DEPARTMENT OF NATIONAL DEVELOPMENT
Secretary: R. W. Boswell

DIVISION OF NATIONAL MAPPING
Director: B. P. Lambert

TECHNICAL REPORT No. 5

AUSTRALIAN ANTARCTIC TERRITORY

MAC ROBERTSON LAND — KEMP LAND

TELLUROMETER TRAVERSE

January – February 1965

by

S. L. Kirkby, L.S., M.I.S. Aust., A.M.A.I.C.

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NMP/65 (facsimile cover to office proof copy)

MacRobertson Land and Kemp Land Traverse 1965

Sydney L Kirkby

With the completion of basic reconnaissance mapping control throughout the Australian Antarctic Territory, it has become necessary to provide control for the current 1: 250,000 topographic series maps. As early as mid-1962 plans were being made for second order Tellurometer traverses throughout the mountain systems in MacRobertson, Kemp and Enderby Lands to provide the basis for this control.

In the summer season of 1961-62 five Tellurometer lines had been measured between coastal islands and the mountains in the vicinity of Mawson; to provide a basis for triangulation in the Framnes Mountains. This was followed in the summer season of 1962-63 by the measurement of six lines for survey purposes and eight lines for glaciological purposes in the vicinity of Wilkes.

The proposition that a series of joint survey and geological programmes, carried out in a period of intensive activity during the short summer season, would be the most economical way of obtaining the data required for the current mapping programme was placed before the Antarctic Division of the Department of External Affairs in 1963 with the request that the facilities of the expedition be made available for such an undertaking, but it was not until the summer season of 1964-65 that the funds were available for ship and aircraft charter.

The Antarctic Division owned a "Beaver" aircraft (which was operated for them by a private firm on contract) and called tenders for the charter operation of three rotary wing aircraft during the summer voyage of the Expedition ship M.V. Nella Dan. To free the expedition ship from base relief duties for a maximum period the M.V. Thala Dan was sub-chartered from the Expeditions Polaires Francaises to carry out the relief of the Wilkes base.

2. Survey Programme : Mawson-Enderby Land :

In initial conception this survey was planned to be run by two parties each of two men running the traverse and doing reconnaissance ahead. Traverse angles were to be read to beacons which would be erected at all stations. Due to doubts as to whether beacons could :-

(a) be erected at all stations, and

(b) be seen over the distances involved,

this was altered to three parties of two men occupying successive groups of 3 traverse stations simultaneously and using heliographs as targets.

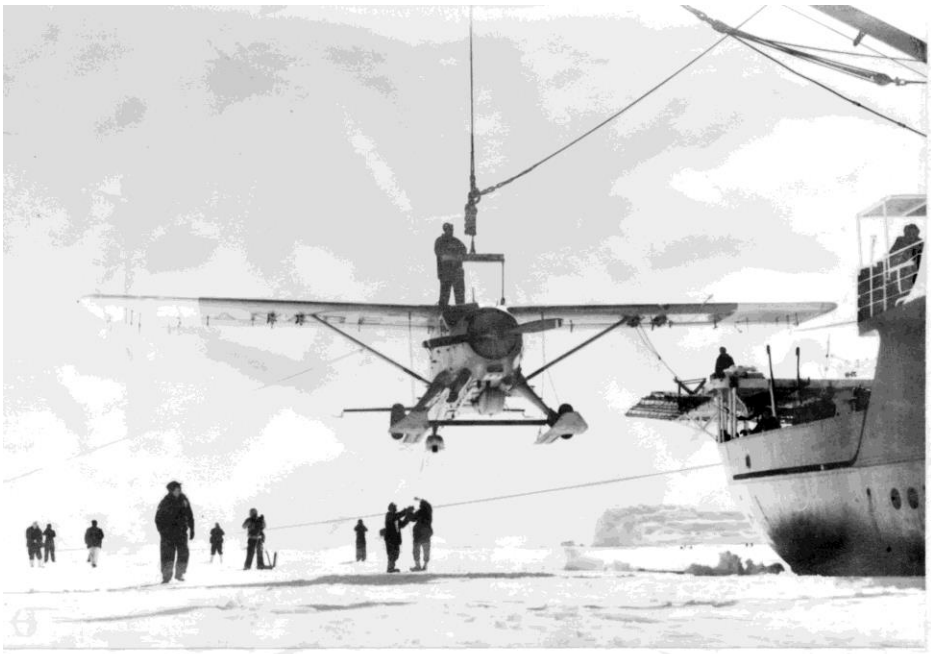
In order to facilitate reconnaissance and clarify party functions, it was proposed that each party would maintain the same position relative to the other two, i.e. the parties would move forward as a block rather than move the rear party around the centre and front parties to become the front party occupying each new station.

1. The projects envisaged on the programme were :-

(a) Tellurometer traverses starting from a suitable region in the Mawson area along the route Mt. Twintop - Baillieu Peak - Fram Peak - Leckie Range - Rayner Peak - Schwartz Range - Nicholas Range with further extension westwards if circumstances permitted (See diagram 1).

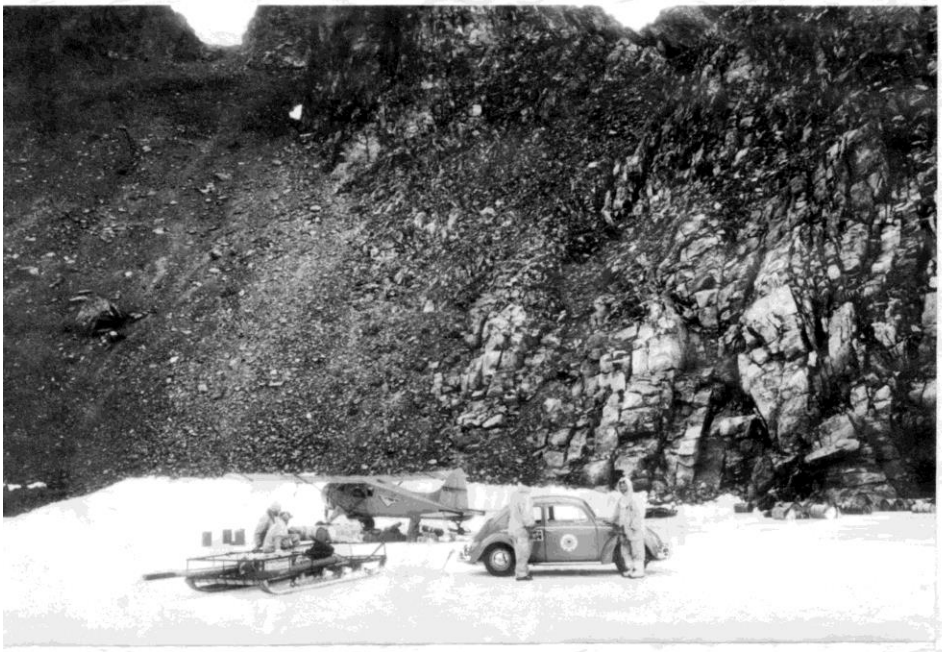
(b) Horizontal and vertical angles to prominent features from each station, and rounds of terrestrial photographs at each station,

(c) Astronomical azimuth observations (reciprocal stellar azimuth observations) where possible and astronomical position determinations at the western end of the traverse.



Unloading Beaver on fast ice near Taylor Glacier.

(Official ANARE Photo by G. BRADLEY)



Beaver at tie down position at Rumdoodle Ice Airfield.

Helicopter landing on deck of M.V. Nella Dan.

2. Framnes Mountains :

2.1 A trilateration or closed traverse within the area Béchervaise Island - Lucas Nunatak - Mt. Twintop - Anniversary Nunataks - McNair Nunatak - Mt. Henderson (see Diagram 2).

It was proposed that the M.V. Nella Dan should provide the main base for operations to Fram Peak from the west and transport was to be by the three Bell 47 G2 helicopters with support from a de Havilland "Beaver" fixed wing aircraft for establishment of sub-bases as required to give the helicopters fuel support. This "Beaver" was also required to obtain aerial photo coverage. To this end it was intended to move the ship into Edward VIII Gulf until either fast ice or a large floe was encountered to serve as a main base airfield and to establish fuel facilities in the regions Nicholas Range and Leckie Range. Operations to Fram Peak from the east were to be supported by the aircraft operating from the Mawson area with fuel facilities in the Fram Peak region.

Distance measurement was to be by Model MRA3 Mark III cathode ray tube read-out Tellurometers with traverse angles and astronomical observations by Wild T3 theodolite. Appendix (i) shows survey equipment disposition and weights, and Appendix (ii) detail functions of each of the three parties.

Concurrent with the survey programme a geological programme was to be run, with the two groups phasing in for mutual assistance wherever possible but also having a separate transport requirement.

Aircraft Capacities and Ranges :

The Bell 47 G2 is a two passenger helicopter of the following broad specifications :-

Maximum all up weight	2450	lbs.
Dry weight in configuration	1780	"
Gross disposable weight	670	"
Survey equipment	130	"
Pilot	180	"
Reserve Fuel	60	"
Nett disposable weight	300	
Gross useable fuel	32	gals (34.5 total)
Reserve Fuel	8	"
Nett Useable	24	gals.
Consumption		12 gal/hr
Mean Air Speed	60	kts.
Radius of operation	60	naut. miles.

Nett weight available for load at max. radius of operation 300 lbs - weight fuel (34.5 gals x 7.2 lbs/gal). = 52 lbs.

By operating three aircraft together, but only carrying 2 lots of survival gear, the total disposable weight was brought up to 1030 lbs.

The de Havilland "Beaver" is a high-wing, single engine aircraft of the following broad specifications :-

Maximum all-up weight	5600	lbs.
Dry weight (with navigational equipment and skis, but without wing racks and cameras)	3870	lbs.
Cameras (without magazines)	210	lbs.
Cameras (with magazines)	320	lbs.

Pilot	200	lbs.
Disposable weight	1320	lbs. (for ferry operations)

The survey parties were made up of three surveyors Class 1 and one Field Assistant (Survey) from the Division of National Mapping, Department of National Development, and assistants drawn from the 1964 and 1965 Mawson personnel. Of the surveyors, one had been at Mawson for the year 1964 and was to join the ship immediately on its arrival at Mawson from Melbourne. Other basic personnel were from the Melbourne office of the Division of National Mapping.

Before departure from Australia all technical and field equipment was checked, and a brief training period undertaken to familiarise the survey personnel with field techniques and equipment.

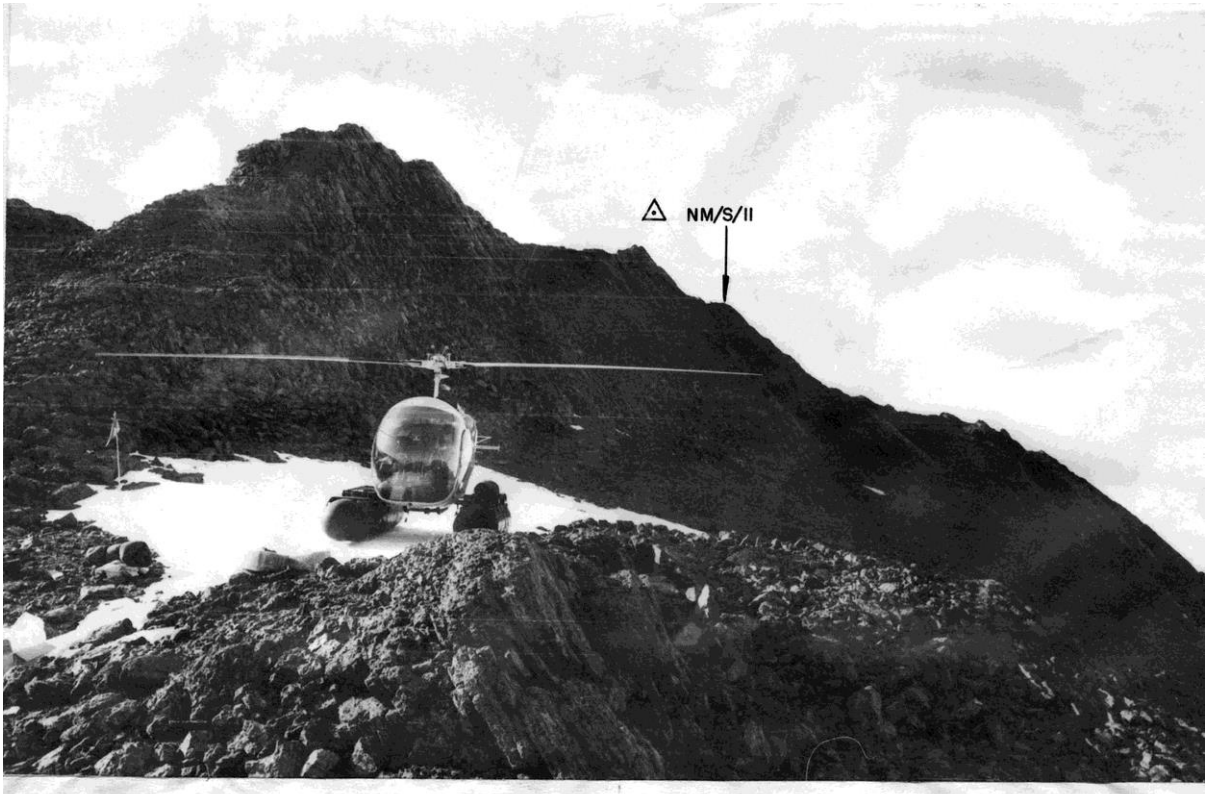
The loading of the ship was completed by the early afternoon of the 22nd December 1964 with the expedition departing South Wharf Melbourne at 1700 on the same day.

On the following day the expedition leader, together with the senior members of the helicopter, Beaver, air traffic control, survey and geological groups began detail planning of the operation and dove tailing of the survey and geological programmes and this continued for the greater part of the voyage. All camp gear and technical equipment was again checked, packed and sorted into group lots, and the required air photos were marked up and issued to the various groups.

Very early it became apparent that transport facilities would be strained to provide the required support, owing to the limited lift capacity of the aircraft, so that it was necessary to reduce weight wherever possible, even to removal of the radios from the equipment of the front and rear parties.

After a singularly calm and rapid voyage Mawson was reached at 2100 hours on 3rd January 1965 and some transfer of general cargo and personnel undertaken. The ship departed Mawson at 2400 hours the same day in an attempt to reach Edward VIII Gulf to commence operations. Heavy pack and fast ice was encountered in 66°47'S. 60°14'E shortly after leaving Mawson. The ice edge was followed westwards and north to about 66°13'S 58°00'E where there was no apparent hope of forcing a path west owing to a great concentration of ice (mainly unbroken fast ice) in that direction. On the 5th January the ship returned to about 56°3'S., 60°15'E so that an ice reconnaissance could be made by helicopter, but because of poor visibility it was not until the evening of 7th January that the flight could be made. During this flight it was seen that fast ice extended all the way to Edward VIII Gulf and that there was no hope of the ship forcing a passage under present conditions. Following this discovery, a meeting of senior group members was held and the decision made to return to Mawson and to commence operations from there while waiting for the ice to the west to break out. When the Mawson changeover was completed it was decided to leave the survey group, one geologist, the "Beaver" and two of the three helicopters at Mawson to continue operations while the ship visited Davis station and proceeded with its relief.

It was foreseen that the unloading of the "Beaver" aircraft at Mawson, where there was no airstrip, and its transfer to Rumdoodle airfield at Masson Range would be a difficult and tedious operation, so it was decided to find a suitable sea-ice airfield in the present vicinity of the ship and fly the "Beaver" to Rumdoodle from here. By the early morning of 8th. January the ship began moving in the ice to a suitable area some miles to the south, which was reached at 1300 hours next day. There the "Beaver" was off-loaded and as Capt. J. Whiting, the senior "Beaver" pilot was unfamiliar with the Rumdoodle airfield and Antarctic ice conditions, the senior surveyor accompanied the aircraft on this positioning flight. After take-off at 1400 hours two photographic flights along the coast towards Mawson were undertaken and a landing being made at Rumdoodle at 1800 hrs. There the aircraft's tie-down points were dug in the ice and frozen in and the aircraft secured by 2300 hours. The remainder of the survey group still on the ship recorded ocean soundings and plotted the ships track on the voyage back to Mawson which was reached by 1200 on the 10th. As no survey positioning could be undertaken immediately, Kirkby again accompanied the "Beaver" on a joint photographic and familiarisation flight east of Mawson.



Lucas Nunatak

The snow patch upon which Helicopter is standing was used as both landing area and camp site.

Baillieu Peak (△ NM/S/13)

The morning of the 11th January was fine and clear with a katabatic wind of 30 knots preventing flying until 1100 hours when a start was made to position Surveyor Corry and his assistant L. Miller, radio operator of Mawson, at Mt. Twintop. On the first flight a seized throttle cable caused one of the helicopters to make a forced landing on the plateau where it was immobilised until the engineer was flown out from Mawson to repair it.

Operations were resumed at 1500 hours but on the return from the flight to Mt. Twintop the pilots advised that in the interests of safety they were obliged to impose a weight penalty of 80 lbs. on loads to be carried by the helicopters at a pressure altitude of 5000 feet, and a penalty of 30 lbs. at a pressure altitude of 4000 feet. They also advised that they would making no further landings on rock surfaces owing to the possibility of damage to the aircraft pontoons. After the completion of the positioning of the party at Mt. Twintop, Surveyor Kirkby with camp gear was moved to Lucas Nunatak where, fortunately, a small 30 ft by 30 ft. level snow platform was found on the outcrop only about 150 feet below and 150 yards S.E. of the crest.

The aircraft then returned to Mawson, picked up surveyor Farley and the technical gear and dropped them at Lucas Nunatak where the camp was set up on the landing platform, and the survey station established on the crest ridge of the outcrop by 2330 hours. Meanwhile the helicopters had returned to Mawson and picked up Field Assistant (Survey) R. Maruff and his assistant T. Foley and positioned them on Béchervaise Island where they were established by 2400 hours.

Tuesday the 12th January was fine and clear, with wind up to 40 knots, so that it was necessary to tie down the tellurometer and theodolite at all stations. Distances were measured from Lucas Nunatak to Béchervaise Island and Mt. Twintop also the reverse measurement Béchervaise Island - Lucas Nunatak. An attempt to measure the vertical angles at Béchervaise Island and Lucas Nunatak had to be abandoned because of the high wind. By 1700 hours the wind had dropped to 15 knots and an attempt was made to contact Maruff at Béchervaise Island via the Tellurometer to read vertical angles but this was not successful due to a flat battery at Lucas Nunatak. Vertical angles were read to Mt. Twintop and prominent features intersected.

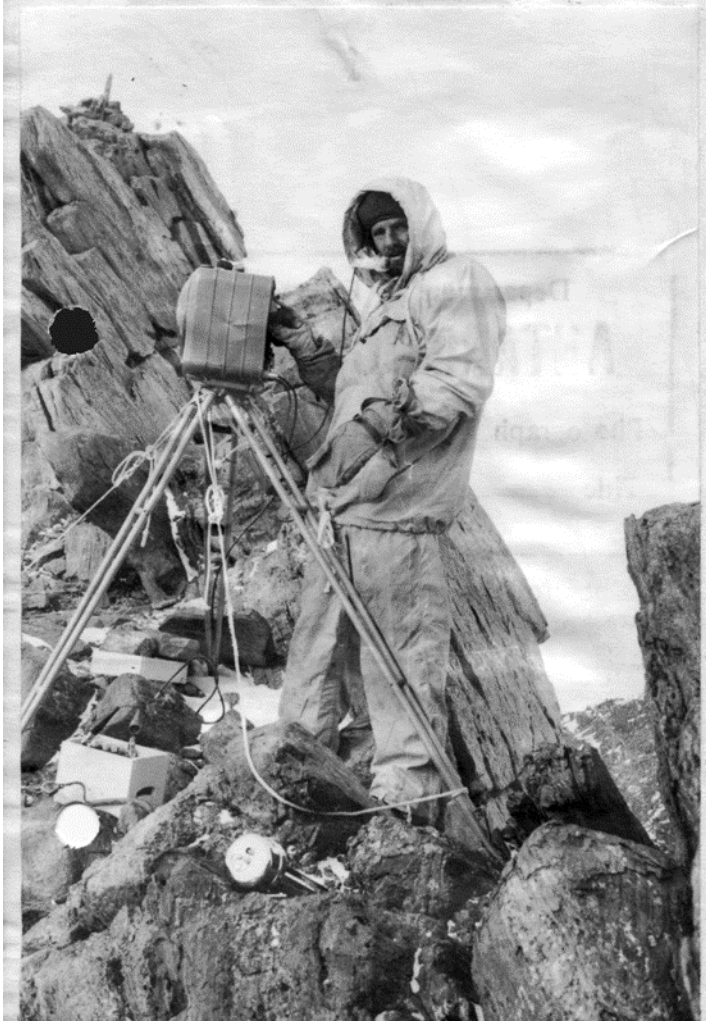
Due to the very limited load capacity of the helicopters it had become necessary to reduce weight to a minimum so that only the centre party carried a field radio, inter-party communication being by Tellurometer. This in turn caused a heavy drain on the accumulators for the Tellurometer, the capacity of which was already limited by the low temperatures, so that there was considerable concern that delays at one station could lead to a total communication break-down. Two T.A.S. portable battery chargers were available and carried by the centre and rear parties. These units were capable of fully recharging the 30 amps. hour accumulators in about 5½ hours for a consumption of about six pints of fuel but no charger was available for the front party.

At 0630 hours on the 13th Kirkby contacted the ship by radio and arranged for the ship's boat to take a fresh battery to Maruff at Béchervaise Island, and made a tentative arrangement to move Maruff on to Baillieu Peak late in the afternoon if the day's work should be successful.

On the arrival of the battery at Béchervaise Island a further measurement of the line Béchervaise Island - Lucas Nunatak was made, followed by an attempt to read horizontal and vertical angles. The wind which was gusting 20-30 knots at Lucas Nunatak again prevented this, so a new theodolite eccentric station was established at Lucas Nunatak in a partially sheltered depression in the main ridge about 60 yards north of the station and 60 feet below it. From here it was possible to complete the angle reading by 1600 hours and free Maruff for the move to Baillieu Peak. The ship was advised of this and asked to proceed with the positioning, then advise by radio at 2200 hours if the operation was going smoothly. A further measurement Lucas Nunatak to Mt. Twintop was made, followed by another set of vertical angles to Mt. Twintop. The ship could not be contacted at 2200 hours and it was not until 0630 hours on the 14th that it was known that Maruff was successfully positioned at Baillieu Peak.

It has not been possible to land Maruff's party on the outcrop of Baillieu Peak because of turbulence. Instead they were landed on the plateau to the south of the peak about 1½ hours climb from the top. The shift from Béchervaise Island had taken three flights, each of two helicopters, and occupied seven hours.

Looking north from Fram Peak (△ NM/S/14)
Tellurometer eccentric station in foreground.



The wind during the 14th was steady at about 45 knots with light drift snow on the plateau. Attempts to contact the Baillieu Peak party at scheduled hour intervals were continued until 2100 hours from both Lucas Nunatak and Mt. Twintop but were unsuccessful. These attempts were continued throughout the 15th, with the wind about 50 knots and drift moderate, but again without success. This was apparently the first experience, on this survey, of signal absorption in drifting snow though this was not realised at the time and will be dealt with more fully later. The expedition leader aboard the Nella Dan was advised of this communication break down and was requested to make an aircraft available as soon as possible to check the safety of the Baillieu Peak party and to deliver a charged battery to them.

During the next three days the wind blew at about 60 knots making any flight or contact attempts impossible. By 0630 hours on the 19th January the wind had dropped to 30 knots, Radio contact with the ship revealed that helicopters would check the Baillieu Pk. party and supply it with a fresh battery in the afternoon. This was done at 1430 hours and at 1600 hours in clear conditions, then Tellurometer contact was established between Lucas Nunatak and Baillieu Peak. Maruff had attempted all scheduled contacts on 14th and 15th without success. Corry at Mt. Twintop was then contacted and given details of the day's programme. The line Lucas Nunatak to Baillieu Peak was measured, followed by vertical angles on this line, then the measurement Baillieu Peak to Mt. Twintop and the reverse measurement Baillieu Peak to Lucas Nunatak. While the reverse measurement Mt. Twintop to Baillieu Peak was being made the horizontal angle at Lucas Nunatak was read. By 2330 hours all work was completed and an unsuccessful attempt made to advise the ship by radio that the Lucas Nunatak party was free to be moved to Fram Peak.

Radio contact was established with the ship at 0620 hours on the 20th when the expedition leader advised that he wanted Kirkby back at the ship to confer on the long shift to the Fram Peak region. The three helicopters collected the Lucas Nunatak party and returned them to Mawson where it was decided that the move to Fram Peak would be made in the following manner.

Two helicopters could fly to Baillieu Peak and depot sufficient fuel there to enable them to make a later flight Mawson - Fram Pk. - Baillieu Peak, and return Mawson. The "Beaver", with Kirkby, camp gear and technical equipment, would be flown to Fram Peak area coinciding with the presence there of the helicopters so that a marked air strip would be available. The "Beaver" would then return to Rumdoodle ice airfield and pick up Trail (the geologist who wished to visit Fram Peak) and a drum of aviation fuel for landing at Fram Peak. Kirkby and Trail could then form the front survey party until Trail could be replaced by Farley on a future depoting flight.

The weather determined before this plan could be initiated and this, with a helicopter unserviceability, prevented any move until 1500 hours on the 24th January.

The only suitable landing strip in the Hansen Mountains area was about two miles north west of Fram Peak on a shallow bowl of blue ice. Access to the highest point of Fram Peak entailed a walk of about four miles with a rise of about 400 feet to the rock ridge, then about half a mile of rock scramble with a climb of about 300 feet to the crest. Trail arrived at the Landing Strip at 2130 hours and by 0400 hours on the 25th the camp had been established on a snow slope to the east of the outcrop, about 20 minutes climb from the crest. The limited lift capacity of the helicopters was placing a great strain on party personnel in station establishment as even a short walk, such as the one at Fram Peak, became very tedious for two men with some 450 lbs. of equipment to move.

Commencing at 1400 hours on the 25th the horizontal angle at Baillieu Peak between Mt. Twintop and Fram Peak was read to complete the Mt. Twintop station. Corry could now move up to Fram Peak and Kirkby could be moved to Leckie Range. The distance Fram Peak to Baillieu Peak was measured in 20 knots of wind and clear conditions, the trace being excellent and very stable. Then the reverse measurement was attempted 3 hours later at 1900 hours the wind had risen to 30 knots with some drift on the plateau. It was barely possible to make speech contact and no measurement could be attempted. Fram Peak and Baillieu Peak stations were occupied until 2200 hours but with no improvement in conditions. At 1900 hours the "Beaver" arrived at Fram with Farley and a drum of aviation fuel, then immediately returned to Rumdoodle.

Salvaging "Beaver" aircraft. *(Official ANARE Photo by G. BRADLEY)*

View of △ NM/S/16 from top of Rayner Peak.

On the morning of the 26th conditions improved slightly and it was possible to measure the distance Baillieu Peak to Fram Peak. Corry and Miller at Mt. Twintop had carried all their equipment from the station to an ice airstrip about three miles away and were picked up by the "Beaver" at 1800 hours in a gusty wind of up to 45 knots and severe turbulence. They were flown to Fram Peak, but by the time of arrival there the wind conditions were so bad that no landing could be attempted. The "Beaver" then returned to Rumdoodle airfield for the night. The following day reciprocal vertical angles were read at Fram Peak and Baillieu Peak.

On the 28th January the "Beaver" arrived at Fram Peak with Corry and Miller and their survey gear, plus a field radio and camp gear. Corry remained at Fram Peak with Farley while Kirkby and Miller flew on to Leckie Range with the "Beaver", arriving at 1230 hours. This change of party personnel was made as Whiting was reluctant to make a plateau landing without someone on the aircraft who had a knowledge of the area. The landing strip at Leckie Range was on an extensive blue ice area on the north-west of the main group of the Leckie Range. By 1300 hours Kirkby and Miller were able to commence the climb to the crest of Leckie Range while Whiting established the camp in the moraine against the western face of the mountain before flying back to Rumdoodle. The Tellurometer and battery were made the first load in an attempt to establish contact with the Fram Peak party at the 1600 hours and 1800 hours schedules. By 1600 hours the load had only been carried up about 1400 feet, i.e., about two-thirds of the way to the top, and the climb was becoming quite difficult for short sections so while Miller left his load and returned to the camp to pick up the next load of technical equipment Kirkby continued climbing the peak to establish a route to the top which was reached at 1830 hours. Two fixed ropes were put in over the most severe parts of the climb to assist in future ascents of the peak, then Kirkby commenced the climb down. Meanwhile Miller had brought the remainder of the survey equipment to about 600 feet up the mountain, where it was left for future pick up, and both men returned to camp. Only the top 200 feet of the highest two peaks of Leckie Range are visible from Fram Peak and on neither of these can a station giving reasonable visibility for extension be established anywhere but within the final 30 feet of the summit. Camp was reached at 2400 hours.

Mawson was contacted at 0900 hours on the 29th. The survey group was advised that the expedition leader was anxious to move the ship to Edward VIII Gulf and would like to move the survey parties out on this day. In view of the weather at Leckie Range, which was full overcast with occasional snow showers, he was advised that this would most likely be impossible for at least another 24 hours and he agreed to a postponement. The Leckie Range and Fram Peak stations were manned from 1400 hours but no inter-party contact could be established, either by Tellurometer or radio, by close-down time at 2000 hours. On the 30th January Mawson was again raised at 0900 hours and the expedition leader again requested that the survey parties be ready for evacuation at 1800 hours. He was advised that every attempt would be made to do this but it could not be guaranteed. The Fram Peak and Leckie Range stations were again manned throughout the day but no contact was established. The following morning Mawson advised that the Baillieu Peak party had been evacuated and, weather permitting, the other parties would be evacuated on the 1st February. There had still been no radio contact with the Fram Peak party by either Mawson or Leckie Range so a massage was broadcast to them to occupy the station in a final, forlorn attempt to establish Tellurometer contact. The wind on Leckie Range was about 45 knots, so that the small platform on the crest on which the station was sited could only be occupied with both the instrument and observer tied to the rock. As there was moderate drift on the plateau, and Fram Peak could not be seen at all, attempts at contact were abandoned at 1800 hours and preparations made for evacuation the following day.

At 1215 hours on the 1st February the "Beaver" arrived at Leckie Range. The camp was struck and loaded on board the aircraft which departed at 1250 hours with Kirkby, Miller and all camp equipment. On the return flight to Rumdoodle airfield a note was dropped to the Fram Peak party advising them of pick-up time. (There was still no radio contact with them). At 1500 hours the Beaver landed at Rumdoodle in gusty wind and low cloud. No further flight could be attempted until the cloud lifted somewhat at 1700 hours when the aircraft departed to collect Corry and Farley from Fram Peak, returning to Rumdoodle at 2300 hours. Corry and Farley were then returned to the ship by helicopter.

Camp site at Baillieu Peak.

Camp site at Fram Peak.

Camp site at Rayner Peak.

Meanwhile Kirkby and Miller had been taken by helicopter to the Nella Dan where a discussion was held concerning the non-contact on the Leckie Range - Fram Peak line, either by Tellurometer or radio. It was suggested that, as drift on the plateau was the probable cause of the lack of Tellurometer contact, and the Fram Peak radio could be unserviceable, that Maruff and Kirkby should re-occupy Fram Peak and Leckie Range stations respectively (each being accompanied by a radio operator) and a replacement radio sent to Fram Peak. They would then make further attempts to establish this line. Corry and Farley would accompany the ship to Edward VIII Gulf and occupy the next station, Rayner Peak, from there. As the expedition leader was agreeable to this, Kirkby, Maruff, B. Allport and V. Dwyer (the latter being two radio operators from the 1964 Mawson party) were landed at Mawson by 2230 hours then the ship departed Mawson Harbour for Edward VIII Gulf.

The morning of 2nd February was again overcast, precluding helicopter transport to Rumdoodle, so at 1030 hours all equipment and personnel were moved the 12 miles to Rumdoodle by tractor and sled. As the cloud had thinned somewhat by 1500 hours Whiting took off with Maruff and Dwyer and the equipment for Fram Peak, only to return 30 minutes later owing to complete whiteout and falling snow to the west. High wind and low cloud prevented any further attempt to position the survey parties until the 5th February during which time the ship had reached Edward VIII Gulf and was moored alongside a large ice floe suitable for a "Beaver" airstrip for operations in this area. The "Beaver" piloted by Whiting and carrying the Fram Peak party, took off at 1300 hours, established the party at the Fram Peak airstrip then returned to Rumdoodle to collect Kirkby and Allport to position them at Leckie Range. The wind at Leckie Range was high with severe turbulence. After three hair-raising landing approaches Whiting advised that he could not land there with safety so flew on and landed alongside the Nella Dan at 2000 hours.

Rayner Peak (△ NM/S/16)

No further flights could be undertaken until 1145 hours on the 7th when the "Beaver" took off to establish the Leckie Range party, fly on to Rumdoodle to pick up the remaining "Beaver" crew personnel then return to the ship. Both of these operations were successfully carried out and the "Beaver" was then loaded with the equipment and personnel required to establish the Rayner Peak station. At 2040 hours, while taxiing prior to take off for this flight, the "Beaver" broke through the ice and settled with the tail ski and high main planes supporting it on the ice and the cabin submerged in the sea. There was no injury to personnel and the aircraft and load were recovered about three hours later. After all equipment had been checked it was found that the only instrument into which water had penetrated was the Tellurometer which was completely full of salt water. This was stripped and

thoroughly and repeatedly washed in fresh water and air dried but without being able to remove all salt, so this unit was considered no longer serviceable without a major overhaul.

On the morning of the 8th February the Leckie Range party contacted the ship by radio and was advised that there was no possibility of the Beaver being useable for future operations, and that Corry would be positioned at Rayner Peak by helicopter during the day. Nothing was heard from the Fram Peak party so both the ship and Leckie Range parties radioed instructions for an attempt to measure the Leckie Range - Fram Peak line.

The Leckie Range station was occupied from 1400 hours to 1800 hours but no contact was made with Fram Peak. The evening radio contact at 2130 hours revealed that Maruff had not received the morning message and had not attempted Tellurometer contact. Corry and Miller with minimum survey equipment had been positioned at Rayner Peak by 2130 hours.

At 0900 hours on the 9th February all parties were contacted by radio and advised of a final attempt to establish the Fram Peak - Leckie Range line as, due to the loss of the Beaver and the difficulty of moving distant parties by helicopter, the expedition leader wished to evacuate the Fram Peak station as soon as possible.

The three stations were occupied from 1400 hours and at 1445 hours Tellurometer contact was established on the Fram Peak - Leckie Range line in extremely good visibility, and low wind, and the measurement commenced. After reading on nine cavities the signal very rapidly dropped off and contact was completely lost after about seven minutes during which time there was a marked increase of haze on the line. The heliographs were then set up at each station as targets for angle reading but by this stage the outlines of Leckie Range and Fram Peak were barely intervisible and no angle could be read. All parties remained at the stations until 1800 hours by which time hope of establishing the complete traverse at these stations had to be abandoned and Maruff radioed this information to the ship.

Operating Tellurometer at Onley Hill (△ NM/S/18)

Bad weather conditions prevented any flying or work on the 10th and until late morning of the 11th February when the helicopters were able to fly to Rayner Peak where they depoted fuel to cover the party shift from this station. At 1510 hours the three helicopters landed at Fram Peak and, under stress, were able to evacuate major survey equipment and the party but no camp equipment, then flew to Rayner Peak via Leckie Range to refuel. This evacuation indicated the severe limitations of these aircraft. It was necessary to have depoted fuel at four places; Fram Peak, Leckie Range, Rayner Peak and Abrupt Point, so that three aircraft could lift two men and about 200 lbs of equipment and return to the ship, the total one way distance being, 140 naut. miles and the maximum leg between refuel points 45 naut. miles. Maruff and Dwyer were landed at Rayner Peak on a snow platform about 70 yards south and 40 feet below the station, which was established on a minor crest at the western end of the outcrop. Corry and Miller were returned to the ship for positioning at their station, Mt. Mueller.

On the 12th and 13th February whiteout conditions with falling snow and winds gusting to over 50 knots prevented any station occupation. By 1000 hours on the 14th the weather appeared to be clearing at Rayner Peak and Leckie Range, so arrangements were made to occupy both stations by 1500 hours and attempt to measure the line. The forward Leckie Range - Rayner Peak measurement was made in intermittent snow showers with no difficulty on the low and middle cavities but with loss of signal strength on the higher cavities, possibly due to thicker snow on the line during this period. Three hours later the reverse measurement was made with the two stations barely intervisible through cloud and snow, and as the ground swings on the first measurement had been large this measurement was made at half the previous frequency differences, i.e., each quarter cavity, to more fully develop the ground swing cycle. The forward and backward measurement differed by 1 part in 173,000. Immediately after this measurement the weather deteriorated badly so no further work could be attempted. The Leckie Range party moved the Tellurometer and ancillary equipment down from the station to the camp, a task which took 4½ hours in drift and winds of about 45 knots.

Blizzard conditions continued until late on the 17th February when it was possible to position Farley and Miller at Mt. Mueller. The expedition leader advised that, due to the probability of bad weather and the lateness of the season, he was concerned for the welfare of the survey parties and also that their support was placing an excessive strain on the transport facilities. He therefore wished to evacuate all field parties to the ship on the completion of the traverse to Mt. Mueller. In view of this Kirkby advised that he wished to return to the ship as soon as possible to discuss future operations and this was approved for late on the 18th February.

On the 18th Leckie Range, Rayner Peak and Mt. Mueller stations were occupied and horizontal and vertical angles read at Rayner Peak and Leckie Range, after which all equipment was removed from Leckie Range station. While this was proceeding; the three helicopters flew to Leckie Range and ferried the Tellurometer, ancillary equipment and all but bare survival camp equipment to Mt. Mueller. They then returned to Leckie Range, picked up the remainder of the equipment and returned Kirkby and Allport to the ship via Rayner Peak and Mt. Mueller where Maruff and Farley respectively were advised of a requirement to establish azimuth and position by astronomical observations. During the night of the 18th and morning of the 19th the distance Rayner Peak to Mt. Mueller and the azimuth of the line were established, and horizontal and vertical angles to prominent features read. As no further commitment to field operations would be given the Rayner Peak and Mt. Mueller parties were evacuated to the ship, the operation being complete by 2130 hours on the 19th February.

All equipment was checked and cleaned and made ready for transfer to Corry for use at Mawson during the remainder of the year, and the expedition leader's approval was obtained for the measurement of the Lucas Nunatak - Goldsworthy Ridge line on the return of the ship to Mawson.

The Tellurometer which had been wet in the "Beaver" was stripped again and checked for salt deposits, there being a few minor ones which it was not possible to remove either by water or brush. It was then re-assembled and a minimum drain fuse placed into the circuit to protect it in case of short circuit, then tested. No crystal current or modulation were found and a careful check failed to reveal the cause, so the instrument was packed for return to Australia for overhaul.

On the 25th February the ship arrived at Mawson after acting as base for coastal geological work on the voyage from Edward VIII Gulf. At 1100 hours next morning, the helicopters took off, with Maruff and an assistant, for the Goldsworthy Ridge station, preparatory to the measurement of the line Goldsworthy Ridge to Lucas Nunatak which would finalise the connection of the western traverse to the existing Framnes Mountains scheme. Several attempts were made to land in the vicinity of Goldsworthy Ridge but these eventually had to be abandoned because of severe turbulence. As Lucas Nunatak cannot be approached by surface transport it was imperative that the necessary connections from this station to the Framnes Mountains scheme be made immediately while the helicopters were available for support. Consequently, a new station was established on Onley Hill, to the south west of Goldsworthy Ridge, in an area easily accessible by surface transport, easily tied to the existing scheme and well sited for future extensions. After landing Maruff at this station the helicopters returned to the ship, picked up Kirkby and equipment and positioned him at Lucas Nunatak, remaining on the ground there while the measurement of the line Lucas Nunatak - Onley Hill was made. Both stations were then evacuated and the parties returned to the ship.

The ship departed Mawson on the 2nd March, after being delayed in the harbour for two days by high winds, and arrived Hobart March 15th.

Generally the results of this operation indicate the considerable results which can be achieved by highly mobile groups with intensive activity over the short summer period. Transport for this type of operation will always be under great stress due to the prevalence of bad weather and the consequent need for high speed movements when conditions permit. For this reason aircraft transport is seen as the only realistic approach to major undertakings. For the factors of speed and carrying capacity relative to fuel requirements and cost, the conventional fixed wing aircraft is greatly superior to the rotary wing machine, but the speed factor is very largely offset by the fact that the conventional aircraft will generally have to be landed some distance from the actual point to be occupied, and the time saved moving to the area will be much more than that lost in the amount of time taken to back-pack equipment from the landing strip to the survey station. For example, the Leckie Range station was occupied seven times, each occasion entailing a more than 2000 feet, three hours climb each day, whereas it is quite possible that a suitable rotary wing aircraft would have been able to position the party and camp within 300 feet and twenty minutes of the summit.

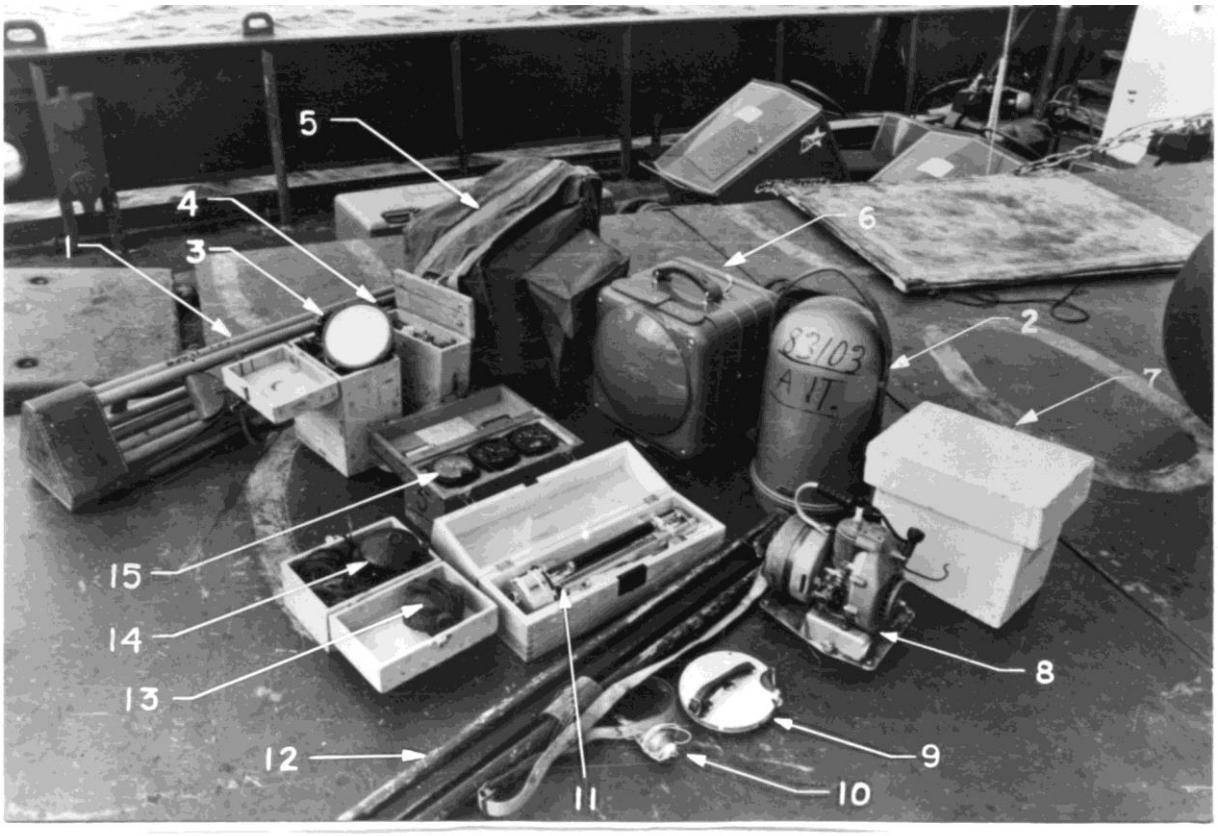
If one considers a solely rotary wing type aircraft support operation it becomes obvious that the aircraft needed would have to be large and costly. The minimum requirement for this type of operation would be at least three aircraft capable of lifting a payload of 840 lbs. with fuel load, a radius of action of about 200 miles and the capability to land, with heavy loads, at up to an atmospheric pressure altitude of about 10,000 feet. Fuel consumption for an aircraft of this capacity would be of the order of 60-80 gals/hour, presenting problems of fuel support for distant operations. It is also doubtful that an aircraft of this size could be operated from any polar ship presently available to Australia. It appears then that the most satisfactory means of supporting major field survey programme would be by both fixed wing and rotary wing aircraft, and this could be done in any of three ways.

Firstly the fixed wing aircraft could be used for station reconnaissance and, when the survey route was decided, then to either land or airdrop fuel supplies at each station. The rotary wing aircraft could then position the personnel and equipment required at each station with the benefit of extended range because of the depoted fuel. This would mean that the rotary wing aircraft should be capable of transporting two men, camp and technical equipment over the distances between stations - say up to 50 miles - with a reasonable safety margin.

Secondly, the fixed wing aircraft could position the survey party and equipment, as well as fuel, as near as possible to the survey station and the rotary wing machines be used only to ferry the party to and from stations, requiring machines capable of transporting lift loads over distances probably not exceeding 20 miles as each party could be positioned in relays.

Thirdly, the fixed wing aircraft could establish a series of field fuel and service facilities in the area of the survey with the rotary wing aircraft operating from these field bases to position parties. The rotary wing aircraft would then need to be capable of lifting a party and full equipment, i.e. about 800 lbs., over distances of about 50-70

miles. Of the three approaches the last is probably the most efficient but would impose the additional condition that the rotary wing aircraft be suitable for operation from a field base with necessarily limited heating and service facilities. With this condition in mind a turbine engined machine would be more suitable than a conventional piston engined machine. In any case, there are rotary wing aircraft which could be easily transported by the presently available ships and operated from them. These would meet the load, range and field operation requirements and not present great logistics problems due to their uniqueness in this country. The "Beaver" would be adequate as a support aircraft though barely so.



SURVEY EQUIPMENT

1	Tripod for Theodolite and Tellurometer.	9	100ft. Tape.
2	Theodolite. (Wild T.3)	10	Plumb bob
3	Heliograph.	11	Psychrometer.
4	Theodolite Lighting Outfit.	12	Heliograph Tripod.
5	Tellurometer Rucksack.	13	Prismatic Compass.
6	Tellurometer. (MRA3)	14	Lucas Lamp.
7	12 Volt Battery Box.	15	Altimeter Battery.
8	T.A.S Battery Charger.		

Communications :

Communications are always a most important aspect of field surveys and more particularly so in an operation of this nature where it is necessary to co-ordinate activities of three field parties and three or four aircraft. The field communications sets used throughout the survey were the U.S. Army Signal Corps set ANGRC 9. This set has an output of 7 watts phone and 12 watts cw. when powered from a vehicle power supply and dynamotor. Weight complete for hand powering is 85 lbs., and 80 lbs. for vehicle installation, excluding battery. Drain with the dynamotor is 200 watts on transmitting and 1.5 watts in receive. The set is of World War II design and quite unsuitable for this type of operation due to its weight and inefficiency. Field sets for future use should be not more than half this weight and must be fully transistorised for lower drain. Single side-band would be very desirable. Crystal frequency control of five channels, two of them on time signal frequencies, is necessary to give stability and an adequate selection of frequencies for various conditions. Hand or foot-powered generators are reliable, but with the availability of nickel-cadmium or silver-zinc batteries, and ultra light-weight petrol powered generators such as the TAS PG200, these would provide a more desirable power supply.

Technical Equipment :

Throughout the survey all technical equipment functioned well though an upper limit of distance that can be reliably measured with the MRA3 under average Antarctic conditions would probably be about 40 miles. The Tellurometers used were modified before leaving Australia by the fitting of a zero detent device on the readout scale. This took the form of a spring steel tongue which engaged in the milling around the edge of the inner circle boss when actuated by a cam lever. At higher temperatures, say to + 25°F this device operated well and held the zero set adequately though it was still necessary to actually sight the reading scale while setting the zero. At lower temperatures there was a good deal of friction between the inner and outer readout drums and the zero detent could be quite easily over-ridden while aligning the cursor to the CRT trace. For future low temperature operation it would be very desirable to machine the bearing surface between inner and outer readout drums so that the contact is made around two fine surfaces rather than the present one 1½ inch wide surface. With low temperature lubrication this could vary considerably reduce friction and allow fitting of a more rapidly set zero detent device. This could take the form of a spring loaded ball in the outer drum and a depression in the body of the instrument to accept the ball with the readout scale at zero.

It would not then be necessary to view the scale while setting the zero and the spring ball could be overridden when the inner and outer drums were locked together after alignment of the CRT trace. The trace was at all times visible though a visor attached to the outer drum and shading the tube face would be desirable for use with the sun behind the observer. The Sonotone nickel-cadmium batteries for internal mounting in the MRA3 were tried only once and there was a considerable spill of electrolyte under normal carriage conditions.

As these batteries do not gas during discharge, and allegedly can be used even inverted, there is some conjecture as to whether there should be a further liquid seal under the vented cap in each cell. Actual battery drain is about 4.0 amps with the crystal oven boost coil on, and 3.0 amps with boost coil off but oven coil on.

Average time from switch-on to first oven cycle at + 10 F is 15 minutes varying by up to ten minutes depending on wind speed and direction and generally the crystal oven heater would be off for only about 10% of the time during the measurement.

The batteries used throughout the survey were standard 12 volts lead-acid car type accumulators of 30 ampere/hour capacity with a high specific gravity electrolyte. These held charge well though were probably somewhat down on rated capacity, possibly as much as 10%-15%.

Batteries were charged in the field with TAS model PG200 portable generators and these functioned very well. Total weight of the unit is 14 lbs., output is either 12V 10 amps DC, or 240V. AC or DC at 1.7 amps. Fuel consumption averaged about 2/3rds pint per hour of 1:30 oil : petrol mixture. No major problems were

encountered though future units could well do without the unnecessary and complicating 240 volt circuitry, and a sounder fuse holder arrangement would be desirable.

The Wild T3 theodolite performed excellently and all clamps and tangent screws operated freely and smoothly to temperatures of -5°F. No stiffness was observed in either horizontal or vertical axis or alidade bubble bearings.

The Assman-Lambrecht psychrometers gave no trouble with the clockwork motors though the thermometer scale could profitably cover a lower and smaller range of temperatures and so make reading easier. Below about 20°F it was not possible to keep water to wet the wet bulb so that it was necessary to read only dry temperature and adopt an average relative humidity for calculation of vapour pressure.

The beacons used in the Framnes Mountains were 10 feet high with 3 feet square vanes painted with orange "Day-Glo". With the sun behind them they were very difficult to see if sky-lined and against a dark background were impossible to see. Generally it is felt that the plain black beacon would be more suitable.

Technical Problems:

The only unusual phenomenon encountered was the absorption or complete reflection of the Tellurometer signal over some lines under some conditions. On several occasions this completely prevented contact being established, and on others was observed to begin and increase during the measurement of a line. In these cases the phenomenon was more noticeable on the high cavities than the lower. Most commonly the drop off in signal would be preceded by a mild ropiness developing in the measuring trace, followed fairly rapidly, within one to five minutes, by a rushing sound in the head phones simultaneous with the loss of measuring trace and development of a "snow" or noise pattern on the CRT trace. This in turn degenerated to complete silence and no indicating of incoming signal on the CRT or the switched meter. At all times crystal current, modulation and battery level were quite acceptable at both ends and there was no indication of tune instability. On all of the occasions on which this phenomenon was encountered there were periods during which the signal returned briefly without any effort on the part of the operators, though these periods every time became briefer, and the signal weaker, until contact was completely lost. On two occasions the loss of signal strength was not so rapid or great at one end of the line as the other; in one case the lesser signal loss was at the remote end and in the other at the master end.

In all, the phenomenon was encountered on five lines with the fluctuation of signal being observed on five occasions. In all but one case of signal fluctuation the loss of signal could be approximately coincided with an increase of drift or haze along the line, and in all cases of complete failure to establish contact there was light to moderate drift on the line. On a 50 mile line it would cause signal fluctuation even where optical intervisibility was still good. The Fram Peak - Leckie Range line presented the greatest difficulty to measure, it being 50 miles, barely line of sight and over an area of relatively high drift. On several of the attempts to establish contact over this line the drift along it, possibly only 20-30 feet high, was sufficiently dense to cause the terminal stations to appear very hazy from the other end and it is doubtful that good measurement conditions would prevail over it except by a very unusual chance.

This phenomenon was also encountered during the over-snow tellurometer traverse at Wilkes in summer 1962-63 on lines as short as two miles. In this case the onset of the phenomenon was definitely correlated with an increase in drift snow density or with the occurrence of snow showers and appears to be something which must be expected for over-snow operations.

One possible explanation of the different degree of signal loss at both ends of a line is that if there is a relatively thin diffusing layer near one end the signal out from that end would be scattered very widely, so that the amount of signal reaching the collector at the other end would, be very small. On the other hand the signal from the end distant from the diffusing layer would not have as great a spread relative to the collector and would show as a stronger signal. This phenomenon has occurred with the Hydrodist system where there is spray close to one end only.

On the Lucas Nunatak to Onley Hill line the largest ground swings encountered during the survey occurred, being 21 milli-microseconds on the forward measurement and 22 milli-microseconds on the reverse. Both stations were situated on rock ridges dropping very steeply (about 400 feet in the case of Lucas Nunatak and 600 feet in the case of Onley Hill) to bare, almost flat blue ice, the maximum ground clearance along the line being about 700 feet with a mean clearance of much the same figure. On both measurements a full cycle of ground swing was developed and the results showed a prominent sinusoidal appearance overlaid with a minor sinusoidal pattern of about 4 ms. The two measurements agreed to within one part in two hundred and four thousand.

Determination of vapour pressure presents some problems with temperatures of the order of 20°F and below, though errors will be less critical than at higher temperatures.

Where it was possible to measure wet bulb depressions the mean relative humidity was of the order of 90% with a range from 75% to 91%. The research section of the Bureau of Meteorology was contacted and asked for any results of relative humidity determinations made on the ice cap. The mean value quoted for observations over the last 10 years was 90% with a range of 15%.

It would seem reasonable to assume a mean relative humidity of the order of 85-90% for temperatures below which a wet bulb depression can be measured, and to use this figure to determine a vapour pressure.

The effect of a 15% error in assumed relative humidity of 90% at various temperatures and pressures typically encountered is shown below.

15th Relative Humidity Error

Temp.°F	PressureRefractive	Index error (Parts per million)
+ 10	26"	2
00	26"	2
- 10	26"	1
+ 10	29	2
00	29	1
- 10	29	1

Appendix iii is a table showing vapour pressure against dry bulb temperature for a relative humidity of 85% to facilitate computation of refractive indices.

Future Projects :

It is very doubtful that the transport facilities available during this survey would be capable of supporting a project of any greater magnitude or one more remote from base facilities so that all possible steps to improve support facilities should be taken if it is intended to continue with traverses of this nature.

The present traverse can be extended westwards through the Aker Peaks/Napier Mountains regions though advice from the pilots indicate that the considerable altitude of the Plateau here would necessitate the use of larger aircraft.

Possibilities of spur traverses to the coast exist from Rayner Peak to Martin Island and Abrupt Point; from Mt Mueller to Martin Island and from Baillieu Peak to Byrd Head. These spur traverses are connected through the chain Martin Island - Abrupt Island - Broka or Havstein Islands - Fold Island - William Scoresby Archipelago - the islands off Taylor Glacier and then to Mawson via coastal islands.

This traverse is one that could be undertaken with the present aircraft if the ship is used for close support along the coast, as it is doubtful that much use could be made of the "Beaver" on coastal work during the summer.

Operations south of Mawson in the Prince Charles Mountains are felt to be impossible without larger aircraft. It is also felt that operations in this area would have to be undertaken from a field base for the aircraft.

Several aspects of the 1964-65 traverse could well be improved in any similar future undertaking. Possibly the outstanding of these is the difficulty of co-ordinating party activities and transport requirements by radio from the field. It is strongly suggested that in future the senior member of the survey group should remain at the main operations base to plan moves in liaison with other sections of the expedition, especially the transport section. This would also allow the Senior survey representative to maintain contact with the photographic programme.

The use of untrained men as assistants in the survey parties placed a good deal of extra strain upon the observers who are already highly stressed in this type of operation. It is realised that the provision of competent field assistants from within the Division of National Mapping would cause problems of shipboard accommodation but if this were possible it is believed the survey could progress much more satisfactorily.

Appendix i

CAMP EQUIPMENT

Beche Tent (complete)	1
Tent repair kit (needles, thread, palm leather, ventile 2" webbing, 1" webbing, fabric adhesive, PVC tape, tying wire)	1
Onazote mats	4
Ice Axes complete with sling & cover	2
12 Man-day ration packs	2
Climbing rope No. 4 120 ft. long	1
Climbing rope No. 3 " " "	1
Karabiners	3
Crevasse rescue stirrups (prs.)	1
Medical kite (additional to personal)	1
Optimus kerosene stoves	1
Stove spares, (pricker, jets, pump washers, spindle, packing, spanner, burner, plate, pump, valve, safety valve)	1
Thermos flasks, 1 gallon	1
Thermos flasks, 1 quart	1
Tent groundsheet	1
Marker poles with pennants	1
Garden spade	1
Nest of billies (3 per set)	1 set
Knife, fork and spoon set	3
Esbit tablets (packs of 20)	4
Kerosene in polythene containers	6 quarts
Aluminium plates	4
Plastic cups	3
Filler funnel for stove	1
Waterproof matches (packets of 12 boxes)	2
Candle	2
Skinning knife	1
Tin opener	1
Whisk brooms	2
Toilet paper (rolls)	1
Paper towel (rolls)	1
Tube parasol cream	1
Headlamp torch c/w spare globe	1
Distress signalling kit (4 polythene strips 7 ft. x 1 ft., 2 Mars distress flares, 1 ground/air code.	1
Kit bags - as required for stowage of above.	

SURVEY EQUIPMENT

Item	Front		Centre		Rear	
	No.	Wt.	No.	Wt.	No.	Wt.
Tellurometer c/w pack & spares	1	41	1	41	1	41
Theodolite *T3* c/w tripod	1	51	1	51		
Theodolite *T2* c/w tripod					1	32
Thermometers, pocket	2	1				
Psychrometers			1	8	1	8
Altimeters, banks of	1	7	1	7	1	7
Camera 35mm. Nikon	1	4			1	4
Panhead for cameras					1	2
Battery 12v. c/w box	1	34	1	34	1	34
Battery charger TAS c/w fuel & leads			1	15	1	15
Hammer & chisel	1	2				
Plumbobs c/w line	2	2	2	2	2	2
Prismatic compasses	1	1	1	1	1	1
Helios	1	10	1	10	1	10
Lucas lamps	1	10	1	10	1	10
Tripods for helios and lamps	1	5	1	5	1	5
Radio AN/GRC 9	1	65	1	65	1	65
ANARE radio receiver	1	5			1	5
Nautical almanac, star almanac, alt- az. tables, star planisphere	1	3	1	3		
Stopwatch	1		1		1	
Chronometer	1	1	1	1	1	1
Yukon pack *	1	8	1	8	1	8
Lighting set H.D.	1	3	1	3		
Polaroid camera	1	4				
Air photography field books, met.tables, maps.	1	3	1	3	1	3
		260		264		249 lb.

* Supply of rope also required for lashing packs.

Appendix ii

Party Functions :

The functions of the various parties will be :

1. FRONT PARTY :

(i) Station reconnaissance and marking.

(ii) Observation of simultaneous reciprocal astronomical azimuths to the centre station, and as accurate an astronomical position determination as time allows. At the first station occupied by the front party, sufficient time will be allowed for the position to be determined with a p.e. not exceeding 2 seconds of arc.

(iii) Provision of an observing target to which the centre party will read horizontal angles.

(iv) Marking of the station in such a manner, THAT IT WILL BE POSITIVELY IDENTIFIED ON 35 mm. aerial station spot photographs.

(v) Identification of the station on the best available aerial photographs existing in the area.

2. CENTRE PARTY :

(i) Observation of simultaneous reciprocal astronomical azimuths to the front party.

(ii) Tellurometer distance measurements to the rear party.

(iii) Observations of each traverse angle and simultaneous reciprocal vertical angles to the rear party.

(iv) Observation of horizontal and vertical angles to all major features visible from each station, and their identification on the best available aerial photographs or maps of the area.

(v) Radio liaison with the ship and aircraft.

(vi) Provision of an observing target to the front and rear parties as required.

3. REAR PARTY

(i) Tellurometer distance measurements to the centre party.

(ii) Observation of simultaneous reciprocal vertical angles to the centre party.

(iii) Rounds of overlapping horizontal terrestrial photographs of the full horizon at each station.

(iv) Aerial photography of each station, as near vertical as possible, at 500 ft. intervals, up to 2000 ft. for identification purposes and several close obliques from various angles of the outcrop on which each station is situated.

(v) Provision of an observing target for the centre party as required.

The surveyor of the rear party will have the assistance of a geologist for the survey operations, and at their completion will place himself at the disposal of the geologist as, and when required.

Standards :

The minimum standard of all observations shall be that acceptable for a Division of National Mapping second order traverse.

Radio Communications :

Interparty communication will be by the Tellurometer speech channel and will be held each day at 0600 and 1900 hours, and, if arranged, at any other time. In addition, each of the front and rear parties will listen out on the A.N.A.R.E. sledge set receiver at the time of any sked. arranged between the ship and centre party.

Meteorological Observations :

In addition to the meteorological observations required in the normal course of survey operations each party will carry out observations as required by the Senior Meteorologist.

Field Notes :

Field notes must be kept clearly, legibly and fully, and, so far as applicable, in accordance with standard Division of National Mapping procedure.

Equipment :

Appended is a list of technical and camp equipment as required by each party. It will be the responsibility of the following to see that all equipment for the respective party is serviceable, and that it is correctly loaded and moved to each station :-

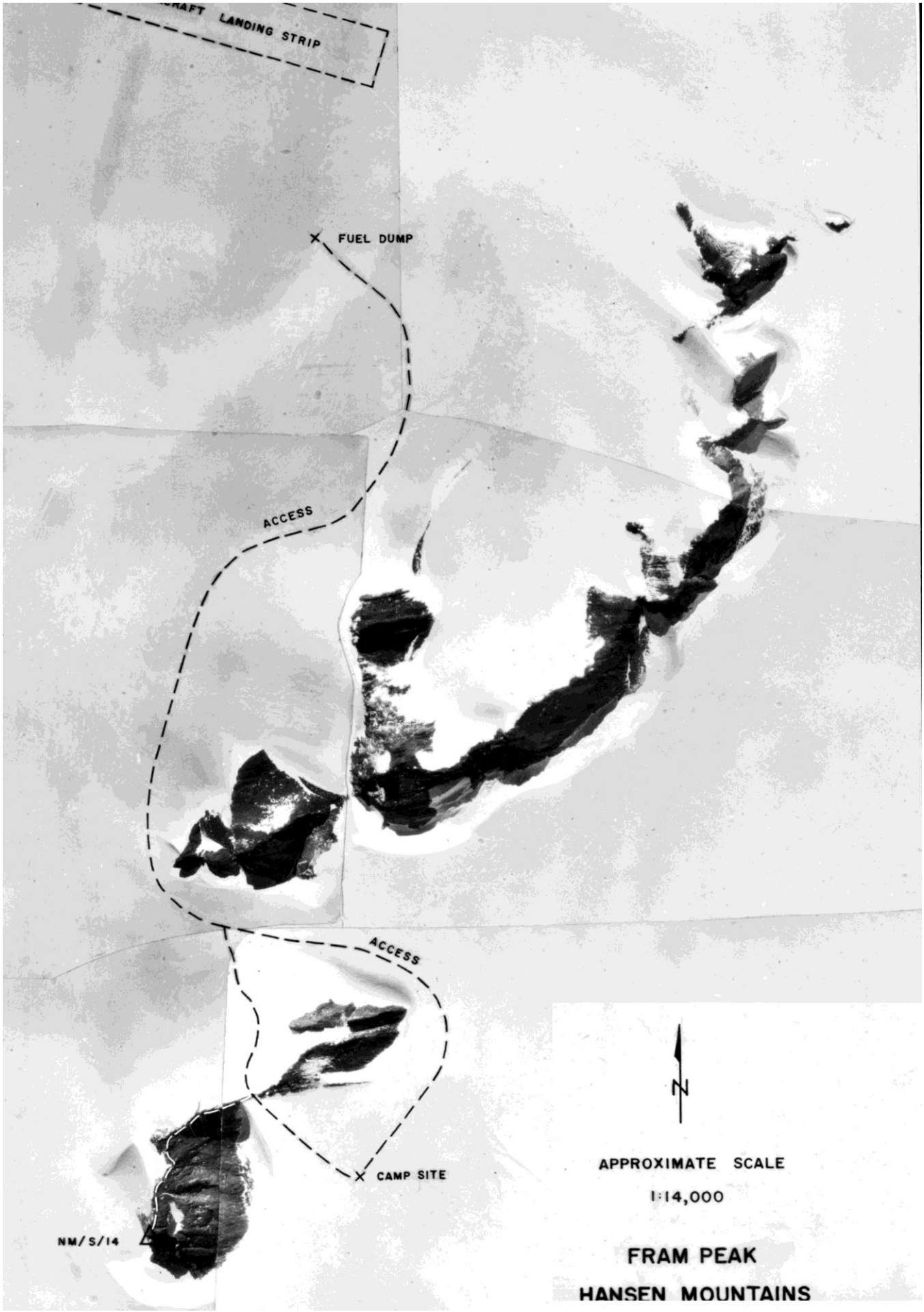
Front party	- R. Maruff
Centre Party	- J. A. Farley
Rear Party	- M. J. Corry

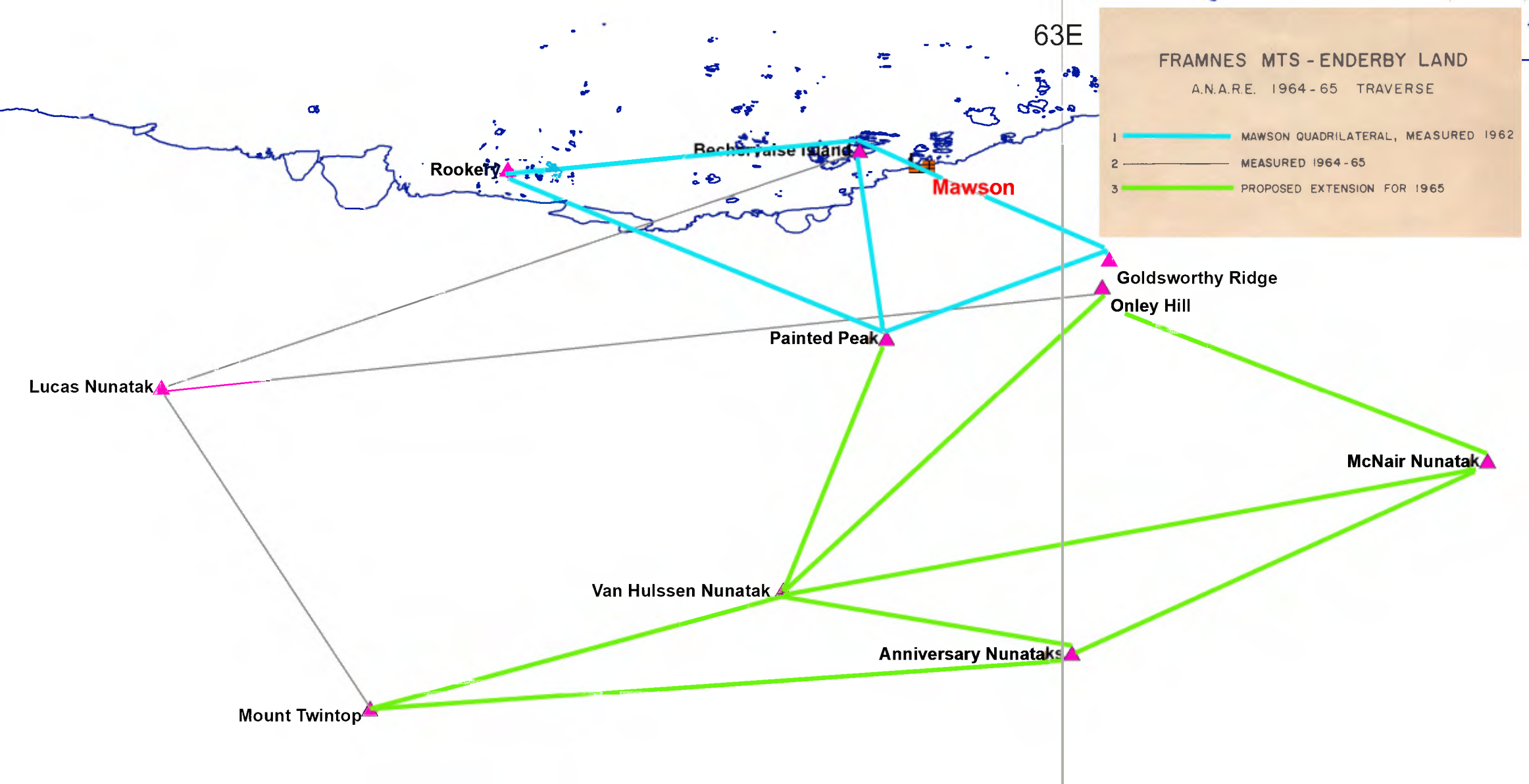
Personal gear will remain an individual responsibility, and will be kept to a reasonable minimum.

The senior member of each party will keep a full official diary, bearing in mind that these will be required for the preparation of the survey report. As such, any unusual phenomena or difficulties (technical or otherwise) should be particularly noted. The parties equipped with official cameras will obtain as many photographs as possible suitable for report illustrations. It would be appreciated if members could make available any suitable personal colour slides for this purpose .

At the scheduled time of any move, the party concerned will be packed and prepared to move off IMMEDIATELY on arrival of the aircraft.

S.L. KIRKBY


RAFT LANDING STRIP
FUEL DUMP
ACCESS
ACCESS
CAMP SITE
NM/S/14
N
APPROXIMATE SCALE
1:14,000
FRAM PEAK
HANSEN MOUNTAINS


63E
FRAMNES MTS - ENDERBY LAND
A.N.A.R.E. 1964 - 65 TRAVERSE
1 MAWSON QUADRILATERAL, MEASURED 1962
2 MEASURED 1964 - 65
3 PROPOSED EXTENSION FOR 1965
Rookery
Mawson
Goldsworthy Ridge
Onley Hill
Painted Peak
Lucas Nunatak
McNair Nunatak
Van Hulssen Nunatak
Anniversary Nunataks
Mount Twintop


FRAMNES MTS — ENDERBY LAND
A.N.A.R.E. TRAVERSE 1964-65
MEASURED 1964-65
POSSIBLE EXTENSIONS
MAWSON AREA
SCALE 1 : 1,000,000
20 STATUTE MILES
30 KILOMETRES
SEE INSET
SEE INSET
ANTARCTIC CIRCLE
ANTARCTIC CIRCLE
KING EDWARD PLATEAU
MT MUELLER NM/S/17
NM/S/16
LECKIE RANGE NM/S/15
FRAM PEAK NM/S/14
BAILLIEU PEAK NM/S/13
LUCAS NTK NM/S/11
MT TWINTOP NM/S/12
Mawson
MT HENDERSON
FRAMNES MOUNTAINS
DAVID RANGE
MASSON RANGE
CASEY RANGE
HANSEN MOUNTAINS
NICHOLAS RANGE
MT KJERRINGA
CONRADI PEAK
Cape Borley
Cape Davis
STANTON GROUP
COLBECK ARCH
Cape Bruce
Oom I
Endresen Is
Hobbs Is
Ryrie Rock
Kidson I
Stevens Rock
Martin Reef
Strahan Glacier
Cape Daly
SCULLIN MONOLITH
MURRAY MONOLITH
Cape Rouse
Shallow Bay
Point Williams
MT KENNEDY
CHURCH MOUNTAIN
LARS
RUSSELL NUNATAK
MCNAIR NUNATAK
PEARCE PEAK
BAILLIEU PEAK
MILL PEAK
MT HORDERN
MT TRITOPPEN
MT WARD
Einstoding Islet
Welch I
Kiung Islets
Canopus Islets
Van Hulssen I
Gibbney Islet
Rookery Islets
Holme B
Fold Island
Oygarden Group
West Stack
Havstein I
Tillett Is
Dales I
Warnock Is
Islay
Scoresby Bay
Hayes Peak
Campbell Head
Byrd Head
Howard Bay
Stevenson Islet
Cape Simpson
Tongue Rock
Low Tongue
Falla Bluff
Stibbs Bay
Oldham I
67°40'S
67°20'S
68°00'S
60°00'E
61°00'E
62°00'E
63°00'E