DEPARTMENT OF NATIONAL DEVELOPMENT AND ENERGY

Secretary: A. J. Woods

DIVISION OF NATIONAL MAPPING

Director: A. G. Bomford

TECHNICAL REPORT 28

SURVEYS FOR THE INTERNATIONAL ANTARCTIC GLACIOLOGICAL PROJECT WILKES LAND 1975–76

by

M. Kros

CANBERRA AUSTRALIA

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CONTENTS

PLATES

ANNEXES

SURVEYS FOR THE
INTERNATIONAL ANTARCTIC GLACIOLOGICAL PROJECT
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1. INTRODUCTION

In 1973 a trilateration network was established about 120 kilometres east of the Australian Antarctic station Casey. It started on Law Dome (S66°43'47",E112°50'08") and extended some 270 kilometres southwards in a series of braced quadrilaterals (see Annex A). Geoceiver stations and astronomical azimuths provided the control, with angles where necessary.

In 1975 the network was to be remeasured. The Division of National Mapping again provided a surveyor.

2. GLACIOLOGY FIELD PERSONNEL

Two field trips were planned for the remeasurement, the first one in autunm-winter, the second one in spring-summer. Eight men were to go on each trip, five of them on both. These were the glaciologist, the electronics engineer, the electronics technical officer, the Geoceiver operator from the United States Geological Survey and the National Mapping surveyor. The other three were the two diesel mechanics and either a radio operator or a meteorological observer, depending on who was available.

3. PRE-DEPARTURE PREPARATIONS

By mid-November 1974 most of the twenty-six men for the 1975 season were in Melbourne for indoctrination and training and to prepare both personal and official equipment. The seven glaciology field personnel organised meetings for general discussion and planning of the work ahead, and to check various instruments. The Tellurometers were fowd to be in poor condition and in need of a complete overhaul. Most of the internal parts were renewed, the work being performed by the electronics staff at Antarctic Division, Department of Science. The Geoceiver was also given a test run on the roof of the building. The batteries were overheating and the power supply in general needed much work done on it before departure. Two new fibreglass living caravans had been designed by the Royal Melbourne Institute of Technology (RMIT). They were similar to the ones already at Casey, but bigger (3.3 m x 3.3 m x 2.5 m) and weighed about 2 tons. Modifications and additions - to bnnks, wiring, installation of stove, etc - were done up to the last minute before departure.

4. SHIPBOARD ROUfINE

All loading was finally completed and the 'Toala Dan' officially farewelled on 10 January 1975 at 1700 hours, stopping at the ammunitions wharf to load some explosives before heading out to sea.

Once at sea, and until the ship neared the Antarctic mainland, everyone had their time to themselves. Talks were held by the doctor on cold weather safety and hygiene, and by the chief helicopter pilot on aircraft use and safety. Depths were sounded on a 24-hour roster by all the expedition members from latitude 60°S until Casey was reached.

After a calm trip, Commonwealth Bay was sighted in the late afternoon of 18 January. A short visit ashore for everyone was organised next morning; the main object of this visit was to report on the condition of Mawson's Hut for possible future restoration (Plate 1). The ship left the same afternoon for Dumont D'Urville, the French Antarctic station, and after a short courtesy visit during which the base was opened for inspection, left for Casey on 20 January. Only light pack ice was encountered and progress was uninterrupted until Casey was sighted on 23 January, the ship anchoring in Newcomb Bay. Shortly after arrival the wind increased until it was blowing a medium strength blizzard, about 75 knots, which lasted two days. When it eased enough to unload, the ship moved closer to Casey, swinging on a bow anchor and mooring by stern lines to bollards on Bailey Rocks. Unloading procedure had already been explained, and everyone knew what was expected and what had to be done.

5. HELICOPTER OPERATIONS

The Alouette helicopter carried on the 'Thala Dan' was useful, especially to the glaciologist. On 29 January it was available for survey use, so the day was spend carrying beacons to trig stations to the south of Casey, as far as Haupt Nunataks. These beacons had been prepared beforehand during the unloading. They were 44-gallon drums with one end removed and a square section (about 0.1 m) taken out of the other end for centering, painted red. A temporary ground mark in the form of a small triangle was chiselled in the rock at each new station. Panels for photo identification were painted on the surrounding rock.

Angles had to be observed from Browning Peninsula (NM/S/100) and Robinson Ridge (NM/S/103) to intersect the four nunataks along the coast around Penney Bay. As the weather was calm and it was possible to work late (there being nearly 24 hours daylight still), a quick return trip to Casey was organised to get a tent and supplies. These were put on Browning Peninsula, the helicopter then returning to Casey for the night. Horizontal angles only were observed during that night and early next morning, until the helicopter returned. No anglework was possible at Robinson Ridge as the helicopter was required elsewhere that day.

6. 1974-1975 CHANGEOVER

The official changeover occurred on 31 January, the 1974 crew changing over to the ship and the 1975 crew moving into the station. On 3 February the 'Thala Dan' left for Melbourne.

7. AUTUMN FIELD TRIP PREPARATIONS

7.1 Vehicles and Equipment

All field personnel were engaged in preparing vehicles, sledges and equipment for the first field trip. This involved a lot more work than expected, and the early departure all hoped for was delayed.

7.1.1 D5 Caterpillar Tractors

The two D5 caterpillar tractors (105 hp, 14 tons) were prepared first. They had been fitted with turbochargers for operating at high altitudes, and had extra wide tracks to reduce the ground pressure to about 4 lbs/sq in. New tracks had been brought from Melbourne; fitting them involved four people for six days, using the Hyster cranes for heavy lifting. Extra work to be done included the resealing of the cabins and the fitting of racks to the back of the tractors to stand on while refuelling. Further maintenance and servicing was done by the diesel mechanics.

7.1.2 Sledges

Four or five Frank Smith sledges were to be taken. These were general purpose sledges 4.0 x 1.8 m, weighing about 1.1 tons and capable of a 5-ton load. All needed many new floor timbers to replace those either broken or missing. Runners and towing bars had to be repaired and straightened. Side rails were fitted to make it easier to chain up the fuel drums, food racks and spares, and to stop the load shifting or being thrown off in heavy sastrugi. When they were ready they were loaded with fuel - aviation turbine kerosene (ATK) for the vehicles and Lister diesels, petrol for the Herman Nelson heaters, oil and glycol - and towed away to S1, the site of an experimental building about 8 km inland from Casey and most of the way up the steep initial climb. One Freighter sledge was also to be taken, 6.1 x 2.4 m weighing 2.5 tons, taking a 9-ton load, with articulated runners. Much work also had to be done to this sledge to make it serviceable.

7.1.3 Nodwells

The two RN110 Nodwells (large, independent, tracked vehicles accommodating usually two people, and fitted out for living and working - see Plate 10) - were the greatest problem, and were the main reason for the delayed departure. Nodwells 2 and 3 were to be taken, No 2 being worked on first. The diesel mechanics completely overhauled the engine, gearbox, and clutch, then with the aid of the electronics engineers installed a 24-volt generator for driving instruments. The existing banks of batteries for the 12-volt and 24-volt supplies were at the rear of the vehicle under the shelf. With this system terminals had to be changed and reconnected when going from one voltage to another, so the batteries were removed and relocated in a more convenient position so that 12 and 24-volt supply could be permanently tapped from them. Existing 12 and 24-volt wiring, mostly PVC, was taken out and replaced with pyro tubing. The interior was cleaned and painted. Shelves for personal gear, instruments and food were built in, then the instruments - VHF radio, navigation radar, ice radar and barograph installed. Additional handrails were fitted on the roof for safety, a support to carry the VHF antenna welded on and a large cross-bar to carry the ice radar antennae added. Defective driving lights were replaced and many minor repairs carried out. Some broken springs had to be replaced and the tracks repaired. A cyclometer with electronically driven counter was added to measure distances; it had a mechanical counter on the wheels in case the primary unit failed. After fitting out with food, fuel and personal equipment, Nodwell 2 was ready for departure.

Nodwell 3 also took a lot of work, mainly due to an unserviceable gearbox. One bearing had to be replaced, a new one being turned on a lathe. After reassembling and trying to fit the gearbox it was found that the clutch bellhousing was of a different size and would not bolt to the engine. Many modifications had to be made to overcome this.

7.1.4 Workshop Caravans

Two workshop caravans were to be taken. These contained the Lister diesels driving 7.5 KVA alternators for 240-volt power supply, as well as a complete set of tools for all the vehicles. They weighed about 2.7 tons. They both had to be cleaned out and restocked with tools and spares. Modifications and realignments had to be done to one of the alternators and exhaust systems, as well as the rewiring of the switchboards.

7.1.5 Living Caravans

RMIT living caravans needed further alterations. Racks were built on the front to take the standard size fibreglass food boxes, with an extra stand for the VHF antenna. A gas bottle was added to the rear and the step modified. Radio and other instruments, personal gear, food and cooking equipment was installed.

7.2 Personal Preparations

First aid lessons were organised by the doctor to give everyone a basic knowledge in case of emergency. Each item in the comprehensive medical kit was explained, as regards dosages, quantities, etc. Some practical work (injections and suturing) was also done. Everyone was subjected to a thorough medical examination shortly before departure.

Practice measurements on Tellurometers were organised, using the complete field set up from a caravan to familiarise everyone with the operation, and also to give the instruments a final check. Trial observations on daylight stars were done using the Ney method to check the T3 theodolite, the stopwatches and radio, and to establish an observing routine between observer and recorder.

8. AUTUMN FIELD TRIP

The first major field trip eventually left Casey late on 3 April, with the first stop at S1 to pick up the fuel sledges and to reassemble each D5 train. Much difficulty was experienced trying to get the heavily laden D5 trains away, as each was towing nearly 25 tons. The combination of slope and blue ice, which gave little traction, was too much so finally both D5s had to be hooked to each train in turn to tow them to the top of the initial slope.

The field party was made up of 'A' and 'B' teams, the letters representing the sides of the trilateration network they were to work on.. Toe 'A' team was made up of Nodwell 2 and a D5 tractor towing three Frank Smith fuel sledges, a workshop caravan and the RMIT caravan. The 'B' team was made up of Nodwell 3 and a D5 tractor towing one Freighter fuel sledge, one Frank Smith fuel sledge, a workshop caravan and the RMIT caravan. Radio call signs had been allocated to each vehicle, prefixed with the team letter. Nodwells were Al and Bl, the D5s A2 and B2, the RMITs A3 and B3. A typical call sign therefore should be 'Al to B3', which meant the 'B' side RMIT was calling the 'A' side Nodwell.

Toe route out to Law Dome (see Annex B) was marked by canes and drums at 0.5 to 1 km intervals - a complete list of markers and distances was in the survey office at Casey. Soon after passing Blythe Junction the traverse was stopped by a two-day blizzard (Plate 7). After it eased, the 'B' team went off to the. Autostation (Plate 18) and the 'A' team direct to B001 and A00l. The Autostation was an automatic recording station for scientific data. It included a Riometer (Relative Ionospheric Capacity Meter) which recorded the 30 megahertz incoming radiation through the atmosphere, a fluxgate magnetometer to monitor the earth's magnetic field, and meteorological instruments to record air pressure, wind speed and direction. Data was recorded automatically on 7-track half-inch magnetic tape, 975 m long with room for 5,000,000 samples of data using CMOS logic. A crystal-controlled clock, accurate to 1 second/year, recorded the time of each recording. The tapes were retrieved at least once a year, either by an expedition passlng through or by helicopter during the changeover periods. An All-Sky camera took one picture every five minutes for monitoring auroras, switched on by a photocell. Banks of lead acid batteries were used to power the instruments, which were charged by solar panels and by a wind driven generator. Only the wind generator, the antennae and meteorological instruments were still above grolUld. The recording equipment and batteries were in a room now below the surface - it was originally on the surface, but had been covered by snow over the years.

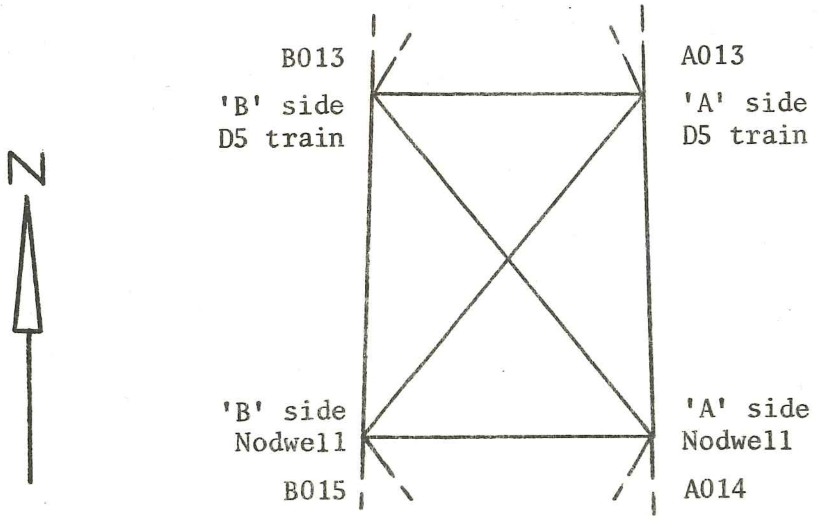
At A00l the Geoceiver was set up for the first time on 10 April 1975, the beginning of the traverse network. A small fuel dump was dug out of the ice and re-established on the surface. 'B' team rejoined next day and the main work began.

Soon after the remeasurement began there was a major mechanical breakdown at 8003, Nodwell 3 having a seized engine bearing. It could not be repaired, and the vehicle was left. One of the men from the 'B' team joined the 'A' team to give more room in the caravan. Nodwell 2 now had to continually go from the 'A' side to the 'B' side to do both forward Tellurometer measurements. Station A003 was missing and had to be replaced. Whiteouts - diffused light coming through thin cloud causing a total or partial loss of depth perception due to the absence of all shadows - low temperatures and strong drifts often slowed progress. A009 was reached on 25 AprH, and the Geoceiver set up. A blizzard stopped all operations until 7 May, when an astro-azimuth was observed and travelling resumed. Station B013 was missing, and some time was spent trying to relocate it. The line between A014 and B015 could not be measured due to a ridge in between, so an intermediate station was set up and tied by measurement to A014, A015 and B015. The Geoceiver was set up on A015 on 16 May. It was originally intended to try and finish the autumn trip at B021, but now winter was close and there were so many delays due to bad weather that we finished at A015. All the spare fuel was taken up to B021 and added to the existing dump there; two men remained behind to try for an astro-azimuth if the weather cleared. The rest went on with the remaining vehicles. While at B021 trouble was experienced with the D5 tractors, the alternator in the workshop caravan and with the Herman Nelson. This prevented them returning to A015 until 24 May, whereupon everything was immediately made ready to leave for Casey. The weather at A015 was notoriously foul, as it lay in the "Saddle" and the winds channelled down into it; everyone was therefore anxious to be away as the continual strong wind and drift snow made outside work unpleasant.

The return trip started on 26 May, travelling almost non-stop to A003 where the 'B' team branched off to retrieve Nodwell 3 still at B003. The rest continued to B001 for a Geoceiver station, arriving late afternoon on 27 May - giving an average speed of almost 5 km/hour. This was a reasonable speed as the surface was relatively smooth. From B001, the 'A' team went back to Casey via Cape Folger (see Annex B), making ice radar and gravity measurements. An ice core sample was taken at the 1974 drill site to be examined for oxygen isotopes for climatology studies. Everyone was back at Casey by 4 June 1979.

9. WORKING PROCEDURE

Once the Tellurometer measurements began, the 'A' and 'B' teams were to act separately, each going down their own side of the network. The usual practice was for the Nodwells to move off together in the morning to the forward station; while they were travelling the D5 trains would be preparing to move, heating the D5 engines, etc. When the Nodwells reached their new stations the back and diagonal measurements would be made. If another quadrilateral was to be measured, then all vehicles would move up to the next station. If not, the D5 trains alone would move up and join the Nodwells, the former two in the meantime measuring the cross distance between the occupied stations.



Typical disposition of vehicles during measurements.

9.1 Barometric Levelling (see Annex C)

Barometric levelling was recorded continuously on the barograph (serial 747) by Nodwell 2 while moving from one station to the next. This was to record the surface profile. The 'A' side train usually acted as a base station for this purpose, taking readings every 10-15 minutes, depending on how quickly the barometric pressure was changing.

The final pressure reading for the station elevation was taken manually after arriving at the forward station and notifying the base station so that the tw9 readings were taken simultaneously.

9.2 Ice Radar (see A nex C)

Ice radar measurements for dep hs of ice were also taken while travelling. Nodwell 2 had two antennae for this purpose, a transmitter and receiver one on e ch side ?f th vehicle. By comparison of these readings with th; barometric levelling, ice depths and a profile of the bedrock could be obtained. The ice radar results were recorded photographically from a cathode ray tube. The intensity of the signal from the ice radar was so great hat the VHF radio ha to be turned off to prevent damage; so no communication was ever possl.ble with Nodwell 2 while it was travelling.

Polarization studies were done at various stations with the Nodwell stationary. The transmitting and receiving antennae were rotated through 360° separately, and the echo times and strengths observed to see if the ice layers were rotating the direction of polarization of the wave. The results, however, were random and only produced a better picture of the bedrock at that point.

9.3 Accumulation of Snow (see Annexes D and E)

At ach station the accumulation was measured. The station mark was a 5 cm diameter snowpole o steel tubing, n three sections 3.15 m long, each fl ged at one end to receive another section. The bottom two sections were white, the top one black and orange for easier identification. A hole was bored 2 m deep with a Sipre corer to take the snowpole. The accumulation was easu:ed from the bottom flange to the ground. By comparison of this readin? with the 1973 value, the amount of accumulation (or ablation) could be derived. A stamped metal tag was wired to each pole for identification.

9.4 Gravity

Gr vity easurements ere made at each station to determine the change in the ice thickness and time, and to supplement the ice-radar for ice thickness determination knowing the latitude and elevation. The latter use' however, gave considerable anomalies and was only a very rough guide. A Lacoste & Romberg Type 6 gravitymeter was used.

10. TELLUROMETER MEASUREMENTS

The MRA2 Tellurometers (serials 976, 2029, 2039 and 2040) had been dapted so that the antenna and dipole could be separated from the main instrument (Plat s 12 and 13) .. The antenna was mounted high on the snowpole, two cables carrying the transmitted and received signal to and from the Tellurometer inside the caravan or vehicle. This worked well for operator comf?r , as measurements could still proceed in otherwise unsuitable conditions. :The only problem was that much of the power output was lost in the cables. On the other hand, the extra clearance over the ice, especially on grazing lines, added to the signal strength. Cable connections often gave problems as they could be worked loose by wind or careless handling. If the connections were at all loose, the signal was hazy and distorted.

On arriving at a station for Tellurometer measurements, the Nodwell drove as close as possible to the pole. An arm was swung out from the roof and clamped on to the pole. The Freighter caravan had a similar system, but was winched in close to the pole by the D5. The pole was made vertical by one person checking on the ground with a spirit level against the pole, the second person on the vehicle or caravan roof adjusting the pole and clamping it when vertical. The antenna was clamped to the pole, the cables connected and passed inside and connected to the Tellurometer. By this means the antenna was held rigid and stable. With the fibreglass caravans, however, the pole had to be guyed by three ropes and a step-ladder used to put the antenna as high as possible. This was never a satisfactory arrangement, but was the only one possible as no platform could be built on their curved roof. If the distant station was visible the antenna was aligned by eye; if not, a reverse compass bearing was set out to the pole, a cane driven in the snow and the antenna aligned on that to establish contact. Fine tuning for maximum signal strength was carried out by one person swinging the antenna slightly and the second person watching the Tellurometer for maximum meter deflection. One Tellurometer in particular needed a very long time to warm up, and was therefore plugged in to the power source while still travelling, to save waiting time at the next station.

The standard measuring procedure used was: coarse readings, mets, fine readings, mets, master/remote change function, fine readings, mets, course readings. With this procedure both sets of fine measurements were as close together as possible so as to minimise the effects of possible sudden changes in met conditions. The radio was used for all voice contact while measuring; the Tellurometers were tried but were found to require major retuning everytime the speak/measure switch was used, and the voice reproduction was distorted. Once a system was established a sequence of cavity changes could be ordered merely by flipping the master/remote switch from A to B and back again or by flipping the speak/measure switch. The remote station would change upon hearing the break in the signal tone. Ten cavities were read for the fine readings, between cavities 3 and 8 at half cavity intervals. Higher and lower cavities were avoided as they often had excessive ground swing. All measurements were recorded in the standard National Mapping Ground Control Traverse field books.

10.1 Meteorological Readings

The met instruments used for the Tellurometer measurements were placed outside (except for the barometer) as soon as the next station was reached, so as to give them the maximum time to cool and settle. Lambrecht Assman psychrometers were used for dry bulb temperature measurement, and were effective and accurate; they had to be placed out of direct sunlight when operating as radiation had a marked effect on the readings. The dial hygrometers of the same make often gave inaccurate readings. They were slow to settle, could freeze in any position and were affected by snow or drift. The vapour pressures were calculated from the relative humidities and saturation vapour pressure tables. The Mechanism digital barometers (serials 747, 748, 618/64 and 646/46) were usually reliable and accurate and kept constant to the Askania carried in Nodwell 2 which was used as a standard. In the caravans the barometers were subjected to heavy knocks while travelling, and were wound back to avoid damaging the contacts.

11. FIELD MEASUREMENT CHECKS

11.1 Tellurometer Distances

All the Tellurometer distances measured were recorded each day in the file 'IAGP 1975 Quad Distances and Checks' and checked. The two measurements over each line were compared. When ambiguous readings occurred, or when the two readings were unacceptably different, the line was remeasured. Over short distances, as from A001 to A011, it was not possible to maintain continual high accuracies in parts per million. Typical accuracies ranged from 1 in 16 000 to under 1 in 100 000 for the same length lines, the only difference being in Tellurometer combinations, different surface conditions and different meteorological conditions. It was not due to the operators as different operators were tried over a few troublesome lines and the same results still obtained. Over longer lines, from A011 to A035, it was easier to obtain better accuracy in parts per million.

11.2 Quadrilateral Checks

The reduced slope distances were used to check each quadrilateral as it was measured. A standard calculation sheet was prepared using the cosine formula - see Annex F. Each of the eight angles were calculated using these distances and then summed to check the misclose from 360°. Overall, this ranged from 1" to 47", with a mean of 20". A few quadrilaterals were checked with slope distances reduced to horizontal sea level distances, and in all cases closed better. All the calculations were done in the file 'IAGP 1975 Quad Distances and Checks'.

11.3 Azimuth Checks

As each quadrilateral was checked the misclose was adjusted and the azimuth carried forward from the previous quadrilateral. The initial azimuth was observed at the first Geoceiver station, and was carried through the quadrilaterals to the second Geoceiver station where another azimuth was observed. This gave a check on the azimuth reductions and on the eccentric calculations.

11.4 Electronic Calculators

These were valuable in the field and simplified calculations and reductions. On both field trips there were Hewlett Packard models 35, 45 and 65. It was never necessary to resort to logarithms or to tables of natural functions as these calculators had all these functions built in. The nickel cadmium batteries lost charge quickly if allowed to get cold, but if the calculators were kept in the vehicles or caravans they performed admirably and could be recharged from the 240 volt supply.

12. NAVIGATION

12.1 Astro Compasses

The astro compass was found to be simple, effective and reliable. It had the advantage of being able to use the sun, moon and stars or glow through clouds from either sun or moon, and of not being affected by unknown or changing magnetic declination. It mechanically solved the astronomical triangle and was used in conjunction with the Nautical Almanac for the appropriate year: values interpolated from this (GHA and hence LHA and the declination) were set on the compass. The latitude was set and the bearing of the direction of travel read off after aligning the sights on the celestial object observed.

The astro compass mounts on the vehicles had to be aligned for and aft, or else the misalignment known and applied to the bearing. The Nodwells usually went on ahead of the D5s, so it was up to them to find the next station. By keeping to the set course as closely as possible it was possible to arrive quite near to the next station, even over long distances. Each of the Nodwells had an astro compass mount on the roof, just in front of the roof hatch. Both D5 tractors also had a mount on their cab roofs, though they were seldom used due to the extreme jolting the compass received while travelling. One mount was later transferred to a Freighter caravan; this was quite effective as it was a relatively smooth base. Course corrections were given from the caravan to the D5 by VHF radio.

An example of a calculation sheet is given in Annex G.

12.2 Magnetic Compasses

These were used as little as possible, due to the large magnetic declination which could vary suddenly in a short distance. Normal magnetic declination was 97^{o} west at A001, but this could change to 107^{o} west quite abruptly. They were therefore used only on those occasions when it was not possible to use an astrocompass. Compasses supplied ranged from the prismatic oil filled type, to less satisfactory hand held models.

12.3 Cyclometers

One was fitted to each Nodwell from a bracket on the rear step. Both had electronic components driving odometers inside the vehicle. They were effective and accurate, and it was never necessary to resort to the standby mechanical odometer on the wheel. The tyres on the wheels of the cyclometers were kept flat: the continual flexing of the tyre prevented a large buildup of snow around the rim.

The D5 trains had no cyclometers; if they had to travel ahead of the Nodwells, distances were measured by noting times of departures and of every stop, and in which gear the D5 was travelling. Second gear was known to be 3.8 km/hour, third gear 4.6 km/hour. This was an effective method and gave good results, but it failed if much winching had to be done.

12.4 Navigation Radar

The radar fitted in each Nodwell was a useful instrument, though it had to be used with caution. Early in the first field trip too much reliance was placed on it, which resulted in lost time by travelling to wrong points visible on the radar screen. In rough country the higher sastrugi peaks were also picked up, and numerous traces were seen on the screen. In this case, the radar was useless as it was impossible to distinguish the station from the false traces. Proper tuning was essential to locate a station as mistuning could cause a trace to disappear. The radars were especially useful at night, as the Nodwell could zero in on a station until it could be seen in the headlights.

13. NEW STATION LOCATION

Occasionally it happened that on arriving at a predetermined point no station was visible. Unless due to an error in navigation this meant that the pole had been bent or broken by the wind and covered by snow. The procedure was then to do a series of coarse readings on the tellurometer to the other three stations in the quadrilateral (if only one was missing). By comparison with the 1973 distances, if would be seen if the vehicle was near the correct position. If not, a bearing and distance would be plotted to the original site. A new pole would be put in if the original one was not found, and the measurements taken. Sometimes observations could not be taken from the origina: site, as ice movement since 1973 had moved the station from a ridge down to one side. A new station would be located on the ridge.

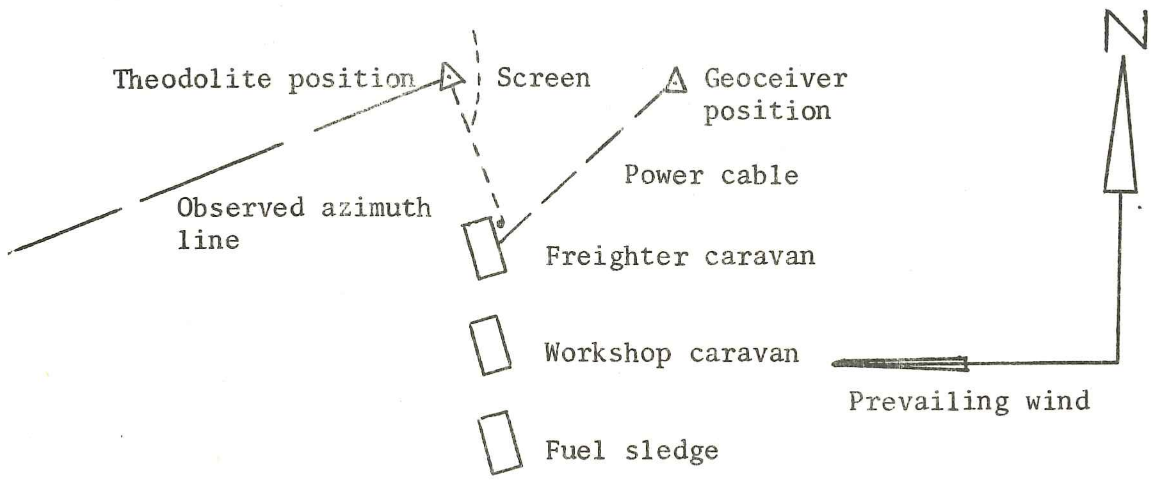
14. CONTROL STATIONS

Control stations for the network were at A001, B001, A009, A01S, B021, A026 and A034. At each of these stations Geoceiver observations were made and an astro azimuth observed.

14.1 Geoceiver

The Geoceiver was usually set up eccentric to the station so that Tellurometer measurements could proceed while the Geoceiver was running. This differed from the previous accepted routine of setting the Geoceiver exactly over the station mark by cutting off the snowpole at ground level - a new bottom section (corresponding in length to the section cut off) would be added and the pole replaced after the Geoceiver was removed. Eccentric corrections were calculated and added after the tapes had been processed in the USA. The minimum length of time spent at each station was three days, which enabled 30-40 passes of the satellite to be obtained. Only one satellite (20131) was observed, the Geoceiver being kept in manual mode. Prediction tables gave the times of rise and set of the satellite, with azimuths and maximum altitudes. The Geoceiver was turned on for each pass.

The prediction tables had been calculated a year in advance, but were reasonably accurate, with a slight drift through the year. There was usually a constant difference between the predicted and actual rise time. If more than one satellite was up at once, the Geoceiver would lock on to the strongest signal. If this was the wrong one, the instrument had to be manually detuned and locked on to the correct one. With experience, it was possible to tell if the correct satellite was locked on by the sound it made. Pressure, temperature and humidity, station and satellite identification were displayed on the front of the control unit in the caravan. A "header" and "trailer", punched separately before and after each pass, recorded this information and separated the passes. An electronic clock showed time to the nearest minute; a flashing light indicated each second. The punching unit operated automatically twice every minute when tracking, on the 32nd and 60th second, and recorded time and Doppler shift from the satellite on to 8-track paper tape. Each pass would take approximately 15 minutes. The information on the tapes was sent by teletype from Casey to Johns Hopkins University in the USA. When processed, the information was sent back to Casey and to the Department of Science in Australia. The results were on the NWL8E ellipsoid and had to be transformed to the International Spheroid for Antarctic purposes. This was done in Canberra by the Divison of National Mapping.



Typical arrangement of eccentric theodolite and Geoceiver at Geoceiver control stations

The antenna was set up on a Wild T2 telescopic tripod, the legs pushed firmly into the snow and kept as low as possible. It was also guyed against the wind. The Geoceiver had to be placed at a reasonable distance from the vehicles so as to give a reasonably uninterrupted horizon, and was tied into the actual station mark by measurement (Plates 10 and 11).

14.2 Astro Azimuths

An astro azimuth was observed at each Geoceiver site using the Ney method. A Wild T3 theodolite (serial 90981) was used, with a Heuer 0.1 s split-second-hand stopwatch and using VNG time signals. On the first field trip all observations were done at night; on the second, daylight stars used. A dozen or more sets were observed if possible.

In preparing for observations, the tripod was first set up and the legs driven hard into the snow. Pillars of snow were often built up around the legs, which gave an extremely solid base when set, helped prevent differential expansion between wood and metal parts, and also reduced any settling. The theodolite was placed on the tripod and levelled, then left to cool and settle before final levelling. A screen was set up as high as possible for wind protection (Plate 10). The whole instrument had to be completely shaded: radiation played havoc with the sensitive plate bubble (7"/2 mm), if part of it was exposed to the sun.

Prediction tables were used for finding the daylight stars. They gave apparent Wild T3 settings for azimuth and altitude for every 5 minutes of time (LST). An initial azimuth first had to be observed from the sun. Twenty-four of the brightest stars were listed. Though the tables were calculated for 1973 they were still suitable for use in 1975, the maximum change being about 4 minutes in azimuth and 1.5 minutes in altitude.

Communication with the recorder in winter was by an intercom system; in summer he was outside by the instrument. The intercom system allowed the recorder to be in the relative warmth of the caravan, making it easier for him to write. The other end of the intercom system was taped to the theodolite tripod.

A 12-volt battery placed under the tripod supplied power for the internal lights of the theodolite. In extreme cold this had to be replaced often as the low temperature reduced its capacity.

A pair of electric gloves were used on the second field trip, protecting the hands well from the cold and making observing much easier. This allowed much better control of the instrument due to the increased "feel", though they had the disadvantage of draining the battery quickly. If no electric gloves were available, woollen gloves with Cape leather gloves over them worked quite well for a short time.

When observing, care had to be taken not to breathe on the instrument, as this caused the eyepiece and lens to fog up. If the eye or cheek touched the theodolite in very cold weather, eyelashes or skin would stick.

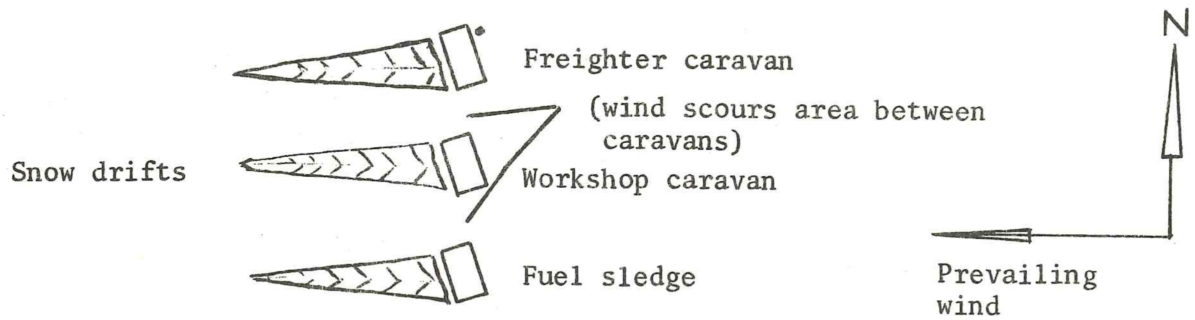
The 40x eyepiece, was mostly used for daylight stars. For night work, the 30x eyepiece gave easier intersections of the star over the five vertical crosshairs. 40x was best for observing over the ground to the reference object, a light on a snowpole on the other side of the network.

All observations were recorded in National Mapping azimuth field books.

15. SETTING UP CAMP

When stopping overnight or for a longer period, the D5 train in particular had to be parked in a special way, as drifts formed quickly in even slight wind. Entrances to caravans could be blocked if the caravan was facing the wrong direction. The entrance had to be just on the leeward side, so that the wind scoured any drift away from the door. The prevailing wind was from east to south-east, so the vehicles and sledges were parked in a generally north-south direction. Each sledge or caravan was pulled up in turn so that there was plenty of slack in the cable - necessary for moving off, so that only one sledge at a time started to move. The caravan itself was winched up to the snowpole for Tellurometer measurements. The workshop caravan was winched up close enough to the fuel sledge in front of it so that the hose from the pump in a 44-gallon drum could reach the tank in the front of the workshop for the Lister diesel, which used 0.3 gallons of ATK per hour. In this way refuelling was simplified in a blizzard.

Some food was taken from the sledge and put in a box near the caravan; again, in bad weather, this helped delay the unpleasant task of going to the sledge for more food. Power lines from the workshops were slung via the roofs to the caravan and Nodwell - these had to be kept above ground level to prevent them being buried from snowfalls or drift. The electric cables had to be sheathed in special rubber to withstand the cold as normal flex became brittle and cracked. The HF aerials for the CODAN radio were also set out at every stop, as there was a daily radio schedule with Casey in the evenings.



16. PREPARING VEHICLES

For heating the D5 engines, and sometines the Nodwells, a Herman Nelson aircraft heater was used. This was a petrol driven unit with a separate burner section capable of 400 000 btu/hour and heating air up to 200°C, and with a powerful fan to blow the hot air through a hose to the engine being warmed. They used 2.5 gallons of petrol/hour when heating. The D5 tractor later had a special plate fitted below their engine sumps for the best heating of the oil and water. The D5 engine had a special heavy blanket over the whole engine section. The hot air blown in from below therefore was contained well. Often on colder, windier days the hose had to have blankets wrapped around it to help reduce heat loss, and occasionally a screen had to be erected on the windward side to help keep the wind off the D5 and Herman Nelson. The carburettor on the Herman Nelson was susceptible to icing up on cold days, especially with drift blowing. The special burner unit on the carburettor did little to alleviate this, so when it iced up the whole engine section had to be removed (a simple job in fine weather with no gloves on with only three butterfly nuts) and taken into the workshop van to have the fuel lines de-iced. The heaters were normally carried in the workshop caravans.

The Nodwells had their own Ebers Pacher engine heaters capable of 52 000 btu/hour. This system was modified so that the warm air was blown directly onto the sump instead of the engine head for maximum benefit. A screen was normally tied around the front of the vehicle to stop the wind blowing underneath as the vehicles had to be parked facing into the wind.

In extreme cases, where the temperatures were low and a strong wind was blowing, it was not uncommon to take four hours or more to warm an engine enough to start it, the oil being so thick. If the engine was started before the oil was thin enough to be circulated properly then the oil pump was at risk. To see if the oil was thin enough, one checked the dipstick - if the oil dripped off, it was thin enough to start the engine. If it still coagulated it was too thick to start.

17. TOWING

Each sledge or caravan was on a separate cable, all being connected to a towing block which in turn was connected to the winch cable (not the towing hook as this was limited to approximately a 5 ton load) on the D5. The towing block was a triangular thick steel block with the winch cable connected at the apex and the other cables connected at the base. Before moving off, each sledge and caravan was given a lift and push in one corner by the D5 to "break it out", as the runners tend to ice in when stopped. When starting, or even bogging down, the winch cable was let rnn free until the D5 reached maximum speed or firmer grot.md. The winch brake was then applied suddenly and the shock usually got the sledges moving, one at a time. This was the reason fm: leaving plenty of slack cable between the sledges when stopping, as when the seldges were heavy or iced in the 05 often could not start the whole lot moving at the same time.

If the D5 t.ra tor had bogged down and could not start the train, it was necessary to nncouple the towing block and bring the D5 back to pull each sledge up to give the cables slack and then try again to move off.

At times in soft snow the 05 tractor could not gain enough traction, despite its extra wide tracks, to get all the sledges moving. Two or three might be moving, but the weight of the next one would be too much and the D5 would stop and bog down. This could sometimes be overcome by putting one or even two sledges directly on the drawbar of the tractor, particularly if they were of the Freighter type, and the winch cable then passed under them to the towing block behind them. The extra inertia gained by these sledges travelling directly with the tractor would held to pull the rear ones into motion when the winch brake was applied.

18. CASEY SURVEYS

A£ter the return from the first traverse, preparations started for survey work in the Casey area between Wilkes and Haupt Nunataks: the proper monumentation and beaconing of all trig stations, some Tellurometer measurements, the location of various islands and reefs, and angle work. Some of the work entailed camping out. Mechanical support would have been welcome, but there were personnel problems and it was decided to do the work by manhauling. This decision was made easier by the number of volunteers keen to do a camping trip. Two of these trips were planned, the first one going as far as Robinson Ridge, beaconing and monumenting, the second as far as Browning Peninsula monumenting all stations en route (Plates 3 and 4). These trips were successful and all the mainland stations south of Casey, as far as Browning Peninsula, were monumented, beaconed and connected to the Casey trigonomentrical network. (See Annex J for map of the area covered and for details of equipment taken.) Brass plaques were made for the station marks, 80 mm in diameter with a raised centre, with the station identification number punched on. A "U" shaped piece was welded to the bottom of the plaque to help anchor the plaque. A Cobra percussion rock drill was used to drill the holes in the rocks for the station marks. It normally functioned well though was hard to start in cold weather.

The plaques were set in the rock with molten sulphur. Sulphur in powder form was melted in a tin over a stove. An asbestos lid was placed on the tin to prevent the sulphur from catching alight as it was difficult to put out once on fire. This also kept in most of the fumes emitted by the molten sulphur. When molten, it was poured into the hole and the plaque put in. It set quickly and held the plaque firmly in the rock. The stove was usually placed inside a 44-gallon drum to protect it from the wind while burning.

Most of the beacons consisted of a 44-gallon drum, with one end cut out and a 0.1 m square section cut out of the other end in the centre for positioning over the ground mark. The drum was filled with rocks to prevent it being blown away by the wind. A section of snowpole, either red or orange and black, was set in the centre of the drum for observing to. Two stations, G11 and G12, had proper vane beacons made up as they were already set on large boulders. These were guyed into position but could easily be removed (Plate 6). The beacons, rock drill, stove, etc, were usually loaded on a Nansen sledge and manhauled to the station. Several people were always willing to help, and the success of the work was largely due to their support.

Until 21 June, work was only done close to Casey, and also in preparing beacons, sledges and other equipment. Another Nansen sledge had to be assembled for the second manhauling trip, and both sledges had to be strengthened to take the heavy loads. On 21-23 June there was a break for midwinter celebrations - and later recovery!

Kilby Reef, Kilby Island and Molholm Island were fixed by resection from surrounding trig stations. Kilby Reef was located by drilling through the sea ice until rock was struck under water. Eccentric stations were used for angle observations at Molholm and Kilby Islands. They were not recoverable points as the existing drum beacons on these points were connected by measurement to the eccentric stations and the centre of the beacon adopted as the station mark. All the angles were later reduced back to this point.

Horizontal and vertical angles were observed from as many trig stations as possible using the T3 theodolite. The T2 could not be used for this work as it tended to sieze at temperatures only slightly below zero.

Wilkes station was visited to fix the position of the Level Datum Point and of the Ionospherics Mast, which was found broken and bent over.

Tellurometer distances were measured from Budnick Hill (NM/S/106) to G9, G11 and NM/S/104; and from G9 to NM/S/104. The existing beacon (three drums high) on Budnick Hill was connected to the actual station mark adjacent to it. The Tellurometers did not perform well over these short distances (500 to 2000 m), and repeat measurements were necessary to try for better results.

A trip was done to Robinson Ridge to erect an emergency shelter there (this was actually the former S1 building). At the same time it was hoped to finish the intersection of the four nunataks around Penney Bay. However, nearly continuous white-outs prevented any observing, so it had to be left for another trip. It was finally done just before the spring glaciology field trip, though no vertical angles could be read due to unfavourable conditions.

It was intended to level from the Wilkes Level Datum around to Casey. On testing the instrument (a Hilger and Watts Autoset) the compensator was found to stick badly in different positions. The project was therefore abandoned as there was no guarantee of reliable results being obtained.

19. WINTER FIELD TRIP

A short field trip was organised from 23 July to 18 August for the glaciology section, going as far as BOO1 and covering the Lanyon-Blyth-Cape Folger Lines. Ice radar was observed continuously, with gravity at each main station. Geoceiver positions were obtained at Strain Grids B & Q, at the Autostation, at the S2 experimental building site and at the 1974 drill Site. Eight people were involved on this traverse, but only three, the glaciologist, the Geoceiver operator and the electronics engineer were from the group who were going on both main glaciological trips. The other six were station personnel who were free to go and who wanted a break from station life.

20. SPRING FIELD TRIP PREPARATION

Preparations for the spring field trip had been going on for many weeks, again mainly on the mechanical side. Both DS tractors had their engine heads removed for decarboning and valve grinds. New cabin heaters were installed, the original ones having proved inefficient in colder weather as they were W1able to keep the windscreen from icing up. A complete vehicle service also had to be done. Nodwell 3 needed much work on the engine again, to replace the seized bearing. A new one was turned on the lathe in the workshops, and this ftmctioned well for the rest of the year.

Both Herman Nelson heaters were stripped down and modified for better starting, as this had caused many problems in the autumn field trip. The workshop caravans had repairs and maintenance done to both the Lister diesels and the alternators. Two Freighter caravans were to be taken this time instead of the two RMIT caravans. Additions had to be made to them in the form of a roof deck and for the clamping arrangements to the snowpoles. Though these caravans weighed a lot more than the RMITs (4.5 tons against 2 tons), the extra weight was justified as they had far more room inside and travelled much better and more smoothly.

21. SPRING FIELD TRIP

The spring field trip left on 25 October 1975. As before, the fuel sledges were taken away first to make it easier to get up the slope. This time they were taken all the way to Lanyon Junction. One workshop and one

Freighter caravan were taken with the fuel sledges, as a Geoceiver station was to be set up there to get a better fix. The Geoceiver was only run for about half a day, but this gave enough passes for the purpose.

The D5 tractors then returned to Casey, picked up the rest of the trains and regrouped at Lanyon Junction later that afternoon. The 'A' team now consisted of Nodwell 2 with the D5 tractor pulling the Freighter fuel sledge, two Frank Smith fuel sledges, one caravan and the workshop (Plate 8). The 'B' team consisted of Nodwell 3 with the D5 tractor pulling an Otago fuel sledge, one workshop caravan and one Freighter caravan. The Otago was a large, articulated sledge 6.1 x 2.4 m with an 18 ton capacity, and carried all the fuel for the 'B' team for the whole trip, 22 tons. It travelled well with its wide articulated runners and was never a problem. The Freighter fuel sledge was quite the opposite. On soft snow it tended to travel through the snow more than over it, and was a great problem - the runners were later found to be buckled.

Nodwell 2 had gone from Casey north towards Cape Folger, and was to rejoin the rest of the traverse at Blythe Junction after measuring accumulation and gravity at the main stations en route. One 'A' side Frank Smith fuel sledge had to be left behind at Lanyon Junction as the surface was so soft and powdery from fresh snowfalls that the D5 tractor could not tow the heavy weight and merely bogged itself. These sledges had narrower runners than the Otago or Freighter type and dug down badly in these conditions, at times riding so deep that they were pushing "bow-waves" of snow ahead of them. They also had the fixed runners instead of the articulated system of the others. In these conditions they were never so satisfactory as the Freighter or Otago types.

The D5 tractor normally consumed their 50 gallons of fuel in 8-9 hours, though this was reduced in soft snow. The Nodwells averaged about 1.6 km per gallon, though this figure varied with the gear the vehicle was using.

A blizzard came up on 27 October lasting three days. Heavy snowfalls after this did little to help travelling conditions.

B001 was reached on 31 October. Barometric levelling was done to B015, a slow process with much white-out; travelling was often possible only by having one person walk in front of the vehicle so that the driver could tell by watching the walking person's feet where the bumps or holes were. The 'A' team went from B015 to A015 to set up the Geoceiver again in preparing for the Tellurometer work to continue. Another blizzard came up here, this time for only two days. B021 was reached on 12 November. Some stations between A015 and B021 were missing and had to be replaced. At B021 the Geoceiver was set up straight away, then the fuel dump was dug out and re-established on the surface. Established in 1973, the drums were now about 1 metre below the surface. A long blizzard came up lasting until 28 November. When it finally cleared enough an astro azimuth was observed, though due to the ice movements since 1973, A021 (used for a reference object) was no longer intervisible from ground level. However high drifts had formed behind the vehicles during the blizzard and by setting up on one of these A021 could be seen (Plates 14 and 15).

The best part of a day was spent digging out the sledges and vehicles, and moving them to clear ground. Measurements were continued on 1 December.

By this time the sun was up for 24 hours a day, so work was possible at any time. The only inconvenience was in trying to sleep; the windows in the caravans were covered over to try to make it darker inside.

A few stations between B021 and A026 were missing. Travelling at A026 was relatively rapid with no hold-ups, and it was reached on 5 December (Plate 9).

Between B021 and A026 were some high ridges with deep, wide valleys between them. The stations were originally located on these ridge tops, though the large ice movements since 1973 had sometimes caused the stations to move downhill. If a station was missing and had to be replaced, it would be relocated on a ridge top, even if this was some distance away from its original position (see Annex C for surface profiles).

A034 was reached on 17 December. The station mark had gone, but the beacon marking the fuel dump was still showing above the ground, so a new station was put in nearby. An approximate connection from this beacon to the original station was obtained, but though this area was scraped away with the D5 tractor down to the 1973 surface level - as indicated by cans, paper, etc, from the 1973 campsite - no sign was found of the station. The Geoceiver was therefore set up eccentric to the new station.

The 1973 fuel dump was located and dug out with the D5. The tops of the drums were at least 1 m below the ground, so the dump was re-established nearby on the present surface level (Plates 16 and 17). Extra fuel and food were also added to this dump. The last quadrilateral was measured, then the whole group reformed at A034. While travelling to the stations to measure this last quadrilateral, Nodwell 3 twice threw off a track. Apparently one of the front axles had been bent by "sastrugi bashing", throwing it out of alignment. It had to be changed with an inner axle to overcome this problem.

The return trip started on 23 December. Everyone except Nodwell 2 started off going back along the 'A' side. Nodwell 2 went back via the 'B' side for barometric levelling,. ice radar and gravity work, with one of the vehicles on the 'A' side acting as a base station for the levelling. Christmas Day was spent at A030 and B027, in a blizzard which kept up until 28 December. As soon as this eased, travel continued to B022. The 'B' team separated here, one half staying at B022, the other half going to B021. The 'A' team went on to A01S for the last two Tellurometer measurements back to these two stations.

Snowfalls and white-outs after this again slowed progress. Travelling from A015 to A001 was a tremendous problem, the snow being so soft that the 'A' s de train had to be split into two sections, one half being taken on a few kilometres then the DS returning for the second half. This of course slowed progress greatly, and involved covering the distance three times. After A001 the surface hardened and travelling became easier. Nodwell 2 went back via Blythe Junction and the Cape Folger line for ice radar, gravity, accumulation and barometric levelling, while everyone else went through the Autostation (to completely recharge the batteries there from the works ops) to Bl he Junction, then back to Casey direct. The fuel sledge was picked up again at Lanyon Junction, and everyone returned to Casey on 8 January 1976.

After the return, all the vehicles and caravans had to be cleaned and emptied, ready for use by the 1976 relieving expedition. A small amount of extra work was done on the Casey triangulation scheme for a few days, then all efforts had to be directed to getting personal and official gear ready for the return trip to Melbourne.

22. 1975-1976 CHANGEOVER

The "Thala Dan" arrived on 19 January 1976, and once again the helicopters were in continuous use. Spot photography was done of the trig stations from Wilkes to Haupt Nunataks and of Donovan, Frazier and Swain Islands. The rest of the time was spent unloading the ship, and in backloading some 1975 equipment, plus personal and official items. A short blizzard held up unloading for a day or so, causing the ship to leave Newcomb Bay when the anchors started to drag - one was lost when snagged in the rocky bottom. The official changeover took place on 27 January 1976.

23. MACQUARIE ISLAND

After leaving Casey, a rough trip was made to Macquarie Island. There was little pack ice to negotiate, which barely slowed the ship. Echo sounding was again organised on a 24 hour roster system until the ship reached the 60th parallel. Macquarie Island was sighted on the evening of 3 February.

No comprehensive vertical photography existed for Macquarie Island, so it was with this aim in mind that camera equipment was sent with the ship to Casey. Flight plans were already drawn up, and covered heights from 1525 m to 3660 m. A heavy, low cloud coverage existed until 6 February, when the cloud base lifted to 900 m. New flight lines had to be drawn first to cover this new altitude. Flying was possible for a few hours only before the cloud base lowered again. At this extra low altitude film was used up at a terrific rate, and the supply brought down (Kodak Aero 2405) was quickly used up. Station personnel then contributed their own personal stocks, along with some official stock (mainly FP4), and this was used for the rest of the photography.

Flying was possible again the next day for a very short time at mostly 650 m. Two short runs at 1830 m were possible on the south-east coast. No more photography was possible after this, and the ship left for Melbourne on 8 February.

A Hasselblad 70 mm camera with 40 mm lens was used for the photography. This fitted into a mount which could be manually corrected for fore and aft tilts by the camera operator, and also adjusted for crabbing angle. The camera was triggered by an intervalometer, the times of shutter release depending on effective ground speed and overlap required. Seventy frame magazines were used. No driftsight was supplied for navigation, which was really essential for accurate positioning of the plane or helicopter - a Bell Jetranger helicopter (Plate 19). Navigation was done by visually positioning the helicopter over ground features which was not very satisfactory and could lead to missed lateral overlap. Only 40% of the island was photographed.

The "Thala Dan" docked in Melbourne on Friday 13 February 1976.

24. COMPUTATIONS

All the computations for the 1975 IAGP were performed at the Melbourne office of the Division of National Mapping between March and October 1976. The computations were done on the CYBER 7600 computer on the CSIRONET system using standard National Mapping programs, the data being input at the CSIRO computing centre at East Melbourne. An electronic data terminal was frequently used to control and alter the programs while the adjustments were being performed, either at East Melbourne or on the terminal at the Division of National Mapping.

24.1 VARYCORD program

The VARYCORD program was used to adjust the IAGP trilateration network. This is a least squares method of adjustment by variation of coordinates of angles, distances and azimuths in horizontal control surveys, and can be used to adjust traverses, trilateration and triangulation.

Preliminary coordinates in latitude and longitude are first given to all the points in the network to be adjusted - in the case of the 1975 adjustment the 1973 coordinates were used. The azimuths and distances between all these points are computed by the program and are then adjusted so that the sum of Lhe squares of the residuals (the difference between the observed and the calculated values) is a minimum. Control station positions are held fixed, with the variable stations being adjusted to best fit (see Technical Report 6 "VARYCORD" by A.G. Bomford).

24.1.1 VARYCORD computations 1975

The trilateration network of braced quadrilaterals was controlled by Geoceiver stations at A001, B001, A009, A015, 8021, A026 and A034. An astronomical azimuth was observed at each of these stations and included in the adjustments for azimuth control.

Eccentric positions were used for the Geoceiver at all sites except B001, A015 (Spring) and B021. Corrections were calculated and applied to each station when results were received from the USA.

Final values adopted were:-

		° ' "	° ' "
A001		S 66 43 47.0516	E 112 50 08.2740
B001		66 41 .39.1371	112 43 03.3870
A009		67 00 53.1718	112 41 43.2437
A015	(Autuum)	67 19 45.9690	112 18 50.9780
A015	(Spring)	67 19 45.9530	112 18 50.7040
8021		67 40 52.0700	111 50 00.8990
A026		68 14 04.9950	112 04 44.2040
A034		68 54 45.4700	112 02 03.5430

All these coordinates are on the International Spheroid, and have been converted from the NWL8E Ellipsoid as supplied by the USGS (see Annex I for the complete list of Geoceiver stations).

The whole network was divided by these Geoceiver stations into five main sections:

Section 1	A001, B001 to A009
Section 2	A009 to A015
Section 3	A015 to B021
Section 4	B021 to A026
Section 5	A026 to A034

The adjustment was done in five stages:-

1. Each section adjusted individually with no azimuths
2. Sections 1 & 2 combined with no azimuths
3. Sections 1 & 2 combined with azimuths
4. Sections 3, 4 & 5 combined with no azimuths
5. Sections 3, 4 & 5 combined with azimuths

See Annex H for a summary of the adjustments.

24.1.1.1 Stage 1: Each section adjusted individually with no azimuths

Horizontal sea level distances (see Annex K) were used throughout the VARYCORD adjustments. These distances and the initial coordinates given to the variable stations were adjusted between the fixed Geoceiver stations. In this way the maximum adjustment in each section could be seen and also the total adjustment per section. All of the sections adjusted well with only relatively small residuals except for section 4, which was left with a total adjustment of about 5 metres. Examination of the Geoceiver station positions and their movements shows a high rate of movement at B021 (0.344 m/day, see Annexes L & M). After a 15 day correction was applied to the position of B021 - the delay between coming to and going from the station, section 4 adjusted well.

	° ' "	° ' "
Mean position B021 (1975:319)	S 67 40 52.070	E 111 50 00.8990
Correction to 1975:334	- 00.154	+ 00.1215
Adjusted position for B021	67 40 51.916	111 50 01.0205

24.1.1.2 Stage 2: Sections 1 & 2 combined with no azimuths

These two sections combined represented the autumn field trip and adjusted well with only a relatively small total adjustment from A001 to A009 (-1.4 m), from A009 to A015 (1.1 m) and overall of -0.3 m. No adjustments were made to any Geoceiver stations.

24.1.1.3 Stage 3: Sections 1 & 2 combined with azimuths

Azimuths observed at A001 and A009 were included in this adjustment. No azimuth was possible at A015 due to continuously unfavourable observing conditions. For the final adjustments exact positions of the observing stations were calculated and used in the azimuth reductions, which were not weighted in the VARYCORD program. The azimuth at A001 received an adjustment of -24.2", and at A009 of +10.1". With the inclusion of the azimuths all the intermediate stations changed positions slightly though the overall adjustment remained practically the same.

24.1.1.4 Stage 4: Sections 3, 4 & 5 combined with no azimuths

These three sections combined represented the spring field trip. Two positions of B021 were used, called B021 and B021 ADJ, the coordinates being as in 24.1.1.1. The connection from B021 to B021 ADJ was calculated and held fixed, while the connection from A021 to A021 ADJ (to correspond with the two B021 positions) was calculated by the VARYCORD program in the course of the adjustment, the stations at A021 being allowed to float. The measured distance A021 - B021 was adopted also for A021 ADJ - B021 ADJ. No other stations were adjusted.

24.1.1.5 Stage 5: Sections 3, 4 & 5 combined with azimuths

This stage was done in two steps:

.1 B021 only adjusted. B021 was used as in 24.2.4. Azimuths were applied at A015, B021, A026 and A034, the adjustments to them being -6.7", 53.2", -6.1" and -2.1" respectively. The azimuth was applied from B021 ADJ to A021 ADJ, this being the position of the station on the day of departure and close to when the azimuth was observed. The azimuth B021 - A021 was calculated by the VARYCORD program, as was the connection A021 - A021 ADJ.

.2 B021 and A026 adjusted. B021 was adjusted twice in this step, firstly back to the position on the day of arrival at the station and secondly forward to the position on the day of departure from the station. These were the actual days of measurement (1975: 317 and 1975: 334). The new positions were called B021 ADJ 1 and B021 ADJ 2: A021 and A021 ADJ are as before. The azimuth was applied from B021 ADJ 2 to A021 ADJ.

	° ' "	° ' "
Mean position B021 (1975:319)	S67 40 52.070	E111 50 00.899
Correction back to 1975:317	+ 00.0205	- 00.0162
Position B021 ADJ 1	67 40 52.0905	111 50 00.8828
Mean position B021 (1975:319)	S67 40 52.070	E111 50 00.899
Correction forward to 1975:334	- 00.154	+ 00.1215
Position B021 ADJ 2	67 40 51.916	111 50 01.0205

A026 was treated in the same way. Even though the length of stay at this station was only three days the high rate of movement at the station warranted the adjustement (0.370m/day - see Annexes L and M). B026 was also given two positions, their actual location and the connection between them being calculated by the VARYCORD program; these were called B026 and B026 ADJ. The azimuth was applied from both A026 ADJ 1 and A025 ADJ 2, as it was observed over the mean day of occupation. The measured distance A025 ADJ 1 - B026 was also applied to A026 ADJ 2 - B025 ADJ. Azimuths were applied to A01S and A034 as well, the corrections overall being -7.2" at A01S, -13.9" at B021 ADJ 2, -2.8" at A026 ADJ 1, 0.6" at ADJ 2 and -1.2" at A034.

	° ' "	° ' "
Mean position A026 (1975:341-342)	S68 14 04.995	E112 04 44.204
Correction back to 1975:340	+ 00.0164	- 00.0203
Position A026 ADJ 1	68 14 05.0114	112 04 44.1837
Mean position A026 (1975:341-342)	S68 14 04.995	E112 04 44.204
Correction forward to 1975:343	- 00.0164	+ 00.0203
Position A026 ADJ 2	68 14 04.9786	112 04 44.2243

24.1.2 VARYCORD computations 1973

The bulk of the 1973 IAGP work had already been computed by D. Bruce, the 1973 Casey wintering surveyor. Some of it was re-examined and readjusted. Sections 1 and 2 were combined and recalculated and sections 3, 4 and 5 combined and recalculated in two stages, once with no adjustment to the Geoceiver stations and then with B021 and A026 adjusted as in 24.1.1.5.2.

24.1.2.1 Sections 1 & 2 combined with azimuth

These sections were re-examined and re-run as there was a large misclose between A009/G and A015. (A009/G is the Geoceiver station at A009, 32.405 m at 266°26'44.6" from A009). Section 1, from A001 to A009/G adjusted well with only a small residual - 0.05 m, but Section 2 had an overall misclose of -5.2 m. The quadrilaterals from A009 to A015 were rechecked with horizontal sea level distances for misclose and found to be satisfactory, so it was presumed there was an error at A015, perhaps in an eccentric Geoceiver position, though this was only an assumption as no field books of this station could be found. The observed azimuths at A002 and A009 had corrections of -24.0" and -2.5" respectively.

24.1.2.2 Sections 3, 4 and 5 combined with azimuth

.1 No adjustments to Geoceiver stations. This was the first run, with the Geoceiver positions being adopted as received from the USA. No adjustments were made to them for movements of the ice. The overall residuals were quite large with a maximum of 1.097 m at B025. The adjustments to the azimuths were -18.7" at B021, -6.2" at A026 and -3.9" at A034.

.2 B021 and A026 adjusted. Both of these stations were adjusted from their mean positions to their positions on the days of arrival and departure at the stations. The azimuths were applied from B021 ADJ 1 to B020 and from both A026 ADJ 1 & 2 to B026 ADJ 1 & 2 respectively. A021 was changed to A021 ADJ 1 & 2, their positions and the connection between them being calculated by VARYCORD. Similarly for B026 ADJ 1 & 2. The azimuths were adjusted by -1.3" at B021 ADJ 1, 1.3" at A026 ADJ 1, 0.2" at A026 ADJ 2 and by -1.3" at A034.

	° ' "	° ' "
Mean position B021 (1973:325)	S67 40 59.6140	E111 49 55.1300
Correction back to 1973:321	+ 00.0411	- 00.0324
Position B021 ADJ 1	67 40 59.6551	111 49 55.0976

	° ' "	° ' "
Mean position B021 (1973:325)	S67 40 59.6140	E111 49 55.1300
Correction forward to 1973:329	- 00.0411	+ 00.0324
Position B021 ADJ 2	67 40 59.5729	111 49 55.1624
Mean position A026 (1973:336)	S68 14 12.9630	E112 04 34.3100
Correction back to 1973:333	+ 00.0327	- 00.0406
Position A026 ADJ 1	68 14 12.9957	112 04 34 2694
Mean position A026 (1973:336)	S68 14 12.9630	E112 04 34.3100
Correction forward to 1973:340	- 00.0436	+ 00.0542
Position A026 ADJ 2	68 14 12.9194	112 04 34.3642

24.2 MI'TELLY program

All the distances used in the VARYCORD program were reduced from the field slope measurements to horizontal sea level distances by the MTTELLY program.

Data required in the reduction of these distances are:

- distance measured in metres or the transit time in nanoseconds;
- temperature in Celcius degrees - dry bulb;
- vapour pressure in millibars;
- barometric pressure in millibars;
- the elevation of both stations in metres - see Annex N - or the elevation of one and a vertical angle to the other.

The program calculates the horizontal sea level distance, the vapour pressure in inches of mercury and the refractive index.

24.3 NEYMET program

The NEYMET program was used to calculate all the astronomical azimuths observed in the IAGP work. The Ney method of observation involves horizontal circle astronomy in which horizontal angles are observed from a refe/ence object to the star with accurate times noted. Approximate elevations are read and plate bubble readings noted so that a correction to the star pointings can be applied during the calculations for dislevelment of. the trunnion axis. The NEYMET program is a least squares solution in whi h the astronomical triangle is solved for every observation and a serle_s of o servation equations formed to calculate corrections to the adop:ed latitude, longitude and azimuth. The program has options for solving for any or all of these three.

24.4 INTSECT program

The INTSECT program will calculate the position of a station in latitude and longitude from distances observed into it from up to ten adjacent stations. Only one pair of these adjacent stations are used at a time; at the end a least squares solution is applied to the results of the individual calculations. In this case the program was used to calculate the positions of the wing points A023/1, A023/2 and B023/1, as they were not included in the VARYCORD program.

The positions calculated were:-

		° ' "	° ' "
A023/1	1973	S 67 48 11.315	E 112 02 14.668
A023/1	1975	67 48 03.113	112 02 23.749
A023/2	1973	67 47 34.522	112 03 48.154
A023/2	1975	67 47 26.254	112 03 57.096
B023/1	1973	67 48 02.912	111 53 07.910
B023/1	1975	67 47 55.066	111 53 15.862

UTM coordinates for these points are:

A023/1	1973	E 543 737.366	N 2 478 521.754
A023/1	1975	543 847.976	2 478 733.959
A023/2	1973	544 851.689	2 479 642.526
A023/2	1975	544 960.857	2 479 896.755
B023/1	1973	537 338,305	2 478 881.468
B023/1	1975	537 434.923	2 479 123.107

24.5 AZARC program

The AZARC program is used for the calculation of distance and azimuth between any two points on the earth's surface, using Rudoe's formula. In this case it was used to calculate the movements of the stations in the trilateration network, by calculating the distance and azimuth between the final 1973 and 1975 coordinates, as calculated in the VARYCORD programs. Only those 1973 stations found and used in 1975 were used in this program. Geoceiver station movements were calculated separately (see Annex L).

24.6 VECTRIG program

The VECTRIG program was derived from the VECTOR program used in photogrammetry to plot error vector residuals of a photogrammetric adjustment, and was adapted for the IAGP work. It was used to produce computer drawn plots of the yearly accumulation rates (see Annex E) and of the vector movements from 1973 to 1975 (see Annex O) of the stations of the trilateration network.

The accumulation plots were drawn at two scales: 1:150 000 from A001 to A015 with a vector scale of 1 m to 1 cm and at 1:500 000 from A016 to A035 with a vector scale of 1 m to 1 cm. In both cases the 1973 VARYCORD coordinates were used to plot the station positions. The first section was plotted at the larger scale as the stations are too close together at 1:500 000 to clearly show the vectors. The vector movement plots were also drawn at the same two scales for the same reasons. A001 to A015 was plotted at 1:250 000 with a vector scale of 20 m to 1 cm and A001 to A035 plotted at 1:500 000 with a vector scale of 200 m to 1 cm.

Those 1973 stations not follllld and used in 1975 have no vectors shown.

Plate I Mawson's Hut, Commonwealth Bay, January 1975.

Plate 2 Casey, as seen from Budnick Hill, July 1975.

Plate 3 Manhauling over sea ice from Campbell Nunatak to Alexander Nunatak, August 1975.

Plate 4 Campsite at Williams Nunatak after crossing the Peterson Glacier, August 1975.

Plate 5 Triangulation work on the Pageos site using a Wild T3 theodolite.

Plate 6 Erecting the beacon on G11, Casey triangulation survey, July 1975.

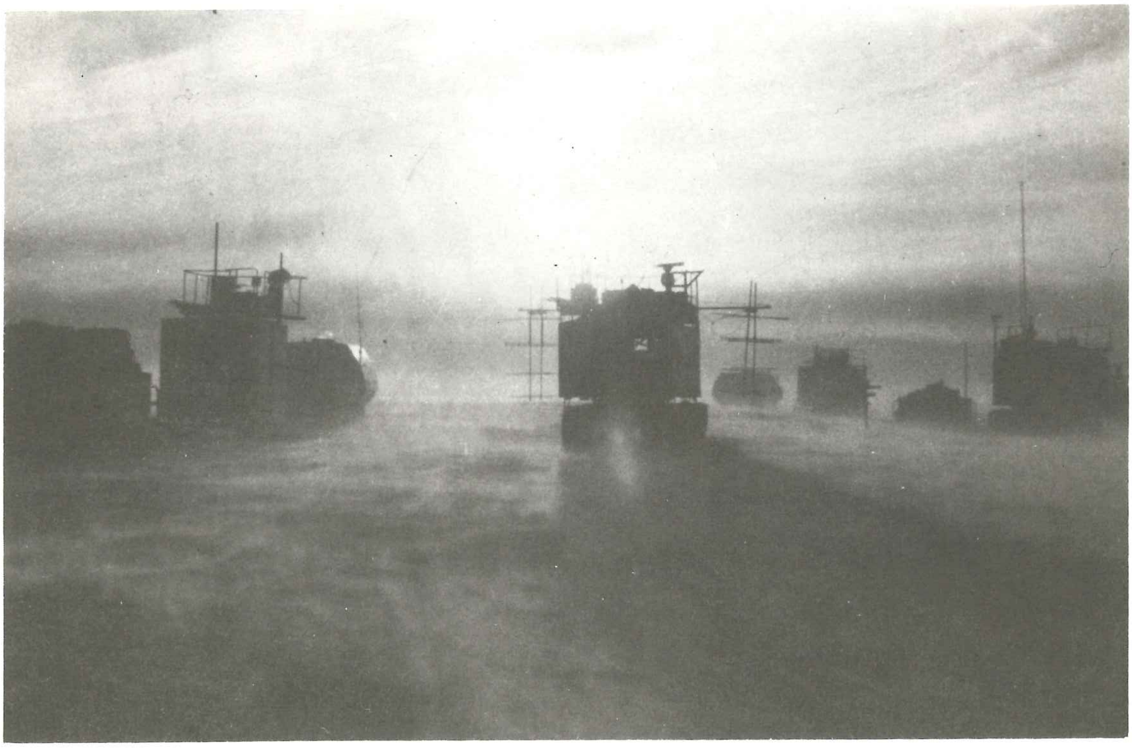


Plate 7 The onset of a blizzard near Blythe Junction April 1975.

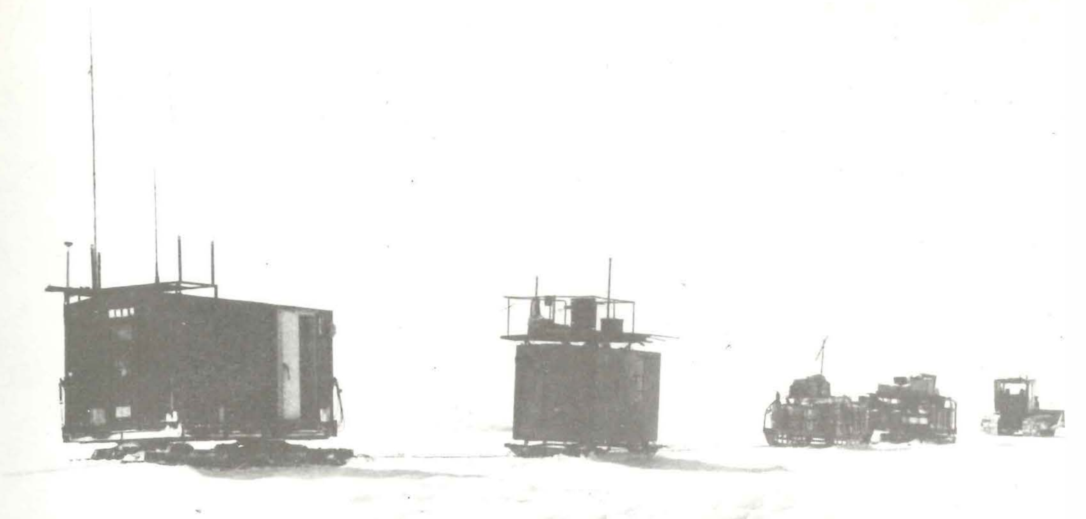


Plate 8 Typical towing arrangement of the D5 train. L to R: Freighter caravan, Workshop caravan, Frank Smith fuel sledge, Freighter fuel sledge, D5 tractor.

Plate 9 The D5 train travelling in heavy sastrugi from A025 to A026. Glaciology spring field trip December 1975

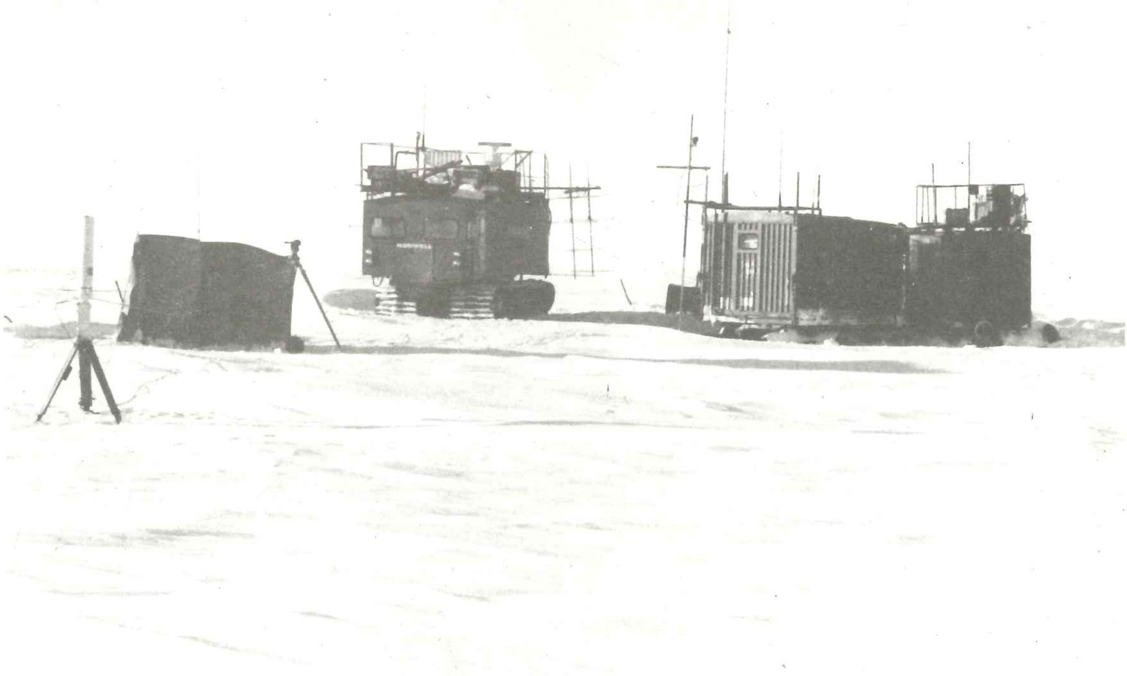


Plate 10 Geoceiver control station AO26. Typical arrangement with eccentric Geoceiver antenna and theodolite. The snowpole is clamped to the caravan ready for Tellurometer measurements.

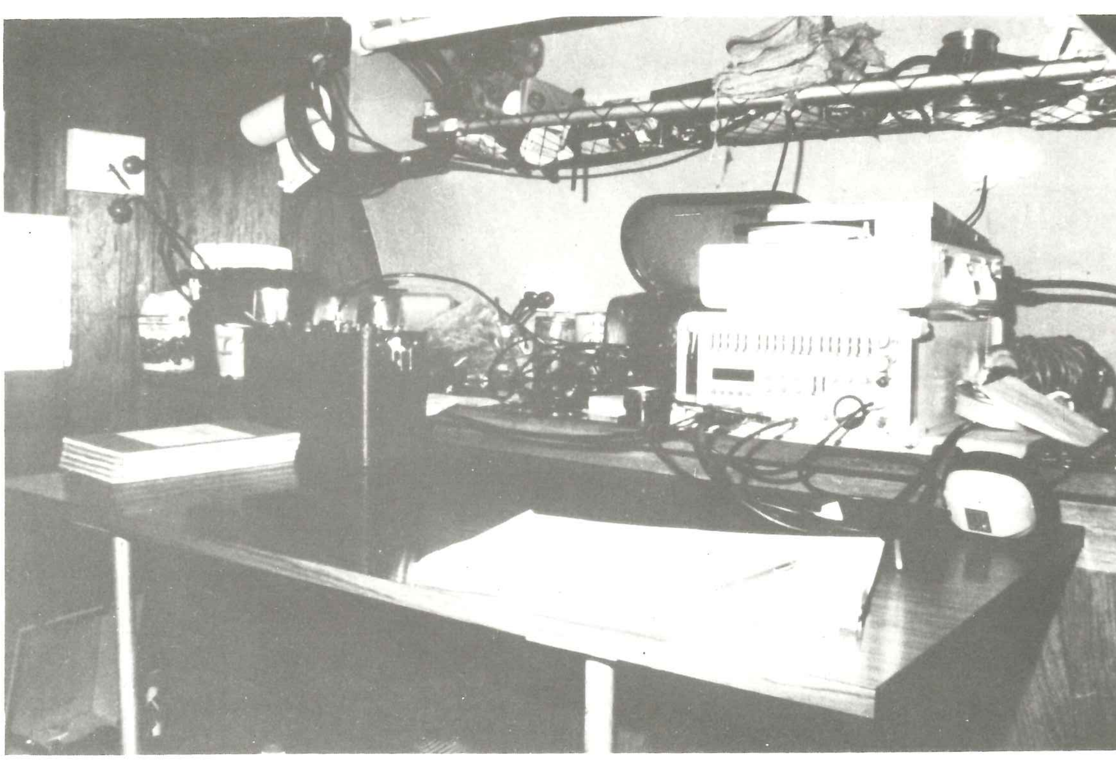


Plate 11 Geoceiver control unit and punch unit inside the RMIT Caravan, May 1975.

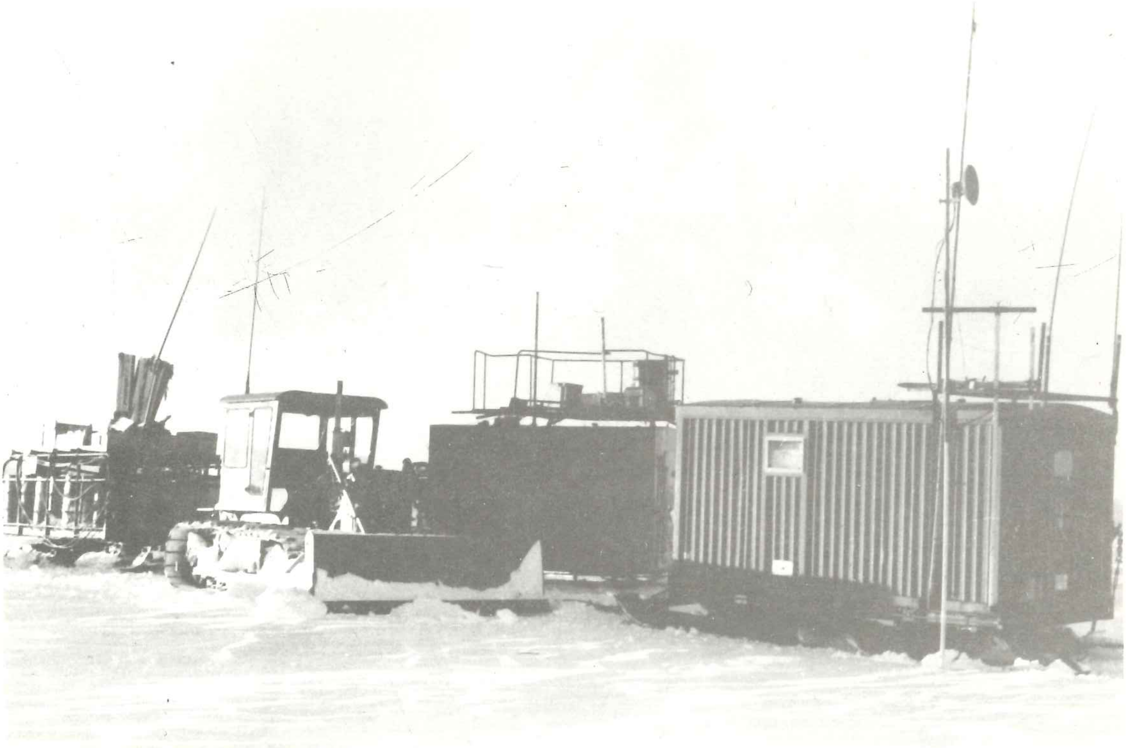


Plate 12 Tellurometer measurements in progress—note the antenna on the snowpole, the pole itself being clamped to the caravan.

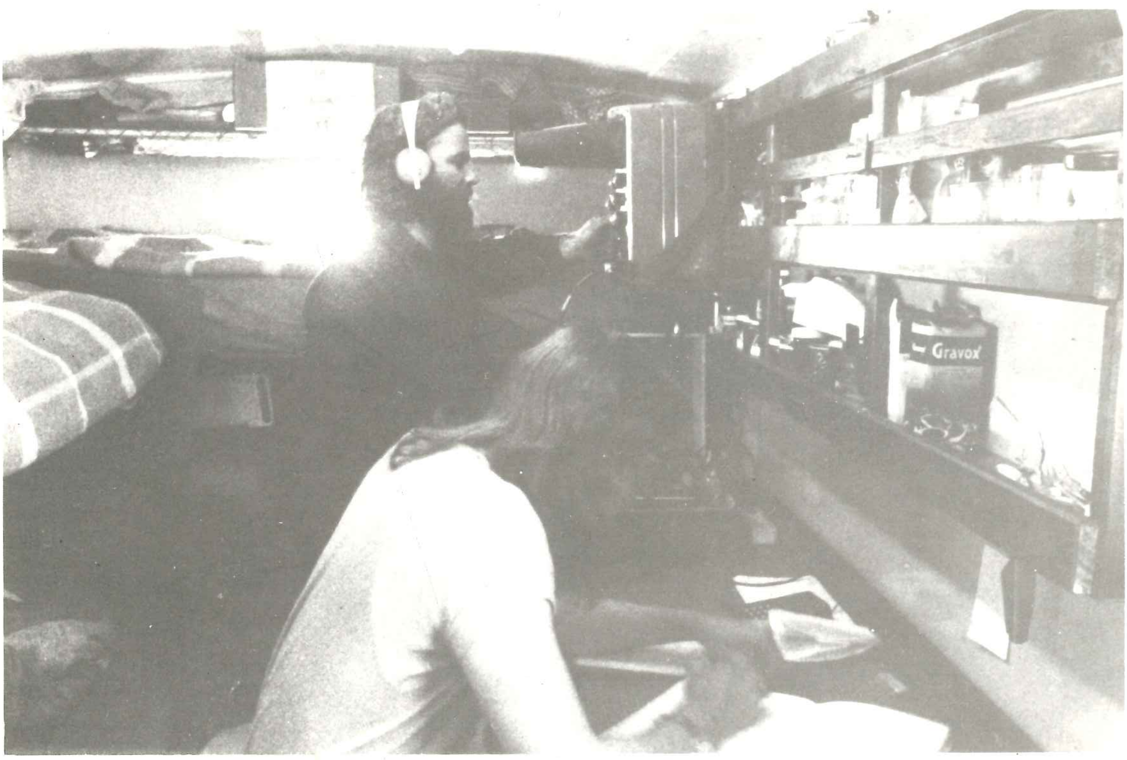


Plate 13 Operating the Tellurometer inside the Freighter caravan.

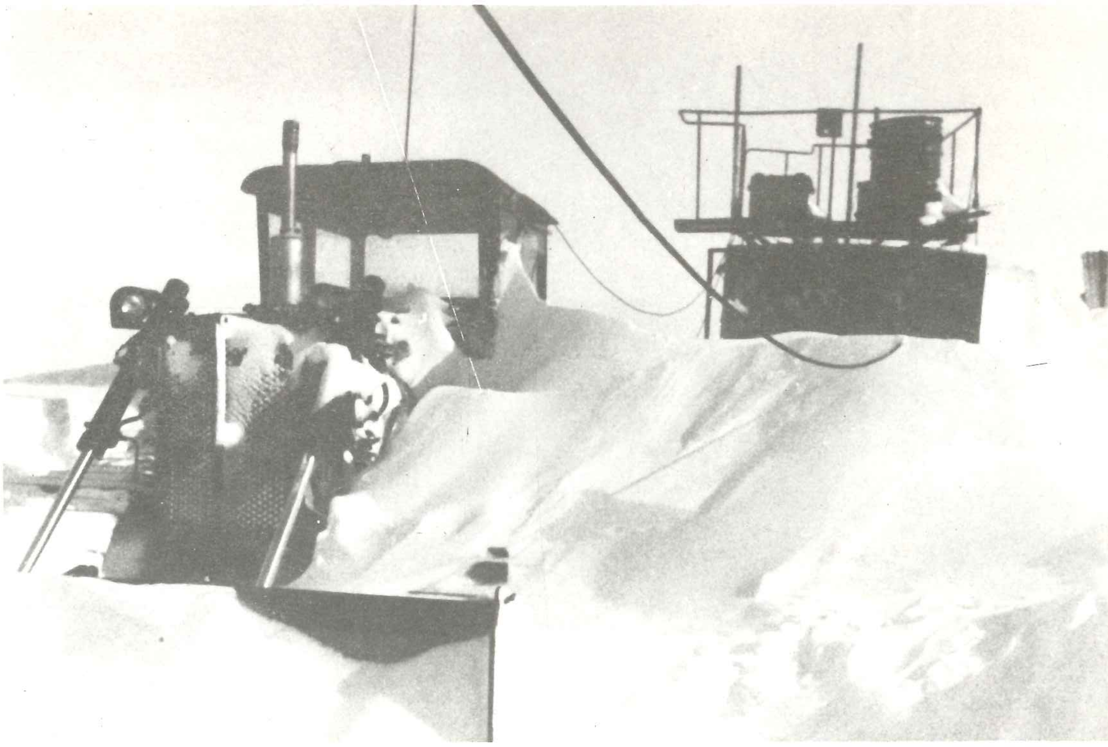


Plate 14 The D5 drifted in after a 17 day blizzard at BO21, November 1975.

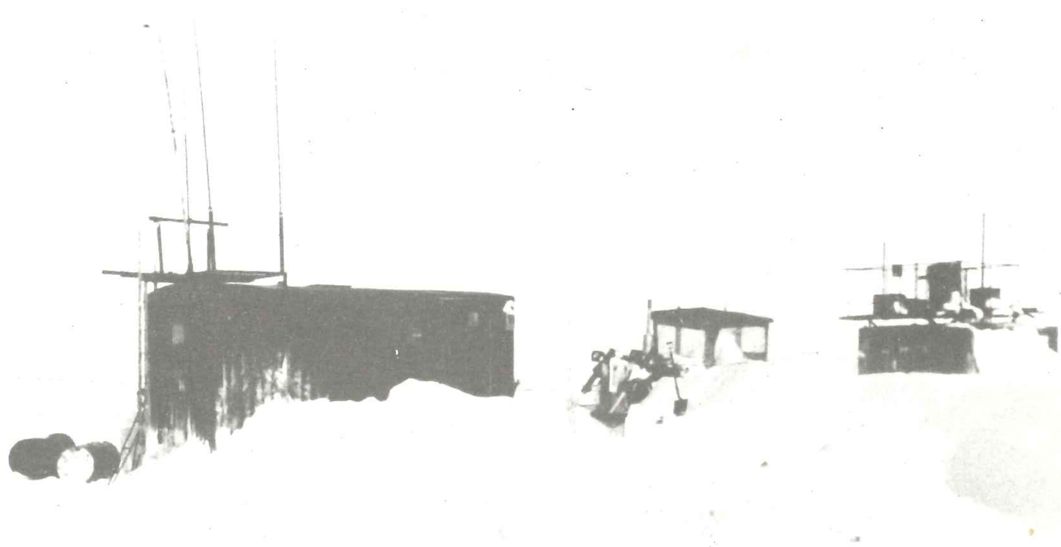


Plate 15 Drifts around the D5 train, BO21.

Plate 16 Excavating the 1973 fuel dump at A034 December 1975. The new dump is being re-established on the present surface level to the left in the photo.

Plate 17 Refueling at the new fuel dump at A034 for the return trip to Casey. Glaciology spring field trip, December 1975.

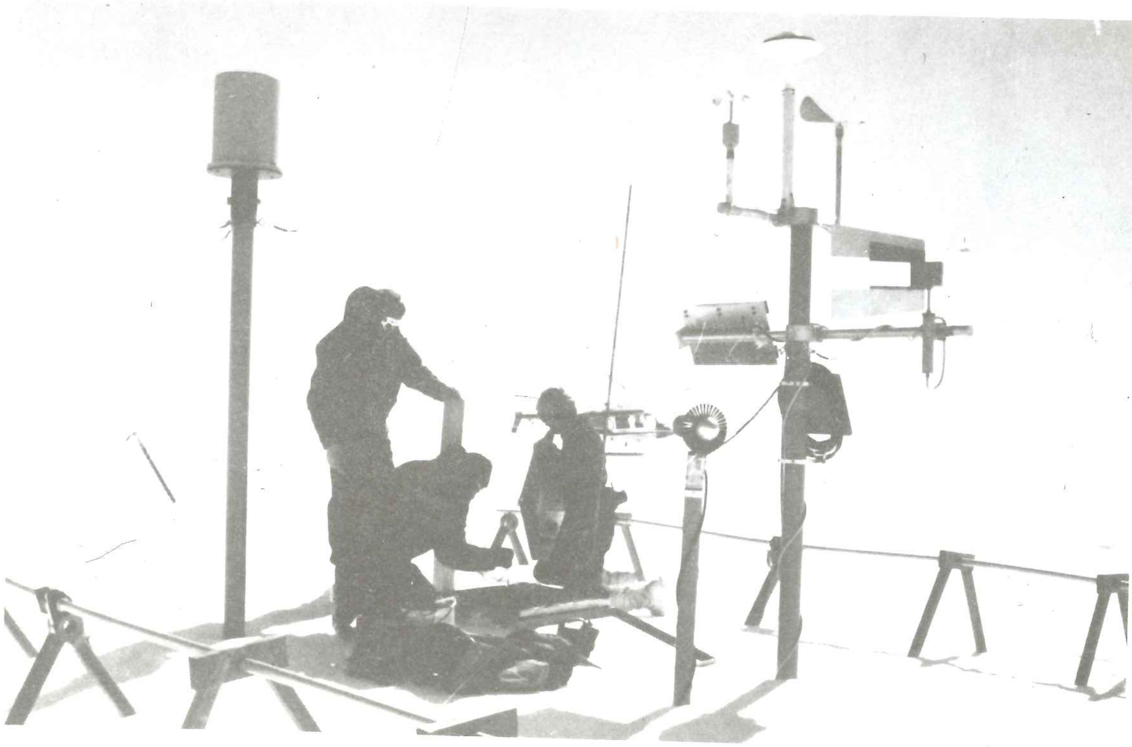


Plate 18 The Autostation: 1975–1976 changeover visit with the helicopters, January 1976.

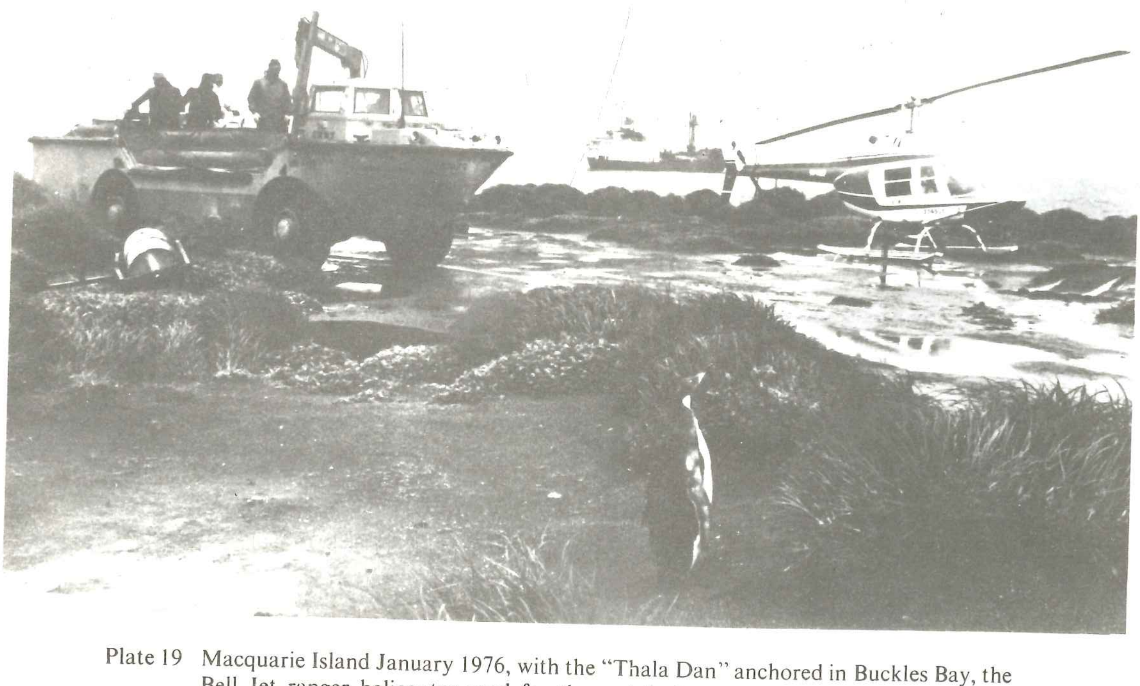
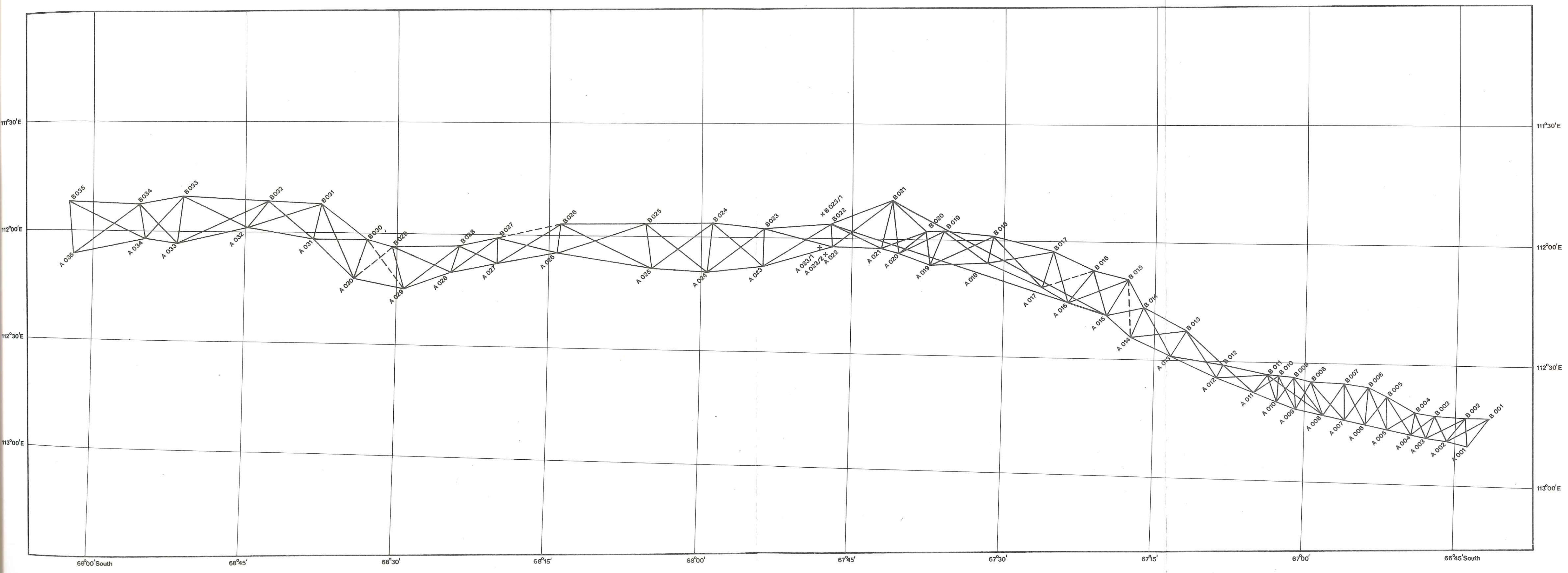


Plate 19 Macquarie Island January 1976, with the "Thala Dan" anchored in Buckles Bay, the Bell Jet ranger helicopter used for the aerial photography and one of the Army LARCs used in the resupply of the stations.

ANNEX. A.



INTERNATIONAL ANTARCTIC GLACIOLOGICAL PROJECT

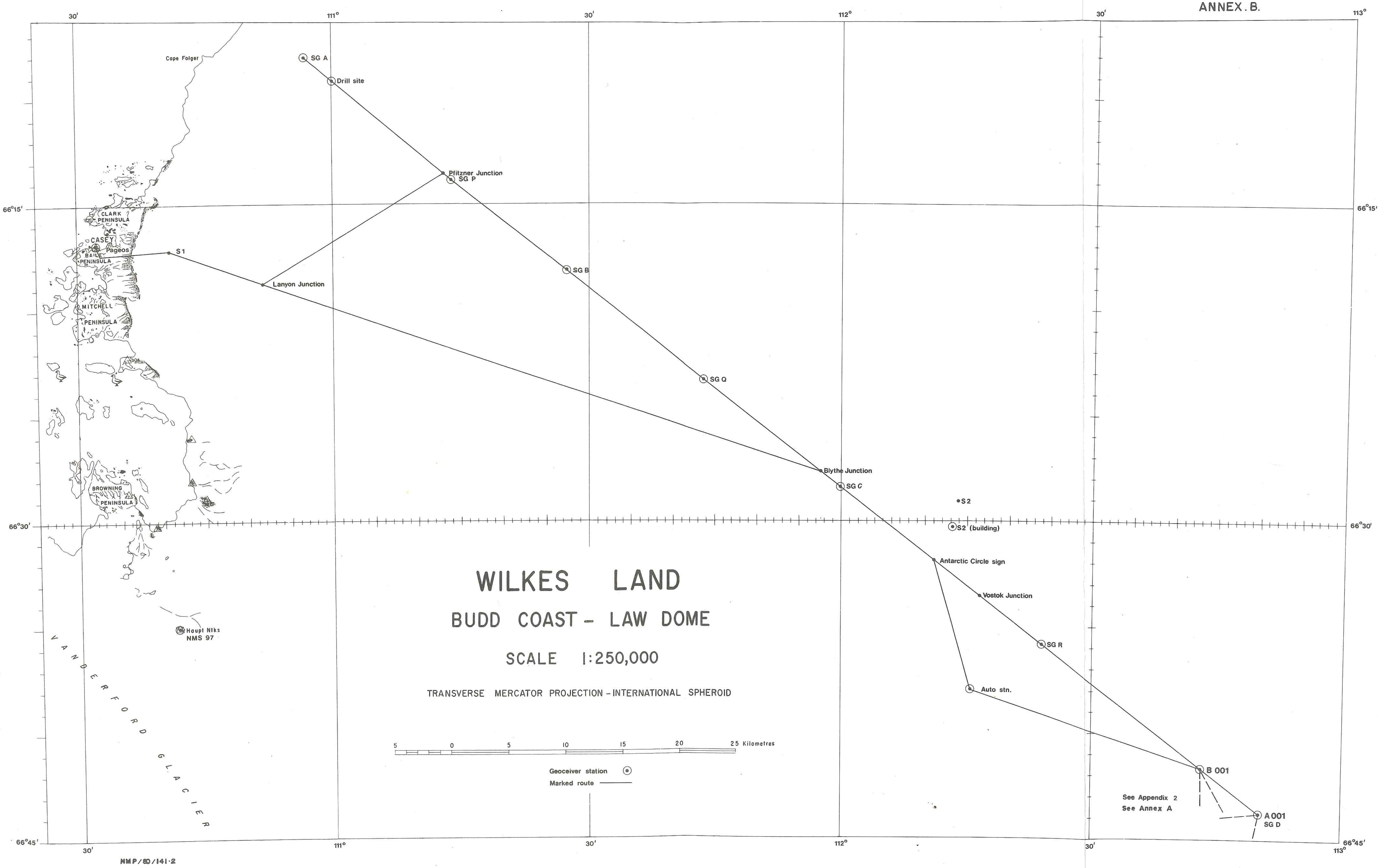
SCALE 1:500,000

Kilometres 10 0 10 20 30 40 Kilometres

NOTE: Calculated lines — — — —

NMP/80/141·1

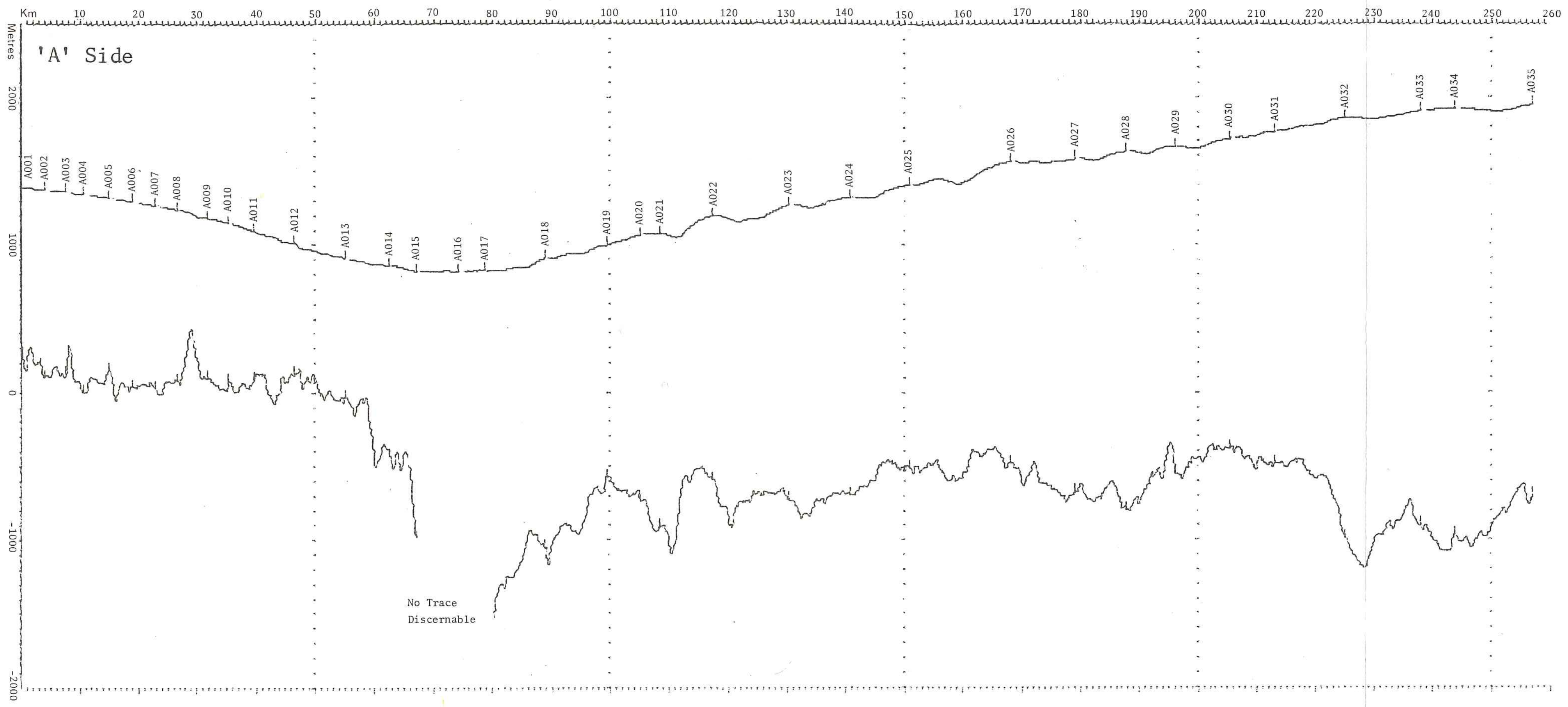
ANNEX. B.

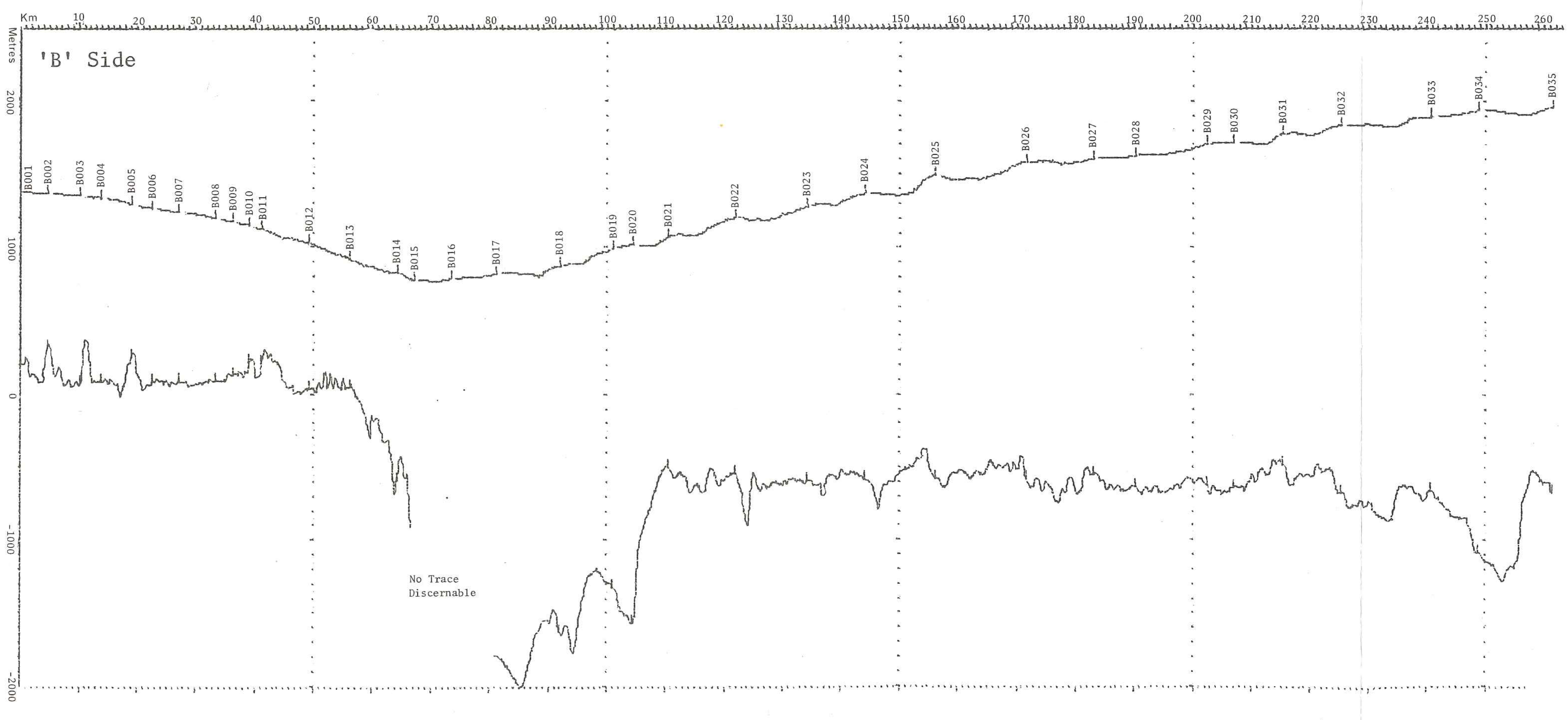


WILKES LAND
BUDD COAST - LAW DOME
SCALE 1:250,000
TRANSVERSE MERCATOR PROJECTION - INTERNATIONAL SPHEROID
5 0 5 10 15 20 25 Kilometres
Geoceiver station
Marked route
Cape Folger
SG A
Drill site
Pfitzner Junction
SG P
CLARK PENINSULA
CASEY
Pageos
BAILEY PENINSULA
S 1
Lanyon Junction
SG B
MITCHELL PENINSULA
SG Q
Blythe Junction
SG C
S 2
S2 (building)
BROWNING PENINSULA
Antarctic Circle sign
Vostok Junction
SG R
Auto stn.
Haupt Nlks
NMS 97
VANDERFORD GLACIER
B 001
A 001
SG D
See Appendix 2
See Annex A
30' 111° 30' 112° 30' 113°
66°15' 66°30' 66°45'
NMP/80/141-2

1973 IAGP

Surface and Bedrock Profiles
Projected onto a North-South Meridian
Scale
Horizontal 1:1 000 000
Vertical 1:40 000





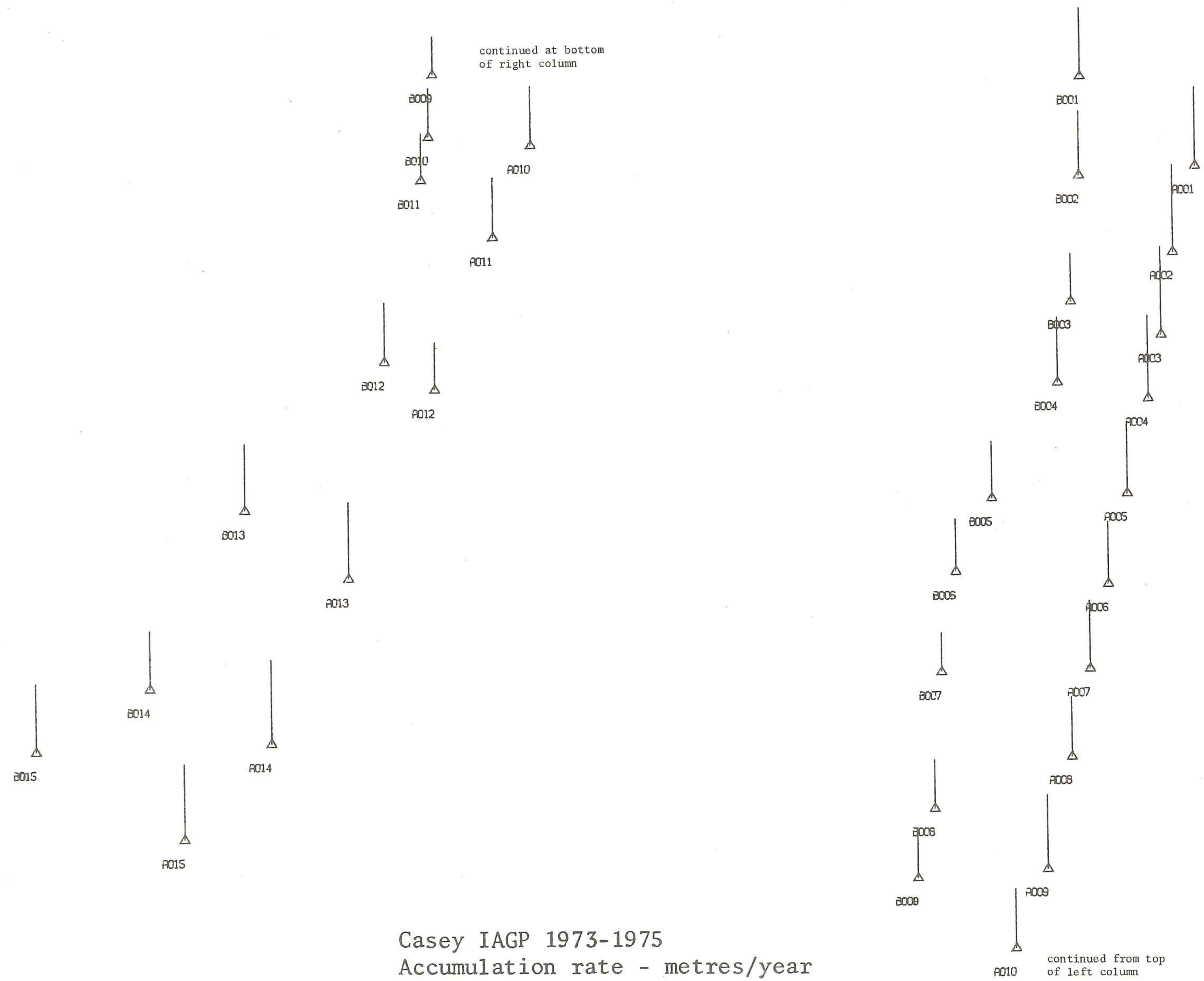
SNOW ACCUMULATION

Station	Period in years	Accumulation in metres	Accumulation Rate in metres per year
A001	2.78	3.93	1.41
B001	2.78	3.39	1.22
A002	2.79	4.34	1.56
B002	2.60	3.00	1.15
A003	0.73	1.15	1.58
B003	2.58	2.19	0.85
A004	2.76	4.10	1.49
B004	2.57	3.01	1.17
A005	2.75	3.55	1.29
B005	2.57	2.63	1.02
A006	2.75	3.09	1.12
B006	2.56	2.42	0.95
A007	2.73	3.33	1.22
B007	2.56	1.80	0.70
A008	2.69	2.87	1.07
B008	2.56	2.25	0.88
A009	2.72	3.62	1.33
B009	2.55	2.28	0.89
A010	2.70	2.90	1.07
B010	2.53	2.23	0.88
A011	2.68	2.86	1.07
B011	2.53	2.13	0.84
A012	2.68	2.24	0.84
B012	2.52	2.66	1.06
A013	2.67	3.69	1.38
B013/73	0.68	0.83	1.22
B013/75	0.48	0.50	1.04
A0142	2.67	4.03	1.51
B014	2.51	2.62	1.04
A015	2.67	3.65	1.37
B015	2.67	3.28	1.23
A016	2.00	3.15	1.58
B016	2.15	3.69	1.72
A017	2.00	3.60	1.80
B017	2.14	2.92	1.36
A018	2.00	2.87	1.44
B018	2.14	2.85	1.33
A019	2.00	1.92	0.96
B019	2.13	1.47	0.69
A020	0.96	0.78	0.81
B021	2.12	1.87	0.88
A022	2.02	2.48	1.23
B022	2.10	2.77	1.32
B023	2.10	2.01	0.96
B024	2.09	2.21	1.06
A025	2.02	3.32	1.64
B025	2.08	2.20	1.06

A026	2.03	1.72	0.85
B027	2.06	1.28	0.62
B028	2.04	2.27	1.11
A030	2.00	1.37	0.69
B030	2.02	2.29	1.13
A031	1.99	0.92	0.46
B031	2.02	1.19	0.59
B032	2.01	1.63	0.81
A033	2.00	1.09	0.55
B033	2.01	1.22	0.61
A034	2.01	2.43	1.21
B034	2.01	1.37	0.68
B035	2.01	1.10	0.55

Note:

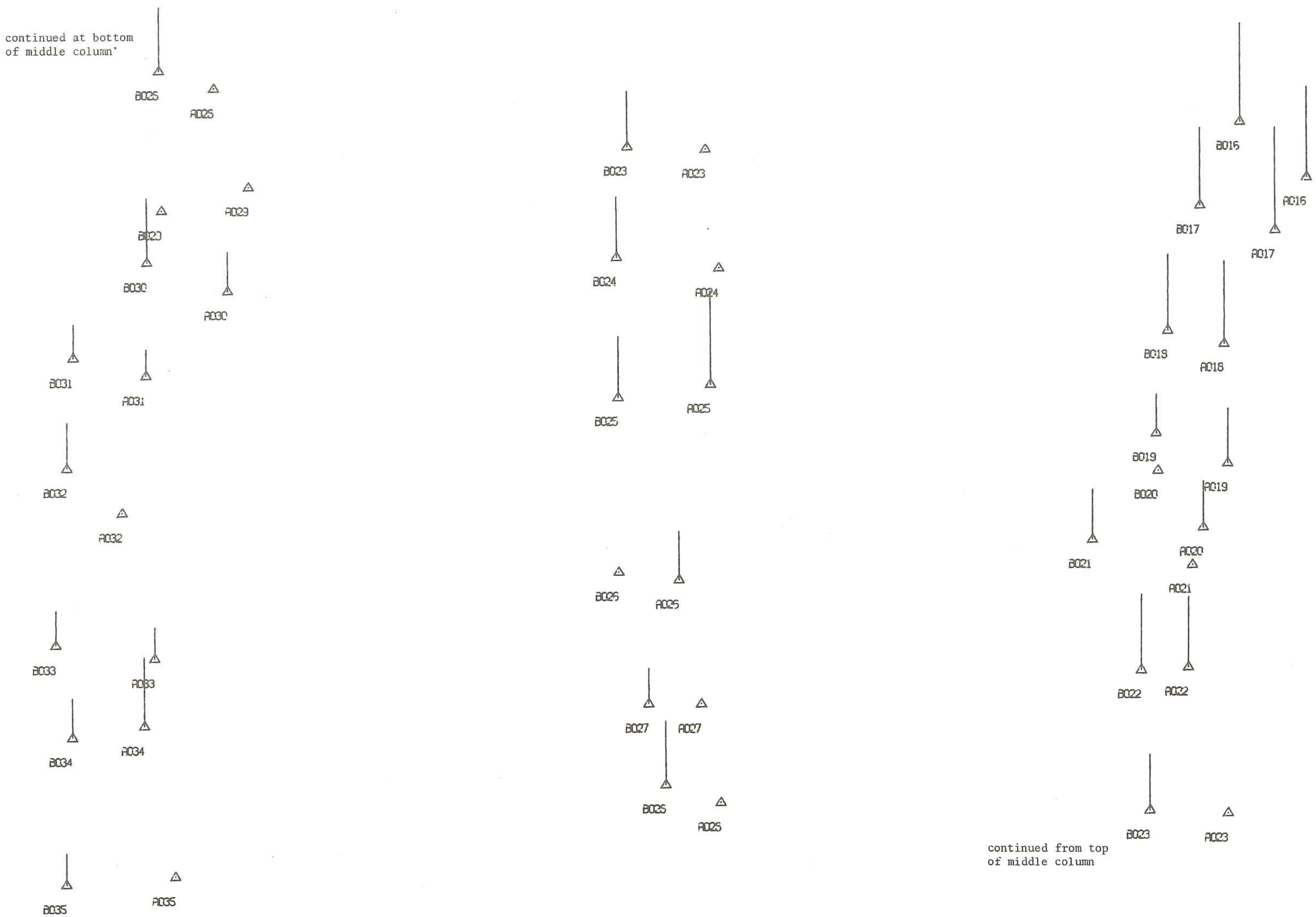
Where original stations were missing and replaced in 1975 some accumulation could still be recorded from measurements in 1973 and 1974: B013/75, A020.



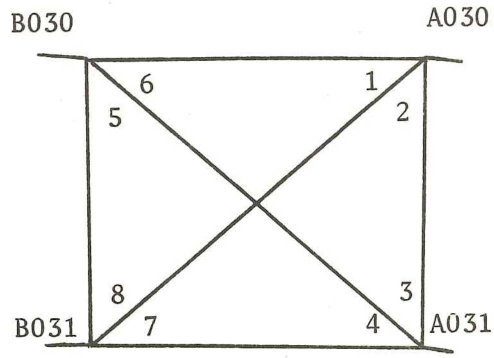
Casey IAGP 1973-1975
Accumulation rate - metres/year
Plot scale: 1:250 000
Vector scale: 1 metre to 1 cm

Annex E

Casey IAGP 1973-1975
Accumulation rate - metres/year
Plot scale: 1:500 000
Vector scale: 1 metre to 1 cm



QUAD CHECK



$$COS\ A = \frac{b^2 + c^2 - a^2}{2bc}$$

TRIANGLE	$B_{30}A_{30}B_{31}$	TRIANGLE	$B_{31}A_{30}A_{31}$	TRIANGLE	$A_{31}A_{31}B_{30}$
a	10587.405	a	6594.500	a	7567.815
b	7567.815	b	14847.600	b	10397.620
c	14847.600	c	10397.620	c	9957.105
COS A	0.7370246	COS A	0.9232894	COS A	0.7243424
A1	42°31'17"	A2	22°35'17"	A3	43°35'09"

TRIANGLE	$B_{30}A_{31}B_{31}$	TRIANGLE	$B_{31}B_{30}A_{31}$	TRIANGLE	$A_{31}B_{30}A_{30}$
a	10587.405	a	6594.500	a	10397.620
b	9957.105	b	10587.405	b	7567.815
c	6594.500	c	9957.105	c	9957.105
COS A	0.2325406	COS A	0.7956261	COS A	0.3205242
A4	76°33'12"	A5	37°17'08"	A6	71°18'19"

TRIANGLE	$A_{31}B_{31}A_{30}$	TRIANGLE	$A_{30}B_{31}B_{30}$
a	10397.620	a	7567.815
b	14847.600	b	10587.405
c	6594.500	c	14847.600
COS A	0.7957521	COS A	0.8755624
A7	37°16'25"	A8	28°53'18"

5	37°17'08"	1	42°31'17"	174°45'10"
6	71 18 19	2	22 35 17	185 14 55 +
7	37 16 25	3	43 35 09	
8	28 53 18 +	4	76 33 12 +	360 00 05
(5+6+7+8)	174 45 10	(1+2+3+4)	185 14 55	

ANNEX G

CALCULATION OF LOCAL HOUR ANGLE FOR ASTRO COMPASS

LATITUDE S 66°45'
LONGITUDE E 112°

DATE 13/12/75 LHA - GHA + LONG E
DEC S 23°06' ADD 5° TO LHA EVERY 20 MINUTES

STARTING TIME	1200		FINISHING TIME	1800	
- TIME ZONE E	8	-	- TIME ZONE E	8	-
- REQUIRED GMT	0400		- REQUIRED GMT	1000	
GHA AT GMT	241°32'	(p 241)	GHA AT GMT	331°31'	
+ LONG E	112	+	+ LONG E	112	+
LHA	353 32		LHA	443 31	
- 360° if possible			- 360° if possible	360 000	-
LHA (nearest degree)	354°		LHA	84°	

CALC. TIME	SETTING TIME FROM	TO	L.H.A.	CALC. TIME	SETTING TIME FROM	TO	L.H.A.
0000	2350	0010		0600	0550 to	0610	
20	0010	0030		20	0610	0630	
40	0030	0050		40	0630	0650	
0100	0050	0110		0700	0650	0710	
20	0110	0130		20	0710	0730	
40	0130	0150		40	0730	0750	
0200	0150 to	0210		0800	0750 to	0810	
20	0210	0230		20	0810	0830	
40	0230	0250		40	0830	0850	
0300	0250	0310		0900	0850	0910	
20	0310	0330		20	0910	0930	
40	0330	0350		40	0930	0950	
0400	0350 to	0410		1000	0950 to	1010	
20	0410	0430		20	1010	1030	
40	0430	0450		40	1030	1050	
0500	0450	0510		1100	1050	1110	
20	0510	0530		20	1110	1130	
40	0530	0550		40	1130	1150	

CALC. TIME	SETTING TIME		L.H.A.	CALC. TIME	SETTING TIME		L.H.A.
	FROM	TO			FROM	TO	
1200	1150	1210	354	1800	1750 to	1810	84
20	1210	1230	359	20	1810	1830	
40	1230	1250	4	40	1830	1850	
1300	1250	1310	9	1900	1850	1910	
20	1310	1330	14	20	1910	1930	
40	1330	1350	19	40	1930	1950	
1400	1350 to	1410	24	2000	1950 to	2010	
20	1410	1430	29	20	2010	2030	
40	1430	1450	34	40	2030	2050	
1500	1450	1510	39	2100	2050	2110	
20	1510	1530	44	20	2110	2130	
40	1530	1550	49	40	2130	2150	
1600	1550 to	1610	54	2200	2150 to	2210	
20	1610	1630	59	20	2210	2230	
40	1630	1650	64	40	2230	2250	
1700	1650	1710	69	2300	2250	2310	
20	1710	1730	74	20	2310	2330	
40	1730	1750	79	40	2330	2350	

Annex H

SUMMARY OF 1973 AND 1975 VARYCORD ADJUSTMENTS

1973

Sections 1 & 2 combined	28 Angles, 4 Azimuths, 77 Distances A001, A009/G, A015 held fixed. Maximum adjustment to distance: 1.393 m at A015 Average: 0.247 m
Sections 3, 4, 5 combined	2 Angles, 3 Azimuths, 105 Distances A015, B021, A026, A034 held fixed. Maximum adjustment to distance: 1.097 m at B025 Average: 0.211 m
Sections 3, 4, 5 combined	2 Angles, 4 Azimuths, 105 Distances A015, B021 ADJ 1, B021 ADJ 2, A026 ADJ 1, A026 ADJ 2, A034 held fixed. Maximum adjustment to distance: 0.840 m at B021 ADJ 2 Average: 0.068 m

1975

Section 1	41 Distances (no angles or azimuths) A001, B001, A009 held fixed. Maximum adjustment to distance: 0.228 m at A006 Average: 0.078 m
Section 2	33 Distances (no angles or azimuths) A009, A015 held fixed. Maximum ajdustment to distance: 0.269 m at A009 Average: 0.092 m
Section 3	30 Distances (no angles or azimuths) A015, B021 held fixed. Maximum adjustment to distance: 0.235 m at A020 Average: 0.049 m
Section 4	26 Distances (no angles or azimuths) B021, A026 held fixed. Maximum adjustment to distance: 0.366 m at B022 Average: 0.107 m
Section 5	3 Angles, 43 Distances (no azimuths) A026, A034 held fixed. Maximum adjustment to distance: 0.136 m at A031 Average: 0.039 m

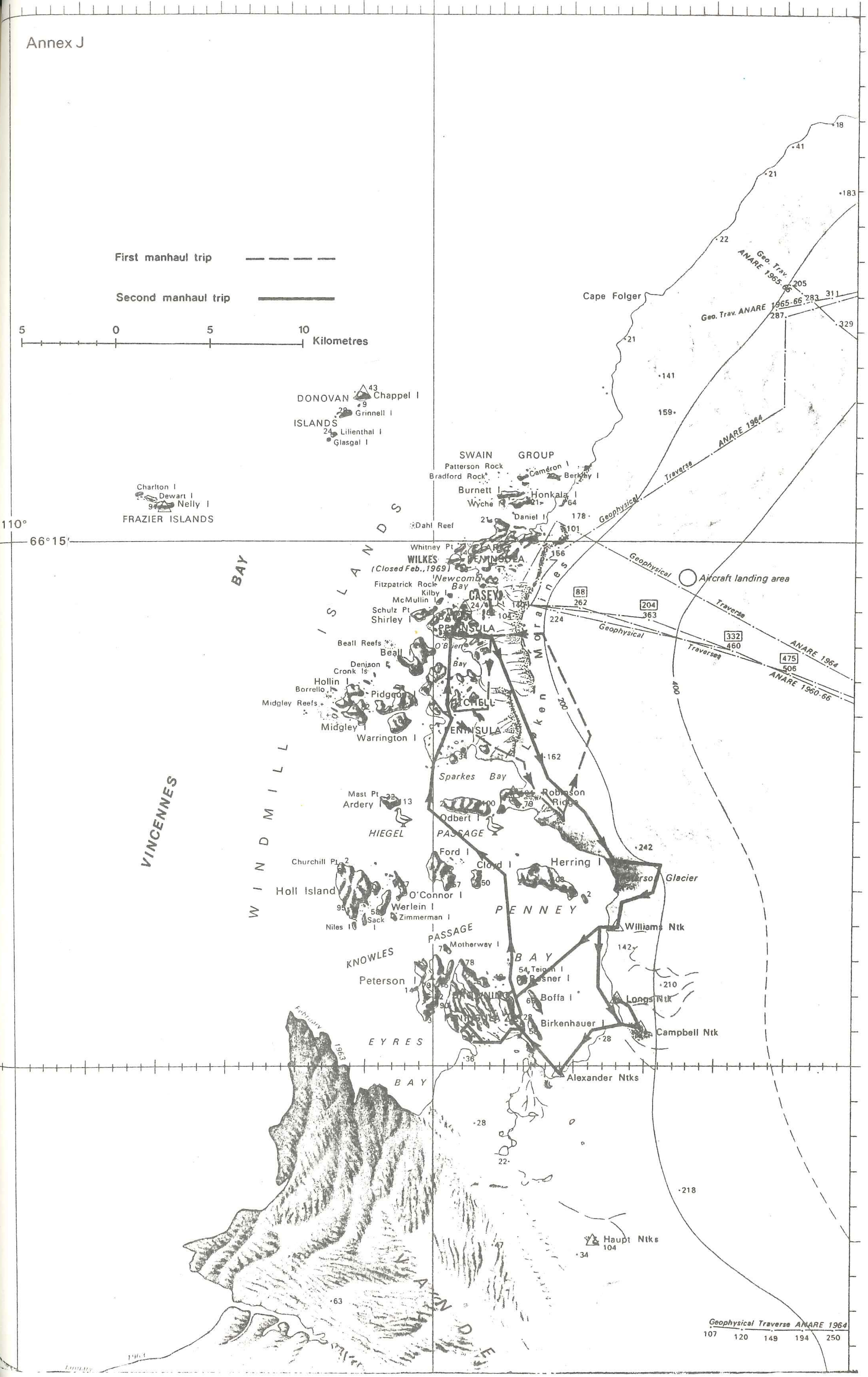
Sections 1 & 2 combined	73 Distances (no angles or azimuths) A001, B001, A009, A015 held fixed. Maximum adjustment to distance: 0.323 m at A011 Average: 0.088 m
Sections 1 & 2 combined	2 Azimuths, 73 Distances (no angles) A001, B001, A009, A015 held fixed. Maximum adjustment to distance: 0343 m at A002 Average: 0.116 m
Sections 3, 4, 5 combined	6 Angles, 1 Azimuth, 99 Distances A015, B021 ADJ 1, B021 ADJ 2, A026, A034 held fixed. Maximum adjustment to distance: 0.357 m at B022 Average: 0.063 m
Sections 3, 4, 5 combined	6 Angles, 5 Azimuths, 99 Distances A015, B021 ADJ 1, B021 ADJ 2, A026, A034 held fixed. Maximum adjustment to distance: 0.848 m at A025 Average: 0.144 m
Sections 3, 4, 5 combined	6 Angles, 5 Azimuths, 99 Distances A015, B021 ADJ 1, B021 ADJ 2, A026, A034 held fixed. (Azimuths weighted) Maximum adjustment to distance: 0.827 m at B024 Average: 0.156 m
Sections 3, 4, 5 combined	6 Angles, 5 Azimuths, 99 Distances A015, B021 ADJ 1, B021 ADJ 2, A026 ADJ 1, A026 ADJ 2, A034 held fixed. Maximum adjustment to distance: 0.602 m at A025 Average: 0.110 m (B021 adjusted from previous runs)

GEOCEIVER STATIONS

Station	Geoceiver Station Serial	Date	NWL8E Ellipsoid			International Ellipsoid		
			Latitude South	Longitude East	Height in metres	Latitude South	Longitude East	Heights in metres
PAGEOS B052	20126	1973:27	66°16'44".70	110°32'07".59	2.50	66°16'46".865	110°32'07".59	-164.4
		1973:150	66 16 44.68	110 32 07.56	3.00	66 16 46.845	110 32 07.56	-163.9
		1974:357	66 16 44.607	110 32 07.813	3.00	66 16 46.772	110 32 07.813	-163.9
		1975:35	66 16 44.751	110 32 07.876	3.30	66 16 46.916	110 32 07.876	-163.9
A001	20127	1973:81	66 43 44.86	112 50 08.28	1370.7	66 43 46.993	112 50 08.28	1204.3
	20148	1974:252	66 43 44.914	112 50 08.165	1368.9	66 43 47.047	112 50 08.165	1202.5
	20127	1975:102	66 43 44.919	112 50 08.274	1368.9	66 43 47.0516	112 50 08.274	1202.5
B001	20135	1973:294	66 41 36.97	112 43 03.85	1348.6	66 41 39.105	112 43 03.85	1182.2
	20147	1974:248	66 41 37.024	112 43 03.509	1346.6	66 41 39.1592	112 43 03.509	1180.2
	20135	1975:150	66 41 37.002	112 43 03.387	1344.3	66 41 39.1371	112 43 03.387	1177.8
A009/G	20128	1973:110	67 00 50.54	112 41 40.86	1160.6	67 00 52.653	112 41 40.86	994.5
	20128	1973:300	67 00 50.67	112 41 41.05	1161.1	67 00 52.783	112 41 41.05	995.0
	20149	1974:261	67 00 50.968	112 41 40.783	1159.5	67 00 53.08	112 41 40.783	993.4
	20128	1975:120	67 00 51.124	112 41 40.58	1158.0	67 00 53.2365	112 41 40.58	991.9
A015	20129	1973:126	67 19 43.997	112 18 51.64	803.4	67 19 46.087	112 18 51.64	637.7
	20129	1973:307	67 19 43.96	112 18 51.58	804.4	67 19 46.05	112 18 51.58	638.7
	20150	1974:265	67 19 43.921	112 18 51.213	805.2	67 19 46.011	112 18 51.213	639.5
	20129	1975:138	67 19 43.879	112 18 50.978	802.0	67 19 45.969	112 18 50.978	636.3
	20129	1975:311	67 19 43.863	112 18 50.704	802.5	67 19 45.953	112 18 50.704	636.8
B021	20130	1973:134	67 40 59.48	111 49 53.52	1057.7	67 41 01.544	111 49 53.52	892.4
	20130	1973:325	67 40 57.55	111 49 55.13	1057.6	67 40 59.614	111 49 55.13	892.3
	20151	1974:275	67 40 54.206	111 49 57.721	1054.5	67 40 56.270	111 49 57.721	889.2
	20130	1975:319	67 40 50.006	111 50 00.899	1050.4	67 40 52.070	111 50 00.899	885.1
A026	20136	1973:336	68 14 10.94	112 04 34.31	1545.2	68 14 12.963	112 04 34.31	1380.5
		1975:341	68 14 02.972	112 04 44.204	1540.1	68 14 04.995	112 04 44.204	1375.4
A034	20137	1973:355	68 54 48.54	112 02 07.58	1897.0	68 54 50.512	112 02 07.580	1733.0
	(New stn)	1975:352	68 54 43.498	112 02 03.543	1893.8	68 54 45.47	112 02 03.543	1729.8

			° ' "	° ' "		° ' "	° ' "	
Drill	20139	1974:76	66 09 06.41	111 00 05.05	340.0	66 09 08.5833	111 00 05.05	172.9
site	20153	1974:353	66 09 06.257	111 00 04.665	342.4	66 09 08.43	111 00 04.665	175.3
1974	20139	1975:227	66 09 06.241	111 00 04.044	339.6	66 09 08.4143	111 00 04.044	172.5
S/G A	20140	1974:117	66 07 57.476	110 56 46.176	262.5	66 07 59.651	110 56 46.176	95.4
S/G P	20141	1974:122	66 13 47.863	111 13 55.243	591.3	66 13 50.031	111 13 55 243	424.3
S/G B	20142	1974:131	66 18 07.257	111 27 25.271	753.1	66 18 09.42	111 27 25.271	586.2
		1975:224	66 18 07.211	111 27 24.832	752.0	66 18 09.374	111 27 24.832	585.1
S/G Q	20143	1974:140	66 23 16.438	111 43 36.005	912.4	66 23 18.595	111 43 36.005	745.6
		1975:220	66 23 16.387	111 43 35.776	912.2	66 23 18.544	111 43 35.776	745.4
S/G C	20144	1973:222	66 28 22.64	111 59 55.58	1047.9	66 28 24.791	111 59 55.58	881.2
	20133	1974:145	66 28 22.549	111 59 55.415	1047.0	66 28 24.700	111 59 55.415	880.3
S2 Bdg	20131	1973:212	66 30 14.59	112 13 09.38	1135.0	66 30 16.739	112 13 09.38	968.3
	20145	1974:239	66 30 14.561	112 13 09.184	1134.0	66 30 16.71	112 13 09.184	967.3
	20131	1975:216	66 30 14.518	112 13 08.539	1132.5	66 30 16.667	112 13 08.539	965.8
S/G R	20132	1973:217	66 35 46.31	112 23 53.48	1220.9	66 35 48.452	112 23 53.48	1054.4
	20146	1974:243	66 35 46.181	112 23 53.054	1218.6	66 35 48.323	112 23 53.054	1052.1
Auto Stn	20152	1974:340	66 37 53.564	112 15 28.611	1170.8	66 37 55.704	112 15 28.611	1004.3
		1975:212	66 37 53.536	112 15 28.338	1170.6	66 37 55.676	112 15 28.338	1004.1
NM/S/97	20134	1973:226	66 34 53.89	110 41 31.94	67.2	66 34 56.034	110 41 31.94	-99.4

Annex J



First manhaul trip
Second manhaul trip
5 0 5 10 Kilometres
DONOVAN ISLANDS
Chappel I
Grinnell I
Lilienthal I
Glasgal I
Charlton I
Dewart I
Nelly I
FRAZIER ISLANDS
SWAIN GROUP
Patterson Rock
Bradford Rock
Cameron I
Burnett I
Honkala I
Wyche I
Daniel I
Dahl Reef
Whitney Pt
WILKES
(Closed Feb.,1969)
Newcomb Bay
Fitzpatrick Rock
Kilby I
McMullin I
CASEY
Schulz Pt
Shirley I
Beall Reefs
Beall I
Denison I
Cronk Is
Hollin I
Borrello I
Pidgeon I
Midgley Reefs
Midgley I
Warrington I
Sparkes Bay
Mast Pt
Ardery I
Odbert I
HIEGEL PASSAGE
Ford I
Cloyd I
Herring I
Glacier
Churchill Pt
Holl Island
O'Connor I
Werlein I
Zimmerman I
Sack I
Niles I
PENNEY
PASSAGE
Motherway I
KNOWLES
Peterson I
BAY
Boffa I
Birkenhauer I
Williams Ntk
Longs Ntk
Campbell Ntk
Alexander Ntks
Haupt Ntks
EYRES
BAY
VINCENNES
BAY
WINDMILL ISLANDS
Cape Folger
Geo. Trav. ANARE 1965-66
Geophysical Traverse ANARE 1964
Aircraft landing area
Geophysical Traverse
ANARE 1964
ANARE 1960-66
Geophysical Traverse ANARE 1964
107 120 149 194 250
110°
66°15'

LIST OF WEIGHTS AND EQUIPMENT FOR FIRST SLEDGING TRIP

4 People

Nansen sledge	78
2 Bechevaise tents, complete	132
3 Primus stoves, 4½ lb each	13.5
2 Tilley lights, 5 lb each	10
4 sleeping bags, 6 lb each	24
4 down coats, 5.5 lb each	22
4 mattresses, 5 lb each	20
First aid tin - helicopter kit	7
Binoculars	4.5
Rope	7.5
Codan radio	21
Marine battery	37
Rock drill and attachments	110
Fuel - 2 stroke	16
Fuel - for stoves and light - 3 gallons	30
Food boxes	55
Torches - 3	4.5
Food	75
Two 44-gallon drums for beacons	116
Brass plaques and sulphur	9
Sundries - food, clothes, boots, etc	100
TOTAL :	892 lb

LIST OF WEIGHTS AND EQUIPMENT FOR SECOND SLEDGING TRIP

	Group 1 (5 persons)		Group 2 (3 persons)
Nansen sledge	78		78
Tellurometer	44		44
Marine battery	37		37
Battery charger	45		45
Theodolite and tripod	53		
Radio	20		20
Polar pyramid tent	90		90
Bechevaise tent	46		
First aid kit	7		7
Food	140		90
Sleeping bags - 2 per man	50		36
Sleeping mats " " "	25		15
Tilley lights - 2	11	-1	6
Stoves - 2	9		9
Fuel - ATK 7 gal	63	6 gal	54
Petrol 1 gal	9		9
2-stroke 1 gal	9		
Rock drill	60		
Rope, 2 ice axes	13		13
Torches - 3	6	-2	4
Food and other boxes	33		20
Binoculars, compass	5		5
Sulphur, plaques	8		
Barometer, anemometer	10		
Shovel, tools	10		8
Pots, pans	3		3
Personal gear	80		50
Sundries - repair kits, metatabs matches etc	15		15
	979 lb		658 lb

CHANGES IN SEA LEVEL DISTANCES 1973-75

Line	1973 Distance in metres	1973 Date	1975 Distance in metres	1975 Date	Difference in metres	Remarks
A001-B001	6541.275	27/3/73	6544.950	15/4/75	+3.675	
A001-A002	3991.540	27/3/73	3994.035	15/4/75	+2.495	
A001-B002	5215.425	27/3/73	5220.935	15/4/75	+5.510	
B001-A002	8937.645	26/3/73	8940.875	15/4/75	+3.230	
B001-B002	4449.635	26/3/73	4451.345	15/4/75	+1.710	
A002-B002	5455.175	26/3/73	5458.150	16/4/75	+2.975	
A002-A003	3765.810	3/4/73	3810.380	16/4/75		A003 is new
A002-B003	5090.265	3/4/73	5094.770	16/4/75	+4.505	station.
B002-A003	8074.850	3/4/73	8212.585	16/4/75		
B002-B003	5684.430	3/4/73	5686.840	16/4/75	+2.410	
A003-B003	4321.185	3/4/73	4505.325	16/4/75		
A003-A004	2912.780	6/4/73	2892.895	17/4/75		
A003-B004	5112.930	6/4/73	5245.595	17/4/75		
B003-A004	5562.915	6/4/73	5566.980	17/4/75	+4.065	
B003-B004	3707.710	6/4/73	3709.370	17/4/75	+1.660	
A004-B004	4103.535	6/4/73	4107.480	19/4/75	+3.945	
A004-A005	4402.845	6/4/73	4405.385	19/4/75	+2.540	
A004-B005	8330.415	6/4/73	8335.870	19/4/75	+5.455	
B004-A005	5902.610	6/4/73	5906.900	19/4/75	+4.290	
B004-B005	5995.080	6/4/73	5997.895	19/4/75	+2.815	
A005-B005	6087.275	6/4/73	6092.780	23/4/75	+5.505	
A005-A006	4180.345	10/4/73	4181.270	23/4/75	+0.925	
A005-B006	8471.290	10/4/73	8476.675	23/4/75	+5.385	
B005-A006	6511.055	10/4/73	6516.705	23/4/75	+5.650	
B005-B006	3697.355	10/4/73	3697.685	23/4/75	+0.330	
A006-B006	6863.930	10/4/73	6870.415	23/4/75	+6.485	
A006-A007	3895.415	10/4/73	3896.920	24/4/75	+1.505	
A006-B007	8463.940	11/4/73	8468.580	24/4/75	+4.640	
B006-A007	7451.215	11/4/73	7458.690	24/4/75	+7.475	
B006-B007	4563.745	11/4/73	4564.345	24/4/75	+0.600	
A007-B007	6676.400	11/4/73	6682.425	24/4/75	+6.025	
A007-A008	4037.800	12/4/73	4039.170	25/4/75	+1.370	
A007-B008	9408.305	12/4/73	9411.060	25/4/75	+2.755	
B007-A008	6973.055	12/4/73	6980.080	25/4/75	+7.025	
B007-B008	6160.770	12/4/73	6162.470	25/4/75	+1.700	
A008-B008	6589.545	12/4/73	6592.680	25/4/75	+3.135	
A008-A009	5186.220	14/4/73	5188.790	28/4/75	+2.570	
A008-B009	8831.505	14/4/73	8833.175	28/4/75	+1.670	
B008-A009	5773.630	14/4/73	5780.280	28/4/75	+6.650	
B008-B009	3222.545	14/4/73	3222.410	28/4/75	-0.135	
A009-B009	5874.085	16/4/73	5878.370	28/4/75	+4.285	
A009-A010	3863.685	23/4/73	3865.395	9/5/75	+1.710	
A009-B010	6825.740	23/4/73	6828.410	9/5/75	+2.670	
B009-A010	5451.265	23/4/73	5459.050	9/5/75	+7.785	
B009-B010	2826.625	23/4/73	2827.700	27/4/75	+1.075	
A010-B010	4594.470	24/4/73	4600.315	9/5/75	+5.845	

A010-A011	4485.290	24/4/73	4487.595	9/5/75	+2.305	
A010-B011	5141.480	25/4/73	5145.630	9/6/75	+4.150	
B010-A011	5384.510	25/4/73	5392.010	9/5/75	+7.500	
B010-B011	1975.945	25/4/73	1976.925	9/5/75	+0.980	
A011-B011	4126.815	29/4/73	4133.335	9/5/75	+6.520	
A011-A012	7313.210	29/4/73	7313.840	10/5/75	+0.630	
A011-B012	7405.120	29/4/73	7404.495	10/5/75	-0.625	
B011-A012	9443.760	29/4/73	9451.105	10/5/75	+7.345	
B011-B012	8345.750	29/4/73	8347.375	10/5/75	+1.625	
A012-B012	2569.290	29/4/73	2577.300	10/5/75	+8.010	
A012-A013	9358.795	2/5/73	9353.900	12/5/75	-4.895	
A012-B013	10139.345	2/5/73	8388.735	12/5/75		B013 is new
B012-A013	9890.670	2/5/73	9889.920	12/5/75	-0.750	station.
B012-B013	9196.710	2/5/73	7346.510	12/5/75		
A013-B013	5553.540	2/5/73	5640.530	12/5/75		
A013-A014	8216.245	2/5/73	8207.175	13/5/75	-9.070	
A013-B014	10214.825	2/5/73	10226.790	13/5/75	+11.965	
B013-A014	10547.595	2/5/73	11888.730	13/5/75		
B013-B014	9088.740	2/5/73	10907.185	13/5/75		
A014-B014	5967.365	3/5/73	5980.625	15/5/75	+13.260	
A014-A015	5834.785	3/5/73	5835.510	15/5/75	+0.725	
A014-B015	10573.870	3/5/73	(10598.090)	15/5/75	(Calculated distance)	
B014-A015	6978.050	3/5/75	6971.055	17/5/75	-6.995	
B014-B015	5859.840	3/5/73	5858.370	17/5/75	-1.470	
A015-B-15	7751.530	3/5/73	7786.920	17/5/75	+35.390	
A014-B014	5970.590	8/11/73	5980.625	15/5/75	+10.035	
A014-A015	5834.960	8/11/73	5835.510	15/5/75	+0.550	
A014-B015	10573.870	8/11/73	10598.090)	15/5/75	(Calculated distance)	
B014-A015	6976.350	6/11/73	6971.055	17/5/75	-5.295	
B014-B015	5859.670	6/11/73	5858.370	17/5/75	-1.300	
A015-B015	7760.745	6/11/73	7795.165	4/11/75	+34.420	
A015-A016	7551.145	9/11/73	7523.405	4/11/75	-27.740	
A015-B016	8612.285	9/11/73	8611.110	4/11/75	-1.175	
B015-A016	11953.880	9/11/73	11961.675	4/11/75	+7.795	
B015-B016	6535.020	9/11/73	6493.670	4/11/75	-41.350	
A016-B016	7640.165	9/11/73	7679.735	10/11/75	+39.570	
A016-A017	5424.680	10/11/73	5397.560	10/11/75	-27.120	
A016-B017	9763.560	10/11/73	(9767.820)	10/11/75	(Calculated)	B017 is new
B016-A017	(9991.785)	10/11/73	(9993.330)	10/11/75	(distances)	station.
B016-B017	8178.870	10/11/73	8180.730	10/11/75		
A017-B017	6961.640	12/11/73	6960.570	10/11/75		
A017-A018	10967.930	12/11/73	10833.460	11/11/75	-134.470	
A017-B018	12982.000	12/11/73	12906.365	11/11/75	-75.635	
B017-A018	12334.950	12/11/73	12187.645	11/11/75		
B017-B018	11378.210	12/11/73	11236.885	11/11/75		
A018-B018	5114.600	12/11/73	5155.550	11/11/75	+40.950	
A018-A019	10550.535	13/11/73	10524.115	11/11/75	-26.420	
A018-B019	9897.925	13/11/73	9832.590	11/11/75	-65.335	
B018-A019	12829.495	13/11/73	12848.405	11/11/75	+18.910	
B018-B019	9085.425	13/11/73	9035.295	11/11/75	-50.130	
A019-B019	6821.060	13/11/73	6835.250	11/11/75	+14.190	
A019-A020	6072.800	17/11/73	5280.185	11/11/75		A020 is new
A019-B020	6182.030	17/11/73	6189.890	12/11/75	+7.860	station.
B019-A020	9292.445	17/11/73	9271.680	12/11/75		

B019-B020	3313.440	17/11/73	3302.485	12/11/75	-10.955	
A020-B020	6407.360	17/11/73	6639.860	12/11/75		
A020-A021	3409.290	17/11/73	4065.310	12/11/75		A021 is new
A020-B021	9801.610	17/11/73	10737.450	12/11/75		station.
B020-A021	8830.045	17/11/73	8677.930	12/11/75		
B020-B021	8369.645	17/11/73	8372.715	12/11/75	+3.070	
A021-B021	9071.175	17/11/73	9010.735	12/11/75		
A021-A022	9007.765	25/11/73	9190.835	1/12/75		
A021-B022	10289.440	25/11/73	10443.280	1/12/75		
B021-A022	14043.545	25/11/73	14045.640	1/12/75	+2.095	
B021-B022	12252.585	25/11/73	12246.285	1/12/75	-6.300	
A022-B022	4155.520	25/11/73	4160.790	1/12/75	+5.270	
A022-A023	13247.225	25/11/73	12914.890	2/12/75		A023 is new
A022-B023	13003.310	25/11/73	12993.585	2/12/75		station.
B022-A023	14668.190	26/11/73	14267.755	2/12/75		
B022-B023	12308.805	26/11/73	12303.675	2/12/75	-5.130	
A023-B023	6519.910	26/11/73	6529.285	2/12/75		
A023-A024	10521.570	27/11/73	11106.790	3/12/75		A024 is new
A023-B024	12371.325	27/11/73	12309.510	3/12/75		station.
B023-A024	13332.110	27/11/73	13331.495	3/12/75		
B023-B024	9755.110	27/11/73	9749.960	3/12/75	-5.150	
A024-B024	9054.375	28/11/73	8598.300	3/12/75		
A024-A025	10207.535	28/11/73	9805.045	3/12/75		
A024-B025	14407.905	28/11/73	13813.070	3/12/75		
B024-A025	13870.690	28/11/73	13851.295	3/12/75	-19.395	
B024-B025	12286.935	28/11/73	12278.475	3/12/75	-8.460	
A025-B025	8244.825	28/11/73	8250.395	5/12/75	+5.570	
A025-A026	17533.810	29/11/73	17574.250	5/12/75	+40.440	
A025-B026	18481.590	29/11/73	18554.500	5/12/75		B026 is new
B025-A026	16998.390	29/11/73	17021.185	5/12/75	+22.795	station.
B025-B026	15451.215	29/11/73	15500.065	5/12/75		
A026-B026	5309.465	29/11/73	5335.590			
A026-A027	11068.630	6/12/73	11355.855	9/12/75		A027 is new
A026-B027	11181.470	6/12/73	11206.415	9/12/75	+24.945	station.
B026-A027	13662.320	6/12/73	14015.665	9/12/75		
B026-B027	11848.025	6/12/73	(11852.770)	9/12/75	(Calculated distance)	
A027-B027	4631.250	6/12/73	4942.56	9/12/75		
A027-A028	8757.790	7/12/73	9507.825	9/12/75		A028 is new
A027-B028	7706.770	7/12/73	7661.505	9/12/75		station.
B027-A028	10691.355	7/12/73	11985.420	9/12/75		
B027-B028	7193.325	7/12/73	7198.720	9/12/75	+5.395	
A028-B028	5124.795	7/12/73	6426.605	9/12/75		
A028-A029	9123.640	8/12/73	7637.715	10/12/75		A029, B029 are
A028-B029	11711.085	8/12/73	11539.960	10/12/75		new stations.
B028-A029	12884.820	8/12/73	12449.390	10/12/75		
B028-B029	12307.260	8/12/73	12313.310	10/12/75		
A029-B029	7989.000	8/12/73	7935.740	10/12/75		
A029-A030	9345.890	11/12/73	9687.855	10/12/75		
A029-B030	(11231.945)	11/12/73	(11304.610)	10/12/75	(Calculated distances)	
B029-A030	9131.110	11/12/73	(9165.385)	10/12/75	(Calculated distance)	
B029-B030	4748.620	11/12/73	4750.960	10/12/75	+2.340	
A030-B030	7565.580	11/12/73	7565.760	10/12/75	+0.180	
A030-A031	10388.790	15/12/73	10394.690	12/12/75	+5.900	
A030-B031	14843.160	15/12/73	14843.450	12/12/75	+0.290	
B030-A031	9948.900	15/12/73	9954.220	12/12/75	+5.320	

B030-B031	10578.660	15/12/75	10584.300	12/12/75	+5.640	
A031-B031	6600.625	15/12/75	6592.660	12/12/75	-7.965	
A031-A032	12319.695	16/12/73	12695.680	14/12/75		A032 is new station.
A031-B032	10694.945	16/12/73	10706.605	14/12/75	+11.660	
B031-A032	14374.565	16/12/73	14566.370	14/12/75		
B031-B032	9716.000	16/12/73	9730.095	14/12/75	+14.095	
A032-B032	6296.035	16/12/73	6219.230	14/12/75		
A032-A033	13097.490	17/12/73	12910.455	14/12/75		A033 is new station.
A032-B033	12967.775	17/12/73	12555.820	14/12/75		
B032-A033	18487.410	17/12/73	18498.455	16/12/75		
B032-B033	15640.970	17/12/73	15657.275	16/12/75	+16.305	
A033-B033	8771.450	17/12/73	8763.305	16/12/75		
A033-A034	5937.725	18/12/73	5946.750	18/12/75		A034 is new station.
A033-B034	10008.185	18/12/73	10011.325	18/12/75		
B033-A034	10530.250	18/12/73	10447.200	18/12/75		
B033-B034	8214.400	18/12/73	8234.265	18/12/73	+19.865	
A034-B034	6454.435	18/12/73	6348.050	18/12/75		
A034-A035	13464.550	19/12/73	13548.150	21/12/75		A035 is new station.
A034-B035	15530.640	19/12/73	15517.600	21/12/75		
B034-A035	15167.365	19/12/73	15278.595	21/12/75		
B034-B035	12907.625	19/12/73	12916.935	21/12/75	+9.310	
A035-B035	9588.650	19/12/73	9793.340	21/12/75		
A015-B021	44494.830	5/1/74	44253.665	1/1/76	-241.165	
A015-B022	53314.105	4/1/74	53045.755	1/1/76	-268.350	

GEOCEIVER STATION MOVEMENTS 1973-75

Station	Measurement Dates	Movement: Bearing	Movement: Distance in m	Interval Days	Metres per Day/Year
A001	1973/81 -1974/252	220°06'19"	2.185	536	0.004/1.488
(20127)	1974/252-1975/102	96 05 27	1.345	215	0.006/2.283
				Mean:	0.005/1.886
B001	1973/294-1974/248	248 08 01	4.510	319	0.014/5.160
(20135)	1974/248-1975/150	294 34 42	1.645	267	0.006/2.249
	Mean:	271 21 21		Mean:	0.010/3.705
A009/G	1973/110-1973/300	150 15 36	4.640	190	0.024/ 8.914
(20128)	1973/300-1974/261	199 21 44	9.755	326	0.030/10.922
	1974/261-1975/120	206 53 13	5.435	224	0.025/ 9.018
	Mean:	185 30 11		Mean:	0.026/ 9.618
A015	1973/126-1973/307	327 58 04	1.350	181	0.008/2.722
(20129)	1973/307-1974/265	285 23 57	4.550	323	0.014/5.142
	1974/265-1975/138	294 51 18	3.096	238	0.013/4.748
	1975/138-1975/310	278 36 23	3.312	172	0.019/7.028
	Mean:	296 42 25		Mean:	0.014/4.910
B021	1973/134-1973/325	17 35 33	62.730	191	0.328/199.875
(20130)	1973/325-1974/275	16 24 39	108.005	315	0.343/125.149
	1974/275-1975/319	16 02 49	135.400	409	0.331/120.834
	Mean:	16 41 00		Mean:	0.334/121.953
A026	1973/336-1975/341	24 44 37	271.840	735	0.370/134.995
(20126)					
Drill site	1974/76 -1974/353	314 31 52	6.770	277	0.024/ 8.921
(20139)	1974/353-1975/227	273 34 27	7.800	239	0.033/11.912
	Mean:	294 03 09		Mean:	0.029/10.417
S/G B	1974/131-1975/224	284 35 50	5.655	458	0.012/4.507
(20142)					
S/G Q	1974/140-1975/220	299 02 56	3.255	445	0.007/2.670
(20143)					
S/G C	1973/222-1974/145	324 04 28	3.480	288	0.012/4.410
(20133)					

S2 Bdg (20131)	1973/212-1974/237	290°20'28"	2.585	390	0.007/2.419
	1974/237-1975/216	279 28 59	8.085	344	0.016/5.499
	Mean:	285 54 43		Mean:	0.016/5.499
S/G R8 (20132)	1973/217-1974/243	307 17 30	6.595	391	0.017/6.157
Auto Stn (20152)	1084/340-1975/212	284 29 01	3.470	237	0.015/5.344

LAW DOME VECTOR MOVEMENTS 1973-75

Station	Measurement Dates	Movement		Interval in Days	Metres per Day/Year
		Bearing	Distance in m		
A001	1973:81 -1973:102	182°18'11"	1.830	751	0.002 / 0.889
B001	1973:86 -1975:105	252 07 10	5.005	749	0.007 / 2.463
A002	1973:93 -1975:105	213 57 08	4.985	742	0.007 / 2.452
B002	1973:93 -1975:106	239 56 03	6.525	743	0.009 / 3.203
B003	1973:96 -1975:107	231 28 57	9.250	741	0.013 / 4.556
A004	1973:96 -1975:109	204 58 08	8.960	743	0.012 / 4.402
B004	1973:96 -1975:109	222 43 45	10.995	743	0.015 / 5.401
A005	1973:100-1975:113	199 27 18	11.630	743	0.016 / 5.713
B005	1973:100-1975:113	222 15 43	13.900	743	0.019 / 6.828
A006	1973:100-1975:113	197 22 28	12.785	743	0.017 / 6.281
B006	1973:100-1975:113	224 24 41	14.565	743	0.020 / 7.155
A007	1973:102-1975:114	194 35 22	14.420	742	0.019 / 7.093
B007	1973:102-1975:114	221 00 51	14.935	742	0.020 / 7.347
A008	1973:104-1975:115	195 18 49	15.805	741	0.021 / 7.785
B008	1973:104-1975:115	211 50 28	15.775	741	0.021 / 7.770
A009	1974:110-1975:120	190 52 20	18.425	740	0.025 / 9.088
B009	1973:114-1975:116	209 51 15	15.805	732	0.022 / 7.881
A010	1973:114-1975:117	186 25 42	19.520	733	0.027 / 9.720
B010	1973:114-1975:117	206 54 49	16.955	733	0.023 / 8.443
A011	1973:114-1975:130	188 50 56	20.731	746	0.028 /10.143
B011	1973:114-1975:130	206 40 06	17.480	746	0.023 / 8.553
A012	1973:122-1975:131	176 53 44	22.175	739	0.030 /10.952
B012	1973:122-1975:131	196 54 14	17.515	739	0.024 / 8.651
A013	1973:122-1975:133	180 24 44	15.350	741	0.021 / 7.561
A014	1973:123-1975:135	199 39 56	3.630	742	0.005 / 1.786
B014	1973:123-1975:135	249 03 36	19.375	742	0.026 / 9.531
A015	1973:126-1975:138	294 42 15	8.710	742	0.012 / 4.285
B015	1973:123-1975:136	307 07 22	44.405	743	0.060 /21.814
A015	1973-126-1973-307	327 36 58	1.340	181	0.007 / 2.702
B015	1973:123-1973:313	303 27 16	10.350	190	0.054 /19.883
A015	1973:307-1975:138	289 13 33	7.620	561	0.014 / 4.958
B015	1973:313-1975:136	308 08 48	34.070	553	0.062 /22.487
A015	1975:138-1975:311	278 36 23	3.310	173	0.019 / 6.984
B015	1975:136-1975:309	310 01 01	11.390	173	0.066 /24.031
A014	1973:312-1975:135	216 36 39	2.540	553	0.005 / 1.676
B014	1973:312-1975:135	251 18 51	14.545	553	0.026 / 9.600
A015	1973:307-1975:311	286 00 48	10.895	734	0.015 / 5.418
B015	1973:313-1975:309	308 35 34	45.445	726	0.063 /22.848
A016	1973:314-1975:309	346 27 32	32.190	725	0.044 /16.206
B016	1973:314-1975:309	337 39 43	74.430	725	0.103 /37.472
A017	1973:316-1975:314	344 07 59	72.875	728	0.100 /36.538
A018	1973:317-1975:315	356 08 23	214.915	728	0.295/107.753
B018	1973:317-1975:315	345 39 59	223.695	728	0.307/112.155
A019	1973:320-1975:316	10 23 36	248.195	726	0.342/124.781
B019	1973:320-1975:316	7 57 52	261.275	726	0.360/131.357
B020	1973:321-1975:317	7 12 26	271.710	726	0.375/136.604

B021	1973:325-1975:319	16 12 32	243.405	724	0.336/122.711
A022	1973:329-1975:335	20 35 33	274.655	736	0.373/136.208
B022	1973:329-1975:335	19 59 46	269.120	736	0.366/133.463
B023	1973:331-1975:336	25 16 10	288.390	735	0.392/143.214
A023/1	1973:365-1975:336	22 43 13	275.500	701	0.393/143.449
A023/2	1973:365-1975:336	22 15 17	276.780	701	0.395/144.115
B023/1	1973:365-1975:336	20 58 26	260.340	701	0.371/135.555
B024	1973:332-1975:337	26 41 46	296.910	735	0.404/147.445
A025	1973:333-1975:339	23 55 58	312.870	736	0.425/155.160
B025	1973:333-1975:339	24 19 30	300.695	736	0.409/149.122
A026	1973:336-1975:341	24 44 36	271.840	735	0.370/134.995
B027	1973:340-1975:341	24 27 41	244.970	731	0.335/122.317
B028	1973:341-1975:343	22 11 52	231.535	732	0.316/115.451
A030	1973:349-1975:345	16 55 43	203.360	726	0.280/102.240
B030	1973:349-1975:345	17 02 49	202.195	726	0.279/101.655
A031	1973:349-1975:348	17 12 51	196.560	729	0.270/ 98.415
B031	1973:349-1975:348	19 48 33	193.190	729	0.265/ 96.728
B032	1973:350-1975:348	20 54 40	179.625	728	0.247/ 90.059
B033	1973:351-1975:351	22 25 11	164.100	730	0.225/ 82.050
B034	1973:352-1975:352	27 00 08	148.695	730	0.204/ 74.347
B035	1973:353-1975:355	23 42 41	134.915	732	0.184/ 67.273

HEIGHTS OF STATIONS IN METRES IN 1975

Station	Height	Station	Height
A001	1388.6	B001	1364.3
A002	1378.1	B002	1354.3
A003	1363.6	B003	1350.1
A004	1346.6	B004	1329.9
A005	1318.9	B005	1292.2
A006	1292.6	B006	1277.7
A007	1265.6	B007	1254.8
A008	1233.1	B008	1221.1
A009	1177.7	B009	1190.1
A010	1146.9	B010	1165.7
A011	1103.3	B011	1146.0
A012	1020.2	B012	1051.0
A013	911.3	B013	964.8
A014	857.5	B014	834.4
A015	823.6	B015	779.9
A016	823.2	B016	792.5
A017	825.2	B017	826.5
A018	906.4	B018	867.0
A019	979.2	B019	986.6
A020	1067.1	B020	1020.2
A021	1076.8	B021	1069.0
A022	1182.0	B022	1198.2
A023	1244.0	B023	1268.3
A024	1304.0	B024	1358.6
A025	1408.4	B025	1486.4
A026	1560.5	B026	1575.9
A027	1574.8	B027	1601.2
A028	1629.2	B028	1621.3
A029	1662.7	B029	1699.3
A030	1720.6	B030	1703.8
A031	1762.7	B031	1771.1
A032	1861.6	B032	1827.2
A033	1903.9	B033	1891.5
A034	1910.9	B034	1931.5
A035	1946.0	B035	1952.1
A023/1	1167.4	B023/1	1178.3
A023/2	1178.2		
A14/15	827.0		

Notes: 1. All the above heights are in metres above notional mean sea level and are 17.05 m above the calculated heights by the Geoceiver on the NWL8E Ellipsoid. The difference was calculated as follows:

Pageos B052 Casey:	20.00 m	above mean sea level
	2.95	mean Geoceiver value
Difference	+17.05	

2. Direct comparisons of elevations from 1973 to 1975 are not possible at all stations as some of the 1975 stations are in new positions and replace those missing 1973 stations, namely A003, B013, B017, A020, A021, A023, A024, B026, A027, A028, A029, B029. A032, A033, A034 and A035.

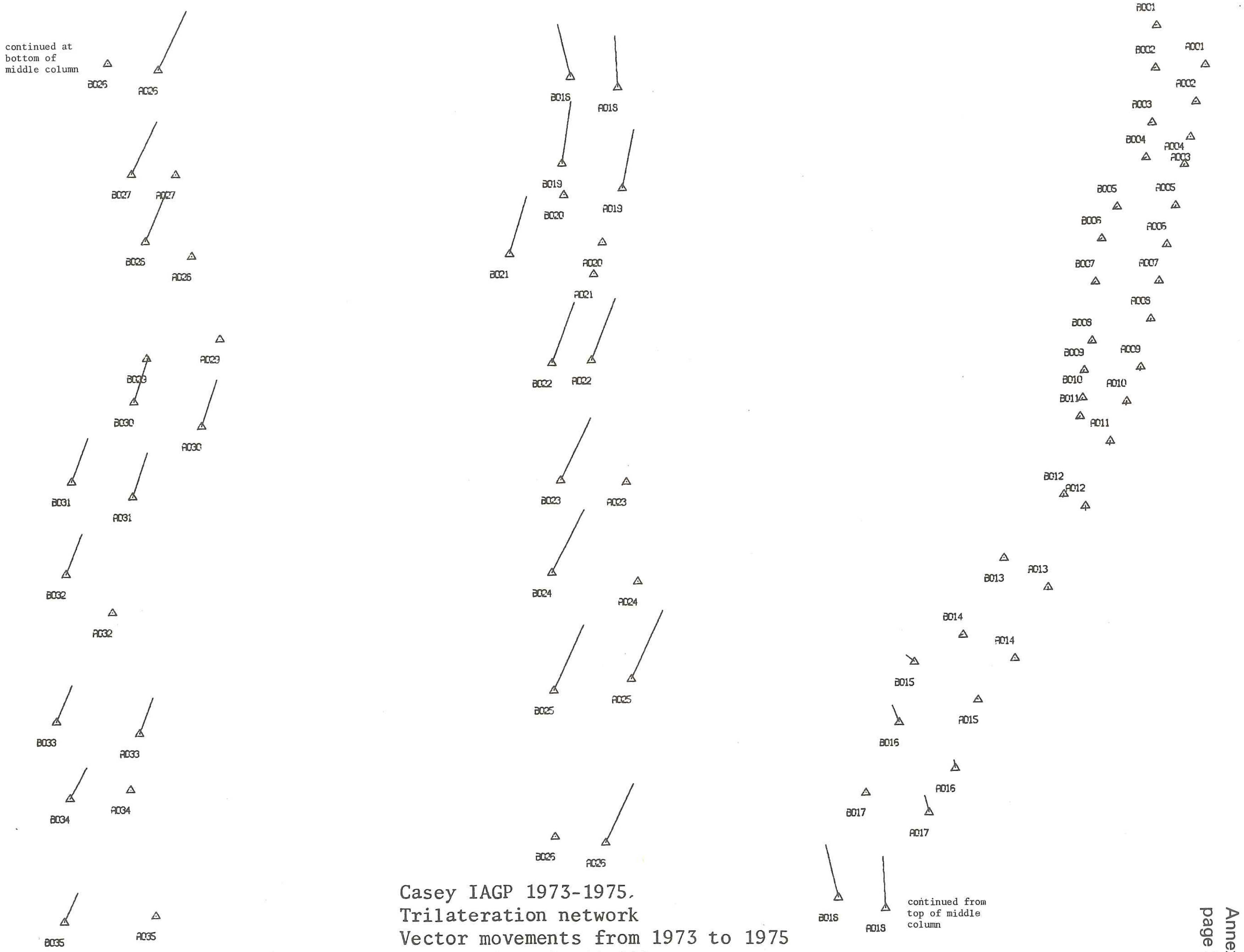
ANNEX O

ICE MOVEMENTS

From A001 to A015 the ice movements are generally in a south to south-west direction, the rate of movement increasing towards A015. An anomally appears to exist at A014, as there is a sudden small rate of movement in an area of higher rates of movement: 1.786 m/year against 7.5 to 9.5 m/year (see Annex N). The rates of movement are related to the gradients of the slopes: the greater the gradient the greater the movement. The area around A015 and B015 is known as the Saddle, and lies between the Law Dome to the north and the main Antarctic plateau to the south. Station A015 lies close to the null point where there is little movement north-south, as the ice arriving at this point flows away west to the Vanderford glacier and east to the Totten glacier.

South of Saddle the rates of movement increase. They are not related to the gradient but are due more to the pressure caused by the outpouring of ice from the plateau region. The rate of movement goes up to 155 m/year at A025. The movements are generally in a north to north east direction.

Vector movement diagrams follow.



Casey IAGP 1973-1975.
Trilateration network
Vector movements from 1973 to 1975
Plot scale: 1:500 000
Vector scale: 200 metres to 1 cm

Casey IAGP 1973-1975
Trilateration network
Vector movements from 1973 to 1975
Plot scale: 1:250 000
Vector scale: 20 metres to 1 cm