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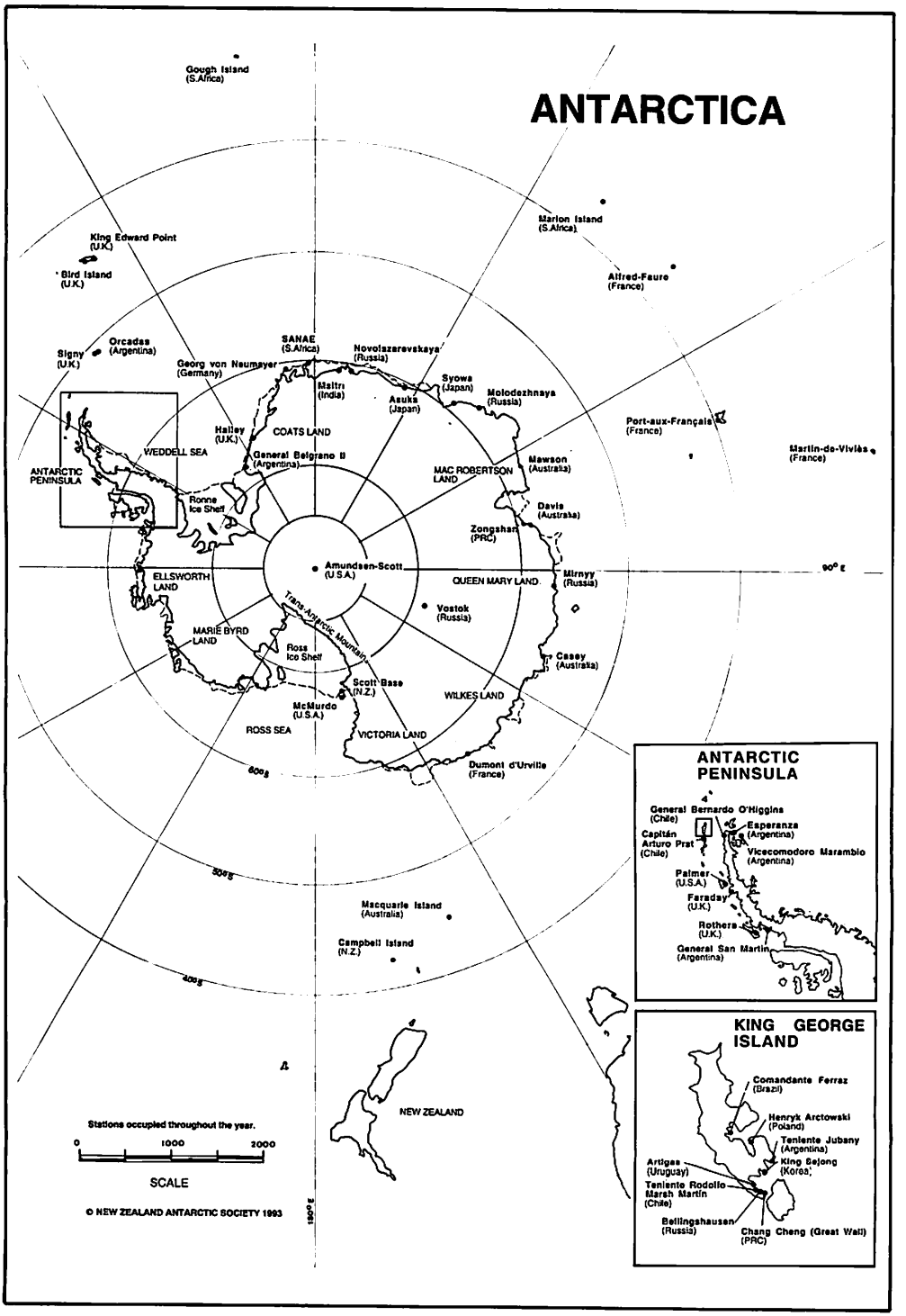
ANTARCTICA
Gough Island (S.Africa)
Marion Island (S.Africa)
Alfred-Faure (France)
King Edward Point (U.K.)
Bird Island (U.K.)
Signy (U.K.)
Orcadas (Argentina)
Georg von Neumayer (Germany)
SANAE (S.Africa)
Novolazarevskaya (Russia)
Maitri (India)
Syowa (Japan)
Asuka (Japan)
Molodezhnaya (Russia)
Port-aux-Français (France)
Martin-de-Viviès (France)
Halley (U.K.)
COATS LAND
WEDDELL SEA
General Belgrano II (Argentina)
ANTARCTIC PENINSULA
Ronne Ice Shelf
MAC ROBERTSON LAND
Mawson (Australia)
Davis (Australia)
Zongshan (PRC)
Amundsen-Scott (U.S.A.)
ELLSWORTH LAND
QUEEN MARY LAND
Mirnyy (Russia)
90° E
Vostok (Russia)
Trans-Antarctic Mountain
MARIE BYRD LAND
Ross Ice Shelf
Casey (Australia)
Scott Base (N.Z.)
WILKES LAND
McMurdo (U.S.A.)
ROSS SEA
VICTORIA LAND
Dumont d'Urville (France)
60°S
50°S
Macquarie Island (Australia)
Campbell Island (N.Z.)
40°S
NEW ZEALAND
Stations occupied throughout the year.
0 1000 2000
SCALE
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180° E
ANTARCTIC PENINSULA
General Bernardo O'Higgins (Chile)
Esperanza (Argentina)
Capitán Arturo Prat (Chile)
Vicecomodoro Marambio (Argentina)
Palmer (U.S.A.)
Faraday (U.K.)
Rothera (U.K.)
General San Martin (Argentina)
KING GEORGE ISLAND
Comandante Ferraz (Brazil)
Henryk Arctowski (Poland)
Teniente Jubany (Argentina)
King Sejong (Korea)
Artigas (Uruguay)
Teniente Rodolfo Marsh Martin (Chile)
Bellingshausen (Russia)
Chang Cheng (Great Wall) (PRC)

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Cover: En route to the Emperor penguin colony at Cape Crozier April 1992.

Photo: Max Quinn

New Zealand

Successful airdrop breaks winter routine for 11 New Zealanders

The midwinter airdrop took place in good conditions as scheduled on Tuesday June 21 and Thursday June 23. Each flight was undertaken by a Starlifter, refuelled en route by KC10 Extender, and crewed by up to 28 members from the selected team, some of whom came from 62nd Group McCord Airbase in the US. Among the cargo handlers were four from the New Zealand army including Staff Sergeant Wayne Henry who has been involved with the drop for many years and who was making his last trip before retiring.

Approximately 5000lbs of goods and equipment packed into five bundles was designated for Scott Base. Overall it comprised some 500lbs of mail, over 400lbs of fresh fruit and vegetables, 20lbs of chocolates, and, packed separately, making up the actual cargo of 3,877 lbs, was one axle and some field equipment required for the summer programme. The resupply, which included some 37,056 lbs of cargo for McMurdo, was dropped from 1,000 feet in the designated zone at Williams Field shortly after 1100 hours on both days. The next series of flights south are scheduled to begin on August 22 when between nine and 12 will be made as part of WINFLY

Six of the Scott Base team assisted with the first airdrop, two in a Search and Rescue capacity and four in the cargo recovery and five of the Scott Base team helped with the second operation, two on SAR and three on cargo recovery. The drop was made in good conditions and, as press time for *Antarctic* coincided with midwinter celebrations, it was assumed that the cargo had arrived accordingly.

Midwinter weekend was being celebrated at Scott Base on June 25 and 26 with a dinner on the Saturday and a BBQ and swim on the Sunday. The dinner was to begin about 7 p.m. Although the final menu was not available the likely format was a smorgasbord including whitebait fritters with garlic and herb butter; grilled sea-food in Italian sauce; oriental kebab with chutney curry and rice; fried chicken; corn in Spanish aspic; roast beef and roast pork with roast potatoes, fresh mid-Winter Williams Garden Salad, baked Mt. Erebus Flame Thrower; hot choco-

late sauce, coffee and Alabama iced tea. (No mention has been made of the alcoholic component but *Antarctic* is confident this would not have been overlooked.)

The fresh supplies dropped at midwinter are being supplemented by the produce from the hydroponics department This programme has operated for a number of years now but this season it has been split into two separate units to allow a broader spectrum of plants to be grown. Lettuce and tomatoes are regularly produced but because they require very different levels of nutrients, a stronger solution has been used in the tank where tomatoes are grown while in the other, it is of medium strength. The second tank is being used for lettuces, herbs and other leafy greens. In the greenhouse basil, thyme, chives, mint, lettuce, savoy cabbage, silverbeet, capsicums chillies, sugarsnap peas, radishes, daikon (Japanese radish) are being grown. Marigolds and petunias are also being produced in the programme which is operating under the watchful eye and attendance of Belinda "Green-fingers" Bennett, the Scott Base Hydroponics Horticulturist, who also doubles as an assistant science technician and base support officer.

Since March the science and engineering work programmes have been proceeding according to plan and some are ahead of schedule.

Winter ozone studies

One of the major winter science programmes is the measurement of trace gases in the atmosphere to see how they affect the amount of ozone. The programme is being undertaken by the NIWA (National Institute of Water and Atmosphere) team at Lauder in Central Otago and it has previously been confined mainly to ground based measurements at Arrival Heights. During the winter one of the NIWA team Stephen Wood has been launching balloons to gather data. The programme involves a range of balloons.

The first winter flights of the 160,000 cubic metre balloons with instruments to measure the concentration of nitric acid, particles of various sizes, ozone and temperature was launched on March 27, later than scheduled because of problems with the equipment that allows the liquid helium to cool to an extraordinarily low temperature. However the flight went well covering 54 km in three hours and landing only 23 km from Scott Base. The equipment was recovered by ground vehicle. A second flight was attempted on May 12 by which time the whole of the atmosphere up to 30km had experienced sunset. Because of premature balloon failure and instrument problems a second flight was launched on May 27 after waiting several days for calm enough weather. This was more successful but it will be the last flight of the big balloons until further supplies of liquid helium arrive on WINFLY in August.

In the meantime smaller 19,000 cubic foot balloons with ozone and temperature sensors are being flown twice a week with additional equipment to take water vapour measurements on alternate flights.

Slightly larger 54,000 cubic foot balloons with particle counters are also being launched about once a fortnight when polar atmospheric clouds are likely to be present. The timing will be judged from temperature soundings from the small balloons, satellite measurements and the lidar experiment operating at McMurdo and is important because the clouds are one of the key elements in ozone depletion.

The final sunset for the winter team

this year was on April 22. Although by that time it hadn't been seen from the Base for two weeks team members travelled regularly to Castle Rock to observe its departure. The occasion was marked by a formal dinner, a sunset swim and the usual barbecue. For the dinner French onion soup, garlic bread, a seafood platter and pasta, New Zealand lamb *a la* Wellington, Chicken dumplings, curry and rice with chutney, and roast potatoes and steamed vegetables made up the first two courses. They were followed by Pavlova and cream chocolate mousse, fruit salad and Baked Mount Erebus. It was all served with a Corbans Marlborough Muller Thurgau 1993, a Montana Gisborne Chardonnay 1992 and a Corbans Gisborne Cabernet Sauvignon and followed drinks in the bar.

A shuttle service brought 46 especially invited Americans to the base in groups of eight or ten. All, including the New Zealanders, wore ties and dinner suits, or evening gowns and when the mess (sorry) dining room doors opened at 7.30 p.m. there were rows of neatly arranged tables, complete with cloths, wine and port glasses, a full suite of cutlery and candles.

The occasion created quite an impression on the participants. Regular contact is now being maintained with the Americans at McMurdo with drinks once a week which, as the leader says, should ensure that each of the neighbours has enjoyed some Kiwi hospitality over the winter months.

Sports activities popular

Sports programmes particularly volleyball, basketball, indoor soccer, ten pin bowling, pool, darts and table tennis are popular and competitive and the newly opened climbing wall at McMurdo has attracted the New Zealanders. Some of the team are taking advantage of other facilities to dabble in ceramics, country and western dancing, and origami while three are involved in running a popular music session on the local radio station.

Winterising

Not all the New Zealand activities have been confined to base or McMurdo. In late March three parties travelled to Black Island, some, with the intention of climbing Mt. Aurora, which at 1041 metres, is the highest point on the island. The exercise was designed to familiarise the party with winter conditions and was tempered with a little team building.

From the reports the composition of the parties is not totally clear but the first comprising Grant West, Dominic McCarthy, Jeremy Ridgen and two Americans left Scott Base in "nippy" but clear and calm conditions unaware that the temperature was dropping. It reached - 43 Celsius one of the coldest March temperatures ever recorded at Scott Base. About 100 metres from the top of Mt. Aurora the air temperature was -47deg C, with a wind of 35 knots giving a chill factor of -90 C. They turned back!

The second party were more fortunate and Steve Wood, Eric Trip, Grant Avery and Arturo Bosman took four hours to reach the summit "taking a rest once an hour or after a particularly tough patch or whichever came first!" From it they could see Mt Erebus and Observation and Crater Hills, sunset over the Royal Society Ranges but at the time Scott Base was in shadow. The third party comprised David Lucas, Belinda Bennett, Angela Bocock, Grant West and (by an editorial process of elimination probably) Bruce Janes They camped out at the island but had already decided that climbing was not crucial to the expedition and tobogganed the lower

slopes of Mt. Aurora instead.

Weather and weight watch

The temperatures during March ranged from -12deg C to -42.7 with an average at 0.900 each morning of -24.2 deg C The maximum wind gust was 75 knots. In April the maximum temperature was -7.1 deg C and the minimum -35.6 deg C with a 0900 average of -20.6 deg C and maximum wind gust of 60 knots. The May and June figures were not available at press time (around midwinter).

A weight watch is being maintained and the team report that in March the average weight of its members was 183.0lbs which by mid April had dropped back to 182.5lbs while by mid May they were reporting an average weight of 183.1lbs. The small gain seems to have been infectious as even Tiddles the (stuffed, for Environmental Protocol watchers) cat has increased in weight. He was 10.5 in March and alleged to be 14.5 lbs by mid April.

The annual beard growing competition took place over an unspecified four weeks during which all manner of growth promotion was tried. Judging, undertaken by Angela Bocock and Belinda Bennett, took an unprecedented four hours after which awards were made for "The most square footage" and the "Highest density" as well as the "Most hen pecked". Not only do the names of winners remained undisclosed but the beards vanished within minutes of the judging - a testament, no doubt to the effectiveness of modern Antarctic clothing with its enhanced protection.

Drilling at Cape Roberts postponed for a year

Preparations continue for the Cape Roberts Project, a multinational effort to core off the coast of Antarctica to study variations in Antarctic climate and tectonic history. However, a recent review has concluded that the first drilling should now take place in October 1996 rather than 1995 as originally planned. Extended preparation time has become necessary because of the complexity in financial planning and long lead times involved, particularly in coordination between the different planning processes and timetables in each of the participating countries - Britain, Germany, Italy, New Zealand, and the United States of America.

A recommendation to extend the preparation time for the project was circulated in early May to participating national programmes, and this was accepted. The final decision was made at a meeting initiated by the New Zealand Antarctic Programme as the project operators, and involving the Institute of Geological and Nuclear Sciences as drilling contractors, New Zealand funding agencies and representation from the project's International Steering Committee.

This summer, the camp buildings, now under construction by Works Consultancy in Christchurch, will be transported on the Italian supply ship to Cape Roberts, along with much of the drilling equipment. The balance of the equipment will be shipped next summer for drilling in October and November of 1996 and 1997. Further planning meetings among scientists and logisticians from the five participating countries have been scheduled during

the SCAR/COMNAP meeting in Rome in August/September 1994. The approximate level and type of commitment from each country has now been confirmed, and generally follows the Record of Understanding negotiated in Washington last September.

Further information about project logistics can be obtained from Jim Cowie, Project Manager, New Zealand Antarctic Programme, P.O. Box 14-091, Christchurch (Fax + 64 3 358 0211) or about project science from Peter Barrett, Project Science Coordinator, Victoria University of Wellington, P.O. Box 600 Wellington (Fax + 64 4 495 5186).

Good, but could be better - New Zealand's environmental management

The New Zealand Antarctic Programme's activities in Antarctica have a high level of compliance with the Madrid Protocol on Environmental Protection but there are still some areas which could be improved according to an independent environmental audit report released early in April. The audit, undertaken by Royds Consulting Ltd, environmental consultants based in Christchurch, is thought to be the first independent review by a member country of the Antarctic Treaty and highlights New Zealand's desire to be at the forefront in implementing the high level of standards of the Protocol.

Two of the three members of the audit team travelled south last summer. Jim Bradley and Linda Smith spent ten days in January examining Scott Base and related activities before visiting Vanda Station, Bratina Island, Granite Harbour, Arrival Heights and Cape Royds. The third team member was Christine Birch.

Two separate reports, have now been published, the first costs $20 and deals with Compliance with the Antarctic Environmental Protocol while the other, available at $8, covers the programmes' requirements in terms of the New Zealand Resource Management Act and Health and Safely Legislation.

Although the audit notes a high level of compliance with the Protocol there are still some areas of non-compliance or where compliance can be improved.

The report notes that compliance is demonstrated by the appointment of an environmental officer to the New Zealand Antarctic programme, the undertaking of an audit, the training of New Zealand Antarctic Programme and science personnel in environmental impact and awareness as well as the environmental assessment of all science and logistic activities prior to their being included in the programme.

Compliance has further been demonstrated through measures to conserve Antarctic flora and fauna, including in specially protected areas, implementation of a permit system for the collection of specimens, controls of visits to areas of special value and the restriction of activities within those areas. Historic sites and monuments are included in this protection policy.

A waste management officer has been appointed and each year the waste management policy will be reviewed. This ensures that detailed attention will be given to waste management issues

both at Scott Base and, in the field with the sorting and return to New Zealand of recyclable and non-burnable waste.

Among the recommendations for improvement are the monitoring of impacts. It is suggested that this be undertaken following the environmental evaluation to record impacts and their consistency with the Protocol, to provide information to minimise/mitigate impacts or on the need to either cancel or modify any specific activity.

The report suggests that more practical advice should be provided on the environmental impact of camping by science personnel in the field. New Zealand Antarctic Programme staff training should be enhanced by the adoption of improved techniques such as an environmental code of practice to encourage greater awareness and hence ownership of Antarctic environment protection requirements. Enactment of the NZAP Oil Spill contingency Plan during the summer of 1994/95 is recommended as is the development and enactment of a further plan to cover integrated chemical spills. Further improvements to waste management disposal procedures at Scott Base are recommended by fitting the appropriate filters to the Scott Base incinerator to reduce emissions and monitor them; improved facilities to disposal of sewage, waste and hydroponics water from Scott Base to ensure direct discharge into the sea are also among the recommendations.

Further consideration is to be given to the impact of sewage disposal on the environment and the establishment of a waste inventory system to cover material from old work and waste disposal sites, to categorising the wastes and producing a database, which can be updated each year, on activities to enhance future management and planning. Examination of current waste storage transport and recycling is suggested and it is recommended that alternatives to PVC in products and packaging supplied to NZAP for use in Antarctica should be found.

Air New Zealand secures contract for Hercules

Late last year Air New Zealand's Christchurch engineering base won a $15 million dollar contract from Lockheed in the States to manufacture three sets of ice skis for Hercules C130 transport aircraft by January 1995. It is the first time that Lockheed has subcontracted directly and the deal not only creates 30 new jobs at the base which currently employs 700 people but also benefits other local machining companies. The project is reported to be on schedule with the assembly coming together in the jigs at the base.

Air New Zealand has had a maintenance contract with the National Science Foundation since 1981 and has been undertaking ski work since 1987. Until recently there were three C130's at the base, one awaiting parts and another undergoing repairs after a propeller dislodged and struck the side of the aircraft. The third, which had damaged an undercarriage in an accident on the ice, has now returned to the States.

Research grants announced

The Foundation for Research Science and Technology has recently announced the following grants as part of the Antarctic Research Strategy embodied in the public good science funding.

Cawthorn Institute for work on Antarctic anaerobes $30,000; Geological and Nuclear Sciences: Cape Roberts Project $275,000, Antarctic Earth

scien $286,000; Antarctic Water and soil contamininants, $18.500. Industrial Research Limited for work on the breakup of sea-ice, $270.000; Land and Soil Consultancy for research into the human impact on soils $30,000; Landcare for continued study of Adelie penguin population dynamics, $135,000, National Institute of Water and Atmosphere for Antarctic atmospheric research receives $676,000.

Vanda Station to be removed in 1994/95 season

A final Initial Environment Evaluation on the decommissioning of New Zealand's Vanda Station has been prepared and is being circulated. The document will determine if the proposed removal of the Station buildings will have more than a minor or transitory impact n the environment. If so, a more comprehensive evaluation of the removal activities will be carried out. The process of evaluation is required under the Environmental Protocol of the Antarctic Treaty, of which New Zealand is a signatory, and means that any activity in Antarctica, whether it be science, logistics or tourist based is now subject to review and monitoring.

Currently (June 1994) it is proposed to remove all buildings during the coming summer season and to establish a monitoring programme in the area. Two small huts will be located within the vicinity of the station, but further from the Lake and used to support ongoing science projects.

In *Antarctic* Vol 13 No. 2 (pages 51-56) we began to trace the history of the station and in this article, part two of four, we cover the completion of the station and the two winters during which it was occupied.

In December 1967 *Antarctic* reported that "Construction has been completed of what will ultimately be a year round scientific station at Lake Vanda in the Wright Dry Valley, Victoria Land, some 70 miles from Scott Base.

"The building of Vanda Station is an impressive milestone in New Zealand's scientific exploration of the Ross Dependency. Since the International Geophysical Year, proposals have been made for setting up a permanent station in the ice and snow-free McMurdo Oasis. It was intended that a station should be jointly established this summer by the New Zealand Antarctic Research Programme and the United States Antarctic Research Programme with possible Japanese participation but this did not eventuate because of the USARP commitments. New Zealand then took the initiative and is now in a strong position to diversify and improve her scientific involvement in Antarctica." Considerable interest in participation in Vanda's programmes was being expressed by a range of organisations in New Zealand, Japan, USSR and in the USA.

"This summer season", *Antarctic* continued, "the newly completed base will be used by scientists from Victoria University of Wellington and in 1969 it is proposed to have a party winter-over at Vanda Station. When the station is continuously manned, New Zealand's

Vanda Station and the adjacent Lake in the summer of 1992-1993.
Photo: Yvonne Martin

scientific element in relation to logistic support will be one of the highest for any signatory nation to the Antarctic Treaty.

By March 1968 actually only two of the proposed three huts had been assembled and the third, intended to be the main accommodation hut, still lay in a dismantled state at the foot of Hogback Hill where it had been deposited by helicopter from the *Burton Island* at the end of the previous summer. The hut came from Cape Royds where it had been used by scientists from the University of Canterbury Antarctic Biological Unit who were studying penguins. Completion of this hut on site at Vanda would give the station a total floor area of 864 square feet.

A helicopter pad had been built adjacent to the station during the summer and Vanda was widely recognised as having great potential as a staging station for the Dry Valley field parties "with scientists from New Zealand, USA and Japan have carrying out extensive work during the summer." By September, however, a sub- committee of RDRC reported that it was not so favourably situated for access to other glaciers in the dry valleys such as the Canada Glacier which would be better for glaciological research than those in the immediate vicinity of Vanda Station. In spite of this, for a proper understanding of the unique area, it was still considered essential that studies of the meteorology, (smaller scale) glacial monitoring, lake temperature and chemistry as well as soil studies be carried out throughout the year. In addi-

tion, a seismograph and auroral equipment should be operated in conjunction with Scott Base programmes. A winter party of four New Zealanders and one overseas scientist (probably American) was considered. The meteorological programme was to include visual and instrumental measurements of the ordinary climate, incoming and outgoing radiation, temperatures and wind speeds at heights above and in the valley and measurements of soil temperatures to a depth of one metre or more. This called for an observer full time for two years.

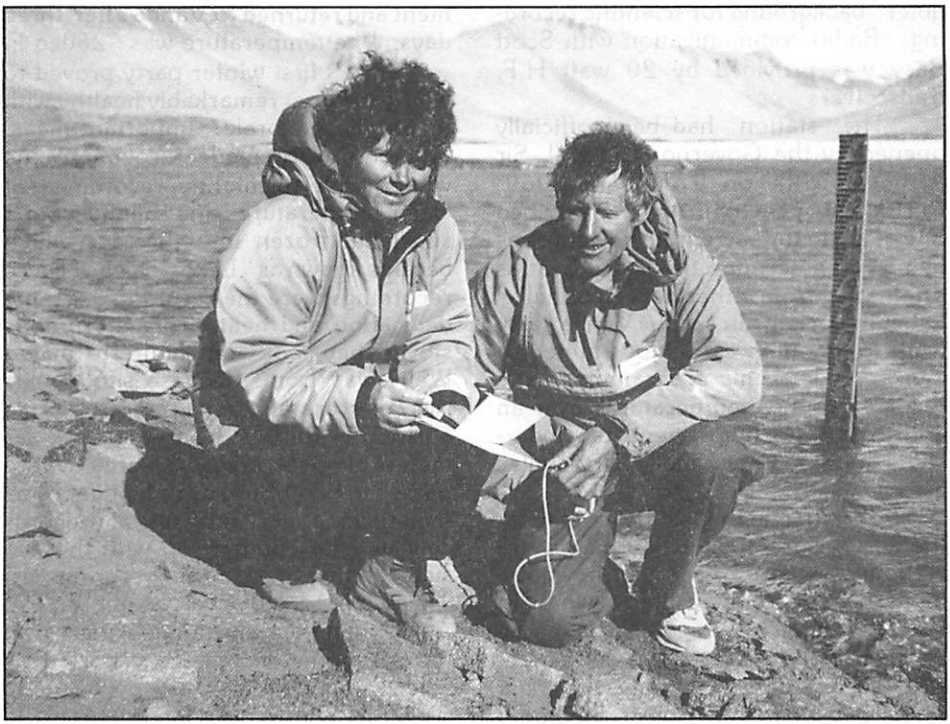
Initially winter occupation of the base had been planned for 1968 but financial constraints precluded this. Instead a party scientists from Victoria University continued their programme of lake studies which included measurements of temperatures and levels as well as of the lake ice. In 1960-61 scientists from the University had found that the lake was 218 feet deep but old levels suggested that it had once been 370 feet deep. They also discovered that the waters were warm - 25deg C - at the bottom and highly saline. With Antarctic Division staff working at the station in 1968-69 the university team camped out on the lake ice close to their work area.

Overall, a detailed surveying programme was undertaken. Marks, later to be resurveyed and become permanent, were established around the margin of the lake so that regular measurements of the level could be made. The Lower Onyx River was surveyed in detail too. Already it was known to flow inland and westwards from the Lower Wright Glacier for a short time each summer. It was proposed to install measuring equipment the following spring. That season, using the markers established around the lake, it was found that the level rose eight feet during the flow of the river which began on December 19 and finished on February 8. The timing of the flow of the Onyx, which varies each year, would later become the subject of a sweepstake at Scott Base. In Wellington further survey work and the establishment of a permanent survey station in the area was on the RDRC agenda for discussion.

The first team to winter over, in 1969, was led by Bill Lucy, who had a long history of Antarctic experience, including two trips on the research ship *Eltanin*. A six week-period of medical training in the Casualty Department of Wellington hospital was regarded as a necessary requirement for the coming winter isolation. The rest of the party included Ron Craig, meteorologist with the New Zealand Meteorolgocal Service, Simon Cutfield as scientific officer, Warren Johns as technician and US exchange scientist Allan Riorden, a meteorologist with the University of Wisconsin.

There was still much preparatory work to be done berfore the station was ready for winter occupation. A helicopter reconnaissance on 20 October 1968 determined a route for the tractor-train into the Lower Wright from the Wilson Piedmont Glacier. On board the helicopter were the Scott Base Leader, Robin Foubister, the engineer, the diesel mechanic and Bill Lucy.

On 22 October 1968, a tractor train carrying five tones tons of cargo and comprising a D4 bulldozer, two Ferguson tractors and one of the snocats used by Sir Vivian Fuchs in the Trans Antarctic Crossing, left Scott Base, travelling north to Cape Royds, then west to the Wilson Piedmont. Rostering of the six-man team gave them 24 hour continuous travel and the tractor train arrived at the top of the Wilson Piedmont overlooking the Wright Valley at mid-



Dr Clive Howard Williams from Christchurch and Julie Hall from Hamilton assess the nute nutrient and sediment loading at Lake Vanda. Photo: Yvonne Martin

night on 28 October. After such an excellent start to the supply trip, things began to go wrong.

Leading the way in the Sno cat Bill Lucy moved on towards the Wright Valley. Following him, in the eight-ton bulldozer, Hugh Clark suddenly broke through a crevasse snowbridge. Lucy turned back to help, but 50 yards away felt the rear pontoons of the Sno cat broke through another crevasse. Both men escaped from the vehicles unharmed.

It would be two weeks before the tractor train could continue. Severe radio blackout delayed transmitting news of the problem to Scott Base, and after recovery gear had been flown out, it took several more days to extract the bulldozer which then hauled out the Snocat. The differential, a universal and also a spring had been broken in the accident and the party now waited for spare parts.

Finally the two Ferguson tractors, together with equipment were lowered down to the Wright Valley floor and driven up to Vanda Station. The tractor wheels created huge clouds of dust and grit, which by the time they reached Vanda, had choked the engines of the trailers.

By the end of the season Vanda Station was ready for its first winter occupation. A 12 volt battery supply was maintained by a wind-driven generator, backed up by a small motor generator for calm periods. Wind generation would ensure an "electrically

quiet" background for scientific recording. Radio communication with Scott Base was provided by 20 watt H.F. transceivers.

The station had been officially opened by the Governor General, Sir Arthur Porritt, on 9 January 1969. During his speech Sir Arthur described one of the team's scientific objectives as being "to determine the lake's heat as originating from either heaven or hell." Other important aims of the Vanda party were to maintain continuous meteorological and seismic programmes, and record ground temperatures over an entire year to help scientists understand more of the unique Dry Valley area.

Unfortunately the last helicopter for the season left Vanda in February 1969 without delivering the scientific equipment needed for the winter. Two Scott Base dog teams tried to cross the sea ice on March 1 to deliver the equipment and the last of the summer mail, but found access to the Bower Piedmont Glacier cut off by open water. The cargo was returned to Scott Base and put aboard the *USS Burton Island*. Later one of the icebreaker's helicopters carried it to the New Zealand refuge wannigan in the Bay of Sails.

Bill Lucy and Simon Cutfield tried to reach the depot running the the Vanda Gnat over the lower Wright and Wilson Piedmont Glaciers, but found themselves continuously bogged down in soft snow. Five, arduous, days later they returned to Vanda.

After fitting tracks to one of the Fergusons, Bill Lucy set out once more on March 16, this time with Warren Johns and Allan Riorden. The party had extreme difficulty negotiating the terminal face of the Lower Wright Glacier and finally anchored a strong rope at the top of the face and slowly winched the tractor up. They collected the equipment and returned to Vanda after three days. The temperature was -26deg F.

Vanda's first winter party proved to be a good one: remarkably healthy with an excellent morale. Important measurements were made throughout the winter with fortnightly recordings of water temperatures and salinity from a small hut frozen into the ice which became known as "Lake Chalet". These recordings were the result of extreme dedication and heat from the primus stove; they took ten hours to make! Well away from the base site weekly records were also made of ice surface ablation. Results from the regular meteorological measurements were passed to Scott Base by radio telephone four times a day, and seismic records collected for comparison with the results of the Scott Base programmes. These lapsed, however, at the end of April when the galvanometer mirror in the seismometer became distorted by cold.

In the end of his winter report, Bill Lucy wrote "If we have not found the answers to all the problems encountered, we have at least found most of the problems." Among them were the lack of sealing in the mess quarter walls causing icing and a heat loss that the stove could not offset. Then there was the unexpected lack of wind during the winter months so the wind generator could not be used. The small back up petrol driven machine was barely adequate. Calm periods lasted for up to three weeks, and temperatures fell as low as -57deg C. There were only six snowfalls during the winter, each one less than one inch. This too, was unexpected.

Towards the end of the winter power generation was becoming desperate. It was alleviated by the arrival of a petter diesel unit in mid-September. The diesel generator had been built at Scott

Base, quite rapidly, from components flown into McMurdo by Hercules on September 1. Snocat Abel left the Base with a load of seven tons including the generator as well as urgently required fuel and replacement parts for various scientific equipment. Twenty miles out, the party was confronted by very thin new sea ice - only four inches thick - and discovered
they had "parked" on ice only 16 inches thick. Retreating cautiously to a safer route they continued onto the Bowers Piedmont meeting the Vanda party in the Lower Wright Valley a few days later.

Five drums of urgently needed petrol was dumped 18 miles from Vanda in favour of hoisting the heavy diesel generator onto the trailer tractor with the help of the snocat party. The petrol was collected later. The Sno cat arrived back at Scott Base on September 12 after crossing 70 miles of sea ice in fog with only their outgoing tracks to guide them.

The 1969 winter over party formally handed over the station to David Lowe, the new leader, on November 9. Garry Lewis was to be technician and Tony Bromley, the meteorologist.

During the summer, Vanda was prepared for its second winter of occupation which would conclude the planned two years of continuous scientific observation. Scott Base staff sealed the living quarters and installed a coleman heater. A 1700 gallon capacity reservoir comprising a series of drums, was built adjacent to the mess hut and filled from the lake. This overcame the necessity to collect ice from the lake every four to six weeks throughout the winter. Ice could now be chipped out of the drums, whenever it was needed.

Further survey work and hydrological studies were made over the summer of 1969/70 and Vanda provided hospitality for many of the field parties working in adjacent areas. A timber weir was built across the Onyx River bed to measure flow rates. It was completed a few hours before water reached it on December 5. Recording equipment was installed the following day.

Supplies for Vanda were ferried over the sea ice from Scott Base in five trips and depoted in the Bay of Sails. They were to be delivered by helicopter early in the season but bad weather and rescheduling of helo-hours after a crash in the Asgard Range delayed their arrival. Once the field season had begun, it proved difficult to fit the Vanda resupply into the helicopter schedule.

On the 1 February 1970 Harold Lowe took over as winter leader at Vanda from Arnold Heine, who had been acting leader following the departure of David Lowe on January 13. Bob McKerrow, another technician, also arrived at the station.

The 1970 winter party proved to be a very active one and a full scientific programme was completed. Regular weekly trips were made to the met screen at the far end of the Lake. Another, which had been installed on top of the Dias, was visited once or twice each month after a walk of 14 miles and a climb of 2600 feet. A third screen, next to the Asgard Hut and beside the Jeremy Sykes Glacier, was also visited and meteorological observations were made at the Meserve Glacier. Some of the party camped on Lake Vanda to see how radio equipment would perform in temperatures of -51deg C.

There was more wind during the second winter and also higher temperatures, the lowest recorded being -53deg C.

Although a full summer programme was implemented from Vanda during 1970-71. RDRC confirmed its decision not to continue with its winter occupa-

tion of the base at that time. Among the problems cited to at least one applicant was that the wind generator did not produce anywhere near the power hoped for and, with the restricted number of helicopter flights available for resupply, sufficient fuel for a continuously operating motor generator could not be provided. Therefore, in spite of the interest, new programmes requiring continuous power could not be supported. Although it was still to see many more years of service the first references to Vanda as a temporary station now appeared in the RDRC records.

Antarctic acknowledges considerable assistance from Margaret Bradshaw, President of the New Zealand Antarctic Society Inc., in the preparation of this article.

ANARE

Private contractor assumes army role

After 46 years an association between the Australian Army and the nations Antarctic programme has come to an end. A special ceremony at the Antarctic Division's Kingston Headquarters in late March marked the occasion. In the summer of 1947-48 the Army first used their amphibious watercraft to land equipment and expeditioners at the newly established Australian research station on Macquarie Island. Fittingly they completed their final run in the heavy surf at the Island in March.

Throughout Australia's modern Antarctic operations, the Army's LARCs (Light Amphibious Resupply Cargo) and the World War II DUKWs from which they evolved have proved to be versatile vehicles used in ship to shore transport in the Antarctic and subantarctic. Essentially, boats with large wheels, they have been invaluable in ferrying people and stores through breaking waves on rock-strewn beaches at Macquarie Island, taking their loads directly from the ship's sides to the station. In the Antarctic where the ships may have to stand well out from the coast the LARCS perform much of the ship to shore transport whenever there is enough open water to permit their use.

In recent years the 10th Terminal Regiment has provided a detachment to operate the amphibious LARCs and the powered barges that can ferry huge containers of equipment and supplies to the Antarctic stations. Army restructuring and an increased reliance on helicopters means that the Army will no longer provide the amphibious equipment which has been an integral part of Antarctic expeditions for five decades.

The opportunity to participate in Antarctic expeditions has been a much sought after privilege among Army personnel. The successful applicants trained in the lead-up to the Antarctic resupply season by loading boxes of rocks on and off their LARCs in Sydney's Middle Harbour. The "Duckies" and "Larcies", as they are known, had become part of the Australian Antarctic community. There were many instances where the professionalism, skill and courage of the army watercraft detachment averted potentially dangerous situations. One of these was the rescue of expeditioners

and crew from the grounded *Nella Dan* at Macquarie Island in late 1987.

Helicopters and barges operated under contract to the Antarctic Division will take the place of the Army operations next summer.

Programme information in brief

At Mawson a multi-year study of the foraging ecology of Emperor penguins is being continued. At Davis the production, nature and utilisation of dissolved and particular particulate organic carbon in the ocean offshore from the station and in the lakes of the Vestfold Hills Region. Studies of the lichens, mosses, algae and micro-organisms continue at Casey with a particular focus on the impacts of environmental change on physiology, biomass distribution, adaptability and survival strategies. The Antarctic Division has a physicist at both Davis and Casey supporting the ongoing Auroral and Space physics Programme. The ASP programme is reorienting its research effort in the middle and upper atmosphere towards better understanding and detecting climate change.

There is no work being undertaken at Heard Island this winter. During this last year Dr Pat Quilty has written a paper on the volcanic activity at the Island in 1992 which is being circulated as part of peer review process prior to publication. (*Antarctic* hopes to carry more information about this in the September issue). but at Macquarie the Australian Antarctic Programme continues to support the Tasmanian Government's management of the research with, among other programmes one of invertebrate pest control and another on the environmental impact of pelagic plastics which will provide information on marine debris in the Southern Ocean region.

Station leaders for the winter of 1994 and 1995

Two men and two women lead the 1994 winter parties at Australia's four stations. Michael Carr, a principal in a management training consultant company, leads the party at Davis. As part of his normal job he designs and conducts training programmes for public and private enterprise clients. Previously, he was a member of the ADF (Army) for over 20 years attaining the position of staff officer. At Mawson Bob Jones, leader at Macquarie in 1992, is in charge. Bob is a qualified veterinarian who has been director of a regional veterinary laboratory and manager of Animal Health and Welfare for the Victoria Department of Agriculture and Rural Affairs.

Angela Rhodes is in charge of Casey. She has been a member of the Australian Defence Force for 20 years and is currently a Squadron Leader in the RAAF responsible for 146 personnel, her duties including financial management, policy implementation and day to day decision making. Joan Russell, a project manager with the South Australian Government, is in charge of the party at Macquarie. Her normal job responsibilities include policy development, human services delivery, research and personnel management. In 1990 she was station leader at Casey.

The station leaders for 1995 have recently been announced.

Peter Melick will be in charge at Casey. He is a motor coach driver and organiser with a company specialising in remote area travel and has held similar positions since 1987 involving complete responsibility for group relations, repairs, itinerary and problem-solving in overseas and out-back areas.

Diana Patterson will lead the party

at Davis. She is currently manager of the Land Protection branch for the Victorian Department of Conservation and Natural Resources where she is responsible for policy, planning and research with a staff of 110. She was leader at Mawson in 1989 and has spent a summer at Casey.

Allan Redpath will lead the party at Macquarie Island. He is currently a social worker employed by Prince Henry Hospital in East Sydney where he is a team leader responsible for individual counselling, supervising staff and chairing groups and family conferences. Paul Butler will be in charge at Mawson. He is currently a Senior Grade Officer with the Department of Environment, Sport and Territories where he is Assistant Director Cocos (Keeling) Section. He has wintered with ANARE three times previously, the last being in 1987.

France

Further preparations made for building of Dome Concorde

Note: This article, translated from French, covers work at Adelie Land, Dumont d'Urville, Kerguelen and Crozet. Antarctic acknowledges the assistance of Dr Graeme Claridge with the translation.

The focus of French activities for the 1993-94 season were logistical operations associated with the French-Italian programme to build a scientific station at Dome C. Basic facilities were prepared at Cape Prudhomme on the continent which is considered the best starting point for convoys to the remote location.

Seven personnel for the first such convoy last season travelled south aboard *MV Icebird*, chartered by the Australian Antarctic Division but diverted to Dumont d'Urville to off load the party on November 2. This gave them an early start and they reached the Dome C site on November 25 staying for 11 days undertaking programmes of geographical mapping and GPS. An attempt to establish the bed rock topography via a sled-borne radar failed when the equipment dysfunctioned.

A second traverse was attempted in order to deposit some material, mainly fuel for future expeditions. By February 2 the team were 640 km from the coast and some 60 tons of fuel was cached before they returned to Cape Prudhomme and Dumont d'Urville.

Working along the route to Dome C French and Italian scientists are documenting with good resolution the geographically different climatic parameters and chemicals both on the surface and in recent layers of snow layers on the route from Dumont d'Urville to Dome C. This cooperative programme will come fully into effect with the building of the station at Dome Concord. A preliminary "radar" reconnaissance was undertaken in the 1993-94 season and long term parallel studies of the chemistry and climate were begun.

The accumulation in the area around Dome Concord will be measured as part of the project.

In addition to the logistical and scientific efforts aimed at Dome C a new station was set up at Gouverneur Island for the study of atmospheric constituents, further collection of micro meteorites were made within the framework of the EUROMET Project and a study of katabatic winds begun using Italian sodar equipment.

On the continent scientists continue to study the layer of katabatic winds. Automatic Meteorological stations have been established at strategic locations including the Dome C site and D57 and D47 from which pressure gradients can be estimated. Italian sodar equipment is being used in this study. It will be positioned after the winter when balloons will be used to obtain temperature profiles and measure the flux, data from which will be matched with the ground based results to establish the limits of the coastal katabatic winds.

A new collection of micro-meteorites was begun by French scientists early this year. They are working within the framework of the EUROMET Project and use is being made of a new laboratory, built at Dumont d'Urville, which provides much improved facilities for analysis and a reduced risk of contamination. Scientists visited a 2000m2 area of blue ice at Cape Prudhomme in 1988 and 1991 and this appears to be the most favourable site for collection of samples. The blue ice moves towards the sea at a rate of seven metres a year and samples can only be collected once every three years if scientists are to avoid the pockets of contamination caused by previous visits to the site.

Seasonal evolution of the emissions of sulfur and light hydrocarbons originating in the circumpolar ocean. are the subject of a two year programme which was initiated at Dumont d'Urville following work on the polar troposphere undertaken on the continent. The new study focuses on sulfur, hydrocarbons originating in the circumpolar ocean. For a start MSA and S04 were measured with the aerosol work being extended to a analysis of the gaseous precursors of DMS and SO2 and the grain size of aerosols. This atmospheric study of derived sulfur will be complemented by the measurement of di methyl sulfide in the sea water during

Airstrip damage

Further details regarding damage to the airstrip at Dumont d'Urville have recently been released by French authorities. The severe storm, which we reported in our last issue *Antarctic* Vol 13 No. 5 pages 199ff occurred on January 26. It partly destroyed the flanks of the airstrip over a length of 300 metres to a depth of six to seven metres and some of the facilities situated on the reclamation. The equipment, necessary for aircraft operations including the control tower, hangar for repairs and navigation system were not damaged.

An inspection team comprising pilots, engineering specialists in harbour and runway construction and from the Administrateur Superieur des TAAF visited the site in February. By mid-April the report had not been released and there has been no further communication with the French authorities. However it is known that the report should give an evaluation of the work required to repair the runway making it suitable for several different types of aircraft.

the summer. Previous work on carbon aerosols was re examined following contamination from the base. This programme may be undertaken on the neighbouring island of Gouverneur.

Earth science programmes. There were no earth science programmes in Adelie Land last season but scientists in France continue to analyse samples obtained in the 1990-91 and 1992-93 seasons. Further earth science work was, however, undertaken at Kerguelen where scientists are studying alkaline and non alkaline silica in the layers of rocks in the central plateau and on the Loranchet Peninsula.

Work on the potential currents and variations in the earth's magnetic field continues with observations being made at both Port of France at Kerguelen and Port Alfred at Crozet. Construction of automatic electromagnetic stations has begun. They will measure three circuits and two currents in the earth's magnetic field Finance for a further station in the area of the Magellan Sea has been deferred.

Geomorphological work at Crozet was completed at the end of 1993 and glaciological programmes are being undertaken on a collaborative basis at Vostock.

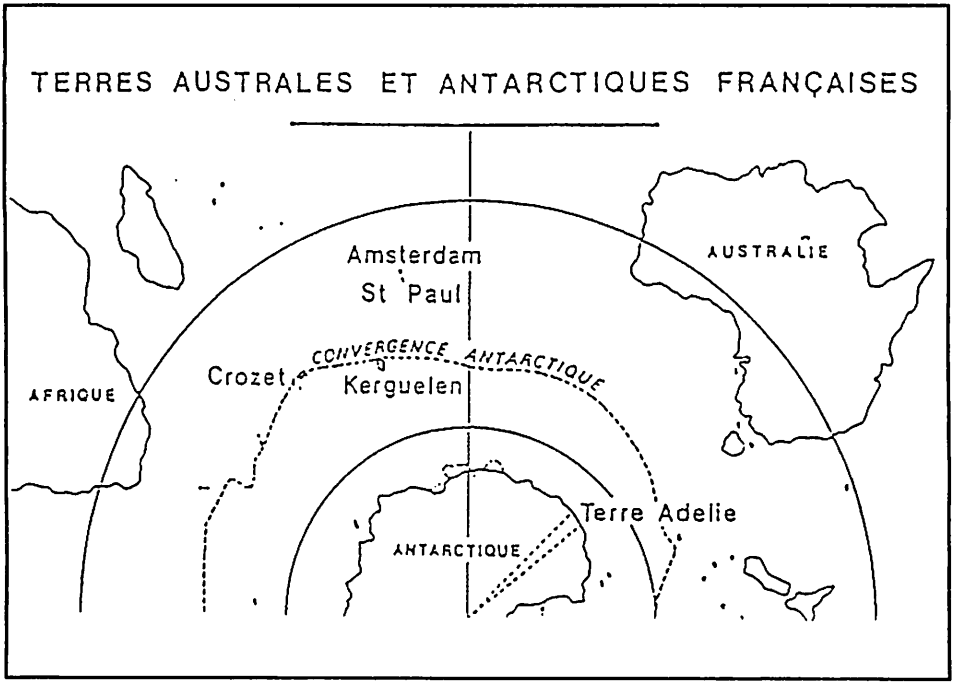
Life science programmes: The marine biological programme begun in 1992-93 off Adelie Land continues. At Kerguelen a new programme involving the study of the carbon cycle in the life of Macrocystic grass was implemented in January.

Soil biology: At Kerguelen and Crozet further interdisciplinary work involving physiology, biochemistry, biometric and morphology continues as scientists study the function and colonisation of the terrestrial ecosystem. On the Island of Amsterdam further study of terrestrial invertebrates at low altitude was undertaken and the results will be compared with similar work at St. Paul.

Birds and mammals: In addition to the routine monitoring of birds and mammals specific programmes were begun in the summer of 1992-93. This last season plankton and the small petrels at Kerguelen were the focus of scientific work. Another study on ecological evolution of two species of bird, one being the black petrel was also initiated.

Animals introduced to the islands: Further work was planned on the population of Corsican sheep at Kerguelen. Population dynamics, reproduction strategy, the changing nature of the population in response to environmental changes are all part of the programme which also includes work on the role of the trophic factors and parasites on the regulation of the population. The reindeer population are also being studied, mainly with helicopter counts at different seasons in order to collect data on which to base management plans. Rabbits have been eradicated on two islands in the Kerguelen Archipelago and the recovery of the vegetation and indigenous animal life is being monitored. On the Island of Guillon an environmental study of the nature and distribution of various types of soils has been implemented along with work on the various groups of vegetation and the populations of birds and invertebrates. Eradiation of rabbits, mice and cats is scheduled to begin on July or August of 1994.

Animal physiology: Metabolic adaptation of birds to the cold is being further studied this year. Following a programme on Adelie Land in which research was undertaken into heat retention in Adelie Penguins in the summer and the emperors in the winter. At Crozet the role of thyroid hormones and glucagon among penguins is being studied while at Kerguelen work is be-



Location map of French Antarctic stations and territory.

ing undertaken on proteins and fatty acids and their role as potential regulators of lipid metabolism.

The energetics of penguins both on land and at sea continues to be studied. In one facet of the overall programme penguins are being used as bio indicators of the evolution of resources in the Southern Ocean. At Adelie Land ecology of emperor penguins over the winter is being studied. The birds are being tracked by radio beacons and the stomach contents of some are being analysed. At Crozet the focus is on the royal penguins and their foraging habits as well as their breeding success while at Kerguelen scientists are studying the different zones of food supply as well as their foraging habits.

Considerable work is also being undertaken on the role of fatty acids in the Adelie's at Adelie Land and on the royal penguins at Crozet where the study is related to seasonal reserves of food supplies.

Marine invertebrates are the subject of work at Kerguelen where the focus is on the study of the structure and spatial and temporal populations of echinoderms and metazoa or more specifically annelides defined with the help of genetic markers in previous seasons The species have been chosen because of their development in relation to their dispersal and previous observations made while diving both in the gulf at Kerguelen and in adjacent waters has allowed scientists to study individuals, populations densities and the process of recruitment. Sampling is being continued over the winter when the reproductive strategies will be studied

as well as the genetic relationships of populations at varying distances.

At Adelie Land a study of biochemistry and microbiology of fish along the theme of molecular adaptation at low temperatures was established last summer.

The winter ecology of sea trout is being studied at Kerguelen with a focus on demography, kinetics, spatial distribution, migration and spawning characteristics. The habitat and population structure are also being studied as well as their relationship to hydrological models and seasonal variations.

Oceanography: The sea level is a major parameter in work on ocean and climate dynamics. Variations of level at different times whether it be every ten years, each year, seasonal or daily are important. During 1994 scientists will study the dynamics of the ocean over the Kerguelen Plateau, the relationships of the data acquired previously at sites in the area, analyse the data from GEEST 86-88, TOPEX/POSEIDON 92-93 and from Crozet, Kerguelen and Amsterdam Islands in order to study the spatial structure and time differences between months, years and ten year periods. They will also design a procedure which will enable them more easily to link up the results from the earth stations with the GPS.

In 1992-93 medical researchers implemented a medical research programme at the four stations but this year at Dumont d'Urville the winter team will be subject to an Antarctic Psychological Programme. The objective is to use the real situation of a polar station to evaluate and validate the methods and instruments of socio psychology from the perspective of medium and long duration space missions. The results will help psychologists devise a means of preventing problems of maladaption in small groups who are isolated and confined.

Permanent observatories:

The operation of permanent observatories continues with some minor changes.

Permanent observatories at Kerguelen have been established for the study of cosmic rays, the ionospheric and the magnetosphere

Atmospheric science programmes are centred on stations in Adelie Land and at Kerguelen. In the station at Adelie Land a permanent observatory has been established to measure cosmic rays and an auroral programme is being undertaken. This programme studies the origin of the auroral forms in relation to interplanetary magnetics. Although it requires more observations than the scientists are able to make at present they find it useful to have the measurements of the different levels of solar and magnetic activity and information about the magnetic properties. Research is also being undertaken into aligned arcs. These are a rare phenomena which occur once or twice a month; their general conditions and appearance have been studied by solar cycle 21 and the results will be compared with those that scientists expect to obtain from the following cycle. This study, as yet incomplete, requires complementary work to be undertaken on space missions. The ionospheric programme continues without new equipment.

Ozone studies also continue. Equipment for the Lidar experiment operates at Adelie Land and a programme of ozone soundings is being undertaken at Dumont d'Urville and on board the *Astrolabe* or the *Marion DuFresne* for studies to be continued for the next few years. This work focuses on the evolution of chemical species, stratospheric clouds and the aerosols.

Overall the ozone work undertaken mainly by French scientists is contributing variously with real time measurements, verification and interpretation of data to the NASA ER-2 and DC-8 flights from New Zealand, the European Meteorological agency and for the Southern Hemisphere satellite operations. The performance of the SAO Z spectrometers have has been improved for measurements of oxygen chlorine and oxygen bromide as well as the lidar.

Equipment for a UV-B programme was dismantled last season and transfer to the Dome C site as part of a cooperative venture with the Italians.

At Kerguelen the cosmic ray and magnetics programmes are being continued.

Earth sciences: Four geomagnetics observatories and five stations have been established in French Antarctic and sub-Antarctic territory. They measure the elements of the terrestrial magnetic field, including daily variations, and transmit in semi real time results to the international programme Intermagnet for which observatories have been established at Crozet, Kerguelen and Amsterdam.. The calculation of indexes of activity, the determination of real mean values and the daily variation are also part of the overall programme. The registration of rapid magnetic variations in the range of 5 - 100seconds, temporarily interrupted in 1992 for the installation of new equipment, resumed in 1993 in conjunction with a Russian programme. A data base has been established on magnetic optical disk for the assembly of the results available from Crozet from 1978 to 1985; from Kerguelen from 1978 to 1992 and from Adelie Land from 1978 to 1992.. The detailed measurements should help make the abnormally conducting structures first recognised in 1988 and 1989 more precise.

Seismology: The programmes of wide band and short period seismology will be continued. They provide seismological information from the high latitudes of the southern hemisphere. The programme GEOSCOPE developed for a French seismological agency in 1982 is being continued but it now includes certain aspects c more regional research in the short domain and wide band.

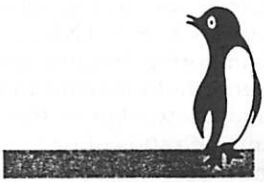
In 1994 the station at Crozet was to be re equipped with new standard VBB. The three stations the Port of France, Dumont d'Urville and Port Alfred will conform with the new standard GEOSCOPE. These regional studies will greatly enhance the overall seismological programme. As in previous years the results will be archived on CD-Rom and distributed in accordance with international plans.

Life sciences: Throughout the year the programme of monitoring of birds and marine mammals will continue and include studied studies of the dynamics of animals leaving the various colonies being observed.

Following programmes already established epidemiology, psycho-social adaptation and personality in natural conditions of stress will continue to be studied.

Marine biology: Fish at Kerguelen

Fish stocks subject to exploitation (particularly *D. eleginoides* and *C. gunnari*) were monitored in the 1993/94 season with two French fishing ships operating in the area Ukrainian fishing in the region was programmed to continue at least until the end of 1993. Observations of birds and fish from the vessels continued.



Germany

Data gathered during 11th cruise of *Polarstern* supports long-term research programmes

The fifth and final leg of the 11th cruise of *RV Polarstern* comprised a south-north transect through the Atlantic Ocean and involved 27 scientists from seven German research institutions and one in Holland. Sailing under the command of Captain E.P. Greve, the vessel left Capetown on 21 May 1994 and was scheduled to return to Bremerhaven on June 17 after a short stop in Rotterdam on June 15. The atmospheric sciences, environmental and marine chemistry were the main research foci supplemented by meteorological programmes, and marine biological and geological investigations. On the voyage back from Antarctica *Polastern* became a mobile platform for investigations of global scale processes taking place in the atmosphere and in the ocean.

. During the cruise, the horizontal distribution of ozone was measured and recorded continuously with a ship based ozone analyser. From Capetown to Rotterdam balloons with ECC ozone sondes were launched daily to provide profiles of atmospheric trace gases up to an altitude of 35 km.. The research, being undertaken by the air chemistry group from the Alfred Wegener Institute, was begun during *Polarstern* cruises X/8 and XI/1. The programme is important because ozone is the prominent photo-oxidant in the troposphere and knowledge of the distribution and mixing ratios of ozone is a key component for atmospheric modelling. Because scientists are attempting to simulate the possible impact of anthropogenic emissions on trophospheric chemistry it is essential to measure the distribution from high southern to high northern latitudes as part of the overall programme.

For the first time ship-based FTIR (Solar Fourier Transform Infared) spectroscopy measurements were made in order to study stratospheric trace gases relevant to stratospheric ozone chemistry. The FITR spectrometer permits measurements of the gases to be obtained from "ground level". When combined with a specially developed solar tracker the sun, or even the moon, can be used as a light source and column densities of a reasonable number of trace gases can be measured in the spectral region from 5000 to 500 cm-1. This work supplements the ozone measurements and will provide valuable information about the chemical composition of the stratosphere.

During this cruise, air samples were collected regularly by scientists from the AWI and stored in stainless steel bulbs for later analysis at their home laboratory where they hope to measure and quantify a selected group of volatile organohalogen compounds in order to estimate the global distribution of these trace substances, their sources and sinks. In addition rain samples were collected in the intertropical convergence zone for subsequent analysis for their content of the various trace metals. The

objective of this study is to obtain further information on atmospheric pollution and the transport mechanisms of atmospheric pollutants. Because of the risk of contamination of samples by exhaust gases from the ship the measurements and sampling programme was to be controlled by observations of wind speed and direction, by a carbon black monitor and continuous measurements of polycyclic aromatic hydrocarbons.

Further profiles of nitrogen combinations measured initially during the first leg of the cruise were to be obtained during Leg 5. The deposition of the combinations can be estimated with models and the profile measurements can be compared with those previously obtained on a west east transect in the Indian Ocean.

Carbonyl sulfide (OCS) is the most abundant sulfur gas of the remote atmosphere and due to its long trophospheric lifetime, it is one of the dominant carriers of sulfur molecules into the stratosphere where it sustains the sulfuric acid aerosol layer. Sources and sinks of this gas are not yet well known but the ocean is believed to be a major source. Oxidation in the atmosphere and uptake by terrestrial vegetation are thought to be the major sinks. In March-April 1987 scientists aboard Cruise VII/5 established the existence of a significant gradient of OCS between hemispheres and found that levels were on average 25 percent higher in the northern hemisophere, a result confirmed by recent work in the United States. Explanations may be that terrestrial anthropogenic sources dominate the northern hemisphere or that the data from the 1987 cruise depicts the meridional variation of a seasonal signal in the atmospheric OCS caused by assimilation by terrestrial vegetation and is in phase with atmospheric carbon dioxide. Using gas chromatography with flame photometric detection. scientists will analyse the samples on board in order to monitor the gradient during the northern summer.

A passive microwave and line scan camera will be used to measure the wind speed over the open ocean. Passive microwave radiometer data obtained from a satellite operating as part of the US Defence Meteorological Satellite Programme, launched into polar

FS Polarstern
Photo: Plotz

orbit in June 1987, already provides reliable wind field information on a global scale. By using suitable algorithms and the data from different microwave emissivities, information on wind speeds can be obtained but the method is inaccurate because the roughness of the sea surface varies with changes of the wind and because there are only a few reference measurements. The Line Scan Camera will offer precise information about the foam concentrations or white caps on the ocean surface and wind speed will be measured aboard ship with meteorological equipment. The data sets derived will be analysed with a special algorithm to provide a relation between wind speed and foam concentrations which will be used to improve the wind speed information derived from the passive microwave measurements.

Carbon dioxide exchange between the ocean and the atmosphere will be studied during the cruise. This is important because the oceans take between 20 and 40 percent of the CO2 released by fossil fuel burning. The objective of the study is to determine the CO2 variables in surface water and the flux between the ocean and atmosphere during the regular crossings made of the Atlantic by the *RV Polarstern*. In combination of earlier measurements this will improve their estimate of the CO2 exchange between the South Atlantic Ocean and the atmosphere. Measurements made on previous cruises were part of this programme. Water sampling to determine nutrient and chlorophyll content will be undertaken to determine flux

Three projects make up the marine and environmental chemistry programme for the cruise. Sources of halogenated compounds and organic nitrates in the North and South Atlantic are being studied by scientists from the University of Ulm whose programme is part of a general one of global environmental chemistry involving the characterisation of pattern and levels of various classes of anthropogenic and biogenic compounds on the basis of a highly developed analytical chemistry of organics including chemometric methods. Special attention is given to the air-sea exchange of organics in this, the third phase of their study aboard the *Polarstern*.

Biological and biochemical research work undertaken by scientists from AWI on benthic invertebrates will supplement investigations of biogenic compounds sampled in Antarctica by comparison with animals from moderate and tropical climates. Neuston and pleuston were collected using a neuston sledge. Comparison of the amount of selected primary and secondary metabolites will provide answers to questions of how the extreme natural environments can influence the biogenic production of substances in the investigated animals. A further objective of the biological programme are studies of the latitudinal distribution abundance and activity of marine microfungi and fungus-like protists within the productive layer of the Atlantic Ocean.

The geological research work during this cruise will continue previous investigations on particle flux in some high-production areas in eastern and equatorial Atlantic Ocean. Moorings, deployed last year, in the Guinea Basin and north of Gran Canaria Island were recovered and redeployed at their same positions. The aim of the programme is to determine the seasonal variations in the chemical, isotopical, mineralogical and species composition of the sinking particulate matter.

A considerable number of the investigations performed during the cruise will provide data and information important to long-term research programmes.

BAS

Dogs rehabilitated in traditional environment after 50 years with BAS

The end of the 1993-94 summer field season for BAS personnel was tinged with sadness with the departure of the dogs from Rothera in compliance with the Madrid Protocol to the Antarctic Treaty under which all non-indigenous animals must be removed from the continent by 1 April 1994. Dogs have been part of British Antarctic operations for 50 years and they have now returned to their original habitat in the Canadian Arctic where they are supporting a traditional way of life. The transition is reported to have gone well.

To mark their last season in Antarctica the dogs were used in a commemorative field project, code-named Lost Heritage. The project was based in Alexander Island and comprised a GPS mapping task for the BAS Mapping and Geographic Information Centre in the region of the Milky Way and Uranus Glacier as well as a shallow ice-core drilling traverse in the centre of the Island.

Both dog teams were used in the operation, the Admirals: Wendy, Tom, Biff, Jimmy, Elwood, Jake, Rachel and Rex and the Huns: Pris, Roy, Max Pujok, Urza and Morgan. Field personnel comprised a field assistant and dog handler John Sweeny, from Rothera and John Killingbeck, an ex-FID surveyor who had been Base Leader at Deception Island and had run dogs during the 1960's. With the dogs teams was a film crew, travelling in the now conventional style on skidoos.

The dogs were deployed to Alexander Island by Twin Otter aircraft on 14 December and flown back to Rothera on February 8. During their time in the field both dogs teams safely covered 250 miles and the party successfully completed their assigned science tasks. On their return to Rothera most staff enjoyed their last opportunity to run the dogs on Adelaide Island.

Then, after all the necessary vaccinations, the dogs were familiarised with their transport boxes and travel food and flown to the Falkland Islands in the Dash-7 aircraft on the first leg of their long journey to their new home Excellent co-operation from the UK Ministry of Defence led to a dedicated RAF flight to the UK via Ascension Island. After an overnight stop in the quarantine kennels at Heathrow, where there was intense press interest, the dogs, accompanied by John Sweeny were flown to Boston in the USA. They were then transported by road from Boston to Chiasibi in James Bay in Quebec where both teams began their sledge journey to their new home, an Inuit village, Inukjuak, on the northwestern shore of Hudson Bay.

Latest reports are that they are now rehabilitated in the Inuit Village where they are being retained as two small working teams, six in one and seven in the other, with two different handlers.

The group of seven are with the Inukjuaks' cultural teacher who has been running dogs for many years and is now passing his knowledge of handling teams onto his students. The smaller group of six are with a local trapper who guides small expeditions during the early summer months and has a trapping and fishing camp for the rest of the season.

The guides in the area are respected for their ability to hunt, navigate and handle dog teams.

All of the indigenous huskies in the Hudson Bay area were exterminated in the late 1950's and even by 1970 there were very few on the east coast of the Bay. The Inukjuak community regard the BAS dogs as a gift to their village and there is considerable interest in their welfare as they represent the potential to greatly strengthen the gene pool of the existing native dogs. Their introduction also coincides with the beginning of a tourist development initiative by Makivik, the Inuit government. It is probable that the huskies will be used on hunting and cultural tourism trips in the very near future providing both a direct link with the past and a means for potential income from guiding and tourism.

The guide and handler from Maine in the USA, who has been assisting BAS with the resettlement of the huskies, maintains regular contact with the village of Inukjuak and all the reports are good.

In returning the dogs to a traditional environment the British Antarctic Survey have made a strong endeavour to ensure that something positive comes from what they perceive as an unfortunate Antarctic Treaty decision to remove the dogs from the continent.

RRS Bransfield makes safe journey to home port

RRS Bransfield, disabled by a major electrical fault, first reported as a fire, in the propulsion motor unit on February 20 arrived at Stanley on March 3 where the damaged motor was thoroughly inspected on March 12 by a GEC engineer flown from the UK. The motor, though seriously damaged, was considered repairable and the after motor assessed as satisfactory for the ship to return to the UK. The ship sailed from Stanley on March 15 arriving at Grimsby on April 3 after an uneventful passage.

The mishap occurred approximately 24 hours after her departure from Halley Station on February 20 She had just deployed equipment and provisions for a forthcoming international project, had taken aboard scientists from the station and was bound for Stanley. At the time she was in 7/10 pack ice, some 1600 nautical miles from her destination and 11 n.m. south of the edge of the pack ice with clear water beyond, the damping effect of the pack ice on the southerly swell made conditions on board reasonable comfortable. But winds of up to 12 knots were causing the *Bransfield* to drift at 0.4 knots west north west with the nearest iceberg some 12 n.m. away to the north west. Initially it was thought that the repair of the motor was beyond the capabilities of the ship's staff and that towage would be required. Overall the assessment suggested that the ship was in no immediate danger but there was no room for complacency.

Early on February 21 the *RRS James Clark Ross* was diverted from a science cruise around South Georgia to assist the *RRS Bransfield*. She estimated her time of arrival at the vessel's

side at 71 deg 45min S/20deg48min W to be 1500 hours.

Communications between the two vessels and Cambridge were frequent with the *Bransfield* regularly updated on assistance which could still be available from either *HMS Endurance* at Stanley which the Royal Navy had placed on standby or a number of tugs and others vessels in the broader area. Urgent communication was maintained too, with the motor manufacturer, GEC Alsthom of Rugby, to ensure that all possible remedial measures were being taken. Acting on the initiative of the ship's staff it was agreed that all the damaged and undamaged parts of the forward motor, would be relocated in order to maintain a balance on the rotating armature and allow the, still serviceable, ship's after motor to operate. The work was undertaken by the engineering staff on board, some of whom fashioned a number of special tools for the operation, and volunteers from among the outgoing Halley personnel, all of whom worked under the direction of A. Allison the Chief Engineer. Preparations were also made for possible towage by the *RRS James Clark Ross*.

Shortly after noon on February 24, after working 24 shifts, some seven tons of damaged parts had been relocated and the after motor started. The ship's Master, Captain S. Lawrence, advised that the vessel could be moved under half power. At 1500 hrs *RRS James Clark Ross* was sighted and soon manoeuvred along side. Following a brief exchange of mail, water and stores the vessel made passage through the pack ice to open water with the *Bransfield* following closely behind. Progress to Stanley was excellent and the *James Clark Ross even* made a brief visit to Signy on February 28, all the while maintaining radio contact with the *Bransfield* and ensuring that the passage time between the vessels was no more than five hours.

On March 3 both vessels arrived at the port. The "Brannie", as she is affectionately known by BAS personnel, is currently at Tyne Dock Engineering in South Shields in the north of England. The motor has been removed from the vessel and is currently being stripped by G.E.C. Alsthom in Rugby. After rebuilding it will be returned to the vessel and fitted probably during the first or second week of September . After brief trials she will then head for her home port of Grimsby to take cargo aboard for the 1994/1995 summer season and base resupply.

Future of Faraday still uncertain

Among the British guests in the Antarctic this last season was Dr. A. Cheburkin of the Antarctic Research Centre of the Ukrainian Academy of Sciences in Kiev. He inspected Faraday at which British activities are being significantly scaled down. Transferring the station to another national operator is preferred to total closure but a condition of the deal will be the maintenance of the long term monitoring of the sea level, synoptic meteorology, ozone recordings and ionospheric programmes.

The negotiations between the governments of the UK and Ukraine over the transfer may have lapsed as latest reports indicate that the British are still looking for another national operator. Alternative plans are, however, in hand to automate the scientific programmes should no other national operator be found who is willing to continue with the current work of the station.

Winter personnel at British stations

Five British bases are operating throughout the winter of 1994. On Bird Island there are four scientists and support personnel under the leadership of N. Huin, a Marine Research Assistant. At Signy there is a party of 12 led by Dr M.C. Davey a terrestrial biologist and at Faraday there are ten, led by D. Haigh, a meteorologist and ozone research assistant. At Rothera there is a team of 15 led by S. Rumble, an electrician, while at Halley there are 17 in the winter team led by B. Mallon, who is also an electrician.

USAP

Major period of construction at McMurdo over winter

A USAF Starlifter made two southbound flights, June 21 and June 23, to McMurdo, the first continuing to the South Pole, as part of the 1994 midwinter airdrop. All up some 37,056 lbs of cargo packed into 58 bundles were destined for McMurdo Station along with 15,000 lbs of mail and 10,000 lbs of "freshies".

For the South Pole there were 2,000lbs of mail, 90 dozen fresh eggs and cargo of 6,597lbs dropped in 16 bundles. The deliveries were made from 1,000 ft. with the aircraft refuelling from an accompanying KC10 Extender before and after the airdrop to compensate for the extra fuel consumed during the low altitude runs when the drag is greatly increased. Extra refuelling was also undertaken on the flights to and from the Pole.

On June 21 the aircraft departed Christchurch at 5.30 a.m., made its first drop at Williams Field at McMurdo at approximately 1100 hours before proceeding to the Pole where the drop was made at 1310 hours. It touched down at Christchurch at approximately 2130 hours. On the second flight the aircraft departed Christchurch at 0.515 hours. and returned after approximately ten hours. The Mission Commander this year was Lieutenant-Colonel Smith from 62nd Group at McCord Airbase and the pilot Captain Ross. Twenty eight crew, including a flight surgeon and cargo handling teams were aboard the first flight with 21 on the second.

The next scheduled flights south are the series undertaken as part of WINFLY which should begin on August 22. This year between and nine and twelve flights will make up the WINFLY series. Some months ago it was intended to continue flying throughout September but this decision has now been reversed and the extra requirement will be met by extending Winfly. It is possible that WINDET, (the extended flying over September) will come into operation in 1995. The first main body flights in support of the new season are to begin on October 3.

Approximately 250 scientists, personnel from Antarctic Support Associ-

ates and construction workers are at McMurdo this winter. One hundred and twenty of them are undertaking construction comprising work on two dormitory wings, the foundations for a SARSAT station at Arrival Heights and for the Black Island Earth-satellite station.

The scientific programmes at McMurdo Station and at the South Pole continue to focus on upper atmosphere studies, astrophysics, monitoring of the long-term atmospheric changes and seismicity.

At McMurdo ozone studies are a priority.

Four different facets of the ozone problem are being studied at McMurdo and at the South Pole station this year.

In co-operation with the USAP, Italian scientists from the Instituto di Fisica dell'Atmosfera-CNR in Rome are making laboratory-based lidar observations of polar stratospheric clouds (PSCs) above McMurdo Station. The results will add to the available information about the annual springtime depletion of ozone in the Antarctic stratosphere and enhance scientific understanding of the role of PSCs in the depletion process. An environmental unit in the Crary Laboratory complex has been dedicated for lidar measurements and associated instrumentation. The project operates closely with two others.

Of these, one involves the regular launching of a series of balloons carrying equipment to measure ozone, polar stratospheric cloud particles and condensation nuclei above McMurdo Station. These measurements are important because the principle cause of ozone depletion is the interaction of chlorine with ozone. Polar stratospheric clouds have a major role in the chemistry that frees elemental chlorine from reservoir gases, hydrochloric acid and chlorine nitrate which then becomes available for the photocatalytic destruction of ozone at sunrise. Scientific knowledge of the formation and physical state of stratospheric cloud particles in the polar stratosphere is limited but should be improved with further understanding of the clouds.

A third element of the ozone programme involves infrared measurements which are being undertaken at both McMurdo and at the South Pole. Scientists from the Physics Department at the University of Denver are using an infrared interferometer to monitor some of the trace constituents in the atmosphere above both stations.

Two types of measurements are being made, one of the absorption mode to detect the sun's IR radiation shining through the atmosphere and the other of the emission mode to detect radiation emitted by the atmospheric gases themselves.

The first technique allows very sensitive measurements of a number of trace constituents, especially during the local springtime when the Antarctic ozone depletion is taking place. The second allows less sensitive but still critical measurements during the long dark polar night when the chemical interactions that set the stage for the springtime ozone depletion take place.

Compounds being measured include hydrogen chloride, nitric acid, chlorofluorocarbon 11 and 12 and nitrous oxide, methane, ozone and chlorine nitrate. All play a role in ozone depletion and several are also important greenhouse gases. This project is a precursor to establishing an Antarctic network to detect stratospheric change. As part of this the team hope to establish a similar station on the high polar plateau possibly at Dome C.

In another ozone related study personnel from the Aeronomy Laboratory of the National Oceanic and Atmospheric Administration have for five years now been making ground-based

visible and ultraviolet spectroscopic measurements of stratospheric column abundances of ozone, nitrogen oxide, nitrate radial, chlorine dioxide and bromine monoxide. The simultaneous measurements of these gases and their seasonal and daily variations are valuable for studying polar ozone holes and the photochemistry responsible for the destruction of the stratospheric ozone layer, particularly in the presence of volcanic aerosols from the eruption of Mt. Pinatubo.

Data from McMurdo is being augmented by that collected from other polar sites such as Palmer Station and Sondre Stromfjord. The programme is being managed over the winter by the ASA science technician for the investigators from the R/E/Alb at the NOAA in Boulder, Colorado.

Meteorological research

The Antarctic Meteorological Research Centre at McMurdo is one of three research centres in the Albert P. Crary Science and Engineering Centre (CSEC) at the Station. It began operating in the 1991-92 summer season as a resource for meteorological research and improved operational synoptic forecasting. The first element of the AMRC-Sun Sparc2 computer system with TeraScan software, which collects satellite overpass data (HRRPT and DMSP) enables scientists to process data at the CSEC in near real- time via a fiber optic cable connection to MacWeather in building 165. The second element of the AMRC - the man-computer interface data acquisition system (McIDAS) was installed in the Atmospheric Sciences Pod of the CSEC during the 1992-93 season. This system captures the flow of meteorological information from polar orbiting satellites, automatic weather stations, station-based synoptic observations and other research projects such as the European Center for Medium-Range Weather Forecasts and the Australian Bureau of Meteorology. It also receives other environmental data from sources outside Antarctica and acts as a repository for existing archived data bases. The principal investigators are from the Space Science and Engineering Center at the University of Wisconsin.

Automatic stations

The Satellite Tracking Facilities (Satrack) at Black Island in the McMurdo area and South Pole Stations were decommissioned early last season and retrograded to the states by ship.

Part of the overall research programme being undertaken by the Applied Research Laboratories at the University of Texas in Austin, comprised a Global Positioning System (GPS) Satellite Tracking system which was relocated at McMurdo and automated for year round operation. The observatory is collecting data from the navigational satellites which are part of the international CORE network being run as a component of NASA's solid earth science programme.

The satellites transmit real-time precise positioning information which is added to data collected from other sites in the network to provide for the production of precise GPS ephemerides, to support earth orbiting space missions that involve on-board GPS receivers and to provide data for the determination of Earth orientation parameters, such as spin-axis orientation and variations in length-of -day.

Arrival Heights

An Extremely low frequency and very low frequency ELF/VLF radiometer, installed at the Arrival Heights Upper Atmospheric Physics Facility, is being

maintained by the contractors science technician over the winter.

The radiometer is one of seven systems that Stanford University operates at different sites throughout the world. It measures the intensity of electromagnetic radiation making possible the study of wave-particle interactions in the magnetosphere plasma (low energy ionized gas that permeates the magnetosphere). Naturally occurring radio noise in the 5-hertz to 30-kilohertz range can then be studied. With the resulting data the scientists hope to develop a long term climatology of natural background noise that will be used to further understanding of coherent radiation from the magnetospheric plasma. The results can also be applied to communications, remote sensing of magnetospheric plasma and modification of magnetosphere and ionosphere by wave-induced particle precipitation. The ASA science technician is maintaining the equipment over the winter and will handle the digital and audio tape recordings which will subsequently be transferred to Stanford University for analysis.

Other McMurdo and South Pole programmes

Many of the science programmes being undertaken by USAP operate either in tandem or on a supplementary basis at both McMurdo and South Pole staations. Over the summer considerable effort is dedicated to training personnel for winter operations.

Magnetometer data continues to be acquired at both McMurdo and South Pole stations. The equipment is part of a network installed in the Northern and Southern hemispheres specifically at Iqaluit, North West Territories, Canada and Sondre Stromfjord in Greenland. The investigators from the AT and T Bell laboratories in New Jersey gather data on the coupling of interplanetary medium into the magnetospheric cusp region and the propagation of low frequency hydromagnetic waves in the magnetosphere. Because of the unique climatic conditions at the South Pole they are able to correlate the optical measurements with particle precipitation and with hydromagnetic-wave phenomena recorded by the magnetometer. At both Antarctic stations the ASA science technicians will maintain the equipment, and record the data on magnetic tape. At the end of the season the tapes will be forwarded to the University of Maryland.

A magnetic micropulsations experiment is being continued at both the Arrival Heights Upper Atmosphere Physics Facility at McMurdo and at the South Pole station Skylab facility throughout the year. The data from the magnetic pulsation sensors located at high-geomagnetic latitude stations in the Arctic at Sondre Stromfjord in Greenland as well as in the Antarctic is analysed by a team from the Space Science Center at the University of New Hampshire in the States.

The measured pulsations, which range in frequency from a few millihertz to a few hertz, are used in conjunction with similar data acquired from a number of satellites and are vital to a scientific understanding of the mechanism by which energy is transferred from the solar wind to the earth's magnetosphere.

Riometry in Antarctica and conjugate regions is being studied by a team from the Institute for physical science and Technology at the University of Maryland. They have installed equipment for broadbeam and riometry experiments at both the Arrival Heights Upper Atmosphere Physics Facility at McMurdo and at the South Pole Skylab

Facility where auroral photometers are being operated throughout the winter in order to collect data for a study of the processes of energy transfer from the solar wind to earth's magnetosphere and ionosphere at high geomagnetic latitudes. The emphasis is on the understanding of the ionospheric signatures of dayside auroral phenomena associated with particle entry into the cusp and boundary layers as well as the nightside substorm effects associated with the magnetotail and plasma sheet.

The South Pole imaging riometer is part of a complex of three, the others being at Sondre Stromfjord in Greenland and at Iqaluit in the Northwest Territories of Canada, the magnetic conjugate to the South Pole. Each provides continuous, simultaneous conjugate measurements of polar auroral phenomena.

The Cosmic Ray monitoring equipment will continue to operate throughout the year in dedicated laboratories at McMurdo and South Pole Stations. Neutron monitors provide a vital three-dimensional perspective on the anisotropic flux of the rays, with energies upwards of one billion electron volts, that continuously bombard earth.

Analysis of the data will advance scientific understanding of a variety of fundamental plasma processes occurring on the Sun and in interplanetary space. Neutron monitor records, which began at McMurdo in 1960 and in 1964 at the South Pole, will play a crucial role in efforts to understand the nature and causes of cosmic-ray and solar-terrestrial variations occurring over the 11-year sunspot cycle, the 22-year old Hale cycle and even longer time scales.

At the other extreme, the investigators from the Bartol Research Institute at the University of Delaware will use new methods to study height high-time-resolution (10 second) cosmic-ray data to determine the three-dimensional structure of turbulence in space and to understand the mechanisms by which energetic charged particles scatter in this turbulence.

For years, the results of intermittent ground observations have hinted to scientists that Earth's high-latitude ionosphere emits radio waves in the low-frequency to high frequency band (0.15-9.6 megahertz). Rocket and satellite observations in the upper regions of the ionosphere and magnetosphere commonly indicate the existence of these terrestrial radio signals, particularly in the lower portion of the frequency range. Theoretical studies have indicated that some of these emissions should penetrate the ionosphere and be detectable at ground level, but ground-based recordings are needed to confirm these theories and to provide insights into auroral emission and wave-propagation processes.

To gather data about this poorly understood frequency band investigators from the Department of Physics at Dartmouth College in Hanover, New Hampshire, are using programmable low-frequency/high-frequency receivers, arrays of small ferrite-rod antennas, power subsystems, and data compression software at three sites; one at the South Pole, and others at McMurdo. The receivers are being operated throughout the year by the ASA Science technicians at both bases.

South Pole operations

South Pole station operations and maintenance support during the summer comprised the construction of a new well utilising waste heat to produce potable water. It was brought into line in order to reduce the station's dependency on a snow melter. Efforts to upgrade the infrastructure of the station to correct safety and health deficiencies

and maximise the life of existing facilities continued. Long-term plans are being developed for a phased replacement of the South Pole Station infrastructure systems.

An augmented LC-130 airlift delivered the construction materials for the new science facilities and emergency generators to be installed in the 1994-95 season. Equipment for many of the science programmes was upgraded during the summer months and some of it was also relocated.

The contractor from Antarctic Support Associates (ASA) completed the structural foundations and enclosure for the AST/RO facility. This is the new Antarctic Submillimeter Telescope and Remote Observatory, the complex for which is also now accommodating the AMANDA/CARA facility being the network of equipment for the Antarctic Muon and Neutrino Detector Array and the Center for Astrophysical Research in Antarctica. So far, also within the complex are the telescopes for SPIREX, the South Pole Infrared Explorer and COBRA, Cosmic Background Radiation Anisotropy and ATP, the Advanced Telescope Project.

Senior CARA administrative staff visited the site for evaluation and planning purposes. The AST/RO project field team began preparation of the facility for telescope operations installing cryogenic compressors and telescope computer systems in readiness for full implementation of all programmes in November 1994. Then the SPIREX team set up a spectrophotometer, light feed, computer control and a data reduction computer and left one of their members at the Station to operate the equipment over the winter.

Nearby the new building is the network for the CMBR, the Cosmic Microwave Background Radiation programme which over the summer was run at a site some 6,000 feet from South Pole Station but was moved before the winter to the new location. The COBRA telescope was set up at the CMBR site in November 1993 and run until mid December. Using a platform near the AST/RO facility the telescope was moved and operations are now established inside the facility. A team from the Department of Physics at the University of California, Santa Barbara, continued to improve their previously successful measurements of the cosmic microwave background radiation (CMBR) variations from a site near the Station. The CMBR is radiation left over from a few thousand years after the creation of the universe and any variations detected reveal the structure of the universe. Because the left over radiation now reaching Earth is in a wavelength range in which water vapor is absorbed, these measurements must be taken from places such as the South Pole where it is extremely dry and cold or from above the atmosphere.

Over the summer they adopted one of the two Jamesways at the CMBR site in early 1993 to set up the equipment which included a wind fence. Nitrogen and helium, both in liquid form, were delivered to the site and measurements taken until mid January when the experiment was dismantled and returned to the States.

In support of AMANDA's winter programme, personnel from PICO, the Polar Ice Coring Office, melted six to nine ice holes to depths of 1.2 kilometres. As each hole was completed a string of ten photomultiplier tubes were lowered and frozen into place.

With the completion of the new accommodation, the experiment was moved and data acquisition systems established along with the associated equipment required to run it. The new array allows the scientists, who are from the Department of Physics at the

University of Wisconsin, to use the ice itself as a Cherenkov detector for high-energy neutrinos of astrophysical origin that have passed through earth. It is also able them to detect neutrinos produced in the atmosphere near the North Pole and can therefore be used to measure neutrino properties.

Neutrino astrology has so far been limited to detection of solar neutrinos and one brief burst from the supernova that appeared in the Large Magellanic Cloud in February 1987. Recently several new sources of high-energy gamma rays, which may also be neutrinos have been discovered by the Compton Observatory and at Mount Hopkins in Arizona. The scientists concerned with the project believe, that because of intervening matter, there should also be many detectable sources that are not gamma rays or any other wavelength of electromagnetic radiation Now that it is becoming technically feasible to build neutrino telescopes AMANDA, as one of the first generation of such instruments, promises to be a large contributor to a new branch of observational astronomy. The equipment is operating throughout the winter.

Infrared and submillimeter astronomy has the potential to answer some major questions about the formation of the universe, including inconsistencies in cosmic microwave background radiation, the processes by which stars form from interstellar gas, the formation of planets, the nature of primeval galaxies and the uneven distribution of matter and energy in the early universe.

Making use of Antarctica's unique physical characteristics and geographic location, scientists from the University of Chicago, in collaboration with Princeton University, AT & T Bell Laboratories, and other institutions, have established the Science and Technology Center for Astrophysical Research in Antarctica. It provides an observatory at the South Pole with instruments designed to probe the far reaches of the universe and to support three significant experiments.

ASTRO, operated for the University of Colorado uses a 1.7 meter diameter submillimeter telescope to survey the galactic plane, the galactic center and the Magellanic Clouds.

SPIREX, (University of Chicago) makes use of an existing 60 centimetre-diameter, near-infrared telescope to explore the potential of the South Pole as an infrared site and is surveying primeval galaxies and brown dwarf stars.. This spectral window is also located within a "hole" in the celestial background and may afford the most sensitive view of light from galaxies formed in the universe. At this wavelength, the South Pole equipment is more sensitive than the Hubble telescope and 200 times more sensitive than a ground-based telescope at a mid latitude site.

COBRA, which operates for Princeton University, searches for and maps anisotropies in the cosmic background radiation at sufficient sensitivity to test current theories of the origin of the universe.

The South Pole center is enabling researchers from these universities and others to make measurements at wavelengths that are usually hampered by the absorption and emissions of the earth's atmosphere. Because of the near absence of water vapor in the atmosphere above the polar plateau, the infrared skies are clearer and darker than anywhere else on Earth. These unique environmental conditions overcome not only the diurnal variations in temperature that lead to atmospheric noise and wind at higher latitudes but also much of the infrared background radiation. The elevation of the Antarctic plateau significantly reduces the atmospheric path that the light must traverse while the geographic singular-

ity of a polar site also allows a unique opportunity to reduce systematic errors in searches for cosmic microwave background anistropies. All these factors combined improve the observing conditions by a factor of 10:100.

The Advanced Telescope Project ATP continues to operate throughout the winter with some minor adaptations completed during the summer.

Equipment for SPASE, the South Pole air shower experiment for gamma-ray astronomy at ultra-high energy, has been upgraded each year since its installation in 1988 but data from the system have not provided convincing evidence for a strong source of the rays, a result, consistent with that from similar detectors elsewhere. The subject is of interest to scientists because since cosmic rays were discovered early in this century, they have sought to determine their origin. At first they believed that they were energetic electromagnetic radiation but more data have shown that they are electrically charged particles, mainly hydrogen nuclei and more particularly protons.

At the south Pole SPASE is a large, phased array of scintillation detectors, installed at to search the southern sky for astrophysical sources of ultra high energy (100 gigaelectronvolt) gamma rays. The circumpolarity of the station makes the site one of the few from which continuous observations can be made.

SPASE was modified, last summer, to operate with AMANDA so that the same high-energy events can be seen with both detectors in order to better understand the nature and origin of the primary cosmic rays that produce such events.

The IRIS (Incorporated Research Institutions for Seismology) Global Seismographic Network (GSN) operates, in cooperation with the Albuquerque Seismological Laboratory of the United States Geological Survey, two stations in Antarctica, an SPA at the South Pole Station and a PMSA at Palmer. Both provide key coverage in the Southern Hemisphere and are crucial in the GSN.

Currently comprising 81 United States Universities, IRIS is a non profit consortium that creates and manages research facilities for seismology. It also provides funding to the University of California at Los Angeles to operate a long-period gravimeter at the South Pole. IRIS operates both the SPA and PMSA seismic stations

Near real-time access to the data is important to the seismological community. Located on the Earths rotational axis, SPA at the Pole is uniquely situated to measure long-period oscillations of the Earth without the effects of rotational splitting of modes while the station at Palmer provides a vantage for studies of the tectonics and seismicity of the Peninsula, South America, Scotia Sea and the Drake Passage.

At the South Pole the station continues to run throughout the year. In November 1993 a field team member checked the equipment and over the summer the contractor constructed a new vault to replace the previous one failing under snow load. The science technician then reinstalled the equipment and is running it over the winter.

The All-sky Auroral Imager operates in the Skylab/Aurora Lab during the winter. The project is designed to investigate the electrodynamics of the polar cap and cleft regions by measuring auroral-precipitation patterns and interpreting the results in terms of coordinated observations of magnetic, radio-wave absorption images and high-frequency, coherent-scatter radar measurements. Late in November last year a field team member from the Lockheed Research Laboratory undertook routine maintenance and upgraded software to

simplify operations and enhance the quality of data obtained from the equipment. Through their investigation the team from the Laboratory hopes to learn more about the sources and energization mechanisms of auroral particles and other forms of energy inputs into the high-latitude atmosphere.

Since 1965 data has also been acquired at the South Pole using a film-based all-sky camera system to study Aurora Australis. With advanced technology scientists from the Center for Atmospheric and Space Sciences at Utah State University are able to digitize photographic images and process large amounts of information automatically. Besides continuing to acquire the 35mm photographic images with the all-sky camera system they are collaborating with Japanese researchers to analyse part of the data with a processing system developed at Japan's National Institute of Polar Research. The system displays data in a geophysical coordinate framework and analyzes images of over short and long intervals not possible with individual images.

The data are being used to investigate dayside auroral structure, nightside substorm effects and polar cap arcs as well as to obtain further insight into the physics of the magnetosphere, the convection of plasma in the polar cap and solar winds in the thermosphere. The camera continues to run throughout the winter. The operation of the ionosonde however was discontinued in May of 1993 because of disturbance to other equipment and retrograded out by ship in February of this year.

Also operating in the aurora laboratory, which is on the fourth floor of the Skylab facility at the South Pole Station, is a Michelson interferometer and a photometer. The equipment was serviced last summer and a photon-counting spectrometer installed for the project which focuses on the physical, dynamic, chemical and atomic molecular processes occurring in the mesopause, thermosphere and ionosphere.

The long dark winters are ideal for the more extensive observations of semidiurnal, diurnal and longer-period disturbances propagating through the mesopause. The investigators from the Space Physics Research Laboratory at Embry Riddle Aeronautical University hope to compare their data from the station with similar data from their stations in the Arctic where different topologically and meteorological conditions prevail and to assess the contributions of these factors to mesopause disturbances.

After completing a summer programme involving kinematic GPS controlled aerial photography and mapping of the Dry Valley region a researcher from the United States Geological Survey went to Pole Station to operate the ultra-long period seismic equipment and the seismometers which form part of the World Wide Seismological network. Survey personnel are also operating the GPS satellite continuous tracking station, which in addition to supporting the United States Antarctic Programme, is providing data to the international geodetic community.

Experiments to determine the long term trends in mass accumulation at the South Pole are being continued. These are important because climate modelling suggests that the global warming might increase atmospheric water vapor, and consequently precipitation worldwide.

In 1992-93 the team installed a hexagonal array of 240 poles centred on the South Pole to establish systematic, long-term monitoring of net accumulation. In 1993-94 they measured the accumulation of mass over the intervening year and drilled three 18 meter cores which are being cut into very

small samples to resolve the exact depth of the known time stratigraphic-marker horizons positioned in 1963-64 and in 1955. They also examined the feasibility of incorporating a global positioning system (GPS) mapping on the surface elevations along the six accumulation lines. Over the next four years they will continue to adjust the array and to test, refine and standardize procedures for recording data in order to leave in place an optimally designed monitoring system that can be incorporated into routine science observations at the station.

In another project a group from the climate modelling and diagnostics laboratory of the National Oceanic and Atmospheric Administration are continuing to make long-term measurements of trace atmospheric constituents that influence climate. Four scientists were involved in the summer programme and two are wintering over to measure carbon dioxide, water vapour, surface and stratospheric ozone, wind, pressure, air and snow temperature, atmospheric moisture and other trace constituents from the station's clean-air facility. The measurements are part of NOAAs effort to determine and assess the long-term buildup of global pollutants in the atmosphere. The results will be used for time-series analyses of multiyear data records that focus on stratospheric ozone depletion, transantarctic transport and deposition, interplay of the trace gases and aerosols with solar and terrestrial radiation fluxes on the polar plateau, the magnitude of seasonal and temporal variations in greenhouse gases, and the rate at which concentrations of these atmospheric constituents change. They will also examine the sources, sinks and budgets of the components.

Working with climate modellers and diagnosticians the data are being used to determine how the rate of change of these parameters affects climate, particularly by including them in climate model studies. Personnel at Palmer are also sampling in support of this project.

Episodic events in the South Polar atmospheric boundary are being observed by a member of the team from the Wave Propagation Laboratory, from the National Oceanic and Atmospheric Administration throughout the year. The results will be used for modelling the surface heat budget which is important to general circulation as well as to the rate at which snow and ice accumulates, melts and evaporates. In Antarctica, the components of this budget vary greatly with significant differences that are not related to local levels of solar radiation. During the summer the field team studied the dynamics of the stable atmospheric boundary layer, focusing on the importance of intermittent and episodic forcing mechanisms that determine the structure and energy transfer within the lowest layers of the Antarctic troposphere. They selected the Station site for the project because the stable boundary layer is reliable, there is a smooth air-snow interface and no diurnal solar cycle and they are particularly interested in the effect on boundary-layer structure and surface fluxes of heat and momentum due to time varying pressure gradients, horizontal temperature advections and mesoscale divergence patterns. Modern remote-sensing wind and temperature profiling instruments collect data on those phenomena and are being used to ascertain their effect on boundary-layer structure and surface fluxes. Numerical simulation models will be used to analyze the data and interpret the observed events.

Over the summer four field team members from the University Washington's department of geophysics upgraded the Fabry-Perot Interferometer (FPI) system and undertook the annual maintenance and calibration. The equipment makes ground-based optical meas-

urements of the motions and temperatures of the upper atmosphere at heights greater than 70 km in order to investigate the dynamic behaviour of the region of the atmosphere.

The location at the rotational pole makes it possible to measure atmospheric motions at all local times and therefore directly determine the zonal wave number mode of the observed travelling wave motions by simple measurement of the longitudinal phase progression of these waves. The measurements indicate that the atmosphere near the poles strongly favours zonal wave number one modes for motions and wave number zero modes for temperature and density. Confirmation of the findings is now in progress.

The dynamics of the higher latitude neutral thermosphere in the Southern Hemisphere are scientifically interesting because of the larger separation between the rotational and geomagnetic poles than its counterpart in the north. Results of the different atmospheric dynamic responses in the two hemispheres to the influences of solar ultraviolet radiation, magnetospheric convection and solar-wind particle effects are being studied As solar activity changes the investigation will help scientists understand the dynamics of the atmospheric region.

Antarctic Treaty

Positive outcomes to 18th ATCM

The XVIII Antarctic Treaty Consultative Meeting, held in Kyoto Japan from 11 to 22 April 1994, marked an important step forward in the transition of the Treaty System from concentration on Treaty negotiations and scientific activity towards the challenges now being set as the Environmental Protocol nears adoption. From reports from those Consultative Parties which have not yet ratified the protocol it seems possible that it may come into force in 1995 or 1996.

Sweden, Australia and the Netherlands announced their ratifications at the meeting bringing the total number to nine. Among these ATCP's are Spain, France, Peru, the UK.

Significant highlights were:

> Agreement on the establishment, at the next ATCM to be held in Seoul, in May of 1995, of a Transitional Environmental Working Group (TEWG) to begin the work of the Committee for Environmental Protection. (In terms of organisation it is planned for the environmental component of the meeting to be undertaken in the first week with the policy work in the second week.)

The question of Liability under the Protocol remains difficult to resolve. A legal experts' group, chaired by Professor Wulfrum from Germany reported to the meeting at Kyoto on its intercessional activities and it was agreed that the same group would meet in the Hague later this year and report further to the Seoul ATCM.

> The passing of a recommendation containing guidance for tourists and non-governmental organisations. It is intended that the guidelines be distributed

to individual tourists and to tour operators in the period before the Protocol comes into force. (Tourism and non-government activities will be further covered in our September issue.)

> Further progress was made on the defining of a permanent secretariat to the Antarctic Treaty with discussion focusing on the legal status, privileges and immunities and functions of the organisation. Its location was not however discussed but it was agreed that a decision on the establishment of the Secretariat Secretariat would be taken at the 19th ATCM.

One feature of the Kyoto meeting was the increasing contact between the five "gateway" countries to the Antarctic, Argentina, Australia, Chile, New Zealand and South Africa. Delegations identified a number of areas of common interest and indicated their intention to continue to develop scientific links as well as the concept of gateway cities.

New Zealand is to host the ATCM XXI in April/May 1997. Leader of the New Zealand Delegation to the Kyoto meeting was Ms Priscilla Williams, Director of Environment Division from the Ministry of Foreign Affairs and Trade (MFAT). Members comprised, Mr Stuart Prior, Head of Antarctic Policy Unit and Mr Allan Bracegirdle, Deputy Director, Legal Division, both from MFAT, Ms Gillian Wratt, Director, New Zealand Antarctic programme, Mr Neil Plimmer, Executive Director, Ministry of Tourism, Mr Michael Prebble, Ministry for the Environment, Sir Robin Irvine, Chairman of the RDRC and Mr Allan Hemmings, from Greenpeace, New Zealand who represented the non-government organisations.

French create Polar Environment Committee

On the advice of the Minister for the Environment and following the passing on 18 December 1992 authorising approval of the protocol to the Antarctic Treaty on Environmental Protection the French Government has created a Polar Environment Committee. Their responsibilities include checking the compatibility of human activities with preservation of the environment in French polar and subantarctic territories.

The Committee is to comprise a president and ten members chosen for their competence in scientific and technological activities in terms of the environment. Of the ten two are to be nominated by the Minister in charge of the Environment, two by the Minister in charge of Overseas Departments and Territories, two by the Minster in Charge of Research and Space while the other two will represent environmental protection organisations and be nominated by the Council for the Rights of Future Generations. Their nomination is subject to Prime Ministerial approval and their term of service is for two years but this can be extended.

The Committee will be consulted on all activities including major projects and impact studies in the relevant polar areas. It will ensure regular and continuous surveillance of human activities, have emergency plans and powers to inspect. It will also be consulted on all other questions relative to the polar environment

A secretariat will be provided by the Ministry for the Environment and the committee may also use the resources of Polar French polar administrations

with whom it will work closely. These include the Ministers in Charge of Foreign Affairs, Environment, Overseas Departments and Territories and Research; the President of the French Institute for Research and Polar Technology - Expeditions Paul-Emile Victor - and the Superior Administrator for French Austral and Antarctic Territories (TAAF).

The Committee is to make considered recommendations on matters referred to it within 60 days although 120 days is allowed for impact studies but where matters are urgent a 30 day limit for advice has been imposed. On its own initiative and in addition to matters referred to it, all questions relative to its spheres of competence may be studied and it will make proposals on recommendations which appear to it to be necessary. The committee, whose members have been nominated but apparently not yet named, will be convened at least once a year and make its recommendations public.

Television New Zealand's Antarctic Trilogy has been widely acclaimed overseas with sales in Asia, Canada, Australia, Europe and the Middle East. The films in the trilogy are *Emperors of Antarctica*, *Solid Water Liquid Rock* and the *Longest Night* In addition the series has picked up prestigious awards in France at the Festival du Film de O'oiseau, at the 36th annual New York Festival earlier this year where the trilogy won both gold and silver medals and more recently in New Zealand's National Film and Television Awards. Here, for their work, Mike Single and Andrew Penniket won the Best Camera Award while the Best Director's Award went to Mike Single and Max Quinn, who tells the story of the filming of *Emperors of the Antarctic*..

The night of the Penguin.....

"That man should wander forth in the depth of polar night to face the most dismal cold and fierce gale....makes a tale for our generation which I hope may not be lost in the telling." Captain Robert Scott wrote in his diary in 1911. He was referring to an incredible midwinter journey to Cape Crozier, Antarctica, to collect the first emperor penguin eggs for science. Three of his men towed sledges for five weeks in conditions so atrocious that they survived only by a miracle. This became known as "the worst journey in the world."

Eighty years later a team from TVNZ's natural history unit repeated the midwinter journey. Director/cameraman Max Quinn tells their story which is here reprinted with the permission of *the New Zealand Listener*.

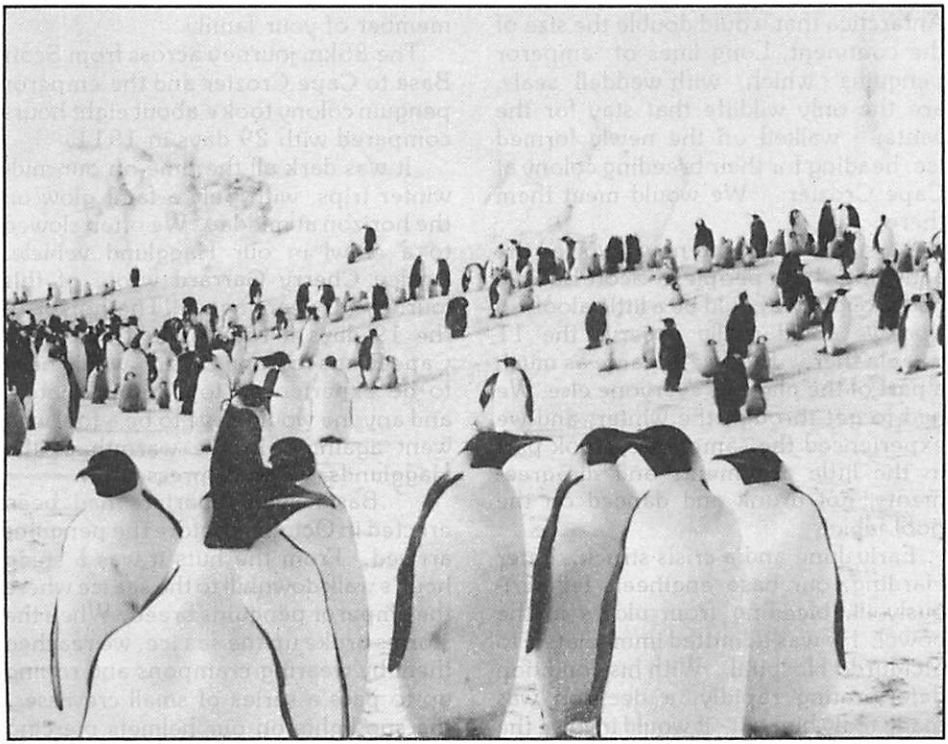
We waited on the tarmac at Christchurch airport, soundman Don Anderson and I. It was January, the temperature was 30deg C and we were sweating in our Antarctic survival gear. Our next ten months were to be spent in temperatures down to -50C, so cold that a cup of boiling water thrown in the air would instantly freeze into hail. I was terrified.

We were joining the small group of

11 people wintering over at New Zealand's Scott Base to shoot two films for the Antarctic trilogy produced by Television New Zealand's Natural History Unit. *Emperors of Antarctica* would be a study of the penguin colony at Cape Crozier, demanding a daunting 85 km journey over heavily crevassed ground each month in the dead of the long Antarctic night. We would be the first winter expedition to study the Crozier penguins since Scott's team made their terrible journey 80 years earlier. *The Longest Night* would be about life with the New Zealanders at Scott Base and the Americans at the larger McMurdo Station nearby. The third film, *Solid Water, Liquid Rock* - a journey from under McMurdo Sound to the boiling crater of Mt. Erebus - was to be filmed by another team that would arrive as we left in November.

Our Hercules aircraft chased the sun south for more than eight hours that January evening. We stepped into the dazzling glare of the Ross ice shelf at 1.00 a.m., temperature -12 deg C - high summer. How would we cope? Would the 11 people we were to live and work with accept us filming their every move? To fall out with any of them would make life intolerable. The last flight of summer left at the end of February: the next flight wouldn't come in until the end of August. Family illness or tragedy would have to be coped with by telephone.

Photo: Max Quinn



We spent the last weeks of the Antarctic twilight filming the constantly changing environment around us. From the deck of the departing US icebreaker *Polar Sea* we filmed orca and minke whales frolicking in the plankton-rich waters. We could look down into the crystal-clear sea and film the huge whales as they surfaced and spouted right under us, spraying the camera with their fishy breath.

The sea began to "smoke", surely one of Antarctica's best kept secrets, caused by the difference in temperature between air and water. McMurdo Sound took on the appearance of a forest fire. In the setting sun it was a thing of rare beauty. The sea now took on an oily look as ice crystals formed on the surface. As the ice solidified the ocean jostled it into pancakes. Then the pancakes formed a solid mass that would eventually drape a skirt of sea-ice around Antarctica that would double the size of the continent. Long lines of emperor penguins - which, with weddell seals, are the only wildlife that stay for the winter - walked on the newly formed ice, heading for their breeding colony at Cape Crozier. We would meet them there.

Most of our filming now involved the activities of the people at Scott Base. I had thought we could be a little aloof, so that we could really observe the 11 people there. But, we became as much a part of the place as everyone else. We had to get through the winter, and we experienced the same lows, took part in the little arguments and disagreements, got drunk and danced on the pool table.

Early June and a crisis struck. Peter Harding, our base engineer, fell seriously ill, bleeding from ulcers in the bowel. He was admitted immediately to McMurdo Hospital. With his condition deteriorating rapidly, a decision was made to fly him out - it would involve the first mid-winter landing in more than 25 years. Two Hercules were brought from California to Christchurch, one to make the flight south and the other to wait at Harewood on standby. Navy teams from the US base worked 34-hour shifts in bitter cold and dark to prepare a snow runway.

Emotions were running high in the small community and not all were keen about a film crew taking advantage of Peter's misfortune. But it had to be done. Luckily Peter felt, as I did, that this was something that needed to be recorded for posterity, and I was able to film and interview him at his bedside.

The evacuation was carried out with military precision. The flight landed, and refuelled with its engines running, and was airborne before I knew it. Life at Scott Base was subdued for some time. Peter was so well-liked and hardworking that it was like losing a member of your family.

The 85km journey across from Scott Base to Cape Crozier and the emperor penguin colony took e about eight hours compared with 29 days in 1911.

It was dark all the time on our mid-winter trips, with only a faint glow on the horizon at midday. We often slowed to a crawl in our Hagglund vehicle. Apsley Cherry Garrard wrote of this journey 80 years ago. "The horror of the 19 days it took us to travel from Cape Evans to Cape Crozier would have to be experienced to be appreciated, and anyone would have to be a fool who went again." In the warmth of the Hagglunds, we fools pressed on.

Basic living quarters had been erected in October, before the penguins arrived. From the huts it was a steep hour's walk downhill to the sea ice where the emperor penguins breed. When the storms broke up the sea ice, we reached them by wearing crampons and roping up to pass a series of small crevasses, the spotlights on our helmets piercing

the dark. The route was extremely arduous and we carried all our gear on our backs, The only thing worse was the cold.

We'd brought a tape player and monitor so we could review our filming before we returned to Scott Base. Our course, we could also watch the odd video during blizzards. Imagine five people in a tiny hut in one of the world's truly desolate places, huddled around a TV monitor watching movies and football. Would Scott, Shackleton and Byrd have approved?

One morning we spied from the huts a large group of about 30 emperors crossing the sea ice. They emerged out of the blowing snow of a blizzard like ghosts. Some would plane along on their bellies while others would waddle on their tiny feet. The birds were enormous. They had spent the summer fattening themselves for their long winter breeding vigil., one of the most remarkable breeding cycles in the animal world. I felt privileged to be there to see it.

We filmed the Cape Crozier penguins in midwinter, for the first time ever. After laying their eggs, the females left the males to a 60-day vigil, and trekked back to the sea to fill themselves with food.

August brought a new noise. When the male raised its brood flap an awkward oversized head attached to a tiny bald body would emerge and give a hungry chirp. When the female returned, the males and females would greet each other, then shuffle together and - after much bowing, trumpeting and pushing - the male would deposit the chick on the ice and the female would quickly scoop it onto her feet. The chick would get fresh seafood instead of an oily secretion and the male could go fishing for the first time in 17 weeks.

These were magical moment and the crowning glory of our months of hard work.

As we headed for August, spirits began to flag. Midwinter depression is common among winterers. Crank behaviour and niggling arguments became part of life. I was expected to capture this on tape, but I was suffering from it a little myself. We needed to see the sun again; it rose for the first time in four months on August 19, just a tantalising glimpse.

For a film-maker, sunrise in Antarctica is the ultimate. The sky is filled with astonishing images. Mirages, earth shadows, parhelions around the sun, the most vivid mother-of-pearl clouds form when the sun refracts off ice particles high in the stratosphere. It is a rare sight, seen only a few days each spring. But these clouds also herald the start of the ozone hole over Antarctica.

As the summer science teams flooded in, we prepared to move out. Don and I knew that we had made lifelong friends. Antarctica is now a special place for me. I've seen and photographed it as perhaps no one else has. Some day it will draw me back.

Footnote: The continent did indeed draw Max back but it was to be a vastly different experience. See *Antarctic* Vol 13. No. 5 217ff.

Stop press:

Lars Eric Lindblad dies

Just as Antarctic was going to press we received advice that Lars-Eric Linblad had died suddenly in Stockholm on 8 July 1994. It was planned to hold a memorial service for Mr Lindblad in New Yorkwithin the next week.

Antarctic Heritage Trusts

Ross Sea Inventory completed, new trustees appointed and UK trust launched and assisted

Over 8,000 historic artefacts from the Ross Sea area are now listed in an inventory and entered on to a database which will be used by the Antarctic Heritage Trust for future management and for planning of a conservation programme. The work, made possible by a grant of $20,000 from the Lotteries Heritage Fund, was begun four years ago by a team of specialists working for the Trust.

Items include clothing, sleeping bags, foodstuffs and scientific equipment from the huts at Cape Evans, Cape Royds and Hut Point as well as articles listed in reports from Cape Adare and the depot at Butter Point. This depot, left by the British Antarctic Expedition during the summer of 1991-12, was removed about five years ago when it was threatened by ice ablation and the possibility of a section of the Bowers Piedmont Glacier breaking away.

During the 1994/95 season another depot left in the Terra Nova Bay area at Hells Gate Moraine near Inexpressible Island by the same expedition will be recovered. This depot comprises a sledge with equipment and provisions wedged between boulders and embedded in the ice. Nearby are the remnants of a tent, food and the rusty remains of some tins. The site was inspected last summer by a number of parties which included representatives from the NZAP, BAS, ENEA and ICAIR who confirmed that it was deteriorating. The Italian Antarctic Programme have offered to assist New Zealanders in the recovery of the equipment next summer.

Two new Trustees have been appointed to the board of the New Zealand Antarctic Heritage Trust. They are former journalist and public relations practitioner Rob Fenwick of Auckland who is a consultant to the Auckland Institute and Museum and David Crerar, a lawyer from Rangiora. David was officer in charge at Scott Base in 1988/89.

The Antarctic Heritage Trust in the UK was formally launched on April 26 with a special function at the Butchers Hall in the City of London attended by their Patron HRH the Princess Royal, Princess Anne and 140 guests, more than half of whom represented science and Antarctic interests. Speeches were made by the chairman Bryce Harland, Alastair Fothergill of the BBC who had worked with Sir David Attenborough on the BBC documentary series and the Princes Royal. John, Collinge the current New Zealand High Commissioner in London and Bob Norman, Associate Patron of the New Zealand Trust, attended the function.

Current membership of the board of the UKAHT is Bryce Harland (Chairman); secretary Captain Pat McLaren. Pat was formerly captain of the *HMS Endurance* after she was bought by the Royal Navy in 1990 and succeeds John Hamilton who died in the New Year. (see page .) Shelley Alexander is assistant secretary. and Peter Hetherington is treasurer. Other members of the board are David Drewry, Director, Brit-

ish Antarctic Survey, Robin Byatt former UK High Commissioner in New Zealand, John Heap, Director of Scott Polar Research Institute, Michael Richardson from the Foreign and Commonwealth Office and Dick Laws, a former director of BAS.

While in London Bob Norman was able to meet with the Trust Board and discuss developments both in the UK and in New Zealand as well as common problems.

Last October the (New Zealand) Antarctic Heritage Trust was asked by its British counterpart to assist with a survey and assessment of a number of abandoned British bases on the Peninsula pending their designation as Historic sites under the Antarctic Treaty. The British have built a total of 30 bases in Antarctica and 16 of them have been abandoned generally at the conclusion of their scientific usefulness.

On February 26 Chris Cochrane, conservation architect from Wellington and convenor of the AHT Conservation Advisory Group boarded *HMS Endurance* at Mt. Pleasant in the Falkland Islands for a four week cruise in the Peninsula Area. Accompanying him, was Ian Collinge from the British Antarctic Survey, which along with Foreign and Commonwealth Office in London were also involved in the project.

Originally it was intended to visit 12 sites but weather precluded landing at three and visits were made to Port Lockroy, Argentine Island, Horseshoe Island and nearby refuge at Blaiklock Island, Stonington Island, Deception Island, Danco, Admiralty Bay and Portal Point. Of these four have been recommended for historic status under the Antarctic Treaty but the recommendations embodied in the report are pending approval by the United Kingdom Antarctic Heritage Trust.

According to Chris Cochrane the construction of the bases visited was very much in keeping with those used by Scott and Shackleton in the Ross Dependency - standard four by two timber framing, tongue and groove weatherboard and malthoid cladding on the roof. Some of the buildings have been damaged by weather and neglect and have deteriorated considerably but others are in good condition. With the warmer and more humid climate metals used in equipment and stores are rusting more quickly than on Ross Island. One of the most interesting sites was that of the base on Horseshoe Island which was built in the 1950s and used for only three years. Chris describes it as a perfect "time capsule". The base remains fully equipped with mattresses on the beds, coal beside a fire ready to be lit, radio equipment, sledges and associated workshop.

The survey party disembarked from the ship on March 24 at Punta Arenas.

"A" for "Able" being restored

"Able", one of the four Snocats purchased by the British for the Commonwealth Trans-Antarctic Expedition led by Sir Vivian Fuchs in 1957-58 is being "tidied up" by Gough, Gough and Hamer Limited in Christchurch for display in the R.H. Stewart Hall of Antarctic Discovery at Canterbury Museum.

Able was one of the three such vehicles used in the crossing from the Weddell Sea side to Scott Base. In the new hall it will join another "member" of the expedition's transport fleet, the Hillary Ferguson tractor, and together they will enhance the Antarctic attractions at the Museum while also drawing attention to the more recent historical events of the region.,

At the conclusion of the TAE the machine was one of two purchased by

the fledgling New Zealand Antarctic Research Programme. "Able" named by British party member and engineer David Pratt was the second machine out of Shackleton Base at the beginning of the Trans-Antarctic Crossing. The other machine bought by the DSIR was the "County of Kent", named by Roy Homard, also an engineer, in honour of his Kentish origins. It was lost down a crevasse on 19 November 1959 in McMurdo Sound when its driver Lt. T. Couzens was killed.

Able continued to play an important role in the McMurdo area until approximately 1970 when it was offered by NZARP Superintendent Bob Thomson to the Canterbury Museum during planning of its Antarctic wing. In 1971 it was brought to Lyttelton aboard *H.M.N.Z.S. Endeavour* and stored in Christchurch until it was placed in a "temporary location" in the Museum's garden court in 1973. Late last year it was lifted out by crane and transported by road to Gough, Gough and Hamer's workshops.

Much of the restoration undertaken by Alan Guard and his team at Gough Gough and Hamer has focused on the tracks but it has also involved tidying up of the paintwork, removal of oil leaks and some general repairs including the re-upholstering of the seats. It is intended to bring it to a state where there will be no further deterioration.

With surprisingly little effort the engine was brought into life and on February 19 this year when Sir Vivian Fuchs, a passenger on the *Marco Polo* visited "Able" he was delighted to sit in the cab and start the machine.

Sir Vivian and Lady Fuchs with Able in Christchurch in February.
Photo: Gough, Gough and Hamer

Once the restoration has been completed the Able will be stored. In order to fit it into its final resting place in the new hall Able will have to be partially dismantled and Gough Gough and Hamer have plans in hand for this aspect of the project.

The new Antarctic Hall is scheduled for completion in 1995-96.

Obituaries:

Dr Trevor Hatherton

OBE, DSc, DIC, FRSNZ

1924-1992

During the last two and a quarter years the international Antarctic Community has lost some of its most prominent members. Many were, as well, great characters. In the next few issues of *Antarctic* we will be paying tribute to their memory.

Antarctic and geological communities lost a unique individual with the death of Dr Trevor Hatherton on 2 May 1992. He is remembered with deep affection and respect, but because he was such a remarkably modest man, many are only now fully appreciating the extent of his life's achievements.

Trevor's contribution to science in Antarctica and the development of New Zealand's Antarctic programme spanned many years. He came to this country in the 1950 as a New Zealand National Research Scholar, a fresh young geophysics graduate with a Yorkshire accent, a deep interest in New Zealand, and a fascination for Antarctica.

After completing his scholarship research programme in 1953, Trevor was awarded a Ph.D. from London University and promptly joined the staff of Geophysics Division of the Department of Scientific and Industrial Research.

In 1955 he fulfilled his dream of visiting Antarctica travelling south in the *Endeavour* to find a site for a New Zealand Base to support the Commonwealth Trans-Antarctic Crossing as well as a route for the expedition up onto the Polar Plateau. Early in 1956, with Bill Smith of the New Zealand Navy and a US photographer, Trevor manhauled 300lbs for four days over difficult sea ice from the mouth of the Ferrar Glacier to Dailey Island. He failed to find a suitable site for the future Scott Base and ended up "with very wet feet".

Two weeks later, Trevor, joined again by Bill Smith and accompanied by Bernie Gunn, hauled two fibreglass sledges up the Ferrar Glacier, experiencing a very difficult surface until the blue ice was reached. At the head of the glacier the party climbed Mount Beehive and surveyed the merging of the Ferrar into the edge of the Polar Plateau.

On the return journey they encoun-

tered some of the very strong winds that keep the blue ice clear in the region, and with typical dryness Trevor remarked that "our confidence in the performance of the light tent was considerably augmented by its survival during the night." The very first issue of *Antarctic* shows Trevor crouched outside the tent in question. With the wind constantly dogging them the party reached the end of the hard blue ice, having broken all eight sets of their crampons.

After a helicopter pick-up, Trevor then continued his search for a base site, eventually finding a suitable gravel terrace near Butter Point.

By now Trevor was 31 years old and had already been noticed by the New Zealand authorities as having "qualities of leadership, endurance and administrative ability which marked him out as a natural leader." He was placed in charge of New Zealand's IGY (International Geophysical Year) team of scientists at Scott Base and in December 1956, again sailed south.

Butter Point proved inaccessible by ship, and Scott Base was built at Pram Point on the other side of McMurdo Sound. Trevor appears to have been in the thick of hauling supplies and equipment across the sea ice from the *Endeavour*. After the weasel broke through, fortunately wedging itself in and not falling to the sea floor, Trevor was one of the group who spent four hours trying to get it out.

It was during this summer and the following winter that Trevor's considerable contribution to New Zealand's budding science programme became overshadowed by the stirring story of the Trans-Antarctic crossing and New Zealand's depot laying trip to the South Pole by Sir Edmund Hillary's party. Trevor was a strong science leader and a dedicated observer of auroral activity throughout the long polar night. Hillary describes how, when all other expeditioners were snug in their beds, Trevor would be standing with his head out of an open hatch in the lab, recording the display with numb fingers. Trevor also operated an All Sky Camera on the top of the building as part of the programme.

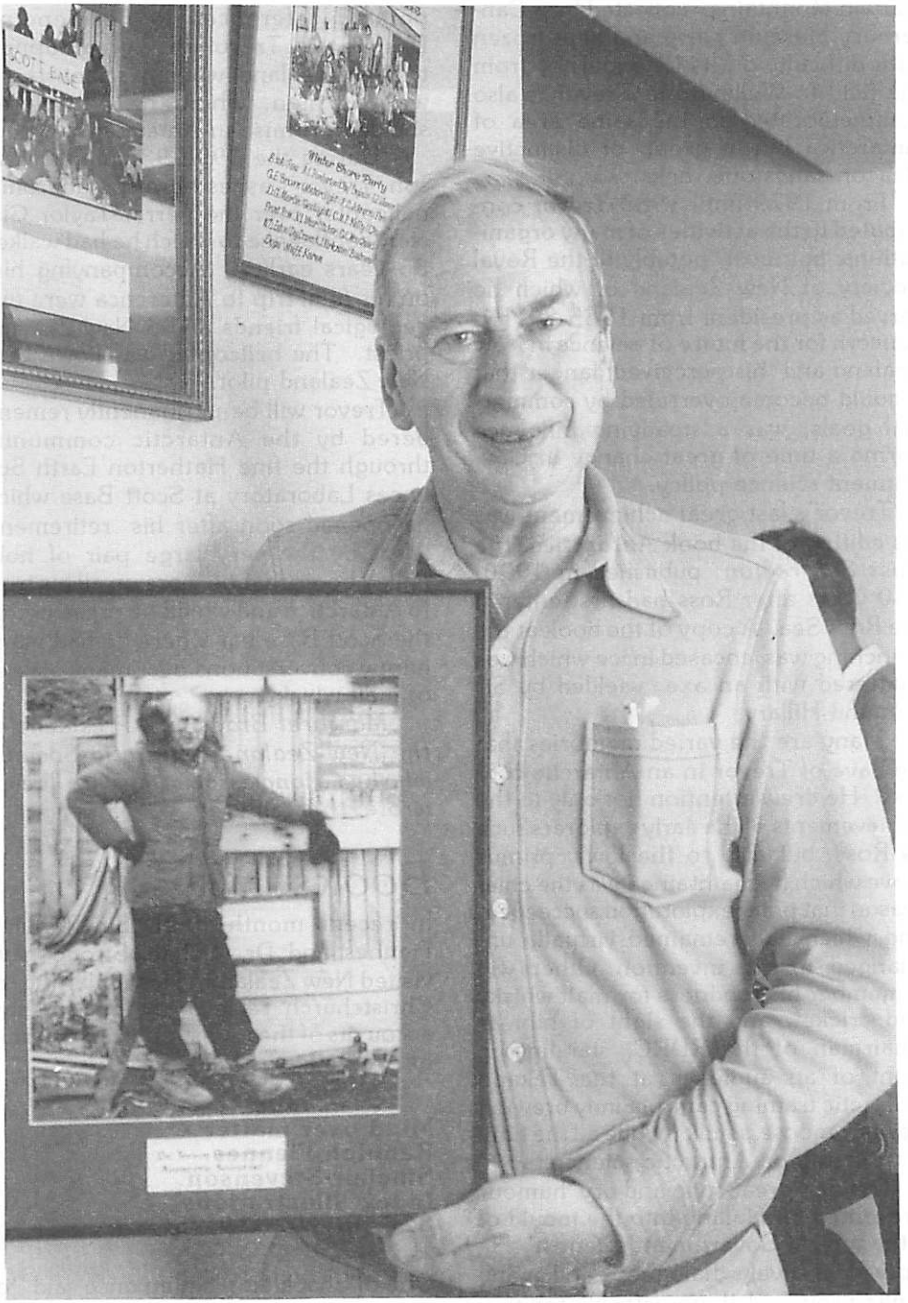
During the winter Trevor was a prominent member of the Scott Base team who participated in the first Antarctic International Indoor Sports Meeting at McMurdo Station, and with Richard Brooke, represented New Zealand in the table tennis.

During November 1957 Trevor visited Hallett Station to discuss NZ-US collaborative work during the remainder of IGY.

Returning to New Zealand, he became a member of the newly established Ross Dependency Research Committee (RDRC), and in June 1958 visited the USA to discuss further collaboration between America and new Zealand scientists, as well as logistic support. This was the real start of Trevor's 30 year involvement with RDRC which culminated in him becoming chairman from 1983 to 1989.

Later to be followed by many other honours and awards, Trevor received the Queen's Polar Medal and an OBE in 1958 for his services to Antarctic science. In 1965 he edited a major review of Antarctic history and science, a book called *Antarctica*. Some years later he became the driving force behind the establishment, in 1987, of the Antarctic Heritage Trust which was set up to protect the historic sites of the Ross Sea region.

From 1967 until 1985 Trevor was Director of Geophysics Division, DSIR, making major contributions to New Zealand science, but relinquishing the position to concentrate on research until his retirement in 1989. Trevor's retirement party was made extra special by


SCOTT BASE

the production of drinks containing ice from a glacier named for him near the Darwin Mountains, collected by a Canterbury Museum party and kept frozen with difficulty on its long journey from the field to Wellington. Trevor is also commemorated in the same area of Antarctica by a group of distinctive Beacon sandstone rocks.

From 1979 until 1989 Trevor contributed to the activities of many organisations, but most notably to the Royal Society of New Zealand of which he served as president from 1985-89. His concern for the future of science in New Zealand and his perceived danger that it could become overruled by commercial goals, was a steadying influence during a time of great change in Government science policy.

Trevor's last great achievement was his editing of the book *Antarctica: the Ross Sea region*, published in 1990, 150 years after Ross had first entered the Ross Sea. A copy of the book at the launching was encased in ice which was shattered with an axe wielded by Sir Edmund Hillary.

Many are the varied memories that we have of Trevor in an Antarctic context. He drew attention not only to the achievements of the early explorers such as Ross, but also to the lowly primus stove which he maintained was the chief reason that polar exploration succeeded, and which had remained virtually unchanged since its invention. Others will remember his fondness for malt whisky and cricket, and the sight of him as Chairman of the RDRC, standing in front of an audience at the Tekapo Antarctic training camp calmly brewing up his "moose's milk" while all the time discoursing on Antarctic science.

Trevor's great style and dry humour prevented him falling into the mould of a the typical Government scientist. He thrived on lively dialogues and many times provoked them with his tongue-in-cheek comments about women in Antarctica, which invariably included pointed references to needlepoint. Despite this, Trevor was a great support to New Zealand women scientists, as well as men, whom he considered showed promise in Antarctic science.

During the 1992-93 summer season, Trevor's ashes were spread from a helicopter over the Ferrar-Taylor Glacier confluence to which he had walked 35 years earlier. Accompanying him on his final trip to Antarctica were two geological friends and a New Zealand priest. The helicopter was flown by a New Zealand pilot.

Trevor will be permanently remembered by the Antarctic community through the fine Hatherton Earth Sciences Laboratory at Scott Base which he opened soon after his retirement. Also, by the very large pair of hobnailed boots that he wore on all his trips to Antarctica and which he presented to the Scott Base bar where he had many happy conversations over many glasses of malt whisky.

Margaret Bradshaw, President of the New Zealand Antarctic Society, who had a long association with Trevor wrote this tribute.

Books

In recent months both Sir Ranulph Fiennes and Dr Michael Stroud have visited New Zealand. Here Bill King, of Christchurch reviews their respective accou nts of the ir unsupported crossing of Antarctica in 1992-93.

Mind over matter -
Ranulph Fiennes.
Sinclair-Stevenson.
Index. Illustrations
326 pp NZ $39.95.

One of Shackleton's men once said "of all those who have explored Antarctica,

few have done so more uncomfortably or with greater hardship than the British." and this epic crossing of Antarctica certainly continued in this vein. For 97 days two men fought pain, starvation and snow blindness; manhauling sledges weighing 226 kg over 2380 km of treacherous Antarctic continent; finally being airlifted out more dead than alive after completing the longest unsupported journey in polar history.

Fiennes, accompanied by Mike Stroud, set off from the edge of the Filchner Ice Shelf early in November 1992 with the idea of completing the first unsupported crossing of the Antarctic continent, and by doing so, raising money for Multiple Sclerosis. They would be manhauling all the way and pulling about twice the load of that of Scott's sledges in 1911-12. In fact, it was not until they had taken their first few footsteps that they actually knew they could pull their sledges.

During the 97 days there were out on the ice, Fiennes and Stroud survived crevasses, blizzards, equipment failure and gangrene, frostbite, hypothermia and suppurating sores. "Our unwashed hair and bodies itched and emitted a powerful stench. The sweat-salt stung my crotch sores and the renewed assault from ultra-violet burns further damaged my lips, from which blood and pus leaked into the chin cover of my facemask" wrote Fiennes.

Although they had completed previous expeditions together and shared great hardship before, their friendship was severely strained on this trip. It turned first to tension and frustration and then to mutual hatred. After Mike Stroud had requested to rest following a attack of diarrhoea and had been told by Fiennes they had to keep moving, Fiennes wrote "he was angry and said I was boorish and graceless; in short a prick of the first order." Further on he writes "I spent the next hour ruminating on how extremely unpleasant I must be as a travelling companion and ended up quite thankful that Mike was not carrying the revolver which in the Arctic was usually his responsibility."

On finally reaching the Ross Ice Shelf, Fiennes and Stroud were in bad physical shape. They had lost 30 percent of their body weight, had frost-bite and insufficient food to continue their journey. Perhaps more than anyone, Fiennes could now relate to Captain Robert Scott and his men, who died on the Ross Ice Shelf, when returning from the South Pole over 80 years ago. Angry at recent historical treatment of those events he writes "Scott's modern detractors make much of his 'narrow-minded stupidity' in championing manhaul travel over the use of dog teams.... In hauling our own loads across this area, greater in mass by far than the United States, we have shown that manpower can indeed be superior to dogpower and, in doing so, have partly exonerated Scott's much-abused theories on the matter."

The book is well written and a good read, and perhaps deserves better than a paperback publication. There is an informative appendix detailing the results of medical tests carried out during the trip as well as equipment lists. It is a pity that many of the photographs chosen to illustrate the book have been taken on previous Arctic and Antarctic trips and seem irrelevant to this text. Having just completed a 60 day stint on the Polar Plateau with the New Zealand Antarctic Programme, nothing in the world would induce me to even contemplate thinking about attempting a journey of great suffering and magnitude as this. Over $9 million was raised for Multiple Sclerosis and every cent was hard earned.

Shadows on the wasteland-
Mike Stroud
Jonathon Cape
Appendix, bibliography, illustrations 182pp NZ$45.

When Sir Ranulph Fiennes and Mike Stroud ended their epic journey radioing for an Adventure Network aircraft to pull them out from the Ross Ice Shelf, they were still 400 kilometres from their final destination. They were frostbitten and close to starvation and, if they had continued, would probably have emulated the deaths of Captain Scott and his party some 80 years earlier.

Although the journey wasn't completed, they had finished the longest unsupported polar traverse in history. The journey itself was not without problems and both physical and mental tolerances were tested to their fullest limits, way beyond that normally endured by man. I did, however, wonder at times if much of the pain could have been prevented had they been more willing to learn the lessons of others before them, especially with regard to their choice of boots and clothing.

Stroud is no stranger to polar travel having been to the Antarctic before on the "Footsteps of Scott" expedition. He has also accompanied Fiennes twice previously on unsuccessful man-hauling attempts to reach the North Pole. However this trip surely tested his physical capabilities and his friendship with Fiennes. Stroud's book gives a very frank and detailed insight of Fiennes as a person and although he does say he could think of no better companion, one does wonder if he can fully lay his complete trust in Fiennes again.

This is a much better written and produced book in comparison to Fiennes *Mind over Matter*. Stroud appears to give a more frank and balanced account of the adventure. However both seem to dwell too much on their self imposed views of unsupported journeys, and where the Antarctic continent actually begins and finishes. Does it really matter?

Few will fail to be impressed by Stroud's revelations which make compelling reading for any adventure buff. Perhaps the journey is best summed up by the cartoon from the "Spectator" on the final page which depicts two polar explorers, walking side by side with "I'm with this idiot" written on both their jackets.

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