

## Letters To The Editor

551.524.7 : 551.509.54(54)

### A SHORT NOTE ON THE USE OF UPPER AIR TEMPERATURES FOR FORECASTING WINTER RAINFALL IN THE PUNJAB

1. *Introduction.* It is well known that the winter rainfall in the Punjab is due to secondary western disturbances moving from SW to NE between latitudes  $20^{\circ}$  and  $40^{\circ}$  N. The primary depressions occur in the Mediterranean and the secondary depressions form in the region of the Red Sea, Persian Gulf or the Mekran Coast. The purpose of this note is to indicate how the formation of such secondary depressions in the Indian region, as are likely to cause widespread rainfall in the Punjab, is reflected on the radiosonde ascents.

2. *Western disturbances and Tephigrams.* On the assumption that secondaries forming in the Mekran or Kathiawar Coast are responsible for the winter rainfall in the Punjab, the tephigrams of Peshawar, Delhi, Jodhpur, Karachi and Veraval during the period of few western disturbances of 1946-47, were examined with reference to the formation of such secondaries. The examination revealed certain interesting features, as explained in this note. It was found that, prior to the occurrence of disturbed weather over Punjab (I), there was a general rise of temperatures at all levels over Peshawar while there was a general cooling at all levels over Veraval for a period of two days. Subsequently, associated with these temperature changes, a practically isothermal field was established at 850 mb level over northwest India. Once this isothermal field was established, rain followed in the Punjab in about 72 hours. If, however, the establishment of the isothermal field was *not* preceded by the cooling at all levels at Veraval, the formation of a secondary in the Mekran or Kathiawar coast which would cause widespread rainfall over the Punjab was *not* a certainty.

3. *Investigation.* In the case of a few western disturbances examined, it was found that 3 or 4 days before the actual occurrence of rain, the 850 mb level temperatures over Peshawar, Delhi, Jodhpur, Karachi and Veraval showed a striking uniformity. That this isothermal field was not the normal temperature distribution at this level during this season was confirmed by working out the normal temperature gradient to be expected at the 850, 700 and 500 mb levels from all the available radiosonde data for these stations for all the days of December. The mean values are furnished in Table 1.

Fairly intense western disturbances caused widespread rainfall in the Punjab between 0800 IST of 28 November and 0800 IST of 29 November and between 0800 IST of 27 December and 0800 IST of 28 December 1946. In the former case, the isothermal field was perceptible on the evening of 24 and 25 November, *i.e.*, 3 days roughly before the occurrence of rainfall; in the latter case the isothermal field was seen on 25 December, again 2 to 3 days prior to rainfall. An examination of another case of a western disturbance indicated an isothermal field on 13 January 1947. But in this case, no rainfall followed 3 days later. Table 2 gives the distribution of temperatures at the 850 mb level on the significant days of the disturbances mentioned above. The temperature distribution of 15 December 1946 is also shown in the above table to show by contrast the conditions that would be prevalent when there would be no chance of rainfall in about 4 days time. Figs. 1 to 3 illustrate the establishment of an isothermal field and the occurrence of weather approximately 3 days later.

4. *Tephigrams of Peshawar and Veraval.* From the available radiosonde ascents in the Indian Daily Weather Reports an examination was made to ascertain whether prior to the establishment of the isothermal field

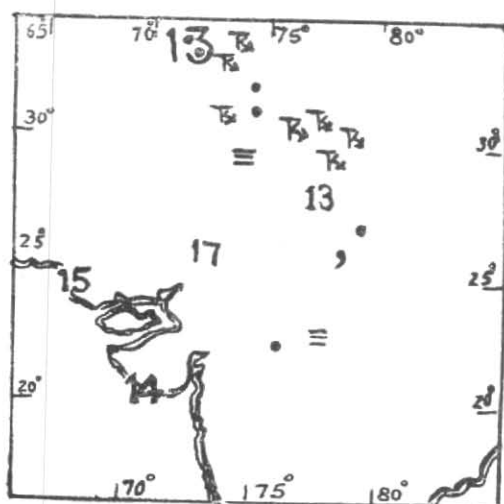


Fig. 1. Temperatures at 850 mb level at 1930 IST on 25-11-46 and weather that occurred between 0800 IST of 23-11-46 and 0300 IST of 29-11-46

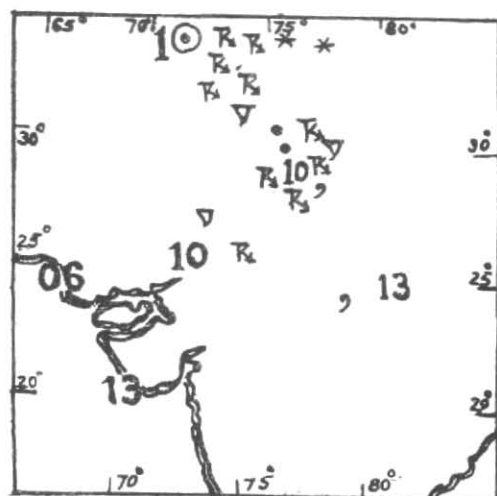
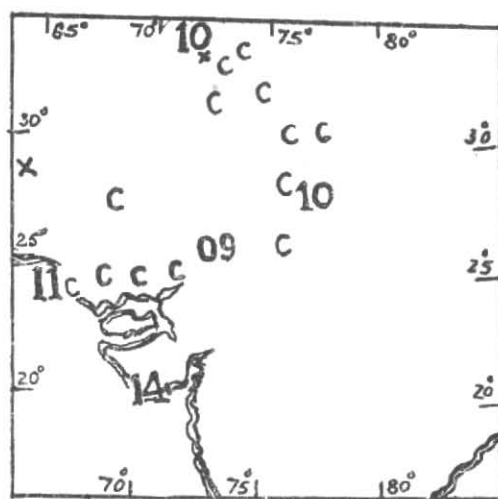


Fig. 2. Temperatures at 850 mb level at 1930 IST on 25-12-46 and weather that occurred between 0800 IST of 27-12-46 and 0800 IST of 28-12-46



X—Overcast C—Cloudy

Fig. 3. Temperatures at 850 mb level at 1930 IST on 13-1-47 and the stations that reported overcast or cloudy skies between 0800 IST of 16-1-47 and 0800 IST of 17-1-47

**TABLE 1**  
Mean upper air temperatures in °F at different levels in December

Station	Levels		
	850 mb	700 mb	500 mb
Peshawar .. .. .	8.2 (30)	-2.9 (28)	-19.0 (26)
Delhi .. .. .	11.6 (31)	2.3 (31)	-12.9 (29)
Jodhpur .. .. .	11.2 (21)	3.4 (19)	-13.3 (19)
Karachi .. .. .	10.2 (30)	3.3 (30)	-12.4 (28)
Veraval .. .. .	16.1 (29)	7.2 (27)	-9.3 (20)

(Figures in brackets give the number of observations used for calculating the mean)

**TABLE 2**  
Distribution of Temperatures in °F at 850 mb level

Station	Mean temperature for December	Actual temperatures on				
		24-11-46	25-11-46	25-12-46	13-1-47	15-12-46
Peshawar .. .. .	08	13	13	10	10	04
Delhi .. .. .	12	14	13	10	10	14
Jodhpur .. .. .	11	15	17	10	09	15
Karachi .. .. .	10	17	15	06	11	11
Veraval .. .. .	16	15	14	13	14	17

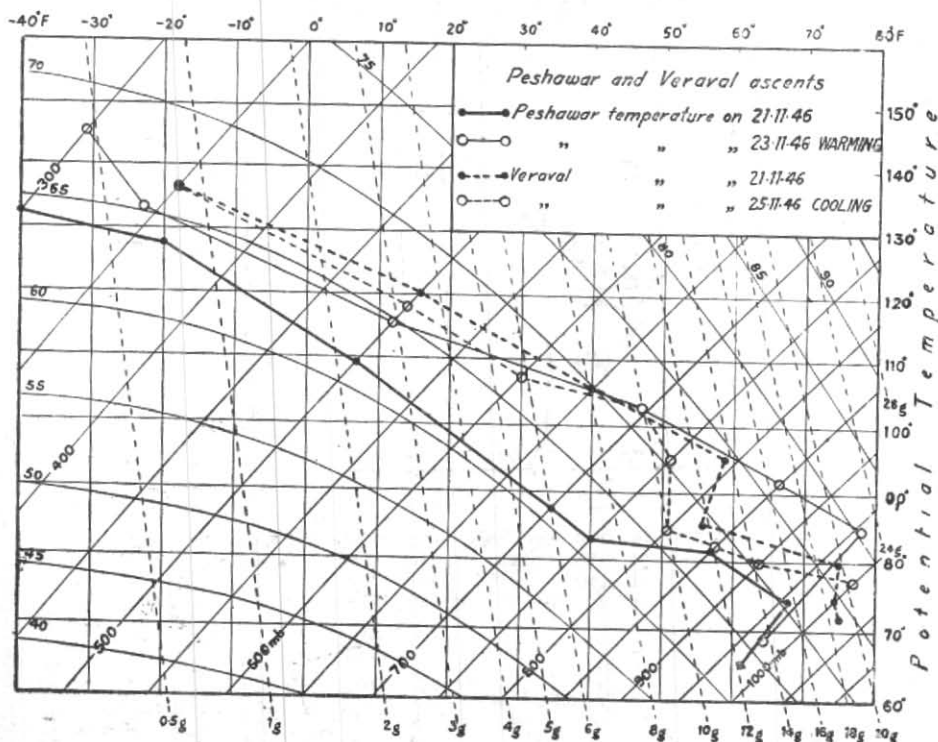


Fig. 4

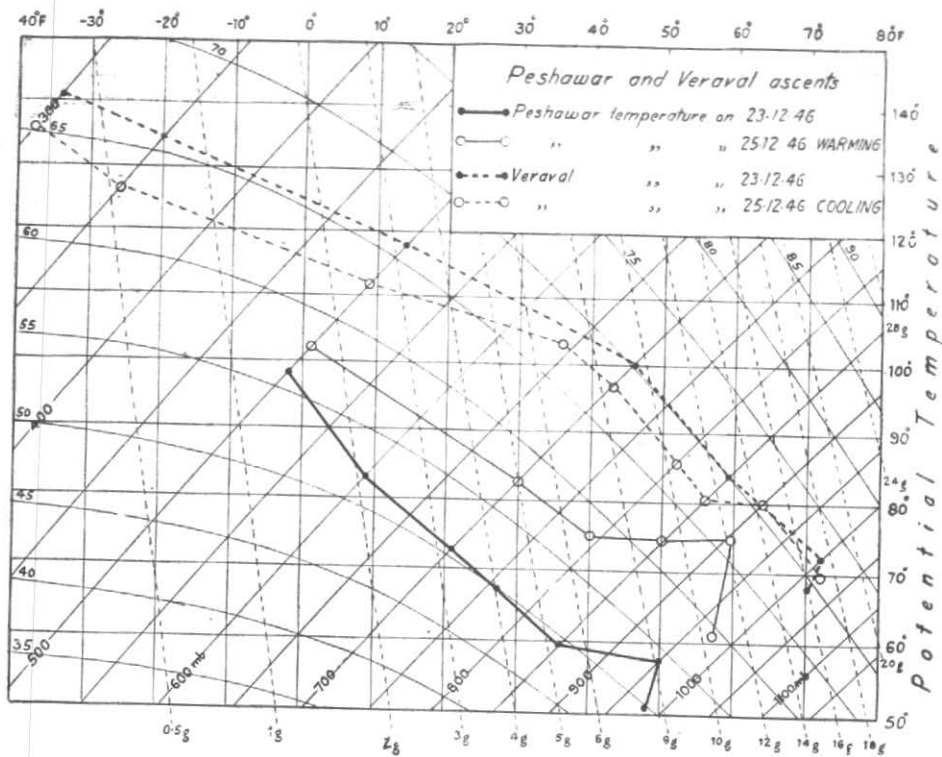


Fig. 5

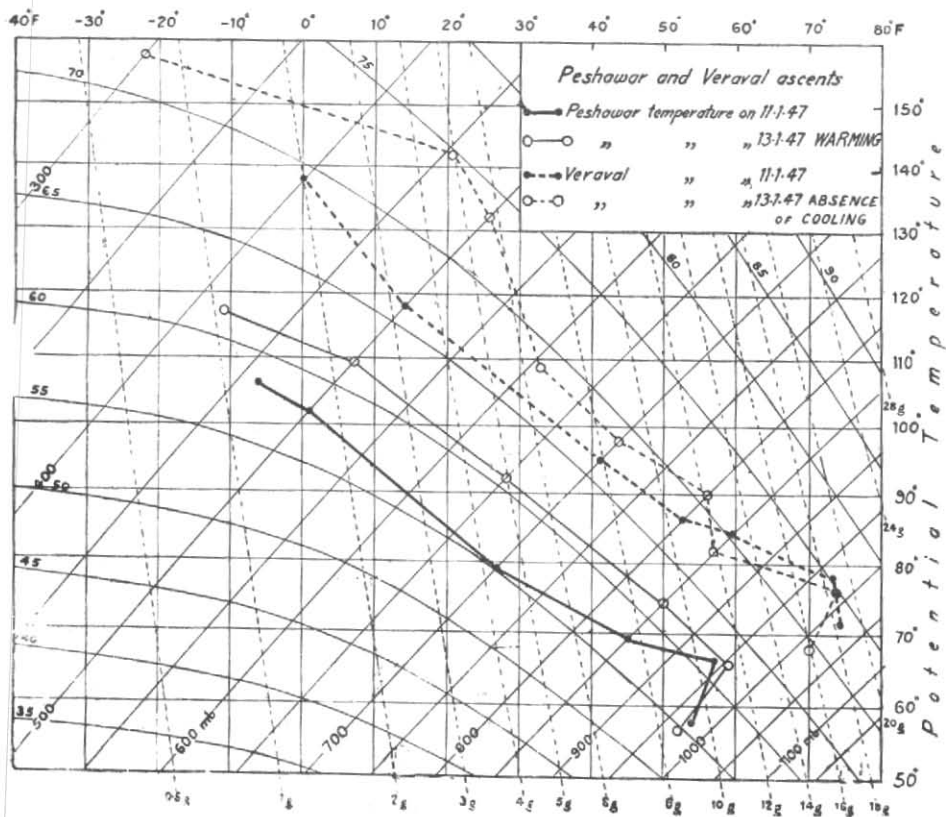


Fig. 6

preceding the occurrence of weather, sensible warming up at Peshawar and cooling at Veraval at all levels occur (Figs. 4 to 6). It was found that in the case of the first western disturbance mentioned above, cooling at Veraval was noticed between 24 and 25 November and it could be reasonably assumed that the process of cooling started much earlier. Between 21 and 23 November Peshawar showed general increase of temperatures at all levels but most marked at 700 mb level. The subsequent weather occurred between 0800 IST of 28 and 0800 IST of 29 November. In the case of a second western disturbance towards the end of December, the tephigrams showed pronounced cooling over Veraval and warming up over Peshawar approximately 3 days before the occurrence of weather. In the third case of a western disturbance in the middle of January 1947, Peshawar showed warming up between the 11th and 13th and the isothermal field was established on the 13th. However, Veraval did not show cooling but on the other hand showed warming up. In this case the western disturbance produced only medium clouds over the Punjab and no further deterioration of weather occurred.

The above examination of the tephigrams would, therefore, indicate that while the rise in temperatures at all levels at Peshawar is a dependable feature to indicate the approach of a western disturbance, the establishment of an isothermal field alone along the Veraval-Peshawar line will not ensure the formation of a secondary responsible for widespread rain in the Punjab, unless this isothermal field is preceded by a cooling as well at all levels over Veraval. In other words, if Peshawar shows warming up at all levels and Veraval shows a simultaneous cooling at all levels, a forecaster can with a fair amount of certainty expect the establishment of an isothermal field and forecast widespread rainfall in the Punjab approximately 3 days later.

F/O V.V.RAO

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