

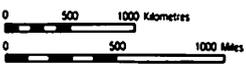
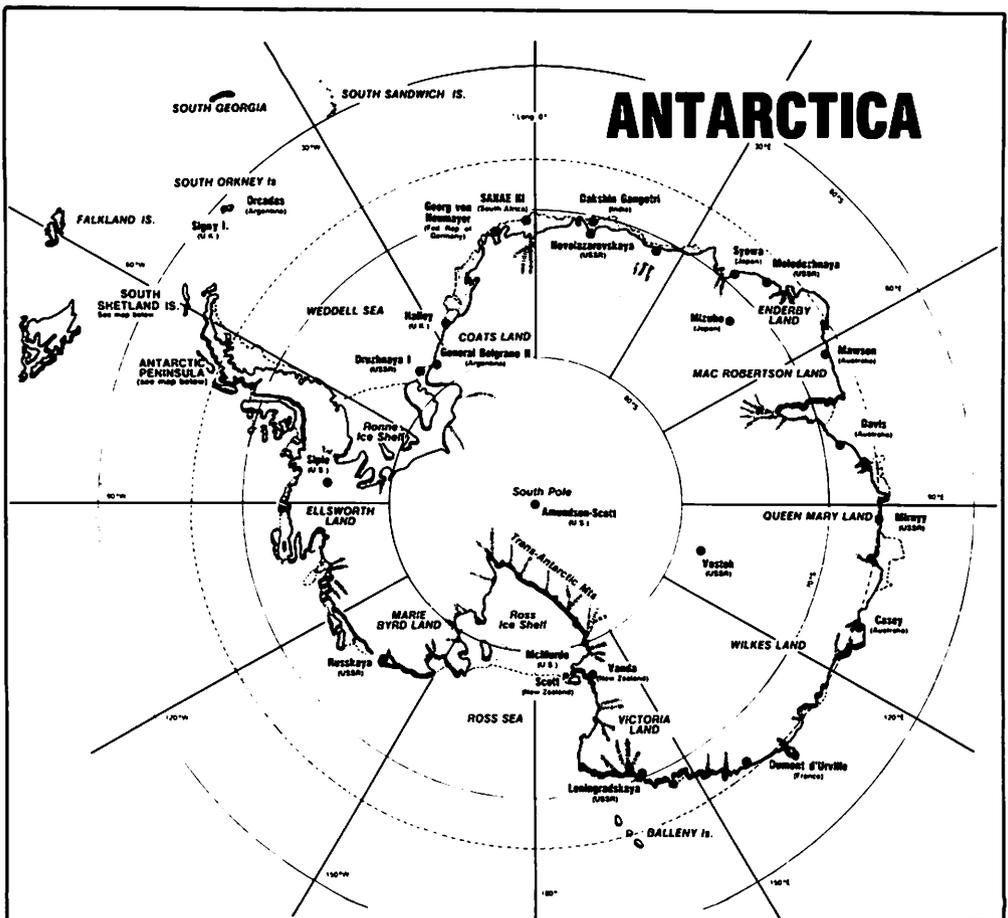
ANTARCTIC



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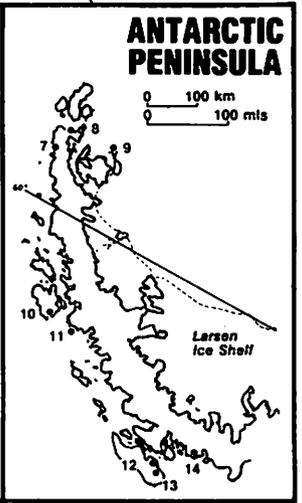


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Note: This issue, published in May 1991, is out of sequence. Normal publication of "Antarctic" resumes from June 1991. Ed.

Cover: A light mantled sooty albatross commands an expansive view over Fly Harbour in the Auckland Islands. This slide, taken by Lou Sanson of DOC in Ivercargill, is available as a poster and postcard.

Last issue: The cover photo depicting a fumerole and crevasse on Mt Melbourne was taken by Dr Paul Broady of the Department of Microbiology, University of Canterbury.

NZARP

Two major co-operative geological projects included in last summer's programme.

Two major co-operative geological projects were undertaken in Marie Byrd Land during the last summer. Abbreviated to SPRITE - South Pacific Rim International Tectonic Expedition and WAVE - West Antarctic Volcanic Expedition, both involved scientists from the United Kingdom, the United States and New Zealand.

SPRITE evolved from studies undertaken by scientists from the US and UK, who in the previous ten years had been working westwards from Ellsworth Land, while New Zealanders had been working intermittently in Marie Byrd Land over the last 12 years. This season's project was the first of a three season co-operative study. It was originally scheduled to take place last summer but was cancelled because of logistical problems.

The NZ scientific leader was Dr John Bradshaw from the Department of Geology, University of Canterbury in Christchurch. He was accompanied by Dr Steve Weaver from the same department. They were joined by Dr Bryan Storey and Dr Bob Pankhurst from the British Antarctic Survey and Dr Ian Dalziel from the University of Texas at Austin, Sam Makusa from Michigan and Vic Di Venere from Lamont Geophysical Observatory - all of whom were part of the United States Antarctic Program. Field leaders for the season were Peter Cleary from Christchurch, Andy Harris from Twizel and Damion Carrol of Birkenhead who came from the British Antarctic Survey.

Prior to 85 million years ago Marie Byrd Land which lies to the west of Ellsworth Land was the partner to the Campbell Plateau which lay to its west. As part of a single continental block they have major rock units in common. Because the Campbell Plateau is now submerged it is impossible to study while Marie Byrd Land is difficult to reach and notorious for its bad weather.

As in the Mesozoic, the margins of the

Pacific basin are still the most geologically active part of the crust. Prior to the breakup of Gondwana an entire southern rim to the Pacific extended from New Caledonia through New Zealand, across West Antarctica to Patagonia leaving Marie Byrd Land closer to the Chatham Islands than any part of the present mainland of New Zealand. Today Marie Byrd Land, although largely covered in snow and ice, contains some of the most vital exposed clues to the understanding of the geology of New Zealand, the Campbell Plateau and the Chatham Rise. Study of the area will help geologists in their understanding of the western margins of the former continent Gondwana.

The team was especially chosen to bring together scientists who have worked on appropriate problems in South America, Antarctica and New Zealand. Their principal objective this season was to examine and sample all available basement outcrop in the Ruppert Coast Hobbs Coast area between 133-146 West. Subsequently all rocks collected will be analysed for major and trace element geochemistry. Extensive collections were made for Rb/Sr, U/Pb and Ar40/Ar39 geochronology, isotope geochemistry and paleomagnetic studies.

On 2 November Dr Bradshaw and the two field assistants were flown to Scott Base to begin preparations for the seasons activities. Ten days later they were joined by the British and American scientists and on 20 November 1990 the nine members of the party were flown into the field by a ski-equipped C-130 to

a site at 75deg/33S, 139deg/50W where fuel had been depoted the preceding week.

Later on that day a BAS Twin Otter landed near the camp with the remaining three members of the party. Piloted by Paul Robertson of BAS with support from Alan Hopkins, an air mechanic from REME, but seconded to BAS for the season, it had been flown from Rothera via Bird Surface Camp. The following day it was used for local reconnaissance work during which scientists involved found the area to be much more severely crevassed than anticipated and the surfaces very rough. Only the Ickes Mountains, Wilkins, Bailey and Partridge Nunataks could be reached safely by land and so two satellite camps were established, one at McDonald Heights and the second at Demas Range. These were areas of particular interest requiring detailed study.

Geological targets along the coastal area were established on a three day rolling basis according to current discoveries and on days when the weather was good one group of scientists would be flown to target locations. The others would form a ground party or be at a satellite camp.

The satellite camp at McDonald Heights was established on November 24. It comprised two tents and took its first four occupants Weaver, Pankhurst, Storey and Carroll - 30 minutes to set up. On 28 November they were replaced by Bradshaw, Mukasa, Di Venere and Harris.

On 2 December this camp was moved to the Demas Range and Bryan Storey replaced Di Venere. After delays because of the weather the camp was pulled out on 18 December. Patton Bluff was visited as a day trip and the return flight could not get back to base due to low cloud. They landed some 20km away and camped. Christmas Day was celebrated in characteristic weather on December 27, with two days work to follow and two further days completed in early January. On January 6 the aircraft left for the WAVE camp at Mt. Haughton, Carroll remaining with the team destined to return to New Zealand.

One thousand five hundred kilograms of rock samples were packed and the camps made ready for all to return to Scott Base. Two weeks later the first pull-out flight arrived at

10.30pm with the task being completed in two further flights during the following days, the team returning to New Zealand early in the third week of January.

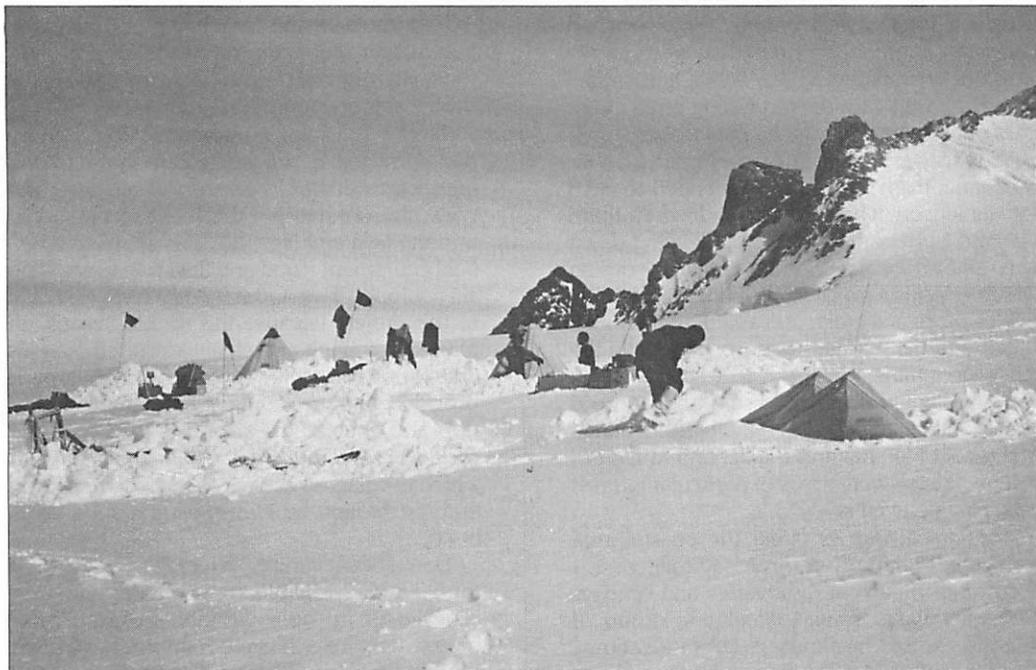
Under the joint agreement each country had provided a roughly equal share of the logistics; from the UK came the Twin Otter and crew, the US had put the fuel and personnel into the field and New Zealand supplied tents, field equipment, food and field transport. The ski-equipped Twin Otter 77-FBC was essential to the project because the rock outcrops in Marie Byrd Land are widely scattered over an area approximately 400km by 150 km. It provided safe, economical and reliable transport and enabled the scientists to visit all the rock outcrops in the area over the region in which the glaciers appear to move very rapidly and are broken by crevasses and snowfall is heavy.

Some 50% of the days were lost because of the blizzards and whiteouts but as this had been allowed for in the expedition's plans all the objectives were achieved. Samples have been returned to New Zealand, the States and the UK for further specialist analysis.

Two further seasons work are planned. The first will focus on the east around Pine Island Bay and will involve icebreaker support and the second will be in the Kohler Range where the Twin Otter will again be essential.

WAVE completes its second season.

WAVE, relatively unaffected by the previous summer's logistical problems, completed its second season in the field. The team comprised Dr John Gamble of Victoria University, Wellington, Dr John Smellie of the British Antarctic Survey and Dr's Bill McIntosh, Kurt Panter, Phyl Kyle and Nelia Dunbar of the New Mexico Institute of Mining and Technology. They were accompanied by two field assistants Bill Atkinson, of Twizel and Paul Rose of BAS. Detailed volcanological mapping and sampling was undertaken on Mount's Sidley, Waesche and Murphy and additional collections made at Mount Cumming, Dorrel Rock and the USAS Escarpment. Planned



visits to the Toney Mountain, the Crary Mountains, Mount Petras and Mount Flint were however cancelled because of bad weather and the aircraft which broke a ski.

WAVE's mapping programme confirmed that the majority of rocks forming Mounts Sidley and Waesche erupted above sea-level. Mount Murphy proved more interesting in that it has been created by a number of eruptions, the first being either below water or ice which is evident at its base. Higher up the structure changes, as is more typical of a volcano which has erupted above sea level. Sub-aerial lavas have erupted onto surfaces scarred by glacial activity and occasional soil horizons separate the units of lava flow. Such sedimentary layers may yield microfossils which will be important paleoclimatic indicators.

Other fossil material, mainly small plants, twigs and leaves were found, possibly for the first time in Marie Byrd Land, in the sedimentary rocks forming the basement of Mount Murphy. Highly accurate argon dating studies are to be undertaken on samples collected across the transition zone. Detailed analysis of this data together with the stratigraphic infor-

Members of the SPRITE team working in Marie Byrd Land dig out their base camp after one of the numerous blizzards experienced during the summer. Photo: John Bradshaw.

Notice to polar buffs, general readers and luddites.

Your editor's attention has been drawn to a number of literals which occurred in the last issue of "Antarctic". That issue represented our entry into Desktop publishing and although the foray was not totally enjoyable, experience is now starting to prevail. Spellchecks are clearly not sufficiently reliable and the human element shall again dominate. In the meantime your editor is very apologetic but does not wish to make a collection of correspondence or log endless hours on the telephone regarding such errors.

mation may yield important information as to the permanence of the West Antarctic ice sheet during late Cenozoic times.

Geochemical studies of the volcanic rocks are being undertaken in order to understand the evolution of the magmas and their source. Xenoliths, rock fragments now contained in the lavas but initially plucked from the deep earth as the magmas moved to the surface, have been collected from small or parasitic scoria cones in all the centres visited. They range in composition from shallow crustal rocks which are either subvolcanic intrusions, immediate basement to lower crustal, or mafic and felsic granulates to mantle peridotite. Such xenoliths promise to yield unique information on the crust and lithosphere of the earth in a region where only the tops of the volcanoes peek through the ice cap. The party were in the field from early November to mid January. They established two base camps, the first on the South side of Mount Murphy and from which six field camps were set up around the mountain, and the second in the northern part of the Executive Committee Range. A further season enabling them to visit the Toney Mountains, the Cray Mountains, Mount Petras and Mount Flint will complete the project.

Skuas spend summer in tents

South Polar skuas are strongly territorial and the number of territorial pairs in any given area varies little from year to year. The presence of adult, non-breeding skuas in small groups, or "clubs" near breeding pairs suggests to scientists that populations are limited by a characteristic in the birds' territorial behaviour.

Gordon Court, a PhD student from the University of Otago and Richard Wilson, an undergraduate in Zoology, are investigating this thesis. From 14 November until 28 January, a period covering the arrival of the birds and the peak of the breeding season they remained at the Northern Rookery of Cape Bird on Ross Island. For the third consecutive season they monitored the size of the "club" finding its numbers never exceeded 40 birds but that its

composition was dynamic. Up to 300 individual skuas may visit the club during the summer. By checking and recovering rings they found most did not appear to be breeders from other skuaries in the Ross Sea area but were non-breeders from rookeries up to several hundred kilometers distant.

The pair removed a number of territorial birds to evaluate whether they represented a surplus of reproductively capable adults which were excluded from breeding by territory or for other reasons. Study the previous season had indicated that the non-breeding birds were not under pressure to find territory and an experiment this summer involving the removal of birds supported this finding. (The birds which had been removed settled amicably in a square green tent normally the preserve of New Zealand Girl Guides. Food in the form of penguin remains generally left by Leopard seals was provided and some put on weight. Each bird was fastidious over cleanliness and behaviour at bathing time was very competitive with a real pecking order emerging). Paired birds in the club did not move to the territory vacated and among the population sexual behaviour and dominance appears to have no bearing on the order of recruitment. When adult males were removed the females quickly found a replacement but when females were removed the male partner was slower to replace them and did so less frequently.

Tissue samples were also collected from dead skuas and Adelie penguins as well as abandoned eggs of both species from the rookeries on Ross Island. These are now being analysed for residues of organochlorine pesticides PCB's and heavy metals with a view to identifying any effects of residues on skuas such as shell thinning, or oxidase activity in the liver. From the results they will assess whether pollutant loads are high enough to adversely affect the reproductive success of these birds.

Skuas particularly are ideal for such studies as they are highly migratory, wintering along the coastlines of developing countries in the southern hemisphere which continue to use persistent organochlorine pesticides like DDT, banned in the most developed northern hemisphere countries. As a scavenger and predator the skua is exposed to the various pesticides



and industrial pollutants which continue to increase in variety and concentration in marine ecosystems.

Although penguins do not move as far as the skuas the preliminary results show that both species contain residues of organochlorine pesticides, including DDT and hexachorobenzene and polychlorinated biphenyls. Levels in the Adelie penguin confirm earlier findings that organochlorines can be transported through the Antarctic convergence by atmospheric fallout and ocean currents. On the other hand levels in the south polar skua show the extent of organochlorine pollution in the world's oceans with PCB and DDT levels over 50 times those in penguins.

Little is known about the effects of man-made toxins on skuas as a group but levels of the compounds in some of the eggs from Cape Bird is as high as "critical levels" in other species of birds. The measured residue levels will act as a benchmark with which to compare pollutants in future but in the meantime skuas particularly make an ideal barometer of environmental health.

The BAS Twin Otter provided safe, efficient, economic and reliable transport for the "international" field parties working in Marie Byrd Land. Photo: John Bradshaw.

New map will link Convoy Range with Thundergut sheet

A further stage in DSIR's geological mapping programme in Southern Victoria Land was completed during the summer. The objective is to produce a series of 1:50,000 maps showing all aspects of the geology of the region. Existing information and the results of new field and laboratory work are being incorporated in the project which is a co-operative effort being undertaken with the Department of Geology, University of Otago and other organisations.

During the summer Dr Ian Turnbull, Andrew Allibone, David Heron, and Jane Forsyth concentrated on the St. John's Range, while

covering an area from Wright Valley to the Mackay Glacier. Field camps were established at Schist Peak, Bull Pass, Wheeler Valley, Sperm Bluff, Pegtop and Gondola Ridge. From these work was supported by helicopters but a considerable amount of backpacking was also undertaken. Once the petrological and geochemical work has been completed the data for the St. John's 1:50,000 sheet can be compiled.

In all the team mapped five geological units. The oldest, the Koettlitz Group, consists of metasedimentary rocks which form two belts, along the central St. John's Range and the Insel Range Nickell Peak area. The eastern belt is mostly amphibolite with abundant orthogneiss and deformed megacrystic granitoids, but diorite and gabbroic orthogneiss also occurs. The western belt is mostly marble with some calc-cilicate and paragneiss.

Eight major granitoid plutons form the rest of the basement. Several of these plutons were traced into the Victoria Valley from where they were previously mapped in the Wright Valley. Mapping of these plutons has allowed the integration of previous radiometric dates with the intrusive sequences established during the season's work and from the Thundergut sheet in 1988-89. Prominent Felsic and mafic dikes occur in several areas.

Numerous remnants of Beacon Supergroup sediments occur throughout the area. On the Olympus Range west of Bull Pass, the normal Taylor Group sequence is preserved but further east and to the north there is widespread conglomerate with an unusual volcanic - lowgrade metasediment source. The underlying Kukri Erosion surface has been offset in most places by later Ferrar Dolerite Intrusions and also by faulting. In the Wright Valley, there has also been lateral movement of the sequence above the "peneplain" Ferrar Dolerite sill. Ferrar Dolerite forms the bulk of the Clare Range area.

Mapping of the morainic deposits in the Victoria Valley confirmed previous work. There is evidence of very high level glaciation in the Miller Glacier and Mackay Glacier areas. Remeasurement of glaciers in the Victoria Valley shows them to have advanced over the last ten years.

Six maps in the series are now at various stages of publications. The St Johns map resulting from work this season combined with analysis of field and laboratory results should be published in 1993. It will link the work undertaken in the Convoy Range in 1989-90 with the Thundergut sheet which will be published in 1991.

Further studies with fish, worms and pollutants

As the Antarctic is a relatively pollution free environment, the flora and fauna have evolved without having to combat pollutants but might therefore be particularly susceptible if exposed. Additionally many of the animals are theoretically living in temperatures which are close to their lethal limits and so extra stress could restrict their adaptive ability or alternatively they may be particularly tolerant. Such hypotheses have been behind the work of Dr Bill Davison and his colleagues from the University of Canterbury's Department of Zoology.

In the summer of 1989/90 they exposed a species of Antarctic fish *Pagothenia borchgrevinki*, to high levels of hydrocarbons from fuel oil and found the fish to be very tolerant. Their results suggested that high levels of stress could be tolerated by this species of fish for short periods of time. This was important because these fish are basically pelagic and likely to be exposed to fuel oil for short lengths of time should spills occur. However chronic exposure is more likely as the pollutant spreads over a wide area and during this last summer they assessed the likely effects.

As with the previous year's study, water soluble components of Antarctic diesel fuel (DFA) were used. Such a fraction of the oil is obtained by continuously stirring a 5:1 mixture for 24 hours before siphoning the water off. The resulting mixture was 100 percent saturated with the water soluble components found in diesel fuel and a 20 percent concentration of this was used for their experiments.

Fish were placed into this water for seven days, half the water was replaced between two

and three times a day and it was continuously aerated. After seven days the fish were examined to determine the influence of the diesel fuel on their respiratory systems and blood chemistry. Two different experiments were used to achieve results. The first involved closed box respirometry. Ten fish, only five of which had been exposed to the oil, were tested in order to assess the effects. A different group of 12 fish, six as controls and six of which had been exposed were killed with an overdose of anaesthetic and blood, gill and liver samples were taken. The blood was analysed for the percentage of haematocrit and haemoglobin concentration and the plasma samples collected and returned to New Zealand for work to determine chloride concentrations and osmolarities. Gill and liver samples were fixed in glutaraldehyde for later examination under the electron microscope; from this the scientists hope to determine whether any morphological or ultrastructural changes had occurred as a result of the exposure.

Results from experiments at Scott Base showed that overall the fish display a high tolerance to the water soluble compounds of diesel fuel oil. None died as a result but after 24 hours stress increased, the skin darkening considerably and ventilation became deep and laboured. Mucous often came from the eye cavity and also covered the gills. This possibly reduced the ability of the fish to extract oxygen from the water but this to some extent could be attributed to the reduced pressure in the aquarium environment. Haematocrit and haemoglobin concentrations were slightly higher in the fish exposed to oil which suggested a recruitment of red blood cells from the spleen. Plasma chloride concentrations and osmolarities are being analysed at present.

Pagothenia borchgrevinkii is, however, only one species living in the cold Antarctic waters and the effects of fuel oil on other animals is important because they may be more susceptible.

Work, the previous season, on the large bottom dwelling Nemertean worms showed them to be working at the limits of their ability to extract oxygen from their aquatic environment. This last summer, the team sought to discover how acute levels of hydrocarbons

would affect the respiratory physiology of the species. They were subjected to two concentrations of the water soluble fraction of fuel oil; 100 percent representing acute exposure and 20 percent being typical of possible chronic exposure. The worms were monitored for several days. Closed box respirometry was conducted in order to observe effects of stress on their metabolic rate.

High concentrations of fuel oil produced a massive increase in the amount of mucus production and killed the worms in a very short time. The amounts of mucus were so great that they interfered with the experiment, coating everything including the oxygen electrode membrane circulation tubes and restricting water flow. Clearly the worms have low metabolic rates even under normal conditions but mucous production prevented the team achieving reliable results at such high concentrations.

At lower concentrations however, the worms survived for at least seven days. Mucus continued to be produced but at a reduced rate. It is thought that the Nemertean worm might be useful as an indicator species in case of oil spills.

Other work included continued study of the prevalence of X-cell gill disease in *Pagothenia borchgrevinkii* and its effect on the supply of blood to the gills. X-cell disease is a hypoplasia of the tissues causing the gills to swell. The team have been monitoring the prevalence of the disease in the fish in the McMurdo Sound area for the past five to six years. In 1985/86 some 16 percent of the fish were infected and this had increased during the 1987/88 season to 26 percent. Last season some 35 percent of the fish were found to be infected. The disease affects the respiratory and osmoregulatory systems of *Pagothenia borchgrevinkii* and the condition of the infected fish is generally poor.

Plastic resin casts of the gills of five fish were made for ongoing study. The fish were killed by an overdose of anesthetic and the heart and ventral aorta exposed. A plastic cannula inserted into the ventral aorta carried a saline solution used to clear the gills of blood and a special resin was injected slowly into the blood system until the gills were filled and the solution appeared in the branchial system and dorsal

aorta. Once the resin was set, the gills were excised and the tissue dissolved in a strong alkaline solution. The cast of the blood system down to the capillary level will be viewed under a scanning electron microscope and the casts compared with those of healthy fish.

Seventy-five live fish of the two species *P. borchgrevinki* and *P. bernacchii* were caught for transport to Christchurch for subsequent experimental work. This will centre largely on cardiac physiology.

The team involved in this project comprised Craig Franklin, Jan McKenzie and Peter Carey under the leadership of Dr Bill Davison who did not go south during the season. The others were on the ice from mid-October to late November and operated between the fish hut on the sea ice in front of Scott Base and in the laboratories. *"Antarctic" acknowledges their assistance in the preparation of this article.*

Adelie Penguin numbers counted in comprehensive programme

Since 1981 a team from DSIR Land Resources (formerly Ecology Division) in Nelson have been collecting baseline data on Adelie penguin populations in the Ross Dependency. They are attempting to relate annual changes in numbers of penguins breeding, and their breeding success to weather, sea ice and other climate parameters in order to distinguish between responses attributable to natural events and those induced by commercial exploitation or human disasters. Data is collected by ground counts and using black and white aerial photography which last summer was extended to experimental use of colour for the first time.

The study is a long term contribution to SCAR Bird Biology Committee's international programme, designed to monitor environmental change in the Antarctic Ocean ecosystem.

Between 1981 and 1990 all islands and coasts of Victoria Land and part of Oates Land

between 158deg E and 175deg E have been searched and eleven previously unreported breeding sites discovered. The region is now known to have 39 Adelie penguin rookeries with a total of over 1,000,000 breeding pairs - almost half the known world population. The team have sampled a range of rookeries chosen for their variations in size, topography and latitude and photographed most of them for ten seasons to study the pattern of natural fluctuations and numbers breeding. A census of most other rookeries have been taken at least once during this time.

Two techniques have dominated; ground counts and black and white aerial photography. Using Cape Royds as an example, the accuracy and efficiency of the two methods have been compared as part of the study. Weights and measurements of 100 chicks sampled randomly provide both an annual and area condition-index for the chicks.

Scientists now know where Adelie penguins breed in the Ross Dependency and the relative numbers. Other researchers have confirmed the importance of krill to the penguin diet, have tested and developed radio-tracking techniques in Antarctica to help determine the areas in which the birds feed and further studies have shown that nesting success is closely tied to the length of incubation shifts and these are probably related to the availability of krill to the breeding birds.

Last summer the scientists from Nelson made two trips to the ice. The first part of the season's work was undertaken by Bruce Thomas, Brian Karl and Kerry Barton and the second by Peter Wilson and Bruce Thomas.

During late November to early December they continued their aerial photographic census of the Adelie in the Ross Dependency, flying most rookeries on Ross Island by VXE-6 helicopter. Cape Bird rookeries, Beaufort Island, and a further 12 rookeries along the Victoria coast from Cape Anne to and including the Duke of York Island were covered by a VXE-6 LC-130 Hercules on 2 December. It is the first time that VXE-6 have undertaken this flight which was necessary because of the early closure of the ice runway precluding the use of the RNZAF 40 Squadron C-130 wheeled Hercules. The team were accompanied by an

RNZAF photographer LC Darryl Thorburn who provided back-up coverage and collected public relations material. In all they photographed 20 rookeries in black and white.

Ground counts were completed at Cape's Royds and Barne between 1 and 5 December. They indicated a decline in pairs breeding at Cape Royds with only 2,525 nests occupied. This represents a drop of 1459 breeding pairs over the last two seasons. Only one pair of Adelies was found at the new Cape Barne rookery where five pairs had bred in 1988. In December 1990 the ice edge was still north of Cape Bird. It is the second successive year that the sea ice was late breaking out from this area and the birds nesting at Cape's Barne and Royds needed to walk between 30 to 50 kilometres to reach open water which is likely to account for the minute number at Cape Barne and their failure to breed there successfully in 1990.

A brief ground check at Cape Crozier rookeries in December indicated that the Adelies there were in much better condition, more settled and further advanced than those at Cape Royds. A polyna in the sea ice gave these birds access to the sea and a ready food supply for the season.

In late January (during the second part of the field programme) Peter Wilson and Bruce Thomas tested colour aerial photographic techniques for the first time from VXE-6 helicopters flying over the Ross Island rookeries. It was attempted because of the lack of definition between adults and chicks on black and white prints. January counts are necessary in order to assess the season's breeding success at the rookery up until the departure of the first chicks.

Also during January 100 randomly selected chicks at Cape Royds were weighed and their flippers measured for length. A further 100 were sampled at Cape Crozier East in order to establish a relative comparison of condition and an index with which to compare future data.

The chicks were in creches with only a few adults and catching them for weighing and measuring without creating a major disturbance within the group was not always simple. The team fashioned a "shepherds crook" from

a bamboo pole and wire and guided the wayward chicks to a point of capture. In all 100 from the eastern rookery were weighed and measured. Progress at Crozier was still much more advanced than Royds with many chicks already moulting and most were in better general condition. The team checked Royds on the return flight to Scott Base to find that progress continued to be slow with only minimal creching evident.

Analysis by computer of flipper length and body weight has confirmed the casual observations that chicks at Cape Crozier were on average older and in better condition than those at Cape Royds.

Further photographic trials were run at Cape Crozier between 22 and 26 January.

All film from the season's flights has now been developed and both printing and counting is underway. Preliminary calculations from Cape Royds chick census data show a 0.85 success rate for chicks per breeding pair. This represents a decline of 15 percent from last season.

In addition to analysing the changes in numbers of breeding penguins between seasons the team is correlating the data with weather information and details of ice conditions in spring in order to help determine the effects of such natural environmental changes on the populations.

"Antarctic" again thanks the field team for their assistance with this article.



ANARE

New mapping programme producing dramatic results

Two further projects last season have enhanced an already extended mapping programme being undertaken by the Australians. They comprised a hydrographic survey of the approaches and anchorages in the vicinity of Australian Antarctic Stations and upgrades of survey controls at all stations except for Law Base. Extra controls have been established in the Prince Charles Mountains for the 1:500,000 mapping series.

From 1957 surveying and mapping support for Australia's Antarctic programme was provided by a Commonwealth agency, the Division of National Mapping, operating in conjunction with, but outside of, Antarctic Division and supported financially by public interest appropriation funding. In the years after 1976 little Antarctic mapping was undertaken but in late 1987 the Australian Surveying and Land Information Group (AUSLIG) evolved within the Department of Administrative Services from government reorganisation. As part of this development responsibility and funding for the Antarctic mapping programme were transferred to the Antarctic Division. Under the new arrangements AUSLIG undertakes surveying and mapping services for the division on a fee for service basis.

For a start the programme was managed on a part-time basis within ANARE by Martin Betts head of the division's Planning and Coordination Section. The appointment, however in August, 1990 of a Mapping Officer, Rupert Summerson has resulted in a full time programme.

One of the first projects of the division shows achievements of ANARE from 1947 to 1966. It is a large double-sided poster map showing voyages, the areas discovered and the scientific exploration by Australians over those years. On the reverse is an itinerary of each Antarctic voyage as well as a brief description of the annual activities of the various bases. The map is being distributed to all Australian secondary schools for use in geography and history programmes.

In 1989 the first experimental colour satellite image map was produced. It covers, at a scale of 1:25,000, Law Base and the Larsemann Hills. A second map covers the area around Casey. Two SPOT images were put together as a mosaic and fitted to existing ground control to produce a 1:50,000 map (2cm:km). The result resembles a large aerial photograph in which features can be identified but detail requires interpretation. To provide this and in a further stage of the project, AUSLIG produced a conventional topographical line map printed on the reverse of the image. This has been enhanced by supplementary photographs of prominent features which indicate something of the general character of the area.

The map, entitled "Windmill Islands, Wilkes Land, Antarctica" also contains a small potted history of the area. Users are told that they are a "group of rocky islands and continental rocks extending northwards for about 25 kilometers from Vanderford Glacier on the edge of Vincennes Bay. The area was first visited in 1947-48 during Operation Windmill: a United States Navy Task Force exercise, after which the Islands were named. In 1956 Phillip Law led the first Australian National Antarctic Research Expedition (ANARE) party to visit the Windmill Islands to be followed later the same year by a Soviet Antarctic expedition. As part of its scientific studies during the International Geophysical Year, the United States established Wilkes Station on Clark Peninsula in February 1957. Two years later, on 4 February, 1959, Australia accepted custody of this

temporary station. In 1965 ANARE began construction of a permanent Station on Bailey Peninsula, across Newcomb Bay from Clark Peninsula. Known as Casey Station since it was completed in 1969, this base has now been superseded by the new Casey station opened nearby on Bailey Peninsula in December 1988. The Windmill Islands are of special interest owing to the summer breeding colonies of the Giant Petrel found on Ardery and Odbert Islands. Because of their particular importance, these islands are internationally protected and cannot be visited or flown over."

The design of the Windmill Islands Map is being adopted as the standard approach for all new larger scale maps. It is being followed by:

- Beaver Lake in the Prince Charles Mountains at 1:100,000
- Framnes Mountains (Mawson) at 1:100,000
- Larsemann Hill (Law Base) Edition 2 at 1:25,000
- Vestfold Hills (Davis) at 1:50,000
- Rauer Group (South West of Davis) at 1:50,000
- Bunger Hills (Edgeworth David Base) at 1:50,000

and, depending on image quality possibly also Heard Island and Macquarie Island.

A further series of three maps at 1:1,000,000 scale in the eastern sector have also been published completing coverage of all rock features at the scale in the Australian Antarctic territory.

These maps extend along the Transantarctic Mountains as far as 84 deg S.

Highlighted on the maps is the route of the manhauling sledge journey to the South Magnetic Pole undertaken by Edgeworth David, Douglas Mawson and Forbes Mackay in 1909. Completed in January 1991 was also a heritage map of Cape Denison in Commonwealth Bay. The Cape was the site of the main base of the Australasian Antarctic Expedition, led by Sir Douglas Mawson in 1912-14. Included on the map is a history of the site as well as general and safety information.

In addition to mapping, AUSLIG organises surveyors from its staff for field parties who require such expertise. A recent example was a further glaciology traverse south of Mawson

along the side of the Lambert Glacier Basin. The Lambert is of particular interest to scientists as it is the world's largest glacier draining about seven percent of the Antarctic icecap. The Lambert Glacier-Amery Iceshelf basin will be mapped by satellites using enhanced colour at 1:500,000. It will be part of a series extending across Prydz Bay as bathymetric maps of the sea floor for marine scientists.

Provisional bathymetric maps at 1:500,000 series were also prepared on the Kerguelen plateau for marine science work undertaken by Aurora Australis on its maiden voyage in 1990.

The priority of the mapping programme has been to produce large scale maps of the most frequently visited areas which are inadequately covered by current maps. Rather than upgrade existing maps by putting surveyors in the field AUSLIG has chosen to make use of the new technology available to it. Two major satellites commonly used in mapping are LANDSAT, operated by EOSAT, an American Company and SPOT, Spot Image, a French Company. Each of the satellites carries a battery of sensors observing earth at different wavelengths. The radiometric information is immediately converted into digital data and transmitted to a ground receiving station for storage on magnetic tape and subsequent use.

Resolution of the objects on the ground depends on the satellite's altitude and velocity, the quality of the lens and the size of the picture element or pixel to which each unit of the digital data is scanned. LANDSAT uses pixels of about 80m on the ground while SPOT has a coverage of about 10 pixels per metre for panchromatic images. Resolution of objects on the ground into pixel blocks determines the scale of the map that can be appropriately reproduced from the image. At a scale of 1:100 000 the detail is so fine as to resemble a photograph but enlarging it to 1:25,000 renders each pixel visible and the impression is blocky as if it is in its raw state.

Both LANDSAT and SPOT are orbiting the earth towards the poles but the Antarctic poses two problems so far as the collection of data is concerned; during winter vast areas are in darkness and for much of that time features of topographic interest are likely to be covered

by snow and not emerge until mid- to late summer. For glaciological purposes the low sun angle shows a much greater definition on ice features both on the sea ice and on the plateau but rock areas are best photographed with satellite imagery in late summer.

Printing of the maps

Printing of the maps was not straightforward and involved much new technology, techniques for which have been developed by an Australian company Lasergraphics in conjunction with AUSLIG. Production of the first edition of the maps, using the best existing cartographic methods, required much intermediate work with losses in colour and resolution. The project was also time consuming and expensive. Lasergraphics is a high tech scanning and plotting firm in Sydney.

Initially SPOT satellite data is produced in digital form in three wavelengths, each sensing a different part of the colour spectrum. The information as supplied is already colour separated but to make the most of this feature a special technique was developed to prepare the printing plates directly by assigning a colour to each wavelength. Line vector information is integrated from other printing plates.

Test printings of the second edition of Larsemann Hills (1:25,000 series) and Beaver Lake (1:100,000) series were undertaken by a specialist printing firm linked to Lasergraphics. After several attempts acceptable results were obtained and the stocks will later be used with a printed line map on the reverse side. Although improvements have already been secured further developments promise even greater resolution. Currently the 1:25,000 scale map of Larsemann Hills is the practical limit of enlargement possible from 20 m pixel space imagery.

Multiple images

Maps can be produced from one or more images or if the map size is greater than the image area it can be produced from a mosaic of images. Should part of the image be obscured by cloud, a part scene from another image can be utilised. Once the satellite has acquired the digitised image, it is geometrically fitted to ground control points positioned by

surveyors while working in the field. Precision to about two metres in three dimensions can be obtained but much more precise relative fixes can be achieved with Ground Positioning System methods (GPS). These involve ground fixes with portable equipment.

AUSLIG is also making use of a geographical information system (GIS) which is basically a computer with special software that can manipulate spatial information. All information that is normally drawn on a map can be digitised and stored as data but GIS offers information that can also be manipulated so that models can be devised and tested against theories.

Three areas currently being used for a trial of GIS by AUSLIG are the Windmill Islands, Vestfold Hills and Heard Island. AUSLIG is also digitising corrected or new topographical maps to form a terrain model to which other geographical and environmental attributes can be added. These will include monthly and seasonal distribution of sea ice, meteorological data, glaciological data such as snow accumulation rates, geology and known habitats of every type of wildlife from lichens to breeding grounds. At first GIS will serve as a resource inventory of what is known but later as the database becomes more complete it will be available for more sophisticated modelling. Plans are being made for all researchers to record their data on a standard computer readable format with spatial referencing so that it too can be recorded on a single Antarctic environmental database.

Although the new mapping is mostly being concentrated on specific locations at large scales, satellite imagery is being collected for mapping on a regional basis as part of a revision of the 1:1,000,000 series. The data is then digitised, as part of an agreement with other SCAR nations, so that eventually the whole of Antarctic will be available as a digital cartographic database. (See Vol 12. No.4.) Map sheets covering featureless interiors of the continent will not be printed, but the data from these areas too will be stored on a database for incorporation into the geographical information system which can be used according to demand for scientific studies or for environmental management.

Navigational charts

Navigation charts are essential for the safety of ships operating within the AAT. Present charts are dangerously inadequate for unrestricted marine operations as they are based on information gathered on a casual basis by supply vessels. Until the early 1980's they were considered adequate because vessels operating in the region usually were small with a shallow draft but more recently larger vessels are used continually both for supply and marine science. Moreover the increase in tourist vessels makes accurate charting even more essential for safety reasons and for environmental protection. Sites of special scientific interest are also a growing priority.

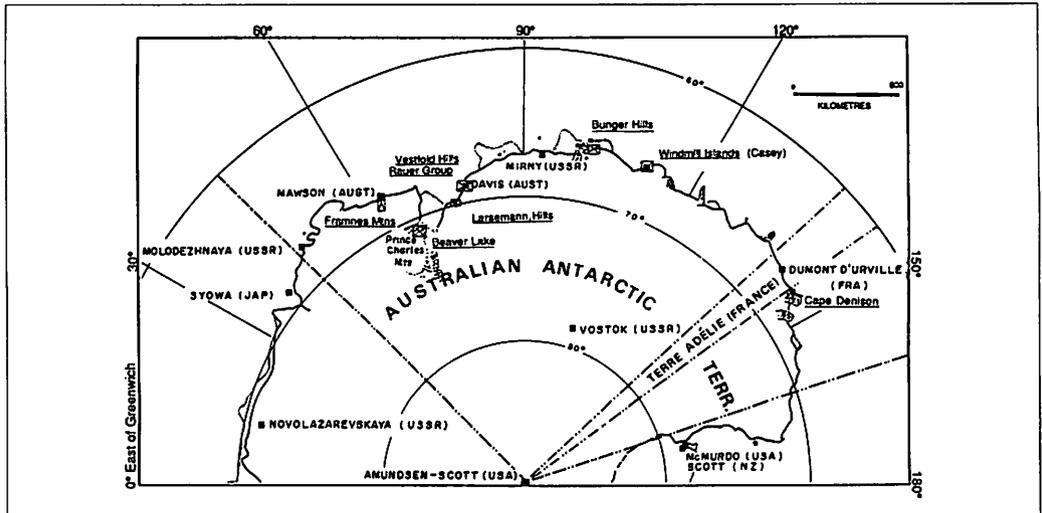
Over the last few summers the Australian Navy's Hydrographic Office has begun and implemented a five year rolling programme of Antarctic coastal charting. The programme is part of a wider objective to develop, manage and maintain a maritime data base as a subset of the General Integrated Model of the Ocean which cover the entire region of Australian Maritime interest and forms the basis, among other things, for the production of nautical charts on a national scale. Its prime function in the Antarctic region is providing charts for navigational safety.

The Hydrographic Office Detached Survey Unit (HODSU) works by arrangement from an

ANARE ship with its own small survey boat. This can be detached from the vessel so long as support is available from either the ship or helicopters or other craft operating in the area. The unit is currently upgrading charts for the approaches to Mawson, Davis and the Heard Island coast.

This last summer however, the field work was concentrated on the approaches to Casey. The work was undertaken under Hydrographic instruction 161 and was divided into two priority areas, the anchorage of Casey in Newcombe Bay which was surveyed at a scale of 1:10,000 and the approaches to the station at a scale of 1:25,000. The work was undertaken in Survey Motor Boat Deliverance which was positioned with the electronic positioning system Falcon IV Miniranger. Shore stations of the Falcon IV were erected over existing or new survey control marks established by HODSU. During the survey a tide station was established in Newcombe Bay. Sailing directions and photographic views were observed for the survey area and adjacent coastlines.

"Antarctic" would like to thank ANARE news and Mr Rupert Summerson for their assistance in the preparation of this article. Mr Summerson was a member of Robert Swan's Icewalk Expedition to the North Pole in 1989.



Australia seeks tradespeople for Antarctica

"If you have trade or technical skills and a yen for something unconventional, then a stint on the ice with the Australian Antarctic Programme may be just when you need" reads a recent press release from the Australian Antarctic Division.

The Division traditionally finds it hard to appoint sufficient plumbers and carpenters as the Antarctic season ties in with a time of peak building in Australia. It was therefore seeking a wide range of tradespeople (approximately 100 in all) and technical staff to serve its research programme at both its continental and subantarctic stations.

Plumbers, electrical fitter-mechanics, radio technical officers and communications officers - commonly in short supply for antarctic service- were the particular target of the recruitment drive.

The Division has advertised in newspapers and around the country for both summer and full year employment next season at Casey,

Davis, Mawson and Macquarie Island. It was looking for people qualified and experienced as plumbers, electrical fitters, radio technical and communications officers, chefs, diesel mechanics, plant operators, carpenters, riggers, painters and plasterers.

Appropriately qualified women were also eligible to apply for all positions with the Division, which is an equal opportunity employer. Women have served the country in Antarctica since the 1970's read the release. Applications closed on 22 February and the response was more than satisfactory leaving the division, puzzled. Income from a stint on the ice can be just as high as that earned at home; was it just a lack of publicity?

FINNARP-90-91

Programme for Aboa cancelled

For the second consecutive year Finland was to have carried out a scientific programme from its station Aboa which was established in 1988/89 and lies at 73deg 03 min S/13 deg 25 min W. The programme, however was cancelled, when under the joint logistical arrangements with the Swedes, transport could not be arranged.

The Finnish party were to have boarded the 60 metre long vessel R/V Aurora at Port Stanley in the Falkland Islands in early January reaching the ice edge on the Western Queen Maud Land about two weeks later. From there they would have used the ship's Hughes 500 helicopter to fly to the station and work for nearly three weeks before returning to the ship, disembarking at the Falklands and flying back to Finland.

Finland signed the Antarctic Treaty in 1984. Her scientists participated in expeditions being undertaken by the Swedes and Australians as well as the Joint European EPOS study. The 1989 expedition was the first large one arranged by the two authorities responsible for the Finnish Antarctic Programme. They are the Finnish National Committee on Antarctic Research and the Finnish Institute of Marine

Research. That expedition marked the start of continuous research for the Finns on the continent and in the marine environment and the scientists involved accumulated an enormous amount of data which is still being analysed.

Aboa is to be resupplied every three years. Because the Finnish marine research vessel R/V Aranda is too small for this operation it will continue to be undertaken with logistic cooperation from other countries but mainly Sweden. Under the mutual agreement made by the Scandinavian countries Finland will be responsible for organising the logistics next season and Norway the following season.

Transport available to the scientists at the station includes a Haggblunds BV-206 and six Lynx snow scooters equipped with Eskimo sledges. Two Honda three wheelers and a Valmet tractor with trailer support base re-

quirements.

Winter programmes being undertaken by the Finns at the station are automatic; a weather station sends data through the ARGOS satellite system. Meteorological and climate programmes focus on producing continuous data for both synoptic and climatological studies. The site of the Aboa gives possibilities for unique information on the continental climate

in this part of Antarctica.

The 1990 programme was to have been much reduced and be carried out by a small group of scientists and technicians who were to collect further data and maintain the station.

A large joint expedition is being arranged by Finland, Norway and Sweden for next summer.

EPF

French finances in doubt but airstrip project continues and new base planned

EPF's (Expeditions Polaires Francaises) 41st French expedition to the Antarctic is well underway with the summer programme completed in early March and winter operations now in hand.

The expedition was supported by L'Astrolabe, constructed in 1986 with a gross tonnage of 1,700. She has an ice classification of 100 AI LMC Class I and is owned by Feronica International Shipping, a wholly French owned Freight Company and subsidiary of Compagnie Nationale de Navigation. There are 20 cabins for passengers and crew.

Sailing under the Command of Captain Gerard Daudon with a crew of 12 L'Astrolabe left Le Havre on 12 October for Cape Town and Hobart where she arrived on November 24. Expedition personnel left France by air on 21 November and joined the ship at Hobart. Between then and 22 April 1991 when she was due to return to Le Havre the ship made five voyages to Dumont d'Urville to support summer programmes and resupply the base for the winter. Six voyages had been planned but the third and fourth were combined after the ship was trapped in sea ice some 60 km from the coast of Terre Adelie for ten days.

One of the major summer projects was further construction of the airstrip with the line between the islands now nearly two thirds complete but needing to be raised to provide the main trajectory. The foundations and scaffolding for the hangar and the control tower were also laid. New laboratories have been constructed but further work on base rebuilding seems unlikely at present for financial reasons. The foodstore and engineering workshops were built in 1957 for IGY, the International Geophysical Year. Finance however is said to be secure for the completion of the airstrip and construction of a new base at Dome Charlie.

According to a recent article in *Nature*, funding and logistical arrangements for the French Antarctic programmes remains complicated. Government grants for research in the French Antarctic Territories and the four sub-Antarctic Islands is still managed by Terres Australes et Antarctiques Francaises (TAAF). It is a government department which was established in 1955 and is part of the Ministry for Overseas Departments and Territories (DOM-TOM). The actual expedition management including the provision of food and equipment and logistical arrangements is the responsibility of EPF, an organisation set up in 1947.

In 1989-90 DOM-TOM gave TAAF FF45 million from its civil research budget and a further FF75 million from its allocation of



Terres Australes in the French sector of Antarctica provides a backdrop to the area of current activity. The airstrip is in the left foreground and Dumont d'Urville lies to the right on the larger Island.

Photo: A. Guichard/EPF

territorial money.

Some FF17 million of DOM-TOM's grant is spent on transport and the hire of the *L'Astrolabe* and a further FF50 on running the *Marion Du Fresne* supporting marine research and sub-Antarctic operations. Over the past ten years however DOM-TOM's funding for TAAF has decreased from FF103 million to FF75 million. Last year TAAF received FF25.5 million for its operations and FF20 million for the airstrip construction at Dumont d'Urville. For the 1991 financial year TAAF requested FF26 million but received only FF20 million. With fixed costs of FF17.5 million for summer and winter programmes alone next years programmes remain in doubt.

Nature also says that discussions in France have centred on the establishment of a new polar research institute which would cost some FF210 million and replace EPF. Negotiations faltered last July when TAAF's chief administrator changed but now that they have re-

started they are focussing on the boundaries of the responsibility between the new organisation and TAAF. Reports indicate it unlikely that the new institute will have scientific staff of its own and researchers will continue to be drawn from the university laboratories in France. Technical and logistic personnel are likely to continue to come from the military and VAT, *volontaires a l'aide technique*.

At present TAAF's scientific committee determines the French Antarctic research programme. It is formulated either from applications from scientists or based on SCAR directives. The evolution of the institute should settle research strategy but in the meantime a group of industrialists have taken the initiative in establishing DIPOL an organisation derived from their interests and drawing on the various current Antarctic organisations. The new foundation will be dedicated to the development of polar engineering technology.

One hundred and six scientists, technicians and construction personnel were involved in last summer's programme at Dumont d'Urville. David Pierre was base leader for the season and Patrice Godon, head of works at EPF was in charge of the scientific and technical programmes. Michel Engler director of EPF in Paris was supervising the construction of the airstrip.

Although the base can accommodate 41 personnel for the winter only 35 are in residence. The leader is Bernard Le Lefevre who replaced Claude Chaufrasse who was in charge last winter.

Thirteen scientific programmes being undertaken in the immediate area and on the continent include geomagnetics, seismology, geodetics, glaciology, meteorology, auroral observations, ionospheric and cosmic ray studies. Mapping of the structures and compositions of the rock outcrops in Adelie Land was continued this season and meteorites were collected. Ozone and atmospheric chemistry work is also part of the programme. Systematic observations of the population structures and dynamics of birds and seals as well as energy budgets and cold adaptation studies of penguins were continued by biologists. Radiotracking of penguins on foraging trips is also being done.

Logistic support during the summer was provided by an Alouette 11 from the French airforce. It was taken south from Hobart on L'Astrolabe.

Four international observers also traveled south with the French team this last summer. They were Alan Hemmings of Auckland representing the Antarctic and Southern Ocean Coalition, James Martin-Jones of the World Wildlife Fund, Veronique Sarano Simom of the Costeau Society and a representative of the French League for the Protection of Birds.

Finance for the continued construction of the airstrip and of a further base at Dome Charlie is said to be secure.

Costing approximately FF100 million the airstrip has involved the reduction of five islands by blasting to create rubble for reclamation. The strip effectively links Cuvier, Lion, Pellux, Zeus and Buffon.

Also according to *Nature* four million FF of

the airstrip budget has been allocated to the implementation of conservation measures some of which are being supervised by Vincent Bretagnolle, a biologist from the Centre for the Study of Wild Animals at Beauvoir-sur-Niort in Western France, CNRS. When plans were made for the construction French biologists were among those who protested in concern for the 10,000 birds, which nested on them. These are mainly Adelie penguins, Cape pigeons, snow petrels and Wilson's storm petrels and some Emperor Penguins.

Bretagnolle's work indicates that the Adelies have adjusted with the aid of specially constructed ramps providing access to breeding sites and dummies to encourage them. More at risk however are the pigeons and petrels. With a lifespan of about 30 years these birds can take up to eight to find a mate and breeding site and they keep both for life. Rocks have been broken on uncolonised islands to provide a suitable nooks and crannies for the birds. The Emperor penguins are said to have been less affected than first thought.

Depending on the choice of aircraft, still to be made, completion of the airstrip should make it possible to reach Dumont d'Urville within six and a half hours from Hobart and only three days from Paris. This not only replaces the average trip of about five days to a week in the L'Astrolabe but will dramatically lengthen the Antarctic season for the French. At present the vessel can usually only reach the base from late December to late February when the 300 km of sea ice can be penetrated.

Although, beyond automatic data collection, the scientific programmes at Dumont d'Urville appear to be in doubt for next season funding for the construction of a second French base is thought to be secure.

In 1982 TAAF's scientific council organised a conference of experts to provide directions for French research in the 1990's. They agreed that a second base was needed and the location chosen was Dome Charlie. It was used by the Americans in 1976-77 and 1977-78 for the repair and recovery of two LC-130 Hercules aircraft which had crashed while supporting field operations. It lies at 124deg 10'E, 74deg 40 min South and is about 1000 inland from Dumont d'Urville.

The French have already carried out research at the remote location. In 1978 Claude Lorius, director of the laboratory of glaciology and environmental geophysics at Grenoble and a former president of SCAR led an expedition there with logistical support from the Americans. They extracted a 950 metre ice core which is providing them with paleoclimatic information from the last 32,000 years. The data is being compared with that obtained from smaller cores near Vostock and the Eurocore drilled by the Greenland Ice Project.

Snowfall at Dome Charlie is relatively light, the ice is stable and its altitude of 3,200 metres on the Antarctic plateau reduces interference for some of the delicate instruments used in international projects designed to collect data on Ozone and stratospheric changes and in which the French are already participating.

The French government has allocated FF36 million over five years to 1993 for the building of a base which will incorporate some of the latest technology in heat conservation and recycling practices. In addition it is likely to run only on kerosene which can also be used for aircraft and vehicles reducing the need for

"And, in January, as the *Astrolabe* crashed through the pack-ice after a solitary and gruelling five days at sea, it was a shock to see a manicured liner, the *World Discoverer*, gliding like a swan on a winter lake. But she could not berth at Dumont d'Urville as planned. Unequipped for pack-ice, the liner stood by as the *Astrolabe* ploughed on like an overblown tug. "Thanks for putting on a splendid show", radioed the captain."—*Peter Coles, Nature, Vol 350-28 March 1991 page 299.*

multiple fuel supplies. The first of the vehicles for the base was taken south last season. It is a *Kassbohrer* tractor which is currently at Dumont d'Urville, complete with a stereo system and full cab heating.

References: This article has been compiled from programme information, and the Letter d'Information issued by AMAPOF, Association Amicale des Missions Australes Et Polaires Francaises. Supplementary information has also been obtained from a Nature Special published in Nature Vol 350, 28 March, 1991.

BAS

RRS James Clark Ross replaces RRS John Biscoe after 34 seasons

At 1.40 p.m on Saturday 1 December, 1990, Her Majesty Queen Elizabeth II pulled a lever allowing the traditional bottle of champagne to crash against the hull of RRS James Clark Ross. Moments later the vessel slid from the Wallsend Shipyard of Swan Hunter into the River Tyne.

Built for NERC, the National Environmental Research Council, of which BAS, the British Antarctic Survey, is a subsidiary the vessel, which has cost \$35 million is to replace the aging RRS John Biscoe. She will mainly be used for research in the Antarctic but for two months of each year she will support NERC's programmes in the Arctic. RRS John Biscoe is currently for sale.

Among approximately 10,000 people who watched the launch were designers, engineers, accountants, construction workers and BAS personnel.

Rear Admiral James Ross, great-grandson of Admiral Sir James Clark Ross, the British explorer for whom the ship has been named also attended. The explorer located the north magnetic pole and between 1839 and 1843 made major discoveries in the Antarctic. The Admiralty had given command of *Erebus* and *Terror* and instructed him to carry out a magnetic survey in the far south. It was the first time that the ice of the Ross Sea had been penetrated and in doing so he discovered the Ross Ice Barrier, and charted part of the coast of Antarctica which he claimed for Britain as

Victoria Land. During a second season they worked off the northern tip of the Antarctic Peninsula finding the James Ross Island Group which was also claimed for Britain. He was knighted for his work and wrote "A Voyage of Discovery and Research to Southern and Antarctic Regions", which was published in 1847. His last polar expedition was with HMS Investigator and Enterprise in 1848-9 when he was sent to the Arctic to search for Sir John Franklin whose expedition was lost in 1845 during their efforts to discover the North-West passage.

Having met officials, including Dr David Drewry, Director of BAS and his wife, the Queen joined in a brief service led by the Reverend Mike Pennington who offered prayers for the ship, those who constructed her and those who would sail in her. After the ceremony the Queen was presented with a model sledge and a leather bound copy of the launching programme.

State of the art technology has been used in the construction of the multipurpose science and cargo vessel which has 20 cabins for scientific personnel and accommodation for 25 officers and ratings. [See Antarctic Vol 11 No 11 page 424ff] She is undergoing sea trials at present and is likely to be handed over to BAS in June or July.

Like the ships managed by Operation Taberin and the Falkland Islands Dependencies - predecessors of BAS - the RRS James Clark Ross has been registered in the Falklands. She carries the BAS insignia on her funnel. Her first Captain will be Nick Beer and her home port Grimsby.

Her first work for BAS will be further sea trialling and testing around the Bay of Biscay of instrumentation such as gravimeters, magnetometers and multi-channel seismic systems for marine geophysics programmes scheduled for August. Biologists will then be testing nets and echo sounder equipment in the Atlantic west of the English Channel.

Once the trials have been completed she will sail from Grimsby on her maiden voyage at the end of September. Cargo and personnel from the UK and South Atlantic ports will be carried to the Surveys research stations in the Antarctic, where she will carry out a wide

variety of marine science programmes in the Southern Ocean. It is also intended that she will be available for use by NERC supported marine research community in the Arctic for about two months each year.

The retiring RRS John Biscoe was the second vessel supporting British Antarctic activities to carry the name of the British discoverer who lived from 1844 to 1843. As an acting master in the Royal Navy he sailed in 1830 with the brig Tula and the cutter Lively. His orders, issued by Messrs Samuel Enderby and Sons of London, were to seek new sealing and whaling grounds in Antarctic waters. His circumnavigation of Antarctica followed a route similar to Bellinghausen's but he discovered Enderby Land in February 1831 and later on the same voyage Adelaide Island and the Biscoe Islands on the western side of the Antarctic Peninsula. He also claimed Graham Land for Great Britain in 1831.

AN-76, a boom defence ship was returned to the American Navy under the Lease Lend agreement. She had served in the war as HMS Pretext before being purchased by the British for \$75,000 in 1947 to support Antarctic activities firstly as MV and from 1953 RRS John Biscoe. Between 1947 and 1955 three captains A.F. McFie, H. Kirkwood and W. Johnson were responsible for the ship during the years when Antarctic operations were conducted as the Falkland Island Dependency Survey. She then resumed the name of HMS Pretext before becoming HMSNZ Endeavour in 1955 in support of the Commonwealth Trans-Antarctic Expedition and serving the New Zealand Antarctic Research Programme until 1961 when she was withdrawn from service. Captains during those years were H. Kirkwood, J.E. Washburn and R.H.L. Humby.

In 1956 the old 416 ton wooden motor vessel was replaced by the British with a new RRS John Biscoe, designed by Messrs Graham and Woolnough, Liverpool and built by Fleming and Ferguson Limited. Classified by Lloyds as being "strengthened for navigation in ice", she was 220 ft long, with a breadth of 40 feet and depth of 20ft. She drew 16 ft 5 in, had a gross tonnage of 1,584, a service speed of 12 knots and was launched in Paisley on 11 June, 1956.

Her sea trials were completed on the Clyde and on 26th November, five months after launching she sailed from Southampton on her first voyage to the Antarctic. She called into Port Stanley and Anvers Island before rendezvousing with the Royal Yacht Britannia and HMS Protector from which dignitaries including the Duke Of Edinburgh, Sir Raymond Priestley, (acting director of FIDS) and the Governor of the Falklands were transferred for a cruise to the Loubet Coast and Detaille Island. Here they went ashore to inspect Base W. Visits were also made to FIDS bases at the Argentine Islands, Anvers Island and Port Lockroy and the Danco Coast before returning to the Falklands.

In the second part of the voyage she visited

all 11 British bases calling in at the Falklands again on her return to Southampton on 4 June. She had sailed 22,517 nautical miles.

Although her activities have been substantially supplemented by other vessels the old John Biscoe has served British operations in Antarctica for 34 seasons. Retiring with her is Captain E.M.S Phelps who has served on her for most seasons since 1972.

Like the James Clark Ross her delivery time was short. The order was placed by the Crown Agents for Oversea Governments and Administrations on 19 May 1955 and she was handed over on November 17, 1956 one day earlier than requested. Her price of half a million pounds held good during the whole time of the contract.

USAP

Twenty-two projects at the South Pole

With the departure of the last flight of the season 21 men and three women of the United States Antarctic Program at the Scott-Amundsen South Pole Station began the longest winter for US personnel on the continent. Last summer began operationally for the Base on 26 October and concluded with the departure of the last flights to McMurdo on 17 February.

Twenty-two projects were part of the summer and winter programmes. Science programmes continue to focus on the upper atmosphere astrophysics and on monitoring long term atmospheric changes and seismicity. Repairs were made to the Dome of the station and the generator up-grade was completed. A new project, begun this year, was the replacement of the station's bulk storage fuel tanks.

Seasonal visitors comprising scientists and support personnel were again housed in the summer camp comprising a series of tents and Jamesways several hundred meters away from the Dome. It provides self contained accommodation and facilities for the 100 people usually expected at the peak of the season.

Cosmic rays

Among the programmes at the station were six studying aspects of cosmic radiation, some of which are continuing throughout the winter. One is an astrophysical investigation of cosmic microwave background radiation at the Station.

Although cosmic radiation was discovered more than 75 years ago, its origin has always remained a mystery. Gamma rays represent only a small fraction of the total cosmic-ray flux but they propagate undeflected from their sources to earth while the dominant, electrically-charged component is deflected by magnetic fields. The scientists are trying to identify sources of cosmic radiation, which according to some theories may have been created by a modest number of supernova. To do this they are installing an atmospheric Cherenkov telescope near the south pole. It consists of an array of parabolic mirrors with photomultiplier tubes at their foci which can detect light from very-high-energy (VHE) interactions in a small amount of atmosphere. The geographic South Pole is ideal for this research because it is possible to view a single object for extended periods through a constant thickness of atmosphere while at a mid-latitude site observations are limited to a few hours viewing at a time.

In a cooperative venture two teams, each of four scientists and technicians spent time at the

Pole upgrading the existing telescope and overseeing the preparation of foundations for a new microwave telescope which is scheduled to be installed next summer. The telescopes are used to observe the very high energy gamma rays from the South Pole.

One of the two teams running the project came from the Physics Department, University of Wisconsin. In addition to upgrading the electronics of the telescope and installing a Global Positioning Service (GPS) Clock they laid cables between the site and the station and modified the telescope building in preparation for next season. The second party came from the Physics Department at Purdue University, West Lafayette. They also assisted with the upgrade of the existing telescope and established the tracking (Cherenkov) telescope for winter observations which are being carried out by a technician specially trained for the project.

Winter-over technicians will also operate the cosmic ray detection facilities and equipment installed at McMurdo and the South Pole. Cosmic rays provide a powerful tool for studying exotic astrophysical processes that occur on the Sun and in its far-reaching atmosphere that controls space near earth. Antarctic monitoring stations are crucial for probing interplanetary plasmic dynamics through observations of variations in relativistic galactic cosmic rays.

Year round observations of cosmic radiation is being continued in collaboration with the magnetospheric cusp program. In order to enhance understanding of the solar physical processes that control the electromagnetic conditions in the earth's environment, the data are used in conjunction with that obtained from other ground-based instruments and spacecraft. The objectives of the team from Bartol Research Institute are to explore the nature of long-term variations and North-South asymmetries of solar activity, to investigate the acceleration, coronal transport, and interplanetary transport of energetic solar particles and to learn more about the three-dimensional structure of interplanetary magnetic turbulence as well as improve understanding of the solar modulation of galactic cosmic rays.

Measuring fluctuations in cosmic background

radiation is one of the few experimental inputs available to atmospheric physicists from comparison with cosmological models. Because large scale (greater than ten degree) measurements of these variations be disrupted by emissions from the galaxy, particularly by high-galactic latitude dust emission, the objective of the programme is to make observations at the 3 millimeter-wavelength level, where galactic emission is near its minimum. Atmospheric fluctuations, particularly water vapor, generally create problems for ground based measurements, but results from earlier antarctic studies indicate that the extreme cold and low water vapor content of the atmosphere at South Pole provide an excellent environment for this type of measurement.

During the summer researchers from the Physics Department university of California combined with others from Princeton University to study cosmic background radiation by using a liquid-helium-cooled detector that operates to a three millimeter wavelength. A one meter telescope, developed as part of their balloonborn program allowed them to make measurements down to one degree. Their measurements were made in the angular region which has not been well investigated and were complementary to other experiments and where the predicted fluctuations were expected to be near the maximum. The measurements will also help them understand the atmospheric fluctuations, providing useful information for future millimeter and submillimeter wave astronomical investigations.

Aurora

Studying the physical, dynamic, chemical and atomic-molecular processes occurring in the upper atmosphere above Antarctica is the purpose of another project supervised by Dr G. Sivjee of the Department of Math and Physics at Embry Riddle Aeronautical University, Daytona Beach, Florida.

During the summer a team installed a two-mirror periscope into an optical dome in the roof of the Skylab Laboratory. It is being used by technicians during the long dark winter for more extensive observations of semi-diurnal, diurnal and longer period disturbances propagating through the mesopause. The scientists,

involved in the project hope to compare their data with that obtained from other stations established in the Arctic where topological and meteorological conditions are different. They will also assess the contributions of the various factors to mesopause disturbances.

Also operating through the winter is an all-sky camera which is taking measurements of the Aurora Australis from Pole Station. The project leader is Dr Frank Berkey of the Center for Atmospheric and Space Sciences from Logan, Utah. Because of the configuration of the geomagnetic field in the Southern Hemisphere, the Station provides a unique platform from which to undertake measurements of the polar ionosphere and dayside auroras can be viewed for several hours each day. Research has shown that the precipitation of low-energy particles, which enter the magnetosphere by means of a solar wind, causes these auroras. The objective of the programme is to continue making winter observations of the aurora by operating a 35mm all-sky camera system which has been in use since 1967. Data from the project will be used to investigate dayside auroral structure, nightside substorm effects and polar cap arcs. Such studies can also be used to obtain further insight into the physics of the magnetosphere, the convection of plasma in the polar cap, and winds in the thermosphere.

The Intensified All-sky Camera equipment, installed in 1982, was checked for winter operation by a scientist and technician from Lockheed in California. The camera produces images of weak optical emissions of the latitude of the cusp, an important but poorly understood boundary region of the earth's magnetosphere. For analysis scientists are using data from a two-channel photometer at Siple Station, correlative data from other projects at both South Pole and Siple and further data from auroral imagery on the Dynamics Explorer satellite. They are particularly interested in the extent to which the satellite mirrors observations of the aurora in the Northern Hemisphere and the South Pole.

Science technicians will continue to collect data from magnetic pulsation sensors located at high-geomagnetic-latitudes which include McMurdo and the South Pole. Additional data is collected in the Arctic at Sondre Stromfjord

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

Satellite tracking and seismology

Taking advantage of the different geographical locations of the two US stations, McMurdo and South Pole to collect data from different satellite orbits are a team from the Applied Research Laboratories from the University of Texas at Austin. Personnel are wintering at McMurdo and the Pole to maintain continuous operation of the programme.

The observatories at both sites record changes in electromagnetic frequencies relative to the positions of the observatory and the polar orbiting satellites. Such data will help scientists determine spatial and time variations of the ionosphere and provide geodetic positioning controls. Data from the South Pole is relayed via the satellite data link and then conveyed to the United States via the University of Texas INMARSAT geosynchronous satellite communications system.

Two U.S. Geological Survey technicians will be at the station over the winter operating electronic doppler equipment. It is being used to track overflights of Navy navigational satellites throughout the year. In addition they will operate the South Pole seismometer which is part of the Worldwide Standardized Seismology Network and the ultra-low period seismology equipment.

During the summer a team worked in the Convoy Range for a time as part of a joint US New Zealand mapping programme. The image and reconnaissance maps developed will present scientific information, such as geologic data, in an accurate manner for expert analysis and can be used in the design and execution of future expeditions.

In the 1989-90 summer season a construction team began work on a new seismic vault at the Station which is uniquely located for long term global studies in this field. The station is a seismically quiet platform, which lies on the

earth's rotational axis and can be used to measure long-period oscillations. Its location on the Great Circle Paths coincides with portions of the Mid-Atlantic Ridge and the East Pacific Rise and includes active seismic regions and other features of intense geophysical interest. The project is funded by IRIS, a non-profit consortium of 57 U.S. Universities which creates and manages research facilities for seismology and is being undertaken for the University of California at Los Angeles. Electrical services were put in place during the summer in preparation for the seismometer scheduled for installation next season.

Automatic stations

Automatic weather stations at sites accessed by the USCGC Polar Sea and from McMurdo and South Pole Stations were variously installed, repaired, replaced or relocated by a team under the leadership of Dr Charles Stearns from the Department of Meteorology at the University of Wisconsin. Such stations measure surface pressure, air temperature, wind speed and wind direction and transmit the data to satellites for interpretation at ground stations. Although information taken from satellites on antarctic weather patterns is valuable such surface data is needed for confirmation.

The weather stations are used to study the barrier wind along the Transantarctic Mountains, vertical motion and sensible and latent heat flux from the Ross Ice Shelf, foehn winds flowing from the Beardmore and Byrd glaciers onto the Ross Ice Shelf, katabatic flow in East Antarctica, and propagating weather systems at the South Pole. The stations also gather continuous and reliable meteorological data that support aircraft operations at McMurdo Station. The units at South Pole were checked, serviced and relocated during the summer. For decades intermittent ground observations have given tantalizing hints that the Earth's high-latitude ionosphere emits radio waves in the low frequency to high-frequency band (0.15-9.6 megahertz). Rocket and satellite observations in the upper regions of the ionosphere and magnetosphere commonly indicate the existence of such terrestrial radio signals particularly in the lower portion of this frequency range.

Theoretical studies have indicated that some of these emissions should be able to penetrate the ionosphere and be detected at ground level, but there is a need for ground-based recording to study the radio band and confirm these theories as well as providing insight into auroral emission and wave propagation processes.

The unmanned automatic geophysical observations (AGOs) are ideal for this because the sensitivity at these frequencies is greatly affected by human produced transmission, which are generally minimal in the Antarctic. Because AGOs can be installed at locations remote from Antarctic stations interference from radio transmission is even less of a problem.

To gather data about this poorly understood frequency band scientists from the Department of Physics and Astronomy at Dartmouth College in Hanover, have used a programmable low-frequency/high-frequency receiver, an array of small ferrite-rod antennas, a power subsystem, and data compression software at two AGO sites. The first represented an integration of the new equipment into the existing site at Williams Field and the second, an installation of a station with the additional equipment at the South Pole.

A network of eight atmospheric current sensors were deployed at sites in the Antarctic over the summer; two at manned stations and six at AGO's. Two of these were installed at the South Pole. The objectives of the study, for which they are used, are to measure the power and voltage level in the global circuit and make a preliminary estimate of the "geolectric index". With the ionospheric electrodynamic data scientists from the Physics Department University of Houston, Texas will be able to interpret the differences in air earth current at various sites in terms of the electrostatic potential of the ionosphere above the sites. With most stations in their network, installed and operating, they will be able to obtain virtually continuous "snapshots" of the ionospheric electrostatic potential and convection patterns in the polar cap. Studies of the relationship of statistical patterns to instantaneous patterns substorm responses and hemispheric differences are anticipated.

Also using the automatic geophysical ob-

servatories and selected manned stations Dr Ted Rosenberg and others from the Institute for Physical Science and Technology from the University of Maryland are carrying out comprehensive investigations of the polar ionosphere at high geomagnetic latitudes in Antarctica. The arrays of instruments are being used to study the energetics and dynamics of the high latitude magnetosphere on both large and small scales but one of the first objectives is to develop a polar cap magnetic index to provide the first continuous characterization of polar cap variability. The project is international and tied in with work in the northern hemisphere.

Working only five kilometers from the Pole was Dr Martin Pomerantz and his team from the University of Delaware in Newark. During the 1981-82 summer they used telescope in a solar observation located about 6.5 kilometers from the station which has subsequently been modified to observe and record global solar oscillations to extend their understanding of the structure and dynamics of the solar interior. This season, they used an enhanced camera to take comparative photographs from which they will investigate possible changes in the level of solar activity and look for new solar features.

Four further studies undertaken at the Pole focussed on aspects of climate change, ozone levels, stratospheric clouds and other measurements.

International co-operation

Two projects were undertaken both at the Pole and at Vostock. The first involved the deployment of a field team at South Pole undertaking an integrated study of the optical and physical properties of the antarctic snow surface and the second involved the removal of equipment from the Pole for onward movement via McMurdo to Vostock to enable scientists to study the refraction and reflection of sunlight by ice crystals which produce atmospheric halos.

Dr Stephen Warren of the Department of Atmospheric Sciences at the University of Washington and five colleagues were involved in the climate studies. Their project has four objectives concerning the processing by which

global climatic variability is imprinted into the antarctic ice record.

Over the course of the summer they measured the effect of the surface roughness (sastrugi orientation) on the angular distribution of reflected sunlight to provide information necessary for interpreting satellite remote-sensing data from the Earth Radiation Budget Experiment. These measurements are also being compared with their theoretical model of atmospheric radiation.

By operating instruments throughout the winter they are able to assist an ongoing experiment involving measurements of the spectral distribution of thermal infrared radiation from the atmosphere.

To study the mechanism of dry deposition of atmospheric aerosols in the snow surface, they measured the flow of air in and out of the permeable upper layers of firm and in samples of hoarfrost; samples of both were also examined for their isotopic composition. The measurements of airflow through the firm will enable them to evaluate the extent to which the concentration of aerosols and ice represent contemporaneous concentrations in the atmosphere, while the hoar frost samples will provide them with data for a comparison of isotopic ratios to ambient air temperature.

Similar work at Vostok was undertaken between 15 December and 5 January.

Two other USAP scientists working at Vostock came from the Department of Math Sciences, University of Alaska, Fairbanks. Extending work previously undertaken at South Pole Station, the pair, led by Dr Walter Tape, were taking further advantage of the unique atmospheric conditions which prevail in the Antarctic interior to produce beautifully formed simple, prismatic ice crystals. Such crystals create strong well defined halo displays. Because they occur on the surface they can easily be collected for examination and the halos they create can be compared.

The pair photographed the halos and simultaneously sampled falling ice crystals. By comparing computer-simulations of halos with observed halos and the crystals they hope to clarify the relationship between the different types. While sampling they also measured the distribution and intensity of polarised light

from associated halos. Theoretically, the distinctive shapes formed by the distribution of polarized light should help them define the size and orientation of the crystals. Such data, when combined with the information from the samples and from halo simulations, will enable them to verify and calibrate polarimetric techniques.

Controlled experiments seeding the atmosphere with dry ice to produce simple, well-formed single type crystals artificially were also conducted. Such crystals of known source, age and growth conditions enable the scientists to clarify the special atmospheric conditions that produce the crystals for the elaborate halos in Antarctica. The results of their research has potential for remote sensing of atmospheric conditions.

Visiting the Pole to service, repair and train over-wintering personnel in the operation of the LIDAR equipment were four Italian scientists undertaking a cooperative program with the Americans. The lidar is designed to take vertical profiles of the upper stratosphere. From the data scientists are able to infer the molecular and aerosol concentration of air and under some conditions, measure parameters such as atmospheric temperature. The information, useful in climate studies, is relevant to other work on atmospheric radiation, structure and composition and may help scientists under the mechanisms involved in ozone de-

pletion.

Also at the Pole is equipment for a sodium Lidar which is not being operated during the 1991 season.

Antarctic communications Survey:

A comprehensive survey of communications resources and needs for the United States Antarctic Program was undertaken this last season involved one of a four man team in a visit to the South Pole. The overall objectives of the project were to examine communications, equipment, systems and operations at South Pole, Byrd and McMurdo Stations, to examine typical field party communications and inspect the Black Island communications facility for the planning of the installation of an INTELSAT satellite earth station.

Three staff from the Argonne National Laboratory in Washington also visited the Pole as part of a project to identify waste minimisation opportunities and potential sources of soil contamination caused by past operations. The project last summer involved a preliminary visual reconnaissance of several sites to prepare for subsequent visits in support of waste minimisation and site characterisation projects. Such activities were also carried out at McMurdo and the Dry Valleys.

Manager of the station for the winter is Dennis O'Neill and science leader John Lowell, a Lieutenant in the NOAA Corps.

New Swedish icebreaker

Oden, a new diesel-mechanical multipurpose icebreaker built by Gotvarken Arendal AB, Goteborg has recently been made available to the National Maritime Administration and Swedish Polar Research Secretariat for use on polar research expeditions. Svenski Isbrytarkonsortium KB, Sweden, Oden is 108 m long and 31 m wide. She has a draft of 7.0-8.5m. The short blunt bow which is broader than the rest of the hull. She will be employed as an escort breaker in the Gulf of Bothnia each winter from January to May and be available for polar work at other times. Four 8 cylinder diesel engines generating in total 18,000kW (25,000 HP) are geared to twin controllable pitch propellers. In open water

Oden cruises at 13 kts and is capable of 17kts; assisted by 12 water jets on the bow the ship can cut at 2kts through ice 2m thick. Twin rudders, manoeverable together or individually, can be turned outward to protect the propellers when going astern. Containerized science laboratories and workrooms can be added when the ship is to be used for expedition work. Accommodation is available for about 50 scientists and a crew of over 30. Between July and October this year she will be used to support a Swedish expedition to the Arctic Ocean. - *Adapted from Polar Record page 249, Vol 26. Number 158 July 1990 who obtained the item from Swedish Polar News No. 2 February 1990.*

Auckland Islands

February expedition takes requirements of management plan a step further

A further step was taken in February towards the implementation of the Auckland Islands Management Plan when an expedition organised by the Department of Conservation traveled south in the Royal New Zealand Navy Vessel *Monowai*. Led by Mr Peter Willemse from the Department's Invercargill Office the team undertook seabird monitoring on Adams Island, checked the success of previous work in goat eradication, destroyed most of the remaining cattle, investigated rabbit eradication on the main Island, undertook pig bait trials and historic site restoration.

The Auckland Islands comprise one of New Zealand's five reserves in the Southern Ocean. While they differ in origin, size and topography each has a distinctive assemblage of flora and fauna which is of international scientific importance. (1) The Auckland Islands support a more diverse floral and faunal assemblage than any other subantarctic Islands in the New Zealand region. Isolation has resulted in the evolution of distinctive flora and fauna composed of many endemic species. Moreover the Islands are the world's most significant breeding grounds for the Hooker's sealion, the wandering albatross and the white-capped mollymawk. (2)

To a large extent the group has been unmodified, but in parts the effects of man's association over 180 years are evident. In addition to the castaway depots established for the survivors of the not infrequent shipwrecks there were attempts at settlement in Port Ross and on Enderby Island. Associated with these activities were the introduction of cattle in 1894 and 1895 which by the 1980's were confined mainly to Enderby Island. Goats were liberated in ten locations but gradually became confined to the Port Ross area. Pigs have been on the main Auckland Island since the 1800s. The common barnyard pigs alone are thought have contributed significantly to a decline in ground nesting birds and have adapted to a herbivorous diet of roots, tillers, leaves and ferns supplemented by scavenged animal material. They and the goats are held responsible

for the elimination, from accessible places, of several species of large leaved herbarium plants and have devastated areas of low-altitude tussock. In addition the French blue rabbit is abundant on Enderby.

Over the years the enormous ecological and scientific value of the islands has been recognised and in creating and implementing a Management Plan the Department of Conservation determined "To preserve and maintain the Indigenous Flora and Fauna, ecological associations and natural environment of the Auckland Islands in a natural state and allow the operation of natural processes and accept their effects as far as possible." In short the Islands were to be returned as far as possible to their pristine state.

Two other objectives among the seven in the plan allow for the protection and management of any biological, scenic, historic, archaeological, geological or other scientific features compatible with the first objective while yet another allows for, and encourages research and studies which will have no permanent detrimental effects especially where it has been demonstrated that the results will contribute directly to the effectiveness of protection and management of the reserve.

This season, implementation of the plan which was formally accepted in 1987 was again taken a stage further with the continuation of some projects and preliminary investigative work undertaken in order to meet other objectives. Assembling in Auckland in late



Ornithologist Graeme Elliott listening for signals from a radio-tagged Auckland Islands rail on Adams Island in 1989. Photo: Neville Peat/DOC

January the DOC party sailed aboard the *Monowai* from the Devonport Naval Base on 31 January. In charge of the vessel was Captain Peter Usher.

The *Monowai* arrived at Port Ross on Tuesday February 5, deployed all except the Adams Island party and sailed for Carnley Harbour arriving later that evening. There she despatched the team for Adams Island and remained for the week undertaking soundings and limited operations with her *Wasp* helicopter before moving to Hanfield Inlet to undertake similar work. The data collected will be used to upgrade navigation charts for general shipping use. From the 13th to the 25th she spent further time at sea encountering hurricane force conditions for part of the time. On the 25th personnel from Adams Island rejoined the ship and she sailed for Dunedin via Enderby Island and Port Ross where the rest of the party had been working. On Thursday 27 February the team disembarked in Dunedin.

Baits for pigs

In a project funded by DOC Science and Research Division at Head Office in Wellington, Mr Colin Clark, a technical officer from the Forest Research Institute in Christchurch, carried out non-toxic bait acceptance trials on the feral pig population in the vicinity of Port Ross. The FRI has been searching for a suitable location for such trials and identified Auckland Island as an area where a pig problem existed and where baits may be used in the near future. The harsh climate and the difficulties the location offered also made the site desirable for such tests.

Using polymer fishmeal baits acquired from Du Pont in America and which had been pretested on feral pigs captured in Canterbury and penned in the Institute's station at Rangiora Mr Clark laid baits at 30 metre intervals across a number of two km lines on the Island and waited for results.

Evidence of pigs appeared to be sparse and the samples of the baits were checked for interference by other animals. Penguins and possibly Hooker sealion pups had shown interest but not consumed them.

The study, though so far inconclusive, was important as the strategy for eliminating the pigs will have to be rethought. It seems clear that the pig population is low and that the animals, having destroyed large tracts of megaherbs and other plants, have "eaten themselves out of house and home". Any baits used will need to stay palatable for a length of time and not break down in the harsh conditions. Possum bait in New Zealand is rendered unpalatable to native birds by the addition of cinnamon; a similar ingredient may need to be found to ensure that pig baits do not appeal to non-target species in the Islands or are laid in areas which they do not utilise.

Included in the management plan is the intention to remove or eradicate goats completely by 1990. From available records on goat distribution the population is estimated at between 50 and 100. They are mostly confined to the northern end of the main Island. With an annual rainfall estimated at between 1500 and 2100mm, high humidity and the lack of a suitable vegetation for "Gel" poisoning, the most practical method of elimination is hunting.

In 1989 DOC shot 105 of the goats. This season, expedition leader Peter Willemse and Mark Mawhinney, also from Invercargill looked for signs to plan for eradication. They found evidence only of two or three goats but were unable to locate them either on foot or during helicopter reconnaissance. It seems likely that the only possible methods to remove them will be extensive poisoning, the use of bailing dogs, or shooting them if sighted during the course of other work. The pair also spent three days on Enderby Island, which they visited to assist in eliminating the last of the cattle.

Rabbits are present on Rose and Enderby Island. Those on Rose Island are descended from animals released by Charles Enderby, about 1850, while those on Enderby were released in 1865 from Australia and are of the French breed Argente de Champagne.

The numbers on Rose Island have been declining probably because of the regeneration of tussock and scrub following the dying out of cattle. On Enderby Island however, numbers are prolific. Brent Glentworth from MAFTech Alexandra and Nick Torr from the

Department of Conservation Te Anau reviewed the problem of exterminating the animals.

Estimating the population at between 4,000 and 6,000 over Enderby they found rabbits present over the entire area but with two concentrations. One of these at Sandy Bay, a sandy and well drained area, is also the main breeding ground of the endangered Hooker sealion. The burrows pose a constant threat to the pups, some of which are suffocated each year in the burrows.

Using two types of non-toxic cereal pellets pre-dyed with rhodamine the pair laid deposits of bait to test for acceptance and preference while also assessing the logistical requirements of the entire project. A report on the results is being prepared for the Department of Conservation.

The rabbits on Rose Island, where the pair spent a day working on similar lines, are grey, brown and white in colour and are more like the New Zealand feral rabbit while those on Enderby have retained their blue colour and the general appearance of their ancestors.

Rare breeds

Three representatives of the Rare Breeds Conservation Society of New Zealand worked on Enderby Island. The team led by Dr Jim Catt from DSIR Grasslands Division in Palmerston North comprised Craig Fergusson, a professional taxidermist and experienced hunter, also from Palmerston North and Lyall Millar, a farmer from the Bay of Plenty.

The Society's objective is to conserve breeds or breeding groups of farmed livestock which were introduced into New Zealand and are small in number. Conserving these breeds will allow future farmers the genetic flexibility they require to meet new market demands. Over the last 200 or more years various breeds have been popular according to utility or economic value. With New Zealand's isolation the introduction of each species is potentially 073 threatening to the farming industry and economy because of possible disease introduction. Feral groups which have been introduced into New Zealand, have been allowed to live in the wild without human interference. Their survival therefore has repercussions in parasite and disease management.

In the 1890's, at the time of their introduction to the Auckland Islands, these shorthorn cattle were required to produce meat and milk and perform as draught animals. In New Zealand in the 1900's, later than elsewhere, the breed was split into beef and dairy and bred specifically for these purposes. The surviving animals on Enderby Island are therefore unique.

For a time after their arrival the team systematically located and destroyed 47 of the estimated 52 remaining cattle. Various samples were initially taken from the animals by Lyall Miller and Dr Catt, who subsequently concentrated on work in a temporary field laboratory established in a ten year old eight by six department of Conservation Hut at Sandy Bay.

The samples included testes from bulls from which the semen was extracted and frozen and eggs from the ovaries of the cows. Samples of semen have subsequently proved fertile but attempts on site to create embryos were unsuccessful largely because the fluctuations in temperature defeated the high tech operation in the low tech environment.

Samples of rumen content were also collected for microbiological analysis by other scientists interested in the archaic microflora. This is of particular interest as between 30 and 40 percent of the diet of the cattle is thought to be seaweed. Because the animals have never been drenched the functions of the enzymes may be unknown.

Fecal samples were also collected for culture of digestive fungi and to enable scientists to determine the types and quantities of parasites present. Each animal killed was given a full autopsy, measured and its skin mapped for colour which varied between black and white with red to all black with the occasional roan. Two complete skins, a head, skin and cape and horns of several of the cattle have been returned to New Zealand for reconstruction of one animal for the society.

The Rare Breeds Conservation Society intends to reconstitute the Enderby cattle by breeding-up using the semen recovered during this expedition. The reconstituted strain will then be available for research to investigate any special attributes it carries.

Seabird monitoring

Among the party were Kath Walker and Graeme Elliott from the Department of Conservation in Nelson and Peter Dilks of the same department but based in Christchurch and Jean-Claude Stahl, a Ph.D student at Victoria University on seabirds.

Plans to spend some time on Disappointment Island were aborted when their flight was terminated because of weather conditions. The party instead spent the entire three weeks on Adams Island which is mountainous and glaciated with exposed rock near the top. Adopting a technique of sweeping across the slopes as a team, or zigzagging down ridges in pairs, they covered the alpine tussock zone of the island in order to census the wandering albatross breeding population. (The topography and the dispersed nature of the nests makes any other method of counting impracticable.)

A study area was established west of Mt Dick and nearly 100 pairs of birds were banded at their nests. Compared to many other species, this great albatross is a docile, easily banded bird. They are biennial breeders, as it takes a whole year to raise the chick. After a short brooding period, the chick is left alone, with parents returning alternately every few days to feed it. There have been reports from fisheries observers of several thousand wandering Albatross being caught each year on baited long-lines set for tuna. Until this last February there have been no accurate counts of the breeding population on Adams Island and scientists have had no idea how the fisheries by-catch problem has affected the viability of this long-live, slow breeding bird species, in the 25 years since the tuna fishery began.

The 1991 expedition collected base-line data with which to assess albatross mortality rates over the next year or two.

While counting the Wandering Albatross the party also recorded the distribution and density of other rare bird species - the Auckland Island Banded dotteral, the Auckland Island rail, the New Zealand falcon, the Auckland Island flightless teal, snipe, and also all the smaller seabird species.

The dotteral were initially believed to be

nesting only on Enderby Island but in late 1989 they were also observed on Adams. At that time there were thought to be a total of about 720 birds in all. Eggs found in Falcon nests and dead chicks were sampled for residual DDT. In 1989 the team had found the first Auckland Island rail and these too, though extremely difficult to locate and capture, were calling and their localities were recorded. It is thought that there may be up to 1,000 birds rather than the 200 estimated at the end of 1989. The party also noted other finds of smaller petrels and snipe.

Historic sites

Part of the expedition also was John Peterson, a carpenter from DOC in Invercargill.

Under clause III of the Management plan DOC is committed "To protect and manage any biological, scenic historic, archaeological, geological or other scientific features....." He undertook repair work to various historic and current structures at Port Ross, Deas Head and Enderby. The castaway huts at Tagua Bay, Ranui Cove and Enderby also came in for attention. New tracks were cut through to Lake Hanemoa and at Terror Cove and work was done on the boat shed. Markers were installed along the route to the Derry Castle Reef for tourists.

References:

(1), (2) Management Plan for the Auckland Islands Nature Reserve.

Treaty Nations reviewing second draft of Protocol covering Environmental Protection

The second part of the XIth Special Consultative Meeting on the Antarctic environment concluded in Madrid on 30 April. The Consultative Parties continued to work on Environmental Protection Protocol, drafted by Ambassador Rolf Andersen of Norway and presented to the first session held at Vina del Mar in November last year. At Madrid the Consultative Parties accepted the document on the basis on which the work of the Antarctic environmental protection negotiations may be brought to a conclusion at a further meeting to be held in Madrid in June. In the meantime the draft protocol has been referred to the Antarctic Treaty Consultative Party Governments for approval.

If agreement on the draft is secured at the next meeting in Madrid "Any activity relating to mineral resources, other than scientific research, shall be prohibited." ... "If, after the expiration of 50 years from the date of entry into force of the present Protocol, any of the Consultative Parties so request a conference shall be held as soon as practicable to review the operation of this Protocol". However, if after the expiry of 50 years parties wish to continue the prohibition on mining, a new regime governing minerals must first come

into force. That regime can only come into force if it is ratified by three quarters of the consultative parties, including all of the countries which currently have consultative status. This in effect, gives each at the current status veto power. If the consultative party governments give their support to the draft the document, it may be opened for signature in Madrid on 23 June, 1991, 30 years to the day of the entry into force of the Antarctic Treaty.

As is customary discussions on the Protocol and four Annexes to it, took place among

Consultative Parties between the meetings at Vina del Mar and Madrid.

At Madrid, the work of the meeting was undertaken by two working groups. Chaired by Mr Deitrich Granow, Head of the German delegation the first group met for seven days during the course of the overall meeting. They undertook a paragraph by paragraph review of the text and towards the end of the first week they appointed a drafting committee under the chairmanship of Mr P.J.M. Veerbeek of the Netherlands Delegation which met in parallel to take into account the views and proposals of the various delegations. It reported to the full session of the working group on April 27.

The second working group was chaired by Mr Roberto Puceiro Ripoll of Uruguay. Discussion, as requested during the first full session of the group, centred on an analysis of topics raised in an equivalent session at Vina del Mar. These included Waste disposal and Waste management, Conservation of Antarctic Fauna and Flora, Marine Pollution, Environmental Impact Assessment, System of Protected Areas, Tourism and non-government Activities, and the Use of Alternative Energies to reduce impact on the environment.

Methods of work and progress plans were also formulated during the first session from which four documents which are likely to be annexes to the proposed protocol emerged. They cover Marine Pollution, Waste disposal and Waste management, Environmental Impact Assessment and Conservation of antarctic fauna and flora. Further work on the other topics has been earmarked for the next Antarctic Treaty Consultative Meeting to be held in Bonn towards the end of this year.

Marine Pollution.

Working from a draft put forward at the first session further documents from the United States, the Netherlands, The Union of Soviet Socialist Republics, Australia and Brazil and the United Kingdom were also tabled for consideration. An informal Sub Group was set up and a revised draft text prepared.

Discussion was wide-ranging and took into account the appropriateness of applying existing internationally accepted rules to the area of the Antarctic Treaty as well as known likely

amendments. More specifically they discussed recommendations to the IMO regarding modifications to MARPOL, as well as the provisions of the London Dumping Convention as may be applied to the area. Some delegates also considered that articles of the annex should include regulation of questions such as the certification of ships and liability for damage to the Antarctic marine environment as is embraced by the International Convention on Civil Liability for Oil Pollution Damages, 1984.

The draft annex on Waste Disposal and Waste Management as proposed at Vina del Mar was then considered by the group. Suggested amendments were submitted in working papers from the United States and Chile as well as in less formal papers from the United Kingdom and Australia.

Concerns expressed in an informal subgroup included bioaccumulation, criteria relating to disposal at sea and of waste in general, the inclusion of guidelines in environmental impact assessment of any proposed activity as well as waste classification, prohibited products and emergency circumstances.

The working group was asked to consider all elements of environmental impact assessment incorporated in the new environmental protection regime including the provisions of an article on EIA included in the body of the protocol and an annex on EIA to be appended to it. Discussion was again based on the work done at Vina del Mar. Further papers on EIA were tabled by Australia, Belgium, France, Italy, the United States, the United Kingdom and Sweden.

Consensus was reached on the text of an article of the main treaty instrument concerning environmental impact assessment obligations and on the insertion of a new paragraph for inclusion in the article of the main instrument dealing with the functions of the Committee for Environmental Protection. Consensus was also reached on provisions of an Annex setting out the environmental impact procedures subject to some points which related to discussion in the first working Group. Details regarding implementation and the frequency of Consultative meetings were clarified in order to ensure that the provisions established were operable.

Conservation of Antarctic Fauna and Flora

Again the starting point for discussion was the Annex put forward at Vina del Mar and a working document was presented by the United States. Overall observations on the document were made.

The parties agreed that the provisions of this Annex should not encroach on CCAMLA. Others were concerned as to whether the provisions were sufficient for a natural reserve. Rather however, than address specific components of Antarctic biota that need to be protected it was agreed that the measures should encompass all fauna and flora systematically and be based on a preventive and comprehensive approach as well as being extended to those components of the ecosystems not specifically considered by the Annex. Provisions in emergencies were also agreed on and in conclusion the working group noted that the modifications to the document significantly improved the text proposed at Vina del Mar.

Specially Protected Area Systems

Two papers regarding the Specially Protected Area System were considered. All agreed that the existing system of multiple-site designation needed to be simplified. A paper presented by the U.K. recommending reducing the system to a single designation "The Antarctic Protected Area" while another paper, presented by the U.S.A proposed a twin system with both APAs and the retention of Multiple-Use Planning Areas (MUPAs). The issue will be further addressed in Bonn.

France and Chile presented papers regarding tourism and non-governmental activities, which formed the basis for discussion by an informal group. Topics covered included requirements for regulation, safety and self-sufficiency of operations, information collation and exchange, monitoring needs and the concepts of tourist areas. In addition the need to ensure comparability of standards between Governmental and non-Governmental activities was discussed. Although no definite conclusions were reached the group agreed that the issues of tourism and non-governmental activity were now a high priority in terms of

environmental protection and the matters would be further discussed at Bonn.

Alternative Energies and Energy Saving Methods

The use of Alternative Energies and Energy Saving Methods in order to reduce Environmental Pollution in Antarctica was discussed on the basis of a working document presented by the Italians. In essence the discussion revolved around the use of alternative energies such as solar and wind power and the study of a systematic way of implementing energy saving methods in order to reduce the use of fuels. Exchange of information has been encouraged among the Consultative parties with a view to eventually recommending a study by SCAR and the Committee of Managers of National Antarctic Programmes.

At the final session of the meeting the revised draft Protocol known as "Andersen 2" was adopted. It comprises a protocol to the Antarctic Treaty and as such it will not interfere with the operation of the Treaty. Contained within the Protocol are clauses which rigorously oblige contracting parties to comply with environmental impact assessment procedures. Rules relating to dispute settlement, compliance, response action and liability have also been strengthened.

The draft also provides for non-governmental organisation (NGO) observers on the Environmental protection Committee and provides explicitly for the appointment of institutional Antarctic inspectors.

It is expected that four annexes on - Environmental Impact Assessment Procedures, Protection of Antarctic Fauna and Flora and Marine Pollution and Waste disposal will be completed and attached to the Protocol when it is opened for signature.

If the agreement is approved by Governments a drafting committee will meet in Madrid between 10 and 14 June, 1991, to prepare a final version of the Protocol which can be confirmed by delegations during the week of 17 - 21 June at a continuation of the X1th SCM.

Signing could take place on 23 June, 1991, the 30th anniversary of the Antarctic Treaty

being agreed.

The XVIth Antarctic Treaty Consultative Meeting is scheduled for 7 to 18 October, 1991 and will be held in Bonn. Definitions, the Protected Area System, Tourism and Non-Governmental activity and Liability are topics likely to be on the agenda. In addition, the Antarctic Treaty Secretariat, the holding of

annual ATCM's and a programme for the effective implementation of the Protocol to the Treaty are also likely to be considered.

If the package proves acceptable to other CP governments it will represent a success for the protection of the Antarctic environment and a return to consensus within the Antarctic Treaty system.

Tour companies opening up Antarctic to visitors

Preliminary plans being made by tour companies indicate that the summer of 1991-92 may be one of the busiest yet for tourism in Antarctica. Two organisations in particular Society Expeditions and Adventure Network International have announced comprehensive programmes which include cruises, flights and overland travel. ANI is also chartering a vessel with Quark Expeditions, a tour company based in Stamford USA.

Some 24 cruises were made to the Antarctic Peninsula last season. They carried around 2,400 passengers. In addition two vessels, the Frontier Spirit, operated by a Japanese Company associated with Lindblad, made four cruises to the Ross Sea. Each ship landed up to 200 people at a time. Tour ships are unlikely to visit the Ross Sea area this coming season but will focus instead on the Peninsula area. Other activities are however planned for the Ross Dependency.

Between ten and 15 travel agency representatives were aboard the Frontier Spirit owned by Frontier Cruises in Japan, a subsidiary of Mitsubishi Heavy Industry when she made her two cruises south to the Ross Sea last season. A company producing commercial tourist promotion films was also given logistical support for what was effectively a private expedition. It comprised Colin Monteath of Christchurch, New Zealand, Mike McDowell of Quark Expeditions in Stamford USA and a Japanese camera man. NHK, a film company had chartered an Australian Bell Jetranger helicopter firm and drew on the expertise of the two climbers as guides to produce a travel film. They paid for the charter and search and rescue insurance.

Society Expeditions, a UK based company have made some 90 expeditions to the Antarc-

tic during the last 12 years. They have been operating Society Explorer and World Discoverer but are planning to add a third vessel the Society Adventurer to their fleet this year. Using the three vessels they are running a total of 31 cruises to the Antarctic Peninsula area next season, several embracing the Chilean fiords, the Falkland Islands and South Georgia.

Their latest vessel the Society Adventurer was commissioned in July 1991. It is 395 feet long, 59 feet wide and has a draft of 15.5 feet and speed of 17 knots. It has a range of 8,500 nautical miles, and can carry 160 passengers in its 94 cabins. It has an ice classification given by Det Norsk Veritas of 1A1 super and a Liberian registration. The new vessel will make six visits to the Antarctic in its first season of operation and during three of them she will go to the Falklands and South Georgia. She is also scheduled to make a Cape to Cape voyage encompassing the Beagle Channel, Drake Passage, Antarctic Peninsula, Elephant Island, South Orkney Islands, the Scotia Sea, South Georgia and Gough and Tristan da Cunha in the South Atlantic.

The Society Explorer which has a capacity for 96 passengers will undertake 16 visits to the Antarctic while the World Discover which carries 139 passengers will make nine visits. Each of the ships is equipped with zodiacs for

landing and carries expert field guides as well as lecturers.

Another company Quark Expeditions operated by Mike McDowell, an Australian and an ANI director, working in conjunction with Adventure Network International is co-chartering the Chilean Vessel M.V. Pomaire for four natural history cruises to the Antarctic Peninsula, The Falklands, South Georgia and South Sandwich Islands. The visit to South Georgia will include a guided climb on Mt Paget and a six day traverse over the route taken by Shackleton after the loss of the Endurance in October 1915.

In the meantime Adventure Network International which flies its clients to the continent and specialises in land based operations has announced a substantial new programme. It has been operating in Antarctica for six seasons, 1991-92 will be its seventh. Using their base at Patriot Hills they will run five guided climbs to the Vinson Massif between mid November and the end of January; two ski safaris to the Ellsworth Mountains, three additional visits to the Ellsworths and two flying visits to the South Pole selling at around \$25,000 each. Two lesser visits are also planned to "The Heart of Antarctica".

In addition ANI have organised a guided climb to Mount Tyree, Antarctica's second highest peak standing at 15,985 feet. This expedition may also include opportunities to climb Gardner or Eppelery the fourth and sixth highest peaks in Antarctica. Mt Erebus may be climbed by a small group to be flown in by ANI from the Patriot Hills Camp in January 1992. They are considering also an expedition that will fly into the South Pole and then return to Patriot Hills driving snow mobiles and for a mere \$100,000 they may, according to demand, offer an alternative trip involving snowmobiling out through the Transantarctic Mountains and the Ross Ice Shelf to Cape Evans where the party would be picked up by ship.

To support these operations ANI flies a DC-6 to Patriot Hills ice runway for paying passengers and uses Twin Otters to move them to other locations. ANI also charter a Chilean government vessel to resupply fuel for their operations and has negotiated with the

Soviet authorities to land aviation fuel at selected tourist locations around the continent in order to extend their operations. The Akademik Federov was to have landed 200 barrels of aviation fuel in McMurdo Sound last season for ANI but the cruise was diverted. In the meantime Greenpeace have carried 20 barrels of fuel for the company to Cape Evans each year for use as required. The Frontier Spirit also landed fuel at Cape Royds and Marble Point last season for ANI.

Other more novel projects planned by ANI include a commemorative media event on 1 December 1991 with a live broadcast from Antarctica to mark the 30 years of the Antarctic Treaty. A visit to an Emperor Penguin colony and the "Ellsworths open," a golf tournament at the nine hole course at Patriot Hills on New Years Eve. "Green fees" include the flight to Patriot Hills, accommodation and a banquet (as well as other meals).

With companies such as Travcoa, which uses a Chilean C-130 to fly from Santiago to King George Island, and other new tourist ships planned to carry greater even numbers of

Tour ships have visited the Ross Sea area of Antarctica in 1974, 1979, 1981, 1981-2m 1982, 1983, 1984 and 1987. Most of the visits have been made by the MS Lindblad Explorer with the World Discoverer going south for the first time in 1983, and making a second visit in 1987. Activity peaked this last season with the four visits by the two ships World Discoverer which is operated by Society Expeditions out of Seattle and the Frontier Spirit.

Under a Department of Conservation-Antarctic Division agreement all vessels intending to land passengers in the Ross Dependency must be accompanied by a New Zealand Government representative whose job it is to ensure compliance with permits, act as a guide and provide site interpretation. Guides this last season included Hugh Logan and Malcolm MacFarlane from Antarctic Division who made two trips and Lou Sanson from the Department of Conservation in Invercargill.

Antarctica with **Society Expeditions**



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Travelling via Buenos Aires and Santiago to Punta Arenas, join the "World Discoverer" - sail via The Beagle Channel - Drake Passage to Antarctica.

Landings by Zodiac are planned at Livingstone - Petermann - Paulet - King George Islands. Ply the stunning Lemaire Channel and Paradise Bay. Many other shore trips planned. Return via Cape Horn to Puerto Williams, fly on to Santiago and home again via Buenos Aires arriving December 13.

This expedition has been chosen by the Society to give members an opportunity of travelling together. Members who wish to return later are able to do so. Fully qualified lecturers are on board. This purpose built ship only carries 90 passengers. Participation will be of benefit to the Society.

Costs depend on the grade of cabin chosen and are inclusive of airfares pre/post accommodation, all meals on board ship, all excursions, whether on shore or by Zodiac, on board gratuities. Travel insurance, New Zealand departure tax. Transfers and expeditions are from New Zealand \$14,495 per person.

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passengers the building of accommodation is inevitable.

So far no one other than ANI appears to have provided accommodation for tourists on the continent but press reports indicate that the Holiday Inn Chain has sought permission from the Argentinean Government to build a hotel at Esperanza.

In addition State sponsored tourism is for the first time being actively pursued by the Soviet Antarctic authorities. Cabin space is

available to tourists on the Akademik Federov and the Processor Vise and helicopter flights are made to selected locations.

The Soviet Nuclear powered icebreakers plying the north-passage will also take passengers. The first, the Sovetskiy Soyuz will leave from Provideniya on the Bering Sea on 18 August and arrive at Murmansk on 9 September 1991. Quark Expeditions has been involved in these arrangements. The fare is from \$26,000.

Scott's "motor" to be recovered from the seabed at Cape Evans after 81 years

Included in the equipment Captain R. F. Scott took south on the British Antarctic Expedition of 1910 were three motor sledges. It was intended that they would tow supplies on conventional sledges to support the expedition's attempt to reach the South Pole. Two were abandoned on the ice in November 1911 after a difficult run of about 50 miles and are likely to have gone out to sea. The third, described by Scott, as one of the "two best motors" dropped through the sea ice shortly after being unloaded at Cape Evans early in the morning of 8 January 1911. Plans are being made in the UK and in New Zealand to locate and recover this vehicle in January or February 1992.

The Vickers Antarctica Project, as it is known, aims to return the vehicle to the UK for restoration and present it for display to the museum of the Scott Polar Research Institute at the University of Cambridge. The Institute and the British Engineerium Trust are associates in the project.

Mr Stuart Wilson, Financial Director of Vickers Defence Systems has overall responsibility for the project with Peter McKenzie, a historian and public relations manager for the company in charge of planning and organisation. Mark Varley, also from Vickers, will cover the engineering aspects of the project and Paul Elliott of Television New Zealand in Dunedin is operations manager for the remotely operated vehicle (ROV) which will be used to locate and recover the "motor" as Scott referred to it. Prince Charles has been invited to be patron of the project and one of two associate patrons will be Sir David Plastow, chairman of Vickers

Defence Systems; the other has yet to be named.

Final plans for the operation have yet to be confirmed as the team is still negotiating for a vessel and the essential equipment. It is likely however that the ship, to be chartered, will be moored at site determined from the depths recorded in the Terra Nova log book and from landmarks identified in Ponting's photographs. The team estimate the depth of water to be about 600 feet. Although there is a strong current in the area experience of biologists and Television New Zealand, which operated a ROV in the McMurdo area in 1988, suggests that visibility under water may be up to a kilometer. They will use a magnetometer to detect the metal and run a remotely operated vehicle with side scan sonar under the vessel.

Once the vehicle has been located a full survey will be undertaken and the method of

recovery determined on site. The vehicle, which will also be chartered from a marine survey and construction company for the operation has twin manipulator arms one with five functions and the other capable of seven. The ship will have a full range of lifting capabilities.

According to an article written by J. Stephen Dibbern and published in the Polar Record in 1976 Scott wrote, sometime in 1907, a paper entitled *Man versus motors. The sledging problem in the Antarctic.* "The manuscript" writes Dibbern "analyses the journey to the pole in terms of speed, fuel and supplies needed, and concludes that neither ponies nor men could haul enough for the round trip."

Scott considered two methods of propulsion over the snow. The first, a pair of Archimedean screws, was dismissed as the vehicle would be too bulky or so small that the screw threads would become clogged with snow. The second writes Dibbern was a modified paddle wheel. "The wheel if solid, would necessarily be too large in diameter for practical use, so he proposes that the paddle blades be placed on pairs of continuous chains and driven by a sprocket.....a tracked vehicle with snow cleats".

Working with Lieutenant R. Skelton, his engineer from Discovery, three prototype vehicles were produced. The first was based on a French de Dion-Bouton single cylinder, 8-10 hp engine, which Scott favoured as it was simple. Skelton however wanted a four-cylinder engine which would produce more power and be smoother. The machine, to be donated by the Marquis De Dion and M. Bouton, was developed in conjunction with the French explorer Jean Charcot.

Scott and Skelton traveled to Le Lauteret in the French Alps in March 1908 with Lord Howard de Walden for trials. de Walden held the patents and had offered to provide the financial backing for the vehicles. The tests were unsuccessful and so many modifications were required that a new vehicle was built in Finchley in 1908.

"In March 1909 Scott and Skelton took their new sledge to Lillehammer in Norway...where they hoped to test it in conditions more like those of Antarctica" writes Dibbern. "The motor sledge worked, and with

some modification worked well." In the meantime a third sledge was being constructed by an engineer named Hamilton. It was built by the Wolseley Tool and Motor Company, a subsidiary of Maxim Vickers in Birmingham.

The specifications, according to Dibbern's article, were drawn up by Skelton and included a four cylinder, air-cooled engine of 12 hp with, an aluminium crank case, Bosch magneto ignition, exhaust heated carburetor, two speed gear box (aluminium casing) with a clutch giving 1 3/4 mph and 3 1/2 at 1100 rpm. It had a worm drive with a 19-1 reduction and separate clutch to allow tracks to free wheel, a main frame of ash wood, with steel cross members, runners for the track system to be wood with S springs to a frame for suspension, a 156 tooth drive and non driven idler cogs on each side, the back driven and a 12 gallon petrol tank. The track system was to be 7 1/4 x 10 inches plywood plates connected by steel links with wooden rollers over the hinge pins; the rollers providing support and roll under the runners. Cleats would be attached to the plywood plates for traction. The overall dimensions were to be 4ft 5 in wide and 14 feet long with a ground clearance of 9 1/2 inches. Weight without fuel would be 1,350lb and fuel consumption at full load not more than eight pints bhp/h.

The sledge was to be ready for testing in February 1910. Trials began in Norway in March and went well although various parts failed and had to be replaced. It hauled 3,250 kg on four sledges and ran for 105 hours. Travel by such means in the Antarctic now seemed possible. Wolseley built two new machines and modified the test vehicle.

The three "motors" were subsequently packed and loaded onto the Terra Nova and taken south. "Just behind the ice-house and on either side of the main hatch are two enormous packing-cases containing motor sledges, each 16 x 5 x 4; mounted as they are several inches above the deck they take a formidable amount of space" wrote Scott."A third sledge stands across the break in the poop in a space hitherto occupied by the after winch. All these cases are covered with stout tarpaulin and lashed with heavy chain and rope lashings, so that they may be absolutely secure.... The Petrol for

these sledges is contained in tins and drums protected in stout wooden packing-cases which are ranged across the deck immediately in front of the poop and abreast the motor sledges. The quantity is 2 1/2 tons and the space occupied considerable."

On 4 January 1911 the first two were unloaded onto the sea ice at Cape Evans, and for the next few days they were used to haul all the timber for the hut and much of the pony fodder. Dibbern writes "As the sledges had no steering clutches the trips back and forth to the ship meant that the motors had to be dragged around 180 deg after each run. The hard ice and the unforeseen frequency of turnarounds crushed or splintered many of the rollers, for which there were few spares." Steering was by means of a kickbar in the front although ropes could be attached to it to enable members of the party to drive the sledge while sitting on it.

The third motor was unloaded early in the morning of 8 January; the ice was soft and because of the weight it was towed across the weak patches. Scott wrote "About 7 a.m. I started for the shore with a single man load, leaving Campbell looking about for the best crossing for the motor. I sent Meares and the dogs over with can of petrol on arrival. After some twenty minutes he returned to tell me the motor had gone through. Soon after Campbell and Day arrived to confirm the dismal tidings, It appears that getting frightened of the state of affairs Campbell got out a line and attached it to the motor - then manning the line well he attempted to rush the machine across the weak place...During the operation the ice under the motor was seen to give, and suddenly it and the motor disappeared. The men kept hold of the rope, but it cut through the ice towards them with an ever increasing strain, obliging one after another to let go. Half a minute later nothing remained but a big hole." According to Wilson it sank in 100 metres of water.

During the winter Day overhauled the engines on the two remaining motors and repaired the damaged rollers. "As he had no lathe he attached pieces of oak and greenheart from packing cases to the crank-shaft of a small motor borrowed from G. C. Simpson.

On 17 October 1911 the motors were due to be taken out of the improvised garage at the

side of the hut where Day had overhauled them and prepared to start their main journey a week later. They were beset by problems but ready to go on 21 October and set off on 23 but after further troubles finally left the following day "each hauling one and a half tonnes on three sledges". The loads comprised the southern party stores, mainly pony fodder. Two carried petrol and oil and the last food and equipment for the motor party which comprised Lashley, Day, Evans and Hooper.

For a week they made their way across the ice to Cape Armitage; progress fluctuated and problems of overheating at the low speeds plagued the party. Each time they had to stop the carburetors and manifolds, particularly overcooled and had to be started with a blow torch. On 26 October they were close to Hut Point and running well in spite of the problems and soon after they reached the Barrier but on the 30th one of the engines finally failed; the big end had broken and a day or so later near the Corner Camp the same happened to the other. As Dibbern writes "In both cases the motor sledges were completely intact and serviceable except for this one fatal flaw." They were abandoned and the party manhauled the supplies for 80deg 31'S to wait for Scott who was to write "So the dream of great help from these machines is at an end."

The motor sledges were not the first such vehicles to be taken south. As Stephen Dibbern also points out in his article Shackleton had included a New Arrol Johnston motor car in his equipment. He describes it as an "early pick up truck with a flat bed in the back for cargo", it had a "12-15hp four cylinder, air cooled engine that was specially designed to replace the original water cooled model. It used a Simms-Bosch magneto ignition and the exhaust gas from one cylinder was used to heat a case built around the carburetor. The other three cylinders exhausted into a muffler which also acted as a foot warmer. The car had a leather clutch (which occasionally froze) and a four-speed transmission (plus one reverse gear) with special low gear ratios. The frame had been strengthened and a large supply of spare parts was taken. Ordinary petrol was used as fuel, but because of the very cold temperatures expected, a special 'Antarctic oil, a forerunner

of modern Arctic lubricants, was obtained from the Price Company of England. Runners were fitted under the front wheels and wooden cogged wheels were used at the back for traction. Bernard Day, who had been an engineer with the New Arrol-Johnston Motor Car Company was included in the expedition as motor mechanic.

It was crated and loaded onto the Nimrod and landed on the sea ice at Cape Evans in 1908. "Shortly after the sledge party started we hoisted the motor car over the side and landed it safely on the sea ice. Day immediately got in, started the engine, and off the car went with the throbbing sound which has become so familiar in the civilized world, and was now heard for the first time in the Antarctic. The run was but a short one....it became bogged in snow and with much pushing and pulling and its own power the car reached a point about half a mile south of the ship "but our hopes as to the future practical utility of the machine were considerably damped. It was returned to the ship. "In the morning" wrote Shackleton "I had dreams of mounting the car with Day and gaily overtaking the sledge-party as they toiled over the ice, but these dreams were short-lived."

Although the trial was inadequate some of the problems had become clear and during the winter of 1908 Day overhauled the engine and stripped the vehicle of all unnecessary equipment "leaving only the frame, a single driver's seat, and the 23 gallon petrol tank which was pressurized by a small hand pump (a smaller gravity feed petrol tank was removed.)....., "To start it, a bowl of petrol was burned under the carburetor cup and intake manifold. Because the batteries were always frozen magneto ignition was used. "Even with the special 'Antarctic' oil, the normal drip lubrication would not work, so oil was poured in manually every two to three miles. Various trials showed that the regular Dunlop tyres fitted with snow chains worked best giving no problems until the temperature reached -34 deg C when they became solid.

The car completed five working trips during September and October 1908. One was a 50 km round trip made to depot stores at the Erebus Glacier Tongue and another took them

even further. When the time came however to set off on the main journey of the expedition the ice was too soft and it was left behind. The vehicle is now at the Canterbury Museum in Christchurch.

The condition of Scott's vehicle which fell through the ice is believed to be excellent because of the low temperature and low salinity of the sea around it. Old metal found in the water shows almost no signs of corrosion because of the constant 29 deg F. The metal parts of the tractor are likely to be intact although the wood has probably long since disappeared.

Vickers say "Not only is the motor sledge an important symbol of a key period in the development of British tracked vehicles but it is also a monument to the British Antarctic Expedition of 1910." Jonathan Mimms of the British Engineering Trust is the conservation consultant.

References: Scott's Last Expedition, Shackleton's The Heart of the Antarctic and The Polar Record; extensive use has been made of an article by J. Stephen Dibbern entitled "The First Attempts at Motor Transport in Antarctica, 1907-1911 published in Vol 18. No. 114, 1976 page 259-267 at the end of which he writes "I would like to acknowledge the invaluable help extended to me by Mr H.G. R. King, librarian of the Scott Polar Research Institute. The story of Scott's motor sledges could not have been told without the collection of Skelton's papers held in the Institute's Archives.



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