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A Brief Report on the Activities of Survey of India Team during Fourteenth Indian Scientific Expedition to Antarctica

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Introduction

In continuity with the successful survey activities carried out by the Survey of India Teams from 10th expedition to 13th expedition the following tasks were assigned to the Survey of India Team of 14th expedition:

a) Control for mapping of an area of 0.5 km x 0.5km on 1:1,000 scale with 1 metre contour interval and its detail and contour survey (immediately west of the area surveyed by the 13th expedition).

b) Determination of deflection of vertical at Maitri from astronomic observation.

c) Monitoring of Dynamic Movement of Dakshin Gangotri Glacier.

(a) Control for Detail Survey and Contouring

i) Control for detail survey: Control for detail and contour survey was established by E D M Taverse which commenced from Maitri 'S'fixed by 10th expedition and closed on T.S.-3 of 13th expedition, fixing 5 traverse stations and 96 Offsets. The data used is tabulated below:

SI No.	Name of the Station	Easting metres	Northing metres	Height metres
01	Maitri 'S'	10,00,000.00	5,00,000.00	117.00
02	T S No.3	9,99,874.00	4,99,583.36	133.00

INSTRUMENTS USED:

The following instruments were used for the job:

Wild T-2 Theodolite No.286501

Auto Ranger No. 6J7106

Psychrometer

Paulin Barometer

ii) Detail and contour survey: Detail survey was carried out as per departmental procedures. The offsets were used for surveying details and contours. Contours were chased with clino pole.

Area surveyed was 0.25sq. km.

(b) Determination of Deflection of Vertical

We have a station named Maitri 'S' fixed by GPS during 10th expedition. With the help of this station a new station named Astro. 'S' was established by measuring distance of this station from Maitri 'S' with EDM and deriving true bearing from observation made to sun.

Astronomic observations were carried out on ASTRO 'S' for determination of deflection of vertical in Maitri area at Antarctica.

The data, used for preparation of observation programme and doing calculation, is tabulated below:

SI No.	Name of the Station	Latitude o ' "	Longitude o ' "	Distance metres
01	Maitri'S'	704551.73	114402.57	156.237
02	Astro'S'	70 45 56.62	1144 06.31	° ' "
03	Azimuth at Maitri 'S' of Astro 'S'=			345 51 31
04	Azimuth at Astro 'S' of Trisul HS =			288 20 29

INSTRUMENTS USED:

The following instruments were used for the job:

Wild T-2 Theodolite No.286501

Auto Ranger No. 6J7106

Psychrometer

Paulin Barometer

Sidereal Chronometer

Stop Watch

4 Band Philips Transistor

Method of Observation

Preliminaries

1) A list of stars was prepared in advance keeping the following points in mind:
   i) Magnitude of the stars to be between 2.0 to 7.0
   ii) Meridian Z D to be between 35 deg. to 60 deg.
   iii) Star should have its upper (in case of north stars) or lower (in case of south stars) transit after 17hrs GMT.
2) For setting the instrument in meridian true bearing at Astro. 'S' ofTrisul HS was determined by observing the sun.
3) Chronometer was compared against time signals emmited from Moscow on 10MHz before starting observation. But the clock could not be compared immediately after completion of observations as the signal was not audible after 20hrs and hence it could be done next day only.

Observation

Latitude Observation: For determination of latitude 16 stars were observed on 10 sets, five before crossing and five after crossing meridian, recordingtime, altitude, temperature and atmospheric pressure.

The altitudes were reduced to the meridian with the formulae given below:

$hm = h + 2.\sin^{-1} [\cos(\phi_a). \cos(\delta). \sin^2 (t/2). \sec(h)]$ (for north stars)

$hm = h - 2.\sin^{-1} [\cos(\phi_a). \cos(\delta). \sin^2 (t/2). \sec(h)]$ (for south stars)

where, $\phi_a = (90-hm) + \delta$ (for north stars)

$\phi_a = (90-\delta) + hm$ (for south stars)

h = Altitude of the star corrected for atmospheric refraction.

hm = Altitude reduced to the meridian.

ϕ_a = Astronomic latitude.

δ = Declination of the star.

t = Hour angle of the star at the time of intersection,

where, t = (LST - RA) X 15, LST = GMTx (366.2422/365.2422) + GST at 0 hr UT + longitude of the station in time.

GST = Greenwich Sidereal Time,

LST = Local Sidereal Time,

UT = Universal Time coordinated,

RA = Right Ascension of the star.

Astro. Latitude = ϕ_a = 70° *45* 54.58" S

Geodetic Latitude = ϕ_g = 70° 45' 56. 62" S

Determination of Longitude

As for determination of longitude, East-West Stars could not be observed due to bad weather, the only possible method left was recording time of transit of stars. So time of crossing of upper transit of 10 north stars and time of crossing of lower transit of 10 south stars were recorded and longitude was calculated as under:

LST = (Chrono time of intersection + clock corr. + rate corr. + BIH corr - distance corr.)

GST = (LST - Assumed Long in time)

Astro. Longitude = λ_a = (RA - GST)x15

= 11° 43'52.56" E

Geodetic Longitude = λ_g = 11° 44' 06.31" E

Note:- Astronomic latitude can be graded as second order as it has been derivedfrom 140 observations carried out in two different nights. But we cannot establish any grade of accuracy in case of longitude due to the following facts:

i) The error due to erronious meridian setting could not be eliminated as south stars could not be observed at upper transit.

ii) The stars below 35 deg. could not be observed as wild T-2 theodolite was used for observations.

iii) Stop watch was used for recording time as Favog Chronograph did not work due to very low temperature.

iv) The place of observation is very close to pole.

Results

Prime Vertical Deflection = $\eta = (\lambda_a - \lambda_g) \times \cos(\phi_a)$

= (11° 43' 52.56" - 11° 44' 06.31") xcos (70° 45' 54.58")

= -06.09"

Meridian deflection = $\xi = (\phi_a - \phi_g)$

= (70° 45' 54.58" - 70° 45' 56.62") = - 02.04"

(c) Monitoring of Dynamic Movement of Dakshin Gangotri Glacier

The dynamic movement of DG Glacier snout was monitored by providing offsets at number of points all along its periphery with the help of theodolite and EDM instrument from two fixed GSI stations. In addition to the offsets three IPs were also fixed at inaccessible places on the face of the glacier. The present position of the snout and surrounding lake was plotted on a graph paper on 1:1,000 scale for further studies by GSI.

Assistance to Other Department

i) Three profiles were provided at three different sites, on the request of Osmania University Scientists, as per their specification.

ii) Direction for orientation of E Mail Antenna was established on the request of scientist of R & D E(Engrs), Pune.

Description of Country

The area of Schirmacher Oasis, where Maitri Station is located, is rockey and undulating, with a number of lakes spreaded throughout the area. The oasis is about 17 km long and about 1.5 km to 2 km wide. Shelf ice exists on the north edge and polar ice on the south edge of the oasis.

Acknowledgement

We are thankful to the Surveyor General of India for providing this unique opportunity of participating in the 14th Antarctica Expedition and his encouragement given to us. thanks are also due to the Addl. Surveyor General, G & R B, and 0 C No. 82 Party (G & R B) for their valuable administrative & technical support and guidance. The leader of the 14th expedition and all other scientific & logistic members deserve our sincerest thanks for providing excellent support, enabling us to complete our task well in time.