

The Twelfth Indian Scientific Expedition to Antarctica: Events and Achievements

V.K. DHARGALKAR

Leader

The twelfth Indian Scientific Expedition to Antarctica comprising 56 members coming from different scientific organisations/institutions and the logistic contingent from three wings of defence services was flagged off by Shri Ravi Naik, Honourable Chief Minister of Goa on 5 December 1992 at 1945 hours. Other dignitaries present on the occasion were Shri Simon D'Souza, Dy. Speaker, Goa Assembly, Dr. P. Rama Rao, Secretary, Shri J.V.R. Prasada Rao, Jt Secretary, Department of Ocean Development, New Delhi and Dr. B.N. Desai, Director, National Institute of Oceanography, Goa, families of the expedition members and friends. This was the smallest team *M.V. Thuleland* ever carried to Antarctica.

On very next day of sailing the members were briefed about the life and facilities available on board the ship and their utilization. More stress was given on code of conduct and discipline to be followed. To facilitate smooth administration various committees were formed.

Assignments

Based on the long term Indian Antarctic programme, the following objectives were identified for the Twelfth Antarctic expedition:

SCIENTIFIC TASKS

Atmospheric Sciences

- (a) Continuation of SODAR experiment and if possible, upgradation to the doppler system.
- (b) Steps to instal the laser heterodyne system in Antarctica for the study of ozone layer and minor constituents of the atmosphere.

Meteorology

- (a) Continuous recording of various surface meteorological parameters including synoptic hour observation. Also real time transmission of

main synoptic messages four times a day over Global Telecommunication Network.

- (b) Recording of surface ozone at Maitri. In addition, about 50 ozone sonde ascents for vertical distribution of ozone to be taken for investigating ozone-hole over Antarctica.
- (c) Radiation budget studies to be supplemented by Radiometersonde ascents during the expedition as in the past.
- (d) Transmission of surface observations from data collection platform.
- (e) Turbidity measurements for Aerosol study.
- (f) Reception of cloud imageries from Polar Orbitting Weather Satellite.
- (g) Facsimile reception of weather charts.
- (h) Arrangements for field meteorological observations for helicopter operations and other activities during summer.
- (i) Slow rising low level radiosonde ascents (one ascent per month) for supplementing the Boundary Layer experiment programme of NPL, New Delhi.
- (j) Pilot balloon ascents for upper winds – 12 ascents as pilot study by optical theodolite.
- (k) Recording of surface and upper air observations during onward and return cruise of the expedition and transmission of data over Global Telecommunication Network.

Earth Sciences

- (a) Continuation of geological work in Schirmacher Oasis and the nunataks.
- (b) Study of the geomagnetic parameters at Dakshin Gangotri and Maitri area.
- (c) Densification/extension of the existing geodetic control (control provided during earlier expedition) for the use of other scientific activities and map making.
- (d) Densification/extension of gravimetric and magnetic observations for analysis of earth resources.
- (e) Test ice-core drilling for palaeoclimatic studies.

Biology and Oceanography

- (a) Biological oceanographic processes in the coastal Antarctic waters.

- (b) Ecological parameters along with distributional characteristics to find out possible relationship with prey-predator species.
- (c) Limnological studies of the fresh water ecosystems of the Schirmacher Oasis.
- (d) Study of the primitive forms of life in Antarctica and nitrogen fixing blue-green algae to be continued.

Environmental Physiology and Psychology

- (a) Study of the behavioural changes to psychological circadian rhythm alterations in the Antarctic environment.
- (b) Study of the influence of the bright light on changes in the circadian rhythm in the Antarctic environment during long winters.

LOGISTIC TASKS

Commissioning of new gensets and running of the station systems

- (a) Setting up of a new genset accommodation and installation of four new 62.5 kVA generator sets, establish all essential electrical connections, test and commission the entire system and to study the behaviour of engineering materials.
- (b) In addition to the routine maintenance, repairs of the vehicles and station support systems and improvement of essential support systems at Maitri to be carried out by summer team and follow-up action to be undertaken by winter team.
- (c) Transportation of the stores and fuel from shelf to Maitri.

Communication

- (a) Indian Navy to provide communication to the Antarctic Expedition. Communication during passage to Antarctica, between ship - Maitri - MI.8 and convoys were the major tasks besides clearing personal and official messages to families and DOD, New Delhi.
- (b) Commissioning of the new INMARSAT terminal at Maitri.

Helicopter operation

- (a) Indian Air Force to operate MI.8 helicopters for transporting men and materials from ship to Maitri to DG and camps. The major tasks of this expedition have been transportation of the construction materials for genset accommodation, provisions, fuel and also to utilize these for scientific purpose.

Medical cover

- (a) Armed Force Medical Services to provide medical cover to the expedition members during voyage, stay at Maitri, in the field camps and convoys. Frequent lectures to be organised on the hygiene, do's and don'ts in Antarctica. Active participation during the execution of the tasks to minimise accidents/injuries.

Other activities

- (a) Seed materials for long-term storage experiment in Antarctica supplied by Indian Agricultural Research Institute.
- (b) Use of thermopak – heat generating pack developed by Defence Metallurgical Research Laboratory, Hyderabad.
- (c) Indigenous polar clothing for trials in Antarctica.
- (d) Operation clean up.

Expedition Programme

Scientific studies of the expedition started on the very next day of the sailing by the Scientists from India Meteorology Department and National Physical Laboratory. Defence Electronics Application Laboratory established contact with India and with Maitri on 9 December 1992 onwards. Studies on human physiology were initiated by All India Institute of Medical Sciences while National Institute of Oceanography started recording of marine birds and mammals as part of the ongoing BIOMASS programme.

From time to time meetings were held with scientists and logistic personnel to draw plan of work and finalise loading and unloading schedules on priority basis. Meetings with Army engineers and R&DE (Engrs) were held to draw a time targeted planning for the construction of genset accommodation and commissioning of generators.

During the voyage, we were fortunate to witness total lunar eclipse on 9 December 1992. Total phase started at 2200 hrs on 9th and ended at 0128 hrs on 10 December 1992.

A series of lectures and sports were organized. Scientists were explained their work and its importance. Medical Officer talked about hygiene, cold injuries, do's and don'ts in Antarctica. Air Force talked on the safety during flying operations. While we continued to cruise smoothly we had first glimpses of Humpback Whales at 39°S. Marion Island and Prince Edward Islands broke the monotony. The last glimpse of greenery was most befitting particularly to the winterers who will miss this for the next 14 months.

Sighting of first iceberg at 50°19'S was talk of the town to most of us while GSI scientists got on to the job to monitor icebergs. Eve of X'mas was great fete to expedition members. On the same day we encountered thick pack ice. This time it was most unusual to have big sheets and hummock ice rather than so called pack ice. On 28th afternoon we entered polynya which was larger than ever and reached our destination Antarctica at 2130 hrs. Due to bad weather spell we could not take out MI-8 from the shiphold until 30th and were made ready to fly only on 31 Dec. 1992. On the first of January after a gala New Year party, the first sortie to Maitri was received with warmth and affection. On the same day logistic personnel were deployed to establish summer camp. Loading and unloading operation and deployment of scientists was possible only on 7th January due to bad weather spell. The scientific and logistic tasks undertaken by the XII expedition and X wintering team have been summarised below.

Scientific Tasks

ATMOSPHERIC SCIENCES

(a) National Physical Laboratory

On the basis of observation from various experiments it has been observed that Planetary Boundary Layer (PBL) remains in the convective state for considerable period during summer over the Schirmacher region and the convection gets suppressed whenever the polar cold winds sweep across this region. Various types of inversions and gravity waves have been recorded. Steep temperature gradients have been recorded in the lower regions indicating the dissipation of heat flux by the horizontal winds very close to surface.

(b) India Meteorological Department

Ship observations: The analysis of the latitudinal traverse of ship during onward journey showed that the speed retarded between 20 and 23 December, i.e., between 50° and 55°S when powerful wind existed due to the steep fall of pressure and high rising sea surface waves.

Observations at Maitri: The observations at Maitri showed daily average pressure variations in line with passing (low/high) pressure systems. The average maximum temperature for January was +8.2°C while minimum was -5.5°C. Occasional spells of high winds touched 44 knot. However, average wind speed was 11 knot.

During the winter period monitoring of long and short term variation in weather parameters, probing ozone in upper atmosphere, temperature and

winds, radiation measurements on ground and in upper air, atmospheric turbidity measurements, weather forecasting using satellite pictures and analysis of charts were carried out.

Uninterrupted three hourly surface weather observations were recorded and turbidity measurements were taken on all clear days. Under upper air studies, 47 ozone sonde ascents, 21 radiometer ascents, 17 low level Radio Sonde (RS) ascents and 9 pilot balloon ascents were taken. Weather forecasting was done for all indoor and outdoor activities using satellite pictures. We also participated in the Regional Ozone Sonde Ascent programme (ROSA-93) with neighbouring stations and exchanged ozone data.

EARTH SCIENCES

(a) Geological Survey of India

Glaciological investigations

- (i) Monitoring of icebergs : First iceberg was recorded at $50^{\circ}19'S$. This is the earliest sighting of icebergs recorded by the time ship reached polynya.
- (ii) Monitoring snout of Dakshin Gangotri glacier was carried out in association with Survey of India. The polar ice front reflected in the form of DG glacier snout which has retreated considerably. A rotational movement was noticed indicating slight advancement at its northern end and distinct retreat at its southern extremity.
- (iii) Test ice core drilling was undertaken on blue polar ice at "Sankalp Point" about a kilometre east of nunatak Vetechia. Ice core of 4.98 m was recovered, properly logged and cut into 10 sections, melted and melt water was packed and labelled for the further analysis in India.

(b) Indian Institute of Geomagnetism

Continuous monitoring of geomagnetic field was carried out in three orthogonal components X, Y and Z through Fluxgate magnetometer, simultaneously at Maitri and DG, on :

- (i) Registration of the three components variation (X, Y and Z) at normal speed 3 cm/hr.
- (ii) Registration of micropulsations range from 10 sec. to 600 sec. (pc3 to pc6) at fast run of 12 cm/hr and on cassette at 10 sec. sampling interval.

During winter, recording of X, Y, Z components of earth's magnetic field and micropulsation contained therein, digital data logging of the above param-

ters, auroral observations and photography were carried out. In all 99% of analog data and 150 megabytes of digital data were collected.

(c) Wadia Institute of Himalayan Geology

The geochemical and mineral chemistry data so generated, supplemented by field data will be used:

- (i) To know the nature of protoliths and mode of its formation.
- (ii) To know mode of charnockitization for which field inclusion data will be supplemented.
- (iii) To know whether the granulites are metamorphic or igneous, depleted or undepleted, prograd or retrograd, unimodel or bimodel, relation of gneiss charnockite modes.
- (iv) Variation in mineral chemistry and their reflection on P-T conditions of rocks.

(d) Survey of India

- (i) To verify the earlier survey around Maitri on scale 1:5,000 with contour interval 5 metres. Survey verified and Insertion Deletion Grid prepared.
- (ii) Triangulation by Wild T2 Theodolite was carried out establishing the ground stations and the intersected points covering an area of 1.4 sq. km.
- (iii) The base length chosen to carry out triangulation was to be the extension of earlier survey. Height and coordinates of the ground contact points and intersected points were computed from the observations made during triangulation.

OCEANOGRAPHY AND LIMNOLOGICAL STUDIES

National Institute of Oceanography

Eight deep stations were sampled for phytoplankton, zooplankton and benthic biomass, particulate organic carbon, aminoacids and other physico-chemical parameters. The vertical distribution of chlorophyll showed high values in the beginning of January decreased later in early February. This confirms earlier findings.

During winter, single station was sampled from the shelf region throughout the year to compare the changes pertaining to planktonic organisms and their contribution to the productivity of the water column. It was also aimed to investigate the origin, transport and composition of Particulate Organic Matter

(POM) below euphotic zone upto 100 m depths. Along with this, detailed systematics of phytoplankton at different depths and in the sea-ice with respect to the seasonal changes in species composition, numerical abundance and to limited extent ecological aspects have been looked into.

(i) Benthic biomass

The benthic studies indicated that macrofauna of the shallower depth was dominated by suspension feeders which are wide spread with high species diversity. The coarse sediment provides favourable food supply for the abundant sessile suspension feeders by strong bottom local currents resulting into resuspension and transportation of detritus.

(ii) Marine biomass

Marine biomass of seabirds and marine mammals indicated definite geographical distribution. Some of the bird species showed very narrow geographical range while some showed wider range even though occurred in lesser numbers.

(iii) Limnological studies

Different ecological habitats such as (a) periphery of fresh water lakes, (b) moss beds for animal-plant relationship and (c) dry soil for soil fauna were sampled to study the community structure, temporal variability and population dynamics of the animal communities inhabiting the oasis ecosystem during Austral summer.

Winter study mainly concentrated on investigations on ecology, carbon and oxygen budget of the lake ecosystems and population dynamics of the animal communities inhabiting different terrestrial ecosystems. Two lakes, one near Maitri station (Priyadarshini or Zub lake) and another near German Hut were selected for the studies to compare and assess the effect of human interference on the lake biology and to evaluate whether these lake ecosystems represent natural environment or by the glacier melt water run-off that carries organic matter to support biota and other processes of the lake ecosystems.

Sediment traps were deployed in the Priyadarshini lake to study the rate of sedimentation and mechanism of biological cycling of carbon flux in the lake ecosystems.

HUMAN PHYSIOLOGY

All India Institute of Medical Sciences

The study of circadian rhythm, immune status assessment and psycho-emotional status assessment was carried out. The recording of physiological parameter and 24 hr holter monitoring was done. Blood samples were collected for immunological test as well as for study of the circadian rhythm of hormones. Psycho-emotional personal interview and sleep records were maintained. Information regarding sleep disorders/disturbances were also collected. The effect of geomagnetic storms, exercise and sleep on ECG holter monitoring was studied.

The assessment of the Human Immune System with regards to the relatively pathogen free though stressful environment of Antarctica was carried out for the first time.

ENGINEERING AND SCIENTIFIC ACTIVITIES

Research and Development Establishment (Engrs) [R&DE(E)]

Participated in the construction of the containerised knock-down type accommodation for gen-set, installation and commissioning of four 62.5 kVA gen-sets and the design and construction of an air lock chamber.

Redistribution of electric load to reduce the imbalance per phase of the alternator within the permissible limits of 20-30%. Installation of timetotaliser in the control panels (4 nos.) of boilers. Rewiring of the pump-house and Klargest room.

Behaviour of materials in the extreme weather conditions in Antarctica, effect of Antarctic environment on structures to determine the best suited shape and size for habitats, trials on hydraulic binder, heating and ventilation, water supply and power supply systems. Field tests on composite materials were carried out and DRDO HF communication for voice and computerised data between Maitri and R&DE (Engrs) and DEAL was established.

HF COMMUNICATION

Defence Electronic Applications Laboratory

- (i) Main objective was to establish communication between Maitri and India at 14,426, 16,225, 17,425 and 18,442 MHz frequencies.
- (ii) To study the suitability of frequencies of operation for transfer of voice and data by beacon transmission.

- (iii) To provide an easy and economical mode of communication.
- (iv) To recommend practical solution for improvement in communication.

Logistic tasks

Besides the tasks inherent to an Antarctic expedition such as cargo handling, taking over the life support systems of the station after joint annual maintenance, preparing the vehicle fleet for the convoys and receiving fuel stock for wintering, the Army team was assigned a major summer task of commissioning a new power house. This additional but important and urgent task involving construction of three knocked down containers and installation of four generators had to be carried out by the Army team with meagre increment of two personnels for summer period.

Notwithstanding the vagaries of the weather and lack of resources, this dedicated and hard working band of Army personnel lived up to our expectations and delivered the goods at the right time. The R&DE (Engrs) worked in very close conjunction with the Army team.

Army team with effective planning and competence, managed all the station support systems such as electric power supply, central heating, water supply system, water disposal, refrigeration and their components were properly maintained and serviced from time to time for efficient and effective performance.

Modifications/improvements were made whenever required from time to time based on our experience making the complicated procedures and systems simple, handy and easy to operate. Disposal of the liquid, combustible, non-combustible and toxic wastes was done as per the procedures laid down by the Antarctic Treaty. Face lift was given to the station by rearranging the various stores, furnitures and painting the interior of the station and making additional facilities on requirement basis and with available resources at our disposal.

During the winter period both the cooling units of deep freezers became defunct, out of which one was put on road by refilling R-502 gas brought from DG. With this, winter team could save all the perishable provisions, till February 94, and could also provide frozen vegetables, meat, chicken and fish to the members of the XIII summer camp including dry provisions during their stay at Maitri.

The vehicles available at our station need regular maintenance for their performance during the convoys. All types of vehicles were serviced and maintained regularly and most efficiently which resulted in the record number of 13 convoys for transporting fuel, provision, stores and scientific work. A record run of 23 hr and 50 min was made during mid-winter convoy from Maitri

to India Bay and back to Maitri including 3 hr of marine biological sampling time. During all these convoys safety of personnel and material was given highest priority and no compromise was ever made.

This team could retrieve five large IOC containers which were buried under the snow at DG since 1988. The retrieval of costly national property resulted in the saving of large sum of foreign exchange. Serviceable spares from the unserviceable assembly of various machineries, spares found at DG hanger and abandoned DG station have been used for repairs thereby keeping the demand of the spares to the barest minimum.

Apart from these, the assistance was provided for ice-core drilling, marine biological sampling, rescue operations to rescue three Russians who were lost in the severe blizzards during winter period. Based on the experience, this team implemented major fuel saving measures which have resulted in saving about 7 to 8 KL of fuel per month. Assistance was also provided to the members of the XIII expedition to establish summer camp, to render repairs of the Mantis crane and the Polar Bear – both of which had problems on arrival at Antarctica. Two convoys were undertaken by this team for XIII expedition, one to show the route from Maitri to Shelf and second full-fledged convoy to Maitri with material meant for the XI winter team.

Communication

The Indian Navy provided communication facilities to the Antarctic expedition. Communication during the passage to Antarctica, between ship - Maitri - MI.8 and convoys were the major tasks besides clearing personal and official messages to families and DOD, respectively. The team commissioned new INMARSAT terminal at Maitri, thus providing additional facilities for efficient communication. During the winter HF link between Maitri and India worked throughout. Approximately 1350 messages were exchanged using this link, thus saving costs to the tune of about Rs 3.5 lakhs, if the same were to be sent via satellite.

Communication equipment were maintained to work at optimum efficiency all through. This was possible solely due to hard work and dedication of the team. Maintenance and repairs were carried out as and when required. Proper communication was provided for 13 convoys and also maintained link with the neighbouring Antarctic stations.

Medical cover

Medical cover was provided by AMC and AiIMS, New Delhi. This medical team stressed on 'Prevention is better than cure'. Frequent informal

talks encompassing wide ranging topics and careful monitoring of all operations/tasks resulted in the lowest ever incidence of injuries/illness during this winter over team.

This team also provided medical cover for foreign nationals. On the request from the Master, *M.V. Akademik Fedorov*, a patient was successfully treated on board. Seven other foreign nationals including one Swiss were also treated thereby fostering International relations.

Experimental Studies

Seed Material for Longterm Storage Experiment in Antarctica Supplied by IAR

The seeds of freshly harvested crops such as rice, maize, pea, mustard, onion, tomato and cauliflower were sent by Division of Seed Science and Technology, Indian Agricultural Research Institute, New Delhi, for experimental purpose. The box containing seed bags was kept in a cubicle with temperature between -2.7°C to 3.0°C during summer. One out of the seven bags was sent back to India storing it in a deep freezer (-20.0°C) for onwards transportation to Division of Seed Science and Technology. Remaining two bags will be sent to the organisation in March, 1994 and 1995 respectively. Further, periodicity of sampling will be decided by the Division of Seed Science and Technology based on third observation.

Use of Thermopak

Thermopak, a heat generating bag, developed by Defence Metallurgical Research Laboratory, Hyderabad was provided to XII Antarctica expedition (a total of 780 bags) to be used in Antarctica. The use of thermopak bag was demonstrated to the expedition members on December 30, 1992 during the general briefing and the bags were distributed to all members. All the members after using these bags felt that they were not effective and were time-consuming. To generate heat, the bags are required to be kept open and thoroughly shaken. This process takes a long time to generate heat and also in the mean time, due to constant shaking the hands get warm.

The effectiveness of these bags was tried during the winter. The packs were extensively used by different groups of winter members who were working outside and also during the convoys in extreme cold conditions up to -25°C . The performance of these packs during winter was not encouraging. However, after considerable shaking temperature rose to 5°C . Probably, the packs were

not effective due to very dry and cold Antarctic air and as the shelf life of these packs being six months they may not be useful in winter in preserved state.

Indigenous Polar Clothing for Trial in Antarctica

The indigenous polar clothing supplied by M/s West Coast Manufacturers and Traders, New Delhi and Bata Company, has been tried out during the summer period. The report on the durability and utility of these articles was, however, assessed in winter. These clothing items were extensively used by the individuals working in the different environment, so that the suitability of these items could be assessed in its entirety. Following items were supplied and tested:

1. Leather gloves by M/s West Coast Mfrs. — 5 pairs
2. Polar underwear " " " — 5 pairs
3. Snow goggles " " " — 5 nos.
4. Sports shoes (Power) by M/s Bata Co. — 5 pairs

Leather gloves – Persons working outdoors on repairs of machinery such as vehicle mechanics need thin flexible gloves to enable them to carry out delicate jobs. Working bare hands during winter months is not possible and gloves supplied are far bulky for such workings. Though, these gloves meet requirement with regards to thinness and flexibility, they tear very easily and are rendered useless in no time. Also gloves supplied by M/s Super Bazar showed similar results. These gloves do not have proper inner lining to give warmth and the material used is of poor quality.

There is a definite need for working leather gloves for all the expedition members. It is recommended that better quality leather gloves similar to ones manufactured by M/s Jamalpal, France be procured. In addition to this, there is a requirement of mittens instead of Bh gloves being supplied. A set of 4 leather gloves and 4 mittens each for winter team and 2 each for summer team members is considered necessary.

Polar underwear – Only the underwear trousers were supplied. These were issued to individuals working in the camps and performing other outdoor duties during summer and winter months. Being light and thin, they were comfortable during the summer period but afforded inadequate protection. However, shockingly after one wash the trousers shrank to 50% of its size. These are of poor quality and hence not recommended for Antarctic use.

Snow goggles – These goggles have rubber frame with felt lining. The lenses are of single tinted plastic sheet. On use, the rubber lining was found to become stiff in the cold and hence uncomfortable to wear. The elastic band is

also of poor quality. The lense being single and without anti-fog coating becomes foggy immediately on going out in the cold. Due to these defects these snow goggles are considered unsuitable in Antarctic conditions and hence not recommended.

Sports shoes – These were tried by selected members, both during summer and winter, inside and outside the station and during the convoys. They are not found suitable during the convoys as the protection from cold was inadequate. As they are very comfortable and rugged, they were found ideal for use in and around the station and also working outside for a limited period. They are very convenient as camp shoes for the wintering members only as they obviate the need for wearing bulky mukluks or trekking shoes every time for a short outing. Moreover, they can be conveniently worn inside the station as well.

It was seen that shoe lace and the eye holes for the laces were not strong. The laces need to be improved and the eye holes need to be reinforced with metal or plastic eyes. With above minor modifications one pair of such shoes is recommended for each winter team members. However, these shoes are to be supplied in addition to the mukluks and trekking shoes.

It is suggested that the more firms may be approached for trying clothing in Antarctic conditions and also be asked to manufacture clothing as per specifications taking into account Antarctic climate. Apart from clothing, other items such as shoes, goggles, gloves, fur caps etc. may be manufactured and tried in Antarctica for durability, comforts and warmth, if successful will definitely help to save foreign exchange.

Fire Fighting Squad

A fire fighting squad was formed and regular fire fighting drills were conducted to prevent fire, the most hazardous danger in Antarctica. This was possible through the laying down detailed procedures for prevention of fire and well co-ordinated fire fighting drills. All the members were vigilant in this aspect and regular inspection and fire drills were carried out. The detail of the fire fighting procedure is given in the logistic section of this report and also in the handing-taking over notes of X-XI winter over teams.

Sports and Literary Activities

Various sporting activities were organised and conducted over the years. Of the sports organised, the Indo- Russian mid-winter marathon and volley ball matches were the two events that require special mention.

On the literary front, fortnightly lectures were delivered by every members of the team. "The Maitri Times" (in-house monthly) describing activities undertaken by the members during the month apart from being humorous became an enjoyable morale booster and was soon a popular feature. A station magazine "Himvaat" containing number of articles and poems in Hindi, English and many Indian languages was published and released on Republic Day. For the first time ever, this winter team brought out Year Book in which the biodata, field of specialization and other interesting details apart from contact addresses have been included.

To boost up morale and to give a homely atmosphere, birthdays, national days and some Antarctic events were celebrated in a grand manner, in keeping with Antarctic traditions. However, when priority work was to be completed within a stipulated time, holidays and other comforts were forfeited by the members, exhibiting great sense of responsibility, zeal, vigour and involvement.

Operation Clean Up

The winter-over team gave high priority to "Operation Clean Up" throughout the period of stay at Maitri. No serious attempt was made earlier to clean up the surrounding areas which had resulted in accumulation of large quantities of unwanted and surplus materials scattered all around Maitri. Regularly, we attempted thorough cleaning of our surroundings by collecting loose papers, metal pieces, plastics, tins, glasses, drums etc. which were blown away by wind and scattered all over the area. These were collected, sorted out and disposed off as per Antarctic Treaty regulations.

The waste water disposal system was modified and the waste water pond was improved to prevent contamination of the Priyadarshini lake through percolation. We formulated and laid down strict and stringent measures for disposal of daily waste such as leftover food, tins, plastic, bottles and papers.

Over the years, a large quantity of metal scrap such as burnt generators and gen-set complex, surplus construction material, outdated food stuff, non disposable wastes, used machines and generator oil and large quantities of unserviceable stores had gathered. All these materials were sorted, packed and earmarked for backloading to India. In this operation, summer camp area was given careful consideration from the ecological point of view as it is situated very close to Priyadarshini lake from where water for drinking and other domestic purpose is being used.

Operation Clean Up activity bore fruits when (a) Russian Environmentalist, Dr. Pomelov Victor, Russian Polar Institute, along with other scientists from

M.V. Akademik Fedorov visited Maitri on 11 January'94. The members were impressed with the cleanliness of the station and our interest in the Antarctic Environment.

Visit of Swedish Inspection Team

Swedish Inspection Team visited Maitri on the 21 January'94 under Article VII(1) of the Antarctic Treaty. A detailed discussion was carried out with the team followed by the tour of the station. The team visited different areas of the station and made detailed inquiries into the scientific, logistic activities and solid and liquid waste disposal. The visiting team was impressed by the maintenance and running of the station especially with the cleanliness and efficient waste disposal system. The visit was concluded with a congratulatory note.

Return Voyage

After completing all the summer scientific and logistic tasks, preparation for the return voyage commenced. Summer camps were closed and all the scientists as well as the logistic personnel were brought to the ship. Unloading of the stores and fuel of the XI wintering team on the shelf was completed and backloading materials were loaded onto the ship and secured.

Bad weather struck on 26 February, 1994 and three ships mooring lines were snapped off and because of this ship had to move into the open water and then into the pack ice to minimize the impact of the cyclonic wind of 60 knots gusting to 70 knots. While manoeuvring through the thick pack-ice ship lost the steerage and started to drift. Series of ballast operations were carried out to raise the aft of the ship for rudder inspection. The inspection of rudder revealed a crack in the collar/jacket of the shaft of the rudder. Automatic steering could not be used and manual steering was attained with the help of cable/winch ropes.

This unfortunate incident caused panic in some groups of people particularly from summer participants with regards to the safety of the ship. A meeting was convened and the Captain was requested to brief the members of the expedition regarding the safety of the ship and contingency plan drawn in case of emergency. This proved to be a morale boosting to the members.

One after another bad weather systems started to cast their spell hindering the progress of sailing. However, Master and crew showed great skill and expertise and were determined to face any challenges. While we were heading for Mauritius instructions were received from Ship's Company to divert the ship to Durban, South Africa for repairs. On inspection, it was found that there

is a major repair of the rudder and ship is not seaworthy in the present state. Therefore, it was decided in consultation with DOD to fly all the expedition members to India. During return voyage whenever ship halted to replace the rudder cable the halting time was used to collect oceanographic samples and recording of seabirds and mammals. Other scientific and logistic personnel started to analyse the data and prepare inventory of the backloading items.

References

- Dhargalkar, V.K. (1993): *Interim Report - XII Indian Scientific Expedition to Antarctica* 92-93. Submitted to Department of Ocean Development, New Delhi, 1-110 pp.
- Dhargalkar, V.K. (1994): *Interim Report of the X Wintering Team, Maitri, Antarctica*. Submitted to Department of Ocean Development, New Delhi, 1-91 pp.

PLATE I



a. Ms. Wanja Tornberg, Leader and Prof. Anders Karlqvist, Dy. Leader of the Swedish Inspection Team under Article VII(1) of the Antarctic Treaty visited Maitri on 21 January, 1994.



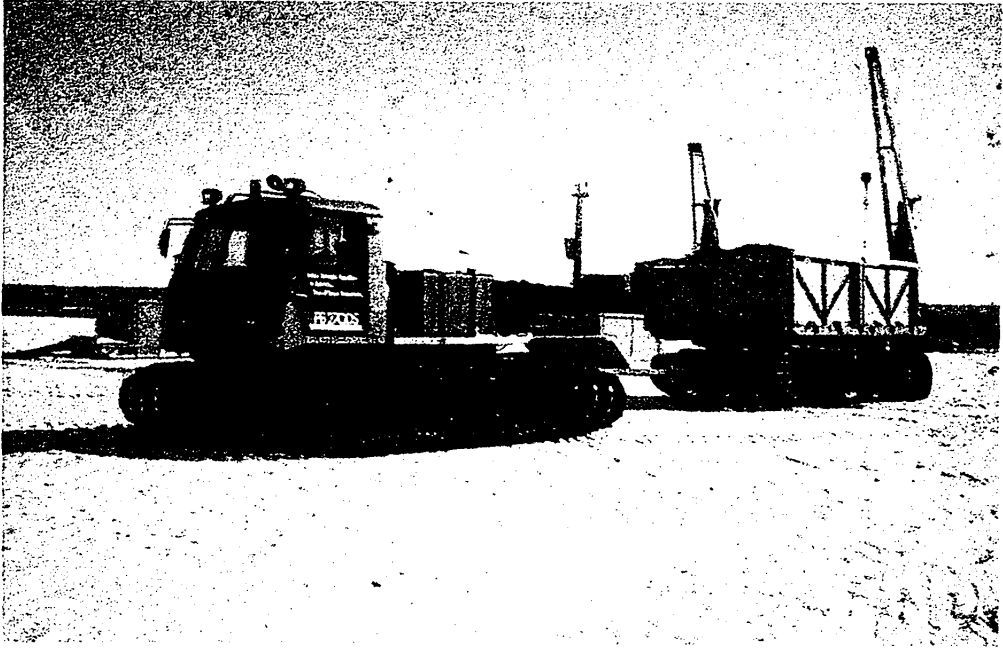
b. Members of the Swedish Inspection Team are taken around the Maitri Station.

PLATE II



X Wintering Team

PLATE III

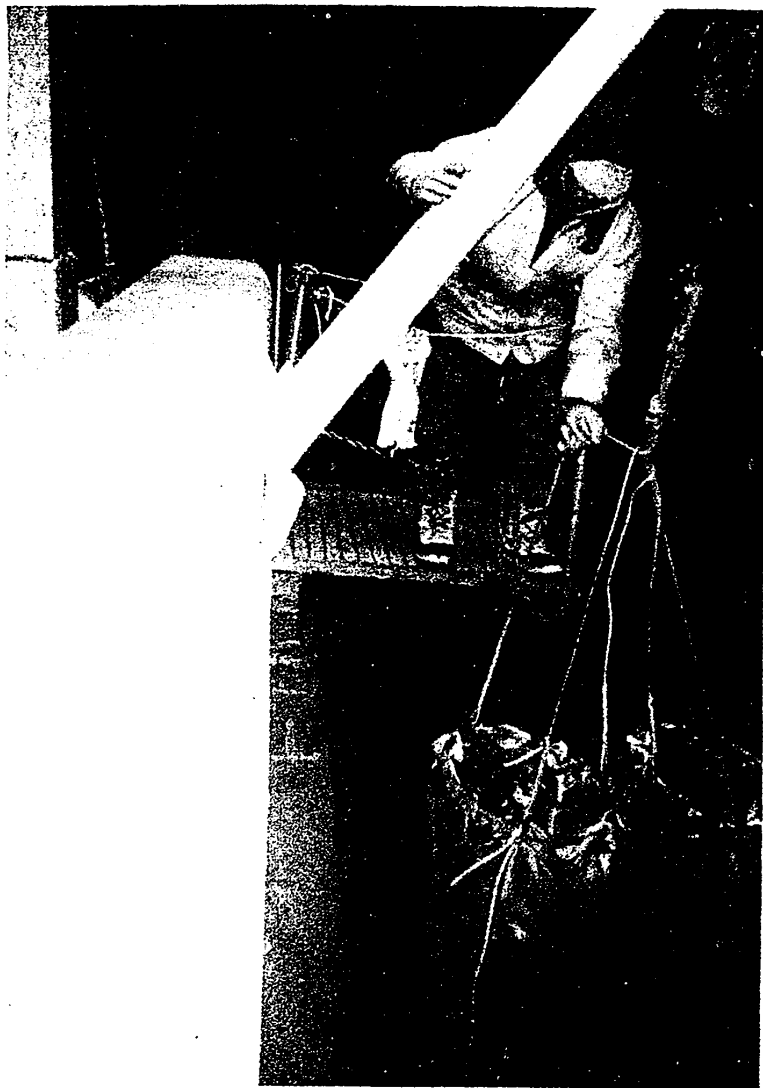


a. Transportation of fuel to Maitri



b. Drilling the lake ice for biological sampling

PLATE IV



Operation of zooplankton net

PLATE V



a. Crab eater seals on fast-ice



b. Adelie penguin on fast-ice