Canada.

The Hudson's Bay Company spread its posts into northern British Columbia in the 1830's. In 1834 J. McLeod, a chief trader for the company, travelled up the Liard and Dease rivers and was the first white man to reach the Stikine River from the east. At this time Russia (which held Alaska, including the southeastern coastal strip) thwarted attempts by the Hudson's Bay Company to enter the region from the sea.

Robert Campbell, an employee of the company, ascended the Frances River in 1840 and reached the Yukon River by descending the Pelly in 1843. He built Fort Selkirk in 1848 at the junction of these rivers. This fort was burned by a raiding party of Coast Indians in 1852. Shortly after, the company abandoned most of its forts in Yukon and northern British Columbia because of the great difficulty in navigation hazardous rapids along the Liard River, by which all supplies had to be transported.

In 1861, miners from the coast discovered gold on the Stikine River; in the following years many drifted into the Cassiar region of northern British Columbia. At the same time miners overflowing from the Cariboo discovered gold in the Omineca area, near Finlay Forks; this camp reached its peak about 1870.

In the 1860's Western Union Telegraph Company, believing a trans-Atlantic cable was impracticable, sent exploring parties through the interior of British Columbia, Yukon, and Alaska to survey a route for a telegraph line that would ultimately join America and Europe across Siberia. In 1866, the line had been built as far as Hazelton, when the first Atlantic cable proved successful and the scheme was abandoned. The men of the telegraph company carried out many of the original exploartions in the interior regions.

In 1873, miners from the east and west met on the Stikine River and in 1874 and 1875 the Cassiar area reached its peak of gold production. The white and Chinese population of this area was then 1,000 to 2,000, and some enterprising ranchers on the Fraser drove 300 head of cattle to Dease Lake to supply them.

PRINCE GEORGE, B.C.

Prince George is a city almost in the geographic centre of British Columbia at the confluence of the Fraser and Nechako rivers. Sir Alexander Mackenzie was the first white man to pass the present site of the city while on his historic journey "From Canada by Land" in 1793. In the fall of 1807 Simon Fraser established the Northwest Company post at Fort George, later taken over by the Hudson's Bay Company, near the site of the present city. He named it in honour of the reigning sovereign George III. In the centre of territory rich in furs the post continued to operate until 1915. First major expansion of the community came with the construction of the Grand Trunk Pacific Railway which reached Fort George in 1913. During the railway boom two settlements, South Fort George and Central Fort George, sprang up near the fur-trading post. After being commercial centres they became residential districts. Clearing of the present-day townsite of Prince George was begun in 1913 by the Grand Trunk Pacific Development Company. The first railway train reached the area on January 27, 1914. The city was incorporated on March 6, 1915; the first mayor, W. G. Gillett, was elected on May 20 and the voters decided 153 to 13 in favour of Prince George rather than Fort George as the name of the new city.

Following the initial rail and land boom population remained relatively static until the Second World War, then, in fifteen years, it tripled and now includes a large percentage of European immigrants. In 1953 the city doubled its area by the annexation of several residential districts. Growth has been due chiefly to the lumber industry on which the basic economy of the area depends. Western white spruce is the main wood cut. Agriculture is also important. As there is no community of equal size within 300 miles the city is the centre of governmental administration and general distribution. It is also the centre for a railway, highway, and airline network. In addition to being a subdivisional point on the Jasper-Prince Rupert line of the C.N.R., Prince George is the northern terminus of the Pacific Great Eastern Railway from the south. The first P.G.E. train arrived in November 1952. The line will eventually continue north to the Peace River District. At Prince George the Caribou Highway from the southern part of the province meets the John Hart Highway opened in 1952 which joins the Alaska Highway at Dawson Creek. The Northern Trans-Provincial Highway also passes through Prince George and Canadian Pacific Airlines operates daily service north, south, and west from Prince George airport.

The city has fifteen churches, a hospital, public library, Public Library Commission branch, civic centre, arena, golf course, radio broadcasting station, and semi-weekly newspaper "The Citizen".

THE ALASKA HIGHWAY

The Alaska Highway was built by the U.S. Army during the Second World War in order to provide access by land to Alaska. The route of the highway was the subject of considerable controversy, many favouring the Rocky Mountain Trench. A route to the east of this was however chosen mainly owing to its value for servicing the airports of the Northwest Staging Route for delivery of aircraft to Alaska and Russia.

The road was begun on 7 March, 1942, and construction proceeded from the two ends, Fairbanks and Dawson Creek, as well as from Whitehorse. The pioneer road was driven through on 20 November, 1942, and military traffic began immediately, the journey then taking about two weeks. At the peak of construction nearly 16,000 civilians were employed in addition to a number of military personnel. A road was also built from Haines to link up with the Alaska Highway at Haines Junction in the Yukon. The cost of constructing the Canadian parts of these roads (1,221 miles of the Alaska Highway and 117 miles of the Haines Road) was approximately $125,000,000.

The agreement permitting the United States to build the highway provided that the parts lying in Canada would become Canadian at the end of the war. On 1 April, 1946, these sections were turned over to the Canadian government and since then the Canadian Army has had full responsibility for maintenance. The army units concerned form the Northwest Highway System, with headquarters at Whitehorse, which is also responsible for maintaining seven emergency airstrips along the highway and the access roads to the airfields and airstrips of the Northwest Staging Route. There are 654 civilian and 385 military personnel employed on this work.

In addition to normal maintenance, a number of permanent bridges have been built to replace temporary structures, and parts of the road have been relocated. The Haines road is closed during the winter months owing to heavy snowfall. For some time after the war civilian traffic required a special permit from the R.C.M. Police but this restriction was removed in February 1948 and civilian use of the highway has increased fairly steadily ever since.

On 16 October, 1957, a major bridge, that over the Peace River, collapsed owing to a landslide. Traffic was rerouted to the Pacific Great Eastern Railway bridge. A new road bridge should be completed by the end of 1959.

The heaviest traffic is on the southernmost 100 miles of the highway owing to lumbering, mining, and oil development and this section is now being paved. The traffic count at the Alaska border in 1958 was: northbound 13,723 vehicles, 34,444 passengers, 5,024 tons; southbound 12,439 vehicles, 34,152 passengers, 1,873 tons.

COLD LAKE, ALBERTA

This community is located on the south-west shore of Cold Lake near the Saskatchewan boundary north-east of Edmonton. The lake, 136 square miles, is a popular fishing and hunting resort.

The nearby R.C.A.F. air base is administered by Air Defence Command. However, it is one of the more isolated stations since communication facilities with the outside, although available, are time consuming. Hence, domestic amenities for bachelor and married quarters, as well as recreational facilities, have been amply provided.

The main activity is in connection with the Air Target Range and the Operational Training Unit, which has the major role on the station. Crews for the CF-100 fighter planes marry up with their aircraft at this centre and become a proficient team. The base is available to the SAC (U.S.A.F.) tankers and the airstrip is currently being lengthened. Facilities are being improved for refuelling installations.

The base started to operate around 1953. It was to have been the locale of the test trials for the Arrow program before plans were changed.

MID-CANADA LINE

In 1954 the federal government decided to erect a radar line along the 55th parallel of latitude to detect aircraft. This was known first as the McGill Fence and later as the Mid-Canada Line.

The line was built for the R.C.A.F. under D.C.L. supervision, with the Bell Telephone Company acting as management contractor, and was in operation by the middle of 1957. The cost of engineering work was about $96 million and the total cost including electronic equipment, designed and supplied by the Bell Telephone Company, amounted to about $236 million.

The line has 106 stations. Eight of these are main stations and are manned by approximately 130 men. Most of the remainder were designed to be unmanned. After an experimental stage when they had a crew of two or three people each, they were turned over to fully automatic operation.

The maintenance contractors are Canadian Marconi Limited for the part of the line east of the Manitoba-Ontario border and Canadian Aviation Electronics for the western part.

FORT CHURCHILL, MANITOBA

Jens Munck, a Dane, discovered the Churchill River in 1619, nine years after Henry Hudson's discovery of Hudson Bay. He wintered with two small ships in Sloop Cove on the left bank of the river. Most of the party died of scurvy and only himself and two others remained to sail one of the ships home. The first Fort Churchill was established in 1689 and the first Hudson's Bay Post at Churchill in 1711. After many years of labour, the Hudson's Bay Company completed Fort Prince of Wales in 1771, but a few years later Samuel Hearne was forced to surrender the Fort to the French, who destroyed it. It is now a national monument and a good landmark from both sea and air. Churchill has been a base for the exploration of the north for over two centuries. It was from here that Hearne carried out his famous journey to the mouth of the Coppermine River in 1771.

Churchill is a seaport, with a large grain elevator, and is served by rail from Winnipeg via The Pas, Manitoba. The port facilities handle over 5 million bushels of grain annually. The role of seaport is seriously restricted at Churchill by the short season of navigation.

The military camp and aerodrome is located close to the shoreline of Hudson Bay, about 4 miles SE of the town. It was originally built during the Second World War by the U.S. Army Air Force as part of the Crimson Staging Route and included a large hospital.

The military camp at Fort Churchill was established on a permanent basis as a joint experimental and training establishment in the spring of 1946. It was intended to provide facilities primarily for the Canadian and U.S. armies, though the other Canadian services are represented there. Local administration is the responsibility of the Canadian Army and the Commandant is a Canadian Army Officer.

The U.S. Army has used the station consistently as a place to "engineer-test" equipment under arctic conditions. This is done on a corps basis. In general all equipment is tested first in cold chambers in the U.S. by the developing agency and it is then sent to Churchill. User tests are undertaken at Fort Greely, Alaska.

The Canadian Army carries out field tests of equipment in the same way as the U.S. Army. The tests are controlled by the Army Development Establishment at Army Headquarters. In addition user trials are conducted from time to time, frequently as part of exercises. The Canadian Army also uses Churchill as a training centre for arctic warfare. Northern indoctrination and instructors' courses are held, and units are rotated through Churchill each winter for training which normally included exercises under extreme cold conditions.

R.C.A.F. cold weather testing is carried out by the Climatic Detachment of the Experimental and Proving Establishment. The Climatic Detachment was formerly known as the Winter Experimental Establishment. Its activities are centred at Edmonton (Namao), but for more extreme conditions Watson Lake and Fort Churchill are frequently used by test teams from the detachment. The R.C.A.F. maintains an important Air Movements Unit at Fort Churchill for the staging of personnel and equipment to Resolute Bay and the Joint Arctic Weather Stations.

The R.C.N. activities at Fort Churchill consist in maintaining a wireless station.

The Defence Research Board has had a detachment at Fort Churchill since the station was established. At first it was intended that scientists would visit Churchill in order to carry out specific tasks. It was later decided to have a permanent scientific staff, and a programme in many scientific fields, especially in the biological sciences, was initiated. There were a number of practical difficulties however, and the emphasis was changed so as to make use of the unique geographical (geo-magnetic) location. Fort Churchill lies under the zone of maximum frequency of auroral occurrence and affords exceptional opportunities to study, in this zone, both its effects on communications and the make-up of the upper atmosphere. Rocket research and auroral research now comprises the major activity of this laboratory. The rocket research at Fort Churchill is mainly undertaken by various American civil and military agencies with the U.S. Army operating the firing range. The Defence Research Northern Laboratories assist to a very great extent in providing synoptic auroral information for the firings.