Project & Field Report
C.S.S. "Richardson", W.- Arctic

Hydrographer-in-Charge A.B. Ages

Summer 1965

WESTERN ARCTIC

C.S.S. " R I C H A R D S O N "

Hydrographer - in - Charge A.B. Ages

June 30 - September 17, 1965

OF: - Nil

Not Completed

Field Sheets WA 10037, WA 10042.

Chart Chronaflexes 7604, 7605, 7606

7607, 7609, 7616, 7617, 7632, 7637,

7645, 7670, 7678.

List of Contents.

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List of Participating Staff

	Arrived		Departed	
Name	Date	From	Date	To
A. B. Ages	31 May	Victoria	23 September	Victoria
W. R. Taylor	2 June	"Wm. J. Stewart"	22 September	Victoria
R. Longbottom (Q.M.)	31 May	Victoria	22 September	Victoria

List of Craft and Major Equipment

1	C.S.S. "Richardson"
1	14 ft. Fibreglass Lifeboat with portable echo sounder
1	14 ft. Aluminum boat
1	8 ft. Fibreglass dinghy
2	Sets MRA2 Tellurometers
1	Kelvin Hughes MS26^{B} Echo Sounder
1	Kelvin Hughes MS30 Echo Sounder
3	Wild T2 Transits
1	Wild N2 Level
1	Kaar Radio Transceiver
3	Spillbury portable RT's
1	Decca 404 Radar
4	Alpine Transponder Beacons

Tabulation of Projects

Main Projects

Continuation of transponder sounding between Pullen Island and Warren Point.

Tellurometer traverse from Pullen Island to Pelly Island.

Tellurometer traverse from Tuktoyaktuk overland to Liverpool Bay.

Detailed survey of Coppermine Approaches.

Inspection of facilities for future permanent tide gauge site near Coppermine.

Area of Operation

Tuktoyaktuk to Coppermine.

CHRONOLOGY ~~OF EVENTS~~

May 31	Advance party arrives at Tuktoyaktuk to commence activation of C.S.S. "Richardson".
June 2	Remainder of crew arrives. Activation of ship and preparation for 1965 season.
June 30	Messrs. Ages, Taylor and Longbottom commence tellurometer traverses and observations of angles in Kugmallit Bay and vicinity by helicopter. Observation of angles at Crater.
July 1,2,3	Tellurometer traverse Pullen Island to Mackenzie delta to tie into old CHS control.
July 6,7	Tellurometer traverse to Hendrickson Island and at Toker Point.
July 8,9,11	Continuation of tellurometer traverse to Mackenzie delta. Checking of buoys and ranges at Tuktoyaktuk.
July 12,13,15,17	Tellurometer traverse from Tuktoyaktuk to Liverpool Bay to tie into 1965 ASE network. Observation of azimuths at Crater and Bols (Atkinson Point).
July 18,19	Building of transponder beacons in Kugmallit Bay. Preparing transponder buoy.
July 20,21,22, 23,24	Evaluating and improving Survey with transponder beacons. Mr. Dennett of Decca Navigation on board to observe field conditions and instruct Electronics Technician, Mr. Taylor.
July 24,26,29, 30,31 August 1,2,3	Detailed sounding of Kugmallit Bay with shore beacons and buoy.
August 4,5	Preparing second transponder buoy in Tuktoyaktuk Harbour.
August 6	Second transponder buoy lost in gale off Toker Point.
August 7	Weather bound Nallok Point.
August 8,9,10	Transponder sounding Kugmallit Bay, (still in scattered ice).
August 13	Departure for Coppermine.
August 14,15,16	En route, tracksounding. Open water all the way except some small floes near Cape Young.

August 17	Arrival Coppermine. Building tide gauge near village.
August 18	Building stations (previously established by ASE 1965 survey) in Coppermine Approaches.
August 19,20,21, 22,23,24	Boat sounding and ship sounding in Coppermine Bay. Reconnaissance of possible future permanent tide gauge. Moved tide gauge to Expeditor Cove after unsatisfactory results village site (too close to river mouth).
August 25	Weather bound Austin Bay.
August 26	Short beach survey Lady Franklin Point. Departure for Tree River and tracksounding island passages Coronation Gulf.
August 27,28	Reconnaissance sounding between Tree River and Coppermine.
August 29,30,31	Boat sounding and ship sounding Coppermine Bay and Expeditor Cove. Marking and observing stations. Reconnaissance sounding of possible refuge harbours for shipping. Radar Scope.
September 1	Tide gauge picked up. Sounding stations retrieved.
September 2	Departed Coppermine.
September 2,3,4	Reconnaissance sounding western Coronation Gulf, Lambert Channel, Dolphin and Union Strait and exploring of refuge harbours.
September 5,6,7	En route, slow progress in poor weather with local gusts and continuous snow flurries.
September 8	Arrival Tuktoyaktuk, unloading survey equipment.
September 9	Building transponder beacons Kugmallit Bay.
September 10,11	Weather bound Pullen Island and Tuktoyaktuk.
September 12	Transponder sounding Kugmallit Bay (Pullen Island).
September 13	Inspection "Richardson" by Marine Superintendent, Mr. E. Geldart.
September 14,15	Transponder sounding Kugmallit Bay.
September 16,17	Testing and evaluating beacons in Tuktoyaktuk Harbour.
September 18	Commenced deactivation.
September 22	Completed deactivation. Crew departed for Victoria.

NARRATIVE

Preparation

During the winter 1964/1965, while the "Richardson" wintered in Tuktoyaktuk, her next Arctic season was planned in Ottawa and the usual arrangements were made with NTCL regarding fuelling, provisions and the use of one of the Eldorado helicopters; with Federal Electric Corporation regarding air transportation along the DEW Line, accommodation and ground transportation; with D.O.T. regarding a rendezvous with the "Camsell" in the Coronation Gulf in case the "Richardson" needed fuel and water. Unfortunately, lack of survey staff forced cancellation of a hydrographic party on board the C.C.G.S. "Camsell" and the launch "Quail" remained in Victoria.

A fourth transponder beacon was added to the "Richardson's" survey equipment. Mr. L. J. Dennett, General Manager of Decca Radar (Canada) was invited to spend a few days on board the "Richardson", observe the performance of the transponder beacons and our method of transponder surveying in Kugmallit Bay and instruct our electronics technician, Mr. Taylor, in maintenance and tuning of the beacons.

Operation

Ice conditions outside Tuktoyaktuk initially kept the "Richardson" confined to the harbour longer than expected. However, the Eldorado helicopter became operational on June 30th and two hydrographers, assisted by one or two crew members, spent the major part of July running tellurometer traverses along the coast between Pelly Island and Liverpool Bay while the remainder of the crew continued scraping and painting the ship and repairing equipment.

Apart from completing various minor projects in the immediate vicinity of Tuktoyaktuk, an 80 mile tellurometer traverse was run west of Pullen Island, tying into the 1930 C.H.S. network at Pelly Island; a second traverse east of

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Tuktoyaktuk (52 miles) to Liverpool Bay was completed just before the helicopter was required by NTCL for ice reconnaissance. In the mean time, the ice in Kugmallit Bay had receded far enough to allow the "Richardson" to move out of the harbour and test methods of anchoring and stabilizing her first transponder buoy under field conditions. Transponder beacons had been set up by helicopter in anticipation of Mr. Dennett's visit so that his limited time would not be consumed by preparations. Mr. Dennett arrived July 20th and stayed with us five days to instruct Mr. Taylor and to observe the performance of the beacons in arctic conditions.

The "Richardson" started transponder sounding July 24th, using two shore beacons and one buoy. When a second buoy arrived on board the "Frank Broderick", an attempt was made to survey with two buoys, anchoring one buoy with a heavy Danforth anchor in a permanent position, fixed by sextant, and using this buoy in combination with one or two of the shore beacons to fix the second buoy. The second buoy, secured with a lighter anchor, could be shifted quickly as the survey progressed. Unfortunately, this plan never materialized; the permanent buoy was lost in a gale on August sixth.

We continued our survey with one buoy, in the mean time following ice and weather reports of the eastern part of Amundsen Gulf where a large ice field was drifting between Holman Island and Cape Young and threatened to block our passage either to Coppermine or to Holman Island. When a strong south east wind had persisted for considerable time between Cape Parry and Cape Young, it seemed more reasonable to try to squeeze past the south edge of this ice field and head for Coppermine than to fight our way to Holman Island, where the "Camsell" had to come to the aid of the "Banksland".

The "Richardson" departed from Tuktoyaktuk August 13th and completed her voyage to Coppermine in four days without much interference from either weather or ice. In Coppermine , Major Arnott of Army Survey Establishment had

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left us a chart with positions of ASE stations in the Coppermine area and with these stations as sounding marks, we could immediately start sounding in Coppermine Bay by boat and ship. While the fibreglass boat sounded the shallow waters around the river-mouth, the "Richardson" explored various inlets, passages and refuge coves in the western part of the Coronation Gulf. A tide gauge was built near the village and maintained for one week, then moved for an equal period to Expedition Cove, where a sheltered indentation near the entrance appeared to be an excellent site for a future permanent tide gauge. The only objections against this site would be its remoteness from the village and the diffraction effect of an easterly swell hitting MacKenzie Point. Various other possible sites were investigated; a separate report will follow.

Although a friendly and colourful settlement, Coppermine may well be one of the worst harbours in the Western Arctic. The village is situated at the mouth of the river and any ship with a draught of over six feet (including the "Richardson") has to anchor at least one mile west of the village, where there is no protection against frequent winds from the NE or NW quadrant. Shoals in the rivermouth continuously shift back and forth and even a shallow-draught vessel runs aground several times before reaching the village.

There is a well protected beaching area below the HBC trading post, where NTCL barges can safely discharge; a good beaching area, however, is neither a necessary nor a sufficient prerequisite of a harbour and it seems strange that Coppermine was selected by the Eskimoes and subsequently maintained by government agencies as one of the major settlements in the western arctic, when only sixty miles east of Coppermine, a most inviting harbour, Tree River, apparently has been ignored. Tree River is a natural harbour, surrounded by high hills to shelter it from any wind and accessible via two narrow deep channels, which prevent the swell from entering the bay. The river provides abundant fresh water and is a spawning ground for arctic char.

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Unfortunately, we were pressed for time when we visited Tree River and had to leave a reliable and detailed survey until a future date when perhaps Tree River may become a potential harbour.

While in the Coppermine area, the "Richardson" carried out several quick reconnaissance surveys for the benefit of NTCL shipping; lines were run into Klengenberg Bay, Austin Bay, Basil Bay and a number of refuge harbours and passages were explored between Coppermine, Tree River and Lady Franklin Point.

We had little trouble obtaining fresh water and fuel. The Coppermine river has a powerful outflow and our fresh water supply was replenished by pumping fresh water from the upper layer of the sea surface one mile west of Coppermine. This method, as we learned to our embarrassment, could only be followed in a smooth sea when there was little mixing of fresh and salt water. The NTCL ships "Expeditor" and "Banksland" supplied the "Richardson" with fuel, making a rendezvous with the "Camsell" unnecessary.

The survey of Coppermine Bay was extended to Expeditor Cove in order to provide shipping with a more protected anchorage. Extra stations were built, observed and marked, and on August 31st, sounding of Expeditor Cove was completed. A few radarscope photographs concluded the survey of Coppermine Bay and after picking up the tide gauge and valuable survey towers, the "Richardson" departed from Coppermine on September 2nd.

Proceeding slowly through the east side of Lambert Channel in surprisingly deep water, the "Richardson" entered Bernard Harbour on September 3rd. We moved out into Amundsen Gulf the next day, bucking high seas and continuous squalls, which covered the entire coastline between Bernard Harbour and Tuktoyaktuk with snow. However, there was no sign of ice. The "Richardson" arrived in Tuktoyaktuk September 7th, discharged survey equipment, loaded water and started transponder sounding in the shoal area east of Pullen Island. One shore beacon was built on Pullen Island and a second one, after a delay of two days due to the easterly swell, was landed on station HAN.

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Mr. E. Geldart, our Marine Superintendent, arrived from Victoria on September 13th, inspected the ship and stayed on board until September 16th. Transponder sounding was stopped September 15th and, after picking up the beacons, the "Richardson" returned to Tuktoyaktuk.

A two days' experiment with the transponder beacons concluded the 1965 season. This field test, mainly to observe the effect of tilt on the signal (i.e. aerial not vertical), cleared up a few questions which had come up during the season and will be covered separately.

On September 19th, the "Richardson" was laid up alongside the deactivated "Banksland" to await the 1966 season. Surveyors and crew departed September 22nd.

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CHARTS AFFECTED BY

"RICHARDSON"s 1965 SEASON.

Number	Title	Recommendation
7080	Demarcation Point to Cape Bathurst	H.C.
7081	Cape Bathurst to Cape Baring	H.C.
7082	Cape Baring to Cambridge Bay	N.E.
7604	Kujmallit Bay and Approaches	N.E.
7605	Toker Point to Cape Dalhousie	H.C.
7606	Liverpool Bay	H.C.
7607	Cape Bathurst to Booth Island	H.C.
7609	Cape Lyon to Tinney Point	H.C.
7616	Dolphin and Union Strait	N.E.
7617	Coppermine River to Lady Franlin Point	N.E.
7626	Approaches to Tuktoyaktuk	H.C.
7627	Tuktoyaktuk Harbour	H.C.
7632	Baillie Islands & Approaches	H.C.
7637	Cape Parry and Approaches	H.C.
7646	Landing Beaches on Western Arctic	N.E.
7670	Bernard Harbour to Lady Franklin	N.E.
7678	Coppermine and Approaches	N.E.

(N.E. = New Edition) (H.C. = Hand Correction)

To follow:

A list of charts affected by changes taking place on the DEW Line Sites this year.

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CORRECTIONS AND ADDITIONS

ARCTIC

in "PILOT OF CANADA", VOLUME III

Page 12 - The Radar Reflector reported fallen over during the 1964 season has been rebuilt.

Page 12 - Lines 44, 45: A large buoy with radar reflector in approximate position 69°46'15" and 132°47'30" marks the eastern side of the shoal area during the navigation season.

Page 51 - Line 18: Delete: Mail Service consists of three flights weekly to Police Point, weather permitting.

Page 56 - Line 1: Delete: Mail Service is provided by three flights each week to Police Point, weather permitting.

Page 62 - Line 45: Delete: Mail Service is provided by three flights each week via Police Point, weather permitting.

Page 70 - Line 29: The low hills east of Austin Bay provide little shelter from strong easterly winds, but the holding ground is good.

Page 116 - Line 32 : A tower, surmounted by a radar reflector is situated On Outpost Island, in position 68°22'21" N. and 110°52'20" W.

Similar towers have been built on two unnamed islands, in positions 68°12'48" N. and 110°57'00" W; and 68°31'12" N. and 110°25'30" W.

Page 128 - Line 49: Add: Fresh water may be obtained from two creeks entering the head of the bay. The head of the bay is well sheltered but holding ground is poor.

Page 129 - Line 5: Add: and in the well sheltered bay.

Line 14: Delete: an unnamed bay and substitute: Klengenberg Bay.

Line 23: Delete: no attempt should be made to pass between it and Cape Kendall.

Supplement 1964: Excellent holding ground has been found in Expeditor Cove.

Page 130 - Line 48: During bad easterly or northerly winds, larger vessels are advised to anchor in Expeditor Cove, while shallow-draught boats may find refuge behind the low alluvial islands, near the settlement.

Page 190 - Line 19: Spence Bay. A set of ranges has been established, consisting of two 30-feet towers painted white; the front range in position 69°31'5" N. and 093°32'0" W., the rear range in bearing 045° - 1400 feet from the front range.

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RECOMMENDATIONS FOR 1966

"RICHARDSON"

Since the "Richardson" will leave the Western Arctic and head back for Victoria in 1966, her survey operations will be limited in time and range. The following recommendations are based on the assumptions that the "Richardson" will leave Tuktoyaktuk for Victoria on September 1st and that an Eldorado helicopter will again be available in early July:

Continue detailed survey of Kugmallit Bay, using transponder beacons. Priority Pullen Island area.

Complete 1964 survey of shoal area near Warren Point.

Strengthen 1965 telluremeter traverse West of Pullen Island by a short traverse from "RAD" to "Snaek".

Extend 1965 telluremeter traverse from Pelly Island to link up to topographic survey net in the Yukon.

Complete the examination of the 2 fathom E.D. shoal off Key Point.

Increase sounding coverage near Herschel Island.

Survey in detail the shoal off Cape Dalhousie.

Extend 1963/1964 hydrographic traverse Warren-Stanton to link up 1964 telluremeter work at Baillie Islands.

Survey Baillie Islands Channel.

Extend sounding of beach area Bar 4 (request NTCL).

Survey entrance of Gillet Bay (Cape Parry).

Survey Queen's Bay and approaches to King's Bay (Holman Island).

Relevel Benchmark #2 in Tuktoyaktuk village (this benchmark has occasionally been mistaken for an anchor post in previous years.)

Survey new DPW wharf at Tuktoyaktuk.

Investigate possibility of a better site for a permanent tide gauge in Tuktoyaktuk. The present site, the NTCL wharf, is in very poor shape due to ice action and cannot be relied upon much longer. This last item should have high priority, particularly since NTCL may build a new wharf in another location and may be persuaded to include a tide gauge house in the design.

CONCLUSION

The 1965 season was marked by virtually uninterrupted good weather and although ice dominated our survey schedule, it never caused serious delay.

The ice lingered much longer in Kugmallit Bay than expected but, while shipping, including the "Richardson", had to wait for a break-up, the Eldorado helicopter remained available for our coast survey. Supported by substantial funds to charter this helicopter, we were able to make good progress in fine weather and complete our projects before break-up.

Heavy ice concentrations in Amundsen Gulf almost frustrated our voyage to Coppermine. The coastal waters between Cape Young and Cape Lyon are deep; there would be no grounded ice floes to hold back a large ice field and leave a protected channel for small craft as the "Richardson" (as was the case in 1962 when she successfully negotiated the shallow waters along part of the Alaskan Coast). However, again we were very fortunate to find our passage between Cape Lyon and Cape Young cleared by continuous, strong south east winds only two days after it had been reported a congested area.

The foregoing remarks indicate how much the success of a summer's work in the Arctic depends on the weather's caprices; and how the odds for success increase with a more flexible survey program, a program which provides for alternatives if ice and weather prevent a ship from entering a certain area (Sachs Harbour, perhaps even Holman Island would have been alternatives had the ice stopped us at Cape Lyon); or from leaving an area (the helicopter traverses were the alternate projects when Tuktoyaktuk harbour was blocked last July).

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SUGGESTIONS

It will take a number of years before the Hydrographic Service in the Western Arctic has established a survey pattern which is compatible with the many peculiarities of that region. In the mean time, however, we should attempt to provide shipping with any information we can possibly gather in the short seasons available to us; we should avoid a time-consuming detailed survey of fairly deep and safe waters when entire areas frequented by shipping lack even a sketchy reconnaissance survey and it seems only reasonable to propose that the Hydrographic Service give high priority to the immediate needs of NTCL shipping anywhere between Demarcation Point and Spence Bay. NTCL ships are the only merchant ships using our hydrographic charts in the Western Arctic at the present time; they often have to operate in unknown waters under very difficult conditions.

To carry out her vast program in the Western Arctic, the Hydrographic Service operates at present:

1) The "Richardson", a sixty tons vessel, with seven men crew, including two surveyors;

2) A party of two hydrographers on board the DOT light ice breaker "Camsell", supported by her helicopter and the hydrographic launch "Quail".

The "Richardson" has an active season of at most 2 1/2 months (1 July - 15 September), winters in Tuktoyaktuk and has to leave the Arctic every four years for a refit in Victoria. For this refit, she must depart from Tuktoyaktuk not later than the first of September in order to pass Point Barrow before the ice moves moves in again; and will not return to Tuktoyaktuk before the second week of August of the following year, again because of Point Barrow. This means that the "Richardson" loses 40% of her precious survey time in two out of four years only because Vancouver or Victoria have better dock and repair facilities than Tuktoyaktuk.

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Would it not be more practical to approach NTCL with a request to accommodate the "Richardson" in the floating drydock in Tuktoyaktuk for a quadrennial refit and inspection than to send her twice through the Bering Strait? It may be argued that the "Richardson" will still lose much survey time because the dock is activated during the summer months, i.e. during the "Richardson"s survey season. She might enter the dock immediately before the dock personnel leaves, in the beginning of September, stay in dock all winter and start her refit in May, long before break-up; or her refit might even begin in September when some heavy parts could be dismantled and shipped south by barge to be returned in the spring. Special blocks would have to be made and shipped North by barge or by "Camsell"; extra personnel and some equipment would have to be flown in. Admittedly, a refit in a remote area as Tuktoyaktuk would be a heavy burden on our engine room department, but the alternative, having this little boat struggle her way in and out of the Arctic two out of four seasons not only seems inefficient but also rather risky.

After two successful seasons ('61 and '62) for our hydrographic party O/b the "Camsell", hydrographic activities came to a virtual standstill in the next three seasons. The 1963 season did not start before the first of August due to the "Camsell"s late arrival in the Arctic. Ice conditions in 1964 were so bad that the "Camsell" spent four weeks trying to make her way past Point Barrow, was helped out by the U.S. Coastguard heavy ice breaker "Northwind", and arrived so late that the hydrographic party awaiting her in Tuktoyaktuk had to be sent back to Victoria. The "Camsell" left the Arctic in late September without any hydrographic achievement and subsequently lost the "Quail" in a storm. No hydrographic party joined the "Camsell" in 1965 because of lack of staff, but even if there had been a party, very little would have been accomplished. The "Camsell" again spent considerable time trying to break her way past Point Barrow and continued escorting ships in the Queen Maud Gulf and the Eastern Amundsen Gulf until

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late in the season.

Disregarding the occasional lucky season, we may safely assume that the "Camsell" will never be a major asset to our hydrographic operations in the Arctic. Her main duty is to assist shipping and we cannot expect her to give priority to hydrographic work. This is a bit unfortunate because the hydrographic party on the "Camsell" represents the ideal mobile unit in the Arctic: two hydrographers, a helicopter and a launch operating from a light ice breaker.

Assuming that the Western Arctic is considered important enough to extend the part-time hydrographic role of the "Camsell" to a full time operation, the building of a new ship would be inevitable. The hydrographic service could copy the "Camsell", perhaps add one or two launches and a chartroom, subtract cargo space and jumbo but would probably end up with the same draught of seventeen feet, a liability for a survey ship in the Western Arctic.

For the design of a new Arctic survey ship, I should like to submit the following suggestions:

She should winter in the Arctic. The alternative, an annual voyage along the Alaskan coast would involve a time-consuming struggle through heavy Polar ice between Icy Cape and Barter Island.

She should accommodate a chartered helicopter during the summer, to set up visual or electronic shore control, locate shoals from the air and carry out ice reconnaissance.

There should be deckspace for one or two sounding launches and an inflatable boat with 20 hp outboard motor for quick shore communications.

Her bunker capacity and storage space for provisions should be large enough to carry her through one summer and allow her to winter anywhere.

Her two protected propellers, powerful engines and reinforced bow should enable her to break through fairly heavy ice to reach her survey areas.

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She should have a very shallow draught, if possible six or seven feet! This last point may be considered impracticable, since it does not easily agree with some of the previous suggestions. However, it is a necessary condition if it is postulated that she should remain in the Arctic. Only a ship with a draught of less than 12 feet can safely enter Tuktoyaktuk Harbour and be docked for repairs and inspection. A shallow draught combined with large bunker capacity and powerful engines would require a large beam, flat bottom. It might be argued that this type of ship would not survive an arctic gale. NTCL towboats very similar to this design have been operating for several years in open water and in adverse weather; their draught of six feet allows these very manageable and powerful ships to enter any shallow bay or river mouth; emergency repairs can be carried out on the beach. The helicopter deck would be vulnerable in rough seas, but instead of a telescopic hangar, a hangar might be designed, which could fold out sideways to form a helicopter deck. The helicopter would fly south shortly after lay-up in September or October and return in the spring.

Some of the foregoing suggestions may seem somewhat radical for a survey ship but it would be very difficult to follow a conventional design agreeable with this unusual maritime region.

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PROJECT REPORT

STATISTICS

Project No: Title: WESTERN ARCTIC, CSS "RICHARDSON"

Category: Oceanographic factor: H.I.C. A.B. Ages

Total staff participating: 2

Total Personnel participating: 7

Operational Craft:- Ships: 1 Launches: 1 Minor Support Craft: 1

Helicopters: 1 Land Vehicles: nil Other: nil

Date commenced: 30 June 1965
Date completed: 17 September 1965
Total number operational days: 80
Days lost due to weather conditions: 4
Days lost, other causes: 0
Total days actual field work: 76

Triangulation Control:

Control Source: ~~C.S.C./Topo./Hydro./Original/Other~~:

Control method: ~~Triangulation~~/Traverse/~~Trilateration~~

Traverse distance: 156 miles

No. Traverse stations: 21

Total Stations occupied: 27

Total Stations monumented: 16

Total Stations recovered: 23

No. Towers built: nil

Average Tower height: nil

Astro observations: mil

Sun Azimuths: 3

Sounding:

Ship, Sq.N.miles:	150	Scale:	75,000	Interval:	1600	Fix method:	Transp.
:	5	:	25,000	:	520'	:	Sext.
Launch: :	12	:	25,000	:	520'	:	Sext.
:		:		:		:	
Multi-craft :	Nil	:		:		:	
Stretchline :		:		:		:	
Other :		:		:		:	

Total linear miles: 1928

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Sounding (Cont'd)

Total, sq. naut. miles: 167

Shoals examined, ship: Nil Launch: Nil

Shoals swept: Nil Method:

Channels swept, sq. naut. miles: Nil Method:

Bottom samples: Nil Method:

Oceanographic stations: Nil

Wharves surveyed: Nil

Shoreline method: Photography

Total shoreline, naut. miles: 8

Aerial photography; date flown: July, 1965

elevation: 600' type: bl/w

quality: good excellent/good/fair/poor/unsatisfactory

Tides - Water Levels - Currents

Gauges established, recording: nil type:

Gauges established, staff only: nil

Datum established by (method): Existing Records

Bench marks recovered: Nil

Bench marks established: Nil

Current measurement stations: Nil

Aids to Navigation

Aids established: Nil

Shore aids positioned: Nil

Floating aids positioned: Nil

Photo-identification

No. stations identified: 16 sketch/photo/airphoto/print-prick

Airphoto altitude: 600 ft.

Targets used, type: Army type signal Towers

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Special Statistics

Helicopter flying time - 44 hours
Linear Miles Reconnaissance Soundings - 1211
" " Transponder Soundings - 564
" " Sextant Soundings - 153

Work Distribution

Percentage of total work time:

Control Observations	26 %
Sounding, basic	50 %
Shoal examination, sweeps, etc.	- %
Wharf surveys, stretchlining;	- %
Tidal/Water Level work:	- %
Sailing directions, place names:	1 %
Data processing, sounding, computations, etc.	8 %
Evaluation Transponder Beacons	9 %
Investigation site tide gauge	6 %
	%
	100%

Field Sheets to be submitted: 2

Special data to be submitted: Report on tide gauge site Coppermine
Report on evaluation transponder beacons

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PROJECT REPORT

PROJECT SUBMISSION RECORD

PROJECT NO: TITLE: WESTERN ARCTIC

ESTABLISHMENT: CSS "RICHARDSON"

PERIOD OF OPERATION: 30 June '65 - 17 Sept. '65.

APPENDIX	SUBMITTED WITH REPORTS	TO BE SUBMITTED	NO SUBMISSION REQUIRED	DATE RECEIVED	INITIALS	REMARKS
Statistics	X					
Tidal	X					
Currents			X			
Sailing Directions	X					
Illustration	X					
Geodesy		X				
Place Names			X			
Photo-Ident.		X				
F.S. WA 10037		X				
F.S. WA 10042		X				
Chart Chronaflex F.S. Nos. 7604, 7605, 7606, 7607, 7637, 7609, 7616, 7617, F.S. 7626, 7627, 7632, 7637, 7645, 7670, 7678.						

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SPECIAL REPORT ON TRANSPONDER BEACONS.

A detailed report on the use of transponder beacons in hydrographic surveying was submitted by Mr. Thomas D.W. McCulloch in 1964 and the following report should be considered as a supplement to his report.

One of the "Richardson"s commitments for 1965 was the further evaluation of the transponder beacons, which had been used in the Western Arctic for the first time in the previous year with good results. However, a number of questions remained unanswered at the end of the 1964 season and in order to assist us with his expert advice, Mr. Dennett, General Manager of Decca (Canada) Ltd. arrived July 20th, four days before the "Richardson" left Tuktoyaktuk to start transponder sounding in Kugmallit Bay. Mr. Dennett instructed our electronics technician, Mr. Taylor, in tuning the beacons and also had an opportunity to observe the performance of his beacons in the Arctic.

Shortly before the "Richardson" started sounding, a hydrographic buoy was equipped with a transponder beacon and a satisfactory way was found to anchor this buoy securely and recover it quickly without overloading the "Richardson"s light tackle. This buoy, the "Dizzy Duck", became an invaluable part of our survey. Where the range of one of the shore beacons fell short of an area to be sounded, the buoy was dropped, its position fixed by transponder distances and sextant angles (if possible) and a circular area of approximately five miles radius could be added to the existing sounding coverage. The survey radius of five miles was governed by the minimum angle of intersection between position circles rather than by the range of the buoy's signal (which usually exceeded five miles). A second buoy arrived in the beginning of August and was immediately equipped with a transponder beacon to extend the survey by simultaneous use of two buoys and two shore beacons. Unfortunately, this second buoy was lost in a gale during her first try out.

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On the advice of Mr. Dennett, the use of Radar Reflector towers as bases for transponder beacons was avoided, particularly because in 1964 these towers seemed to be weak links in our survey pattern. Instead, we tried a design of a 20 foot aluminium telescopic mast supporting a metal box to hold the beacon. The mast, held in position by nylon guys, was easy to assemble and quite strong.

As in 1964, 12-volt batteries supplied power to the beacons. One fully charged battery keeps a beacon operating exactly one week. It is remarkable that the beacon continues to operate until the very "last drop" of the battery; the signal keeps coming in clearly until it suddenly (without first becoming weaker) disappears. The battery then is absolutely dead.

During Mr. Dennett's visit, the "Richardson" carried out a few test runs on Kugmallit Bay to observe the performance of three beacons, placed on stations "Ice", "Lif" and "Rad". The beacon at "Rad" (drums) was held out to approximately 15 miles (the same distance as in 1964); the signal from "Ice" (telescopic mast on Toker Point), a new beacon, remained very strong as far as 21 miles and "Lif" (telescopic mast) faded out at about ten miles, but, at a different bearing, came back strongly at 18 miles. "Rad" also came back at a different bearing (SE) beyond the visual range, was still visible at 22 miles. The unexpected distances beyond optical range could quite well be explained by the phenomena of ducting and refraction, but we were still unable to explain why the signals at times faded out at distances very much smaller than the visual ranges. It was at times a frustrating experience to lose "Lif"s signal while we could still see the station through our binoculars! It was purely by accident that the cause of this mysterious fading out of the signal became clear.

After the buoy had been dropped off Toker Point one day, we observed an unusually weak signal, which faded out completely at a distance of three miles, despite the fact that the sea was smooth and the weather clear. We returned to the buoy, found connections and batteries o.k. but noticed that some ballast had

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shifted and that the buoy had a list. The ballast was straightened out and, much to our surprise, the beacon's range immediately increased back to normal. Obviously, the aerial's angle with the vertical was an important factor. It might also explain why station "Rad" (built on a fairly horizontal platform) had a normal range in 1964, while station "Warren" (with its beacon leaning forward on a wooden beam protruding from the station's lattice) never lived up to its range. And it might also explain why we lost the signal of station "Lit" much sooner in bearing SE than in bearing NE; the telescopic mast was leaning forward slightly in a NW direction.

At the end of the season, we carried out a field experiment to test the foregoing observations under controlled conditions: All three beacons were moved to a little hill five miles inland from the NTGL wharf. The "Richardson" was shifted to a berth where no obstructions would affect the signals. The three beacons were successively put on top of a telescopic mast and while this mast was slowly rocked forward and backward, the signal on the "Richardson"s radar screen was closely watched; the field party, of course, kept in touch with the "Richardson" by radio telephone all through the operation. When the mast had an inclination of five degrees in the plane of the line of sight, the signal disappeared. However, tilting the mast in a plane perpendicular to the line of sight had no effect on the signal strength. It was thus proven conclusively that, for best performance, the aerials have to be perfectly vertical. A small circular level had been glued to the beacon for this purpose but we had been unaware of the importance of this bubble, particularly after two of the bubbles had come off without any effort. Moreover, we did not think that the aerial's tilt had such an effect on the signal, since the beacon performed quite well on the buoy, which of course was never on an even keel. Again, the buoy normally was never off level for a prolonged period either and when it was, the signal at once disappeared beyond a three miles' range.

The test also provided us with a unique opportunity to check the per-

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formance of all three beacons under exactly the same conditions. We discovered that the three beacons did not perform equally well; in fact the signal of one of the beacons purchased last year hardly appeared on the screen at all while the signal of the recently purchased beacon was extremely strong. We had been aware of this difference but thought that it was due to their relative location, not to their individual performance. This matter has been reported to Decca Navigation in Toronto and all three beacons have been sent to Toronto for a thorough check-up.

The corrections which we had applied to our transponder readings during the season were also checked by tellurometer distances and were confirmed to be -0.16 n.m. for all three beacons.

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CONCLUSION

The range of a transponder beacon can be improved considerably by carefully levelling the beacon.

Rain and fog affect the signal badly. There is no evidence that ice floes weaken the signal's propagation.

The power supply by acid batteries is satisfactory. There is no need for any type of generator, which probably would outlast a battery but would most likely be more expensive, much heavier and would have more vulnerable parts. The beacons are generally built near the shore, so that batteries can easily be changed by boat once per week.

The accuracy of the transponder method should be improved by the installation of an Alpine precision ranging system or a similar device to provide more detail in reading distances. Without such a device, a set of distances read on a radar screen cannot be expected to provide as good a fix as a set of sextant angles.

The transponder beacons are definitely an asset to our Arctic work, particularly where a quick survey is required in poor visibility; however, they are no major breakthrough in hydrographic surveying. They do not carry our sounding area beyond the optical range.

Finally, as far as the shore beacons are concerned, is not a great deal of energy wasted by radiation in all directions? Would it not be possible to concentrate the radiated energy in a sector covering our survey area, thus obtaining a stronger signal?

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SPECIAL REPORT ON C.C.G.S. "CAMSELL"

The "Camsell" operated again without a hydrographic team in the 1965 field season, due to lack of staff. The new launch "Quail" remained in Victoria.

The "Camsell" obtained tracksoundings in some areas, affecting the following charts:

7081, 7604, 7617, 7618, 7678, 7682, 7696,

7697, 7705, 7706, 7733, 7735.

Location of a future permanent tide gauge at Coppermine.

On August 17th, the "Richardson" arrived at Coppermine to survey the approaches and to investigate the possibility of establishing a permanent tide gauge at Coppermine.

Since the approximity to the village would be desirable, we initially chose a site near the mouth of the river (appendix VI). An Ottboro tide gauge was established on a rocky ledge, sloping down to a depth of three feet at a distance of five feet from the low water line. Unfortunately, the graph showed a very small range, probably affected by the river flow. Other sites along the shore were too shallow to be considered and would be badly exposed to ice during break-up. The tide gauge was maintained for one week, while several other possible locations were examined between Expeditor Cove and the mouth of Coppermine River. Finally, a good site was found at the entrance of Expeditor Cove and the Ottboro was moved from Coppermine to Exp editor Cove.

The site in Expeditor Cove (appendices V and VIII) is a small cove near Mackenzie Point, well protected against wind and swell. The steep shore rises about 40 feet above high water. The sea bottom slopes down to a depth of between six and twenty feet immediately below the rocky ledge.

Per se, the location appears very good for a permanent tide gauge. However, maintenance would be a major problem. In order to keep the stilling well ice-free, we would need a small generator to supply power to a heating coil. The generator and tide gauge would have to be looked after by an attendant living in Coppermine. This attendant would have to travel a distance of four miles to Expeditor Cove by canoe in the summer and by dog team in the winter. I discussed this matter with Mr. A. R. Pedersen, the Northern Administrator in Coppermine. Mr. Pedersen assured me that he would

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be able to locate a reliable resident to take on the duties of an attendant. He suggested a monthly salary of $100.00 - on a base of three inspection trips per week.

Conclusion

The immediate vicinity of Coppermine cannot be recommended as a site for a permanent tide gauge, due to the following factors:

i) Tidal range affected by river flow.

ii) Damage by ice during break-up.

iii) Very shallow beach.

However, there are several excellent sites for a tide gauge within reasonable distance from Coppermine and although there are maintenance problems, it seems quite possible to establish a permanent tide gauge in the Coppermine area.

Illustrations and Sketches

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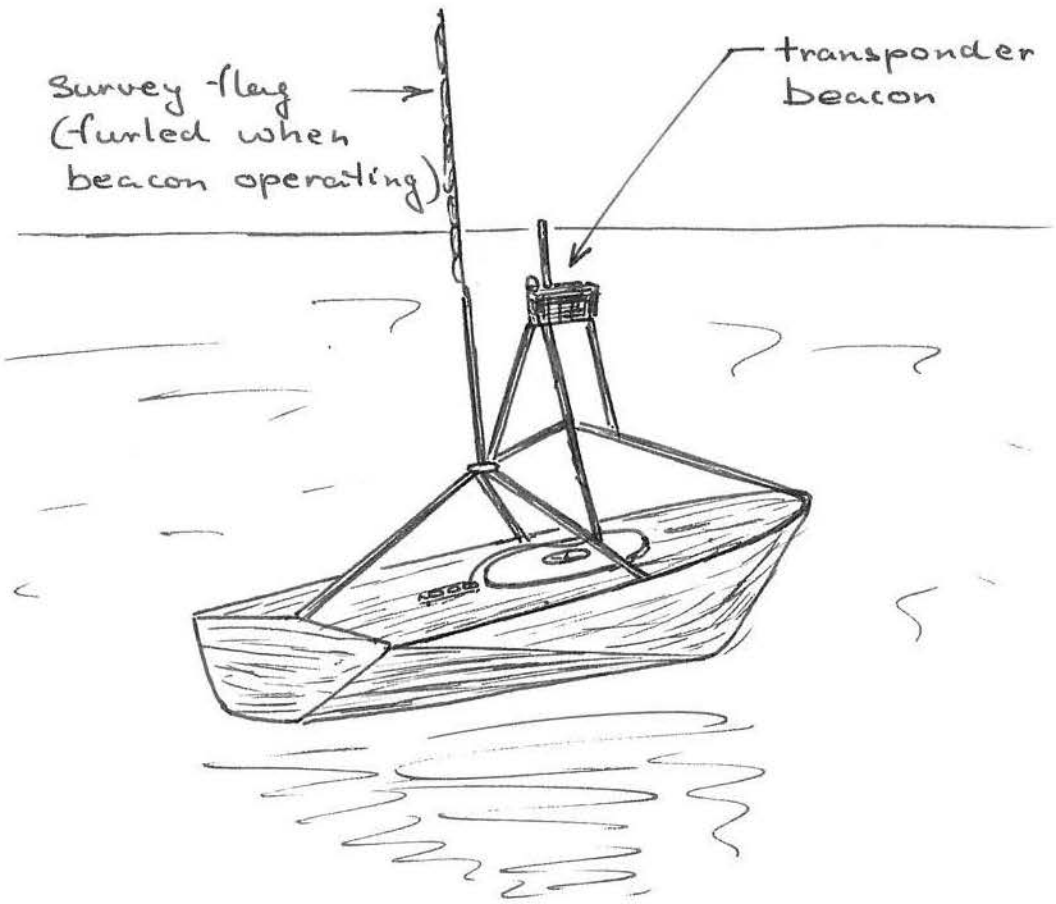


SKETCH OF TRANSPONDER BUOY, SUMMER '65.

The buoy was secured to a Danforth anchor with a 3/4 inch nylon line. To help recover the anchor, its location was indicated by a small anchor buoy and a short line. The flag could be unfurled to make the buoy a target for sextant sounding. A 12-volts battery and 400 lbs ballast were stored inside the buoy.

June 1965

"Richardson" in ice alongside "Banksland", Tuktoyaktuk

Cutting a hole in seven feet of ice for our water supply

Provisioning by bombardier...

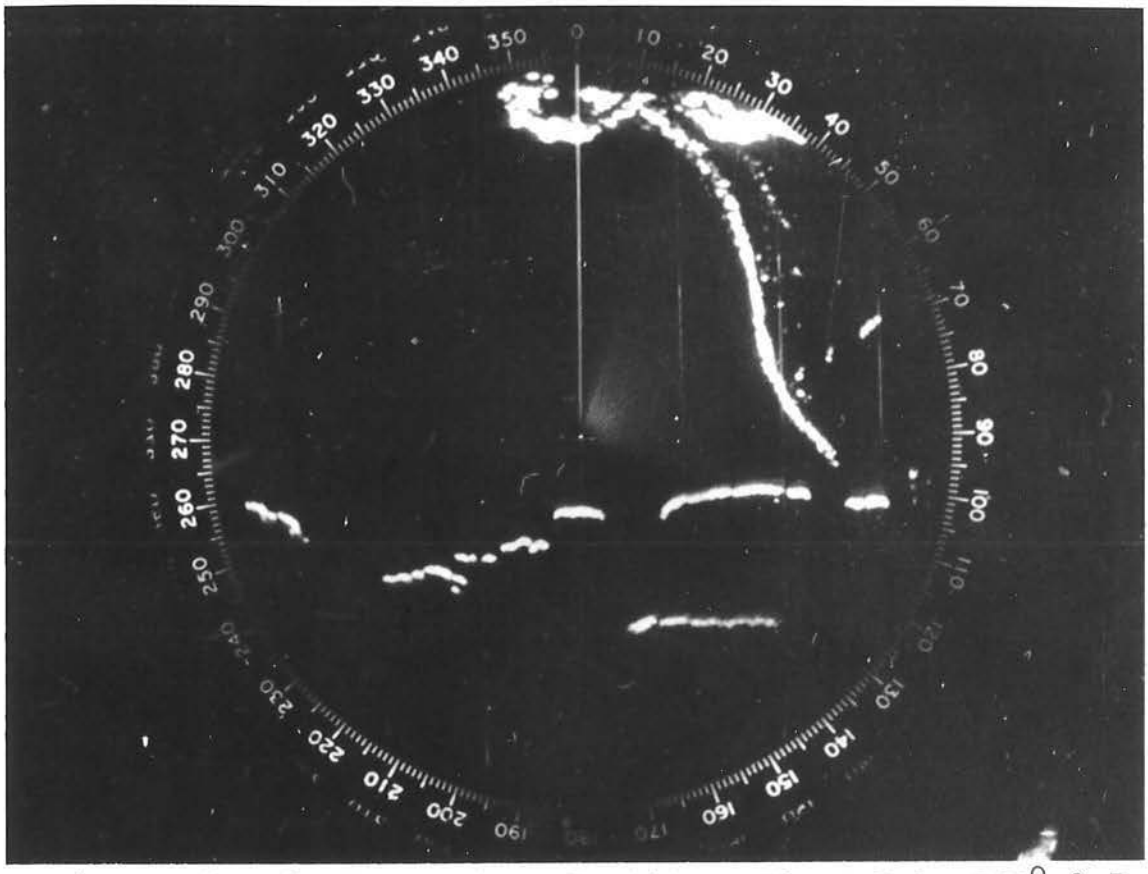
.... until the ice became too thin

Break-up: June 21st
Floating dock in background

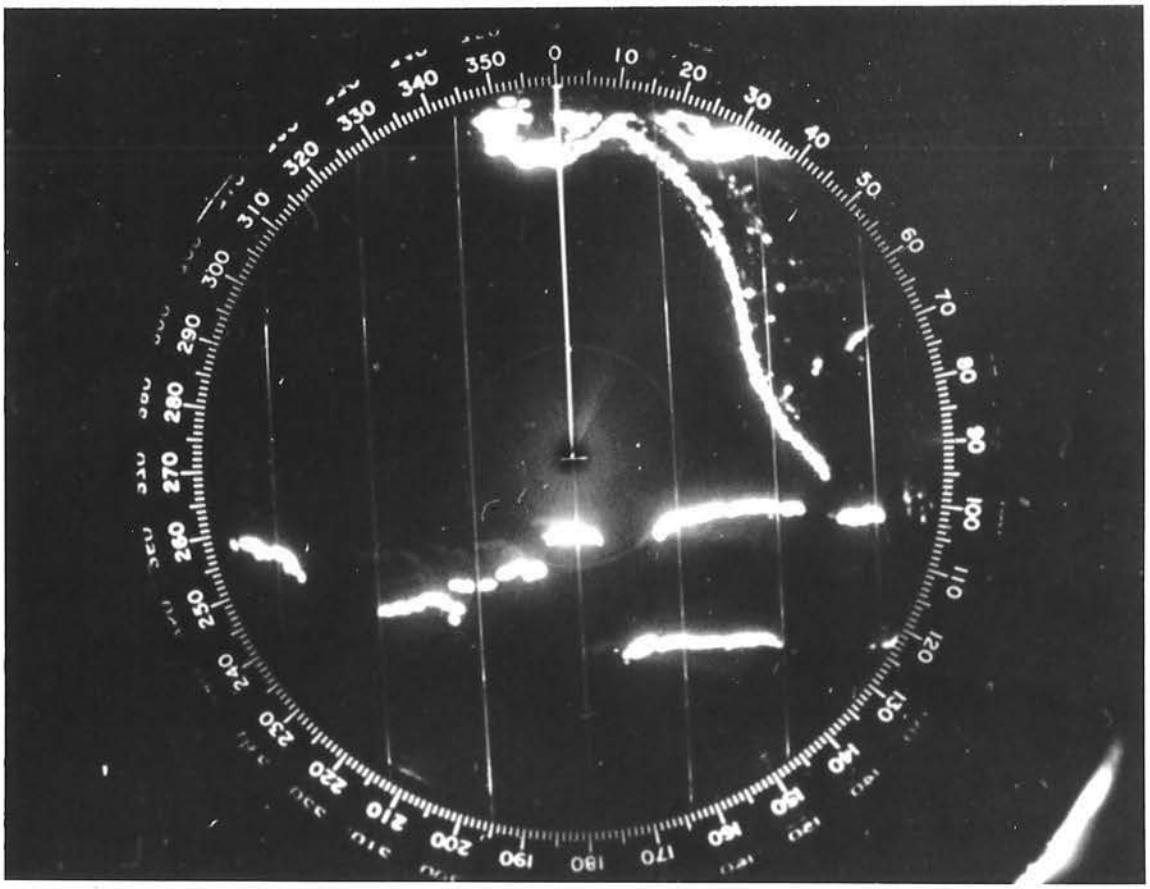
Tuktoyaktuk

NTCL wharf with "Richardson"

RADARSCOPE PHOTOGRAPH



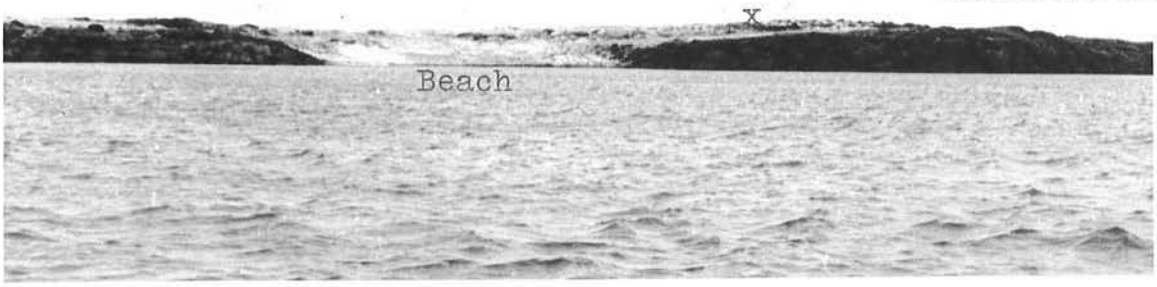
Approaches to Coppermine; Position: Blaze Isl. 325°-0.5 n.m. Heading 145°; range 3 miles



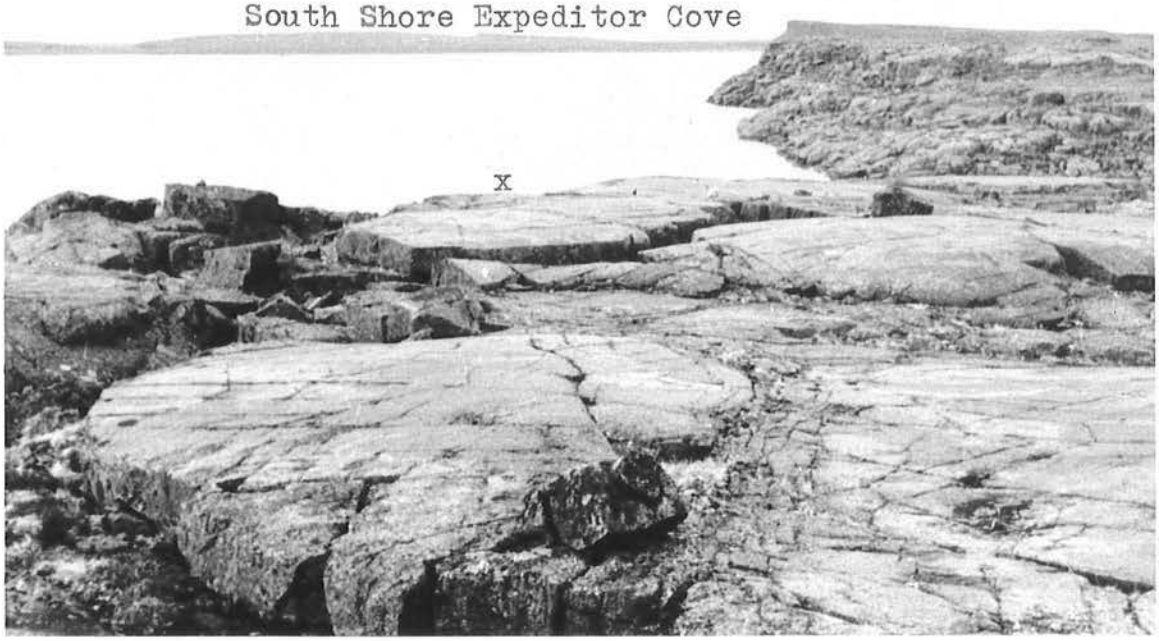
Appendix V

Possible Location of Permanent Tide Gauge, Coppermine

Mackenzie Pt



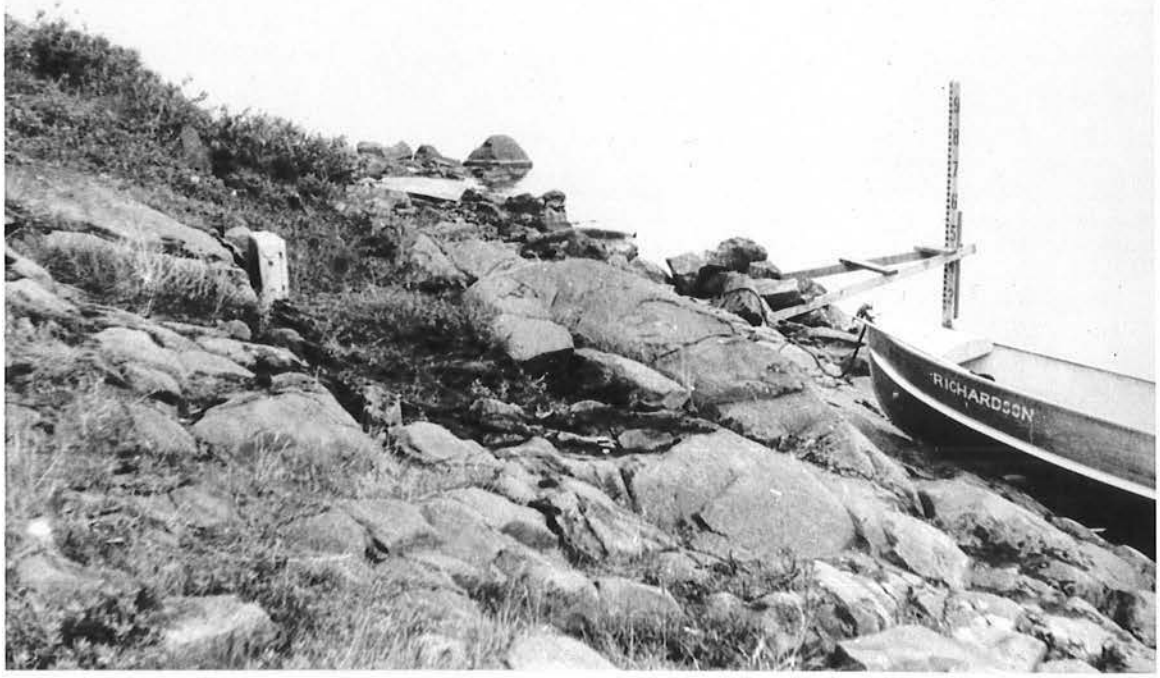
South Shore Expeditor Cove



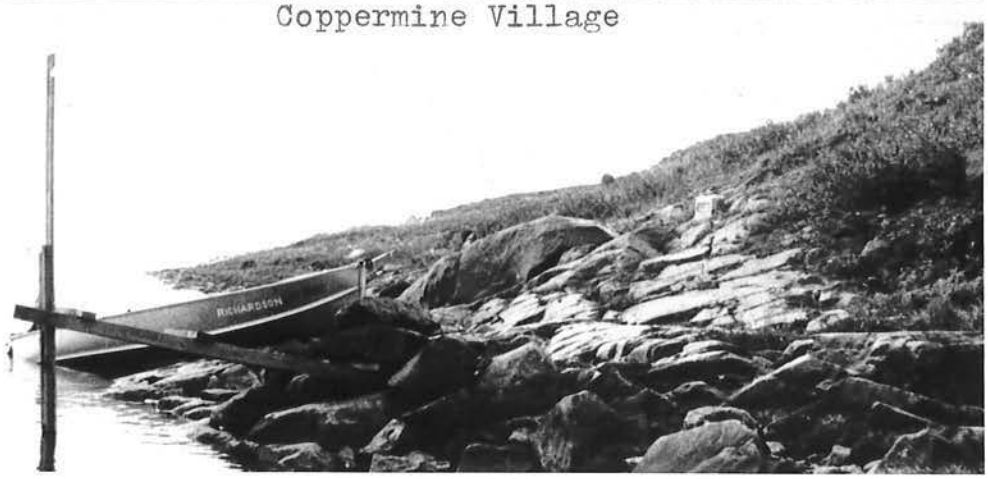
All three photographs apply to the site at Expeditor Cove

Possible Location Permanent Tide Gauge Coppermine

Expeditor Cove



Coppermine Village



Coppermine Village

Appendix VII

Survey of Kugmallit Bay and vicinity.

20'

10'

0'

"PULLEN"

"HOOPER"

"GROUW"

"HAN"

"RAD"

Pelly Island

"PELLY"

"RAE"

"BALK"

"Sneek"

Carry Island

"WHALE"

Kendall Island

RICHARDS ISLAND

KUGMALLIT

"ICE"

Baker Pt

"CHIC"

"NORTH"

"HENA" BAY

"HEN"

TURIQ OKTUK

"HILL"

"Crater"

"WAR"

"LIF"

"OLE"

"BOLS"

Nuvorak Pt

70°

"Brigitte"

"claude"

"Astrid"

"Mary"

LAKES

65A40

65A41

"Alice"

"Saskia"

ESKIMO

131°

69°

LEGEND

Sounded Area

Transponder Marks

Traverse

Sunshot

Appendix VIII

Survey of Coopermine

1|0'

115°00'

54'

53'

52'

51'

67°50'

49'

48'

NICHOLS ISLANDS

TINA

Mackenzie Pt.

ROSA

MARIA

Expeditor Cove

BLAZE

Blaze Island

SONJA

Gurling Pt.

SNOW

EDAM

Approximate bank line

FLAG

Shallow

Coppermine

COP

Natural Scale 1 : 50,000

LEGEND

- Sounded Area
- Sounding Mark
- Tide Gauge

2|0'

1|5'

1|0'

0|5'

115°00

Appendix IX

Sketch of the "Richardson"s voyage to Coppermine

ISLAND

Cape Kellett

Sachs Harbour

Thesiger Bay

Cape Lambton

Nelson Head

De Salis Bay

Wynniatt Bay

2000

Greely Haven

Berkeley Pt.

Fort Collinson

Cape Wollaston

VICTORIA ISLAND

Holman Island

Prince Albert Sound

AMUNDSEN GULF

Martin Pt

Demarcation Pt

Herschel Island

Mackenzie Bay

Whale Mtn.
6566

4902

Tuktoyaktuk

Stanton

Cape Bathurst

Franklin Bay

Cape Parry

Paulatuk

C. Lyon

Dolphin and Union Strait

Cape Baring

Mt. Bumpus
1700

Simpson Bay

Bernard Harbour

Cape Krusenstern

Coppermine

Coronation Gulf

Dease Strait

Cambridge Bay

Cape Barrow

Banks Pen

Bathurst Inlet

Perry River

Mackenzie River

Fort Good Hope

Great Bear Lake

Yukon River

Dawson

2450

6920

7100

4733

280 290 300 310 320 330