THIRTY-SECOND ANNUAL REPORT

Navigation Conditions on the Hudson Bay Route from the Atlantic Seaboard to the Port of Churchill

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SEASON OF NAVIGATION
1960

DEPARTMENT OF TRANSPORT
NAUTICAL DIVISION

Price 50 cents

CANADA

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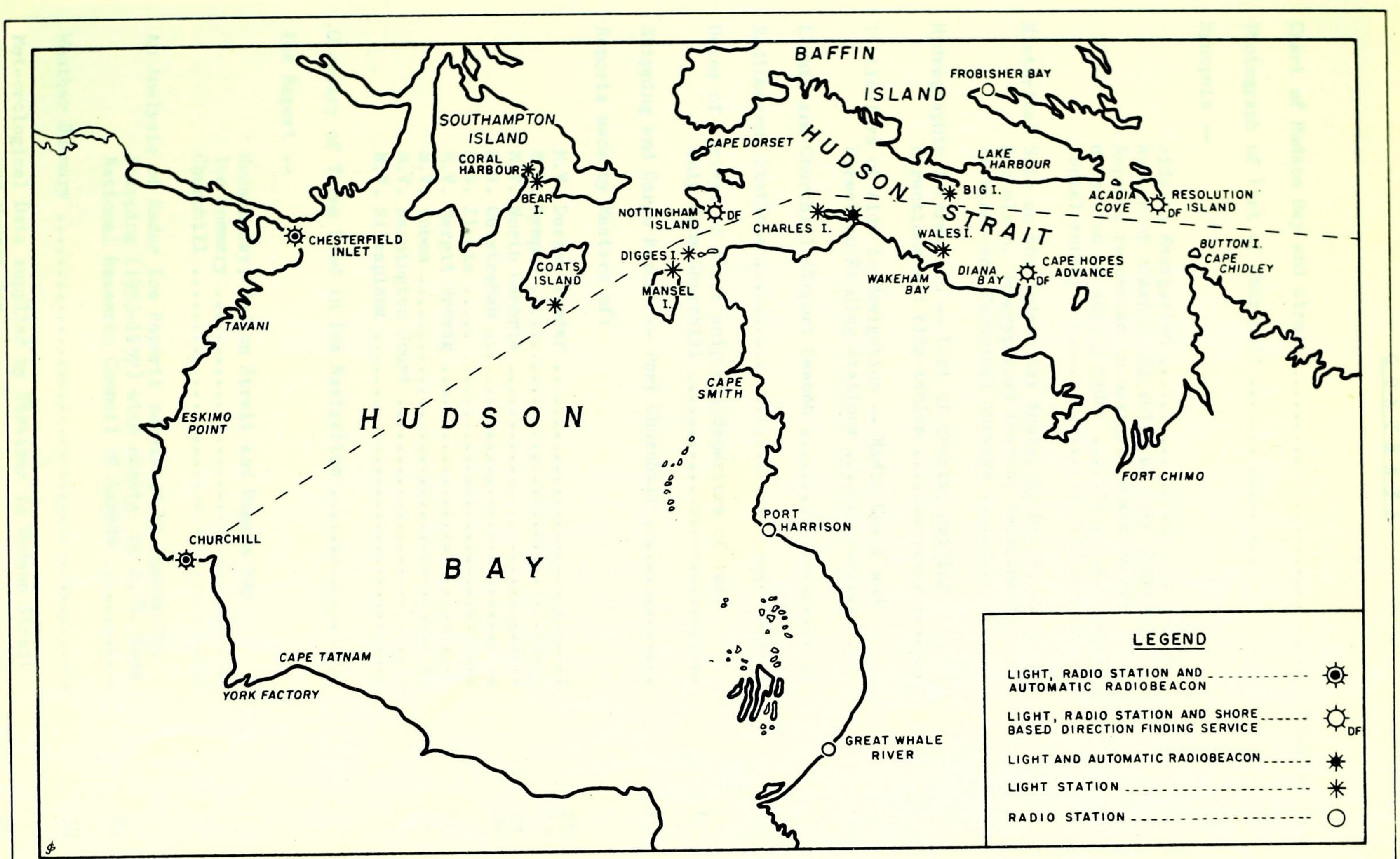
BAFFIN
ISLAND
FROBISHER BAY
SOUTHAMPTON
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CAPE DORSET
HUDSON STRAIT
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I.
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ACADIA
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ISLAND
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NOTTINGHAM
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CHARLES I.
WALES I.
BUTTON I.
CAPE
CHIDLEY
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INLET
DIGGES I.
COATS
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WAKEHAM
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DIANA
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CAPE HOPES
ADVANCE
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TAVANI
CAPE
SMITH
ESKIMO
POINT
HUDSON
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PORT
HARRISON
CHURCHILL
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RIVER
LEGEND
LIGHT, RADIO STATION AND AUTOMATIC RADIOBEACON
LIGHT, RADIO STATION AND SHORE BASED DIRECTION FINDING SERVICE
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LIGHT AND AUTOMATIC RADIOBEACON
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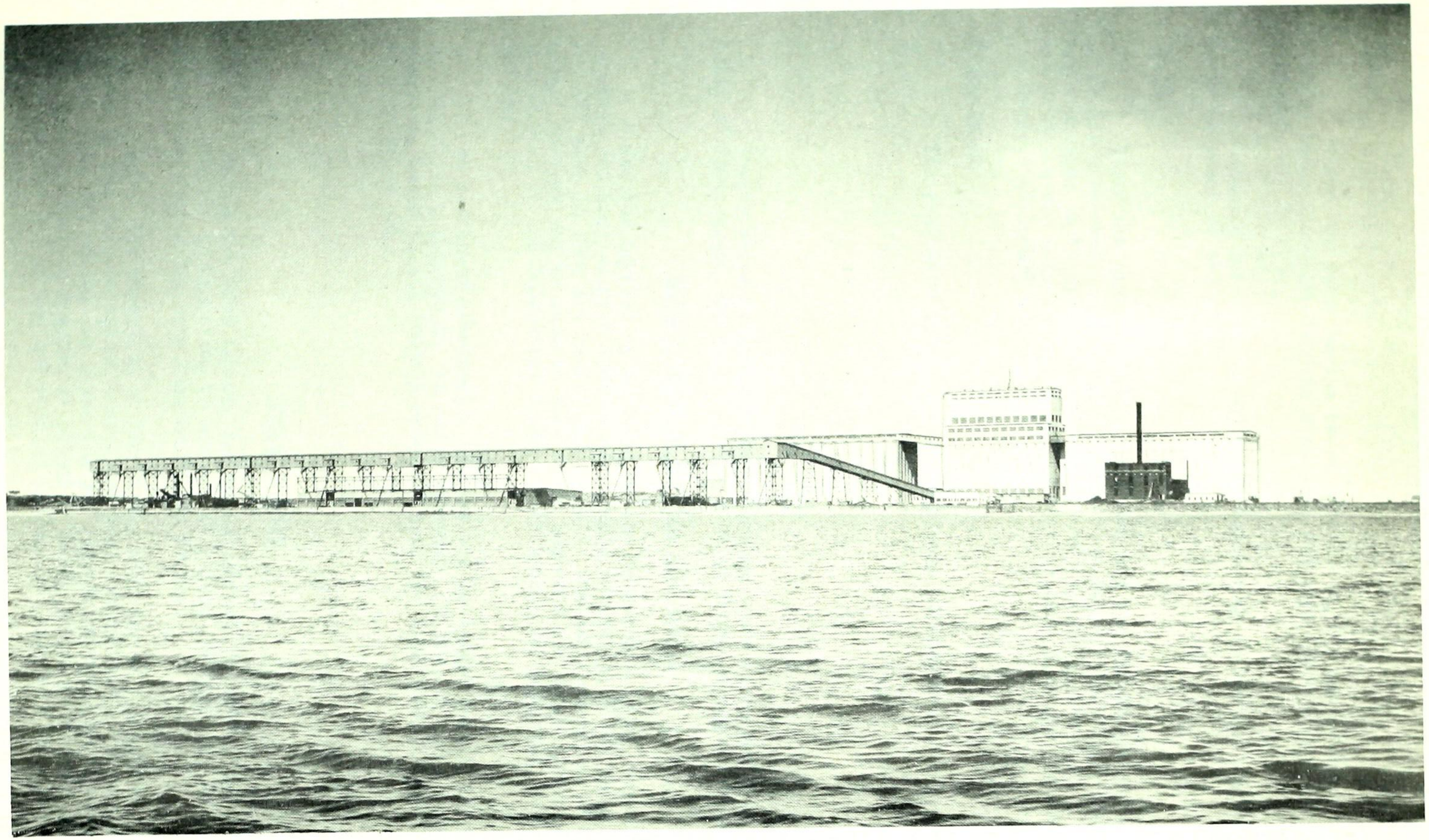
C O N T E N T S



CHURCHILL - GOVERNMENT ELEVATOR AND OVERHEAD CONVEYER FOR LOADING GRAIN IN BULK

(Courtesy National Harbours Board)

AIDS TO NAVIGATION

Radio

There are seven marine coast stations on the Hudson Bay route, including three direction finding stations, and also three marine radiobeacon stations.

Detailed information regarding these aids to navigation will be found on pages 16 and 18.

Lights

There are sixteen lights in Hudson Bay and Strait area, twelve of which are unwatched. A list will be found on page 17 and their locations are indicated on the frontispiece chart. At Churchill, there is a light on top of the grain elevator building. A lighted buoy lies off the entrance and range lights mark the channel in.

Hydrography

For available charts and hydrographic publications see pages 13 to 15.

SHIPPING

Twenty ships made one voyage, fourteen made two voyages for a total of forty-eight voyages. Details will be found on pages 20 and 21.

REPORTS MADE BY MASTERS OF VESSELS

For the benefit of mariners on the Hudson Bay route, reports and comments are invited from Masters of vessels navigating these waters. The reports made in 1960 are reproduced in full, whether favourable of otherwise. Masters may be assured that their comments and suggestions are valued even if the Department finds itself unable to implement them immediately.

As mentioned previously, masters are no longer requested to submit, on Form MN-2-7, reports on the radar detection of ice. A final composite analysis, based on all reports received over the last several years, appears on page 53 et seq.

AERIAL SURVEY

During the 1960 season, the annual aerial ice survey was conducted and the results communicated to masters of ships. Hudson Bay, Hudson Strait and Ungava Bay were covered by the survey.

Under the direction of the Deputy Minister of Transport, the Director of the Meteorological Branch has been charged with the responsibility of carrying out aerial ice observing and reconnaissance, ice forecasting and advisory services in support of shipping in ice infested waters. Marine Services provided an Ice Information Officer at Churchill who gave assistance to shipping.

THE HUDSON BAY ROUTE

by

Dr. N. L. Nicholson

Geographical Branch, Department of Mines and Technical Surveys

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Toward the end of the sixteenth century the wave of overseas colonization stimulated various English adventurers to sponsor the search for a northwest passage to Asia.

The earliest of these voyages was made by Frobisher between 1576 and 1578 but he did not penetrate further west than the bay which now bears his name. Davis, from 1585 to 1587, just entered Hudson Strait and named Capes Chidley and Warwick. But it was not until 1610 that Hudson Bay and Strait were really "discovered" by the navigator whose name these features now bear. He sailed south along the eastern shore of the bay and was frozen in by November 1st. After wintering at the southeast corner of James Bay, he, and a few sick sailors, were cast adrift by his mutinous crew, never to be heard of again. Nevertheless, many of the principal points along the Hudson Strait route were named by him and have been retained to this day. Cape Hopes Advance, Digges Island, Cape Wolstenholme and Nottingham and Salisbury Islands are but examples of this. Sir Thomas Button entered the Strait and Bay in 1612, and to him we owe the names Button Islands, Resolution Island, Cary's Swan Nest and Cape Southampton. He wintered at the mouth of Nelson River, which he named after his mate who died there. Bylot and Baffin, in 1615, sailed through Hudson Strait to the northeast coast of Southampton Island naming Savage Islands, Cape Comfort and Mill Island. In 1619, the only British expedition to northern Canada discovered Churchill River. Under the command of Jens Munck, this expedition arrived early in September and wintered there. In 1631, rival interests sent Luke Foxe and Thomas James to explore the bay, Foxe entered Roes Welcome Sound and named Marble Island (though he called it Brooke Cobham) and returned to England. James sailed south naming Cape Henrietta Maria and Charlton Island, where he wintered, and, of course, the bay itself was later named for him.

Thus, within thirty years of Hudson entering the Strait and Bay, the main outlines of their coasts were known, the existence of many islands mapped and information on ice conditions and other navigational hazards, collected.

Meanwhile, two Frenchmen, Radisson and Groseilliers, had learned that the area around James Bay was rich in furs. They ultimately succeeded in persuading the English authorities of this and as a result a party was sent out in 1668. They built a fort on Rupert River, wintered there and returned to England the next summer with a full cargo of furs. This led to the incorporation of the Hudson's Bay Company in 1670, an organization which for nearly two hundred years was to be the chief agency in the development of the region around the Bay and Strait. By 1685 the company had established five posts on the Bay at the mouths of important rivers - Rupert House, Albany, Moose Factory, New Severn and Fort York. Churchill river was almost forgotten until its "rediscovery" in 1686. An attempt to establish a post there was made in 1689, but due to the war between France and England from 1690 to 1713, was soon discontinued and was not resumed until 1717. Few further discoveries were made around the coast of the bay. Ships entering it made immediately for the Company's posts, usually in late July

or early August, and left again in September. There was no object in their making the passage any earlier as the boat expeditions bringing furs from the interior of the country could not arrive at the coast depots before the end of July and, as soon as the imported supplies were landed and the export cargoes loaded, there was nothing to delay their return to Europe.

However, the search for the Northwest Passage was revived in the middle of the eighteenth century. Middleton's expedition of 1741-42 wintered at Churchill. He sailed up and named Wager Bay and Repulse Bay while Christopher, in 1762, explored Chesterfield Inlet, and in 1821, Parry proved conclusively that Southampton Island was not part of the mainland although it was not known to be separated from Coats Island until after 1860.

In 1860, the whaling industry shifted from the Norwegian Sea to Baffin Bay and Hudson Bay. Whalers often wintered in the Bay in order to start hunting early the following season and they accumulated much practical knowledge of navigation conditions there although it was frequently kept secret for commercial reasons.

In 1870, title to "Rupert's Land and the Northwest Territories" passed to Canada and interest turned to the possibility of using the Hudson Bay Route for purposes of commerce. In 1884, the government sent an expedition to the area to ascertain for what period of the year the straits were navigable. Scientific stations were established along it where ice observers spent the winter of 1884-85. Port Burwell was one of these and was named for the observer who established the station. Similar expeditions under Commander Wakeham, for whom Wakeham Bay is named, investigated earlier and later dates for navigation. These expeditions also surveyed the mouths of the Churchill and Nelson Rivers and carried out other scientific work. In 1903, another government expedition on similar work, wintered at Cape Fullerton.

But this sea route could be of little economic use to Canada until its terminus was connected to the southern part of the country. In 1908, a railway line from Hudson Bay Junction to The Pas was completed and, in anticipation of a terminus at Churchill, the townsite was laid out and lots granted. In 1909, the first permanent trading post along the sea route was established at Cape Wolstenholme and within the next few years other posts were opened on both sides of the Strait and along the west coast of Hudson Bay. Meantime, work had been progressing on the railway and by 1918, the track extended to 332 miles beyond The Pas. Work was then suspended until 1927, when Churchill was finally chosen as the terminus, but by 1929, the remaining 176 miles of track had been laid.

Although four freighters were unloaded at Churchill in 1928, and two in 1929, the harbour was not developed and the cargoes were entirely for local consumption. But by 1931, the port was substantially complete and two ships were cleared with full cargoes of wheat from western Canada. Thus Churchill was opened as a modern commercial port and the Hudson Bay route became a twentieth-century practical reality.

HYDROGRAPHIC INFORMATION

The Canadian Hydrographic Service, Department of Mines and Technical Surveys, publishes a series of navigation charts and a volume of Sailing Directions covering Labrador and Hudson Bay. These are kept up to date and added to from time to time as new information becomes available.

The "Tide Tables for the Atlantic Coast of Canada", published by the Tidal Survey of the same Service, contains predictions for Diana Bay in Hudson Strait, the Port of Churchill and for Charlton Island in James Bay. Tidal differences for sixteen localities in Hudson Strait, twelve in Hudson Bay and seven localities in James Bay afford the times of high and low waters in these areas. The time of the turn of the tidal stream in the southern offing of Resolution and Nottingham Islands and information on the currents in Digges Sound are also given. An automatic tide gauge is operated at Churchill to assist in the improvement of the predictions.

HYDROGRAPHIC PUBLICATIONS - HUDSON BAY AND STRAIT

Standard Charts -

4775 - Nain to Saglek Bay
4776 - Entrance to Saglek Bay to Button Islands
5000 - Hudson Bay and Strait
5348 - Hopes Advance Bay and Approaches
5349 - Hopes Advance Bay
5351 - Payne Bay and Approaches
5352 - Payne Bay and River
Kyak and Tuvalik Bays
5400 - Cape Churchill to Egg River
5401 - Wakeham Bay
Fisher Bay
5402 - Cape Prince of Wales to Cape Weggs
Douglas Harbour
5403 - Pritzler Harbour to Cape Weymouth
Balcom and Barrier Inlets
Shaftsbury Inlet
5405 - Port Burwell and Approaches
5406 - Cape Tatnam to Port Nelson
5407 - Anchorages in Hudson Strait
Savage Harbour
Charles Inlet
5408 - Cape Churchill to Churchill Harbour
5409 - Churchill Harbour to Hubbart Point
5410 - Coral Harbour and Approaches
Munn Bay
5411 - Lower Savage Islands to Pritzler Harbour
Pritzler Harbour
5412 - Erik Cove to Nuvuk Harbour including Digges Islands
Erik Cove
Digges Harbour
Port de Laperriere
Nuvuk Harbour
5414 - Rupert Bay
5415 - Mouth of Rupert River
5416 - Mouth of Moose River
5417 - Approaches to Nelson River
5418 - Churchill Harbour
5427 - Rankin Inlet
5430 - Entrance to Chesterfield Inlet
Chesterfield Anchorage
5449 - Hudson Bay, Northern Portion
5450 - Hudson Strait

5452 - Diana Bay
5459 - Resolution Harbour and Acadia Cove
5461 - Approaches to Koksoak River
5462 - Koksoak River Mouth
5464 - Diana Bay, Southern Portion
5467 - Leaf Bay and Approaches
5468 - Leaf Passage
5469 - Leaf Basin
5513 - Culbertson Island to Koojesse Inlet
5515 - Culbertson Island to Frobisher's Farthest
5516 - Koojesse Inlet and Approaches
Koojesse Inlet

Provisional Charts -

5331 - Abloviak Fiord and Approaches
5396 - Marble Island to Chesterfield Inlet
5397 - Dawson Inlet to Marble Island
5398 - Eskimo Point to Dawson Inlet
Eskimo Point
5399 - Egg Island to Eskimo Point
5431 - Chesterfield Inlet - Black Rocks Point to Imilit Islands
5432 - Chesterfield Inlet - Imilit Islands to Dangerous Point
5433 - Chesterfield Inlet - Dangerous Point to East Point
5434 - Chesterfield Inlet - East Point to Promise Point
5435 - Chesterfield Inlet - Promise Point to Primrose Island
5436 - Chesterfield Inlet - Primrose Island to Cross Bay
5437 - Chesterfield Inlet - Cross Bay to Bowell Island
5438 - Baker Lake (Eastern Portion)
Chesterfield Narrows
Polaris Narrows
Regina Narrows
5439 - Baker Lake
5440 - Wager Bay
5445 - Rankin Inlet - Vicinity of Thomson Island
Melvin Bay Anchorage
5451 - Cape Dorset and Approaches
5453 - George River
5455 - Lake Harbour and Approaches
Lake Harbour
5456 - Button Islands
5457 - Deception Bay
5458 - Sugluk Inlet
5470 - Belcher Islands
5471 - Port Harrison and Approaches
5473 - Little Whale River
5475 - Povungnituk Bay
5476 - Harbours and Anchorages - Hudson Bay and James Bay
Winisk
Bear Island
Bear Island Landing Beach
Cape Jones
Great Whale River
Entrance to Great Whale River
Landing Beach, Cape Henrietta Maria
Fort Albany
5533 - Ross Welcome Sound (Chesterfield Inlet to Cape Munn)
7050 - Resolution Island to Cape Mercy
7065 - Mill Island to Winter Island
7404 - Frozen Strait, Lyon Inlet and Approaches

7405 - Repulse Bay and Approaches
7430 - Repulse Bay (Harbour Islands to Talun Bay)
Talun Bay

SAILING DIRECTIONS -

LABRADOR AND HUDSON BAY PILOT

TIDE TABLES -

TIDE TABLES FOR THE ATLANTIC COAST OF CANADA

NOTE:- Charts may be obtained from Chart Distribution Office, Canadian Hydrographic Service, Department of Mines and Technical Surveys, 249 Queen Street, Ottawa, Canada or from Dubois-Phillips and McCallum Ltd., 11 Rumford Place, Liverpool, England. The Sailing Directions are sold at $5.00 per copy and the Tide Tables at 50 cents per copy by the Publications Branch, Department of Public Printing and Stationery, Ottawa, Canada.

AIDS TO NAVIGATION IN HUDSON BAY AND STRAIT

Radio Coast Stations

	Station	Call sign	Calling freq.(1)	Working freq.(2)	Latitude N.	Longitude W.	Hours of Service	Coast charge
Ⅱ	Resolution Island	VAW	500 Kc/s	484 Kc/s	61° 18' 30"	64° 53' 24"	Continuous during season of navigation	8¢ per word
Ⅱ	Cape Hopes Advance	VAY	500 "	446 "	61° 05' 12"	69° 33' 24"	Continuous during season of navigation	" " "
Ⅱ	Nottingham Island	VCB	500 "	458 "	63° 06' 48"	77° 56' 18"	Continuous during season of navigation	" " "
	Churchill	VAP	500 "	420 "	58° 45' 42"	93° 54' 48"	Continuous during season of navigation	" " "
	Chesterfield Inlet	VBZ	500 "	420 "	63° 20' 05"	90° 42' 33"	Continuous during season of navigation	" " "
	Port Harrison	VAL	500 "	430 "	58° 27' 17"	78° 08' 29"	Continuous during season of navigation	" " "
	Great Whale River	VAV	500 "	484 "	55° 17' 00"	77° 45' 00"	Continuous during season of navigation	" " "

Ⅱ Direction Finding Station

(1) All stations maintain a listening watch on 500 and 2182 Kc/s during the navigation season.

(2) All stations except Resolution Island take and transmit bearings on 410 Kc/s after communication has been established on 500 Kc/s.

(3) All messages relative to navigation are handled free of charge. The eight cent per word coast charge applies to all other traffic. For forwarding charges beyond Churchill enquire at any of the above stations or see Canada Rate Sheet, International List of Coast and Ship Stations.

LIGHTS

Location	Position Latitude	Longitude	Character	Elevation	Remarks
Resolution Island	61° 18' 28"	64° 53' 16"	Flashing	129 ft.	White square, wooden lantern on wooden skeleton base.
Cape Hopes Advance	61° 04' 45"	69° 33' 30"	Flashing	270 ft.	Steel tower.
Wales Island (U)	61° 51' 37"	71° 58' 19"	Flashing	280 ft.	Steel tower.
Ashe Inlet (U)	62° 31' 40"	70° 33' 00"	Flashing	191 ft.	On wooden pole.
East end of Charles Island (U)	62° 36' 28"	73° 56' 12"	Flashing	200 ft.	Steel tower. Radio beacon station (automatic responder beacon), radar reflector.
West end of Charles Island (U)	62° 42' 30"	74° 40' 00"	Flashing	45 ft.	On wooden pole.
Nottingham Island (U)	63° 05' 45"	77° 56' 55"	Flashing	86 ft.	Steel tower, radar reflector.
Digges Island (U)	62° 35' 18"	78° 06' 42"	Flashing	91 ft.	Steel tower, aluminum, radar reflector.
Mansel Island (U)	62° 25' 00"	79° 36' 00"	Flashing	46 ft.	Steel tower, radar reflector.
Coats Island (U)	62° 10' 20"	83° 08' 00"	Flashing	41 ft.	On steel tower, painted buff, with 12 foot square white wooden daymark and radar reflector on top.
Coral Harbour (U)	64° 07' 33"	83° 15' 13"	Flashing	75 ft.	Steel tower, radar reflector.
Bear Island (U)	64° 00' 30"	83° 13' 01"	Flashing	58 ft.	Red lantern on pole with tripod slatwork daymark at base.
Chesterfield Inlet	63° 20' 06"	90° 42' 32"	Flashing	121 ft.	Light on top of radio tower.
Churchill Harbour lighted bell buoy	58° 49' 48"	94° 06' 00"	Flashing	--- --	Black steel. Equipped with radar reflector.
Churchill Harbour, Manitoba	58° 46' 35"	94° 11' 18"	Flashing	218 ft.	Red light on top of elevator penthouse.
Churchill Range (U)	(58° 47' 06"	94° 13' 55"	Fixed	43 ft.	White wooden tower.
	(5,430 feet, 236° from front		Fixed	125 ft.	White wooden tower.
Merry Rocks bell buoy	58° 47' 35"	94° 12' 17"	--	--- --	Black steel buoy (no light).

(U) Unwatched

BEACON - CHURCHILL AIRPORT

Approximate Position -- Latitude 58° 45' 30" N, Longitude 94° 03' 38" W.

Flash - every 10 seconds, 2.3 million candle power, 175 ft. above sea level.

RADIOBEACON STATIONS

Station	Frequency Kc/s	Characteristic		
Churchill	305	Transmissions continuous	.--- .--- .--- —	Navigation season only
Chesterfield Inlet	341	Transmissions continuous	-.-. ...	Open year round
Charles Island	298		-.-. -.-. -.-. —	Navigation season only

Charles Island beacon is unattended and is automatic in operation, being brought into operation by a radio signal from the ship desiring to obtain direction-finding bearings.

The radio operator on any ship wishing to use this beacon should transmit by radio two 10-second dashes, spaced 20 seconds apart, using A1 or A2 type of emission. The frequency of such transmissions must be 410 Kc/s. Approximately 50 seconds after this interrogation the beacon will transmit its characteristic for a period of 5 minutes.

In the event that the beacon is not heard, a period of 8 minutes from the end of the interrogation should be allowed to elapse before a second interrogation signal is sent.

Cape Hopes Advance (VAY) monitors this radio beacon daily and will provide any additional information required with regard to it.

Comments regarding reliability of response, range of the beacon and reliability of the bearings are invited and may be forwarded without charge to the Director of Telecommunications, Electronics Branch, Ottawa, through the Cape Hopes Advance station.

GRAIN SHIPS USING THE PORT OF CHURCHILL

Dates of arrival of first ship and departure of last ship from Churchill

Year	Arrival		Departure	
	Name of Ship	Date	Name of Ship	Date
1951	s.s. WARKWORTH	29, 7,51	m.v. JOHN LYRAS	2,10,51
1952	s.s. WARKWORTH	29, 7,52	s.s. GLUCKAUF	9,10,52
1953	s.s. WARKWORTH	26, 7,53	m.v. BERLIN	13,10,53
1954	s.s. WARKWORTH	27, 7,54	m.v. PINDAR	7,10,54
1955	s.s. WARKWORTH	27, 7,55	s.s. TRILAND	10,10,55
1956	s.s. WARKWORTH	27, 7,56	s.s. GARDENIA	7,10,56
1957	m.v. NORDMEER	31, 7,57	s.s. OUISTREHAM	10,10,57
1958	m.v. RICHARD DE LARRINAGA	26, 7,58	s.s. TROMPENBERG	11,10,58
1959	m.v. NORTH DEVON	27, 7,59	m.v. LA BAHIA	15,10,59
1960	m.v. MARGIT BROVIG	27, 7,60	m.v. LA BAHIA	12,10,60

PARTICULARS OF GRAIN SHIPS USING THE PORT OF CHURCHILL DURING 1960

	Name	Nationality	Net Register Tonnage	Arrived	Sailed	Destination	Outward Cargo Wheat in Bulk (Bushels)
m.v.	MARGIT BROVIG	Norwegian	5,935	July 27	July 28	Oslo, Norway	541,333.3
m.v.	DURHAM TRADER	British	5,339	July 31	Aug. 3	U.K. for orders	470,400.0
m.v.	TOBON	Norwegian	4,209	July 31	Aug. 4	U.K. for orders	361,797.3
s.s.	ZINNIA	British	3,921	Aug. 3	Aug. 5	U.K. for orders	358,400.0
s.s.	OUISTREHAM	French	4,326	Aug. 5	Aug. 8	U.K. for orders	373,333.3
m.v.	HANNINGTON COURT	British	3,467	Aug. 5	Aug. 7	London	392,000.0
s.s.	SIDERIS	Liberian	4,451	Aug. 7	Aug. 9	U.K. for orders	378,000.0
m.v.	SILVAPLANA	Swiss	3,436	Aug. 8	Aug. 10	U.K. for orders	388,266.7
m.v.	GEDDINGTON COURT	British	4,777	Aug. 5	Aug. 13	U.K. for orders	387,333.3
m.v.	NYMPHE	Greek	4,639	Aug. 10	Aug. 12	U.K. for orders	388,266.6
m.v.	NORTH CAMBRIA	British	3,245	Aug. 12	Aug. 14	U.K. for orders	336,000.0
s.s.	YIANNIS	Panamanian	4,316	Aug. 11	Aug. 15	U.K. for orders	337,066.6
m.v.	SILS	Swiss	5,511	Aug. 13	Aug. 16	U.K. for orders	411,600.0
m.v.	AGHIOS NICOLAOS	Greek	3,728	Aug. 14	Aug. 17	U.K. for orders	395,920.0
m.v.	LAVAUX	Swiss	5,306	Aug. 15	Aug. 18	London	461,066.6
s.s.	KOSTIS	Liberian	4,475	Aug. 16	Aug. 19	U.K. for orders	369,599.9
m.v.	MILROSS	Norwegian	5,001	Aug. 17	Aug. 21	Continent for orders	429,333.3
m.v.	BETTY	Norwegian	7,316	Aug. 19	Aug. 22	Antwerp	597,333.4
s.s.	BASIL 11	Liberian	4,428	Aug. 19	Aug. 25	U.K. for orders	379,866.7
s.s.	THISTLEMUIR	British	4,367	Aug. 21	Aug. 25	U.K. for orders	355,600.0
m.v.	LEERSUM	Netherland	4,828	Aug. 25	Aug. 27	U.K. for orders	358,400.0
m.v.	ANTIOPE	Panamanian	4,243	Aug. 25	Aug. 28	Glasgow	369,600.0
m.v.	MARGIT BROVIG	Norwegian	5,935	Aug. 27	Aug. 29	Norway	541,333.3
m.v.	ZWIJNDRECHT	Netherland	7,426	Aug. 31	Sept. 1	Continent for orders	601,066.7
m.v.	LA BAHIA	British	2,992	Sept. 1	Sept. 3	U.K. for orders	336,933.3
m.v.	NORDLAND	German	4,816	Sept. 2	Sept. 4	U.K. for orders	414,400.0
m.v.	REGINA	Swiss	6,263	Sept. 4	Sept. 5	Rotterdam Range	444,266.7
m.v.	DURHAM TRADER	British	5,339	Sept. 5	Sept. 7	U.K. for orders	470,400.0
m.v.	HANNINGTON COURT	British	3,467	Sept.11	Sept.13	U.K. for orders	392,373.3
m.v.	SILVAPLANA	Swiss	3,436	Sept. 5	Sept.15	U.K. for orders	389,013.4
s.s.	MEDINA PRINCESS	British	4,079	Sept.15	Sept.17	U.K. for orders	358,400.0

m.v.	TOBON	Norwegian	4,209	Sept.11	Sept.18	U.K. for orders	364,373.3
m.v.	LEIV EIRIKSSON	Norwegian	4,890	Sept.17	Sept.19	Hull	421,866.6
s.s.	IRISH SPRUCE	Irish	4,575	Sept.18	Sept.20	Eire for orders	343,466.7
s.s.	HARRIER	Liberian	4,327	Sept.19	Sept.22	U.K. for orders	363,066.6
m.v.	CORCOVADO	Liberian	3,590	Sept.20	Sept.22	U.K. for orders	390,133.4
m.v.	LAVAUX	Swiss	5,306	Sept.21	Sept.24	Avonmouth	461,066.7
m.v.	DONA KATERINA	Liberian	5,836	Sept.23	Sept.25	London	529,200.0
m.v.	NORTH CAMBRIA	British	3,245	Sept.24	Sept.27	U.K. for orders	336,000.0
s.s.	SIDERIS	Liberian	4,451	Sept.27	Sept.29	U.K. for orders	380,800.0
m.v.	SILS	Swiss	5,511	Sept.28	Sept.30	U.K. for orders	405,066.7
s.s.	ANAX	Greek	4,851	Sept.28	Oct. 1	London	427,466.6
s.s.	YIANNIS	Panamanian	4,316	Sept.29	Oct. 2	Liverpool and Birkenhead	378,933.4
m.v.	NAYADE	Panamanian	5,727	Oct. 3	Oct. 6	Antwerp and Hamburg Range	509,600.0
s.s.	THISTLEMUIR	British	4,367	Oct. 5	Oct. 7	U.K. for orders	351,680.0
m.v.	GEDDINGTON COURT	British	4,777	Oct. 2	Oct. 8	U.K. for orders	382,666.7
s.s.	BASIL 11	Liberian	4,428	Oct. 6	Oct. 9	U.K. for orders	376,133.3
m.v.	LA BAHIA	British	2,992	Oct. 11	Oct. 12	U.K. for orders	332,266.7

Total - 19,582,490.4

Outward - 19,582,490.4 bushels wheat
- 108,376 bushels mixed feed oats
- 2,576 tons No. one feed screenings

Inward - 4,807 tons general cargo
- 68,959 tons petroleum products
- 22,446 tons domestic cargo

- 9,034 tons of miscellaneous cargo shipped to various missions, Hudson's Bay Company posts and R.C.M.P. detachments and different government departments throughout the north.

Arr YQ July 31
dep YQ Aug 3

REPORT MADE BY CAPT. E. E. ATKINSON
MASTER M. V. DURHAM TRADER

The passage to Resolution Island was made under good weather conditions, the first ice being encountered 130 miles before entering the Hudson Strait. A small amount of field ice was met off Resolution Island but was easily navigated in this area.

In a position approximately midway between Resolution Island and Cape Hopes Advance much heavier field ice was encountered, this ice covered a very large area, extending to the horizon in a northerly direction. By heading due south this ice was passed without too much bother and the vessel passed Cape Hopes Advance at a distance of 12 miles. Very few bergs were sighted in the Strait but poor visibility reduced the chances of making reliable observations.

From Mansel Island the passage across the Hudson Bay was ice free until a position a little over 100 miles from Churchill was reached. Here the ice was extremely heavy with up to 9/10 coverage and extending in a line running roughly northwest and southeast. As the reports from Churchill were not of any assistance in planning a sensible approach to the port a convoy of 3 ships was formed, including the "Durham Trader". These ships proceeded through the ice with the "N. B. McLean" preceding them but one vessel had to be left in the ice as the conditions proved too severe for her to maintain 'station'.

(1) The damages suffered by each ship that navigated this route were sufficient proof that this was a stupid route to attempt. After discussing the matter with the ship's agent a message was sent to all other vessels approaching the port, explaining that the normal route was too hazardous. The result was that the later arrivals made different approaches and fortunately one vessel succeeded in finding an approach with less severe conditions.

Upon sailing, this alternative route was tried and found to be much easier. The ice in the Hudson Strait consisted of several large bergs and a considerable amount of growlers, the field ice had gone completely by this time.

This particular voyage was definitely the most difficult one that I have ever experienced on this trade. Although the situation was the result of a spell of unusual weather I am sure that the heavier parts of the icefields could have been avoided if the ice observations had been more reliable.

(2) I particularly note that the suggestion of a D/F Beacon being installed to the north of Churchill has been ignored, as has also the suggestion that Mansel Island be fitted with a Radar Reflector. The D/F Beacon on Charles Island has never yet given out a single signal as far as I know although the operators on Resolution Island continually assure us that it is in working order.

If these improvements were made to the navigational aids and the ice reports were reliable enough to have some confidence in them, then the voyage to Churchill would present no more difficulties than a voyage to the St. Lawrence River.

ED. NOTE:

(1) The track taken was the only practicable route as the ice extended to the shore to the east and west of the course followed and was as severe, or worse, elsewhere.

(2) This is also mentioned by other ships. The establishment of a

radio beacon on Exkimo Point is under consideration.

(3) A radar reflector, similar to those installed in the Arctic, has been placed on Mansel Island.

(4) This beacon is activated every twelve hours by Cape Hopes Advance Station and performance reports are available. While attempts are being made to improve its record of serviceability there is a suggestion that in the case of some ships the operating procedure set forth on page 2 of the Departmental publication "Radio Aids to Marine Navigation" may not be adhered to strictly.

REPORT OF M. V. NYMPHE
MASTER, CAPT. G. LYKIARDOPULO

The m.v. "Nymphe" left Birkenhead on the 26th July, 1960, for a voyage to Churchill in the Hudson Bay. From Malin Head we shaped a course 85 miles off Farewell Cape, then on to Hudson Strait. From Farewell Cape to Hudson Strait we encountered moderate southeasterly winds, but with dense fog. 100 miles from Resolution Island we had the first radar target on our starboard bow.

The recommended course was 5 miles off Button Islands, 5 miles off Cape Hopes Advance, 5 miles off Charles Island, 5 miles off Nottingham Island, 5 miles off Coats Island.

We passed Button Islands at 1 a.m. on the 4th August, within 5 miles, in dense fog, and we had many radar targets as far as Cape Hopes Advance, but no pack ice.

From Cape Hopes Advance to Coats Island we navigated in perfectly clear water and good visibility until about 50 miles off Churchill.

The recommended course was between ice fields with the open lead very narrow. Suddenly at 9 p.m. on the 5th August, the ship was almost locked in the ice, and because of the prevailing dense fog we decided to stop at 3.30 a.m. on the 7th August. The concentration was then 9/10ths.

At 7 a.m. we resumed passage with engine dead slow, the fog having lifted and the ice starting to move fast. The concentration then became about 7/10ths to 8/10ths.

We observed open water straight ahead, and succeeded in reaching this at 8.30 a.m. but at 11 a.m. we again entered a new ice field, concentration being 7/10ths, and finally reached open water at 1.30 p.m. on that same day, because of the great assistance rendered by the Ice Information Officer, who met vessel in a helicopter and gave us new recommended courses to avoid the surrounding ice fields. From this point up to Churchill we had very little difficulty. We loaded at Churchill a full cargo of wheat of 10,400 long tons, and sailed on the 12th August at 0900 hours.

The return voyage was in open water except in the ice fields outside Churchill, which were very severe, and we were escorted through these by the icebreaker "Wolfe", and their helicopter which made regular reconnaissance flights.

The officials at Churchill were most co-operative, especially the Ice Information Officer, Captain Kelso and the Master of the icebreaker "Wolfe", and the only suggestion to make is that to assist navigation, especially when ice fields exist outside Churchill, a radio beacon on the Eskimo Point would be most helpful in order to obtain cross bearings with radio beacon Churchill.

REPORT MADE BY CAPT. J. T. JAMES
MASTER M. V. NORTH CAMBRIA

The m.v. "North Cambria" left the River Tyne on the 26th July, 1960 and arrived at the port of Churchill on the 7th August, 1960.

The conditions were normal following the tracks given through the Hudson Strait and Bay until the last 50 miles when very heavy ice concentrations were encountered. No clear leads could be found and it was inevitable despite careful navigation that some damage was sustained. I realize that conditions were abnormal but I think that perhaps greater use could be made of the icebreakers in keeping a clear track to Churchill. On leaving I followed the advice of the Master of one of the icebreakers which had been recalled to help the shipping and worked around a heavy concentration immediately opposite the port and aided by his helicopter had no trouble in working clear.

REPORT MADE BY CAPT. M. RECAMIER
MASTER S. S. OUISTREHAM

Inward passage

Met ice (growlers and little bergs) in longitude 63 W. Passed 5 miles south of Resolution Island the 24th July at 5 p.m. From Resolution Island to thirty miles east of Cape Hopes Advance, heavy scattered ice coverage two to three tenths with not extensive concentrations four to six tenths easily avoidable except the ice edges with coverage minimum five tenths.

Open water from Cape Hopes Advance to latitude 60 N. in Hudson Bay. The 26th July, Ice Information Officer, Churchill, advises: Heavy close packed ice westward 5945 N, 9228 W to 20 miles off Churchill (breadth of icefield about seventy miles).

On 28th July at 10 a.m. in sight of icefield in position 5940 N, 9140 W and awaited to meet icebreaker "N. B. McLean" until 29th July at 8 p.m. At 9 p.m. steamed in icefield behind "N. B. McLean" with two other ships, coverage four to six tenths. Proceeded without special difficulties. The 30th July in position 3935 N, 9155 W met very heavy and concise pack ice coverage eight to ten tenths. Sailed very hardly and very slowly. At 3 p.m. we must stop to await m.v. "Tobon" in position 5926 N, 9217 W. At 5 p.m. beset in ice we cannot start and the "N. B. McLean" proceeds with the other ships.

Drifted with icefield south-southeastward (about twelve miles per day) until the icebreaker coming back at noon on August 2nd in position 5908 N, 9148 W.

The 2nd and 3rd of August tried unsuccessfully to proceed with assistance of icebreaker. Account of ridging and high pressure in icefield the wake is immediately closed.

The 4th of August steamed in icefield behind "N. B. McLean" full speed ahead proceeding about two knots. Very dense fog, visibility near zero. Sailing very difficult.

From position 5850 N, 9230 W heavy ice but not so close, coverage five tenths, but sailing very difficult due to dense fog.

Sailed out icefield at 5 p.m. in position 14 miles east-northeast of Cape Churchill.

We have steamed in icefield about one hundred miles.

Outward passage

Left Churchill roads the 9th of August. According to the information of Ice Officer looked for a way east of Churchill. In position 5900 N, 9320 W we found a lead northeastward then crossed about eight miles of ice, coverage four to five tenths, then open water.

In Hudson Strait sailed close to the south shore. Between Wales Island and Button Islands many bergs and growlers.

Ice information

Received very good information on the position of icefields and the best track from Ice Information Officer and icebreakers.

Radiofinders and radiobeacons

(1) Received accurate bearings from Nottingham Island. Those received from Cape Hopes Advance and Resolution Island, often wrong, did not give a good safety. Radiobeacon of Churchill is very useful.

When arriving on ice edge a master does not know the state of icefield and must rely on the information of the icebreaker and the Ice Officer. When the ice is as difficult as this year it would be good to give special advice to the master of a low-powered steamer and avoid him to proceed with a convoy.

I think we could be due the 30th July if we were alone with the icebreaker and had not to stop to await the other ship. We proceeded full speed ahead and we had not enough power to start after having stopped, and the icebreaker cannot work in the same way if she proceeds with three ships.

ED. NOTE:

(1) Reports from the majority of ships indicate that the radio stations are helpful and the D/F services that they provide are satisfactory.

REPORT MADE BY CAPT. W. R. HUNTER
MASTER S. S. ZINNIA

Voyage from Avonmouth - Churchill - Southampton. July/August. 1960.

Sailed from Avonmouth steaming the normal courses, passing 708 south of Cape Farewell and making a position south of Resolution Island. Thence usual route along Hudson Strait and down into the Bay, east of Coats Island towards Churchill.

No bergs encountered off Cape Farewell. First bergs and growlers were met 60' east of the Strait then widely scattered bergs and growlers up to Cape Hopes Advance thence clear waters to about 100 miles off Churchill.

After passing Coats Island made usual track towards Churchill, when about 210' off same heard the continued difficulties of some ships to make headway through the ice off the port. I decided to proceed westward to find a way through to what I hoped may be a clear coastal passage, winds tending to hold ice offshore. The Ice Officer confirmed my thoughts when I contacted him and advised me to carry on. Proceeded until ice-edge encountered in position 60 40 N, 91 20 W following the same in southwest direction and closing the land at the same time. When at estimated closest point to land (through ice), position 60 08 N, 93 00 W, headed WSW into the

ice, then 6/10 2/10 coverage increasing to 9/10 this being a 10' stretch of heavy ice, then 6/10 to ice edge. Entered at noon and cleared at 0700 following morning making an estimated distance of 35' through the ice and emerging about 60' north of Churchill. I followed the edge down the coast being about 5' to 10' offshore and occasionally having to go back into the ice because of shallow waters. This coastal route was followed to Churchill without mishap.

The coast line is very flat and affords no check by radar, the only discernable point on the screen was Hubbart Point which was held for 6'. Used soundings and D/F on Churchill for positional checks.

Before sailing from Churchill was informed by Ice Officer of a narrow neck of ice observed by plane close to the outbound track. This I headed for and proceeded through 4/10 and occasionally clear patches for about 4 hours after leaving fairway buoy. Then entered heavier ice about 6/10 to 8/10 steaming for about 10 hours making about 18'. Exceptionally heavy and large pieces of ice were encountered on this stretch. Once clear of the ice the normal track to Coats Island was maintained thence through the Strait. A few scattered bergs and growlers were encountered between Cape Hopes Advance and a position 20' east of Button Islands. A straight run home from there.

Navigational aids

(1) Resolution Island and Cape Hopes Advance D/F stations continue to give their good service. It would be advantageous to have a radiobeacon on Eskimo Point for a check on position approaching Churchill. A radar reflector on Mansel Island as on Cary's Swan Nest would be helpful. Most lights on the route were observed at maximum distance but were small and only seen in the excellent visibility.

Ice

Once again thanks to Capt. Kelso and his Air Reconnaissance team the ice problem was eased. The ice reports were appreciated though the Master was left to a wide speculation as to the actual position of the ice edges and how far they stretched. I would like to make the following suggestions.

(2) 1. Make the ice report more specific if possible, indicating by a number of Lat. Longs. the ice position so the Master can sketch same on his chart.

2. Indicate the narrowest point in the icefield and advised course through same.

3. Devise a Grid System covering Strait entrance to Cape Hopes Advance also for Churchill approaches, this may amplify No. 1 suggestion. Any ship bound Churchill could easily be supplied with same.

Churchill

Still lives up to its name of friendly officialdom and a quick turn round.

ED. NOTE:

(1) Radar reflectors, similar to those installed in the Arctic, have been placed on Mansel Island and Cary's Swan Nest.

(2) These three suggestions have been noted.

REPORT MADE BY CAPT. KR. STRAY ANDREASSEN
MASTER M. V. MARGIT BROVIG

We passed Cape Chidley July 23rd bound for Port Churchill. The northern part of the entrance and the Strait were congested with heavy polar pack ice about 6/10 coverage. The southern part was much better. From Button Islands we steered for a point 5 miles north of Cape Hopes Advance, but we had to deviate south a little to avoid very heavy belts of dangerous polar pack ice. As we proceeded slowly we didn't have too much trouble, but were able to steer clear most of the ice. After passing Cape Hopes Advance we had open water as we favoured the south side to a point 7 miles north of Charles Island, 10 miles north of Digges Island and 10 miles north of Mansel Island. In Hudson Bay we met the pack ice about 120 miles off Port Churchill and there was no route to avoid it. The ice was up to 35 feet thick and 5/10 to 10/10 coverage. The Canadian Government icebreaker "N. B. McLean" escorted us through. We arrived Port Churchill as the first grain ship of the season July 27th, 1960 and sailed in the evening July 28th.

On our outward passage the ice condition had improved a little in Hudson Bay and quite a bit in Hudson Strait. We favoured of course the south side again. In the Strait and outside - inward and outward bound - we passed many icebergs and growlers and had dense fog about half of the time.

On our second trip we arrived Port Churchill August 27th. At that time we didn't see any pack ice - just icebergs and growlers.

In my opinion it is too dangerous to navigate those waters for ships not equipped with radar and gyro on account of ice and magnetic disturbance.

Commencing July 23rd a suggested shipping track is issued daily by the Ice Information Officer, Port Churchill, but I am sure you know all about the wonderful job the Canadian Government do in those waters.

REPORT MADE BY CAPT. K. K. MIDTUN
MASTER M. V. TOBON

Like the season of 1959 the m.v. "Tobon" also this summer made 2 voyages with grain from Churchill with discharge in U. K. ports.

1st voyage

m.v. "Tobon" sailed from Rotterdam 15th July. Passed Cape Farewell at a distance of 80 miles on a great circle track from 20 miles off Fastnet. First ice, consisting of growlers and smaller floes was observed 25 miles before entering the Strait. Icebreaker "N. B. McLean" was contacted and we were granted permission to enter the Strait. Ice reports and routing instructions we received from Resolution Island Marine Radio. The track was given as from 5 miles south of Resolution Island. We found however that the south side of the entrance had more open water, and entered the Strait at a distance of 25 miles south of Resolution Island.

July 25th

At 1209 passed Resolution Island. Steered for track position 5 miles north of Cape Hopes Advance. After encountering numerous growlers and smaller bergs, we commenced navigating loose floes at reduced speed at 2343 hours. Speed was kept at a dead slow and with frequent stops in order to further reduce speed.

July 26th

At 0330 the track was clear of ice. At 0603 passed Cape Hopes

Advance, distance 7 miles. Followed suggested track to 5 miles north of Charles Island light. Encountered numerous icebergs of different sizes. The track however, was free of field ice.

In Hudson Bay a large field of ice, with 9/10ths coverage, was reported on the regular shipping track, about 90 miles from Churchill. We arrived at the edge of this field in the afternoon of July 28th. We tried to force the ice with reduced speeds, but pressure became too heavy, and we returned to open waters. In company with two other grain ships we awaited the arrival of Government Icebreaker "N. B. McLean", as suggested to us by the Port Authorities of Churchill. The icebreaker arrived at 2000 hours on July 29th. With the assistance of the icebreaker, we then steamed through heavy ice 8/10ths coverage till darkness stopped further maneuvering at 0048 hours, July 30th.

July 30th

Resumed navigation at 0545 hours, at very much reduced speeds. At intervals the convoy of three ships came to a stop due to heavy ice pressure. In the afternoon one of the three ships could not proceed, as she had sustained heavy propeller damage. At 2100 hours navigation ceased on account of darkness. The vessel was left behind in the ice, was picked up by the icebreaker 4 days after and assisted into port.

July 31st

Resumed navigation at 0310 hours. During the forenoon ice conditions improved some. By 1300 hours the convoy was steaming through loose field ice, at a better speed. At 1345 hours we reached open water, and steamed full speed for Churchill approaches. Arrived and berthed at 1940 hours. Inspection on arrival revealed minor propeller damage, and also a few rivets drawing water. Damages to the hull were temporarily rectified by vessel's own crew. On arrival in Churchill the cargo was not available. Commenced loading at 1145 hours August 2nd. Completed loading at 1045 hours August 4th. Sailed at 1514 hours August 4th. Cargo: 361,797 bushels, 9,691 long tons,heavy wheat. On departure from Churchill no icebreaker assistance was available. Accompanied by another grain vessel, we made our way through heavy field ice at reduced speed. The vessels being stopped during dark hours. Arrived in open waters at 0220 hours August 6th. For the remainder of the voyage numerous icebergs were observed in Hudson Strait. The bergs being more numerous in the eastern part of the Strait. No ice was observed east of Resolution Island. Arrived in Hull at 0540 hours August 19th.

Second voyage

Sailed from Hull at 2300 hours August 30th. Passed Cape Farewell at 1400 hours September 5th. Observed no ice east of Resolution Island which was passed at 1840 hours September 7th. We followed the same track as on the previous voyage. Observed in all 14 icebergs of different sizes on the stretch from Resolution Island to north of Charles Island. No ice observed in Hudson Bay. Arrived fairway buoy Churchill roads at 0130 hours September 11th. Berthed alongside at 0520 hours. Awaited clearing of grain cargo till September 16th when loading commenced at 1450 hours. Completed loading at 2105 hours September 18th. Sailed at 1611 hours September 18th. Cargo: 364,333 bushels, 9,760 long tons, heavy wheat.

Radio aids

All coast stations in Hudson Bay and Strait are very helpful and give all assistance required. The responder radiobeacon on east tip of Charles Island is not to be relied upon. In 10 tries we have endeavoured to raise the beacon working only once. Early arrivals in the Strait should acknowledge the necessity of keeping the propeller well submerged when navigating through icefields. Some of the ice to be encountered is very hard and does easily sever propeller blades.

(1) Ice information

I feel it should come to your notice that many Masters traversing the Hudson Strait, feel that the ice information service is not as satisfactory as it should be. We appreciate the fact that the flights are not frequent enough, and the weather conditions difficult, for operational flights. However, I feel the Ice Information Officer, stationed at Churchill, should enter every ship prior to departure, and supply the Master with all the latest information as regards ice conditions and track suggestions. On my first departure from Churchill this season, I received the most valuable information from the Master of a British vessel, just arrived in Churchill. To pick up such information and notify departing vessels should be the work of the Information Officer in Churchill. It would furthermore be useful if ships in the area are notified about the times the flights are taking place, as the observation plane may be contacted on the ordinary marine wave lengths via ship's radio. Apart from the ice hazards, the navigation of Hudson Bay route to Churchill presents no difficulties. A gyro compass is essential, and so is also a reliable radar, for navigation in these waters.

ED. NOTE:

(1) The Ice Information Officer visited fifty ships at Churchill. If any ship was not boarded it was due to his absence from the port on ice reconnaissance or air/sea rescue operations.

REPORT MADE BY CAPT. C. IRELAND
MASTER M. V. HANNINGTON COURT

U. K. to Churchill - 22.7.60 to 5.8.60

Followed Great Circle track to position 90 miles south of Cape Farewell thence steered to position 10 miles north of Lacy Island sighting first large bergs in Long. 6135 W. Shortly after passing Lacy Island encountered patches of light drift ice and several growlers which persisted until about 30 miles east of Cape Hopes Advance. From thence only isolated small bergs sighted, close inshore and clear of shipping track. Passing north of Charles Island and north of Mansel Island had a clear run to edge of ice field in Long. 9113 W. Following advices from Ice Information Officer made an attempt to penetrate the ice field using extreme caution but had to abandon this attempt after encountering heavy 10/10ths ice. Returned to open water outside ice field and 'hove to' awaiting icebreaker assistance. Further advised by Ice Information Officer that both icebreakers in service were fully engaged in extricating two vessels already fast in the ice and that by steering to a position 8 miles east of Eskimo Point the ice could be navigated with caution. Followed this route and although ice varying from 3/10ths to 9/10ths was encountered, after painstaking progress, and some damage to hull and propeller, reached open water about 40 miles north of Churchill and about 8 miles east of Hubbart Point. Thence steered 190° true to the anchorage at Churchill.

Throughout the 1st, 2nd, 3rd and 4th of August when navigating the ice field conditions were aggravated by persistent low lying fog which restricted visual observation of conditions for more than a few cables ahead. It is appreciated that these conditions must have restricted the operation of the Air Reconnaissance Unit.

Churchill to U. K. - 7.8.60 to 20.8.60

During our stay in Churchill visibility improved and a further air survey was made and from the map provided it appeared that a belt of 3/10ths to 5/10ths ice only, existed about 025° true 15 miles from Chur-

chill and extending in a 055° true direction for about 30 miles. On leaving Churchill, therefore, course was set to pass through this belt and the conditions as mapped proved to be substantially accurate, the first ice being met 13½ miles from Churchill on a 015° true course and after passing through patches of 3/10ths to 5/10ths ice open water was reached in 5928 N, 9236 W and no further ice sighted until off Wales Island when to small bergs were met with. In Hudson Strait poor visibility was again encountered and keeping to the south side of the Strait sighted several bergs, growlers and radar targets passing Lacy Island 15 miles north, in poor visibility, and saw no further ice except for a radar target about 20 miles east of Lacy Island.

U. K. to Churchill - 30.8.60 to 11.9.60

Made a similar approach to entrance to Hudson Strait but on this occasion no ice was sighted until about 40 miles west of Lacy Island again in poor visibility, when speed had to be reduced owing to several radar targets observed on our track. Navigated with caution through these and with visibility improving kept to south side of Strait, as advised by Ice Information Officer, and had an ice free passage on normal route to Churchill. Two large bergs were sighted close inshore, probably grounded, in vicinity of Wales Island. In this same area had a short but heavy westerly gale lasting about 12 hours.

Churchill to U. K. - 13.9.60 to 24.9.60

On leaving Churchill encountered a severe northwest gale, gusting to force 10 at times with a short, high, dangerous sea. This gale also whilst violent at onset was of comparatively short duration, the wind veering north and moderating within 24 hours.

Followed normal steamer track favouring south side of the Strait as advised by Ice Information Officer and met with only isolated bergs between Cape Hopes Advance and Lacy Island and more or less in positions as mapped by Meteorological Branch ice observers, Frobisher Bay.

Observations and suggestions

(1) Found the lights already established of little value as in our case poor visibility was always met with when in the locality of the lights. As most vessels make the Hudson Strait from the southward side would suggest a light and D/F beacon be placed on the Button Islands group. Found the automatic beacon on Moses Oates unreliable as on only one occasion, being within 10 miles, did we get a response. I would suggest that the early ice reconnaissance reports be extended to cover the seaward approach to Hudson Strait and when an ice field is known to exist off Churchill approaches that an icebreaker be stationed on the outer fringe to assist vessels in finding the least hazardous way in. The same icebreaker could also pass to Masters a copy of the latest air survey map available. I found in all other ways that the assistance of the various shore bases, Resolution Island, Cape Hopes Advance and Nottingham Island always at our service and the ice reports to be very good in general. The port of Churchill is well equipped to handle cargo and the authorities very helpful particularly in the efficient handling of temporary repairs with the limited means at their disposal. The pilotage in Churchill Harbour is also of a high standard and I have every confidence in the pilot.

I must also mention that when my radar developed a fault this also was put in order by the Kelvin Hughes technician.

ED. NOTE:

(1) Arrangements are being made to establish a light on the Button Islands.

REPORT MADE BY CAPT. F. A. M. GERARD
MASTER M. V. SILVAPLANA

On the 1st August in Davis Strait, we received the first suggested shipping track for navigation in the Strait and Hudson Bay. During the night, nearing Button Islands the radar detected a few bergs about 30 miles off in the east of Button Islands. We entered the Strait on August 3rd at 01.30 local time and made course with fog and drizzle from Button Islands direct to Cape Hopes Advance according to suggested track. At 8 a.m. the visibility became good enough and we saw many large icebergs. We passed Cape Hopes Advance at 2 p.m. and Charles Island at midnight, Coats Island at 9 p.m. on the 4th. We took suggested track in Hudson Bay where heavy conditions of ice existed, in purpose to reach position 61° 25' Lat. N, and 92° 25' Long. W and the western side of the Bay where there was open water. But on the 5th about 7.30 a.m. we saw an ice field on the whole horizon and as it was not very thick, we came in. However for a moment the floes and bergs became much thicker and we proceeded, accordingly with caution, at slow speed, stopping the engine when big pieces were crossing our course. They looked like rotten ice and broke easily on contact with the stem, and when too heavy to break, the push of the ship at dead slow speed made them swing out of our way. We were in open water at 12.30 and made full speed until 4.15 p.m. Thence maximum speed till 11 p.m. when ice was again in sight, the position was approximately 58° 45' N, 92° 40' W and about 8/10ths of very heavy pieces. About 3 a.m. on August 6th, a large piece stayed 3/4 of an hour below the hull near the No. 3 hatch, perhaps being kept in position by the bilge keel. We did about 40 miles in this heavy pack from 11 p.m. to 6 a.m. when we were very happy to meet open water and were able to proceed full speed till Churchill where an ice belt of 4/10ths was surrounding the "roads waters". I will add that the view of the ice all around the boat during this night under a full moon was a beautiful and fantastic sight. We anchored at Churchill at 8 a.m., the 6th.

HOMEWARD: The ice conditions were again very bad on the day of departure, very heavy pack ice in the vicinity of Churchill, the suggested track in open water being dangerously close to the western shore. In this case we had the assistance of icebreaker the "Wolfe" and leaving pilot at 9 p.m. August 10th we followed the "Wolfe" near the ice edge altering the course according to the indications of her Master. At 1 a.m. on August 11th we met heavy ice pack both sides. At 02.10 hours, the "Wolfe" wired "Proceed moderate speed, heavy scattered pans ahead". We were already at slow speed and stopped immediately and so had very little speed when passing scattered pans. Nevertheless, when discharging the ship in Leith, we discovered many damages due to ice pressure on stem plates adjacent starboard side of the fore peak about seven feet height by 2 feet longitudinal. The "Wolfe" returned to Churchill at 2.30 a.m. about 55 miles from the harbour. We still met important scattered ice until 4 a.m. stopping the engine and moving frequently and at this time proceeding full speed in open water about six or seven miles width between two fields of very dense pack ice which were quickly out of sight. In the Strait many bergs in sight in the north and in the south of our course. We passed Button Islands at 9 a.m. on August 13th.

SECOND TRIP TO CHURCHILL: We left Leith on 27th August and arrived in Hudson Strait on 2nd September at twelve. Clear weather, very few bergs but many growlers on the suggested track and some giant icebergs in the north, which we could see in the darkness with the help of glasses at 15 miles distance. We arrived at Churchill's roads at 7.30 a.m. on September the 5th and were berthed at twelve.

HOMEWARD: We left Churchill on September 15th at 12.30. In spite of continuous E. S. E. wind we drifted to the east about 10 miles and passed nearby Mansel Island (5 miles) having radar target spot of this island at about 10 miles distance only. After Charles Island and in the

vicinity of Cape Hopes Advance we met many bergs and growlers (one being detected by the radar at 2 miles abeam). To Resolution Island and Cape Hopes Advance stations, out of Hudson Strait at twelve o'clock.

RADIO-ELECTRIC AIDS: Radar highly useful (detecting bergs and growlers).

RADIOBEACONS - RESOLUTION ISLAND AND CAPE HOPES ADVANCE: Helped us to fix our position in the vicinity of Hudson Strait.

CHARLES ISLAND: Did not work on our second trip.

REMARKS: Our radar detected Mansel Island at 15 miles distance on our first homeward run and only 10 miles distance on our second homeward run.

During thick weather and poor visibility it is not prudent to close Coats Island which is very low land notwithstanding the beacon reflector and the sounds which do not give sufficient precision in position.

Regarding the frequently poor visibility in that country, I consider that a radiobeacon on one of the islands (Coats Island or Mansel) would be an appreciable help for shipping.

"Churchill" and "Chesterfield" beacons are a very great help but we did not hear them in the northern part of the Bay and furthermore they are very far. I think also it would be useful, mainly in the beginning of navigation, the Masters can make a rough chart of ice pack by receiving radio positions of some outline delineation of the heavy ice pack.

MAGNETIC DISTURBANCES: On August 5th approaching Churchill at 10 p.m., we were surprised to see that our magnetic compass had suddenly a deviation, more than 90 degrees, keeping a long moment, justifying fully the "Considerable Disturbance" printed on the charts.

GLOSSARY OF TERMS USED IN ICE NAVIGATION

Growler ..... Smaller piece of ice than a bergy-bit, frequently appearing greenish in colour and barely showing above water. May originate both from sea-ice and from glacier ice.

Hummocked ice ..... Ice piled haphazardly one piece over another and has been repeatedly covered with snow and well weathered.

Ice-blink ..... A typical whitish glare on low clouds above an accumulation of distant ice. It is especially glowing when observed on the horizon.

Ice-field or Field of ice .... Area of pack-ice or drift ice, consisting of any size of floes, of such extent that its limits cannot be seen from the crow's nest.

Ice-floe or Floe ..... A single piece of sea-ice, other than fast ice, large or small, described if possible as "Light" or "Heavy" according to thickness.

Giant	-	3000' - 5 miles across
Medium	-	600' - 3000' across
Small	-	30' - 600' across
Block	-	6' - 30' across
Brash	-	less than 6' across

Lead or Lane ..... A navigable passage through pack-ice or drift ice.

Pack-ice or Drift ice ..... Term used in a wide sense to include any area of sea-ice, other than fast-ice, no matter what form it takes or how disposed.

Pancake ice ..... Pieces of newly-formed ice, usually approximately circular, about 30 cm to 3 m across and with raised rims, due to the pieces striking against each other, as the result of wind and swell.

Rafted-ice ..... Type of pressure-ice or screw ice formed by one floe over-riding another.

Ridged ice ..... A continuous line of rafted ice along two floes which have come together and become one. This process may be piled to a height higher than a man.

Slush or Sludge ..... An accumulation of ice crystals which remain separate or only slightly frozen together. It forms a thin layer and gives the sea surface a greyish or leaden-tinted colour. With light winds no ripples appear.

Water-sky ..... Typical dark patches and strips on low clouds over a water area enclosed in ice or behind its edge. It is due sometimes to an open water area out of the limits of visibility.

HUDSON BAY, HUDSON STRAIT AND UNGAVA BAY ICE SUMMARY

SEASON 1960

Under the direction of the Deputy Minister of Transport the Director of the Meteorological Branch was charged with the responsibility of carrying out aerial ice observing and reconnaissance, ice forecasting and ice advisory services in support of shipping in ice infested waters.

Ice observing and reconnaissance along the Hudson Bay route from the longitude of Cape Chidley to Churchill was provided by the Meteorological Branch.

Pre season coverage of this area, to assist in the preparation of a long range ice outlook and to observe the progress of the initial breakup, was provided by two series of round-robin ice reconnaissance flights between April 25th and May 23rd, 1960, over all Arctic shipping routes below latitude 78° north.

The regular annual programme of ice observing and reconnaissance in Hudson Bay and Hudson Strait was carried out from two field ice reconnaissance units at Churchill, Manitoba and Frobisher Bay, N.W.T. Aircraft chartered by the Meteorological Branch provided the platform for these observations.

The field ice reconnaissance unit at Frobisher Bay was staffed by three trained ice observers and was in operation from June 30th to November 18th. Between July 1st and November 16th, twenty-three ice reconnaissance flights totalling 133 hours were carried out from this unit over Hudson Strait.

The field ice reconnaissance unit at Churchill was in operation between July 6th and November 18th, 1960. This unit was staffed by three trained ice observers and completed 24 aerial ice patrols in support of shipping using the Hudson Bay route. 18 of the patrols were completed durint the latter part of July and August.

A field ice forecast office was established at Frobisher Bay on July 12th, 1960 and issued 48 hour forecasts on a daily basis until October 5th, 1960. These bulletins were relayed to marine radio stations for broadcast and ice data charts were broadcast by radio facsimile twice daily from July 18th to September 14th and then once daily until October 4th. Five day ice forecast bulletins were issued three times weekly by the ice central at Halifax and transmitted by Meteorological Branch teletype circuits to Frobisher, N.W.T. and Churchill, Manitoba. Radio facsimile broadcasts of five day ice charts were made from CFH, Halifax.

The Marine Branch ice information officer, Captain E. L. Kelso, was stationed at Churchill, Manitoba and was responsible for informing ships' captains and marine interests regarding ice conditions which affected their operations. The ice information officer was provided with the necessary briefing and ice reports, charts and bulletins by the Meteorological Branch.

Meteorological Branch ice observers also accompanied R.C.A.F. transport flights from Churchill to Resolute via Coral Harbour in April and October, 1960. Valuable breakup and freezeup data was obtained on these flights.

Five Meteorological Branch ice observers assigned to C.M.S. d'Iberville, C.M.S. Labrador, C.M.S. C. D. Howe, C.M.S. N. B. McLean and C.M.S. Montcalm and one ice observer being assigned to C.M.S. Sir John A. Macdonald

provided shipboard ice observations as well as completing aerial flights by helicopter when directed by the ships' masters.

The following description of ice conditions listed chronologically gives a historical record of the Hudson Bay route as observed by the Meteorological Branch ice observer.

OBSERVED ICE CONDITIONS IN HUDSON BAY - 1960

April 25 Area of observation east shore Hudson Bay, ice conditions average coverage 9/10 close ice except for area surrounding Belcher Islands and King George Islands average coverage was 10/10 consolidated ice. Area lat. 59° and 60° N average was 6/10 broken ice. Area vicinity 58° N 80° W average 4/10 scattered ice. Area vicinity Cape Henrietta Maria average 9/10 close ice. Area of observation Churchill to south tip Southampton Island to Seahorse Point. Fast ice in Button Bay with congested leads west of long. 92° W. Average for total area 9/10 close ice.

May 23 Area of observation eastern shore Hudson Bay, southern shore thence Churchill to Seahorse Point. Fast ice along eastern shore to lat. 53° N averaging 10 to 15 miles wide. Open water lay parallel to fast ice averaging 10 to 30 miles in width, ending at Great Whale River. Area west of Cape Jones average 3/10 scattered ice. Area vicinity 55° 30' N 84° W average 3/10 scattered ice. Numerous cracks northeast of Churchill. Flaw lead north shore Coats Island. Remainder of area 8-10/10 close to consolidated ice. Ice in James Bay area discolored brown.

July 6 Area observed from Churchill to Chesterfield Inlet to Seahorse Point to South Sleeper Island to Churchill. Ice conditions open water east of longitude 84° W except for a 50 mile wide area between northeast shore Coats Island and Seahorse Point, and a 10 mile wide belt surrounding Mansel Island south of latitude 62° N, concentration averaging 3/10 scattered ice. Area west of 89° W coverage averaged 8-9/10 close ice. Area between 84° W and 89° W and south of 59° north latitude average coverage 3-6/10. Area southeast of Southampton Island average coverage 3/10. Shore lead 5 miles wide from Cape Churchill south. Puddling averaged 3-4/10 throughout with about 30 per cent of the puddles burnt through.

July 13 Area observed from Churchill to Coats Island to Winisk to Churchill. Average ice conditions coverage in Button Bay, 20 miles radius from Churchill was 2/10 scattered ice. Northeast of the above ice boundary to position approximately 61° N 89° 30' W, coverage 6-9/10 broken close ice. In vicinity of 61° 30' N 89° W average coverage 4/10. Along southwestern shore Hudson Bay, ice edge lay 5 to 25 miles off shore with average coverage 6-8/10 broken-close ice. Narrow belt south of York Factory average 4/10. Few patches in vicinity 58° 20' N 85° 15' W and 56° 50' N 85° 40' W average 3/10. Puddling averaged 3-4/10 throughout with approximately 40 per cent of the puddles burnt through. Remainder open water.

July 18 Area observed from Churchill to Chesterfield Inlet to Coral Harbour to Churchill. Ice conditions open water east of longitude 88° 30' W. Average 1/10 scattered ice in Button Bay. Area along western shore average 7-9/10 broken-close ice. Area between 90° W and 92° 30' W and south of latitude 60° N average 1-4/10 scattered ice open water was observed in Rankin Inlet, and Chesterfield Inlet with a congested lead from Chesterfield Inlet to Cape Fullerton.

July 20 Area observed from Churchill to 62° N 88° W to 50 miles north of York Factory to Churchill. Ice conditions within radius or 60 miles of Cape Churchill, average coverage 5-9/10 broken to close ice with shore lead approximately 15 miles wide along southwestern shore. Between latitude 60° N and 61° N and west of longitude 90° average 3/10 scattered ice. In vicinity of 61° 40' N 90° W average 7/10 broken ice. Remainder open water. Area observed from Churchill to 61° N 92° W and from south tip Southampton Island to Nottingham Island to Churchill. Due to weather, observation of this area was limited. Ice conditions west of longitude 92° W. Average coverage 9/10 broken to close ice with a 10-20 mile wide shore lead from Cape Churchill along western shore. Areas of lesser coverage were observed in vicinity of Cape Churchill and 59° 30' N, 91° W. Area east of longitude 86° W observed open water.

July 26 Area observed from Churchill to Marble Island to 60° N 91° W to Churchill. Ice conditions open water enclosed in area between latitude 60° and 61° N and east of 91° W. This area, average coverage 9/10 broken to close ice except for patches of lesser concentrations in the vicinity of 59° 20' N 93° 50' W, 60° 50' N 93° 30' W, Marble Island and 60° N 91° W average 3-4/10 scattered ice. Shore lead extending from Cape Churchill along western shore to limits of observation 40 miles northwest of Churchill. Puddling averaged 4/10 with 40 per cent of puddles being burnt through.

July 29 Area observed from Churchill to Marble Island to 58° 30' N 91° 40' W to Churchill. Ice conditions along western shore Hudson Bay north of latitude 59° 40' N and west of longitude 92° W average 5-9/10 broken to close ice with few patches of open water in vicinity of 60° 30' N 92° 30' W and in vicinity of 61° 30' N 92° W. Area east of longitude 93° W and south of latitude 59° N average 5-6/10 ice with belt of 9/10 in the southern portion of this area observed open water except for belt parallel to shoreline from Cape Churchill to 40 miles north of Churchill averaging 4/10 ice.

July 30 Area observed from Churchill to 60° N 90° W to Port Harrison to Great Whale River to Cape Henrietta Maria thence parallel to shoreline to Churchill. Ice conditions, open water was observed predominantly throughout this area except for belts and patches in vicinity of Cape Henrietta Maria, Winisk, 40 miles east of Fort Severn. And an extensive belt extending from longitude 90° W to 91° 30' W approximately 40 miles north of Cape Tatnam. Average 5-7/10 broken ice west of longitude 91° 30' W to longitude 93° W and south of 60° N average 5-9/10 broken to close ice with a patch of 3/10 ice in the southern portion of this area.

Aug. 1 Area observed from Churchill to Marble Island to 58° N 90° 30' W to Churchill. Ice conditions again visibility was restricted due to weather. Ice conditions, between 59° 30' N 92° 30' W. Average 4-8/10 scattered and close ice with open water observed east of last longitude up latitude 61° N. Open water along shore from Tavani to Marble Island. Few belts and patches southeast of Cape Churchill average 5-9/10 broken to close ice.

Aug. 2 Area observed from Churchill to Tavani to 59° 10' N 91° 50' W to Churchill, visibility restricted due to weather. Ice conditions, ice edge lying parallel to shoreline approximately 10-25 miles offshore from Cape Churchill to Tavani with ice area narrowing to a lesser concentration in vicinity of Tavani average 5-9/10 broken to close ice with average coverage 3-4/10 north of latitude 61° N.

Aug. 4 Area observed from Churchill to 61° N 93° W to 61° N 81° W to

Cape Tatnam to Churchill. Ice conditions ice edge contimued to lay parallel to shoreline from Cape Tatnam to Tavani averaging from 10 to 30 miles offshore with an average coverage 5-9/10 broken to close ice. Open water was observed east of longitude 93° W and between latitudes 59° 30' N and 61° N. The indication was that the central and south central Hudson Bay was ice free except for the area along the western and southwestern shore.

Aug. 6 Area observed from Churchill to Eskimo Point to
Aug. 8 Churchill, ice conditions again the ice lay parallel to the western shore in a band averaging from 20 to 60 miles wide in places average coverage 5-9/10 broken to close ice. A shore lead averaging 10 miles wide extended from Tavani to Cape Churchill area in vicinity of Chesterfield Inlet average coverage 2-5/10 scattered to broken ice. All rest open water.

Aug. 10 Area observed from Churchill to Tavani to Cape Tatnam to Churchill. Ice conditions belts and patches lay parallel to western shore average coverage 5-9/10 broken to close ice with few patches in vicinity of Tavani average coverage 1-3/10 scattered ice. Puddling 5/10 to rotten. All rest open water.

Aug. 12 Area observed from Churchill to Marble Island to Wager Bay to Coral Harbour to Churchill. Ice conditions numerous belts and patches west averaging 3-5/10 scattered to broken ice larger patches of heavier concentration lay in vicinity of Churchill and Cape Churchill to Cape Tatnam averaging 5-8/10 broken to close ice. All rest open water.

Aug. 17 Area observed Churchill to Tavani to Seahorse Point to 62° N 82° W to Churchill weather restricted visibility throughout most of the flight. Ice conditions vicinity Seahorse Point average coverage 8/10 close ice with puddling rotten. All rest open water.

Aug. 19 Area observed Churchill to Tavani to Cape Tatnam to Churchill.
Aug. 23 Ice conditions a large patch with average coverage 6-8/10 broken to close parallel to shore between Cape Churchill and Cape Tatnam with a few small patches average coverage 2-4/10 scattered ice.

Sept. 15 Area observed Churchill to Coral Harbour to Nottingham Island to Churchill. Ice conditions large belt lay from Walrus Island parallel to southern shore Southampton Island extending to 20 miles west of Nottingham Island average coverage 6-8/10 broken to close ice with few patches and belts with average 5/10 broken ice.

Sept. 24 Area observed Churchill to Coral Harbour to Nottingham Island to Digges Island to Churchill. Ice conditions wide belt extended from northeast shore Coats Island to western shore Nottingham Island average coverage 4-7/10 scattered to broken ice.

Oct. 3 Area observed from Churchill to Nottingham Island to Seahorse Point to Churchill. Ice conditions few patches scattered small floes average 1-2/10 coverage.

Oct. 29 Area observed Churchill to 63° N to west of Nottingham to Churchill. Ice conditions in Fisher Strait and Evans Strait, average 7/10 broken ice with few belts and patches western shore Nottingham Island. Average coverage in Button Bay 9/10 close pancake ice.

Nov. 18 Area observed from Churchill to Coats Island, to Mansel Island to Smith Island to Churchill. Ice conditions north of latitude

61° N and west of longitude 90° W ice coverage averaged 7-9/10 broken to close ice predominantly young ice. Rest open water.

OBSERVED ICE CONDITIONS IN HUDSON STRAIT - 1960

April 25 Area of observation 69° W to 79° W. Total area averaged 8/10 close ice. Open water north shore Charles Island. Few bergs, bergy bits and growlers vicinity Big Island.

April 27 Area of observation between longitude 65° W and 68° W. Open water along east shore of Ungava Bay. Area coverage averaged 7-9/10 broken to close ice. In vicinity of 60° 20' N 65° 20' W average 3/10 scattered ice. Few bergs vicinity 60° N 66° W. Open water lay parallel to north shore Hudson Strait from Resolution Island to longitude 67° 30' W averaging 20 miles wide.

May 23 Area of observation between longitude 69° W to 80° W fast ice along north shore in vicinity of Big Island. Open water south of Big Island. Remaining area averaged 4-8/10 scattered close ice.

May 25 Area of observation between longitude 63° W to 69° W. Average coverage for complete area 4-9/10 scattered to close ice. Fast ice along eastern shore of Ungava Bay. Open water surrounding Button Islands and Akpatok Island. Flaw lead 10 miles wide parallel to southwestern shore Ungava Bay. Vicinity East Bluff average coverage 2/10 scattered ice. Few bergs, bergy bits and growlers east shore Akpatok Island. Few bergs vicinity Cape Kattaktok in Ungava Bay.

June 30 Area observed from longitude 65° W to 79° W. Ice was 4/10 from longitude 65° W to 67° W. From longitude 67° W to 70° W ice was 6-9/10 broken to close ice. Along the south shore of Hudson Strait the average coverage was 6/10 broken ice extending from Cape Weggs to Cape Hopes Advance. Along the north shore extending from Cape Dorset to Big Island, the average coverage was 2-3/10 scattered ice. The centre of Hudson Strait to 79° W was open water except for a few patches of 3/10 scattered ice in the vicinity of Charles Island, Digges Island and north shore of Nottingham Island. Puddling averaged 4/10.

July 6 Area observed from 65° W 71° 30' W longitude. Ice coverage averaged 8-9/10 along the north and south shore of the Strait from longitude 65° W to 70° W. The centre of the Strait in the area surrounding Akpatok Island the average coverage was 5/10 broken ice in belts. Open water was observed from 70° W to 71° 30' W longitude. Few icebergs were observed throughout this area. Puddling 3/10.

July 10 Area observed from 68° W to 79° W. Ice along the north shore north of a line extending from Rawson Island to Cape Hopes Advance and thence to the Middle Savage Islands the average coverage was 1-4/10 scattered ice with a heavier concentration along the north shoreline from Big Island to the Lower Savage Islands with an average coverage of 6-8/10 broken to close ice. In the area west of Cape Hopes Advance a patch of 1/10 scattered ice was observed. In the area adjacent to the northwest shore of Nottingham Island to King Charles Cape the average coverage was 1/10 scattered ice. Few bergs, bergy bits and growlers were observed throughout the area. Puddling averaged 3/10.

July 11 Area observed between longitude 66° W and 71° W and north of latitude 61° 30' N. Ice conditions in this area were 7-9/10 broken to close ice with a patch of 4/10 average coverage in the vicinity

of Big Island. Few bergs, bergy bits and growlers were observed throughout the areas.

July 16 Area observed was the Ungava Bay area. Ice conditions were 2-5/10 scattered to broken ice along the eastern and southern shores. Open water was observed northeast of Akpatok Island. Many bergs, bergy bits and growlers were observed throughout the area. Puddling rotten.

July 22 Area observed from 63° W to 79° W. Ice conditions were 1-5/10 scattered to broken ice along the north shore north of a line extending from Fair Ness to Akpatok Island then north in a circular arc to the Button Islands. Immediately adjacent to the north shore in this same area the coverage was 6-8/10 broken to close ice. All rest open water. Few bergs, bergy bits and growlers were observed throughout the area. Puddling 3/10.

July 26 Area observed between longitude 63° W and 71° W. The ice remained along the north shore north of a line from Big Island to Akpatok Island and to Resolution Island. The average coverage 1-3/10 scattered ice with a few patches of 5-6/10 broken ice adjacent to the north shore. All rest open water. Many bergs were observed in the vicinity of the Middle Savage Islands and the east shore Resolution Island, with few bergs, bergy bits and growlers in the vicinity of 61° 30' N 67° 30' W.

Aug. 15 Area observed from longitude 63° 30' W to 71° W. In the vicinity of Big Island a belt with average coverage of 1/10 scattered ice containing many bergs, bergy bits and growlers was observed. Few bergs, bergy bits and growlers east-northeast of Cape Hopes Advance. All rest open water.

Aug. 23 Area observed from longitude 66° W to 81° W. Ice conditions patch in vicinity of East Bluff with average 1/10 scattered ice. Area enclosed in line extending from Leyson Point to north tip Mansel Island to west tip Nottingham Island to northeast shore Southampton Island average coverage 4-8/10 scattered to close ice. Few bergs, bergy bits and growlers were observed throughout the area. All rest open water.

Sept. 9 Area observed from longitude 64° W to 81° W. Many belts of 1-5/10 in the vicinity of Seahorse Point. Many bergs along coast between North Bay and Lower Savage Islands. Few bergs, bergy bits and growlers throughout remainder of area. All rest open water.

Oct. 27 Area observed between longitude 68° W and 72° W and the Ungava Bay area. Few bergs, bergy bits and growlers were observed throughout the whole area.

Nov. 13 Area observed from 65° W west shore of Ungava Bay average coverage 4-7/10 scattered to broken ice. In the vicinity of the Middle Savage Islands and along the north shore the average coverage 3-6/10 scattered to broken ice. North of latitude 62° 30' N and between longitude 76° 30' W and 80° W the average coverage was 5-9/10 broken to close ice. All rest open water. Few bergs along north shore Hudson Strait. Ice in the eastern half of Hudson Strait was predominantly young while in the western half predominantly winter.

STATION ICE REPORT - 1960

CHURCHILL

June 7 First signs of ice movement occur.
June 10 River entirely clear of ice.
July 13 Open water to the west of the longitude of Cape Churchill.
Oct. 17 Ice present for one mile up the river.
Nov. 1 The ice was considered safe for use as a road.
Nov. 9 The ice was anchored on the east shore.
Dec. 5 The ice was frozen and anchored across ten-tenths coverage.

NATIONAL RESEARCH COUNCIL OF CANADA

RADIO AND ELECTRICAL ENGINEERING DIVISION

AN ANALYSIS OF RADAR ICE REPORTS SUBMITTED BY HUDSON BAY SHIPPING (1953-1957)

A.D. HOOD

OTTAWA, MARCH 1958

ABSTRACT

Reports on radar detection of ice, submitted by Hudson Bay shipping, have been analyzed to determine the value of radar in reducing the navigational hazard in ice-infested waters. The seasonal change in ice conditions has been investigated and the most dangerous sections of Hudson Strait have been located. The limits of the ice hazard have been well defined and the maximum ice concentration is located in a 450-mile section of the Hudson Strait route. Reports on the radar detection of all formations have established the dangerous types of ice and the fact that sea clutter, in excess of 1000 yards, is present most of the time. Radar is a definite asset in ice navigation provided it is operated with an appreciation of its limitations in detecting small targets in sea clutter. Short ranges, under 10,000 yards, are preferred for the detection and tracking of dangerous ice, such as bergy bits and growlers. All formations of berg size were detected at a minimum range of 10,000 yards, and the leading edge of floes and field ice may be detected at ample range for evasive action. A ship will encounter about 50 per cent less ice in Hudson Strait during the latter half of the shipping season.

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FIGURES

AN ANALYSIS OF RADAR ICE REPORTS SUBMITTED BY HUDSON BAY SHIPPING (1953-1957)

- A.D. Hood -

INTRODUCTION

This is the fifth and final analysis of radar ice reports submitted by Hudson Bay shipping*. The information is based on data submitted by masters of vessels using the Hudson Bay route into Port Churchill during the shipping seasons of 1953 to 1957, inclusive. Emphasis is placed on the data of 1956 and 1957 which was collected in somewhat greater detail than in previous years. Certain refinements in the ice report forms and the cooperation of masters in listing detailed information on the various ice formations encountered has been helpful in establishing the navigation hazard and assessing the ability of a commercial marine radar to assist in navigating ice-infested waters.

It has been established, from data submitted during the past five years, that radar is an invaluable aid in navigating Hudson Bay shipping lanes, but it may be dangerous if not wisely employed and its limitations appreciated. Numerous reports have been accumulated on ice formations that could not be detected by radar but were of sufficient size to cause severe damage to a ship. These formations are known as "growlers", and in sea clutter detection is difficult and in many cases impossible. The general appearance is deceptive since about nine-tenths of the volume is submerged and reports show that growlers approaching 100 tons in weight have remained undetected by radar. In the five-year ice survey, the general area of dangerous navigation in Hudson Strait has been well defined. The location of all ice formations reported during the survey period is shown on a copy of Chart 5000 (see Fig. 1). The 1957 reports show the same general concentration as in previous years. Of particular note is the almost complete absence of ice west of longitude 75°, and east of longitude 60°. Several large isolated bergs were reported in the Atlantic as far east as longitude 44°. However, these were all detected at long range, and this type of ice is not considered dangerous to a radar-equipped ship.

The 1957 data was forwarded by ten ships reporting 132 ice formations. Of these, 56 were suitable for radar analysis, and the graph of detection range vs. radar cross-sectional area is shown in Fig. 2. Data from the four previous seasons was included, giving a total of 265 formations, and the same general scatter was apparent in each season. Average detection ranges of all formations larger than bergy bits were reasonably close to theoretical expectations, but sea clutter is a predominant factor in detection of the smaller types of ice at close range. Sea clutter, in excess of 4000 yards, is not

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* The four previous reports: ERB-330, 356, 394, 416

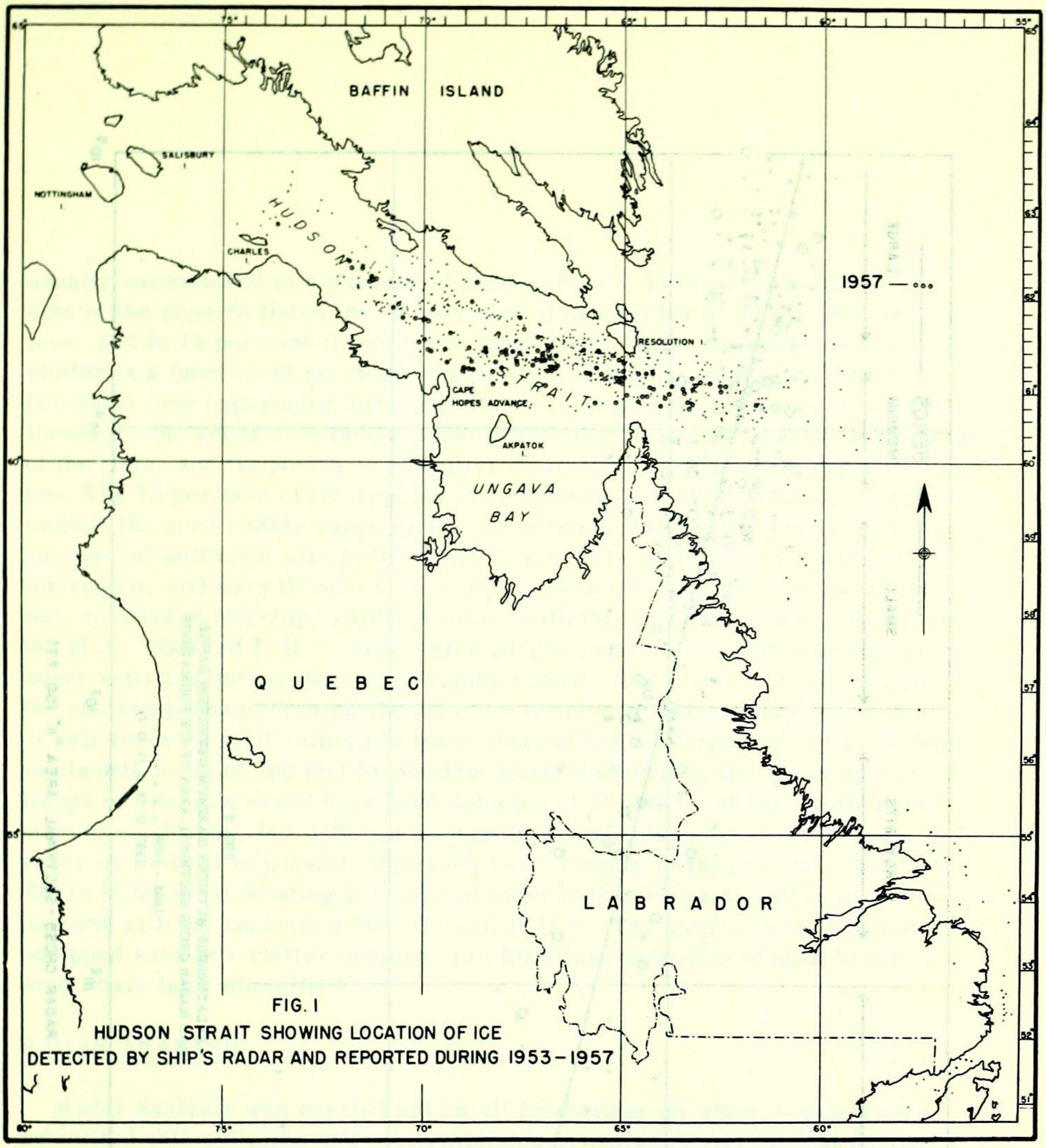

FIG. 1

HUDSON STRAIT SHOWING LOCATION OF ICE
DETECTED BY SHIP'S RADAR AND REPORTED DURING 1953–1957

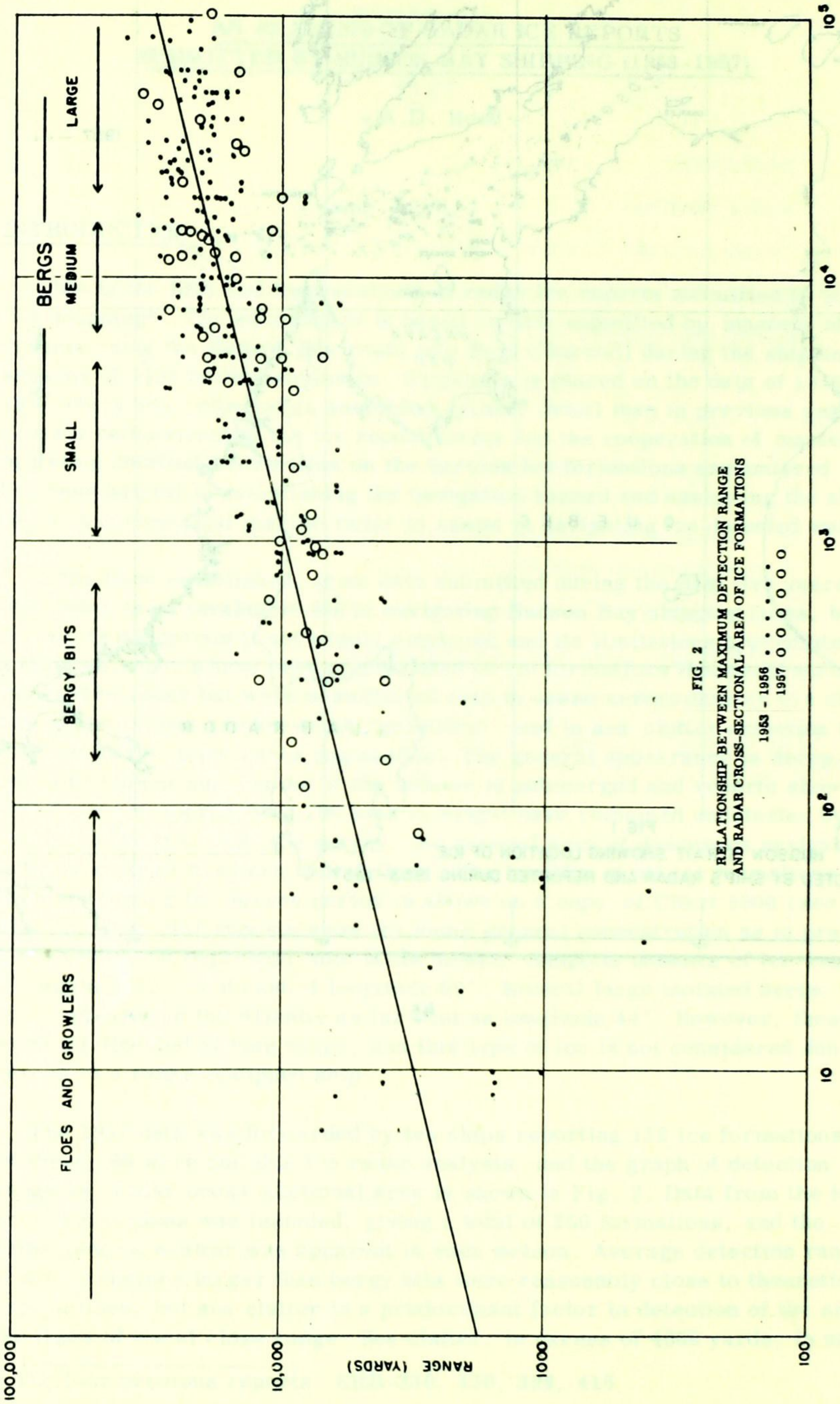

FIG. 2

RELATIONSHIP BETWEEN MAXIMUM DETECTION RANGE AND RADAR CROSS-SECTIONAL AREA OF ICE FORMATIONS

usually encountered in a passage of Hudson Strait. In the 1957 data, 91 per cent of the reports listed the radar range of sea clutter at 4000 yards or less, and in 75 per cent it was under 2000 yards. Since the range of sea clutter is a function of receiver sensitivity and antenna gain of the radar, two ships may experience different clutter ranges in the same sea condition. However, the reports do indicate that sea clutter is present a large percentage of the time, and frequently is of sufficient strength to obscure dangerous ice. The 75 per cent of the reports taken in less than 2000 yards of clutter include the zero clutter range or flat calm condition. In 2000 yards of clutter, any ice, of sufficient size to be dangerous, will be detected beyond the clutter region, and even if lost on closing to a lesser range, the location of the ice, relative to the ship, will be known. With the exception of one voyage, by the M.V. "Gerard L.D.", sea-clutter ranges in excess of 4000 yards were never reported during the 1957 shipping season. The "Gerard L.D." made the eastern passage through the Strait on October 9 and encountered winds of gale force up to 50 miles per hour. Sea clutter was reported out to 16,000 yards and bergs of 100 feet by 400 feet were obscured on the radar screen. Bergs of this size would have been detected at 16,000 to 20,000 yards under normal conditions, but with sea clutter at the saturation level for 10,000 yards or more it is possible that such large targets could go undetected. There is no substantiating evidence of other long range sea clutter for comparison with the reports of the "Gerard L.D.". The ship's radar was not equipped with anti-clutter devices, in which case detection of such bergs would have been simplified.

RADAR ANALYSIS

Radar analysis was carried out on all formations on which reports were submitted with sufficient data to establish a cross-sectional area at the detection range. This, necessarily, eliminated all reports that were taken in poor visibility and any for which dimensions and contours were missing. Of the 752 reports in the five-year period, 265 were complete with all dimensions and sketches or photographs. The analysis was based on the fundamental radar equation which states that the maximum detection range is a function of the target area:

$$R^4 = K \times A,$$

where R is detection range and A is radar cross-sectional area of the target. K is a function of receiver sensitivity, antenna gain, power output, and frequency for a given radar, and the value may vary considerably for different makes and models. For the purposes of analysis, it was assumed that K was a constant for all radars, and that detection range was a direct function of radar cross section of the ice formation. The value of A is not necessarily that of the projected cross section of the ice, but some lesser value depen-

ding on the contours of the formation. For example, the value of A for a berg sloping away from the radar scanner is not equivalent to that of a sheer wall of ice of the same projected dimensions. However, ice formations are of such irregular shape that it is impossible to determine the effect of slope on the detection range. The detection range vs. radar cross-sectional area of each of the 265 formations is shown plotted in Fig. 2. There is considerable scatter but this is to be expected when the value of A must be estimated in many cases and the value of K is considered equal for all radars. The locus is the fourth-power curve from the radar equation, and while not necessarily the best fit it is theoretically of the correct slope. The section of the locus on which the average formation, of each ice category, will fall is also shown in Fig. 2. There is some overlapping in each case, and in view of the few reports no distinction can be made between floes and growlers.

The height of a ship's antenna has little bearing on the short radar ranges used in ice navigation. However, maximum radar range bears a direct relationship to antenna height, and consequently there is some variation between ballast and loaded conditions. From the reports of the 1956 and 1957 shipping seasons, the average antenna height was 56 feet for a loaded ship and 70 feet under ballast. The radar range equation can be used to calculate the difference in maximum range for the two conditions. A simplified equation for the distance to the radar horizon is:

$$0.8684\ R = [2h]^{\frac{1}{2}},$$

where R is range, in nautical miles, and h is antenna height above sea level, in feet. From the above expression, the increase in detection range, for the average ship under ballast, is about 2500 yards. The lowest antenna height recorded, for a merchant ship navigating Hudson Strait, was 42 feet. This height is equivalent to a radar horizon of 18,000 yards and is considered more than ample for navigating ice-infested waters. Large bergs, detected at greater ranges, would not be fully illuminated by the radar beam but this has no bearing on safe navigation.

Anomalous propagation conditions have been found to exist in arctic waters and measurements have been taken in Hudson Strait. However, the changes in the refractive index are not considered sufficient to have any noticeable effect on the radar ranges used in ice navigation. Neither is there evidence to support the theory that pockets of cold air in the lee of an ice field may reduce radar ranges seriously.

GROWLERS IN SEA CLUTTER

The growler is recognized as the most dangerous ice formation that can be encountered in the navigation of ice-infested waters. It is usually of glacial

origin, being broken from large bergs, and is more prevalent in the vicinity of large bergs than elsewhere. The ice report forms require ice from 2 to 6 feet above the water level to be listed as "growlers", without restrictions on length and breadth. However, growlers are not to be confused with formations such as floebergs, that may be 6 feet high and 100 feet long. A typical growler is actually a miniature berg that projects a few feet out of the water or in some cases may be practically awash. To be certain of detection in sea clutter, a growler must have an echo amplitude greater than that of the clutter. The echo from a growler, at a given range, is a direct function of its radar cross section, whereas the echo from the sea clutter, at the same range, consists of the returns from all of the wave fronts in the area illuminated by the radar beam. Thus, the discrimination between growler echo and clutter echo has a direct relationship to the antenna beam width. From the ice reports, the antenna beam widths of the various radars varied from 1.6 to 3 degrees. Theoretically, assuming the radars are equivalent in other respects, the performance of the radar with the 1.6 degree antenna should be approximately four times better than that of the radar with the 3 degree antenna. Owing to variations in target area, radar equipment, and sea conditions it is not possible to say what improvement in growler detection range resulted from the use of radars with the narrower-beam antennas. A growler that is undetected at sea-clutter range normally has a cross-sectional area smaller than the combined areas of the wave fronts, and is obscured at the shorter ranges by the increased amplitude of the clutter. It is at this time that anti-clutter devices are extremely valuable. It is the function of the anti-clutter circuit to reduce the receiver gain immediately after the transmitter pulse and then increase it gradually, arriving at maximum sensitivity at maximum clutter range. At some finite range the growler echo is greater than the sea-clutter echo, and if the receiver is held below saturation level by an anti-clutter device, the growler can be detected. The only disadvantage of anti-clutter devices is that manual controls must be provided for various sea states, and these may be misadjusted to obscure targets that would normally be detected. Details on the detection of ice using anti-clutter devices were requested in the 1957 ice report forms, but only two ships reported that they were so equipped. It is assumed that anti-clutter devices are not standard equipment on the average merchant marine installation.

Analysis of all growlers reported in the five shipping seasons shows that the maximum radar cross section was 150 square feet, and some of the larger growlers could be reclassified as bergy bits. From Fig. 2, maximum detection range for a growler of this size is approximately 6000 yards. Under normal conditions, with sea clutter less than 2000 yards, any growler large enough to cause damage to a ship should be detected beyond the clutter region. However, to ensure safety in 2000 yards of sea clutter, continuous radar watch is a necessity, since a growler entering the clutter region undetected is almost certain to remain undetected. Fig. 3 is a photograph of

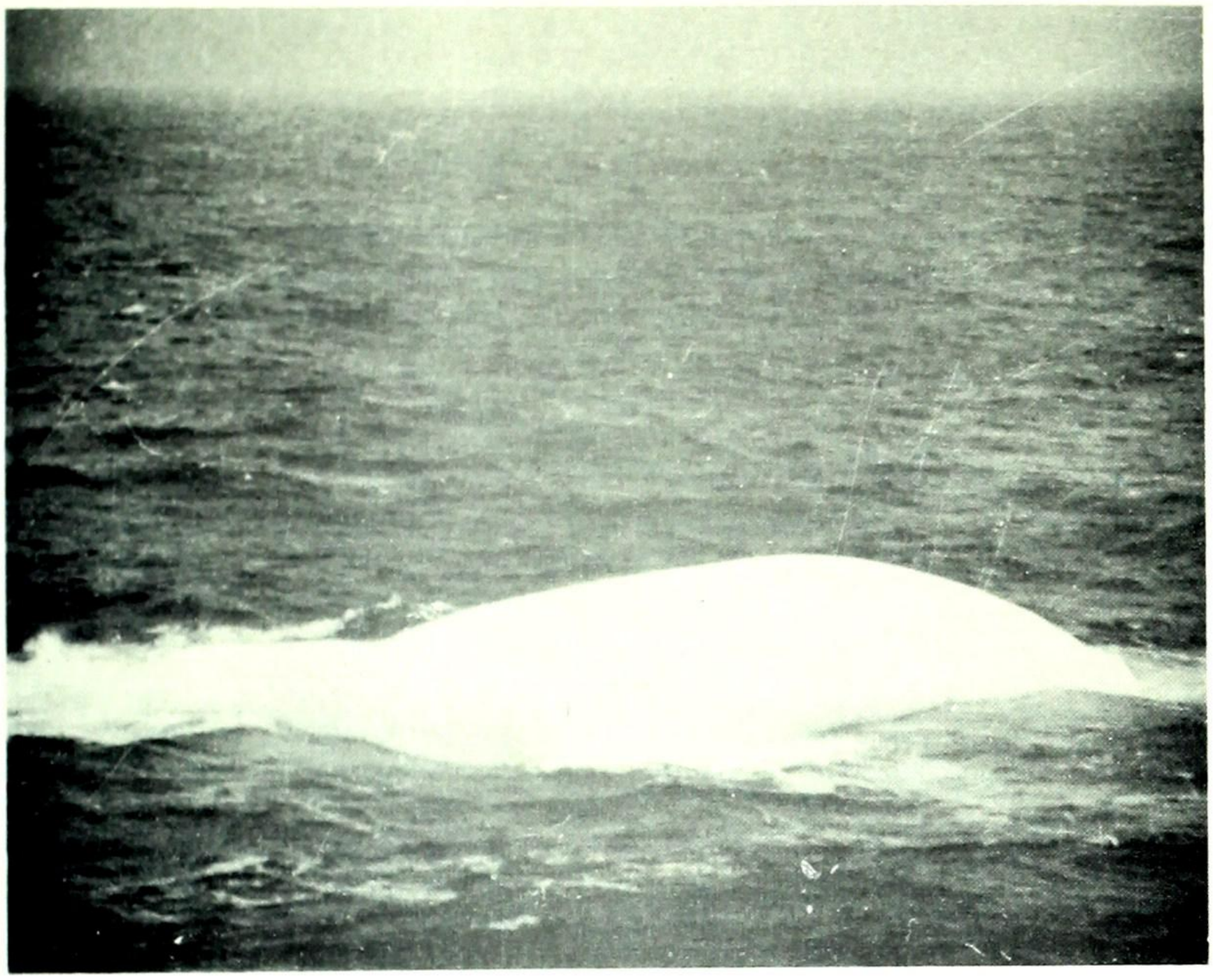

FIG. 3. 20-FOOT GROWLER
UNDETECTED THROUGH SEA CLUTTER

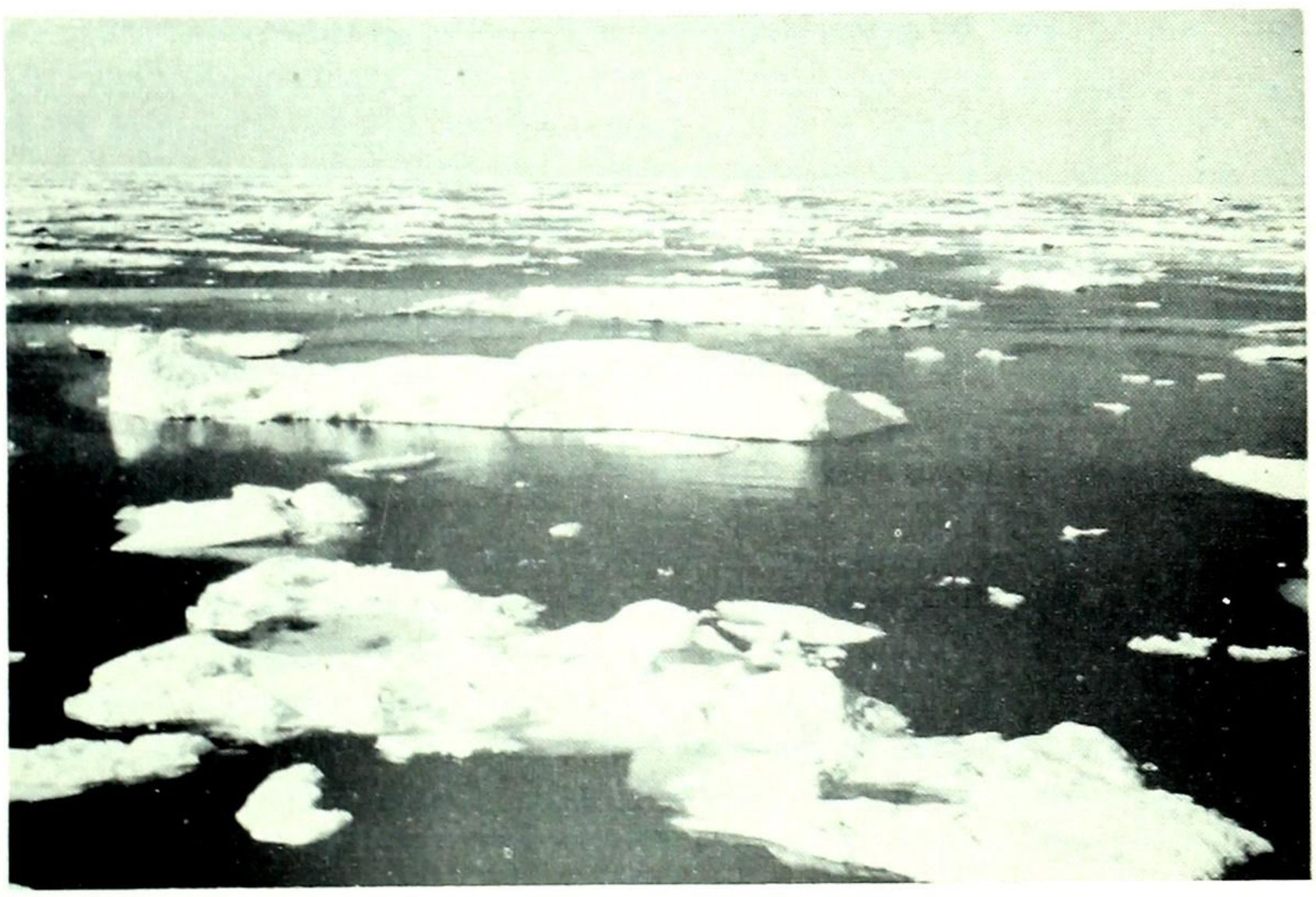

FIG. 6. LOOSE FIELD ICE

a small growler that was not detected in 3000 yards of sea clutter. It projected 3 feet out of the water and was 20 feet long. A typical cross section of such a growler is shown in Fig. 4, assuming glacial ice 85 per cent sub-

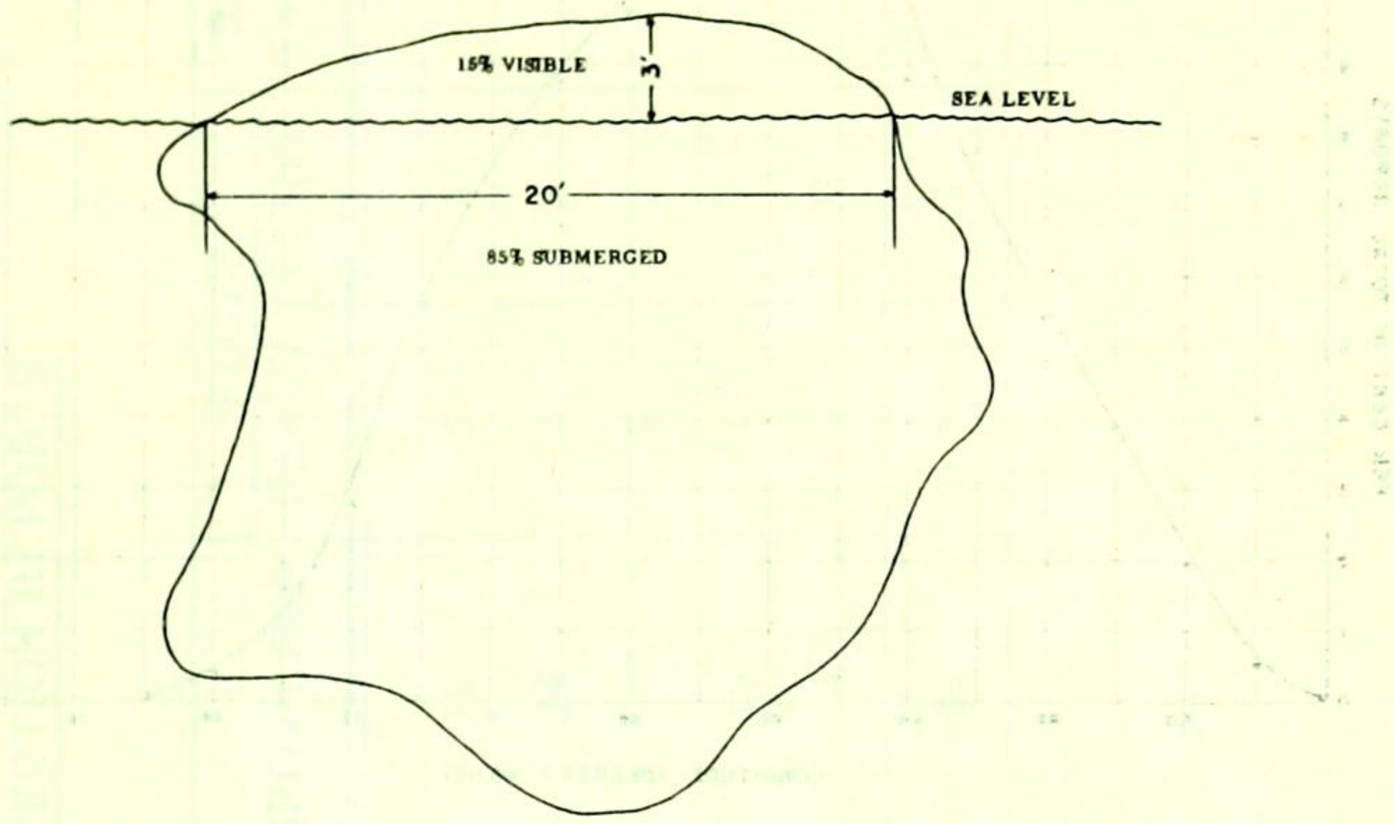

FIG. 4. TYPICAL CROSS SECTION OF A GROWLER

merged. For an average breadth of 15 feet, the volume of ice would be 5000 to 6000 cubic feet and the weight in excess of 100 tons. Growlers of this type are usually smoothly rounded by the action of the waves and consequently have very poor echoing properties. The detection range of this growler, in a calm sea, would be between 2000 and 3000 yards, and for a ship proceeding at ten knots this represents a warning time of 6 to 9 minutes. A growler of 100 tons is quite capable of inflicting severe damage to a ship. Of the 54 growlers reported, only 22 were detected by radar, and all contacts were made outside the clutter region or in calm water. There were no reports of growlers being detected within the clutter region, although several reports stated that contact was lost after the growler had entered the clutter region.

ICE CONCENTRATION IN HUDSON STRAIT

In the 1957 shipping season, the greatest concentration of ice was again located between the eastern approaches to Hudson Strait and Cape Hopes Advance. Fig. 5 is a graph of ice density vs. longitude for the shipping seasons of 1953 to 1957, inclusive. Data for this graph was taken from merchant vessels only. All reports from Canadian Government ships were omitted because they are engaged in coastal station supply and patrol work and are not normally concerned with traversing the Strait. From Fig. 5 hazardous ice conditions are seen to be confined to the area between longitude 74° west and longitude 59° west, a distance of 900 miles. Eightly per cent of the hazard, in this overall area, is centered about longitude 67° west, for approximately

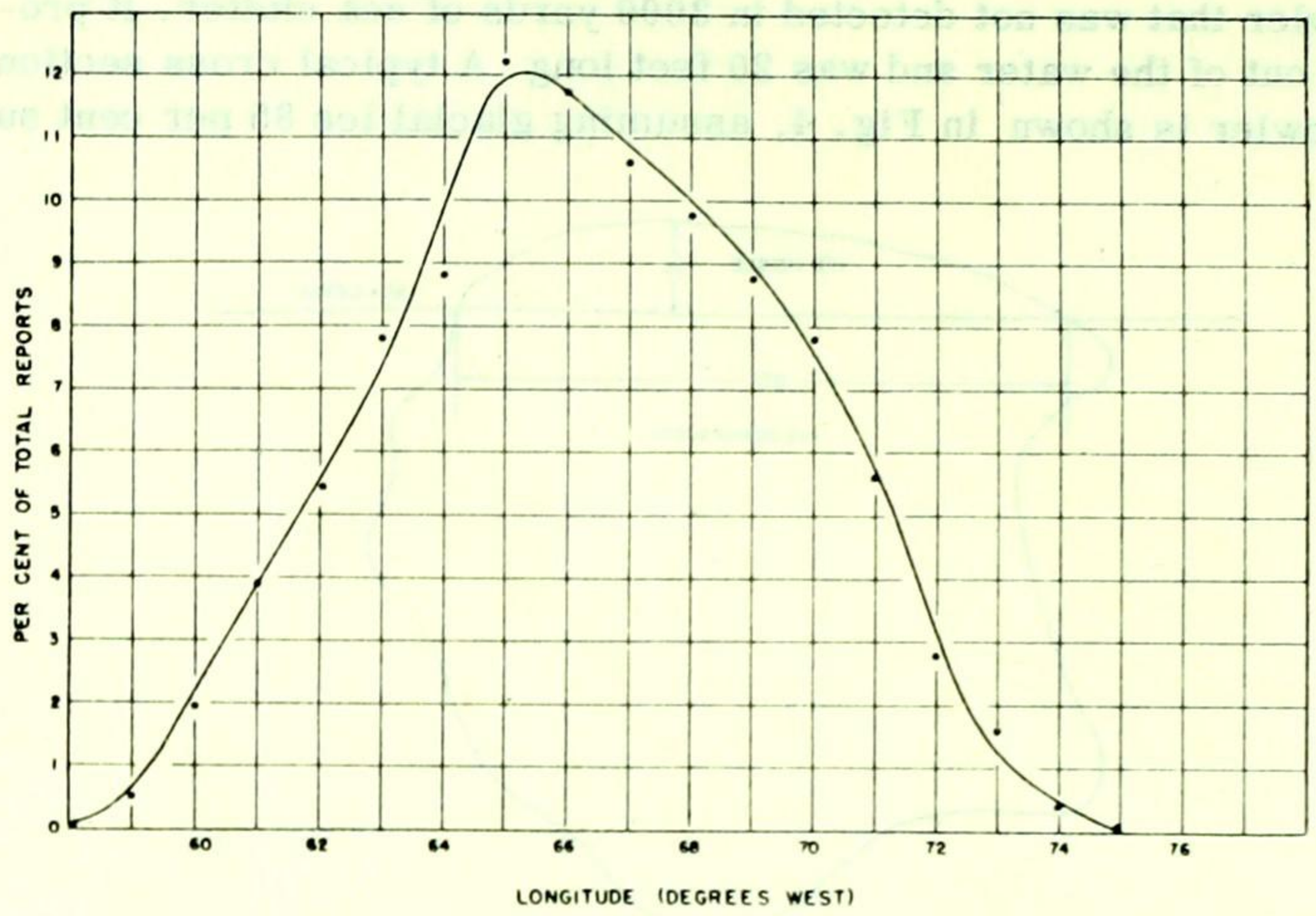

FIG 3. ICE DENSITY VERSUS LONGITUDE FOR 1953-57 SHIPPING SEASONS

450 miles. This area of high ice concentration has appeared in the same general location for the past five years and may be considered the most dangerous section of the route to Port Churchill. Floes, both large and small, have appeared in the shipping lanes off Charles Island in the early part of the shipping season, but they have never seriously hampered navigation. They consist mostly of local ice, packed by the wind and tide, but sea ice moving out from Fox Channel is a contributing factor. Floes in this vicinity are rather exceptional and all vessels report ice-free shipping lanes from Charles Island to Port Churchill.

To assess the seasonal trend in the ice hazard, it is assumed that September 1 is the mid-point in the shipping season. A comparison of reports from ships navigating the Strait before and after September 1, and particularly reports from all ships that made two voyages during the season, indicates that 50 to 60 per cent less ice will be encountered in the latter half of the shipping season. The latest seasonal report of field ice or floes was on August 21, 1954, and the possibility of encountering this type of ice later in the season appears most unlikely.

A total of 752 ice formations were reported by 55 ships during the five seasons under survey. These are shown in Table I, under the seven ice classifications listed in the ice report forms. The large berg class predominated with 237 reports, and bergs of all sizes comprise 83 per cent of the total. This does not include the 148 reports taken in poor visibility and listed as radar targets. However, if classification of these reports were possible, it is assumed that the ratio would be the same. It is reasonable that berg formations should outnumber other types of ice because of their long detection ranges and the ease with which visible statistics can be taken. A berg, reported at 10 miles, may

TABLE I

STATISTICAL DATA OF RADAR ICE DETECTION REPORTS

YEAR	SHIPS REPORTING	BERGS			BERGY BITS	GROWLERS	FLOES		RADAR TARGETS	TOTAL
		LARGE	MEDIUM	SMALL			HEAVY	LIGHT		
1953	13	55	41	24	7	12	2	0	0	141
1954	14	69	46	40	10	24	2	2	77	270
1955	8	47	36	5	4	5	3	2	19	121
1956	10	17	20	7	7	10	1	1	32	95
1957	10	49	39	7	7	3	0	0	20	125
TOTAL	55	237	182	83	35	54	8	5	148	752

be accompanied by bergy bits and growlers that would not be detected unless the ship closed to within a few thousand yards. Fig. 2 shows the detection ranges for all formations that were sufficiently complete for a radar plot, and 75 per cent of the total were reported at a detection range of 10,000 yards or less. This is considered to be the minimum detection range for small bergs.

Thirteen floes were reported, and all were detected at ranges greater than 4000 yards. Even in strong sea clutter the edge of a floe presents a sharp line of demarcation between ice and sea clutter, and consequently a packed floe is not considered a dangerous ice formation. "Field ice" or "pack ice" are terms commonly used to describe large areas of loosely packed ice that may be several miles in diameter. A number of these fields have been reported off Cape Hopes Advance and Resolution Island. They are usually formed early in the season, after the local ice break-up, and the ice is concentrated in huge fields or packs by the wind and tide. If sufficiently loose, the fields can be navigated and frequently lanes will be found that are reasonably clear of ice. Radar detection of field ice is not difficult since the ice has a tendency to dampen any sea clutter that may be present. When a ship is traversing an ice field the radar picture is similar to that for sea clutter but any large area of open water, such as a lane, can be easily distinguished. A photograph of loose ice is shown in Fig. 6. This picture was taken off Cape Hopes Advance by the master of the S.S. "Corcovado". Field ice of this type can be treacherous, particularly in changing weather conditions. Ice conditions can alter by the hour and it would be advisable for the master of a ship to know the extent of an ice field before entering a navigable lane. Since an ice field may extend for many miles, only prior survey by an icebreaker or an aircraft and ideal weather conditions can ensure against a ship being beset.

RADAR EQUIPMENT

In the five shipping seasons under survey, 55 sets of reports were submitted from 40 different ships. The names of the ships that reported in each season and the type of radar installation in use are shown in Table II. Table III is a list of the number of installations of each radar model with the associated power output. The "Akti Hill", in 1954, was the only vessel that submitted ice reports and was not equipped with radar. Twenty-one of the remaining 39 were equipped with Decca radar and the other 18 were divided among 6 manufacturers. The peak power output of all radars varied from 7 to 60 kilowatts, but the higher output is of little advantage in ice navigation where the shorter ranges are preferred. Antenna heights are listed in Table II, but in most cases it was not stated whether the given height was for loaded or ballast conditions. The only advantage of additional antenna height is in long-range detection of large bergs, and these are not considered dangerous to any ship navigating with radar. Several types of antennas were used with the various radar installations, and the beam widths varied from 1.6 to 3 degrees. It has been shown that improved discrimination with a narrow-beam antenna is an asset in detecting growlers in sea clutter, but there is not sufficient data available to determine the improvement in detection range that may be expected.

TABLE II

RADAR INSTALLATIONS

1957	NAME OF SHIP	RADAR	MODEL	ANTENNA HEIGHT BALLAST	ANTENNA HEIGHT NOT STATED	ANTENNA HEIGHT LOADED
1	Cydonia	Decca	45		55	
2	Elstead	Decca	159		80	
3	Hallerwijk	Decca	159	56	-	42
4	Corcovado	RCA	CR-104A		87	
5	Clintonia	Decca	159		-	
6	Gerard L.D.	Sperry	MK2		75	
7	Camellia	Decca	12		50	
8	Gardenia	Decca	159	73	-	61
9	North Anglia	Decca	12	64	-	50
10	Fernglen	Decca	159		70	
1956						
1	North Anglia	Decca	12	64	-	50
2	Ittersum	RCA	CR-103		54	
3	Sylvaplana	RCA	CR-104		62	
4	La Sierra	Decca	159		65	
5	Irish Hazel	Marconi	MK-4		75	
6	Svanaas	Kelvin Hughes	2C		45	
7	Irish Elm	Marconi	MK-4		80	
8	Thistlemuir	Decca	45		56	
9	Fernland	Sperry	MK-2	86	-	75
10	Ranger	CAL-268	B		70	
1955						
1	Warkworth	Kelvin Hughes	1A		52	
2	North Anglia	Decca	12		50	
3	Irish Cedar	Marconi	MK-3		73	
4	Thistlemuir	Decca	159	65	-	56
5	Essex Trader	Decca	159		70	
6	Ranger	CAL-268	B		70	
7	Irish Elm	Marconi	MK-4		80	
8	La Hacienda	Decca	12		80	
1954						
1	Cairnavon	Decca	12		-	
2	C.D. Howe	Decca	12		-	
3	d'Iberville	Decca	12		75	

1954	NAME OF SHIP	RADAR	MODEL	BALLAST	ANTENNA HEIGHT NOT STATED	LOADED
4	La Hacienda	Decca	12		74	
5	St. John	Decca	12		50	
6	Ravenshoe	Decca	12		70	
7	La Estancia	Decca	12		70	
8	Thistlemuir	Decca	159	65	-	56
9	Anna C	Decca	12		85	
10	Akti Hill		No Radar Installed			
11	Begonia	Decca	159		-	
12	N.B. McLean	CAL-268	-		60	
13	Ramillies	Decca	159		65	
14	Arundo	RCA	CR-103		80	
1953						
1	San Guisto	Decca	12		-	
2	C.D. Howe	Decca	12		-	
3	Warkworth	Kelvin Hughes	1A		-	
4	Arundo	RCA	CR-103		80	
5	Ranger	CAL-268	B		70	
6	Marine Fortune	Decca	159		-	
7	Begonia	Decca	159		-	
8	Italsole	Raytheon	EX-1197		-	
9	Irish Hazel	Marconi	MK-4		75	
10	North Anglia	Decca	12	64	-	50
11	Cairnavon	Decca	12		-	
12	Italterra	Kelvin Hughes	2A		-	
13	LaCumbre	CAL-268	B		-	

TABLE III

RADAR	MODEL	NUMBER OF INSTALLATIONS	PEAK POWER OUTPUT (KW)
Decca	12	9	7
Decca	45	2	20
Decca	159	10	7
RCA	CR-103	2	30
RCA	CR-104	2	40
Marconi	MK-3	2	40
Marconi	MK-4	3	50
CAL-268	B	3	30
Sperry	2	2	30
Raytheon	EX-1197	1	20
Kelvin Hughes	2C	3	60
No Radar	–	1	–
	Total	40	

WEATHER SUMMARY

HUDSON BAY ROUTE 1960

January and February were mild along the Hudson Bay route, particularly in February, when mean temperatures twenty degrees above normal were reported along Hudson Strait. By contrast March temperatures averaged five to ten degrees below normal and smaller deficiencies were recorded in April. May and June maintained the two month cycle with mean temperatures generally above normal especially in Hudson Bay, where excesses averaged about six degrees in both months.

In July mean temperatures were a degree above normal in the eastern half of Hudson Strait, but increased westward to reach five degrees above normal at Nottingham Island. In Hudson Bay mean July temperatures ranged from three degrees above novmal in the northeastern section to two degrees below normal at Churchill. In both August and September, mean temperatures were generally normal to two degrees above normal except for a one degree deficiency at Resolution Island in August and the same at Churchill in September. In October mean temperatures were two to four degrees above normal in Hudson Strait and the northern part of Hudson Bay, near normal in the central part of the Bay and three degrees below normal at Churchill.

July precipitation totals ranged from forty to ninety per cent below normal along Hudson Strait, while all stations on Hudson Bay experienced excesses ranging to eighty per cent, except Churchill which reported a ten per cent deficiency. A similar pattern prevailed in August when there were precipitation deficiencies of eighty and sixty per cent at Cape Hopes Advance and Nottingham Island, respectively, and excesses at all stations on Hudson Bay except Churchill which had normal precipitation, and Great Whale River, well off the route, which had a ten per cent deficiency.

In September all stations along the route experienced deficiencies of precipitation averaging about fifty per cent. Off the route Chesterfield and Port Harrison each reported a twenty per cent excess.

October precipitation was also light along the route particularly at the head of the Bay, where Nottingham Island received less than one tenth of the usual month's total. On the other hand, there was a small excess at Resolution Island and Churchill experienced just over one and a half times the normal fall.

RESOLUTION ISLAND METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind			Precip.	Vis.		Cloud Tenths of Sky Cover	
	Mbs.	Mbs.	Max.	Min.								
1960	0700	1900	F°	F°	0700 am		1900 pm	Total	am	pm	0700	1900
July												
1	1012.6	1013.6	35	31	E	28 E	18	.09	8	6	10	10
2	1014.0	1013.6	41	33	E	12 NE	16	.02	10	15	10	10
3	1011.6	1011.0	45	37	N	2 E	10		15	15	7	7
4	1010.2	1010.7	42	37	E	12 E	18		¼	3	10	3
5	1010.2	1010.5	44	35	E	14 NE	10		8	8	10	8
6	1009.0	1008.5	46	38	N	8 W	2		15	15	8	6
7	1007.4	1005.5	43	35	W	4 E	16		3/4	15	4	4
8	1003.7	1004.9	38	33	E	14 E	16		¼	½	10	10
9	1008.0	1010.5	39	35	E	20 E	10		½	½	10	10
10	1011.9	1011.3	39	36	NE	20 NE	24		8	10	10	10
11	1011.0	1012.4	40	36	E	18 E	10		2	¼	10	10
12	1012.6	1010.6	39	32	E	10 E	16		10	½	10	10
13	1007.6	1007.3	38	37	E	14 NE	14		1/8	¼	10	10
14	1006.4	1010.1	40	36	E	10 E	8		¼	15	10	8
15	--	1006.8	38	37	--	- E	20		-	1½	-	10
16	1006.0	1005.0	38	35	E	12 E	20		¼	¼	10	10
17	1005.6	1007.8	40	33	E	10 NE	24		¼	1	10	10
18	1009.2	1013.1	40	37	NNE	12 W	8		10	1/8	10	10
19	1015.1	1016.9	42	27	ENE	6 S	2		½	15	10	9
20	1016.5	1017.4	42	32	ENE	10 SW	6		15	15	4	2
21	1014.9	1012.4	51	35	NW	6 W	2		15+	15+	0	1
22	1010.8	1009.5	50	40	WNW	6 W	6		15+	15+	3	1
23	1011.0	1012.5	44	37	WNW	6 W	6		15+	15+	4	3
24	1013.5	1013.8	49	37	WNW	8 W	8		15+	15+	4	8
25	1015.7	1016.2	49	35	E	4 W	4		15+	15	3	4
26	1010.1	1003.3	41	34	ESE	22 E	28	T	15	10	8	10
27	998.9	1002.7	38	36	E	20 SW	6	.20	3	15	10	10
28	1006.7	1007.9	43	34	W	10 SE	14		5	5/8	9	7
29	1002.9	1002.2	42	33	E	22 E	20	.28	5	10	3	10
30	1005.9	1010.4	41	32	W	6 W	8		3	15	10	2
31	1010.0	1000.3	43	32	E	30 E	32	.47	15	½	10	10
August												
1	993.8	1000.3	46	35	SSW	12 E	18		3	10	9	2
2	1004.9	1002.9	51	35	E	6 NE	26		15+	8	3	10
3	999.7	995.3	41	35	NE	26 E	28	T	¼	½	10	10
4	999.9	999.2	40	35	E	16 E	24	.05	0	¼	10	10
5	1002.3	1010.0	40	35	E	18 SE	4	.06	½	½	10	10
6	1013.3	1012.7	44	32	E	16 NE	24		15	5	8	7
7	1013.4	1012.0	37	33	NE	30 NE	26	.04	10	¼	10	10
8	1011.0	1008.0	40	26	NE	26 NE	26	.12	½	¼	10	10
9	1002.6	998.9	43	35	E	32 E	28	.45	2	¼	10	10
10	998.0	998.3	42	35	E	16 NE	16	.04	5	¼	10	10
11	990.7	994.1	41	34	E	30 E	12		1	½	10	10
12	995.7	1001.8	39	31	S	12 SW	10		0	¼	10	10
13	1005.0	1006.6	42	32	E	8 E	20	.24	10	¼	10	10
14	991.3	993.6	40	34	SE	22 S	28		1	10	10	10
15	1001.2	1002.4	37	34	SSW	16 SW	16		10	15	8	8
16	1006.8	1008.3	37	33	W	12 W	10		5	15	9	10
17	1009.5	1012.9	40	32	WNW	14 ENE	6		¼	15	10	2
18	1016.2	1009.7	39	32	E	12 SE	38	.62	15	10	9	10
19	996.2	1004.6	40	32	WSW	20 W	24	T	¼	10	10	8
20	1001.4	999.6	38	34	W	22 W	20	.04	10	2	4	10
21	1005.3	1006.9	37	31	WNW	20 W	8		¼	¼	10	10
22	1004.8	1005.0	38	30	W	8 WNW	4		½	10	1	4
23	1006.7	1008.4	42	32	E	2 N	4		10	15	9	7
24	1013.2	1015.9	44	32	WNW	6 W	12		15	15	8	4

RESOLUTION ISLAND METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
August													
25	1014.6	1014.5	41	32	WNW	2	NW	14		15+	15	4	8
26	1011.9	1006.9	41	33	WNW	6	E	4		15	15	8	3
27	1002.2	1001.1	41	36	E	10	NE	18		15	8	3	10
28	1004.9	1007.1	41	34	E	20	E	20	T	10	1/4	10	10
29	1004.4	1004.0	39	36	E	24	E	28	.12	6	1/4	10	10
30	1007.9	1012.0	39	35	E	24	ENE	20		1½	10	10	8
31	1012.5	1011.6	41	34	ENE	10	E	8		15	15	8	3
September													
1	1008.9	1011.8	48	35	NE	16	W	4	T	15+	15	2	4
2	1014.4	1017.3	50	36	Calm	0	NE	12		15	15	8	7
3	1017.8	1009.7	37	32	NW	8	S	2		1/4	1/4	8	10
4	1001.8	1001.9	42	31	E	10	E	8	.05	15	1/4	9	10
5	1003.7	1004.9	40	36	E	8	NW	12	.18	1/4	1/4	10	10
6	1007.0	1004.9	37	32	WNW	10	W	4	.14	0	10	10	4
7	993.5	986.7	40	30	E	18	NE	10	.14	1/4	1/2	10	10
8	990.0	1005.3	40	31	NNE	22	W	6	T	3	10	10	10
9	1011.1	1014.3	35	32	WNW	10	WNW	10		5	15	2	2
10	1011.1	1008.0	34	31	WNW	6	S	4		15	10	10	10
11	1007.5	1009.1	34	30	WNW	8	WNW	14		10	15	6	8
12	1008.3	1015.3	34	30	WNW	16	W	10		10	10	9	2
13	1013.8	1007.2	37	30	E	16	E	18	.06	15	15	9	10
14	1007.6	1001.2	38	35	E	20	NE	30		8	10	10	10
15	993.5	1004.3	37	35	NE	30	NW	14		5	10	10	7
16	1010.4	1014.9	36	31	WNW	14	W	24	T	10	15	10	4
17	1010.1	1001.1	35	31	SW	8	ESE	18	.13	1	8	10	10
18	999.8	1006.8	35	32	ENE	20	NNE	4	T	5	15	10	7
19	1012.2	1017.9	34	30	NW	10	W	20		15	10	7	10
20	1019.9	1016.8	36	32	S	2	E	14	.04	15	10	8	7
21	1011.4	1018.5	40	33	E	20	NE	10		2	10	10	10
22	1007.2	1004.6	38	33	ESE	30	W	20	.13	8	15	10	7
23	1004.8	1003.8	38	34	SSW	24	W	20		10	10	4	10
24	1006.9	1017.8	35	32	W	30	W	34	T	10	10	10	10
25	1025.0	1015.5	36	32	NW	6	E	32	.13	10	10	0	10
26	1005.1	1006.2	37	32	ESE	28	E	12	.33	1/2	1/4	10	10
27	1005.1	1008.2	38	34	Calm	0	S	6	.02	15	10	7	10
28	1007.1	1008.7	37	33	SE	2	SSW	4	.06	10	15	8	10
29	1009.5	1009.8	38	34	S	10	SE	16	.05	10	7	10	10
30	1008.0	1006.3	38	33	ENE	6	NW	2		15	15	7	7
October													
1	1008.9	1013.5	33	30	W	12	WNW	16		5	1/8	10	10
2	1013.3	1012.0	36	25	NW	20	NW	18		15	15	8	6
3	1007.5	998.4	33	32	NW	24	WNW	32	.25	15	2	8	10
4	1003.0	1006.0	34	32	W	12	SW	12	.07	1/2	1/8	10	10
5	1004.9	1005.5	35	28	S	6	S	8	T	1	10	10	10
6	1003.1	998.6	38	32	E	22	E	24	.05	15	15	2	10
7	993.4	994.9	40	35	E	40	E	24	.36	10	1/2	10	10
8	998.3	1003.6	39	32	ENE	38	NE	56	T	3	8	10	10
9	1005.6	1005.1	36	34	NE	40	NNE	30	.06	10	3	10	10
10	1006.8	1004.0	39	33	NE	16	NE	10	.05	5	10	10	10
11	998.6	999.3	39	34	NE	10	NE	8	T	1	1/4	10	10
12	998.9	999.6	39	34	NNW	6	NE	12	.35	10	5	10	10
13	997.1	1000.2	36	33	NW	10	NNE	24	.08	2	1/4	10	10
14	1007.3	1009.6	35	32	NW	6	NW	12	T	10	10	10	10
15	1012.6	1016.7	33	29	W	10	W	12	T	5	2	10	10
16	1015.6	1015.2	31	29	SW	10	SSE	12	T	10	10	10	10
17	1010.1	1005.7	34	29	ESE	26	ESE	24	.13	10	8	9	10

RESOLUTION ISLAND METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
	Mbs.	Mbs.	Max.	Min.									
1960	0700	1900	F°	F°	0700 am		1900 pm		Total	am	pm	0700	1900
October													
18	998.2	995.8	33	32	ESE	10	E	4		2	¼	10	10
19	990.9	995.6	32	31	WNW	8	W	20	T	5	10	10	10
20	1002.7	1010.8	32	29	W	28	SW	10	T	10	10	10	10
21	1008.5	997.6	33	29	E	16	NNE	18	T	10	10	10	10
22	983.5	988.7	32	29	NW	32	SW	24		2	½	10	10
23	1000.3	1012.3	31	29	SW	22	WSW	18	T	½	10	10	6
24	1020.3	1020.5	33	30	S	8	E	20	T	15	5	10	10
25	1019.5	1015.5	34	32	E	16	E	18	.03	2	6	10	10
26	1005.6	1004.5	33	32	S	10	W	20	T	2	0	10	10
27	1009.5	1010.9	33	29	WNW	30	SW	16	T	15	15	3	10
28	1007.3	1003.9	36	31	SSW	18	SSW	24	T	10	5	10	10
29	1005.4	1021.8	36	29	WNW	36	WNW	34		5	10	10	10
30	1025.6	1024.1	31	29	WNW	22	WNW	32		10	10	10	10
31	1020.9	1017.6	31	21	NW	30	N	6		10	15	10	4

CAPE HOPES ADVANCE METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
July													
1	1007.9	1009.9	33	30	E	10	E	8	.06	0	8	10	10
2	1011.1	1012.6	36	31	E	5	E	2	.03	0	15	10	10
3	1011.3	1009.7	38	32	W	6	W	5		1½	15	7	0
4	1008.5	1009.1	47	35	Calm	0	NNW	4		15	0	0	10
5	1009.5	1010.6	49	31	N	6	W	4		0	15	10	2
6	1010.2	1008.0	55	37	Calm	0	W	1		15	15	0	0
7	1003.7	999.7	58	43	S	10	S	2		15	15	9	9
8	999.7	1003.2	39	35	SSE	10	E	4	.05	¼	¼	10	10
9	1005.6	1009.9	36	34	E	8	ENE	5	.01	¼	0	10	10
10	1013.1	1014.6	40	35	ENE	12	WNW	4	.02	1/8	5	10	10
11	1011.0	1011.6	39	34	NW	12	E	5	T	3	0	10	10
12	1010.0	1009.3	37	32	NE	2	Calm	0		0	1/8	10	10
13	1006.1	1006.2	37	35	E	4	NW	2		0	0	10	10
14	1006.6	1007.0	44	34	Calm	0	SE	8		0	1	10	5
15	1001.7	1002.6	41	32	ESE	14	S	3	.02	¼	2	10	8
16	1004.0	1004.7	39	33	Calm	0	N	2	.07	¼	0	8	10
17	1006.0	1009.7	40	35	NE	6	W	4	.05	1/8	1/8	10	10
18	1010.5	1012.1	50	36	WNW	10	E	5		15	12	9	2
19	1013.2	1013.8	51	40	NW	10	S	2		15	15	2	1
20	1015.1	1016.8	51	31	Calm	0	Calm	0		5	15	1	0
21	1015.4	1011.9	62	40	Calm	0	Calm	0		15	15	0	1
22	1009.4	1009.3	59	50	Calm	0	S	2		15	15	0	1
23	1010.7	1011.0	73	50	Calm	0	S	4		15	15	1	4
24	1011.8	1014.6	64	44	W	6	W	10		15	15	5	1
25	1016.7	1012.1	57	40	WNW	10	SE	10	T	15	15	1	4
26	1001.8	995.1	54	40	SE	16	S	3	.05	15	0	10	10
27	991.9	997.7	59	39	SSW	8	SW	8		15	15	10	9
28	1004.8	1001.3	59	41	NW	4	S	15		15	10	7	5
29	997.7	1001.7	52	38	SE	4	Calm	0	T	10	1	3	10
30	1005.9	1006.3	63	37	NW	4	SSE	10	.03	15	12	7	6
31	994.8	990.1	45	37	E	38	E	20	.08	3	0	10	10
August													
1	978.8	995.1	56	35	E	8	SE	8		1/8	15	10	8
2	999.3	1003.7	49	36	SE	4	E	8		15	15	6	1
3	1000.9	996.3	44	32	NE	4	NNW	10	.07	15	5	9	10
4	995.6	998.1	39	36	E	4	NE	8	.03	0	0	10	10
5	1001.5	1005.9	40	34	E	12	E	2	T	0	1	10	10
6	1008.8	1009.4	39	45	Calm	0	E	15	.03	0	5	10	10
7	1010.0	1011.7	38	34	E	12	E	8	.04	6	8	10	10
8	1007.8	1007.0	38	35	E	14	E	8	.01	1/8	10	10	10
9	1001.4	998.6	39	31	E	22	NE	12	.11	¼	¼	10	10
10	997.7	997.8	40	35	NE	4	Calm	0	.03	0	0	10	10
11	995.4	997.2	44	36	NW	10	NE	4	.03	10	5	10	9
12	995.8	997.2	50	37	N	4	S	8		0	12	10	9
13	1001.3	998.3	56	42	S	2	ESE	15		15	15	5	9
14	981.6	986.3	53	38	SE	8	W	12		15	15	8	6
15	994.2	999.3	52	43	W	12	W	8		15	15	6	5
16	1004.8	1006.2	51	43	SW	10	SW	3		15	15	10	7
17	1009.3	1011.1	50	40	Calm	0	SW	4		15	15	9	2
18	1011.1	995.5	54	39	SW	10	E	35	.07	15	1	6	10
19	993.9	1001.6	55	44	W	18	SW	5		15	15	7	9
20	999.4	1001.2	47	39	W	14	WNW	25		15	15	8	3
21	1006.7	1006.7	53	38	NW	16	W	2	.01	15	15	7	9
22	1003.8	1005.0	41	36	NW	10	NW	15		10	15	9	9
23	1007.1	1009.8	40	38	WNW	24	W	15		0	10	10	9
24	1014.3	1015.9	40	37	W	12	W	5		1/8	15	10	4

CAPE HOPES ADVANCE METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
August													
25	1014.9	1014.2	54	38	NW	10	SSW	4		15	15	10	8
26	1009.0	1004.0	60	45	S	2	SSE	5		15	15	4	3
27	997.3	1000.9	43	39	ESE	10	E	15		15	15	9	9
28	1004.0	1002.0	45	35	NW	4	E	8		15	0	8	10
29	998.4	1000.2	39	35	E	16	E	15	.04	1/8	0	10	10
30	1005.1	1010.6	38	36	Calm	0	E	5		0	0	10	10
31	1010.7	1009.0	40	36	E	10	E	8		0	0	10	10
September													
1	1010.3	1013.0	42	35	SE	2	W	10		15	10	10	3
2	1016.2	1018.0	44	37	NW	24	W	12		0	15	10	1
3	1014.9	1003.2	49	37	S	2	S	18	.13	15	3	7	10
4	995.1	998.9	44	38	S	6	NW	12	.01	1/8	0	10	10
5	1003.4	1006.0	40	37	NW	22	NW	22		4	10	10	9
6	1007.3	999.3	42	33	W	10	SE	15	.07	0	5	10	10
7	986.9	984.8	54	38	SE	4	NW	6	.04	7	1/8	7	10
8	993.3	1007.7	38	35	NW	22	NW	50		6	5	10	10
9	1015.0	1014.7	38	32	NW	40	NW	8		8	15	9	1
10	1010.1	1007.4	40	32	N	2	NW	10		15	15	10	9
11	1007.4	1005.6	44	31	NW	8	NW	6	T	15	15	8	10
12	1008.7	1010.8	40	33	WNW	7	S	5		15	15	8	9
13	1006.4	1001.6	39	34	SE	16	E	28	.02	15	15	7	9
14	1003.6	1000.6	35	33	E	30	E	40	.04	2	3	10	10
15	1000.0	1006.5	38	34	N	8	NW	30		15	10	9	4
16	1012.9	1014.7	39	32	NW	34	S	4	T	8	15	8	8
17	1003.6	997.3	35	33	SSE	8	E	10	.03	6	1/8	10	10
18	1000.8	1007.8	41	33	NE	5	NW	12		1	15	10	9
19	1013.6	1016.4	39	32	NW	10	N	4		15	15	8	7
20	1016.8	1008.6	43	32	S	2	SE	12	T	15	5	2	10
21	1011.0	1017.2	38	33	NW	25	N	3	T	8	15	10	1
22	994.5	1000.6	45	31	SE	40	SW	16	T	1/8	15	10	3
23	998.3	1001.0	38	33	SW	15	W	35		15	15	4	9
24	1008.8	1020.0	38	34	W	40	NW	35		15	12	7	9
25	1024.3	1004.0	36	30	S	2	E	40	.04	15	½	3	10
26	998.7	999.8	43	32	S	4	SW	8	T	10	8	10	10
27	1000.6	1002.9	41	37	S	4	S	4		12	12	9	10
28	1002.9	1002.7	40	33	S	2	SE	8		15	15	9	6
29	1003.2	1005.4	39	33	SE	5	W	5		¼	0	10	10
30	1005.6	1006.0	35	31	W	2	SSE	2		1/8	10	4	2
October													
1	1008.0	1014.0	35	31	Calm	0	NW	14		10	15	10	10
2	1015.3	1014.4	37	32	NW	20	NW	10		15	15	6	3
3	1011.5	1004.8	35	33	NW	10	NW	30		15	15	3	0
4	1002.5	1003.9	39	32	NW	32	NW	14		4	15	10	4
5	1002.7	1001.7	37	29	NW	10	Calm	0		¼	10	9	10
6	999.4	994.3	35	32	E	5	ESE	30	.05	0	6	10	10
7	994.9	997.4	36	33	ESE	24	N	24	.08	½	3/4	10	10
8	1002.6	1009.4	36	32	N	10	N	20		6	8	10	10
9	1011.0	1009.3	37	32	NNW	20	NW	34	M	15	6	6	10
10	--	1004.1	35	32	--	-	N	5	.01	-	6	-	10
11	1000.4	999.2	34	32	N	5	NW	10	T	15	4	9	10
12	999.6	1001.6	37	30	NW	18	NW	20	.01	15	15	10	6
13	998.6	1003.4	34	30	NW	55	NW	34		10	10	10	10
14	1008.0	1007.2	33	30	NW	33	NW	34		15	10	9	10
15	1010.9	1013.6	32	23	NW	30	SW	6	T	15	15	10	10
16	1012.8	1010.3	31	27	S	5	SE	5	T	15	15	8	10
17	1006.0	1001.4	33	31	SE	8	E	10	.15	15	4	10	10

CAPE HOPES ADVANCE METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
October													
18	--	993.3	34	28	E	2	NW	5		6	10	10	10
19	990.5	994.2	32	22	NW	20	W	30	T	10	8	9	10
20	1001.9	1006.6	29	23	W	33	S	5	T	15	15	3	3
21	1004.4	999.7	30	27	E	20	E	20	T	15	8	10	10
22	989.4	986.9	31	29	NW	18	NW	50		15	8	10	10
23	998.3	1009.8	31	25	WNW	36	NW	15		15	15	10	4
24	1016.2	1015.8	32	31	S	5	E	20	.02	15	15	9	10
25	1013.0	1010.0	35	31	E	10	SE	5	T	8	¼	10	10
26	1003.6	1004.7	34	27	W	5	NW	20		1/8	15	10	10
27	1009.2	1003.7	35	30	WNW	24	S	10	.01	15	15	8	10
28	1003.3	998.4	37	29	SW	18	S	14		8	10	10	10
29	1009.0	1021.5	31	28	NW	40	W	30		15	15	10	7
30	1025.8	1024.8	30	26	W	24	W	20		15	15	5	8
31	1023.2	1018.1	27	23	NW	18	NW	6		15	15	10	10

NOTTINGHAM ISLAND METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
	Mbs.	Mbs.	Max.	Min.									
1960	0700	1900	F°	F°	0700 am		1900 pm		Total	am	pm	0700	1900
July													
1	1008.9	1012.8	44	33	NE	18	NE	19		8	15	10	2
2	1015.7	1014.0	52	38	NE	9	E	5		15	15	4	0
3	1014.6	1012.7	59	33	E	3	SW	4		15	15	0	0
4	1012.2	1012.2	58	37	N	3	NW	10		15	15	0	0
5	1011.8	1010.1	62	42	SE	3	SE	5	T	15	15	4	3
6	1010.2	1006.6	53	39	Calm	0	NE	10	.02	15	10	0	10
7	999.2	1000.2	50	41	E	2	Calm	0		1	8	10	10
8	1003.1	1006.8	53	37	NW	10	SE	12		15	15	8	3
9	1008.3	1012.7	-	38	Calm	0	ENE	12	M	15	10	9	8
10	--	1017.0	60	43	--	-	WSW	8		-	15	-	4
11	1015.9	1015.2	59	46	Calm	0	Calm	0	T	15	15	9	8
12	1012.3	1010.8	64	37	N	12	NW	12		15	15	9	4
13	1006.8	1005.3	54	35	Calm	0	SSE	7		15	15	9	6
14	1005.6	1003.8	50	37	WSW	10	NE	16	T	1/8	15	10	8
15	994.7	1001.5	44	-	NE	28	NE	12	M	3	8	10	8
16	1006.0	--	-	-	NE	8	--	-	M	10	-	8	-
17	--	--	-	47	--	-	--	-	M	-	-	-	-
18	--	1015.1	66	56	--	-	NW	12		-	15	-	5
19	1014.1	1014.5	59	39	W	3	ENE	4		15	15	3	0
20	1016.0	1016.1	58	45	W	8	WSW	7		15	15	1	3
21	1014.1	1011.6	64	-	SE	6	E	8		15	15	6	3
22	1009.1	--	-	-	NE	12	--	-	M	15	-	3	-
23	--	--	-	39	--	-	--	-	M	-	-	-	-
24	--	1016.4	53	45	--	-	W	6	M	-	15	-	8
25	1012.9	1003.4	56	43	SE	12	E	21	.05	15	3	9	10
26	988.2	998.6	53	41	E	15	NE	14	.07	7	10	10	9
27	998.5	999.7	52	41	SE	8	SE	6	T	½	0	10	10
28	999.2	994.7	50	41	SE	22	S	16		5	15	10	3
29	996.0	1001.3	54	40	SE	14	SE	14		15	15	4	3
30	1001.2	1004.5	54	40	ESE	15	E	9	.02	9	15	9	9
31	995.0	994.7	51	42	NE	24	S	9	.05	10	15	10	10
August													
1	984.9	990.2	49	41	NE	25	E	7	T	5/8	12	10	10
2	1000.6	1007.5	53	37	NE	8	NE	15		15	1	1	10
3	1010.1	1009.2	62	35	N	4	NW	15		15	15	1	0
4	1000.6	1004.1	54	44	N	18	N	12	.02	15	15	0	10
5	1005.8	1009.4	57	45	NE	15	SW	10		15	15	1	1
6	1010.0	1014.1	54	43	NNE	10	NE	14		15	15	6	10
7	1014.1	1014.7	56	38	NE	16	E	12		15	15	10	7
8	1012.9	1012.1	55	43	NW	8	NE	12		15	15	5	0
9	1011.6	1006.2	58	40	Calm	0	SW	6		15	15	0	4
10	1001.7	999.3	60	41	N	10	Calm	0	.06	15	8	7	10
11	997.3	998.6	50	41	NE	12	NE	10	T	8	8	10	10
12	997.9	997.6	60	42	NE	6	NE	10	T	15	15	3	2
13	998.4	998.8	48	42	NE	15	NE	20	T	8	15	10	7
14	990.0	985.7	48	38	N	20	NW	20	T	15	10	10	10
15	991.0	998.3	41	36	NW	20	W	16	.12	8	3	10	10
16	1001.7	1006.3	42	37	SW	25	W	6		5	12	9	9
17	1008.5	1006.8	48	33	W	12	NE	20		10	15	10	8
18	1000.1	980.8	49	40	NE	16	SW	30	.09	15	1½	9	10
19	987.7	993.0	43	40	SW	30	SW	40		3	8	10	10
20	995.4	1005.7	40	36	W	34	W	7		8	15	10	8
21	1008.7	1008.3	50	34	W	7	NW	12		15	15	8	0
22	1008.5	1011.0	53	37	NW	12	NW	16		15	15	9	6
23	1014.9	1017.2	49	34	NW	12	NW	18		15	15	1	1
24	1019.6	1018.7	48	34	W	2	SW	8		15	15	4	8

NOTTINGHAM ISLAND METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
August													
25	1014.0	1008.3	52	41	SE	18	S	20		15	8	9	10
26	1006.3	1003.9	47	40	SW	12	Calm	0	T	3/8	10	10	9
27	999.2	1001.5	47	43	NE	20	NE	10	.11	12	15	10	10
28	1003.5	1001.6	49	39	NE	2	NE	16		½	15	10	2
29	998.9	1003.0	45	38	NE	10	NE	25		3/4	15	10	8
30	1009.4	1011.0	53	41	E	8	E	14		15	15	7	7
31	1010.5	1011.1	44	38	NE	18	NE	16		½	15	10	10
September													
1	1015.3	1020.7	59	37	Calm	0	NW	12		15	15	1	0
2	1023.8	1019.6	50	38	N	3	S	12	.05	15	15	4	8
3	1003.2	997.9	45	42	SSE	22	W	6	.30	1	½	10	10
4	999.7	1006.1	40	36	NW	16	NW	14		10	10	10	10
5	1009.2	1009.8	44	34	W	12	SE	9		15	½	1	10
6	1006.5	997.8	39	31	NE	14	NE	20	T	1½	8	10	10
7	993.5	1002.2	40	33	NNE	14	NW	31	T	10	10	10	10
8	1011.6	1018.1	35	31	NW	28	NW	16	T	15	12	10	8
9	1018.6	1016.4	38	29	NW	10	W	3		10	15	10	8
10	1016.4	1010.0	43	31	E	6	W	9	T	15	15	8	9
11	1008.8	1010.0	34	29	NW	18	NW	8	T	10	12	9	8
12	1003.8	1000.6	40	27	SE	16	SE	20		1½	8	10	10
13	996.2	1003.0	41	36	E	18	NE	20	T	8	12	10	9
14	1005.7	1010.3	40	34	NE	26	NE	10	T	8	15	10	2
15	1010.1	1015.2	36	29	N	5	NW	13		15	15	7	4
16	1014.6	1011.3	39	27	NW	10	E	6	T	15	15	10	9
17	1002.4	1004.4	41	35	NE	15	NE	20		10	12	10	10
18	1008.3	1013.2	36	27	NW	6	NW	12	T	15	10	1	10
19	1013.1	1013.8	39	27	W	10	SE	12	.01	10	15	10	8
20	1007.9	1003.2	42	37	SE	14	E	10	.04	10	0	10	10
21	1015.0	1013.3	42	32	SW	12	E	10	.10	15	15	1	9
22	977.0	983.7	39	32	NE	30	SW	38	.10	8	3	10	10
23	989.0	1003.0	33	29	W	30	NW	22		½	10	10	10
24	1013.5	1021.9	31	26	NW	18	NW	8		12	½	10	10
25	1017.8	998.0	35	25	NE	18	NE	42		10	8	10	10
26	992.0	993.4	36	32	NE	36	NE	26		12	½	10	10
27	994.0	997.6	39	33	NE	22	NE	15		1	15	10	3
28	999.2	1001.8	38	33	NE	12	NE	15		½	15	10	9
29	1004.6	1007.4	40	32	NE	10	N	6		15	12	9	8
30	1006.5	1008.0	37	32	NW	8	NW	11		15	12	8	9
October													
1	1011.6	1015.0	37	32	NW	12	W	7	T	15	15	9	8
2	1016.4	1015.1	37	29	SE	5	E	12	M	10	15	10	1
3	--	1014.1	35	24	--	-	E	17		-	15	-	9
4	1013.2	1010.6	36	27	N	6	NE	3		15	15	1	8
5	1005.3	1003.2	33	23	NE	8	NE	11		15	15	8	7
6	1003.3	1005.4	32	20	NE	6	Calm	0	M	15	15	10	9
7	--	1013.3	35	29	--	-	N	20		-	15	-	3
8	1016.0	1020.8	38	26	N	14	N	8		15	15	3	8
9	1021.6	1018.1	35	22	NW	10	SW	11		15	15	0	1
10	1011.0	1005.9	35	27	N	2	SE	6		15	15	1	7
11	1003.8	1005.2	32	27	Calm	0	Calm	0		15	15	10	10
12	1009.0	1013.9	34	26	NW	12	NW	16	T	10	15	10	7
13	1015.9	1016.3	-	22	NW	12	NW	8	M	10	15	10	1
14	--	1016.1	35	20	--	-	Calm	0		-	15	-	1
15	1015.3	1014.0	32	30	NW	8	SW	9		1/8	10	10	10
16	1011.3	1010.1	33	26	SE	10	E	12		15	15	9	7
17	1008.0	1006.4	31	24	E	19	NE	15	T	10	10	10	10

NOTTINGHAM ISLAND METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
October													
18	1004.6	1000.5	30	25	N	10	NW	10	T	10	8	9	10
19	996.0	995.4	27	25	NW	22	SW	20		5	10	10	10
20	995.3	998.1	33	21	SSW	14	SSE	20	T	12	5	7	10
21	1000.6	1002.9	30	20	SSE	22	SE	8		7	15	9	0
22	1001.3	999.2	29	20	N	4	NW	12	T	15	10	8	10
23	1001.2	1009.6	27	17	NW	8	NW	12	T	10	15	9	1
24	1014.9	1018.6	33	24	NE	10	SE	8	T	8	5	10	10
25	1016.1	1006.5	32	25	SE	18	SSE	15	.02	15	5	10	10
26	1001.7	1004.2	33	28	WSW	20	SW	24	.06	12	10	10	10
27	1001.6	992.7	35	22	SSE	10	NW	20	T	½	10	10	10
28	1002.7	1000.9	26	22	W	10	W	7		½	12	10	10
29	1010.0	1019.9	28	22	WSW	25	W	22		10	15	10	6
30	1025.8	1027.1	24	21	SW	22	NW	15	T	15	12	3	10
31	1023.3	1019.2	27	11	WSW	10	N	4		8	15	10	8

CHURCHILL METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
July													
1	996.2	1007.9	36	32	NNW	24	N	24	.02	1½	¼	10	10
2	1014.1	1018.9	36	31	N	12	NNW	11		1/8	½	10	7
3	1019.4	1017.4	53	29	NW	12	N	11		¼	20	10	6
4	1018.4	1017.5	70	33	NW	6	Calm	0		20	20	7	7
5	1015.5	1010.9	80	51	SW	12	SW	7	T	20	20	6	4
6	1008.7	1006.0	78	56	WSW	19	W	16	.03	15	20	9	6
7	1004.8	1014.1	58	41	WNW	20	N	5		20	10	4	9
8	1016.6	1010.9	70	39	SSE	8	SSE	18		0	15	10	10
9	1004.5	1002.0	76	47	SE	17	ENE	14	T	20	12	10	6
10	1005.3	1008.1	41	35	NE	5	NNE	12	.02	¼	3	9	10
11	1011.7	1018.0	40	34	NNW	16	N	18	T	3/4	¼	10	10
12	1023.1	1021.8	64	34	NW	11	WSW	11	T	15	20	9	4
13	1016.9	1011.7	66	55	W	20	W	4	.15	20	12	8	10
14	1004.5	1009.3	49	38	NNE	18	WNW	14	.30	20	20	8	7
15	1013.0	1014.4	60	33	NNW	23	WNW	8		½	20	9	4
16	1015.3	1014.9	63	50	WNW	10	E	10		15	20	7	8
17	1016.7	1016.5	69	45	SE	10	ESE	14	.01	20	20	3	5
18	1018.1	1018.3	68	48	SSE	8	SE	12		20	20	2	5
19	1018.5	1014.3	74	44	S	16	S	18		20	20	8	7
20	1011.9	1006.0	72	51	S	15	S	17	.04	20	20	9	8
21	1004.0	1005.2	65	55	WNW	12	WNW	15	.07	20	20	7	9
22	1009.8	1011.0	77	53	NW	14	Calm	0		15	15	3	5
23	1012.2	1008.5	76	51	SE	10	SE	15	T	15	15	7	5
24	1008.1	999.8	73	41	N	12	SE	15	.54	15	5	6	6
25	989.4	987.8	61	45	WSW	21	NW	16	.46	10	12	9	10
26	992.0	1001.7	66	50	NW	29	NW	24	.03	5	20	10	8
27	1002.2	996.5	69	48	SSE	10	NW	10	.40	20	20	10	7
28	995.9	998.7	55	48	W	35	WNW	20	T	20	15	8	7
29	998.3	1000.7	55	45	W	25	WNW	25	T	20	15	7	8
30	1001.7	1002.3	52	45	WNW	20	NW	9	.05	15	20	9	7
31	1002.5	1005.7	52	45	NW	18	WNW	9	.02	15	20	9	3
August													
1	1002.7	1002.9	53	46	WNW	24	NW	30	.01	20	20	8	10
2	1007.1	1014.1	51	47	NNW	24	NW	9	T	10	15	10	10
3	1017.0	1016.8	55	45	NW	9	NW	5	T	20	15	10	10
4	1017.3	1016.4	60	46	NW	5	NE	8		15	15	9	2
5	1017.2	1018.0	62	49	WNW	12	E	12		15	20	3	2
6	1019.7	1017.8	64	47	NNE	7	SE	8		20	20	2	2
7	1017.0	1015.7	69	48	Calm	0	E	12	.05	20	20	3	7
8	1014.0	1019.4	62	51	SE	12	NE	18	.05	15	20	10	3
9	1017.4	1013.9	71	47	SW	12	NNE	22	T	20	15	9	9
10	1017.3	1013.8	68	48	N	12	W	7	.01	20	20	2	6
11	1008.0	1009.0	56	46	S	12	WNW	6	.14	20	15	9	9
12	1003.8	1000.6	51	45	W	18	NNE	12	T	20	15	9	9
13	1005.4	1010.3	55	39	NNW	19	NNW	10	T	12	20	10	9
14	1006.0	1012.9	53	47	WNW	23	NNW	13	.01	15	20	10	5
15	1016.4	1007.1	74	40	SW	11	SW	18		15	20	9	4
16	1004.2	999.9	73	55	SW	20	S	24		20	15	5	7
17	999.1	993.6	76	56	S	10	W	12	T	10	15	10	5
18	994.5	1002.3	69	57	W	18	W	18	T	15	20	4	5
19	1005.9	1011.6	63	50	W	18	NE	8	T	15	20	2	4
20	1011.1	1009.3	52	45	SE	12	NE	18	.77	20	12	9	10
21	1013.3	1017.9	50	41	N	12	NNW	6	.06	½	15	10	5
22	1021.7	1022.3	61	43	NW	10	ESE	16		20	15	1	7
23	1020.3	1010.7	60	41	SE	19	SE	35	.53	20	15	10	6
24	1001.5	997.9	73	50	SSE	27	SSW	32	.04	4	20	10	7

CHURCHILL METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind				Precip.	Vis.		Cloud Tenths of Sky Cover	
1960	Mbs. 0700	Mbs. 1900	Max. F°	Min. F°	0700 am		1900 pm		Total	am	pm	0700	1900
August													
25	1002.9	1008.5	60	54	WSW	27	NE	4		15	20	9	8
26	1005.7	1002.5	63	45	NNW	6	E	7		20	20	9	2
27	1002.5	1000.5	52	45	NW	8	N	12	.05	15	15	5	10
28	997.6	1002.3	47	43	N	22	NNW	13	.32	8	20	10	9
29	1006.6	1008.5	59	43	WNW	8	ESE	20		20	20	2	2
30	1005.4	1000.9	47	42	ESE	18	E	21	.53	20	6	8	10
31	1002.8	1017.5	45	40	NE	6	NNW	13	.06	¼	½	10	10
September													
1	1024.1	1022.0	51	36	NE	4	SE	17	T	1/8	15	10	10
2	1015.4	1009.2	69	44	S	26	NW	7	T	15	20	9	10
3	1012.6	1017.3	55	47	W	18	WNW	6		20	20	1	7
4	1015.1	1009.5	74	41	SSW	14	SW	15		15	20	3	1
5	1004.4	987.7	60	47	SSE	13	SSE	18	.06	20	15	9	9
6	987.3	991.6	64	48	SW	15	NNW	12	.02	12	20	3	9
7	1006.8	1023.0	42	38	N	24	NNE	12	T	4	15	10	8
8	1025.2	1019.4	44	30	SW	8	S	15	T	20	15	6	10
9	1015.7	1010.6	54	32	SSW	6	S	12	.05	2½	15	8	9
10	1007.9	1018.9	45	38	SE	6	NNE	27	.08	8	15	10	9
11	1022.6	1010.0	48	34	SSW	23	NNW	10	.12	15	15	5	10
12	1004.4	1013.5	42	39	NNW	30	NNW	35	T	12	20	8	9
13	1010.2	1009.3	39	32	NNW	26	NNW	38	T	10	15	9	8
14	1012.4	1019.0	39	34	NNW	29	N	18	.01	1	10	10	10
15	1020.5	1012.9	46	33	S	12	W	14		15	15	10	9
16	1004.7	1002.9	51	38	W	14	W	12	.09	15	15	9	9
17	1002.2	1012.7	43	39	NW	24	NNW	12	.04	2	15	10	9
18	1016.0	1008.2	52	39	W	8	SSE	18	.02	15	15	10	9
19	998.4	1002.3	55	45	S	18	W	12	T	20	15	9	9
20	1015.5	1019.8	42	38	NW	24	ESE	7		20	15	2	9
21	1013.2	1008.7	46	32	ESE	8	WNW	39	.10	15	6	10	9
22	1010.8	1014.1	42	32	W	18	NW	24	T	15	20	4	7
23	1015.0	1011.2	44	28	SSE	7	WSW	26	T	15	15	7	10
24	1008.4	1002.8	57	37	SSE	16	SW	10	.14	15	20	10	10
25	994.7	1000.2	42	39	NW	12	NW	20	.20	½	10	10	10
26	1007.4	1013.0	39	37	NNW	29	WNW	24	.03	3/4	12	10	10
27	1014.3	1016.9	37	33	NW	30	NNW	18	.03	15	20	8	8
28	1016.3	1015.3	33	30	N	15	N	9	T	10	20	10	10
29	1016.0	1016.6	36	30	N	4	E	10		20	20	9	3
30	1012.7	1009.9	43	25	SSE	12	SSW	6	.02	20	15	8	8
October													
1	1008.8	1009.2	46	32	S	10	ESE	12	.01	20	15	10	5
2	1012.1	1016.3	36	28	NNW	24	WNW	22	.03	6	20	10	10
3	1017.1	1012.2	37	31	SSW	7	ESE	24	.10	15	15	10	10
4	1000.5	989.1	50	34	SE	12	SE	12	.13	15	15	9	10
5	986.5	998.2	37	35	WNW	30	NW	24	.23	8	6	10	10
6	1008.4	1013.5	38	32	WNW	10	NW	12		20	15	3	9
7	1018.5	1018.9	35	31	N	15	E	18	.01	20	12	10	10
8	1016.9	1017.3	39	30	SE	28	ESE	24		10	20	10	10
9	1018.4	1012.2	40	33	SE	18	SSE	18	.11	20	15	10	10
10	1009.3	1011.8	37	33	WNW	39	WNW	24	T	15	15	10	8
11	1010.8	1018.5	35	31	NW	6	NNW	24	.09	15	15	7	9
12	1021.7	1018.8	32	28	NNE	15	ESE	12	.11	15	15	7	9
13	1012.6	1006.6	35	28	ESE	16	SE	13	.03	1 3/4	3	10	10
14	1010.0	1014.1	38	31	SSW	7	NW	13	.05	15	20	8	10
15	1017.3	1012.4	34	31	NW	24	SE	12	.08	12	12	10	10
16	1007.7	1015.1	33	28	ENE	24	NNW	30	.03	10	2½	10	10
17	1014.6	1014.2	34	22	NW	30	NW	36	.42	15	4	10	10

CHURCHILL METEOROLOGICAL REPORT - 1960

Date	Barometer		Temp.		Wind			Precip.	Vis.		Cloud Tenths of Sky Cover	
	Mbs.	Mbs.	Max.	Min.								
1960	0700	1900	F°	F°	0700 am		1900 pm	Total	am	pm	0700	1900
October												
18	1020.8	1028.0	25	13	N	44	NW 27	.11	½	1	10	10
19	1021.8	1015.2	24	11	WNW	24	WNW 24	.03	15	6	8	9
20	1014.7	1010.4	17	9	NW	18	WNW 9	.05	6	15	10	5
21	1004.3	1007.1	20	6	NW	12	WNW 13	.06	10	15	10	6
22	1006.9	1007.9	15	7	W	10	NW 21	.09	15	6	6	10
23	1013.1	1016.0	17	4	NW	21	SW 5	.04	2½	20	10	7
24	1006.3	999.2	29	-2	SSE	25	S 18	.12	15	3	10	10
25	1004.0	1010.6	31	25	WNW	14	NNW 20	T	15	20	9	10
26	1011.1	998.7	33	15	SSW	14	SE 12	.04	12	15	10	10
27	1000.8	1008.0	29	19	N	24	NNW 20	.01	10	15	10	10
28	1008.6	1016.2	25	12	N	24	W 7	.01	10	12	10	9
29	1023.0	1029.2	27	7	S	8	E 6	.14	20	15	3	10
30	1029.7	1026.1	30	22	NNE	23	NNE 18	.11	1½	1	10	10
31	1019.7	1014.2	31	25	ENE	10	NNE 8	.02	10	15	10	10

VESSELS OF THE CANADIAN MARINE SERVICE ASSIGNED FOR OPERATIONS IN THE EASTERN ARCTIC

Name of ship	Built	Length	Gross tonnage
✯ John A. Macdonald (H)	1960	315 feet	6,186
✯ d'Iberville (H)	1952	291 "	5,678
✯ Labrador (H)	1953	250 "	3,823
C. D. Howe (H)	1950	280 "	3,628
✯ N. B. McLean (H)	1930	260 "	3,524
Sir William Alexander (H)	1959	258 "	2,154
✯ Wolfe (H)	1959	208 "	2,022
✯ Montcalm (H)	1957	208 "	2,017
Edward Cornwallis	1949	245 "	1,965
Sir Humphrey Gilbert (H)	1959	208 "	1,931

✯ Indicates icebreaker. Remaining ships are strengthened for navigation in ice.

(H) Indicates that ship is equipped with helicopter.