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NATIONAL RESEARCH COUNCIL OF CANADA  
RADIO AND ELECTRICAL ENGINEERING DIVISION



ANALYZED

THE BELCHER ISLANDS EXPEDITION, 1967

M. D. WATSON AND D. A. SWORD

ON LOAN  
from  
National Research Council  
Radio & E.E. Division  
Document Control Section

OTTAWA

APRIL 1968

NRC #22168

ABSTRACT

ANALYZED

A temporary photometer station was established in the summer of 1967 on the Belcher Islands, Hudson Bay, to study auroral phenomena at a point as near as possible to the geomagnetic conjugate of Byrd, Antarctica. The practical details of planning, establishing, and operating the station, difficulties encountered and solutions found are described.

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## THE BELCHER ISLANDS EXPEDITION, 1967

- M.D. Watson and D.A. Sword -

### INTRODUCTION

The Upper Atmosphere Research Section of this Division has operated all-sky cameras and auroral photometers at Great Whale River (Poste-de-la-Baleine), Quebec, and at Byrd, Antarctica, since early in 1966. These two stations are usually thought of as being approximately geomagnetically conjugate, that is, as being located at opposite ends of the same line of constant geomagnetic potential (line of force). In fact, they are not exactly conjugate: the point in the northern hemisphere which is conjugate to Byrd is located somewhere between Great Whale and the Belcher Islands, according to various calculated models of the geomagnetic field which have been adjusted to fit the observed results of magnetic surveys. The map (Fig. 1) shows one of these estimated locations.

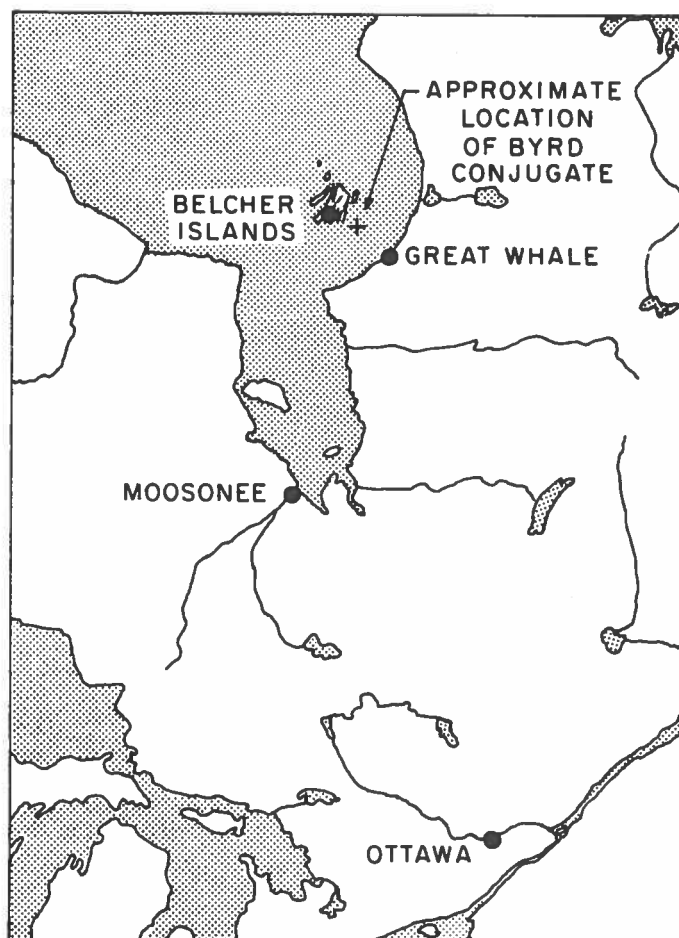


Fig. 1 Map showing approximate mean location of Byrd's northern conjugate point

There is experimental evidence that the geographic position of Byrd's northern conjugate point undergoes a marked diurnal motion in an east-west direction, being located west of the "normal" position during the local morning and to the east after local noon (Walker 1967). Since the aurora is known to be a geomagnetically conjugate phenomenon, it is probable that this diurnal motion of Byrd's northern conjugate could be detected from auroral observations, using a single station at Byrd and several stations grouped around Great Whale, a network similar to that of Walker's (1967) magnetometer experiment. The major practical hindrance to the establishment of such a network in the north is that very few settlements exist at present in the area, whereas during the period of Walker's observations (October 1963) there were a number of now defunct Mid-Canada line radar stations conveniently located.

As a first attempt at operating such a grid of auroral observatories, a single station was established at an Eskimo village at the south end of Flaherty Island, one of the large islands forming the Belcher Islands group. This location is near and slightly southwest of the Byrd conjugate (Fig. 1). The instrumentation consisted of a single-channel auroral photometer sensitive to 5577-Å radiation and pointed to the zenith, with the same circular field of view ( $8.6^\circ$  diameter) as the photometers at Great Whale and Byrd.

This report is a record of the practical details that were necessary for the planning, installation, and operation of the South Belcher station. The problems encountered were new ones to most of the personnel involved, and an appreciable amount of time was spent in trying to obtain usable information from other agencies. Hence, it is felt that a permanent record of our experiences may be of some value for any similar work in the future. Scientific results obtained on the expedition are not described in this report - they will be published later.

The two authors went to Flaherty Island to establish the camp and install the photometer equipment. Watson returned to Ottawa after one week, leaving Sword in charge of the station. Approximately two months later, Sword closed the station and returned to Ottawa with the equipment.

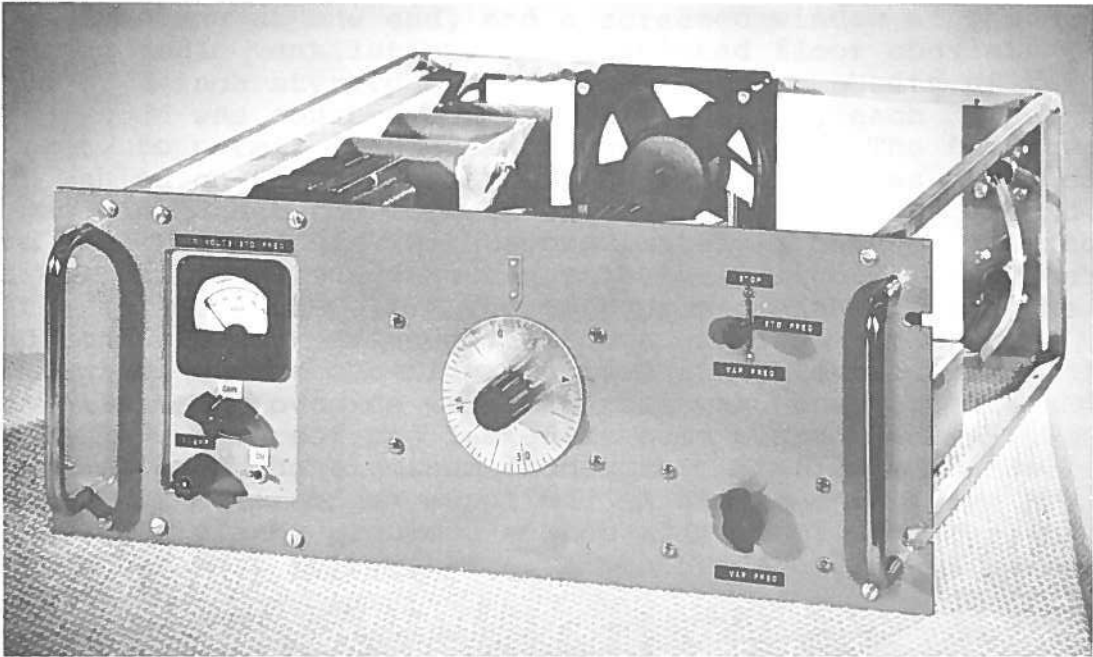
#### DESCRIPTION OF EQUIPMENT

##### Auroral Photometer System

The photometer system was essentially the same as the Model B Conjugate-Point Auroral Photometer described in the NRC REED document ERB-775 (Watson 1967). Reference should



be made to that report for details of the equipment. The photometer differed from the system shown as a block diagram in Fig. 1 of ERB-775 in that no storage battery was provided for standby timer power in case of a power outage, and in that the 60-Hz supply and timer were incorporated into a single chassis. The timer was a simpler and less versatile unit than that described in ERB-775. A photograph is shown in Fig. 2.



*Fig. 2 Front view of timer and 110 V 60 Hz standard power source for recorder chart drive*

Two radio receivers were taken along: a fixed-frequency receiver tuned to 10 MHz (WWV) and a communications receiver. The fixed-frequency receiver output was coupled to a small loudspeaker through an audio amplifier, which was found to overload the low-voltage power supply in the photometer system. For this reason, and also because of the variability in receiving conditions at 10 MHz, the communications receiver was used almost exclusively for obtaining time signals. It was necessary to connect a separate ground wire between the receiver and the photometer system ground to avoid shocks from atmospheric static electricity induced on the antenna.

#### Housekeeping Gear

A surprisingly large amount of furniture, appliances, utensils, and "odds and ends" in general, was found necessary to support two men for one week, and then one man for the



subsequent seven weeks. Several major items are described below, and a complete listing of all housekeeping items is included as Appendix A.

No housing was available on site, so accommodation was provided by NRC in the form of a 10 × 12 foot tent, with double walls, supported by a demountable aluminum pipe frame. Two men were able to erect the tent completely in half an hour (with some prior practice). A canvas door and asbestos stovepipe ring at one end, and a screened window at the other, provided ample ventilation. An insulated floor consisting of slabs of 2-inch styrofoam sandwiched between sheets of ¼-inch fir plywood was constructed in four sections, each 3 feet by 10 feet, to permit loading into the aircraft. The floor was left behind on the island after the expedition was finished. It was found that the corners on the floor sections should have been rounded off (with approximately a one- or two-inch radius), to avoid snagging the relatively lightweight material of the inside tent wall. The tent proved stable under the wind conditions experienced, without external guying, but with rocks piled on the sod-flap provided at the outside base of the walls. The outside wall material was, however, not sufficiently waterproof and leaked at some places where it was stretched over the aluminum framework. Similarly the door was not weatherproof as supplied. A simple door-frame of 1 × 10-inch planks provided enough additional wind resistance to keep out most rainy gusts. A picture of the tent is shown in Plate I.

A refrigerator with a capacity of 2 cubic feet was supplied, of the type normally sold for installation in travel trailers. The unit could be operated either from 110-V electric power or from a propane supply. A 20-lb propane tank located outside the tent was connected to the refrigerator for use in case of prolonged power failures but no such problem occurred. The refrigerator gave no trouble and its capacity was large enough to serve one man's needs.

Cooking was done mainly on an electric hotplate whose two calrod elements were rated at 500 W and 1000 W. In addition, a two-burner camp stove was taken for use as an emergency cooking and heating facility. The stove was of the type which uses methyl alcohol to start and pressurized kerosene (coal oil) for continuous burning. When started according to the manufacturer's directions, the stove burned with a clean hot flame with no odour or smoke, as advertised. The alcohol can supplied was poorly designed and spilled badly when used. A plastic wash-bottle was satisfactory. The kerosene-burning stove was chosen rather than a naphtha-fueled type because of the easy availability of kerosene, even in out-of-the-way places. (As it turned out, both kerosene and

naphtha were available at South Camp.) A folding camp oven was used for baking bread, cakes, and biscuits, on top of the camp stove. The electric hot plate did not supply enough heat to operate the oven. A sheet metal adapter was made to support the oven over the camp stove burner.

The tent was heated electrically, with the assistance of the camp stove on very cold days. Initially, a 750-W automobile-type heater was used, but this proved totally inadequate owing to its low power rating and small fan area. About three weeks after the start of the expedition a thermostatically-controlled 1500-W cottage heater was flown in. This unit was able to maintain the tent at a livable temperature throughout the remainder of the period.

It should be noted that the electrical service to the tent was supplied from an existing diesel-electric generator through 150 feet of 2-conductor 12-gauge "cablet" cable. The service was protected at the source by a 20-A circuit breaker. The heater, hotplate, and an electric kettle each drew 15 A when turned on, so the 20-A breaker was replaced with one rated at 30 A, the largest rating which would fit the service box. Hence, the cooking of meals sometimes presented an interesting problem in programming appliances.

Sleeping accommodation consisted of two standard sleeping bags filled with 4 lb of Terylene. These provided adequate warmth on the coldest nights experienced but would probably not have been satisfactory had temperatures dropped any lower. Two folding wood and canvas camp cots were obtained on loan from the Department of Energy, Mines and Resources.

Unused food was stored temporarily in plastic containers. The covers on these containers form a seal which is air- and water-tight, and completely prevented any possible spoilage by bacteria, insects, or other small animals. While expensive, the containers are nearly unbreakable under normal use, and we highly recommend them for this kind of service.

A photograph of the interior of the tent (single person occupancy) is shown in Fig. 3 and a sketch of the furniture layout is shown in Fig. 4.

Most of the "furniture" was made from packing crates which had to be re-used, and thus could not be modified to any great extent. A little more prior planning would have resulted in a considerable increase in convenience.



*Fig. 3 Interior view of tent, showing sleeping bag on cot at left and larder-cum-folding-table at centre. Note freshly-baked loaf of bread on rack at right side of table*

### Menu

The personnel involved in organizing the expedition had no experience in planning food supplies for extended periods. Advice was solicited from several other agencies, but the sample menus that were forthcoming seemed somewhat over-generous and unimaginative. Consequently, the authors had to make their own attempt at victualing; the resulting food list is given in Appendix B.

The food supplies were packed in 12 x 12 x 18-inch cardboard cartons, with approximately one week's provisions to a box. Foods which were not in cans were sealed in polyethylene bags and then wrapped in heavy paper. The cheese supply was not hermetically sealed, and spoiled during shipment. There were 13 cartons to supply a total of 11 man-weeks (allowing for a possible delay in departure from the Belchers, and approximately one extra week on emergency rations). Between 9 and 10 cartons were actually consumed, indicating a slight over-estimation of the food requirements. The surplus food was distributed among the local residents just before departure. (It should be noted that Sword is subject to a mild allergic reaction to eggs and some starchy foods. The menu listed in

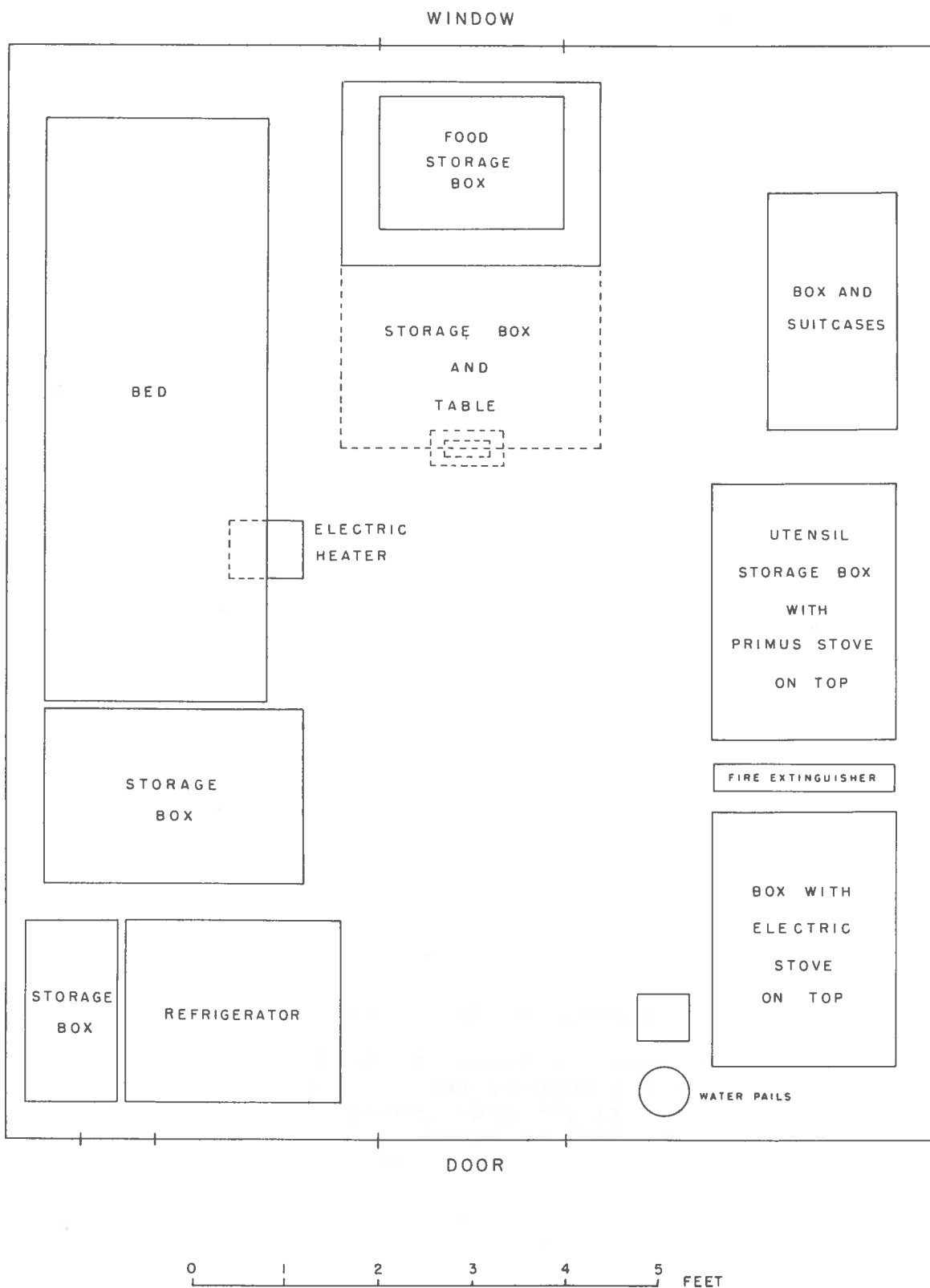


Fig. 4 Floor plan of tent interior, as arranged for single occupancy

Appendix B therefore contains relatively small quantities of such foods, and any subsequent users could perhaps increase the amounts to suit their own tastes.)

It was planned to supplement the canned and dried foods by fresh meat, vegetables, and fruit flown in from Moosonee. Arrangements were made for Mr. S. Cameron to buy such supplies in Moosonee and to send them on any aircraft that happened to be flying to the Belchers. Unfortunately, no such Moosonee-Belcher flights took place. On the other hand, L.A. Petch and V.F. Cyr of the National Research Council arranged to send several pounds of frozen meat to the Belchers aboard a flight from Great Whale. The aircraft was, however, detained a week, during which time Mr. A. White, of the Department of Indian Affairs and Northern Development (DIAND), took charge of the shipment. The delayed (but still frozen) meat finally arrived on the Belchers, and was greatly appreciated.

An attempt about the first of August to have some fresh supplies sent from Great Whale on the Department of Indian Affairs boat, M.V. Siku, failed because authorization to buy food at Great Whale did not come through until after the vessel had left.

On a few occasions the visitors at the nearby fishing camp gave Sword some surplus fresh fruit and/or vegetables. This was a welcome addition to the menu and was greatly appreciated.

A nearby lake and river provided an extra source of protein in the form of freshly-caught arctic char. Fishing licenses for the Belcher Islands (N.W.T.) were obtained from the RCMP officer at Moose Factory (fee \$2.00).

## LOGISTICS

### Transportation - Ottawa to Belcher Islands

The total weight of equipment and supplies was about 1½ tons. For this reason it was thought preferable to charter an aircraft directly rather than try to fit in with the scheduled flights from Moosonee to Great Whale. A Canso aircraft was hired for the morning of July 26.

Equipment for the expedition was shipped from Ottawa to Moosonee by rail express. The shipment left Ottawa on July 7 and had arrived at Moosonee by July 21 (the probable transit time had been estimated by the express company as 7-10 days).

Watson and Sword left Ottawa the evening of July 24 by rail, changing trains at North Bay and proceeding to Moosonee

via Cochrane. The train arrived some 3 to 4 hours late, leaving barely enough time to procure the few items that were still required (fresh food and kerosene). The airline staff had nearly completed the loading of the Canso aircraft. It was found that ground transport at Moosonee is, to a certain extent, unreliable, and ample time should be allowed for the moving of equipment and luggage. It is possible to walk from one end of the village to the other within about 30 minutes.

The charter flight left Moosonee shortly after 0600 EST on July 26, as scheduled, and proceeded uneventfully to the Belcher Islands. The sea was clear of ice on the day of arrival, but the following day strong south winds drove a number of small icebergs up into the inlet where South Camp is located. Hence, local weather conditions must be considered when planning such a flight, even at the end of July. The authors may have been luckier than they knew.

Unloading of the aircraft was done by means of whaleboats belonging to the Eskimos, and powered by outboard motors. Although there is a stone wharf at the village, unloading was done at the beach where a minimum of lifting (and a maximum of splashing) was necessary. The gear was then man-handled to the campsite. Local labour was hired at an hourly rate of \$1.25, with the local foreman doing the actual hiring and receiving \$1.50 per hour. The entire load of equipment was moved to the tent site, a distance of about 350 feet, in three hours.

#### Support During Expedition

As mentioned above under the heading "Housekeeping Gear", a few items had to be flown in after the establishment of the campsite. One parcel left with Mr. Scott Cameron at Moosonee was picked up by the fishing camp supply plane during a fueling stop and flown in to the Belchers. A later shipment (consisting of the tent heater, several 30-A circuit breakers, a plastic wash-bottle for priming the camp stove with alcohol, some steel wire for repairing the camp stove, and a cake rack) was mailed to George Theriault at Chapleau for forwarding to the Belchers. Mail for Sword was routinely addressed in care of George Theriault as well; we are grateful to him and his staff for providing this service.

#### Transportation - Belcher Islands to Ottawa

Toward the end of September the decision was made in Ottawa to have Sword and the equipment picked up on September 29. The photometer system was shut down and packed on September 26, and the housekeeping gear and tent were packed on the

following day, Sword spending the night of the twenty-seventh in the spare bedroom of the teacher's house. A Canso aircraft arrived at South Camp on the twenty-eighth to pick up medical and police personnel, who had come by boat from the other Eskimo settlement at the north end of the island, and in view of the unsettled weather conditions (wind and snow), Sword decided to seize the opportunity to leave that day rather than wait until the next. The next aircraft landing at the Belchers was in February 1968.

The tent floor, the photometer mounting frame, a few surplus packing crates, and various scraps of wood were left behind at South Camp, as were the remaining food supplies. In addition, as a result of garbling in a message from Ottawa listing items which were expendable, the propane tank and copper tubing for the refrigerator were left as well.

On September 28, Sword, accompanied by 10 crates, 3 canvas bags, and 5 bundles of aluminum pipe (the dis-assembled tent), weighing in all about 3/4 ton, left the Belchers and proceeded via Great Whale to Moosonee. The freight was transferred to the railway express company on September 29, and Sword left Moosonee September 30 enroute for Ottawa, arriving October 1.

The equipment reached Ottawa on or about October 9, having suffered no apparent damage in transit.

## ENVIRONMENT

### Weather

No attempt was made to maintain any sort of meteorological observing schedule, but it is estimated that daytime temperatures ranged from nearly 70° F in August down through the 50's early in September to the low 40's in late September. No ice formed on any of the nearby lakes or streams, although a pail of water left outside the tent froze over at night during the latter part of September. In spite of the apparently moderate temperatures during August, very few warm days were experienced. A cool breeze was usually blowing, keeping away mosquitoes and black flies. No other insect pests were encountered.

A fair amount of precipitation occurred, in the form of rain during August and early September, and snow flurries later in September. No snow had accumulated on the ground by the end of September. Rain came usually as a drizzle or "Scotch mist", as well as one or two heavy downpours lasting less than an hour. Although a rubber raincoat was provided, the standard Arctic



issue parka (with the nylon shell treated with a commercial silicone waterproofing compound) would have provided enough protection for all but the few downpours mentioned above.

### Terrain

The terrain in the vicinity of South Camp appears quite barren. The island seems to consist of low, rolling hills of bedrock, either bare and smooth or covered with lichens or moss (and in any case, extremely slippery when wet), with occasional patches of coarse gravel and clay or sandy soil. Numerous small boulders left by retreating glaciers dot the landscape. Most of the small valleys or hollows contain lakes, ponds, or swamps. To walk any distance requires patience and some care. It is a fair comment, perhaps, that if a given area was horizontal, it was probably water. High-laced waterproof insulated boots with heavy cleated rubber soles and heels were excellent footwear for such conditions. Within the village itself the footing was made more hazardous by loose, broken rocks, canine excreta, and lumps of decomposing seal and whale blubber, which were scattered freely about. Vegetation was sparse, and grew very close to the ground. Scrub arctic willow, blueberries, cranberries, wild flowers, and coarse grass were identified; other unfamiliar plants were also seen.

### Communications

A radio transceiver was located in the teacher's house, and contact with the DIAND staff at Great Whale was scheduled three times daily. Equipment difficulties, propagation conditions, and operator forgetfulness reduced the number of conversations to an average of roughly two per day. Messages from Ottawa were telegraphed to the personnel at the Great Whale Geophysical Station and relayed through the DIAND staff there to the Belchers.

Commercial AM radio broadcasts could be heard on the communications receiver. The CBC short wave service was also a welcome source of news and entertainment.

As mentioned above, mail was brought in once a week by the fishing camp supply plane.

### Neighbours

The village had a population of about 60 Eskimos, a dozen or so of whom spoke English. All were unfailingly friendly and polite. The authors, accustomed to the incidence of petty thievery and shoplifting in the civilized south, were pleasantly surprised to discover that theft was apparently non-existent.

Even articles like tools remained where they were last placed. (On the other hand, edible items were at the mercy of roving dogs, and would disappear quickly if left unguarded.)

The school teacher and his wife were the only other "long term" white residents at the village. Personnel at the nearby fishing camp included a guide (until the end of August) and an average of about five tourists.

Visitors included three anthropologists from the National Museum of Canada, who stayed a few weeks, a working party of three DIAND personnel who stayed for a week or so just prior to the arrival of the school teacher, and a Department of National Health and Welfare doctor and an RCMP corporal, both from Moose Factory. The last two stayed a few days and left at the same time that Sword did.

The village was visited several times by the DIAND M.V. Siku and once by the Canadian Coast Guard supply ship, M.V. Raven.

#### Hazards

During the planning stage some concern was expressed as to possible danger from sled dogs which would be running loose at or near the village. Two axe-handles were taken to perform the function of "dog-repellent". Upon arrival, however, it was found that these particular dogs were easily intimidated and were more of a threat to garbage containers than to people.

The diesel-electric generator unit proved quite reliable. On those few occasions when some fault developed and caused a temporary power failure, a battery-operated alarm circuit aroused the operator in his tent. Invariably, Sword arrived at the generator building to find the local maintenance man, Johnny Cookie, already at work. Incidentally, these outages always occurred near dawn, fortunately after the photometer had been automatically turned off by its photocell control unit.

The drinking water supply was a nearby lake, which was also the nearest source for char. The water was siphoned from the outlet of the lake to a point near the teacher's house through about 500 feet of two-inch plastic pipe, the difference in levels being approximately 10 feet. The flow was continuous at a rate of a few gallons per minute. The water temperature was not much above freezing. No special effort was made to purify the water, and no ill effects were noted from its use.

The existing sewage disposal facilities were somewhat primitive. A so-called chemical toilet (or "honey-bucket", to use the more picturesque term) was lined with a disposable green

plastic garbage bag. Two or three times weekly this bag was removed and carried (rather gingerly) to the edge of an outcrop overlooking a small swamp located east of the village. The bag was then (equally gingerly) swung back and forth a few times and flung as far as possible into the swamp. This operation provided one of the local sources of entertainment, at least for the onlookers who maintained a prudent distance. Interestingly enough, the drinking water pipeline traversed this same swamp, and although it was realized intellectually that the positive water pressure inside the pipe would prevent any seepage of sewage into the drinking water, the emotional acceptance of this fact took a few days. In late September the water pipe was elevated above the swamp on an "aqueduct" made of old oil drums. It is probable that the low ambient temperature accounted for the lack of any apparent diseases resulting from this basically unsanitary sewage disposal procedure.

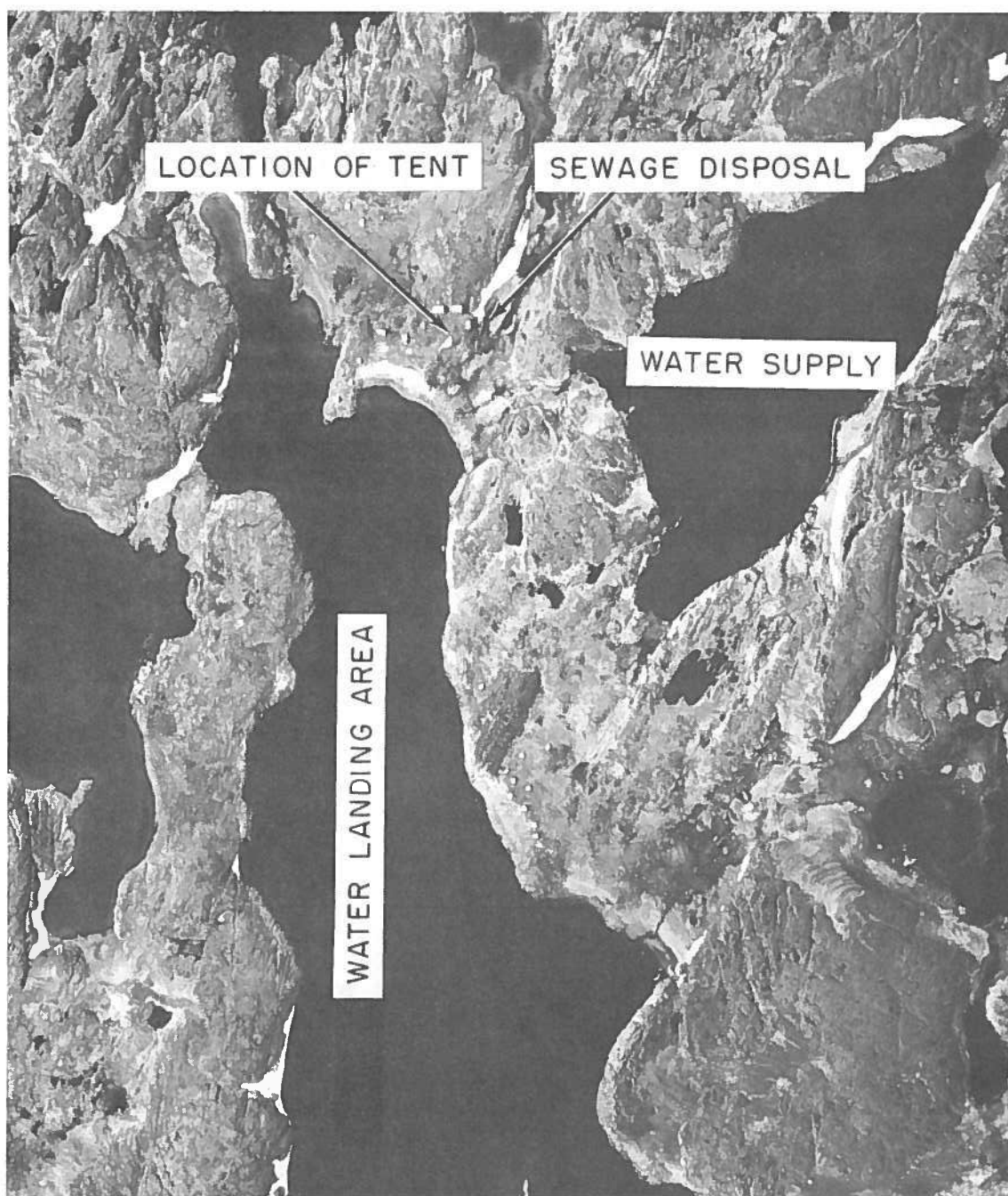
Kitchen waste and other garbage was carried to an empty oil drum in the midst of the swamp mentioned above (this task required rubber boots and a strong stomach) and was burned there.

Some of the locations mentioned above are identified in the air photo reproduced as Fig. 5.

A standard-issue first aid wall kit was purchased from the Department of Veterans' Affairs Central Medical Stores. The Department of National Health and Welfare nurse stationed at the Radio and Electrical Engineering Division, Mrs. M. Amell, also kindly supplied the following extra first aid items: analgesic balm rub for sore joints, elastic bandage for sprained wrists, etc., carob pulp flour tablets for diarrhoea, antacid tablets for stomach distress, antiseptic lozenges for sore throat, calamine lotion for skin irritations, and several extra bandages and gauze pads. A supply of vitamin C tablets (ascorbic acid 100 mg) was included as a diet supplement for use in case of head colds or other infections. It is recommended that some sort of antibiotic ointment be supplied for future expeditions, if this could be arranged.

### The Use of Leisure Time

The photometer equipment was basically simple to operate, requiring approximately twenty minutes of attention each evening and each morning, aside from a short period at the beginning of the expedition when trouble was experienced. Hence the operator was faced with a large amount of free time. A certain part of this was taken up with routine housekeeping chores, such as cooking, washing, cleaning, and so on, but



*Fig. 5 Vertical air photo of South Camp on Flaherty Island, showing various points of interest. (North is at top of picture.) The photo was taken in 1962; locations of some of the tents visible in the picture have since been changed, and more buildings have been constructed*

most of the daylight hours were composed of what is generally thought of as leisure time.

It was considered from the beginning that the question of what to do with this time was essentially a personal one which would have to be solved by the individual concerned. Indoor activities included reading, writing letters, radio listening, and conversation with those of the neighbours who spoke English. 16 mm movies were shown at the school several times per month, at a nominal admission fee. More athletic pursuits were walking, fishing, and accompanying both Eskimo and tourists on seal and whale hunts. Interest in these rather simple pursuits tended to flag after a few weeks. The authors recommend that intensive planning should be done for any future expedition, particularly with regard to hobbies or small handicraft type projects which may be of interest to those to be isolated for any length of time.

## TECHNICAL DIFFICULTIES

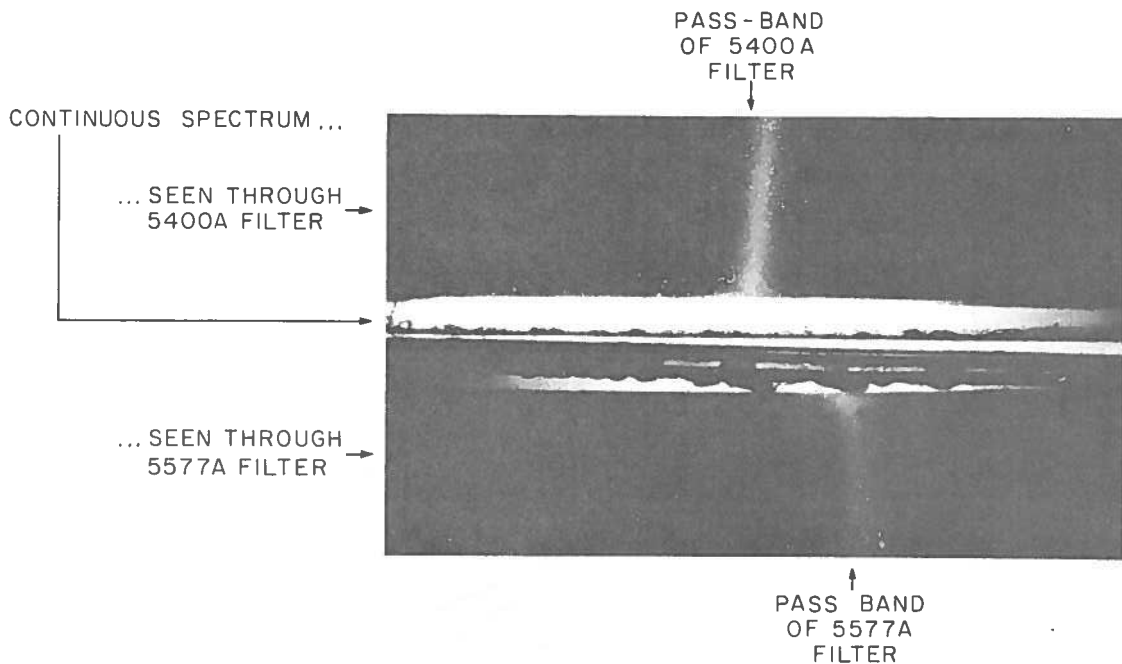
### Optical System

The photometer was put into operation on July 29. After several overcast nights, the sky cleared and on August 8 aurora was observed visually in the zenith. It was also noticed that no deflections were occurring on the recorder chart, but that the meter indicating the high voltage applied to the photo-multipliers was deflecting apparently in synchronism with the motions of the aurora. These symptoms suggested that the interference filters had been accidentally interchanged when the two photometer modules were assembled.

Sword queried D. Hislop, the supervising technician at Great Whale, via the DIAND radio link, and received the advice that the interference filter centered at 5577 Å had no apparent colour when viewed in reflected light, while the 5400 Å filter appeared green. By this criterion the filters seemed to be reversed; they were therefore interchanged and the photometer was placed in operation once more on August 9. An auroral display on the same night produced acceptable records, and the optical system behaved properly henceforth.

This test is not reliable in all cases: a better method in general is to view the confused filters side by side with transmitted light. In the present case, both filters would have transmitted light that appeared green in colour, but the 5400 Å filter would have had a more bluish hue in comparison with the 5577 Å filter, because of the shorter peak wavelength of its passband. People with certain types of colour blindness may experience difficulty in making this test, especially with two

filters as close in wavelength as 5400 Å and 5577 Å. A still more definite check involves the use of a wedge interference filter. A wedge filter has dielectric "interference" layers which vary linearly in thickness from one end of the filter to the other. Hence the passband is not fixed at one specific wavelength but changes peak wavelength smoothly along the length of the filter; the device is essentially a direct-viewing spectroscope. If a wedge filter and a normal interference filter are placed together and an incandescent lamp or other continuous source is viewed through the combination, a narrow band of light is seen, lying parallel to the short edge of the wedge filter, whose colour and position along the length of the wedge filter are both characteristic of the passband of the ordinary interference filter. Two filters may be easily compared simultaneously by this technique, and their differing passbands show up not only as a difference in colour but also as a difference in position along the wedge filter, as shown on Fig. 6.



*Fig. 6 Enlarged view of incandescent source spectrum seen through combinations of interference and wedge filters. The different positions of the two passbands are clearly shown*

## Electronics

On two mornings (August 12 and 14) it was found that the overvoltage protective circuit had operated, removing primary power from the photomultiplier high voltage supply and shutting down the photometer. A check of the components in the appropriate circuit revealed nothing obviously amiss. However, Sword

noticed that the room in the warehouse was appreciably warmer than usual, due to the mild weather. This suggested that the photomultiplier power supply might be producing too high an output voltage because of the increased ambient temperature. The photometer was switched on manually, with the head shielded from daylight by a black polythene tarpaulin, and the high voltage power supply control board was heated by the electric automobile heater originally used to heat the tent. The air

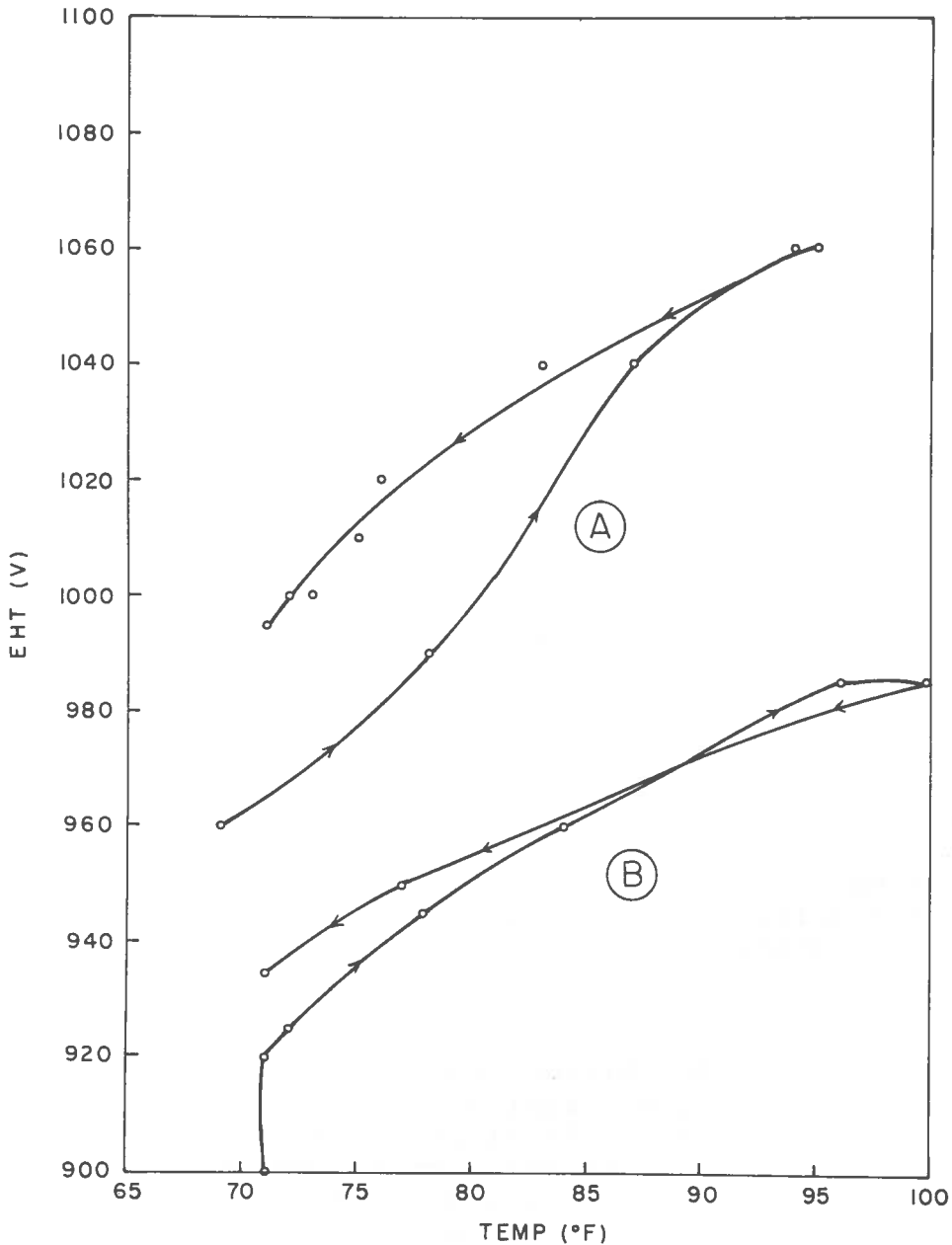


Fig. 7 Graphs showing dependence of high voltage supply output upon ambient temperature. Curve A - original high voltage circuit control board; curve B - spare control board



temperature near the circuit board was monitored using a thermometer borrowed from the school. It was found that the high voltage supply was indeed temperature-sensitive with the relationship plotted in Fig. 7. Accordingly the oil heater in the warehouse was turned off during all warm days and the room temperature was maintained at about 60° F to 70° F by manual adjustment of the heater. No further trouble was experienced with the electronics. On rare occasions a small accumulation of dust had to be removed from the recorder pen tip.

The timer proved awkward to set after power outages lasting more than one hour, since it was difficult to ascertain the effective position of the 1 RPH arm relative to its reed switch. It is recommended that a timer be designed which is easier to adjust, for any future field work.

#### POSSIBLE FUTURE WORK AT SOUTH BELCHER SITE

##### General

As mentioned in the Introduction to this report, a network of photometer stations in the vicinity of Great Whale would be necessary to study the diurnal motion of Byrd's northern conjugate. It is possible that the South Belcher site might be used as one of these stations. The following points are included as advice concerning any future work at this location.

##### Logistics

The arrangements for procurement, packing, and shipping of supplies were, in the main, satisfactory. It should be emphasized that the authors were probably extremely lucky in that aircraft flights to and from the Belchers occurred on the same days as had been planned (except the final flight out to Moosonee, which took place one day early). It is felt that such precision in timing was fortuitous, and that subsequent planners, to be realistic, should allow for possible delays of up to at least a week, at each stage of air transport.

##### Station Operation

It is quite possible that consideration might be given to hiring one or more of the local people to operate equipment on a basis similar to those in effect at other instrumental stations of the Upper Atmosphere Research section. Aside from the schoolteacher, there are two or three of the Eskimos who would probably be quite competent to operate an auroral photometer. The authors suggest the use of a timer which is simpler to reset than that used on the 1967 expedition.

If, on the other hand, the station were to be re-activated and staffed by NRC personnel, it is suggested that DIAND be consulted with regard to the food supply. The warehouse at South Camp still contained a fair quantity of provisions when the supply ship arrived, and it is possible that some arrangement could be made in future to make use of some of the food-stuffs that might be available.

The following additional housekeeping items would prove useful for future campers: a hardwood cutting board; a metal pail for heating relatively large quantities of water; some light machine oil for small motors (such as fans); a tray for storing cutlery; and flannelette sheets instead of cotton sheets for the sleeping bags (note that the sheets were sewn into the shape of bags and fitted with tie tapes; the sleeping bags had corresponding tapes sewn inside them so that the sheet bags could be tied in place and would not wrinkle or bunch up).

#### ACKNOWLEDGMENTS

The suggestion to establish a photometer station on one of the Belcher Islands was originally made by A.L. Spitz of the Arctic Institute of North America.

It is necessary to obtain a Scientists' and Explorers' License to operate in the Northwest Territories; we are grateful to J.H. Craven, of the Space Research Facilities Branch of NRC, for arranging this and other preliminary details.

Information and advice concerning the local conditions and general techniques of sub-Arctic camping was received from Miss K.M. Lutley of the Department of National Health and Welfare, P. Gillespie of the Department of Indian Affairs and Northern Development, who were both at Great Whale during the early summer, and Dr. R. Blackadar of the Geological Survey of Canada.

The authors are grateful for help given on various occasions during the operation of the station by J. Cookie and R. Tookalook, and by A. White, E. Sieber, and J. Cann of DIAND.

We wish to thank George Theriault and his staff at the fishing camp on Flaherty Island for delivering mail.

APPENDIX A

LIST OF HOUSEKEEPING ITEMS

Items marked \* were sent after the start of the operation.

<u>QUANTITY</u>	<u>DESCRIPTION</u>
1	Tent, 10 × 12 feet
2	Camp cots (Dept. Energy, Mines and Resources)
2	Foam mattresses (DEMR)
2	Sleeping bags
4	Sheet bags, cotton
2	Pillows, foam
4	Pillow cases, cotton
1	Electric table range (hot plate), 1500 watt
1	Electric kettle, 1500 watt
1	Electric automobile warmer, 750 watt
*1	Electric cottage heater, 1500 watt
1	Frying pan, cast iron, with lid
1	Double boiler, stainless steel (i.e., two nesting saucepans with two lids)
1 set	Kitchen utensils (fork, spoon, spatula, masher, etc.)
2	Vegetable peelers
2	Hand-held can openers
1	Knife, carving
1	Knife, paring
1	Knife, bread
1	Sharpening stone, carborundum
1	Tea pot, 4 cup, aluminum

1 set	Dishes, plastic (setting for four)
1	Casserole dish, with lid
2	Dish cloths
4	Dish towels
1 lb	Baking soda
1	Collapsible plastic 2 gallon water container
2	Plastic pails
1	Broom
2	Axe handles
1	Auto type "trouble light"
1	Camp stove
2	Dish pans, plastic
200 ft	Sash cord
12	Pot scrubbers
1	Battery-powered lantern
2	Waxed paper, extra heavy
3	Aluminum foil, extra heavy
1	Paper towel dispenser
3 rolls	Paper towels
3 boxes	Facial tissues
2 boxes	Paper wipers
5 pr	Leather gloves
2	Cake pans
1	Cookie sheet (custom made to fit oven)
1	Folding camp oven

1	Wire grid toaster, hand-held
2	Flashlights with batteries
6 cans	Insect repellent (personal application)
*2 cans	Insect killer, spray
*1	Cake rack
2	Cook books
1	Fire extinguisher with refill
1 pr	Kitchen tongs
1	Egg beater
2 pkg	Mosquito coils
1	Desk lamp
1 gal	Methyl alcohol for camp stove
5 gal	Kerosene for camp stove
2 rolls	Rope tape, 1 inch
2	Tarpaulins, plastic
2	Mosquito headnets
*2 pkg	Paper garbage bags
*1	Plastic washbottle for alcohol
2 cans	Gray paint (spray bomb)
2 cans	Black stencil ink (spray bomb)
1	Return address stencil
12	Shipping tags
1 roll	Cloth-backed tape, 3 inch
2 lb	Asbestos-filled putty
1 roll	Butcher's cord
1	Foot ruler

1	Notebook (for daily log)
2 rolls	Electrical tape
1	Epoxy adhesive kit
1 tube	Silicone rubber adhesive
1	Toilet paper dispenser
3 pkg	Toilet paper, folded
1 set	Aluminum measuring spoons
31	Plastic food storage containers
	Assorted electrical components and supplies (junction boxes, wire, connectors, etc.)
	Assorted writing implements (pens, pencils,, marking pens)
	Assorted nuts, bolts, screws, nails, etc.

APPENDIX B

Items marked \* were sent after the start of the operation.

<u>DESCRIPTION</u>	<u>SIZE</u>	<u>QUANTITY</u>
Fruit Juice		
Apple (vitaminized)	20 oz.	5
Orange	20 oz.	12
Grapefruit	20 oz.	12
Pineapple	20 oz.	5
Tomato	10 oz.	10
Cereal		
Quick cooking oatmeal	3 lb	5
Mixed grain hot cereal	2 lb	2
Staff of Life		
Tea biscuit mix	2 lb 5 oz	2
Bran muffin mix	14 oz	3
Blueberry muffin mix	13½ oz	3
Apple cinnamon muffin mix	14 oz	3
Bread mix	3 lb	2

Fresh Vegetables

Potatoes (from Moosonee)	10 lb	2
Turnip (from Moosonee)		1
Bunch carrots (from Moosonee)		1

Fresh Meat

Beef steakettes (from Moosonee)	2 lb
Back Bacon (from Moosonee)	1 lb
Wieners (from Moosonee)	1 lb
*Chicken legs	2 lb
*Minute steak	2 lb

Canned Meat

Ham	1½ lb	4
Pork shoulder	1½ lb	2
Bacon	1 lb	10
Meat balls	24 oz	4
Chicken	1 lb	5
Beef roast	3 lb	1
Braised beef steak	1 lb	5
Corned beef	7 oz	6

Canned Fish

Red sockeye salmon	4 oz	12
Sardines		6 tins

Starches

Instant mashed potatoes	12 oz	3
Instant scalloped potatoes	8 oz	2
Canned potatoes	20 oz	6
Rice	24 oz	2

Canned Vegetables

Tomatoes	15 oz	6
Peas	15 oz	4
Cream corn	15 oz	4
Niblet corn	12 oz	4
Carrots	15 oz	4
Beets	15 oz	4
Green beans	15 oz	4
Wax beans	15 oz	4
Pork and beans	15 oz	4
Kidney beans	15 oz	2
Yams	15 oz	2

Canned Stew

Chicken turkey stew	20 oz	4
Beef stew	20 oz	3
Irish stew	20 oz	3
Chuckwagon dinner	20 oz	2
Chicken with dumplings	20 oz	3



Dry Dinner

Macaroni with cheese dinner		5 pkg
Bulk macaroni		5 pkg
Spaghetti with meat sauce dinner		5 pkg

Canned Soup

Tomato	10 oz	3
Cream of mushroom	10 oz	3
Cream of celery	10 oz	3
Scotch broth	10 oz	3
Vegetable beef	10 oz	3

Instant Puddings

Chocolate		3 pkg
Vanilla		3 pkg
Lemon		3 pkg
Butterscotch		3 pkg
Banana cream		3 pkg
Tapioca pudding (for cooking)		3 pkg

Jelly

Raspberry (small)		2 pkg
Strawberry		2 pkg
Apple		2 pkg
Cherry		2 pkg
Lime		2 pkg

Sweets

Honey - tins	1 lb	2
Ginger marmalade	9 oz	1
Thick cut orange marmalade	9 oz	1
Grapefruit/lemon/orange marmalade	9 oz	1
Raspberry jam	9 oz	1
Strawberry jam	9 oz	1

Chocolate bars

Chocolate nut bars		24
Dark chocolate bars		24

Cookies and biscuits

Assorted fancy biscuits		2 lb
Oatmeal cookies		10 lb
Cheese flavoured soda biscuits	$\frac{1}{2}$ lb	5 pkg
Soda biscuits	1 lb	3 pkg

Cheese

Old cheddar (must be hermetically sealed)	1 lb	5
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Beverages

Instant coffee	10 oz	2
Orange pekoe tea	60 bags	3 pkg
Powdered skim milk	12 qt	5 pkg
Powdered chocolate drink	2 lb	2
Evaporated milk	1 lb	20

Margarine

Coloured margarine	1 lb	15
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Sugar

White sugar	2 lb	10
Dark brown sugar	2 lb	3
Golden syrup	2 lb	1

Dried Fruit

Raisins - seedless	15 oz	6
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Flour

All purpose	5 lb	1
Cornmeal	1 lb	3

Condiments

Salt	2 lb	1
Black pepper	1¼ oz	1
Ketchup	15 oz	1
Cornstarch	1 lb	1
Baking powder	8 oz	1
Nutmeg	1 3/4 oz	1
Shortening	12 oz	1

Canned Fruit

Peaches - slices	20 oz	5
Bartlett pears - slices	20 oz	5
Fruit cocktail	20 oz	5
Raspberries	20 oz	5
Applesauce	20 oz	5
Cherries	20 oz	5
Orange and grapefruit sections	20 oz	5
Pineapple tidbits	20 oz	5
Mandarin oranges	10 oz	6

Miscellaneous

Sink cleanser - large		1
Coldwater detergent	6 oz	3
Paper baking cups		200
Bath soap - large		5
Dish detergent - large		4
Kitchen matches		6 boxes
*Vanilla extract		1

Cake Mixes

Gingerbread, white, chocolate

6 pkg

Powdered eggs

(equivalent to 2 dozen eggs)

2 lb



*Plate I – View of camp site, looking south; tent in left foreground, with boat and aircraft anchorage in background; photo-meter equipment was installed south end of warehouse at right; one mast for radio antenna is fastened to wall of warehouse*