SCIENTIFIC REPORT
THIRTEENTH INDIAN EXPEDITION
TO ANTARCTICA

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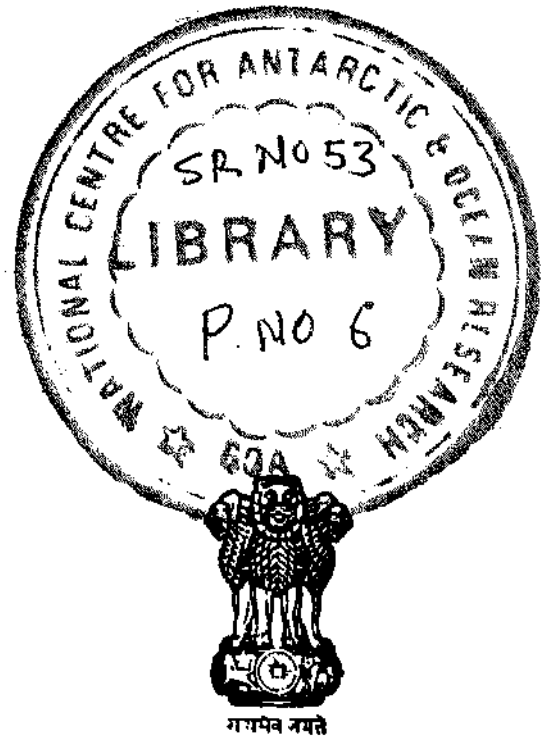

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DR. A.E. MUTHUNAYAGAM
SECRETARY

भारत सरकार
महासागर विकास विभाग
महासागर भवन, ब्लाक 12, सी.जी.ओ. कम्पलैक्स,
लोदी रोड, नई दिल्ली–110 003

GOVERNMENT OF INDIA
DEPARTMENT OF OCEAN DEVELOPMENT
' MAHASAGAR BHAVAN', BLOCK-12, C.G.O COMPLEX,
LODHI ROAD, NEW DELHI-110 003

January 20, 199

FOREWORD

India has crossed one more milestone in Polar Research with the successful completion of the Thirteenth Indian Scientific Expedition to Antarctica. The publication of the technical report of this expedition will certainly contribute to a better understanding of the intricate global processes which nature controls from the remote continent of Antarctica,

The quest for truth, the pursuit for scientific knowledge and the spirit to face challenges have been the principal motivating force behind this multi-disciplinary and multi-institutional expedition. Despite all odds, during the expedition, two sophisticated instruments, namely, the laser heterodyne system and the mm wave radio spectrometer were successfully commissioned and tested for measuring ozone concentrations over Antarctica. Geological survey was extended further South to the Orwin Mountains. A unique experiment to monitor and study day-time auroral phenomenon was also initiated, thereby adding new dimensions to the Indian Polar Research.

The valuable data collected and the scientific knowledge gained through this expedition has been systematically collated by Shri G. Sudhakar Rao, the leader of the expedition in this report. I am sure that this technical publication will make valuable contribution to the furtherance of polar science and will serve to be a useful source of information for those interested in this field of research.

(A. E. Muthunayagam)

PREFACE

Thirteenth Indian Scientific Expedition to Antarctica with thirteen scientific organizations will be remembered in the history of Indian Antarctic Expeditions as an expedition with many superlatives to the continent of superlatives, i.e. Antarctica. Highest ratio of Scientists to Logistic personnel (25 out of 58), least flying facilities (only two Chetak helicopters, out of which one became unserviceable after one month of usage). Because of limited flying facilities, best possible planning to use the air-sorties with maximum efficiency was done so as not to sacrifice any assigned scientific responsibilities. The summer camp was set up on 1 st Jan itself and the scientific induction started on the same day. Except for the Laser Heterodyne Experiment, all scientific works of summer programme started in about a week. Due to the blessings from weather god with many fair weather days, scientists completed their programmes very early and by the 20th of Feb, all summer scientific programmes in field camps were completed.

Even though weather favoured this expedition with practically no blizzard day during summer and all scientific programmes went smooth, many odd events occurred in this expedition; starting with Chief Officer of Ship's fall in a crevasse, followed by helicopter's crash landing and its unservicability for the expedition, fire accident in main Maitri building, rudder breakdown to the expedition's ship during its return voyage, breakdown to the newly supplied heavy transport carrier, viz., Polar Bear Transporter during in its first journey itself enroute to Maitri, frost-bite to an expedition member to name only a few followed in order. It is a miracle that even though all the above mentioned accidents had the potential of taking invaluable human lives, I am happy to record here that the members who were affected by these accidents could escape even without minor injuries.

The reason behind the successful completion of all the assigned scientific tasks even with facing many odds is hard work, sincerity, dedication, full cooperation, and daring efforts shown by each and every member of the team. An expedition is a team work, and every member should have concern for every other member for ensuring safety of all and at the same time, completing all the assigned tasks especially in a place like Antarctica. All the team members

followed this principle irrespective of their ranks/designations, and organizations to which they belong. My sincere appreciations to all of them. The support, guidance and help received from the concerned officials of Department of Ocean Development and all the participating organisations from time to time was an immense help in achieving our tasks.

Myself and my team members are grateful to Dr. P. Rama Rao, Secretary(Retd) and members of team selection committee for giving us a chance to work in the expedition. I thank all the heads and concerned officials dealing with Antarctic activities of all the participating organisations,viz., India Meteorological Department (IMD), Research and Development Establishment(Engrs.) (R&DE), Defence Electronics Applications Laboratory {DEAL), Indian Institute of Geomagnetism (IIG), All India Institute of Medical Sciences(AIIMS), National Physical Laboratory (NPL), Physical Research Laboratory (PRL), National Environmental Engineering Research Institute (NEERI), National Institute of Oceanography (NIO), Geological Survey of India (GSI), National Geophysical Research Institute(NGRI), Osmania University (OU), Survey of India (SOI), Indian Army, Indian Navy, Director General Armed Forces Medical Service(DGAFMS), for their keen interest in Antarctic studies, help and encouragement given to us for the success of the expedition. I am thankful to the Commandant and other training instructors of Indo-Tibetan Border Police(ITBP), Auli for imparting valuable acclimatization training to the team prior to the expedition; Medical Superintendent and the concerned Medical Officers of All India Medical Institute of Medical Sciences, New Delhi for certifying our fitness for the expedition after thorough Medical Examinations.

The affectionate welcome at Maitri to our team by Dr. Vinod K.Dhargalkar, Leader & Winter Team members of XII Indian Antarctic Expedition and their help in passing their invaluable experiences of Antarctica for station maintenance and running of convoys is unforgottenable, for which we are very much thankful to them. There were no bounds to our happiness when we received Dr.S.D. Sharma, Leader & members of XIV Indian Antarctic Expedition who brought messages from our near and dear ones and fresh food. Our sincere thanks are to them also.

Our sincere, thanks are due to Mr. Nikholai Dmitriev, Leader and members of the Russian Antarctic Expedition at Novolazaravskaya station for their good cooperation and help at any time of need. We are thankful to the team of Japanese Antarctic Expedition at Syowa for Ozone data exchange. We are extremely thankful to the Honourable Prime Minister, Minister of Ocean Development of India, honourable President of United States of America, Honourable president of Peoples Republic of China, Honourable Minister dealing with Antarctic Expeditions of Japan and various stations in Antarc-

tica,viz., Sanae of South Africa, Von Neumayer of Germany, Molodyoznaya and Novolazaravskaya of Russia, Syowa of Japan, Halley Bay of United Kingdom and Mcmurdo of United States of America for their mid-winter greetings which gave us lot of encouragement to us when we were living in continuous darkness. We are grateful to DOD, R&DE(E), IMD,IIG, DEAL, Indian Army, Indian Navy for their greetings on many occasions.

Though the ship MV Stepan Krasheninnikov is chartered for the first time and there was lot of language barrier between expedition members and many crew members, the adjustments, friendship, cooperation and help shown by the Master, Mr. Ruslan Zyanigabdinov and his crew members is commendable in solving the day to day problems onboard the ship, cargo handling, etc., and our sincere thanks are due to them. We are thankful to the Master and crew of M.V. Polar Bird who brought back safe to mainland to join with our near and dear ones.

I record my thanks to several experts in different disciplines of science for reviewing the technical papers of this report and offering suggestions for improving the quality of the papers. Thanks are also due to Dr. N. Sen Roy, Director General of Meteorology, Shri Bhukan Lad, Dy. Director General of Meteorology and Dr.V.S.Tiwari, Director and to all my colleagues in India Meteorological Department who have helped me directly or indirectly in bringing out this publication in the present form.

I am thankful to Dr.A.E. Muthunayagam, Secretary; Shri A.K. Chugh, Joint Secretary and Dr.A.Mitra, PSO of Department of Ocean Development, New Delhi for their encouragement and help to bring out this publication.

My sincere thanks to each and every team member of the expedition for their discipline, cooperation and sincere efforts in making the expedition a grand success. Last but not least, my sincere thanks to all the family members of the XI winter team members for their patience in tolerating our long absence and handling our personal affairs.

This report covers the articles on the scientific achievements and logistic tasks accomplished by different participating organizations during the both summer and winter parts of the expedition with available analyses of the data collected during the expedition. Articles from AIIMS could not be included in this report due to. non-receipt from them and will be included in the further Technical Publications of Department of Ocean Development.

India Meteorological Department
Mausam Bhavan, Lodi Road
New Delhi-110003.

G. SUDHAKAR RAO

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Subrata Das

THE TEAM

Summer Members	Winter Members	Organisation
	Shri G. Sudhakar Rao Leader and Station Commander	India Meteorological Department (IMD)
	Shri Satish B. Gaonkar	do
Shri S.S. Gaikwad	Shri Tathagat Varma	Research and Development Establishment(Engrs.) (R&DE)
	Shri Dinesh Mohan	Defence Electronics Applications Laboratory (DEAL)
Shri S. Banola	Dr. A.N. Hanchinal	Indian Institute of Geomagnetism (IIG)
	Shri M. Sridharan	do
Ms. M. Naidu	Dr. Aran Joshi	All India Institute of Medical Sciences(AIIMS)
Dr. S.L. Jain		National Physical Laboratory (NPL)
Dr. R.S. Arora		do
Dr. V.C. Nagar		do
Dr. Patrick Dierich		do
Shri D.P. Raju		Physical Research Laboratory (PRL)
Shri R. Narayanan		do
Dr. T.K. Ghosh		National Environmental Engineering Research Institute (NEERI)
Dr. (Ms) Lokabharathi		National Institute of Oceanography (NIO)
Shri M.J. D'Souza		Geological Survey of India (GSI)
Shri Mirza Javed Beg		do
Dr. S.H. Jafri		National Geophysical Research Institute(NGRI)

Contd.

Summer Members	Winter Members	Organisation
Dr. M.S. Joshi		National Geophysical Research Institute(NGRI)
Dr. P.C.Reddy		Osmania University (OU)
Maj.Tavinder Paul		Survey of India (SOI)
Shri O.P.Sharma		do
Sub. Prabbu Dayal	Maj. M.D. Alexander	Indian Army
HMTQubadUddin Ahmed	Capt Atul Tandon	do
Nb/Sub. Hardev Dingh	Sub. Dina Nath Singh	do
	Sub. G. Mani	do
	Sub. N.S. Parmar	do
	Sub. K.K. Ganapathy	do
	Sub. Rameshwar Prasad	do
	Nb/Sub. Surender Singh	do
	HMT Baljit Singh Mor	do
	HMT Haradhan Dey	do
	HMTEThanupillai	do
	Hav. Rajpal Singh	do
	Nk. Shiv Darshan	do
Cdr. R.H.L. Maini	Lt. Harkirat Singh	Indian Navy
Lt.Cdr.M. Sarangapani	Mohar Singh, MCPOR (TEL)	do
LtCdr.M. Ravindran	A. Shajee, POELR	do
Lt. Rajneesh Kumar	P. Singh, CPOCK(O)	do
Lt. S.S. Bal		do
Lt.T.P. Asbok		do
K.T. Upendra. MCAAII		do
S.K. Moinuddin, AA 2		do
V.T. Pullickalan, EAA 3		do
V.V. Vincent, POELAR		do
S.K. Roy. LCK(O)		do
M. Lakshmanan, LCK(O)		do
	Maj. Subrata Das	Director General Armed Forces Medical Service (DGAFMS)