ANTARCTIC

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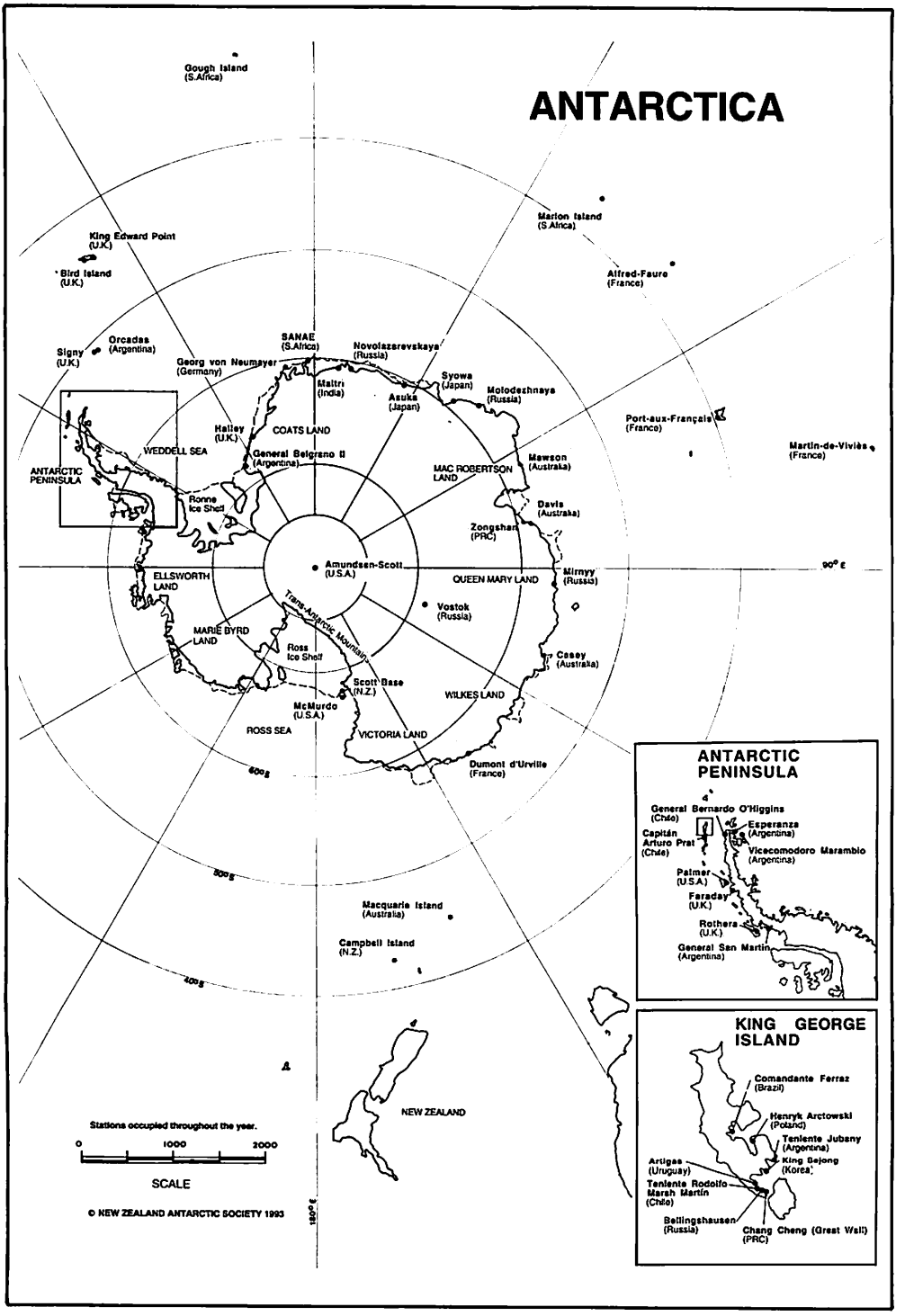
ANTARCTICA
Gough Island (S.Africa)
Marion Island (S.Africa)
King Edward Point (U.K.)
Bird Island (U.K.)
Alfred-Faure (France)
Orcadas (Argentina)
Signy (U.K.)
SANAE (S.Africa)
Novolazarevskaya (Russia)
Georg von Neumayer (Germany)
Maitri (India)
Syowa (Japan)
Asuka (Japan)
Molodezhnaya (Russia)
Port-aux-Français (France)
Martin-de-Viviès (France)
Halley (U.K.)
COATS LAND
WEDDELL SEA
General Belgrano II (Argentina)
Mawson (Australia)
MAC ROBERTSON LAND
ANTARCTIC PENINSULA
Ronne Ice Shelf
Davis (Australia)
Zongshan (PRC)
Amundsen-Scott (U.S.A.)
ELLSWORTH LAND
QUEEN MARY LAND
Mirnyy (Russia)
90° E
Vostok (Russia)
Trans-Antarctic Mountains
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
30° S
Macquarie Island (Australia)
Campbell Island (N.Z.)
40° S
NEW ZEALAND
180° E
Stations occupied throughout the year.
0 1000 2000
SCALE
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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
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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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Wordie House from the West with the British Crown land sign and the flagpole. Photo Chris Cochran
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International

Further rounds of planning and preparation for the Cape Roberts project

Further preliminary work for the Cape Roberts Project will be undertaken this season. This is a co-operative drilling venture between scientists, administrators and Antarctic support personnel from Britain, Germany, Italy, New Zealand and the United States of America. According to the July issue of *Cape Roberts News* the project is designed to obtain cores that record Antarctic tectonic and climatic history from around 30 to a 100 million or more years ago by coring 1500 metres of strata lying close to the sea floor off the Victoria Land Coast at Cape Roberts where they have been titled up by the rising Transantarctic Mountains and exposed by erosion. Because of time constraints and the nature of the drilling system the strata will be drilled in three to four overlapping holes some 500 metres deep during October and November of 1996 and 1997. The logistics costs of the project were originally estimated at approximately four million US dollars) but have now risen a further ten percent. Agreement to provide the additional funding was reached at meetings of the projects, operations and logistics management groups held in Rome in August and September this year.

Studies of the cores will allow the scientists to establish the climate and vegetation in a high latitude continental setting during the period before Cenozoic Antarctic glaciation was established around 36 million years ago. Drilling will also sample the oldest sequence in the western part of the West Antarctic Rift System and allow dating of its early history. The data will help test models of global climate and sea level change and also of the interaction between mountain-building and glaciation.

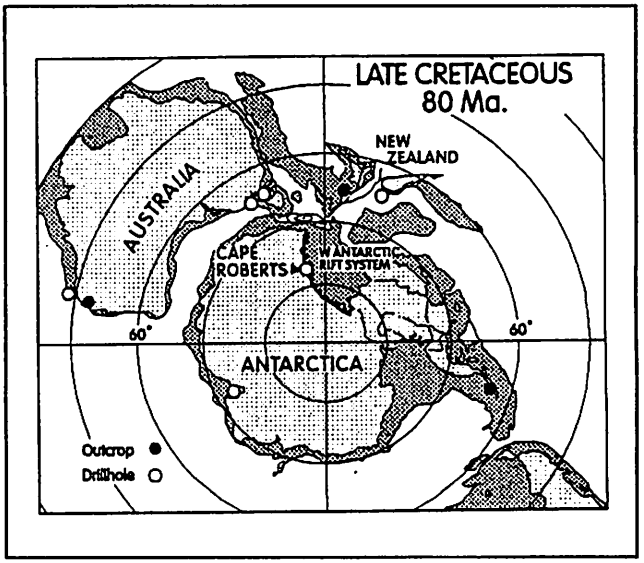
Seismic surveys indicate that the strata comprise three major sequences which scientists expect to be early rift terrestrial sediments from the late Cretaceous age, marine early Cenozoic strata and shallow marine glacial strata left during the late Oligocene or early Miocene age.

Only the lower part of the late Oligocene and the upper part of the Early Cenozoic strata have so far been drilled and this was by CIROS 1 in 1986 as part of the then New Zealand Antarctic Research programme. when a depth of 702 m below the sea floor was reached with a 98 percent core recovery. This was an extension of the series of drill holes drilled in Western McMurdo Sound which began with the Dry Valley Drilling Project, a co-operative venture of the United States, New Zealand and Japan between which operated between 1970 and 1974.

The Cape Roberts project, which further extends the series of drill holes, has had a lengthy gestation period beginning with a workshop in Wellington in May 1992 which resulted in a report providing scientific justification and an outline of the way in which the project could be carried out.

In September 1993 programme managers and scientists from the five participating countries, met in Washington and agreed to proceed. Britain was to provide between five and ten percent of the resources for the project, Germany about ten percent and Italy, New Zealand and the USA would provide between 30 and 30 percent each. The scientific participation from each country was to be roughly in proportion to the resources supplied; the New Zealand Antarctic Programme would be the operators and managers of the project but an international Operations/Logistics Management Group, convened by New Zealand would oversee the full operation. There was to be an International Steering Committee responsible for oversight of the project and facilitation of its scientific programme. This Committee comprises Dr Fred Davey from the Institute of Geological & Nuclear Sciences Ltd in Lower Hutt, New Zealand who is convenor for 1993/94; Dr Maria Bianca Cita from the Department of Earth Sciences at the University of Milan, Dr Franz Tessensohn from Bureau for Minerals and Mining in Hannover, Germany; Dr Mike Thomson from the British Antarctic Survey in Cambridge and Dr Peter Webb from the Department of Geological Sciences Ohio State University, Columbus Ohio who will chair the meetings sessions in 1995/96.

In January 1994 the project was outlined to the wider scientific community in the American Geophysical Union's EOS newspaper with an invitation to scientists to send in one page statements of interest. About 100 scientists responded and the results were collated to help further project planning. The



Map of Antarctica and surrounding continents 80 million years ago (from Lawyer, Gahagan and Coffin, AGU Antarctic Research Series, Vol 56, 1992) showing the high latitude of strata off Cape Roberts and their relation to other late Cretaceous strata.

national science coordinators in Italy, USA, New Zealand and Germany have subsequently convened workshops.

The overall science coordinator for Cape Roberts is Dr Peter Barrett whose role in the preparatory phase of the project has been to develop a science programme. Peter is the director of the Antarctic Research Centre at Victoria University in Wellington. He has a background in stratigraphy and sedimentology acquired in the 1960's and 1970's of the Beacon Supergroup strata of the Transantarctic Mountains. In 1972/73 he was involved in Leg 28 of the Sea Drilling Project in the South Indian Ocean and the Ross Sea, and since then in several drilling projects in the McMurdo Sound Region. Peter will be at Cape Roberts during the drilling phases of the project in 1996 and 1997 when he will be responsible to the International Steering committee to ensure that the project runs as planned.

The science operations manager is Alex Pyne who will be responsible for organising core processing equipment and personnel, safety and monitoring at the drill site - ice movement thickness and downhole gas and liaising with the drill team on the downhole logging. Alex has a degree in geology, experience as operations manager acquired through the Antarctic Research Centre and has worked on three previous drill holes in McMurdo Sound. He also designs specialist equipment for polar use.

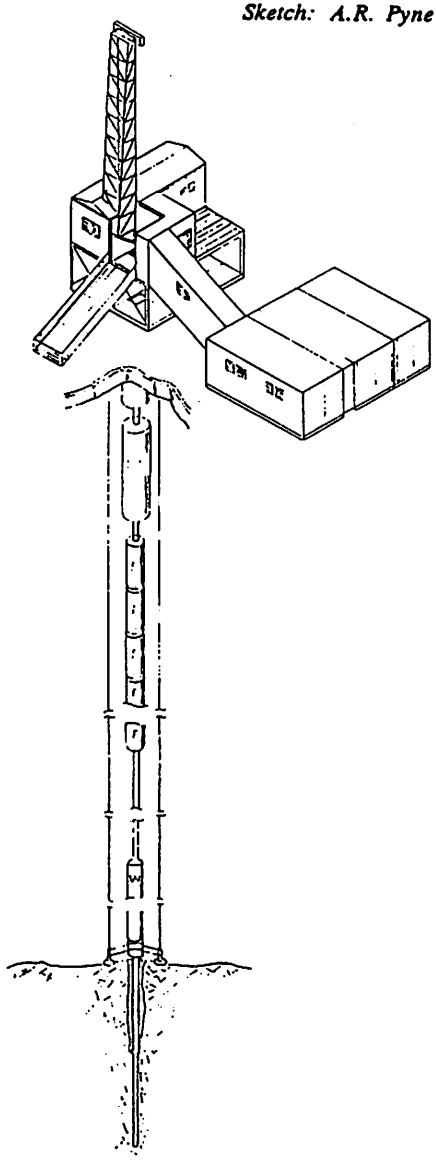
In February 1994 Jim Cowie was appointed project manager operating out of the New Zealand Antarctic Programme Headquarters in Christchurch. Jim has a degree in History and Geography and education and training experience acquired with the Royal New Zealand Airforce. He has spent three summers in Antarctica including one as Deputy Leader at Scott Base when he was responsible for ensuring logistic support for the drilling of CIROS -2 in 1984. He will be camp manager at Cape Roberts during the drilling phase of the project but in the meantime has been involved in reviewing the project budget, preparing briefs and is ordering equipment as well as developing a more detailed plan for the logistics during the life of the project 1994-1998. At present the team on the ice for each of the drilling seasons is likely to be about 36 with 12 based at Cape Roberts and 24 at McMurdo Station.

Scientists involved in the Cape Roberts programme and working on the ice during 1996 and 1997 will include sedimentologists, paleontologists covering at least five different groups of microfossils, geophysicists for downhole logging, core properties and magnetic stratigraphy and several other types of specialists.

In August this year and the project operations and logistics group and the international steering committee for the project met during SCAR XXIII to review plans for funding, logistics and science. The budget, initially estimated at US $4 million over the four year life of the project has risen by 10 percent but the parties agreed to guarantee resources for the project through its first year of drilling and to raise an addition sum of $US350.000 for the second season. The science team also agreed to complete core description and preliminary interpretation within three months of the completion of drilling.

Within the next two months camp buildings, prefabricated by Dawn Construction Limited in Christchurch, and some drilling equipment, including approximately 130 tons of mud and DRILL rod, are being assembled in Christchurch for transport to Cape Roberts on the Italian supply ship *MV*

Fast ice drilling system for Cape Roberts. – Sketch: A.R. Pyne



Italica where it will be offloaded and stored. In November Alex Pyne and Jim Cowie will spend three weeks in the Cape Roberts area surveying site conditions, servicing the tide gauge and monitoring ice movement. Further aeromagnetic and seismic surveys will also be undertaken to improve the data on the areas where the holes are to be drilled.

In September 1995 the ISC will meet in Sienna, Italy to review the science programme and personnel and in January 1966 final equipment will be shipped to Cape Roberts. Between August 25 and 30 1966 an advance party from the project will check the sea ice, travel to Cape Roberts, establish the camp and rig for drilling. Between October 5 and November 20 the first season of drilling will be undertaken. By February 1997 the initial report is expected to be ready for publication and in August a workshop will review the preliminary scientific results and prepare for the second season. Again an advance party will fly in to check the ice conditions, establish the camp and rig for drilling, programmed again for between October 5 and November 20.

In January 1998 the camp will be removed and the area reviewed for compliance with the Comprehensive Environmental Evaluation and in February a report is expected. In August 1998 a workshop will review the results from both seasons and finalise their publication.

Late release of Antarctic

The editor apologises to members and subscribers for the extremely late release of this issue of Antarctic. Changes to the deadlines and international reporting procedures, as required by the Antarctic Treaty, contributed to the very late arrival of programme information for this season. Our normal production schedule will resume with the December issue.

NZAP

Strong emphasis on global questions in New Zealand Programme

Twenty-six science projects are planned by the New Zealand Antarctic Programme for the summer of 1994/95. Several continue to focus on global questions such as aspects of ozone depletion, atmospheric pollution and climate change. Botanists will look at the ability of Antarctic mosses and lichens to cope with increased temperature and UV light. Zoologists will monitor changes in Adelie penguins in their quest for clues about the health of the Southern Oceans. Adaptations of Antarctic fish and bacteria, the ecology of lakes and streams in the Dry Valleys, geology, glaciology, sea ice and its effect on climate and the physical nature of the upper atmosphere will also be studied.

A training programme for southbound personnel was again held at Tekapo. The course, which began on August 5 was attended by 170 of the scientists, students, defence personnel and support staff from the New Zealand Antarctic Programme. It comprised exercises in ice travel, camping, survival, first aid and communications, and included lectures on waste management.

Twelve support staff and scientists flew south at WINFLY, a series of flights organised in late August. Some 6,000 lbs of "freshies" and general resupply made up the bulk of the cargo. The first five of the main body flights were made during the week beginning on October 4. A further three flights are planned each week until the season ends in February. US, Italian and New Zealand Hercules-C130 aircraft will make up the bulk of the flights with US Starlifters supporting the operation.

Among the first scientists south were Sylvia Nichol and Karin Kreher from NIWA, the National Institute of Water and Atmosphere in Wellington and Alan Thomas from NIWA in Lauder all of whom were involved in aspects of ozone studies.

Stephen Wood from NIWA at Lauder had spent the winter at Scott Base studying aspects of the ozone problem. He reports that "the programme of winter balloon flights to make various measurements in the stratosphere, suffered a setback when supplies of liquid helium ran out at the end of May. This meant that the largest balloons of 160 000 cubic feet intended to carry spectrometers cooled by the helium to measure nitric acid couldn't be flown until fresh supplies could be obtained at WINFLY in August. In the meantime a programme of smaller 19,000, 54,000 and 140,000 cubic foot balloons with instruments to monitor temperature, ozone, water vapour and various kinds of particle concentrations was very successful, obtaining the particle size distribution measurement of the early polar stratospheric clouds that form in the cold polar stratosphere over winter.

WINFLY brought fresh liquid helium and the flights of the large balloons could be resumed. A total of five flights were then completed before the end of September.

At the same time the ground based measurements of trace gases from Arrival Heights could resume as the sun came up. Other atmospheric scientists arrived for similar work, including Karin Kreher and Sylvia Nichol who were to work on additional ground based trace gas measurements and a team from the Univeristy of Wyoming to expand the programme of ozone and particle counter balloon flights

When the main body flights in early October brought the new season's staff in and most winter over were counting the days before heading home, an important phase of the balloon programme was just about to begin. This was the recovery of as many of the balloon instruments as possible with helicopters. Many hours of searching, aided by the recorded location for some packages and locater beacons for others, resulted a large proportion of the packages being recovered, including one from 7500 feet up on the slopes of Mt Terror that was retrieved as an exercise by the summer search and rescue team.

Stephen Wood will soon be travelling to the US to continue collaborative work on analysing the data from the largest balloon flights. Results from the simpler instruments will be presented at a conference in San Francisco in December.

Sylvia Nichol reports that the "1994 Ozone hole began to form in August, and by the end of the month ozone values over the Antarctic were about 20 percent lower than the "pre-ozone hole" values. The ozone depletion continued rapidly through September, so that by the last week of September the ozone hole had reached its maximum extent, covering an area of 23 million square kilometres. At this stage there was a relatively large a area with ozone values less than 100 Dobson Units, which represents a loss of about two-thirds of the ozone. There were indications that the 1994 Ozone hole could be deeper than ever before.

The extremely low ozone values persisted through the first week of October and then the ozone hole began to decrease in size very slowly. At the end of October it covered an area of 19 million square kilometres, which is about ten percent smaller than last year's record ozone hole was at that time. During the last few weeks of October the ozone hole was elliptical, and, at times passed over the southern region of South America.

Mid-way through November the ozone hole is still in existence. The lowest ozone values are now around 180 Dobson Units. The ozone hole should break-up towards the end of November, or in early December, when ozone values will return to normal values. Severe ozone holes, with at least half of the ozone over the Antarctic being depleted during the springtime, have now occurred in each of the last six years.

Geology

The Transantarctic Mountains are both extensive and high. They are a dominant feature of Antarctica. Comparable mountain ranges such as the Himalayas are generally associated with the collision and crumpling of the earth's tectonic plates but the Transantarctic Mountains have formed adjacent to where these plates are pulling apart to form the West Antarctic Rift system and the mechanisms involved in the forma-

tion of such mountains are poorly understood.

During the 1990-91 season the SERIS (Seismic Experiment on the Ross Ice Shelf) Expedition collected seismic reflection and refraction data as well as gravity data during a traverse that began in the Transantarctic Mountains and continued down the Lowery and Robb Glaciers onto the Ross Ice Shelf. Processing of the data has yielded new and interesting results that significantly contribute to the scientific understanding of the mountain front but has highlighted the need to obtain more data from the region. This season the 1994 SERIS-A project will be extended a further 100 km east to search for further deformation in the sediments that infill the West Antarctic Rift.

The party comprising Ron Hackney and Julie Quinn both students at Victoria University will be joined by Tony Haver, a technician also from the University, and Bill Atkinson, a field assistant from the New Zealand Antarctic Programme. They will be flown into the field in late November by LC-130 and use three skidoos to tow their science and camp equipment.

High resolution seismic, radio echo sounding and gravity measurements will be made along the line. The data will be used to gain ice thickness measurements along the portion of the SERIS line where strong seismic reflections from the base of the crust were recorded. The subsequent determinations will be used as static corrections for re-processing and enhancing the reflection events recorded in 1990-91 and will provide a clearer image and understanding of the mountain front. The measurement sights and traverse directions will be determined using GPS navigation.

Working and on the Mawson and Campbell Glaciers in the Royal Society Range during November and December this season are Yvonne Cook, Danny Higgins and Sean Waters from the Geology Department of the University of Otago, who will be joined in the field by Tarn Pilkington, an NZAP field assistant. They will be examining in detail the relationships between faults, granite and fluids in the evolution of the middle crust at about 15 km depth for comparison to active collisional mountain belts around the Pacific. The schists of the Terrane were originally deposited as tectonic sediments and lava flows on the margin of a continental rift which may have separated East Antarctica from North America about 500 million years ago. These deposits are particularly important because they record the first opening of the Pacific Ocean. From their investigation of the middle crustal processes, which have governed the plutono-metamorphic architecture of the terrane, it will be possible to determine the original nature and tectonic setting of the protoliths and correlate these with others elsewhere in the Pacific.

Dr David Christoffel and two students, Adam Wooler and Nerida Bleakley from the Research School of Earth Sciences at Victoria University, will be spending a month in the Table Mountain, Mt Crean, Mt Feather and Mt Kempe region from mid November. Their objective is to measure the paleomagnetic directions of the earth's magnetic field in small rock samples collected from the Beacon mudstones spanning the Devonian-Triassic periods of 400-200 million years ago in order to determine the movement of Gondwanaland in respect to the magnetic pole and latitude. As part of the overall programme similar determinations have been made for Australia and are being made for New

Zealand. They are also seeking to understand the mechanisms of thermal alteration of the Beacon sediments caused by the Jurassic dolerite intrusions. One significant result of their work will be the comparison of climate changes with latitude for different geological times. Such data are useful for better understanding of current climate changes.

The origin and preservation of glaciotectonic and sedimentary structures in high latitude ice marginal deposits is poorly understand. Interpretation of the origins and significance of such structures has caused controversy in the scientific literature and is an impediment to the interpretation of the Pleistocene glacial deposits which are important because they form the basis of our understanding of glacier responses to climate change.

Dr Sean Fitzsimons and Marcus Vandergoes from the Department of Geography at the University of Otago will examine the links between the glaciological processes and sedimentary products to establish field criteria for the recognition of different types of deposits at the margins of alpine glaciers in the Taylor, Wright and Victoria Valleys of Southern Victoria Land.

Working specifically on the Suess, Taylor and Meserve Glaciers they will use a combination of structural sedimentological and geomorphological analyses of deposits in the field and laboratory as part of their investigation into the origin and preservation of glaciotectonic and sedimentary structures in deposits that form at the margins of their cold-based glaciers in order to establish field criteria that can be used for the interpretation of Pleistocene glacial deposits and help clarify the controversy.

Scientists from New Zealand and the USA will begin the first phase of a six year multiscale, multiprocess study of the sea ice, its breakup and its effect on the climate of the Southern Ocean. The team led by Dr Tim Haskell from Industrial Research Limited in Lower Hutt and comprising Simon Gibson, Chris Gannon and Matthew Jury also from IRL will be joined by Dr's Pat Langhorne and Vernon Squire from the University of Otago, Paul Callaghan and Craig Eccles from Massey University and Colin Fox from the University of Auckland. Haley Shen from Clarkson University in New York State and Susan Frankenstein from the Cold Regions Laboratory in the USA will also be in the team.

Working in the Tent Island area during October and November the team proposes to complete the work done on fatigue in sea ice in October 1992. Further work will be done near the ice edge and later in the marginal ice zone to determine the mechanisms by which sea ice breaks up. The programme is expanded now to cover the sea, sea ice atmosphere interactions with a view to understanding the influence sea-ice has on the climate in the southern latitudes. This ground truth information will be integrated with available satellite imagery to allow climate related issues to be addressed on a global scale.

Fish studies

The field work for a three year investigation into the ecological physiology of Antarctic fishes will be completed this year. Dr John Macdonald, Clive Evans, Victor Cauty, Robyn Holland from the Department of Experimental Biology of the School of Biological Sciences at the University of Auckland will be joined in the field by Nick Ling from the University of Waikato,

Bruce Anderson from Victoria University in Wellington and Craig Thorburn from Kelly Tarlton's Underwater World in Auckland.

The team have been comparing different Antarctic fish species as part of their investigation into the consequences of niche specialisation in closely related but ecologically diverse species. The focus of their work has been the mechanisms which control oxygen delivery, including heart rate, blood cell numbers, and modulation of haemoglobin binding. The contraction rates of single muscle fibres will be measured and a survey made of ectoparasitic crustaceans and infestation of different fish species. Incubation and sampling involved in the programme will be undertaken in the fish hut and laboratory wannigans to be sited near Cape Armitage, two kilometres from Scott Base.

Aspects of the circulatory physiology of Antarctic fish will be studied by a team from the Department of Zoology at the University of Canterbury. It will be led by Dr Bill Davison and comprises Malcolm Forster, and two Swedish scientists Michael Axellson and Stefan Nillson all of whom will be in Antarctica for three weeks during November.

Working in the McMurdo Sound area they will investigate control of oxygen uptake by the blood of Antarctic fish by examining blood flow through the gills and red cell storage and its release by the spleen. They will also look at the heart rate of free-living fish and measure oxygen consumption related to substrate use by isolated muscle mitochondria.

The project is important because oxygen is required by the cells of Antarctic fish to allow aerobic respiration and control of oxygen uptake is poorly understood in these fish at very low temperatures. The team intends to develop an extracorporeal loop across the gills which will allow repeated sampling and measurement of oxygen tension and content from both sides of the gill without blood loss. The spleen acts to control numbers of circulating red cells which determines how much oxygen can be carried by the blood and of course how much can be picked up at the gills.

Penguins

This season a team of scientists from Landcare Research in Nelson will investigate the factors regulating population size and colony distribution of Adelie penguins *(Pygoscelis adeliae)* through studying the importance of key resources (nesting space, food) and the way they are allocated by behavioural traits (philopatry, immigration, emigration).

An ongoing programme to collect baseline data on Adelie penguin population trends will continue. Using aerial photography, the number of breeding pairs of Adelies at the three colonies on Ross Island, will be censused.

Foraging effort (feeding trip duration and food load size) of Adelies with chicks will be measured at Cape Bird using an automated weighbridge and data-logger currently being developed by AVID electronics in the USA. Prey species of Adelie penguins will be identified from stomach samples.

Chick counts at the end of the breeding season, just before the chicks fledge, will be carried out to measure breeding success. A sample of chicks at each colony will be weighed and measured to index chick growth rates.

The role of natal philopatry in the structure of colony formation will be assessed by measuring genetic homogeneity among and within the colonies

on Ross Island using mitochondrial DNA analysis of chick tissue. Chicks will be banded at the colonies on Ross Island, to assess the relative direction of emigration.

Satellite imagery will be used to quantify the various sea-ice conditions and the amount of suitable breeding habitat available.

The team comprises, Kerry Barton and Bruce Thomas who will be on the ice in December and Peter Wilson and Brian Karl in January. Mike Biegel, an engineer from AVID, will assist in setting up the automated weigh bridge system in December.

Further work will be undertaken this season on sperm competition among Adelie penguins. Sexual selection theory suggests that males should compete for females and that females should chose males. One factor governing this behaviour is sperm competition. Fiona Hunter from the University of Cambridge in the United Kingdom will be joined by Rob Harcourt and Marj Wright from the Department of Zoology at the University of Otago in investigating sperm competition in the Adelie penguin with a combination of behavioural observations and paternity analyses. The study is of particular interest because it may pay a female to copulate with a high quality male prior to repairing with her mate of the previous season, while maintaining her partner's help in raising her offspring and males may benefit from having other males raise their offspring. The party will be working at Cape Bird variously between mid October and early January.

Mosses

Mosses are the predominant form of terrestrial vegetation in Antarctica. Biodiversity of the mosses of greater Antarctica at the species level is low; for example, only eight are known from the McMurdo Sound region. Genetic variability, a primary indicator of within-species biodiversity has so far been poorly studied in Antarctic mosses. Apart from biodiversity, studies of the (micro) geographic distribution of genetic variation at isozyme and DNA marker loci also allow inferences about past and present colonisation processes of mosses in Antarctica.

This season, a team from the Antarctic Research Unit at the Department of Biological Sciences of the University of Waikato in Hamilton will study isozyme and DNA level genetic variation in selected moss species sampled from the McMurdo Sound region and North Victoria Land. Based on the results of a previous expedition in 1992/93 a minimum-impact sampling strategy has been devised that will allow the studying of genetic variability on a geographic and microgeographic scale. The field team comprises Dr Dieter Adam formerly from the University of Waikato but now with Rayonier New Zealand Ltd., Tracey Dale from the University and Dr Patricia Selkirk from Macquarie University. They will be in Antarctica for three weeks from the end of December 1994.

Samples of selected species will be collected from Ross Island (Capes Crozier, Evans and Royds) and Bratina Island and Mt. Melbourne, Terra Nova Bay and Edmonson Point, North Victoria Land coast and Miers and Garwood Valleys in South Victoria Land. Samples will be analysed for isozyme and DNA level variability and the data collected will be combined with results from a previous project and used to draw a detailed picture of the geographic distribution of genetic variation in selected mosses area, to assist the taxonomic

study and model colonisation processes in Antarctic mosses.

Atmospheric changes have the potential to strongly affect the photosynthetic production of Antarctic terrestrial plants. Elevated UV-B radiation, from the thinning of the ozone layer, is deleterious to photosynthesis because it damages the photosystems in light-harvesting centres. Increased carbon dioxide (C02), in contrast could increase production since the photosynthetic rate of mosses and lichens are CO2 limited at normal ambient CO2 levels.

The photosynthetic rates of selected, common mosses and lichens will be measured in the field during November and early December by Dr Allan Green and Kadmiel Maseyk from the University of Waikato who will be joined by Ludger Kappen from Kiel University and Bukhard Schroeter from the Polar Institute in Kiel, Germany, and Dr Rod Seppelt from ANARE. They will be using advanced, Antarctic proven equipment with the capacity to control temperature, light and carbon dioxide (CO2). The photosynthetic patterns will be followed over several days as a baseline study. Photosynthesis will be investigated at sub-zero temperatures to set optima and minima. The effects on photosynthesis of UV-B and CO2 will be investigated by varying the levels of both factors. The study will be at Discovery Bluff, Granite Harbour, North Victoria Land and a concurrent listing of plant species and brief ecological description will be made.

Thermophilic bacteria are generally considered to have growth optima of 65deg C or above. Natural habitats for such organisms (hot springs) are not uncommon, but occur in discrete regions of the earths surface and often display physical and chemical attributes restricted to that region. Several attempts have been made to correlate the distribution of thermophilic bacteria to the geographic origin of the spring. The thermal areas of Antarctica are possibly the most isolated of any on earth, have been less affected by human contact than any other and due to their elevation may provide unique ecosystems to harbour novel organisms. Because of the cold there is a continual reflux of steam, up from the vents which freeze as ice and may re-thaw and drip back down over the algal mats which colonise the surface layer and possibly carry more nutrients from the algae back down into the vent. This contrasts with a temperature spring where hot water continuously runs away. Dr Hugh Morgan, Karl Steffer and Juergen Wiegel from the University of Waikato will spend nearly three weeks from early January working at Mt's Melbourne and Erebus where they will describe the microbial flora of the two thermal regions. Field assistance will be provided by Rachel Brown from the New Zealand Antarctic Programme.

Knowledge of anaerobic processes and bacteria in low temperature environments is very limited. Stimulated by the need for information on anaerobic degradation and nutrient cycling in sediments underneath cyanobacterial mats, Dr's Henry Kasper and Taka Nakamaru from the Cawthron Institute in Nelson have devised a study which will enhance the understanding of Antarctic environments and provide new material for biotechnologically oriented studies of organisms from extreme environments. New bioactive compounds and enzymes which function optimally at low temperatures are of particular interest to the food, chemical and pharmaceutical industries.

For nearly three weeks in January they will be at Bratina Island studying

they will be at Bratina Island studying the anaerobic components of Antarctic environments in order to contribute to sound environmental policies. They will identify the special features of organisms living in these environments which can be exploited for a variety of human endeavours such as waste treatment in cold climates, and new medicines. Research on pond sediments on the McMurdo Ice Shelf includes a study of the effect of osmotic pressure change on overall biomass degradation and on the physiology of heterotrophic anaerobes from these sediments. The isolated bacteria will be screened for the production of antibiotic, antitumor and vasodilating substances. By studying anaerobic bacteria and processes in environments unique to Antarctica they will enhance the understanding of ecological process fundamental to global element cycling.

Aquatic system

Another study being undertaken this season aims to provide fundamental information on the biology of Antarctica's inland aquatic system. The project leader is Dr Clive Howard-Williams and his team comprises Dr Ian Hawes, Mark James, and Peter Mason all of NIWA in Christchurch who are to be joined on the ice by Kevin Purdy from the University of Essex in the UK. They are focusing on the links between the dry valley lakes and their catchments in order to obtain information on how the link may be affected by human activities and/or localised climatic change. The key processes which determine how community composition, trophic structure and function are maintained are being examined by the team who are also investigating how aquatic organisms and communities respond to changes in their environment over diel, seasonal and longer time scales. The links between spatially separated communities and processes are being quantified in the study which includes analysis of e nutrient processing in lakes and streams, suspended sediment transport and its effects on aquatic communities, trophic structures and physiological and phylogenetic adaptations to Dry Valley environments. The team will be in Antarctica variously from mid November to mid January and will work on the Onyx River and at Lake Vanda.

This season Drs Iain Campbell and Graeme Claridge from Land & Soil Consultancy in Nelson and Wellington will be joined by Roger MacCulloch and Dave Campbell from the University of Waikato in their continuing study of the properties of permafrost. Their progrmme aims to determine the impact of human activity on Antarctic soil systems by measuring properties of permafrost and by assessing the visual disturbance from field activities. Their objectives will achieved by making for further measurements of the properties of permafrost at two locations of contrasting climate, and by assessing human impacts from past field operations.

At Scott Base, neutron probe measurements of changes in the water content in the permafrost following simulated landscape disturbance will be continued. Field properties of permafrost in the Convoy Range, an intermediate environment between that of Marble Point and the Arena Valley, where previous field observations have been made, will be measured. Environmental impacts from field activities carried out at various sites over a 30 year period will also be assessed using establish impact assessment criteria. The party will be in Antarctica from the end of December to the end of January and will be working

at Scott Base, Marble Point, the Convoy Range, Asgard Range and in the Barwick Valley.

In 1992/93 scientists from NIWA (the National Institute of Water and Atmospheric) continued an investigation of air-snow interactions and examinations of the usefulness of snow core data in determining the nature of the atmosphere back through several decades. Samples were collected in 1990/91 from the snow formed in the clean atmosphere of the East Antarctic Plateau and models of source-receptor relationships for ionic contaminants are now being derived. A new approach begins in 1993/94 using simple models to identify the effects of an inhabited base on snow downwind. This season scientists Dr Tom Clarkson and Tom Kerr will be in Antarctica for two and three weeks respectively to begin a practical assessment of the wind trajectories close to Scott Base as a first stage in deriving source-receptor relationships for aerosols and trace chemicals over ranges of a few kilometres. The pair will be tracking tetroons, tetrahedral helium balloons designed to fly at a set constant level, such as 100 metres above sea level. The tetroons, to be used in light winds only, will trace the airflows over the Scott Base area. In a later stage of the project new snow cores will be taken from long-lived snow down-wind of the Base, which will be combined with the history of emissions from the base in order to identify an emissions "fingerprint" for the Base.

Regular programmes

Climatic observations continue to be made daily at Scott Base. Recordings of wind, temperature, pressure and direct, diffuse and global radiation are also made. The climate record began in 1957 and is one of the longest continuous records in Antarctica. In addition clean air samples are taken every two weeks throughout the year near Scott Base for further analysis in New Zealand. Trace gases for which there are now several years of record include carbon monoxide, methane and other light hydrocarbons. In 1988 the programme of comparative research on atmospheric trace gases being collected by the New Zealand Meteorological Service (NZMS) and Forschunsanlage Julich of Germany was begun and this will continue.

The measurement of selected trace gases will continue at Scott Base where the technician collects samples for analysis in New Zealand. The project is designed to improve predictions of change in aspects of atmospheric chemistry related to climate and therefore provide input into climate prediction models. It is the fifth year of measurements of 14c and stable isotopes of carbon monoxide to validate global scale models of atmospheric chemistry and is a collaborative project between NIWA Tropac and the Lawrence Livermore National Laboratory and Harvard University in the USA. Further measurements of latitudinal profile in non-methane hydrocarbons between 40deg and 70deg S relate New Zealand Measurements at Baring Head, near Wellington with German measurements in Antarctica and measurements of 14c in CH4 extend global data used for CH4 budget estimates.

Ionisation mechanisms, scattering characteristics and the dynamics of waves and tides observed in the wind patterns of the mesosphere continue to be studied by a team from the Department of Physics and Astronomy at the University of Canterbury. The programme involves the operation and maintenance of a 2.9 Mhz backscatter

radar, and the acquisition, analysis, and interpretation of experimental data which are collected on a synoptic bases for at least one solar cycle. It is a continuation of an existing programme which has been yielding reliable data since 1984. This season Dr Andre von Biel, Graham Fraser, Roger Govind and Lijia Ma all from the University of Canterbury will be visiting Antarctica in connection with the programme.

A long term project to determine the corrosion resistance of an architectural aluminium alloy in the atmosphere is being continued at Scott Base and Arrival Heights. Different thicknesses of anodic film to resist corrosion are being evaluated by exposure to a range of atmospheres in a number of countries. The project is the preserve of the Department of Mechanical Engineering at the University of Canterbury.

Scott Base has one of the few seismographs in Antarctica, and the data collection makes a significant contribution to global earthquake studies. The observatory has been in continuous operation since the International Geophysical Year in 1957. In 1963 it became part of the Worldwide Standardised Seismograph Network, and in 1993 it was upgraded to digital recording as part of the IRIS network. The current instrument is an alternate to the one at Vanda, which was installed at the same time and is telemetered via Scott Base to the U.S. Geological Survey in Albuquerque, New Mexico.

The technician at Scott Base maintains the seismograph, performing a daily record change, initial analysis of the records and transmission of these parameters to the National Earthquake Information Centre. The final analysis of records in Wellington and transmission of results to the International Seismological Centre for inclusion in their bulletins is undertaken at the Seismological Observatory in Wellington, part of the Institute of Geological and Nuclear Sciences.

Other programmes

Perry Gilbert from DOSLI in Blenheim will be providing survey assistance for New Zealand Antarctic Programme and support if required for the United State Antarctic Programme. Among his principal tasks this season will be monitoring around the historic huts, lake levelling, a topographic survey at Vanda and photocontrol work at Linneaus Terrace in the Asgaard Range as well as routine work around Scott Base.

Personnel from Telecom Limited in Christchurch will undertake annual maintenance and installation around Scott Base. Team members this year are Dean Flintoff, Chris Robertson, Jim McGregor and Bryce Kerr. Supplementary communications installation and upgrading will be done by Paul Purves, also from Telecom.

A team from Television New Zealand will be south for a week in early November filming a series of Antarctic stories for broadcast on New Zealand's *Son of a Gunn show* and *What New in New Zealand*. Aaron Devitt, Alan Henderson, Paul Skelton and Mike Rehu make up the party. They will visit Scott Base and Vanda.

Jo Andrews and Peter Wilkson from Independent Television News in Wellington will film a range of New Zealand science activities for broadcast on ITN, the World News and CNN. They will visit Lake Vanda and Cape Royds during their two weeks in Antarctica from mid November. Other media coverage will be provided by Tim Higham from the New Zealand Antarctic Programme

and Keith Lyons who will be at Scott Base for most of January.

Defence personnel

The New Zealand Army are again providing assistance to the New Zealand Antarctic Programme for maintenance and environmental tasks. Richard Tawhiri, Coolene Rura, Maree Henderson and Ruben Merrett from Wigram, near Christchurch will be in Antarctica from early November for nearly four weeks. They will be working at Lake Fryxell and Lake Vanda. Further hut and environmental maintenance will be provided by a team from the Royal New Zealand Navy comprising John Crighton, Graeme Hearn, Brent Snopovs, and Lisa Glennie who will be in Antarctica and mainly at Lake Vanda from late December to mid-January.

Aircrew from the Royal New Zealand Airforce will be involved in field training for RNZAF-C-130 crews in Antarctica from late October. This year the team comprises Sergeants L. Homburg, S. McKenzie and R. Norton and Flying Officers D. Webb, M. Starkey, M. Hill, S. Goffin and B Oliver-Kerby.

Logistic support will again be provided by a helicopter from RNZAF 3 Squadron. The field team this year comprises Sqn Ldr Russell Pirihi, Fg Off Keith Buckley and Sgt Darran Goodwin, Flt Lt Tim Donaldson, Fg Off Stu Blair and Sgt Whatarangi Heke; Flt Lt Paul Stockley, Fg Off Stu Brownlie and Sg Ty Cochran; Sqn Ldr Richard Stent, Sgt Alan Atchison, Sgt Peter Wilson, Cpl Grant Plested and LAC Zak Edmonds; Flt Sgt John Bartlett, Sgt Grant Bennie, Sgt Rex McCowatt, Cpl Jack Jackson and LAC Mel McGrath. They will variously be in Antarctica from early November to late January.

Lt Cdr Clive Holmes from the Royal New Zealand Navy will be one of two officers to have experience of USCG Icebreaker operations in the Antarctica this season.

WCDR Ian Gore from the RNZAF, Ian Brown from the Army, Derek Larsen from the New Zealand Defence Force and Cdr Peter Usher from the RNZN will visit to Antarctica as part of an exercise to familiarise New Zealand Defence Force staff with Antarctic operations.

David Foote, a medic from the New Zealand Defence Force will also spend some time south familiarising himself with Scott Base and Antarctic operations.

Two representatives from Youth Groups will travel south to experience life and work in Antarctica. They are Colin Robck, aged 18 from the Boys' Brigade in Auckland and Glenda Walker aged 19 from the Girls' Brigade in Timaru..

A number of men and women from difference different organisations will travel south to oversee various projects being carried out at Scott Base.

Della Marriat from the International Antarctic Visitors Centre in Christchurch will visit Scott Base and other New Zealand facilities. Dean Ashby and Dawn-Lee Hartley from ICAIR will spend two weeks at Scott Base and McMurdo from mid December.

The names of distinguished visitors travelling to Antarctica with the New Zealand Antarctic Programme this season had not been confirmed at publication time.

Antarctic Heritage Trust

A team of four will be continuing the work of the Antarctic Heritage Trust this season with further conservation and restoration of the Historic Sites on

Ross Island. They are John Charles from, Roger Fyfe, Neville Ritchie and Lawrence Smith and they will spend six weeks at Capes Royds and Evans, Hut Point, Scott Base and at Terra Nova Bay. Their objectives for the season are to undertake the annual preventative maintenance and housekeeping programme and required repair work; to survey and record details of the precincts of Cape Royds and Evans and make recommendations for site restoration, to undertaken routine environmental and conservation monitoring and to complete an inventory of the artefacts held in the reserve collection at Scott Base. They will also survey, record and recover the items in an historic depot at Hell's Gate Moraine.

ANARE

Two Sikorsky S76 long range helicopters will boost the Australian Antarctic programme this summer

For the first time helicopters will be used by the Australians in Antarctica this summer. They will significantly increase the ability to move staff and equipment between stations and field camps, such as the Prince Charles Mountains, 550km south of Mawson. Each of the twin-engined helicopters can carry up to 12 people plus equipment or 2000 kg of cargo. Their long range will boost current research by allowing flights to be made further from the coast to survey sea ice and seal populations.

The aircraft will be based at Davis, but new helicopter pads will be built at all stations. A main feature of their work will be the first planned air link between Australia's Antarctic stations, connecting ship visits to Davis with research programmes at Casey and Mawson and field programmes in the northern Prince Charles Mountains.

The two helicopters went south on the Australian Antarctic research vessel *Aurora Australis* which left Hobart at the end of August. The vessel will carry some 360 expeditioners to the continent, Macquarie Island and on marine science voyages in the Southern Ocean between now and May next year.

The 1994/1995 season is Australia's longest summer programme, and the ship will make six scheduled voyages in that time. Assistance will come from the French vessel *l'Astrolabe* to transport ANARE staff and their gear to and from Macquarie Island via Dumont d'Urville.

Seventy days of marine science research aboard *Aurora Australis*, are scheduled, up from 51 days last summer. Most of the voyages this season have a marine science component, emphasising the new flexibility of the ANARE voyage programme.

Staff numbers are down slightly this season from the 1993/94 record levels, but the same number of science projects are being undertaken. Of the 360 expeditioners who will travel south, 160 are science personnel involved in 130 science projects and 74 are winter

staff.

Highlights of the 1994/95 year

This summer's research has a focus on understanding climate change and protecting the environment.

Marine geoscientists on the *Aurora Australis* will collect sedimentary cores and seismic and near-bed current data from the Prydz Bay, MacRobertson Shelf and Kerguelen Plateau regions. The data will support paleoenvironmental studies of changes to the Antarctic ice sheet and Southern Ocean circulation during the past 5 million years. Complementary coring and seismic studies in the South Tasman Rise region will be undertaken from the AGSO vessel *Rig Seismic*. Scientists aboard the *Southern Surveyor* in sub-Antarctic waters and the US research ship *Nathaniel B Palmer* in the Ross Seas will measure dissolved trace metals (manganese and iron) for their biogeochemical cycling studies.

Six staff will undertake the return leg of last season's 100-day 2250 kilometre traverse of the Lambert Glacier, the world's largest glacier. They will measure ice movement stations again and provide data on ice sheet velocity to try to determine whether the ice sheet is growing or shrinking in the Antarctic's major drainage basin.

The fourth oceanographic transect between Tasmania and Antarctica will be completed to further analyse the properties of deep and intermediate water masses. This is part of an international study of world ocean currents.

Scientists aboard all the ANARE voyages will undertake extensive air and water sampling for the first time. This data will be used in a study of seasonal estimates of temperature and salinity in the upper ocean plus dimethyl sulphide and carbon flux in the Southern Ocean.

As part of the joint US-Australian research into the Antarctic Circumpolar current, a new array of current meter moorings will be put into place.

The *Aurora Australis* in Prydz Bay and the *Nathaniel B Palmer* in the East Weddell Sea and Bellingshausen Sea area will collect data on sea ice thickness and related parameters as part of the Anzflux experiment.

Upward-looking sonar buoys north of Casey will be recovered to obtain for the first time full seasonal sea ice thickness data.

Biologists based at Davis will investigate impacts of UV light and climate change, such as the microbial role in carbon cycling, and study sulphate-reducing bacteria and the impact of underwater light and UV-B on phytoplankton and bacteria in the inshore marine area.

The northern Prince Charles Mountains is the focus of tectonic, glacial and ice sheet studies aimed at understanding the structural evolution of the continent.

A tide gauge will be installed at Casey to complete the first phase of the East Antarctic tide gauge network.

On-station programmes will continue to study Adelie and Emperor penguins, fur and elephant seals.

A four-year international study of seals in the pack ice zone will begin. It will concentrate on crabeater seals and their relationship to the sea ice ecosystem.

A joint project with the Italians is planned to install a automatic penguin monitoring system near Terra Nova Bay. This is a continuation of the Mawson Adelie and Emperor penguin monitoring studies.

Macquarie Island will again host a major study on the apparent decline in

elephant seals and recovery of fur seals.

Support work

Rebuilding of Davis will be finished this season. The science building and fuel farm building and installation of the reverse osmosis water supply system and a 600,000 litre holding tank will complete the work. Site works will start at Davis for the installation of the LIDAR module which is planned for the 1995/96 season.

Mawson's rebuilding programme will be substantially complete after the living quarters are finished and the emergency power house and operations buildings modified. The second phase will begin with the plumbers workshop, general store and clothing/glaciology laboratory being demolished to make way for the new workshop, set to be built in 1995/96.

Helicopter pads will be built at all stations to accommodate the new long range Sikorsky helicopters.

Removal of the old Dovers field station will begin, in keeping with the Madrid Protocol.

Casey station will get a new wind turbine in line with a continuing programme of developing alternative energy sources.

The satellite linked computer network from all stations back to Antarctic Division in Australia will be completed after Mawson gets a fibre optic local area network installed this season.

Back-up work in Australia

Research programmes on the ice will be supported in Australia by a range of key initiatives.

Detailed analysis of the law Dome ice cores continues. Researchers are looking at past greenhouse gas composition, changes in atmospheric chemistry, and volcanic fallout.

Australia joins the British Antarctic Survey and the US Byrd Polar Research Centre in the First Regional Observing Study of the Troposphere (Frost) project. This will survey, over three special observation periods, the entire region south of 50 degree South to investigate current forecast models for the Antarctic and Southern Ocean region.

Work continues on the requirements from the Madrid Protocol, particularly on a programme of environmental audits, waste classification system and inventories of past waste sites.

A new National Antarctic Data Centre will be set up at the Antarctic Division. It will be responsible for the GIS programmes, coordinating Antarctic samples and mapping and survey activity.

Initial work will begin on the new Human Impacts Research Plan. A joint environmental monitoring study is to be set up in the Larsemann Hills area with the Russian and Chinese programmes.

The first international conference on biology and conservation of Albatrosses, is being planned for Hobart in August next year.

An observer will travel on the ship of Antarctic tourist operator Quark Expeditions to check up on the new Antarctic Treaty tourism guidelines.

Antarctic Division's photographic section is acquiring digitised technology. This means better reproduction, conservation and accessibility of current and historical material.

Work will continue on a framework to determine priority science projects for the future in keeping with the four key Government goals for the Antarctic programme. The first round of strategic science plans will be published, supported by detailed programme support plans.

In brief

Three ships to support varied Italian programme this season

Italian Antarctic operations this year will focus on Terra Nova Bay in the Ross Dependency, the Scotia Arc and Peninsula areas, and an area known as Triple Point Bouvet. They will be supported mainly by *MV Italica*, a cargo vessel which has recently been rebuilt to support research, a seismic vessel *OGS Explora*, and a Russian geophysical vessel, the *Akademik Strakhov*. The *Italica* will be utilised in two different scientific expeditions, the first from 2 November to 1994 to 2 January 1995 will study the Antarctic waters; the second starting on 5 January 1995 and terminating on 7 March 1995, will explore the climatic system and the sea ice-atmosphere relationships. About 200 research scientists and support staff will be engaged in the two oceanographic campaigns, 70 of whom will participate in the annual research programme in and around Terra Nova Bay. For 50 days from the beginning of March the Russian geophysical vessel, the *Akademik Strakhov* will be involved in research work.

Operations in TNB were scheduled to begin between 10-12 October. Approximately ten flights of a C130 Hercules of the Italian Air force was to transport scientific and logistic personnel, 115 in total, from Christchurch to TNB via McMurdo Sound between October 10 and November 30. Until November 30 Dr Mario Zuchelli will lead the expedition but from then onwards until March 7 Umberto Ponzo will be responsible.

Scientific activity this year will focus on:

- Structure and evolution of the lithosphere in the Ross Sea region
- Periantarctic basins and margins of the Antarctic plate
- Glaciology and paleoclimate
- Antarctic atmosphere
- The climatic system and the sea-ice-atmosphere relations
- Sun-earth relationships
- Astrophysical research
- Physiological, biochemical and molecular mechanisms of adaptation
- Ecophysiology and ecotoxicology
- Ecological and genetic aspects of differentiation processes in populations of Adelie penguins
- Ecology and biogeochemistry of the Southern Ocean
- Environmental contamination
- Human biology and medicine
- Geophysical observatories
- Telesurvey, GIS and database
- Robotics and telescience
- Sensors development
- Telemedicine.

Five worker visitors will be at Terra Nova Bay during the summer and a total of 25 Italian scientific and logistics personnel will work at foreign stations.

Two inland traverses, in collaboration with the French are planned for the transportation of materials and fuel to the new inland camp Concordia.

France

Airstrip abandoned

France has abandoned plans to repair their airstrip, near Dumont d'Urville part of which was washed into the sea during a storm in late January. According to reports in the *New Scientist* of 16 July 1994, and confirmed by French Antarctic authorities the government sent in a team of engineers and other experts to evaluate the damage. It also set up a committee to look at the impact of France's polar activities on the environment. *(See Antarctic Vol 13. No. 6)*

In June the committee recommended that the airstrip not be repaired and an official at the environmental ministry confirmed that plans to land large aircraft at Dumont d'Urville have been abandoned. The decision was apparently made party to avoid further disruption of the bird colonies and partly because of the cost. Three islands were flattened to build the runway cost at a cost of about 110 million francs. Replacing the material washed away would mean bringing further material from other islands or shipping in construction spoil at a possible cost of between 25 and 50 million francs and there was no guarantee that the runway would withstand the extreme weather. The services of smaller aircraft may however be considered.

Jamaica

Second Antarctic expedition

Jamaica will conduct its second Antarctic expedition this summer.

Jamaican physicist Mr Walton Reid of the University of the West Indies Electron Microscope Unit will work in Antarctica under the auspices of Dr John Macdonald of Auckland University in New Zealand and subsequently in Kingston

The programme will include field observations on the visual behaviour of Antarctic collembolans and preparation of material for electron microscopy. It builds on the previous Jamaican work on the Antarctic Peninsula conducted in conjunction with the Chilean Antarctic Institute. The objectives are to investigate how the eye structures in collembolans avoid being damaged or otherwise affected by the high prevalent summer UV radiation and to investigate the problem of "miniaturisation in photorecepters." This is important because there is a smallest limit for eye size, beyond which vision is physically almost impossible. Mr Reid has a background in physics and is an electron microscope engineer.

United Kingdom

Dr Drewry resigns from BAS

In August 1994 Dr David Drewry advised that he is leaving the British Antarctic Survey effective from the end of Sep[tember to take up a post of Director of Science and Technology at the Natural Envirnment Research Council. This is a new position created in NERC following the resrtrecuturing of the Research Councils. Dr Drewry will play a central role in the formulation of NERC scientific strategy for the whole enviroment and be responsible for its implementation. He will have particular

oversight of University Research awards and training, NERC's scientific services such as research ships, computing provision and analytical facilities, as well as the newly emerging area of technology interations. Dr Drewry will not loose touch however with the polar community as he will take on the role of the UK representative on the international Arctic Science Committee and retain an involvement in a number of other areas such as the European Committee on Ocean and Polar Science. Dr Barry Heywood, formerly a deputy director at BAS has taken over from Dr Drewry.

USAP

Scientists studying ozone and aspects of biology in McMurdo Sound make early start this season

Eighty-nine USAP science projects* teams are scheduled to deploy through the International Antarctic Centre in Christchurch to Antarctica during the 1994/95 summer season. US scientists studying ozone depletion and the biology of McMurdo Sound flew south at WINFLY with others from New Zealand and Italy.

Several aspects of the thinning of the ozone layer were being studied by scientists this season, the start of which also saw the end of a programme of winter balloon flights. Among the springtime projects was a cooperative and collaborative programme between USAP, the University of Wyoming, and Italian scientists from the Instituto De Fisica Dell'Atmosfere in Rome. Two members of the field team flew south on the second WINFLY flight to study the formation, evolution and other unique characteristics of polar stratospheric clouds (PSCs) above McMurdo Station by making laboratory-based lidar observations and using multispectral backscatter sondes to make in situ measurements. These data will add to the available information concerning the annual springtime depletion of ozone in the Antarctic stratosphere and enhance scientific understanding of the role of PSC's in the depletion process.

This team worked closely with another from the Department of Atmospheric Sciences at the University of Wyoming, led by Dr Terry Deshler, studying vertical profiles of polar stratospheric clouds, condensation nuclei, ozone, nitric acid and water vapour in the Antarctic winter and spring stratosphere. This group, which travelled south on the first of the WINFLY flights in late August, launched 35 ozonesonde balloons and 10 aerosol-counter balloons that provided profiles of ozone and aerosols from the surface up to between 30 and 35 kilometres. They used GPS equipment to track the balloons' locations during the flight and

**Further details of the McMurdo and Dry Valley programmes will appear in our December issue.*

also to facilitate the payload recovery at the end of each flight within a 120 mile radius of McMurdo Station. The data from the balloons, which can also be obtained during the flight, was used to chart ozone deterioration in real-time. Information on the polar stratospheric clouds (PSCs) was supplemented by the Lidar measurements and correlated with the ozone depletion events.

In a separate collaborative project balloons launched during the winter with ozone sonde systems, water vapour, particle counting and HNO3 instruments to collect data for the study of some aspects of the chemistry and physics of the stratosphere were recovered for data analysis.

Spectroscopic observations, begun in 1986, of millimeter-wave emissions of certain trace gases in the stratosphere above McMurdo Station during the spring, continued this season with a team led by Dr Robert L. DeZafra from the Physics Department at the State University of New York. They too, deployed south on the WINFLY flights, set up and debugged their equipment and studied the ozone hole as it developed. They used liquid-nitrogen cooled spectrometers in the Little House Laboratory near McMurdo Station to measure the concentration of stratospheric gases: chlorine monoxide, ozone and nitrous oxide. These gases are used as chemical and dynamical tracers for events in the stratosphere.

During the summer two long duration balloon missions will circumnavigate Antarctica measuring upper atmospheric phenomena. The National Scientific Balloon Facility (NSBF) operating out of the Physical Science Laboratory of New Mexico State University will provide ope operational support for the launch, tracking and data and payload recovery of 81,200 cubic meter high altitude helium research balloons for the National Aeronautics and Space Administration - Wallops Flight Facility/Long Duration Balloon Programme. The launches will begin approximately November 10 and continue through to January 15 in 1995. The missions will be tracked and recovery flights coordinated by the NSBF. As each balloon completes one or more circumnavigations of the Antarctic continent the mission will be terminated by radio from an LC-130 aircraft, Twin Otter of HH-1N aircraft and the payload recovered if possible.

Two flights of NASA sponsored experiments under the Solar Physics discipline are planned for the NASA/LDB annual balloon campaign in Antarctica. The principal investigators are Dr Robert Lin of Space Sciences Laboratory at the University of California, Berkeley-High Resolution Gamma-Ray and X-Ray Spectrometer (HIREGS) and Dr Jeffery Wilkes of the Department of Physics at the University of Washington, Seattle-Japanese American Cooperative Emulsion Experiment (JACEE). The campaign will take place during November to mid January with each balloon being launched near Williams Field. They will circumnavigate Antarctica near 79 deg S with termination and recovery planned over the Ross Ice Shelf. Additionally NSBF will launch up to five .265 MCF pathfinder balloons with small GPS payload up to an altitude of 3mb for gathering information on the float wind conditions prior to the launch of the main balloons.

Also making an early start for the season were a number of biologists who deployed south on WINFLY. Dr Samuel S Bowser and five colleagues from the Wadsworth Center for Laboratories and Research at Albany in New York are continuing to their test morphogenesis

in giant Antarctic foraminifera. One member deployed to McMurdo during WINFLY to initiate benthic foraminifera sample collection using SCUBA in McMurdo Sound adjacent to the station before being joined by other members of the field team who came on the main body flights and were to work at the Explorer's Cove Camp from mid October to mid December. The programme is important because some types of foraminiferan protozoa produce shells composed of mineral grains tightly bound by a chemically resistant, biological cement.

During development these single-celled animals collect mineral grains from the sediment and secrete the cement in the proper amount and location to sculpt architecturally elegant structures. Focusing on one giant celled species allows the study of the secretion of cement in a cold-adapted marine organism without the complications of cell-to-cell and cell-to-tissue interactions common to multicellular animals. Studies using time lapse videomicroscopy, light and electron microscopic cell chemistry and gel electrophorese will provide information about this kind of construction at the cellular and biochemical levels of analysis. Materials testing combined with structural modelling will characterise the mechanical properties of the cement.

From a practical view point, this environmentally safe cement binds immunoglobulins and has useful material properties that may have applied biotechnological or biomedical applications. Molecular genetic analyses of selected species will provide a much-needed framework for determining the evolution of this important protozoan group. This highly interdisciplinary project is made possible by new advances in biotechnology and has both basic and applied implications for a variety of fields such as medicine, molecular pharmacology, protozoan development and evolution, palaeontology, engineering and marine products chemistry.

Oceanographers believe that the cysts of brine microalgae may be important paleonvironmental indicators of past global climates. To improve scientific understanding of how these microorganisms respond physiologically to their enviroment a team from the Horn Point Environmental Laboratory in Cambridge MD led by Dr Diane K. Stoecker deployed to McMurdo during WINFLY and, working at a portable sea ice lab on the Sound, collected ice and brine samples for analysis. Their investigation focused on the flagellated microalgae living in brine pools that form in the land-fast sea ice in McMurdo Sound and they examined the growth and life history of the dominant cysts forming brine microalgae. Field and laboratory experiments were planned to evaluate the physiological growth responses of the microalgae and of cyst formation to changes in temperature, salinity, inorganic nutrients and irradiance. They also assessed the presence of brine microalgal cysts in the water column and sediments under the annual sea ice. The data from their project will provide significant biological information on the interaction of brine microalgae in land-fast ice and underlying marine sediments.

Working on the sea ice adjacent to McMurdo Station, Granite and New Harbours Dr James A. Raymond and Charles Amsler from the Department of Biological Science at the University of South Alabama will be studying the biochemical, biophysical and physiological characterisation of an ice-active

proteinaceous substance released by sea ice diatoms. Until recently such substances were known only to be produced by fish, insects and bacteria but this newly discovered ability of sea- algae is significant because it is the first known instance to be associated with algae and may provide new insights on how biomolecules interact with sea-ice. In additional to characterisation studies the scientists will be determining the temporal and spatial distribution of the substance in the Sound, the influence that temperature and light have on its production and which species and habitats are commonly found.

Among the other biological projects this season is a study of the physiology and energetics of King and Emperor Penguins being conducted by Dr Gerald L. Kooymann, from the Scripps Institution of Oceanography at the University of California in San Diego and colleagues. These investigations will focus on the physiology of diving, the biological development of diving in chicks, the development of methods to ascertain foraging success; a population assessment of re-discovered Emperor penguin colony at Bartlett Inlet and a chick census at the major western Ross Sea Emperor colonies.

Early in October a field camp will be established near the edge of the sea ice and members of the team will capture penguins and hold them for an extended time during which they will have free access to a dive hole cut in the ice. The birds' underwater behaviour will be recorded from an observation chamber, via a remote camera and during the SCUBA dives by team members. Several physiological variables will be monitored by microprocessors attached to selected birds. Researchers will also observe foraging success.

A second camp will then be established in McMurdo in an area of stable ice also will dive hole access probably in New Harbour or near Heald Island. Researchers here will handfeed the birds and observe their swimming to study the ontogeny of diving in chicks which are likely to be the late season abandoned birds found at Cape Washington. From early November to December a Twin-Otter will be used by the team which will travel to the major Western Ross Sea emperor penguin colonies to conduct censuses.

A team of nine scientists led by Dr Michael A. Castellini from the Institute of Marine Science at the University of Alaska will be studying the physiology, behaviour and survival of juvenile Weddell Seals. Deploying to McMurdo Station at various times from mid-October through early November they will establish a small camp of fish huts and tents on the sea-ice near the Dellbridge Islands. Using satellite telemetry they will record physical and physiological changes related to the amount of maternal care, weaning and development of diving abilities of the young seals and in a related project they will track the development of diving behaviour and dispersal of pups.

Helicopters fitted with external antennas will be used to locate seals carrying satellite transmitter packs deployed on selected animals during the 1993-94 field season. These studies are important because the first year of life for Weddell seals is critical and likely to significantly affect survival to adulthood and eventual reproductive success.

Dr Arthur DeVries from the Physiology Department at the University of Illinois, with three colleagues, will continue their work on the role of antifreeze proteins in freezing avoidance of Antarctic fishes. Working on the an-

nual sea ice in McMurdo Sound they will examine the physiological and mechanistic processes involved in freezing in order to better understand how antifreeze's evolved. They will focus on the synthesis of antifreeze's and the factors that control their understanding of how creatures adapt to extreme environments. The project is providing data that may have implications for human pathologies, nucleation theory and crystallography.

Dry Valley Programmes

NSF's Long Term Ecological Research (LTER) project enters its second year at Lake Bonney, Lake Hoare and Lake Fryxell. From mid-October to early February the field team will use the Lake Hoare camp as an operations base from which they will collect samples, and conduct experiments on the glaciers, streams, soils and lakes in the Taylor Valley and in the Wright Valley. The Dry Valleys are among the most extreme deserts in the world, far colder and drier than any of the other LTER sites. The perennially ice-covered lakes, ephemeral streams and extensive areas of exposed soil within the valleys are subject to low temperatures, very limited precipitation and salt accumulation. The biological systems in the valleys are composed only of microbial populations, micro-invertebrates, mosses and lichens without interference from higher plants and animals. However complicated trophic interactions and biogeochemical nutrient cycles exist in the lakes, streams and soils.

The two key hypotheses of this phase of the LTER are that the structure and function of the Taylor Valley ecosystems are differentially constrained by physical and biological factors and that the productivity of the systems are modified by material transport. These objectives are being accomplished through a seasonal programme of multi-year, multi-site (lakes, glaciers, streams and soils) systematic environmental data collection, long-term experiments and model development.

During this season scientists will focus on glacier mass balance, melt and energy balance; the chemistry of streams, lakes and glaciers, the long-term stream flow and productivity, the lake pelagic and benthic productivity and soil productivity and on ecological diversity and collection of meteorological data. Efforts will focus on the integration of the biological processes within and material transport between the lakes, streams and terrestrial ecosystems in the Dry Valley landscape. The team of 27, some of whom are also involved in other projects, will be in Antarctica from early October until early February.

Also working at Lake Bonney, will be a team of seven led by Dr John C. Priscu from the Department of Biological Sciences at Montana State Univeristy who are studying water column transformations of nitrogen in a perennially ice-covered Antarctic Lake. Limited sampling will also be undertaken at Lakes Joyce, Vanda, Miers and Vida.

Lake Bonney, particularly, presents a special situation in which turbulence and upper trophic levels are virtually nonexistent and microbial mediated processes dominate biogeochemical reactions. Data on the nitrogen dynamics of the lake show phytoplankton are generally nitrogen deficient and that nitrous-oxide concentration in the chemocline of the east lobe is the highest recorded in nature. Bulk denitrification does not exist in the east lobe and the natural abundance of 15N in nitrate within the west lobe is the

highest ever measured in an aquatic system.

The team believes that both ammonium and oxidised nitrogen are significant regenerated nutrients in the upper trophogenic zone, maintain that nitrous oxide is the product of nitrification and that in the west lobe, bulk denitrification acts as a sink for nitrous oxide and regulates its accumulation. To address such hypotheses they will measure microbial generation and use of ammonium, nitrite and nitrate and nitrous oxide and determine the distribution of nitrifying and denitrifying bacteria. The study is one of the first to examine nitrogen dynamics in a system lacking top-down regulation and will provide important clues regarding global microbial nitrous oxide production and consumptions. Much of the analysis will be undertaken in the laboratories at McMurdo. The team will be in Antarctica from early October to mid- February.

Lake Vanda

With its 69 meter deep water column, Lake Vanda, an ice-covered, permanent stratified lake, presents a wide range of geochemical and microbiological environments. The lake's 1,2000 year stratigraphic record and its water-column stability make it a model system for exploring the relationship between chemical processes and microbial diversity and activity.

Dr William J. Green, from the Miami University School of Interdisciplinary Studies and Drs Thomas M. Schmidt and Bonnie Jo Bratina are particularly interested in the relationship between successive reductive and oxidative zones and the microbial and chemical characteristics of those zones. Their study is the first simultaneous investigation of chemical and microbial community structure, and for it, they will use a combination of measurements including determinations of microbial biomass and diversity as estimated by microscopy and nucleic-acid extraction and identification.

Central to their work is the role played by manganese-reducing organisms in metal cycling in the Vanda water column. To assess the capacity for microbially mediated manganese cycling they will determine the abundance of manganese reducers and the mechanisms involved in manganese reduction. In addition they will make a detailed study of metal-transport mechanisms along the 27 kilometre course of the Onyx River, the lake's sole inflow and will determine metal loadings and residence times in the lakes. They will be in the field from early October to early late December and spend some time at McMurdo before flying out in early January.

Dr Brian L. Howes, from the Woods Hole oceanographic Institution at Woods Hole in Massachusetts and six colleagues are studying the pathways of organic matter production and decomposition in an ecosystem dominated by recycling and an extreme light/dark cycle. Focusing on Lake Fryxell in the McMurdo Dry Valleys they will develop an ecosystem level understanding of the rates and pathways of carbon, nitrogen, suflur and water cycling. The data will be used to produce a model of the lake's carbon cycle for comparison to similar ecosystems. Specifically they will determine the relative importance of physical versus biological processes in controlling the composition and distribution of bioactive and nonbioactive gases in Dry Valley Lakes. They will also determine how important the rate at which the water column is cycled versus the rate of

algal-mat photosynthesis is to the production of organic matter in the system and what the contribution of these processes is to the ecosystems carbon cycle. The overall annual rate at which organic matter decomposes in the lake ecosystem will be estimated. By understanding the processes controlling elemental cycling in this relatively simple physical environment with six monthly light dark cycles, they hope to enhance understanding not only of antarctic lakes but also of other aquatic systems, especially marine and estuarine sediment systems and stratified water columns.

Among the other projects in the dry valleys this season is a study of the creptoendolithic microorganisms which colonise the upper few millimeters of limestone rocks in the ice free regions of Antarctica and live near the absolute limit of their physiological potential. Researchers have found that a climatic gradient spans a range of sites located in the McMurdo Dry Valleys in Southern Victoria Land. By using automatic data loggers to monitor the microscale climate inside the rocks Dr E. Imre Friedman and three colleagues from the Departmnet of Biological Science at Flordia State University will use computer models based on the measurements to identify the exact environmental threshold between life and extinction. To document how dead microbial comunities degrade and form trace fossils they will collect living and fossilized communites and use transmission electron microscopy to analyze the samples. To estimate the present trend of long-term climate change in the area and to provide a better estimate of total productivity of the crypotendolithic ecosystem they will survey the extent and frequency of dead and fossilized communites in the deserts of the Dry Valleys.

Because the cryptoendolithic microbial ecosystem in the Dry Valleys is thought to parallel the last stages of life on early Mars their investigation will help other researchers to reconstruct the process of extinction of life on Mars and may suggest what form such traces of life might take on present-day Mars.

Nematodes are microscopic invertebrates found in all ecosystems but they are particularly abundant in soils, where they live in the films of water surrounding particles. Like bacteria and other decomposers they play an important part in nutrient cycling in soil food webs by feeding on microscopic plants and animals. During the 1990-91 and 1991-92 austral summers Dr Diana Frickman and colleagues from the Natural Resource Ecology Laboratory at Colorado State University found nematodes over wide range of dry valley soil properties (moisture, salinity and nitrogen and carbon content). In response to harsh conditions nematodes can assume a cryptobiotic state in which their metabolism becomes undetectable and physiological and morphological changes occur. Studies of cryptobiosis will determine the potential duration of nematode activity in this cold desert and will complement research on nematode population dynamics.

Working in the contrasting environments of Lake Hoare, where they will establish baseline levels, Capes Crozier and Bird which are rich in nitrogen, the higher altitudes of Linneaus Terrace, Arena Valley, Battleship Promontory, Redcliff Nunatak and the lower human impact environments of Wolcott Glacier and Garwood Valley they will collect samples for analysis in the laboratories at McMurdo. They will examine the response of nematodes and total soil microbial activity to levels of temperature, moisture and energy in the soil.

To determine their total soil response they will measure carbon-dioxide efflux and substrate-induced respiration, which is related to soil microbial biomass. The genetic diversity of populations of the dominant nematode in the dry valleys will be evaluated using molecular biology techniques. If nematodes are easily dispersed by wind, the diversity should be comparable over a wide area. Their research will further understanding of the abundance and trophic role of nematodes.

Continued in Antarctic Vol 13 No. 8

Ice front and iceberg research with the US Antarctic Program

Ice sheet behaviour and global change

New Zealand scientist Dr Harry Keys took part in two research cruises last season looking at the West Antarctic ice sheets. He joined a party of eight, led by Dr Stanley S. Jacobs, from the Lamont-Doherty Geological Observatory of Columbia University, New York. Harry spent ten days on the USCGC Polar Sea and then 50 days on the R/V Nathaniel B. Palmer. Harry, who works for the Department of Conservation in Turangi, describes his trip and his research.

Changes recently observed in parts of the West Antarctic Ice Sheet (WAIS) have reopened the debate about its possible instability. They also reinforce questions about its role in global climate change (including sea level change) over a wide variety of time scales. Ice regions of high latitude oceans may be where the effects of such change are first proven in the next few years. Obtaining conclusive evidence as early as possible would give us more time to mitigate or adjust to adverse effects.

Despite more than three decades of research we still do not know enough about the WAIS, streams of ice draining it or the floating ice shelves which form most of its northern fringe. Glaciological studies have recently revealed that complex non-steady flow of ice occurs in these ice streams and ice shelves over time periods perhaps as short as ten years. These changes which are due probably to some internal forcing are poorly understood. Similarly the potential for some Antarctic glaciers to rapidly increase their velocity (surge) is still not clear but water and wet soft sediments which might contribute to fast motion have been found beneath them. So their response to external forces such as increased global temperatures is not fully resolved. We simply can not accurately predict the behaviour of these ice masses or any short or long term effects on sea level.

Small wonder then that such a globally crucial question as the age of the whole Antarctic Ice sheet is still controversial. A major debate is in progress between those who think the ice sheets periodically collapse or become substantially smaller (perhaps most recently as 110,000 years ago) and those who

think the ice sheets have changed relatively little over the last 20 million years or more. While this debate may appear academic or irrelevant on human time scales it is quite closely related to the question of ice sheet induced sea level change on a scale of a century or so.

Ice shelves

Because they are floating ice shelves do not have a direct influence on global sea levels but they may have an indirect effect. Ice shelves help regulate the flow of ice streams feeding them and hence influence the thickness and volume of the ice sheet (as a vast frozen water reservoir). Mathematical models suggest that this influence may be less than once supposed but still sufficient to result in a sea level rise of up to 0.3 metres a century after a hypothetical disintegration of the fringing ice shelves. This is faster than current rates of sea rise. More rapid rise would accompany more rapid changes in ice flow.

The Ross and Wordie ice shelves represent the extremes of recent ice shelf behaviour. The Wordie is the northernmost ice shelf on the exposed western side of the Antarctic Peninsula while the Ross is at a much higher latitude.

Wordie Ice Shelf has mostly disintegrated into icebergs over the last three decades. This occurred during a period of apparent regional warming of summer and autumn air temperatures. Such warming could have increased ablation (ice loss) and meltwater production leading to breakup as icebergs.

Ross Ice Shelf is the longest known and largest ice shelf. Icebergs break off the northern edge (the ice front) and ocean water melts its base so that the precise position of the ice front is always changing. However it has increased in size since 1962 due to the northward advance of its ice front. Important questions such as the stability of the ice front, the mass of the ice shelf, and its influence on ocean circulation have lead to an increasing amount of research over the past two decades. Air temperatures in this region are too cold and the ice shelf too thick and homogenous for it to be as vulnerable as the Wordie. In addition no significant climatic warming has occurred in the Ross Sea Region.

Nevertheless it is important to monitor Antarctic Ice shelves and ice streams for change. The position of ice fronts, their heights and the reduction of icebergs there may be an important part of the global change picture.

Ice front mapping

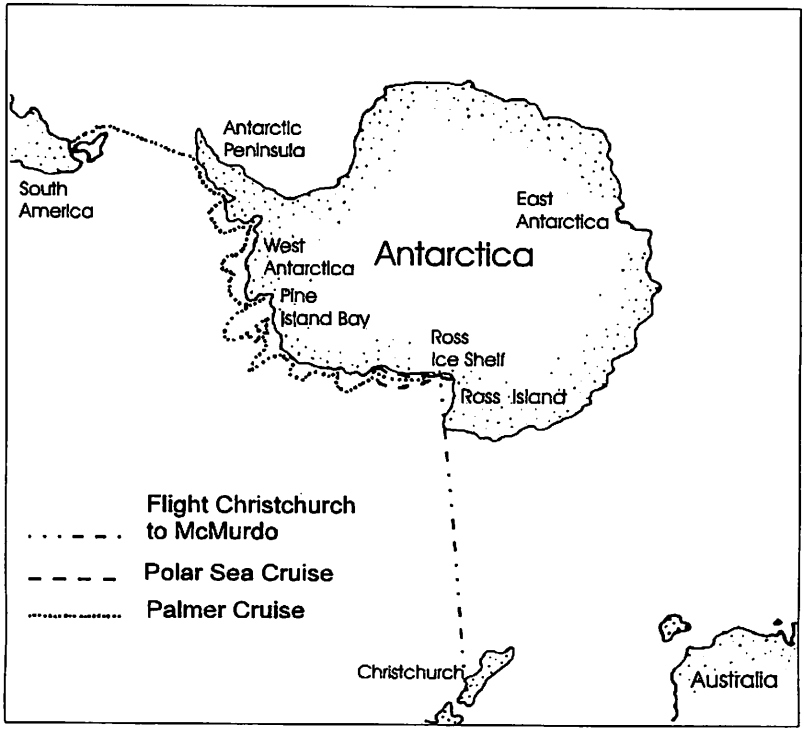
In February and March 1994 we investigated the position and heights of several West Antarctic ice fronts. I had been invited by polar oceanographer Stan Jacob's from Lamont Doherty Earth Observatory in New York state to take part in two United States oceanographic research cruises on board the Coastguard Icebreaker *USCGC Polar Sea* and the research icebreaker *Nathaniel B. Palmer*. The objectives of the cruises were to study ocean circulation and upwelling, variability, and impact on floating ice. Stan and I had corresponded over the last ten years and jointly studied the giant B9 iceberg which broke off the eastern Ross Ice Shelf in 1987 but we had never met so it was a nice moment when we finally did in Christchurch prior to our flight to McMurdo Station.

After a visit or two to Scott Base, we boarded the *Polar Sea* for a ten day cruise in the Ross Sea. It took almost five days to work along the 800km long

front of the Ross Ice Shelf, taking an intensive set of sea water samples and investigating the Bay of Whales and several other indentations in the ice front. Then we sampled into Granite Harbour off the Victoria Land Coast which gave me a different perspective on areas I had visited before. Three days later we boarded the Palmer for the main 50 day cruise zigzagging through the pack ice belt around 4000 kilometres of coast to the Antarctic Peninsula and then north to Chile.

We used the ships Global Positional System and radar to map the position of the ice fronts and a sextant to measure their heights. The ice front position showed a wide variety of changes from previously mapped locations but no consistent overall trend such as would be expected if climate change was affecting them.

The changes we observed are more likely due to the normal cycle of slow advance followed by retreat due to calv ing of icebergs. Climatic, oceanographic sea ice and glacial ice dynamics influence this cycle.



Map showing Antarctica in relation to New Zealand, Australia and South America. The routes of the s two scientific cruises by the USCGC Polar Sea and the R/V Nathaniel B. Palmer.

The Ross Ice Shelf has continued its northward advance, except in the east from where the giant B9 iceberg calved.

In the west the front is now north of Cape Bird on Ross Island and substantially north of its historical position (i.e. since 1841). The maximum advance rate appears to have increased to 1.6 km/year between 1987 and 1994. This maximum rate occurred at the northeast headland (at 178.5deg E) of a major new bay which has developed apparently since 1987 on the site of a rift feature visible in satellite imagery. Rifts near Ice fronts are known to exert a major control on ice shelf calving.

The height of the ice front shows a systematic decrease from east to west due to ice thickness and calving patterns. Heights are greatest at the 1987 calving site of B9 and least in the thin ice of Bay of Whales. Heights are also low in other bays and near Ross Island. These tends generally match those apparent in data from 1901 and 1911 when heights may have been less, although the historic measurements are not accurate enough to provide convincing evidence of such a change.

Present calving seems to be having the greatest effect "downstream" of Roosevelt Island, Here, a new Bay of Whales has started to form after the B9 calving eliminated the previous version. Future major calving may occur in the thinning western portion of the shelf within several years, with potential implications for ship resupply of McMurdo Station and Scott Base.

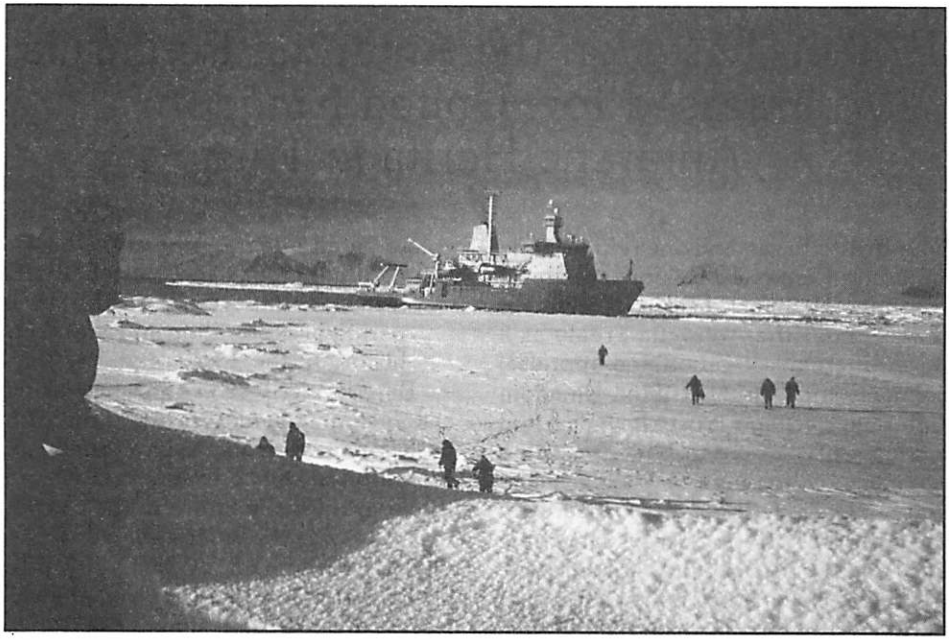
Pine Island Glacier

We were particularly keen to visit Pine Island Bay for oceanographic sampling and mapping the front of Pine Island Glacier. Some theoretical studies of this fast moving glacier suggested it was unstable and had the potential to drain the West Antarctic Ice sheet. This would cause a catastrophic rise of up to six metres in global sea level over the space of several decades to a few centuries. Our research suggests that ice front is fairly stable but possibly the underside of the floating part of the glacier is melting faster than any other Antarctic glacier due to upwelling "warm" water from the ocean surrounding Antarctica.

Icebergs and sea ice

My work also involved examining the highly variable concentration, shape and size of icebergs. In Amundsen sea we circumnavigated the 100 km long 30 years old Iceberg B10 (formerly the Thwaites Iceberg Tongue) which is probably the largest and oldest iceberg in the world at present. The highest numbers of icebergs were found in the east, near actively calving glaciers and in major areas of iceberg grounding such as off Cape Colbeck. The largest concentration of bergs was found near the Wordie Ice Shelf, consistent with its recent collapse. The more general hypothesis that climate warming in the Antarctic will result in more icebergs in the next few decades will only hold true if other marine glaciers also begin collapsing.

We kept a close eye on the sea ice which has trapped several ships in this part of the Antarctic over the years. There is a belt of pack ice around Antarctica which expands and shrinks with the seasons. We travelled north or south through the belt nine times on the Palmer. Polynyas (areas of open water or thin ice) develop in the pack each summer due to wind, currents, warm water upwelling and coastal topography. We travelled through six of these starting with the Ross Sea polynya, one



Members of the science party from the R/V Nathaniel B. Palmer stretch their legs on the fast ice of Marguerite Bay on the Antarctic Peninsula. Photo: Harry Keys.

onset of autumn and early winter. It was fascinating watching the ice build up in a myriad of forms, under the influence of wind, waves and ice movement.

Acknowledgments

I am grateful to the national Science Foundation for inviting me on the cruises, the Department of Conservation for supporting my participation and to the Trans Antarctic Association for additional funding. Thanks also to Captain Lawson Brigham, Captain Joe Borkowski and the ships' crews and to the science team for their support and excellent company.

Master directory for Antarctic science

France has agreed to join Italy and the United States as international partners in the ICAIR bid to host the Antarctic Master Directory. Dr Steve Smith, Director of ICAIR, based in Christchurch New Zealand, demonstrated the prototype Antarctic Master Directory of scientific databases at XXIII SCAR in Rome in August. The prototype runs on a PC platform using Folio Views software. ICAIR has also developed access to the Italian South Pole Director via the Gateway to Antarctica. Using this form of access, scientists are able to search the database based on keywords such as the subject, author, data centre or instrumentation from anywhere in the world with access to Internet.
ICAIR Newsletter, November 1994

British bases on the Antarctic Peninsula assessed for United Kingdom Antarctic Heritage Trust

Four British bases and one refuge in the Antarctic Peninsula Region are to be recommended for Historic Monument Status under the Antarctic Treaty as a result of an investigation and appraisal commissioned by the United Kingdom Antarctic Heritage Trust. It was carried out by Chris Cochran a conservation architect of Wellington, New Zealand and Ian Collinge, Logistics Officer with the British Antarctic Survey. They travelled south on board *HMS Endurance*, the Royal Navy's new patrol ship, and between 26 February and 24 March 1994 visited a total of nine of the 16 abandoned British bases in the region. Firm recommendations on their future management have been made and tentative recommendations put forward for the other seven bases.

In their report to the Trust, entitled *Conservation Survey of Abandoned British Bases in the Antarctic Peninsula Region*, they wrote:

The four bases and one refuge recommended for Historic Monument status are

- Port Lockroy, Base A, for its historic importance as an Operation Tabarin base and later scientific research;
- Argentine Islands, Base F (Wordie house for its historic interest as an early FIDs base);
- Horseshoe Island, Base Y, for its historic interest as a relatively unaltered and completely equipped base for the later FIDS period. Blaiklock, the refuge hut nearby is considered to be an integral part of the base.
- Stonington Island, Base E, for its historical importance in the early period of exploration and later BAS history of the 1960' and 1970's.

Base B and Base O on Danco Island are recommended for retention with basic repair work only to be carried out. Retention of Danco Island is to ensure its survival for the future in the case of the loss of a base designated as an Historic Monument. A firm work programme has now been evolved and will start in the 1995/96 summer season at Port Lockroy and, if possible, at Danco.

Admiralty Bay, Base G and Portal Point are recommended for removal. Cape Geddes, Base C; Hope Bay, Base D; Prospect Point, Base J; Sandejord Bay,, Base P; Detaille Island, Base W; Orford Cliff and View Point, Base V are tentatively recommended for removal.

Recommendations were made on the basis of the **historic importance** of the base, the **practicality** and the **value of carrying out conservation** as well as for the potential for the enjoyment and education of visitors. The historic importance was assessed in terms of important events, people or scientific research or exploration associated with the base. The question of the representativeness of scientific or exploratory achievement was considered as was the ability to evoke conditions of an earlier period, the historic importance of the building and the architectural and/or technological interest. The practicality of carrying out

conservation was considered in terms of the condition of each base, the cost of conservation and of continuing maintenance as well as the impact of such activities on wildlife as well as the scientific values. The value of carrying out the conservation was examined in terms of accessibility, general interest, potential to educate, ease of management, the security of the buildings and artefacts, the aesthetic quality of the base and of its landscape setting.

The British have had a long association with Antarctic exploration but since 1944, a total of 30 bases or refuges have been built in the Antarctic Peninsula region by the British Antarctic Survey or its predecessors, Operation Tabarin and the Falkland Islands Dependencies Survey. Only seven of these bases are in operation today either as all year round or summer only bases; seven have been destroyed or are otherwise inaccessible and the remaining 16 are "abandoned".

Protocol

Annex III to the Protocol on Environmental Protection to the Antarctic Treaty, adopted in Madrid in 1991 requires that abandoned bases shall be cleaned up but not necessarily removed. During the last three years the British Government has taken active steps to implement the provisions of the Protocol, including its obligations on waste disposal and clean up. In 1991-92 BAS conducted an initial survey of the abandoned bases in the Antarctic Peninsula region and has subsequently had clean up teams at a number of sites; this programme of work is set to continue.

The future of the abandoned British Bases in the Antarctic are, for different reasons of interest to the British Antarctic Survey, the Government of the British Antarctic Territory and the United Kingdom Antarctic Heritage Trust. This charitable trust, formed in 1993 has as its main objective "to inform and educate the British people about their antarctic heritage and to preserve that heritage in the Antarctic and in Britain.

To augment the 1991-92 survey and provide a sound basis for policy decisions on UK abandoned bases, these three organisations considered that a more comprehensive survey was required assess whether the bases should be cleaned up or removed, converted into refuges or designated under the Antarctic Treaty as Historic Monuments. The three organisations therefore cooperated to assist with the survey. The UKAHT commissioned the report with financial assistance from BAT, while BAS provided the services of Ian Collinge, briefing, logistic, and secretarial support as well as archive and library services.

The brief

The brief, written by Dr John Shears, BAS Environmental Officer in a paper "Conservation Survey of Abandoned British Bases in the Antarctic Peninsula Region dated 11 November 1993 says:

The objectives of the conservation survey are to

1. Inspect as many of the abandoned British bases on the Antarctic Peninsula as possible with a view to providing expert advice on the preservation of buildings of particular historical significance.
2. Record the present state and condition of each base visited using the BAS abandoned base inspection checklist as well as by using other appropriate checklists, written notes, photographs and video;
3. prepare a final report which makes

practical and realistic suggestions as to what future action should be taken for each of the bases visited;

4. select a small number of bases which are of particular historical significance and which could be suitable for designation as Historic Monuments, and provide sensible recommendations as to how they could be best conserved.

History of involvement

The history of the British Antarctic Survey actually begins during the Second World War, in 1943 with the Royal Navy's Operation Tabarin. The purpose of Tabarin was to establish shore bases to prevent enemy use of anchorages in the area which may have been used to control shipping lanes through the Drake Passage; an additional purpose was to advance the cause of British sovereignty of the lands known as the Falkland Islands Dependencies. There were all the islands and territory between longitude 20 and 50 degrees West and south of latitude 50 deg; and between longitude 50 and 80 deg W and south of latitude 58deg S. (In 1962, the region lying south of latitude 60deg S, subject to the provisions of the Antarctic Treaty, was detached to form British Antarctic Territory.)

Under the command of Lieut Cdr James W.S. Marr, Tabarin acheived the establishment of bases at Deception Island (Base B, 3 February 1944), and Port Lockroy (Base A, 16 February 1944). Under Captain A Taylor, the following year, the third and main base at Hope Bay was established on 12 February 1945. The logistical achievement in setting up these bases was considerable, since the operation was carried out in secret; ships, personnel and material were hard to come by with wartime restrictions, and planning time was very limited. That they were established at all and that they served their military purpose, were significant achievements. Science was not forgotten either: meteorological reports were kept at each base; there was some geological investigations and at Port Lockroy Dr I.M. Lamb carried out important work on lichens. It was noted by Marr (in his first report on the Work of Operation Tabarin *Op Tab 261*) that Surg Lieut E.H. Black kept weather records which "....apart from their scientific value, will strengthen our political position....should sovereign rights over these territories again be questioned by a foreign power."

Administrative responsibility

At the end of the war, administrative responsibility for the operation was transferred from the Admiralty to the Colonial Office under the new name Falkland Islands Dependencies Survey (FIDS). The intention was both political, to maintain a permanent presence in the Falkland Island Dependencies, and scientific, to continue and expand the exploration and mapping done during Operation Tabarin and to carry out systematic scientific research.

The shore command was first with Surg Cdr E.W. Bingham (1945-46); then Major K.S. Pierce-Butler (1947-48), and during 1948-50, Dr V.E. (Later Sir Vivian) Fuchs. This period saw the rapid expansion of the programme with the establishment of two bases in 1946; Cape Geddes (Base C) and Stonington Island (Base E), and three stations in 1947 - Argentine Islands (Base F), Admiralty Bay (Base G) and Signy (Base H). From Hope Bay to Stonington Island, in particular, extensive surveys were made using dog sledges, and in the 1947-48 season the surveys were linked

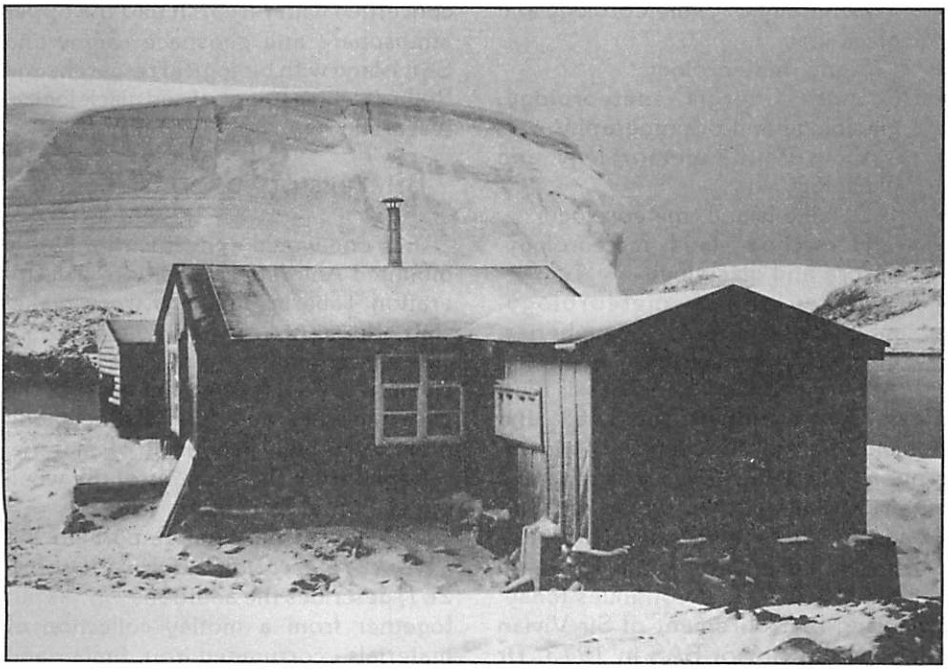
by the meeting of parties from the two bases. The emphasis at Hope Bay and on Stonington Island during this time was on topographic survey work.

The base at Argentine Island was established on Winter Island on the site of the British Graham Land Expedition Hut, was relocated to Galindez Island in 1954 and has been principally used as a geophysical observatory; it was renamed Faraday in 1977. Geological, glaciological and topographic surveys were carried out from Admiralty Bay, while Signy was principally a biological station.

In 1950 The Falkland Islands Dependencies Scientific Bureau was formed under the direction of Dr Fuchs, who was responsible to the Governor of the Falkland Islands for scientific administration of the Survey. Sir Raymond Priestley acted as director from 1955-1958 while Fuchs led the Commonwealth Trans-Antarctic Expedition. During the mid and late 1950s leading up to the International Geophysical Year, a number of stations were built by FIDS; View Point (Base V) in 1953; Anvers Island (Base N) and Horseshoe Island (Base Y) in 1955; Danco Island (Base O); Portal Point and Detaille Island (Base W) in 1956 and Bird Island (Base BI); Prospect Point (Base J); Orford Cliff Hut and Blaiklock Hut in 1957.

The International Geophysical Year (IGY) was a remarkable example of international scientific co-operation, involving scientists from 67 nations and the operation of over 40 stations spread throughout the Antarctic continent, with others on offshore islands. Its purpose,

Wordie House, north and west elevations. The original section which dates from 1947 is the middle block clad in corrugated iron.



was summed up by Dr. J.T. Wilson (and quoted in Quartermain 1964) : "IGY was to be all embracing, to fit the earth into the pattern of the universe, to relate its parts together, to discover hidden order, and to interpret the whole in relation to space, and especially, to that greater greatest influence in nearby space, the sun." British scientists played a significant role in planning IGY and ensuring its great scientific success. There were eleven British bases operating during the year, including the Royal Society's station Halley Bay, the ownership of this station was transferred the following year to FIDS. The bases were:

- Port Lockroy, aurora and ionospherics,
- Deception Island, meteorology
- Hope Bay, meteorology and glaciology
- Argentine Islands, meteorology, magnetics, aurora, oceanography and seismics
- Admiralty Bay, meteorology and glaciology
- Signy, meteorology
- South Georgia, meteorology, glaciology and oceanography
- View Point, meteorology and glaciology
- Detaille Island, meteorology,
- Horseshoe Island, meteorology, aurora and glaciology
- Halley Bay, meteorology, magnetics, aurora, ionospherics, glaciology and seismics.

Adelaide (Base T) and Fossil Bluff (Base KG) were opened in 1961, and Adelaide became the centre of air operations. In 1962, FIDS was renamed the British Antarctic Survey, and in 1967 it became one of the research institutes of the National Environmental Research Council (NERC), as it continues today. Following the retirement of Sir Vivian Fuchs as director of BAS in 1973, Dr R.M. Laws was appointed. Dr D.J. Drewry who replaced Laws in 1987 has recently resigned and Dr Barry Heywood has been appointed *(see page 297)*.

The first bases to be built by BAS, as distinct from FIDS, and in fact the last new ones to be built, were Rothera (Base R) and Damoy (no letter), in 1975, although new buildings and facilities have continued to be built at all operational bases. (Halley , which is located on a ice shelf has been rebuilt five times since 1956 because of constant problems with snow-drift and the buildings being buried.)

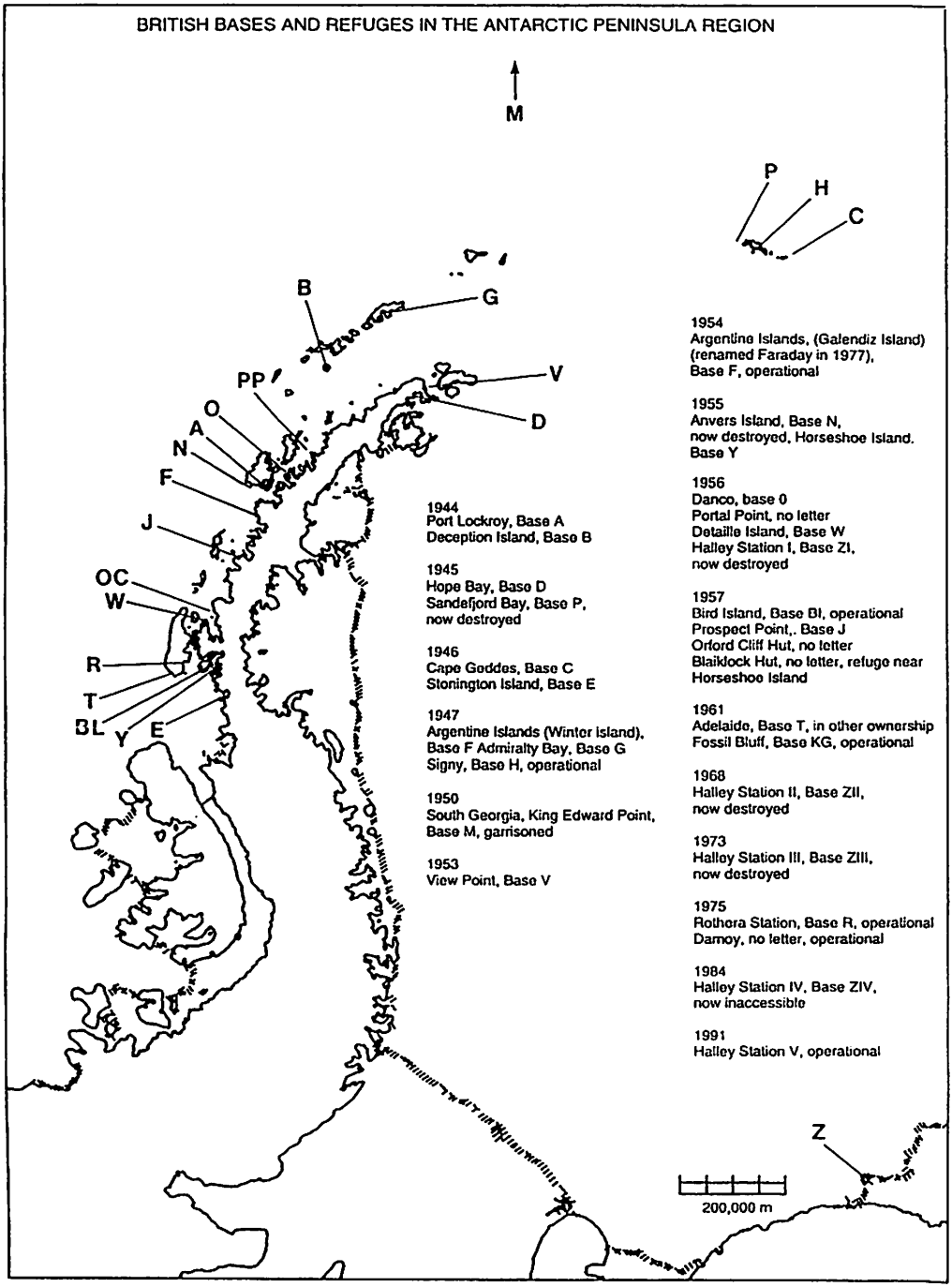
Rothera became the centre of air operations in 1975, and since its construction has remained in continuous occupation. The other fully operational bases today, in continuous occupation through the winter, are Signy, Faraday, Halley and Bird Island. Fossil Bluff and Damoy see summer or occasional use only . Faraday and Halley are primarily concerned with research into the upper atmosphere and geospace; Signy and Bird Island with biological research, and Rothera with geological and glaciological research.

Brief history of construction

As one would expect with a hastily mounted Antarctic expedition, the Operation Tabarin buildings were makeshift affairs. At Port Lockroy, a prefabricated structure from the firm of Boulton & Paul formed the heart of the base building, and four distinct additions were built around it of material salvaged from the remains of the whaling station at Deception Island.

Marr, in his First Report on the *"Work of Operation Tabarin" (Op Tab 261)* describes the additions "....as put together from a motley collection of materials - corrugated iron, timber and

BRITISH BASES AND REFUGES IN THE ANTARCTIC PENINSULA REGION



lining paper from Deception, heavy beams dating from the whaling days dug up out of the ice on Wiencke Island, the woodwork and beaver board of the second Nissen Hut which was not erected, packing cases and junk of every description, the whole eked out with a quantity of timber, sisalkraft and aluminium foil supplied as good measure by Boulton & Paul along with the original hut....the bath came from the derelict hospital at Deception....We are indebted for this fine residence to the energy, genius and craftsmanship of Lewis Ashton, the carpenter."

The same haste in planning and ingenuity in construction applied not only to the Tabarin base buildings but also to the provision of early FIDS buildings. The first part of Wordie House was made 18 feet square in plan, because, according to F.K. Elliott in his General Report of 1947, "the timber was in 18 foot lengths, [so] it was decided to make the hut outside measurements 18 feet by 18 feet to avoid waste of timber". Additions were made to Wordie House with makeshift materials even as late as 1960 when aircraft crates dismantled at Deception Island were used to effect improvements. Generally the early bases followed this pattern of making-do with what was available rather than being purpose-designed structures.

During the 1950's a pattern was established whereby the Crown Agents purchased, on behalf of FIDS, prefabricated buildings from Boulton & Paul, Norwich. This firm was founded in 1797, and it still operates today as a manufacturer of domestic joinery. Drawings were prepared by the Crown Agents showing the facilities required at the particular base; Boulton & Paul in turn produced their own more detailed drawings, submitted a price, and in due course delivered the pre-cut building for shipping south. The technology involved in these structures was not dissimilar to that employed by Captain Scott in his 1911 base hut at Cape Evans : a conventional 100 x 50 mm timber framing with timber tongue and groove lining boards on the inside and outside; felt was fixed between the layers of boards with insulation in the cavity of the wall. Ruberoid, a heavy tarred building paper, was used to sheath roofs and in some instances walls as well; the same material had been used by Scott as exterior sheathing.

A large number of Boulton & Paul buildings still exist. There are several at operational bases such as Faraday and Signy. Others include the first part of the main building at Port Lockroy (1944); possibly Sandefjord Bay (1945); the base building at Hope Bay (1952) the FIDASE base building at Deception Island and the base building at Horseshoe Island (both 1955); the base buildings at Admiralty Bay, Danco Island and Detaille Island built in 1956; the generator room (steel frame) of the generator room at Port Lockroy and base building at Prospect Point built in 1957 and the boatshed/store built at Port Lockroy in 1958.

The Boulton & Paul buildings had a mixed reception from the men, not often trained as builders, whose first job at a new base was to erect the main building. Several reports back to headquarters state that components went together easily, erection was quick and the huts were comfortable and functional Others were forceful in their criticism, pointing out that the technology was out of date, and that it was difficult, particularly in poor weather conditions, to build a timber frame structure and then clad it up to with up to six layers of different materials each fixed separately.

The Horseshoe Island Building Re-

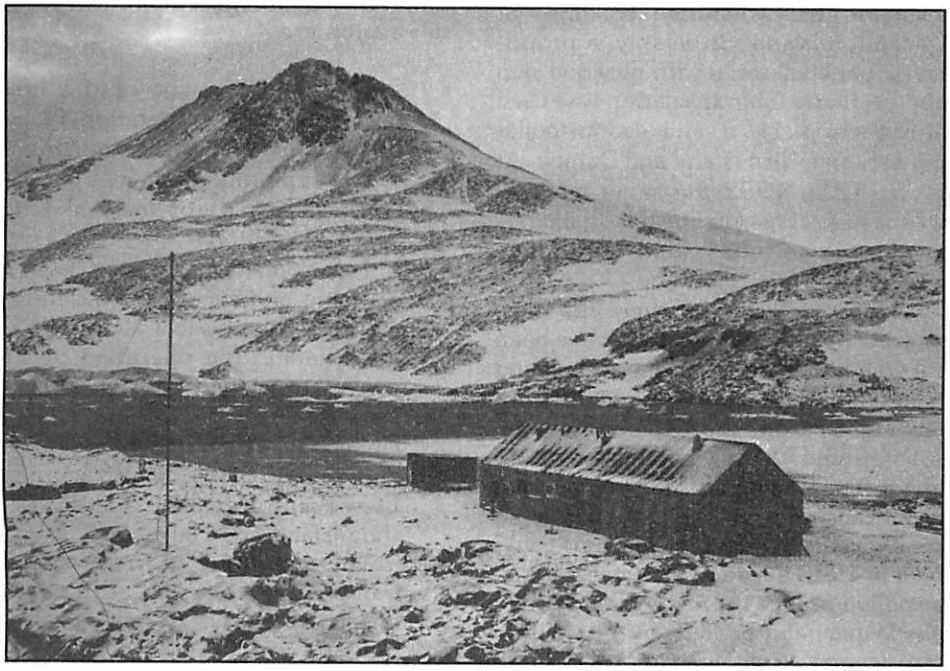
port for 1955 by KIM. Gall details criticisms of the technology and contains a section called "Suggestions for a New Approach to Base Huts". It makes a case for innovation and the use of new materials in prefabricated form, and finishes with an eloquent plea that: "....the building of huts should not be considered simply as a grim means to an end. The work of producing a really well-designed Antarctic hut should be considered experimental work, in line with the general programme of discovery work, and comparable in importance to the various scientific studies.:

The report for Detaille Island the following year (B.L.H. Foote) mentioned great temperature differences between different parts of the hut. "True this is in the English tradition, but must we have a hut modelled on the English home? Let there be a consistent temperature throughout the building.... the fault is in the design o f the h Hut as a whole and not in the parts thereof".

The various difficulties with the traditional design of the Boulton & Paul buildings had been acknowledged as early as 1953 when an architect Peter Falconer, of the firm Ellery Anderson Roiser and Falconer, was commissioned to design a hut "made up of panels". Drawings and a specification were prepared, and a tender of L4,986 pounds was received to construct a prototype, but it appears the prototype was never built and that the design work had no impact on later buildings.

Changes came however. The new generator room extension at Port Lockroy, built in 1957, was framed with steel portals rather than timber, and the

Horshoe Island, Base Y, general view of the building from the north,west. 1994



boatshed/store at Port Lockroy, built the following year, was made of prefabricated panels 3' wide x 8' high. These panels were timber framed with plywood stiffening gussets and they had weatherboarding fixed to the outside face. The last timber framed building was possibly the generator shed built at Signy in 1974, but by then panel construction for new buildings was the norm.

When the Stonington Island base was re-opened in 1960, a new two storey building was built. It had a mixture of timber and steel framing (the main beams took ten men to lift), but the cladding was plywood and it took one man only a day and a half to close in the lower floor. The first floor sheathing was plywood "insulated panels" made up of 75 x 50 mm framing with 9 mm ply outside and 5 mm inside, with fibreglass insulation between. Experimentation continued with new materials : fibreglass reinforced plastic material was used for the two-storied building at Deception Island. Structaply, a proprietary panel material with plywood skin and urethane foam insulation was used at Rothera in 1975, and also for building at Signy, Bird Island and Damoy. At Halley IV in 1982 the same material was used to construct the base buildings and the large tube within which they were built.

Halley is the base where the most interesting design innovation have been carried out, as the problems of building on a floating ice shelf demand different techniques from those being built on solid ground. Halley I and II were both lost through being crushed by the great weight of snow and ice that built up an around and over them. Halley III was built in 1973 inside Armco steel tubing, designed to take the snow loadings that would inevitably build up over it. Within ten years the whole base was buried some 12-15 metres below the surface and access and ventilation problems led to its abandonment. The design of Halley IV (1982) followed the same concept, but the tube was built of timber, Structaply rather than Armco. Subsequently the tubes distorted and the top panels had to be removed and the encroaching ice regularly cut back to maintain the tube shape and gap between the ice and the hut buildings.

Halley V is a radical departure from its predecessors. Built in 1989 for a 15 year life, it stands on adjustable legs; it avoids the problem of drift burying the base buildings as they are well clear of the ground. The primitive beginnings of BAS in the Antarctic Peninsula Region exemplified by the Operation Tabarin Building at Pork Lockroy , makes a startling contrast with the sophistication of Halley V.

Among the more recent British achievements in the Antarctic Peninsula region are:

- The establishment of the first permanent land-base station, Hope Bay, on the Antarctic Continent
- The exploration and mapping of the greater part of the Antarctic Peninsula region
- The contribution made to the planning and success of the International Geophysical Year 1957-58 including the operating of 11 bases during that time. They were Port Lockroy, Deception Island, Hope Bay, Argentine Islands, Admiralty Bay, Signy, South Georgia, View Point, Detaille Island, Horseshoe Island and Halley Bay.
- The measuring of ozone depletion over the Antarctic and the identification of the Ozone hole at Halley Station.

The visible reminders of the these achievements are the base buildings and associated artefacts that remain today.

Antarctic is indebted to Chris Cochran and Captain Pat McLaren, Hon. Secretary of the UK Antarctic Heritage Trust for permission to reprint segments of the report and for their assistance with this article.

New issue of Ross Dependency stamps

A definitive series of Ross Dependency stamps were issued by New Zealand Post on 2 November.

The ten stamps which range from 5c to $3 denominations, feature Antarctic wildlife. This is accompanied by a first day cover featuring a blue scalloped iceberg covering the whole envelope.

The Ross Dependency stamps are being reissued after a hiatus following the closure of the Post Office at Scott Base in 1987. They will replace the New Zaland stamps currently being issued for postage from the Ross Dependency. Mail can be posted by staff at Scott Base, but all cancellations will be done at the New Zealand Ross Dependency Agency at the Christchurch Philatelic Sales Centre. Philatelic mail will also be cancelled in Christchurch.

The stamps were designed by Wellington freelance art director/designer Gregory Millen.

It's the first stamp issue that he's done and he says it is very pleasing personal design achievement .

Gregory is a graduate of Wellington Polytechnic Design School and he's worked in Sydney and for design company's and advertising agencies, and for theatres in New Zealand. His interest in Antarctica stems from a design thesis he did in his last year at polytech. Searching for an interesting topic a TV documentary on the continent fired his imagination.

"It's such an enormous topic," he said. "From a design point of view it's very challenging and a visual delight."

Gregory's thesis based on Antarc-

tica was to develop an international identity for the continent. It was to be educational and used to create public awareness. "I wanted to work on something with a soul rather than the run-of-the-mill commercial outfit," he said. It has been tremendously satisfying to be able to carry over the research he did for his thesis into the stamp design.

New Zealand Post gave Gregory an open brief at the end of last year to come up with a series of concepts. A few months later they came back with a more specific brief centering around wildlife and their environment using photographs.

Greg pursued the theme of species and portrait concept. He spent a day at Hedgehog House, the photo-library of veteran Antarctic Photographer Colin Monteath, in Christchurch. Greg looked through about 20,000 images before making his choice - South Polar Skua (5c), Snow Petrel Chick (10c), Black-Browed Albatross (20c), Emperor Penguin (45c), Chinstrap Penguin (50c), Adelie Penguins (70c), Elephant Seal (80c), Leopard Seal (41), Weddell Seal ($2), and Crabeater Seal Pup ($3). The images come from seven different photographers.

The rectangular portraits are placed on a green-tinted background border which is a shot of the Lake Vanda ice. "I used this to give some common reference on each stamp to pull them together as a series" he says. "I also wanted to emphasis the different colours of the ice and its coldness," thus the blue berg on the envelope.
Gregory says he aimed for a clean, simple, uncluttered look to give emphasis to the species and reflect the pristine environment of Antarctica "very clean and sharp."

An oval on each stamp contains the denomination, and symbolises the wholeness of the Antarctic continent.

Gregory has been a member of the Antarctic Society for a year and hopes to incorporate Antarctic themes into future projects and to one day set foot on the ice.

Message in bottle found

In a quest for information about ship-borne flotsam in the Southern Ocean, an Australian researcher Andre Phillips threw a bottle overboard from *MV Icebird,* in April 1989. Up to this season the vessel has regularly been chartered to support Australian activities. The bottle has not only survived but was found recently on a beach near Bulls in the Manawatu region of New Zealand by two schoolboys riding their motorbikes along the sand.

Mr Phillips had enclosed a note in the bottle which read "I hope if sufficient replies (from this and earlier bottle throws), are received, this will provide information on the destination of ship-borne flotsam in the Southern Ocean." Mr Phillips is based at Adelaide University's Mawson Institute for Antarctic Research. Daniel Gilliard and Isaac Walker, who found the bottle plan to write to him.

30 years ago

The Royal Navy's first icebreaker is to be called the *Terra Nova* after Captain Scott's famous little ship. There will, however, be little in common between Captain Scott's 764 -ton sail and steam propelled ship and her planned successor. The new "Terra Nova" which will combine the tasks of patrol, survey and scientific support, is to have four diesel electric engines developing some 15,000 horse power. She will be equipped with two helicopters. Reprinted from *Antarctic* September 1964 page 509

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