CLIMATE OF GULMARG

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Meteorological observations (temperature, humidity, sky conditions and precipitation) throughout the year for Gulmarg, have been collected with special reference to diurnal and seasonal cycle of variations.

In connection with scientific compilation of climatological data of high altitude locations like Gulmarg, need for regular and systematic recording of observations have been realized because of the increasing use of such terrains for Defence purposes. The meteorological data for Gulmarg[1] are available for the last 40 years but only for four months e.g. June to September. Therefore it was essential to extend the recording of the meteorological observations throughout the year in those areas. The elements being of temperature, humidity, sky conditions and percipitation. Moreover, these data are collected with special reference to the diurnal and seasonal cycles of variations, so that these can be correlated with the physiological problems as well as those of weapons/equipment, clothing and food which are the essential items for the armed forces.

Gulmarg (Lat. 34°, 03′N, 74°, 34′ E) with an average altitude of 2664 m. is situated 28 miles west of Srinagar. The observatory which is surrounded on three sides by long pine trees at the corner of gold field is located on the eastern slope of the hills. The distance of the observatory from the laboratory building, which is to the south of it, is more than 30 ft. The whole area was protected by the wooden fencing. All necessary precautions were taken so that the observations are not affected by the building or the trees. The maximum, minimum, wet and dry thermometers were kept in the Stefensons screens alongwith the thermograph and hairhygropgraph. The height of the screens from the ground was kept at 5 ft. to take observations easily during the snow season. The sun-shine recorder was kept at a height of 6 ft. from the ground. The chart was replaced daily in

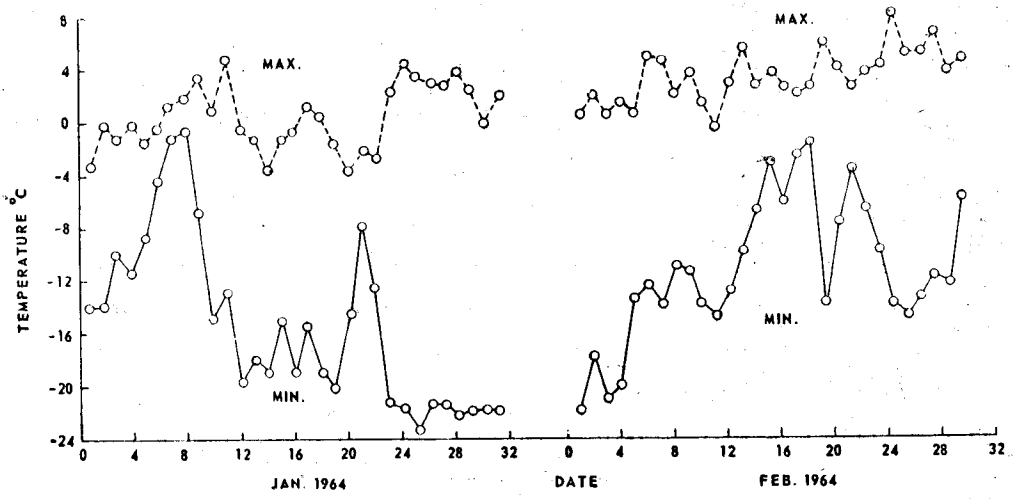

Fig. 1(*a*)—Variation of daily maximum and minimum temperature during January and February 1964.

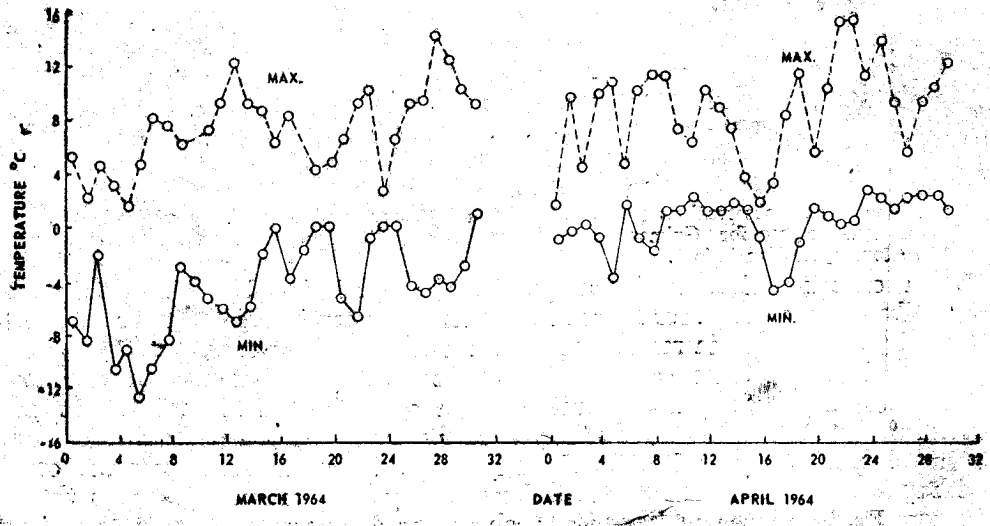

Fig. 1(*b*)—Variation of daily maximum and minimum temperature during March and April 1964.

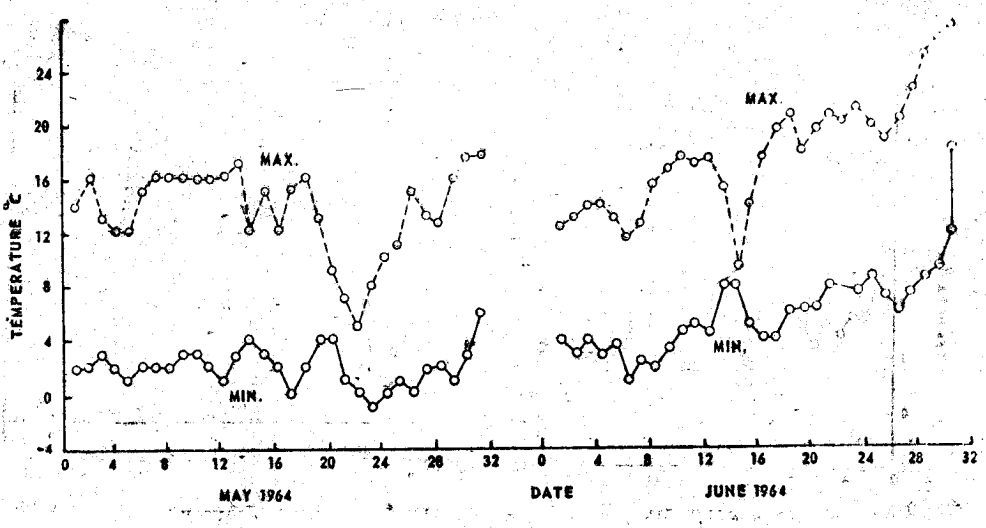

Fig. 1(*c*)—Variation of daily maximum and minimum temperature during May and June 1964.

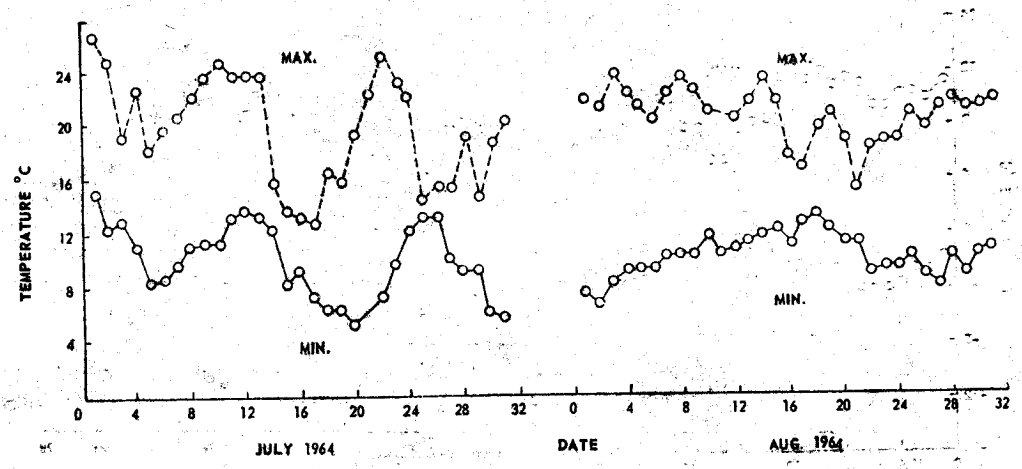

Fig. 1(*d*)—Variation of daily maximum and minimum temperature during July and August 1964.

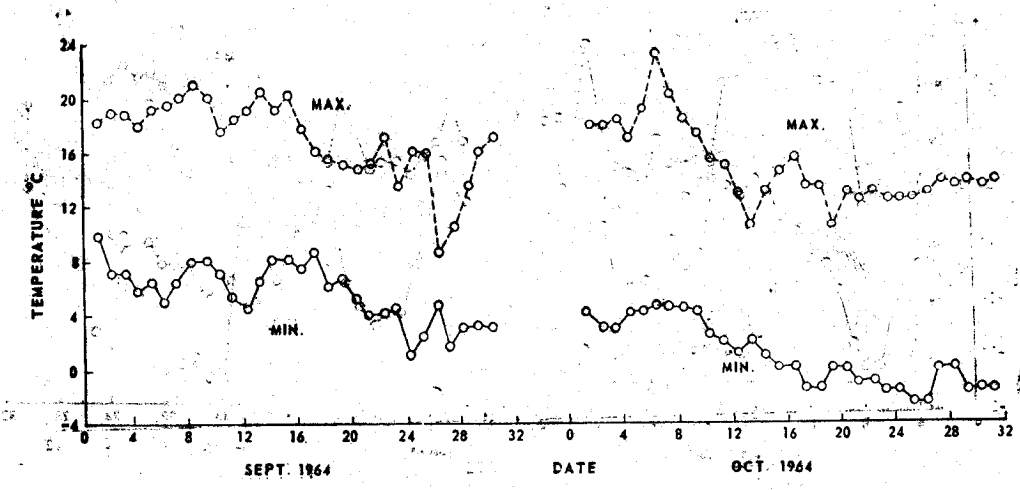

Fig. 1(*e*)—Variation of daily maximum and minimum temperature during September and October 1964.

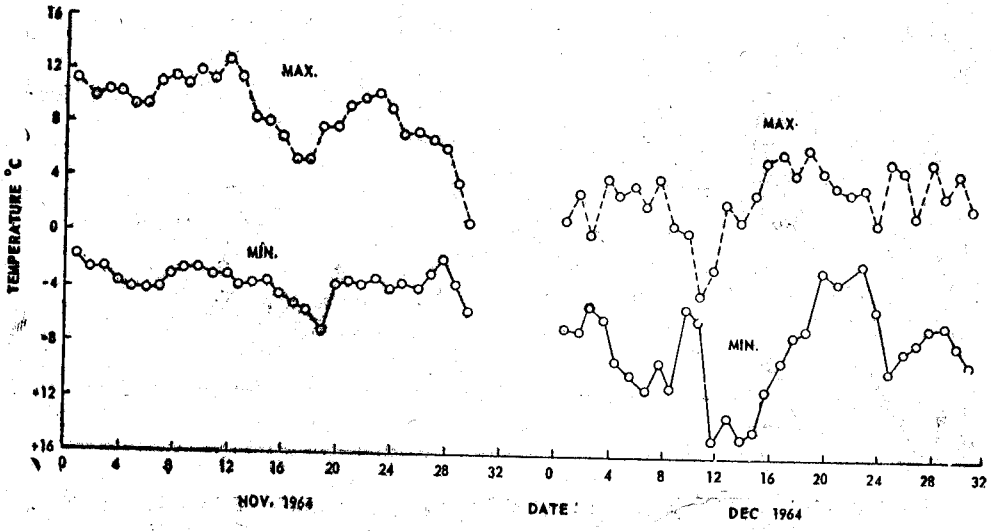

Fig. 1 (*f*)—Variation of daily maximum and minimum temperature during November and December 1964.

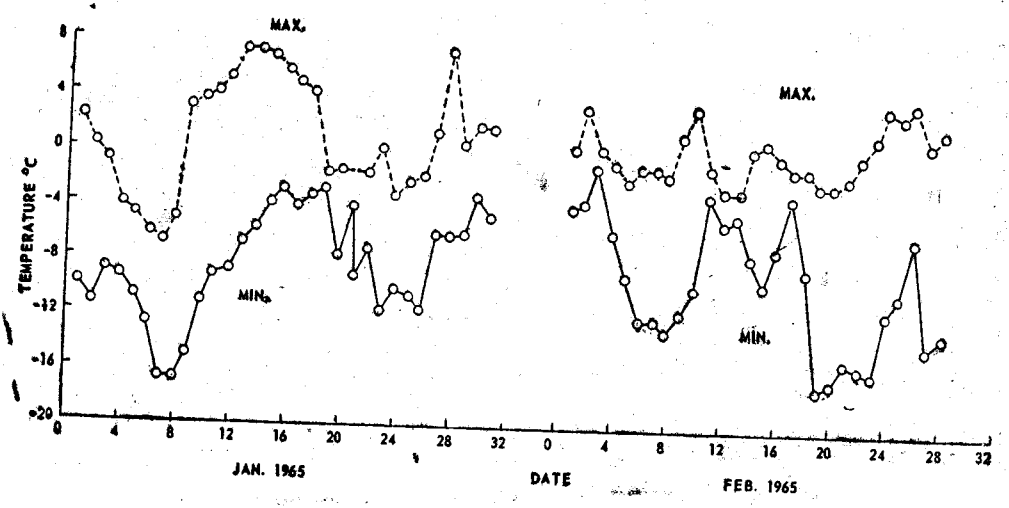

Fig. 2(*g*)—Variation of daily maximum and minimum temperature during January and February 1965.

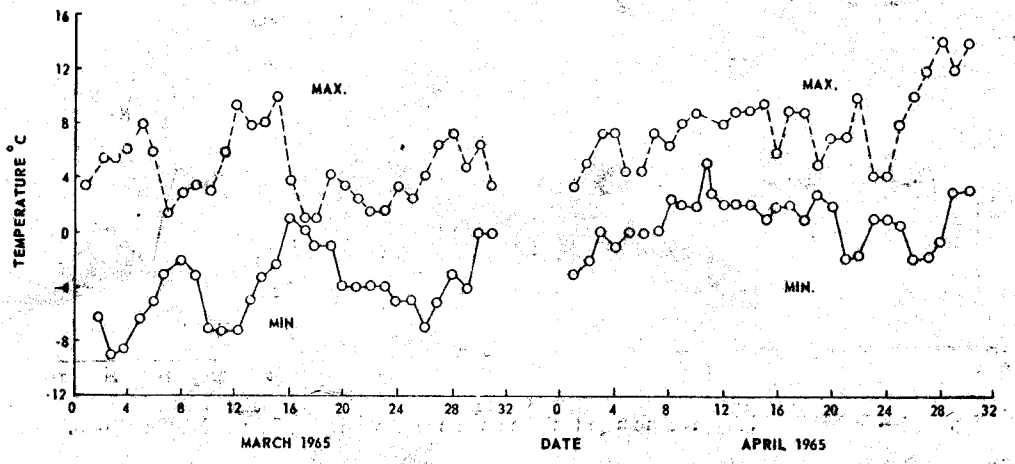

Fig. 2 (*h*)—Variation of daily maximum and minimum temperature during March and April 1965.

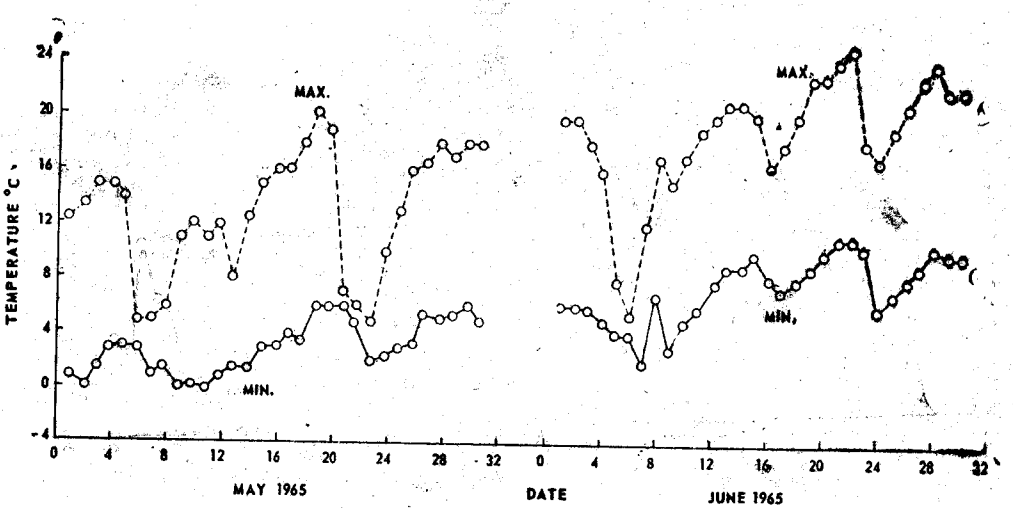

Fig. 2 (*i*) —Variation of daily maximum and minimum temperature during May and June 1965.

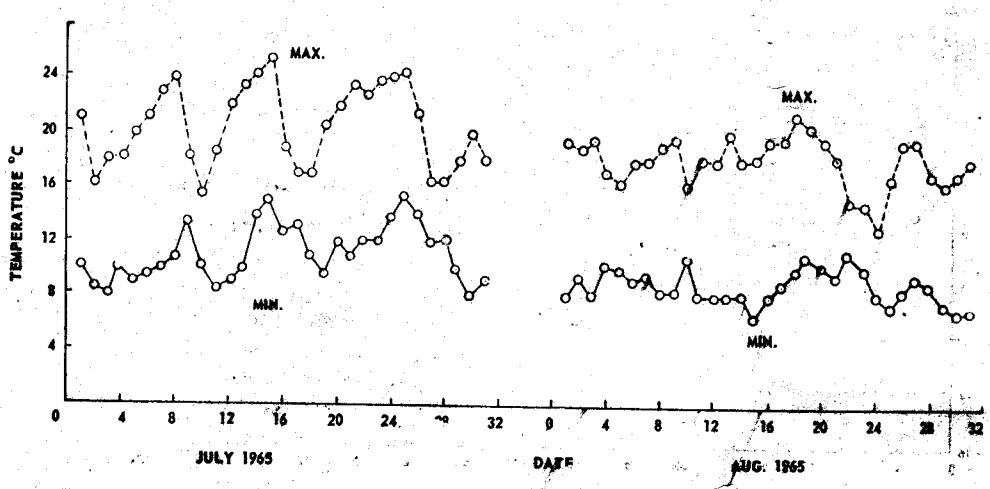

Fig. 2 (*j*)—Variation of daily maximum and minimum temperature during July and August 1965.

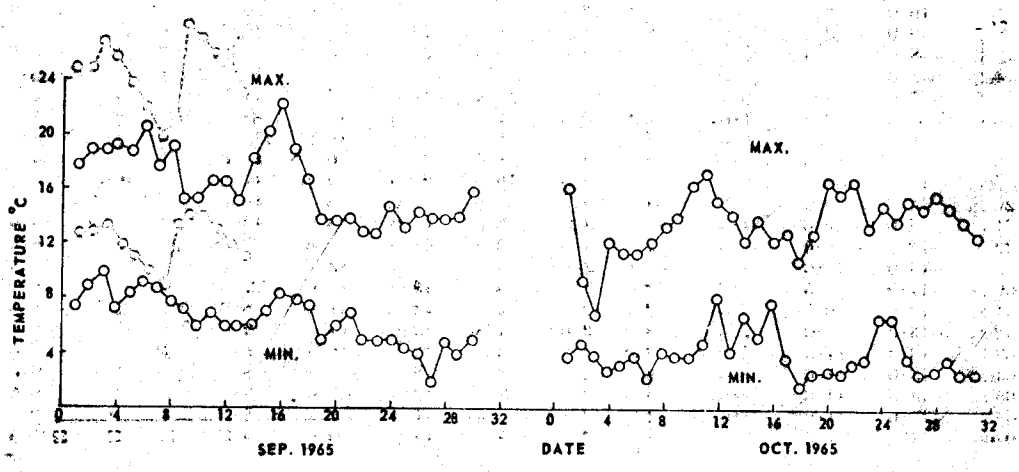

Fig. 2 (*k*)—Variation of daily maximum and minimum temperature during September and October 1965.

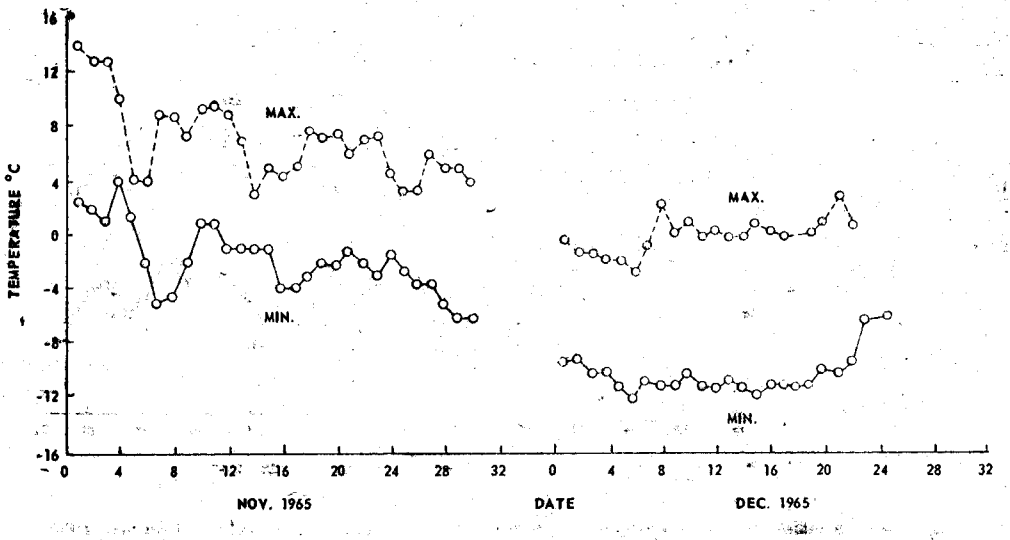

Fig. 2 (*b*) —Variation of daily maximum and minimum temperature during November and December 1965.

TABLE 1

AVERAGE HOURLY TEMPERATURE (°C) DURING 1964-65 AT GULMARG*

Time	Month											
	Jan.	Feb.	March	Apr.	May	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
0800	—15·0	—10·0	—1·0	—3·5	1·5	6·0	18·0	14·0	10·0	9·5	—1·0	—8·0
0900	—14·0	—8·0	1·0	—3·0	1·5	7·0	19·5	15·0	12·0	14·0	4·0	—4·0
1000	—12·0	—4·0	1·0	2·0	2·0	7·0	20·0	16·0	16·0	15·0	6·5	—1·0
1100	—10·0	—2·0	1·0	3·0	2·5	8·0	20·0	15·0	14·0	16·0	7·0	—1·0
1200	—9·0	—2·0	0·5	4·0	4·0	8·5	20·5	15·0	15·0	17·0	7·5	0·0
1300	—8·0	—1·0	0·5	4·5	4·0	9·0	21·0	15·0	14·0	17·0	7·5	0·5
1400	—8·0	—1·5	0·0	5·0	4·0	10·0	21·5	16·0	16·0	17·5	8·0	0·0
1500	—7·0	—2·0	0·5	5·0	3·0	11·0	21·5	15·5	16·0	18·0	9·0	0·0
1600	—7·0	—2·0	1·0	5·0	2·0	11·5	21·0	16·5	18·0	17·0	6·5	—1·0
1700	—8·0	—4·0	0·5	7·0	2·0	11·0	22·0	16·0	15·0	16·0	3·0	—2·0
1800	—10·0	—7·0	0·0	2·0	2·5	11·0	21·5	16·0	12·0	12·0	1·0	—4·0
1900	—11·0	—9·0	0·0	0·0	2·5	10·0	21·5	15·0	11·0	11·0	0·5	—5·5
2000	—12·0	—9·5	—1·0	—1·0	1·5	8·0	17·0	13·5	10·0	10·0	0·0	—7·0
2100	—12·0	—10·0	—1·5	—2·0	1·5	6·0	15·0	13·0	10·5	9·5	—0·5	—8·0
2200	—12·0	—10·0	—1·5	—2·0	1·5	5·5	14·5	13·0	9·0	9·0	—0·5	—8·0
2300	—13·0	—10·0	—1·0	—2·0	1·5	5·0	14·0	12·5	8·5	8·5	—1·0	—8·5
0000	—14·0	—10·5	—1·0	—2·5	1·5	5·0	13·5	11·0	8·0	8·5	—1·0	—9·0
0100	—13·0	—10·5	—0·5	—3·0	2·0	4·5	13·0	11·0	8·0	8·0	—1·0	—9·0
0200	—13·0	—11·0	—1·0	—3·0	2·0	4·0	13·0	11·0	9·0	7·5	—1·0	—9·0
0300	—13·0	—11·0	—1·0	—3·0	2·0	3·5	12·5	10·0	9·0	7·0	—1·5	—9·0
0400	—13·0	—11·0	—1·0	—4·0	2·0	3·5	12·0	9·0	8·0	6·5	—1·5	—9·0
0500	—14·5	—11·0	—1·0	—3·5	2·0	3·5	12·0	8·0	8·0	6.5	—2·0	—9·5
0600	—15·0	—11·0	—1·0	—4·0	2·0	3·0	11·5	8·5	8·0	6·5	—2·0	—9·0
0700	—14·5	—11·5	—1·0	—4·5	2·0	5·0	13·0	10·0	9·0	6·0	—2·5	—9·0

*Lat. 34° 03′ N, Long. 74° 34′ E, Height (asl) 2664 meters.

the evening while the other observations were recorded in the morning at 0830 hrs. All the necessary equipment was obtained from Indian Meteorological Department, Poona. Temperatures recorded here are ambient temperatures.

OBSERVATIONS AND RESULTS

The daily maximum and minimum temperatures (monthwise) for 1964 and 1965 are plotted in Fig. 1 and 2 respectively. It can be seen how the temperature varies from day to day and month to month. It is observed that the coldest month at Gulmarg is January with maximum temperature below zero for 17 days in 1964 and 13 days in 1965. July and August are the summer months when the minimum and maximum temperatures are above 8°C and 16°C respectively. The maximum diurnal range 26°C was noted in the month of January while the minimum in the months of April and September to November.

The hourly temperatures are recorded in Table 1 and partially plotted in Fig. 3. It is seen that the temperature first rises to a maximum, then decreases monotonacally and becomes sensibly constant between 00·00 – 06·00 hours. It is also noted that the minimum variation in the hourly temperature, is found in the months of March, May and July while the maximum variation is observed in the months of December to February and June. The maximum temperature during the day was recorded at about 1500 hrs. and the minimum just before sunrise. The mean daily temperature is recorded in Table 2. It is

TABLE 2

DAILY AVERAGE TEMPERATURE (°C) DURING THE YEAR 1964-65 AT GULMARG*

Date	Month											
	Jan.	Feb.	March	Apr.	May	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	—6·2	—6·2	—3·0	0·6	7·4	10·6	18·2	14·0	13·4	10·6	6·6	—2·0
2	—6·2	—4·0	—0·6	3·2	8·0	10·5	15·4	14·0	13·5	9·0	5·6	—1·8
3	—5·2	—5·2	—0·5	3·0	8·2	10·5	14·5	14·8	13·8	8·0	5·8	—1·8
4	—5·2	—6·4	—2·5	3·8	8·0	9·5	15·4	14·6	12·8	9·2	5·2	—1·4
5	—7·0	—6·2	—1·4	2·8	7·5	7·0	14·0	14·2	13·2	9·5	2·8	—1·6
6	—6·0	—5·2	—1·8	2·3	6·2	5·5	14·6	14·0	13·8	10·3	2·0	—2·2
7	—6·0	—5·8	—0·5	4·2	6·0	5·5	15·8	15·0	14·0	10·0	2·8	—1·8
8	—5·2	—6·2	0·0	4·5	6·4	10·5	17·0	15·2	14·2	10·2	3·2	—0·4
9	—0·5	—5·0	1·0	5·6	7·5	9·5	16·6	15·2	12·8	10·0	3·5	—2·1
10	—5·4	—5·2	—1·6	4·8	7·8	11·2	15·2	14·8	11·5	9·5	5·0	—0·5
11	—3·4	—5·0	—0·2	4·0	7·2	11·8	16·0	14·5	12·0	10·0	4·8	—2·4
12	—5·8	—4·5	1·4	5·2	7·5	12·5	17·0	14·2	12·0	9·5	4·5	—4·0
13	—4.8	—3·0	2·0	5·2	7·5	13·0	16·5	15·2	12·2	8·0	3·5	—3·2
14	—5·2	—3·0	2·0	5·0	7·5	11·8	16·4	15·2	13·0	8·4	1·8	—3·8
15	—3·2	—2·2	3·5	3·8	9·0	12·2	15·5	14·5	13·8	8·5	2·2	—4·4
16	—4·2	—3·0	6·5	2·2	8·2	11·5	13·0	14·0	14·0	9·0	0·8	—3·6
17	—3·4	—1·4	3·4	2·2	9·0	12·0	12·4	14·6	13·2	7·2	0·4	—3·4
18	—4·4	—2·4	—0·2	3·4	10·0	13·6	12·6	16·0	11·8	6·2	1·2	—5·2
19	—6·0	—6·8	2·0	4·4	11·0	14·0	13·0	16·0	10·2	6·6	1·6	—3·8
20	—6·5	—5·8	—1·0	3·8	8·5	14·6	14·5	15·0	10·0	8·2	2·5	—3·2
21	—6·0	—4·6	—0·2	4·0	5·2	16·0	16·8	13·5	10·0	7·6	2·8	—2·5
22	—6·0	—5·0	—0·2	5·8	4·0	16·0	16·7	13·2	9·8	8·2	3·0	—3·4
23	—6·4	—5·2	1·6	5·0	3·5	14·2	17·0	14·0	9·0	7·2	3·0	—4·4
24	—8·0	—3·6	1·0	4·8	5·6	12·8	18·5	12·2	9·2	8·2	2·4	—6·6
25	—8·0	—4·4	0·2	6·0	7·0	13·0	16·8	13·6	9·2	7·8	1·4	—6·6
26	—6·8	—2·8	0·4	4·5	8·5	13·5	16·0	14·0	7·8	7·5	1·0	—4·2
27	—7·2	—4·8	1·4	4·2	9·2	15·5	13·4	14·6	7·0	8·0	1·8	—3·4
28	—4·2	—4·6	3·6	6·0	9·4	17·0	14·2	14·4	9·0	8·2	1·0	—2·0
29	—6·0	—	2·2	6·8	10·0	16·8	12·8	13·4	9·2	7·8	0·8	—2·2
30	—5·8	—	3·4	7·5	11·0	16·0	13·2	13·6	10·2	7·2	1·4	—1·0
31	—5·5	—	3·4	—	11·6	—	13·0	14·2	—	7·2	—	—3·0

*See footnote at Table 1.

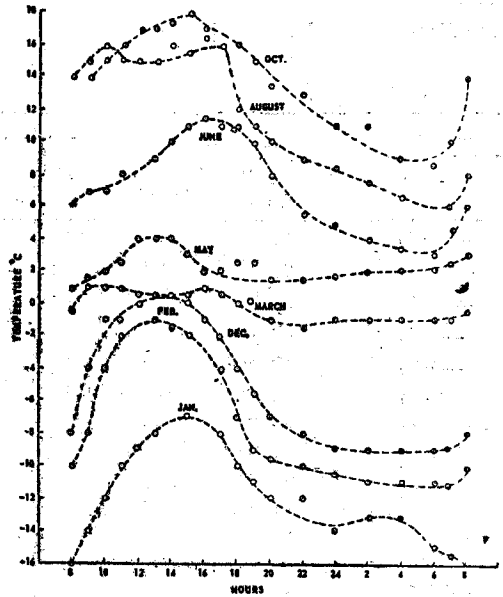

Fig. 3—Variation of daily march of temperature at Gulmarg during the year 1965.

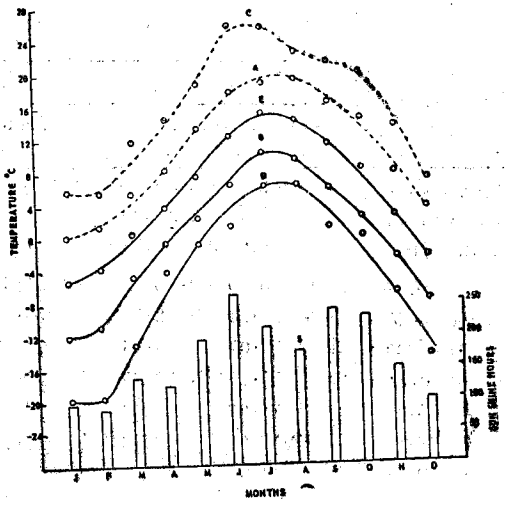

Fig. 4—A—Mean monthlymax. temp.
B—Mean monthly min. temp.
C—Mean of absolute max. temp.
D—Mean of absolute min. temp.
E—Mean annual march temp.
F—Mouthly sun shine hours.

interesting to note that the daily mean temperature for the months from December to March generally remains below freezing point. The mean monthly maximum and minimum; the mean absolute maximum and minimum, and the mean monthly range temperatures are presented graphically in Fig. 4 together with the sunshine hours. It is to be noted that these temperatures increase during January to July and then keep on decreasing upto December. The maximum in all the cases is found in the month of July. The mean monthly range is regular but the absolute monthly range shows slight variation.

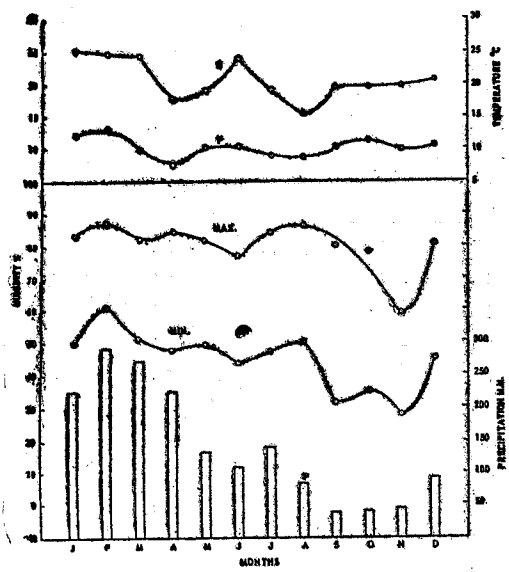

Fig. 5—Percentage humidity max. min. (A.B.)
G—Absolute monthly range.
F—Mean monthly range.
P—Mean monthly precipitation.

The air over Gulmarg is humid for most part of the year and relative humidity is found maximum in the month of February (86% in the morning and 62% in the afternoon). The lowest values are recorded during the month of November (60% in the morning and 30% in the afternoon). These values are shown graphically in Fig. 5. The precipitation and humidity have been shown graphically in Fig. 5 which depicts the mean monthly rain fall. For the accurate measurement of precipitation at Gulmarg where snowfall is very

TABLE 3

CLIMATOLOGICAL DATA AT GULMARG,* KARGIL** AND MINIMARG†

Month	Gulmarg						
	Mean daily		Absolute		R. H.	Precipitation	Number of cloudy days
	Max. (°C)	Min. (°C)	Max.	Min.	%	(mm.)	
Jan.	0·64	—11·90	5·95	—19·50	67	229	18
Feb.	1·5	—10·40	5·75	—19·50	74	292	16
Mar.	5·70	—4·40	12·0	—12·75	68	274	17
April	8·16	—0·35	14·50	—4·00	67	229	16
May	13·25	2·50	19·00	—0·50	67	138	16
June	18·00	6·55	26·00	1·50	56	109	10
July	19·70	10·50	26·00	6·50	67	145	15
Aug.	19·20	9·40	22·50	6·50	70	74	14
Sept.	16·80	6·05	21·75	1·50	57	41	8
Oct.	14·35	2·60	20·25	0·25	58	41	4
Nov.	7·95	—2·65	13·50	—6·50	45	51	10
Dec.	3·20	—8·00	7·00	—14·50	65	102	15

*See footnote at Table 1.

**Lat 34°34′ N; Long. 76° 08′E; Ht. (asl) 2682 m.; Period 1911—1940

†Lat 35°00′ N; Long. 74°02′E; Ht. (asl) 2770 m.; Period 1897—1911

Month	Kargil						
	Mean daily		Absolute		R.H.	Precipitation	Number of cloudy days
	Max. (°C)	Min. (°C)	Max.	Min.	%	(mm.)	
Jan.	—3	—12	7	—33	..	33	20
Feb.	—1	—13	18	—32	..	34	17
Mar.	5	—6	17	—25	..	54	17
Apr.	14	3	25	—12	68	42	15
May	21	9	33	—6	56	25	9
June	27	13	40	—1	49	5	8
July	31	17	43	4	51	8	9
Aug.	30	17	41	6	50	9	8
Sept.	26	12	38	—1	49	3	7
Oct.	19	6	32	—11	..	7	5
Nov.	10	—2	20	—9	..	3	7
Dec.	2	—8	—12	—25	..	15	14

Month	Minimarg						
	Mean daily		Absolute		R.H.	Precipitation	Number of cloudy days
	Max. (°C)	Min. (°C)	Max.	Min.	%	(mm)	
Jan.	0·4	—12·3	11·9	—24·4	77	150	..
Feb.	2·3	—12·7	18·2	—32·5	73	117	..
Mar.	6·9	—8·8	17·9	—20·8	74	201	..
Apr.	..	..	..	..	..	..	..
May	..	..	..	..	..	..	..
June	..	..	..	..	..	..	..
July	..	..	..	..	..	..	..
Aug.	..	..	..	..	..	..	..
Sept.	..	..	..	..	..	..	..
Oct.	..	..	..	..	..	..	..
Nov.	..	..	..	..	..	..	..
Dec.	2·7	—10·7	16·3	—20·6	75	..	..

heavy from December to April, special snowgauge was used. It consists of a cylindrical receiver (8″ dia. and 2 ft. in length), mounted on an iron stand at a height of 5½ ft. above the ground and provided with wind-shields. After the snowfall, the receiver was removed from the wind-shield and a measured quantity of hot water was poured into it to melt the snow. When the snow was completely melted, the total amount of water in the receiver was measured. The amount of hot water added was subtracted from it to obtain the amount of precipitation (in mm.). The depth of snow was measured with snow poles and the water equivalent of snow was determined. The total annual precipitation was recorded to be 1730 mm; half of it was recorded during January to April in the form of snow. The ground remains covered with it from 15th December to 15th April. The total snowfall was measured to be 40 ft.; its depth goes up to 7 ft. Minimum rainfall was recorded in the months of September to November. It is noted that rainfall mostly occurs in the afternoon. The average sunshine hours are shown in Fig. 4. It is observed that during the winter months, the average sunshine hours are 100 per month while maximum average sunshine hours as well as days are in June, July, September and October. Comparative data for Kargil[2] and Minimarg[3], (a short period record is available) whose situations in respect of altitude, latitude and longitude are similar to Gulmarg, are shown in Table 3.

CONCLUSIONS

Although the observations are for only two years, the data collected may be considered as guide line for defence use. In the face of extreme scarcity of data for such heights these may prove useful. The following tentative conclusions are drawn :

1. Months of December to March are very cold; monhts of April, May, October and November are cold; and months of June to September are moderate.
2. Gulmarg is a humid place except for a few months.
3. Half of the rains take place during winter in the form of snow.
4. Sky remains clear from September to November; afternoons are generally cloudy.
5. Maximum snowfall is 2 ft. a day.
6. Maximum and minimum temperatures 26°C and —23°C respectively.

ACKNOWLEDGEMENTS

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REFERENCES

1. "Climatology of Himalayas, Tibet and Adjoining Areas" (Indian Meteorological Department), 1963, Table 123.
2. *ibid.*, Table 123
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