Letters To The Editor

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UNUSUAL THUNDERSTORM ACTIVITY IN PENINSULAR INDIA POSSIBLY DUE TO UPPER DIVERGENCE

Widespread thunderstorms, some of them heavy to very heavy, occurred over Peninsular India south of about Lat. 20°N from the afternoon of the 13th to the morning of 14 June 1956. Some of the noteworthy amounts of rainfall recorded at observatory stations were—Bidar 4″; Cochin 3″; Kurnool, Bellary, Punaloor and Puttalam 2″ each. According to newspaper reports, stormy weather with very heavy rain occurred in the Trichur district of the Travancore-Cochin State on the 13th night, causing extensive loss and damage to property. Probably, the stormy weather was due to thunderstorms of tornadic violence.

By the 13th, the monsoon had established itself over most of the Peninsula and northeast India. On the 13th morning, monsoon activity was, however, weak over the Peninsula. The peculiar feature of the weather situation that morning was that upper winds over the Peninsula upto 6 km had become unusually northerly. It is not easy to expect that such northerly flow will lead to the widespread thundershowers that occurred during the following 24 hours. Figs. 1(a) and 1(b) show the rainfall amounts and thunderstorms that occurred during 24 hours ending at 0300 GMT of 13th and 14th respectively.

A possible explanation for the occurrence of the unusual weather from the afternoon of the 13th is given below.

At 2100 GMT of the 11th, the winds at 4 km at Port Blair had become southerly. Next morning at 0200 GMT, Port Blair winds were southerly from 3 to 5·4 km. Simultaneously, Madras winds had become more northerly. This shows that a trough had appeared over the southern and central parts of the Bay of Bengal. The veering of winds at Madras from the 12th to the 14th indicated that this trough was moving westwards and probably passed over Madras by the morning of the 14th. Until 1500 GMT of 13th, this trough was to the east of Madras since the winds at 3 km and aloft were north to northeast. The height changes of the pressure surfaces over Madras support this analysis. The time-altitude cross-section of Madras given in Fig. 2(a) illustrates these features.

On the 12th morning, an upper level trough at about 5 km had appeared over U.P. with axis near long. 78°E. Study by time-altitude cross-section shows that this trough moved eastwards, passing the longitude of Allahabad some time after 1500 GMT of the 13th and Gauhati between 0200 and 1500 GMT of the 14th. At 1500 GMT of the 13th, Allahabad winds between 4 and 6 km were SSW to E but had become NW to W by 1500 GMT of the 14th. Also at Gauhati, at 0200 GMT of the 14th between 4 and 6 km, winds were strong WSW to SW but became W to NW by 1500 GMT. There is no evidence of this trough having passed over Delhi earlier. This shows that this trough had extended into Indian latitudes only from the 12th morning onwards. The time-altitude cross-section of Allahabad is given in Fig. 2(b).

Riehl (1948a, 1948b and 1950) has pointed out that upper level troughs and ridges moving in high and low latitudes interact with one another. In the movement of such systems, if the trough lines come near about the same longitude, the northerlies to the west of the trough lines become pronounced. Such juxtaposition of troughs is called in-phase superposition. Riehl has observed that tropical perturbations tend to deepen when they come under such pronounced northerlies in the mid and upper troposphere associated with in-phase superposition. He

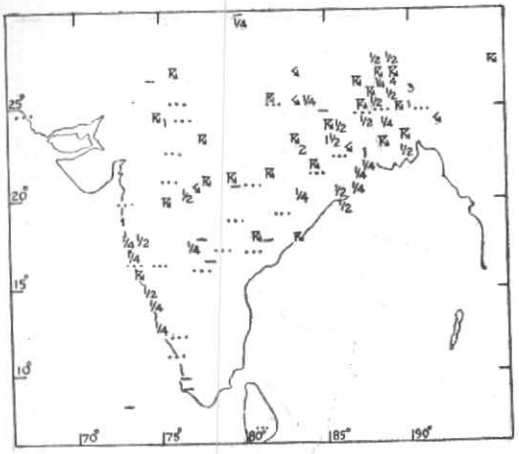

Fig. 1(a)

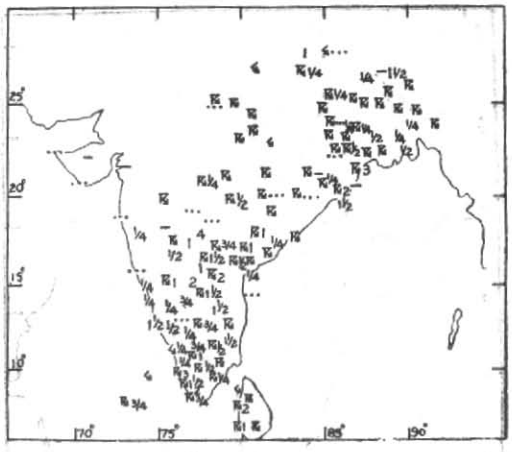

Fig. 1(b)

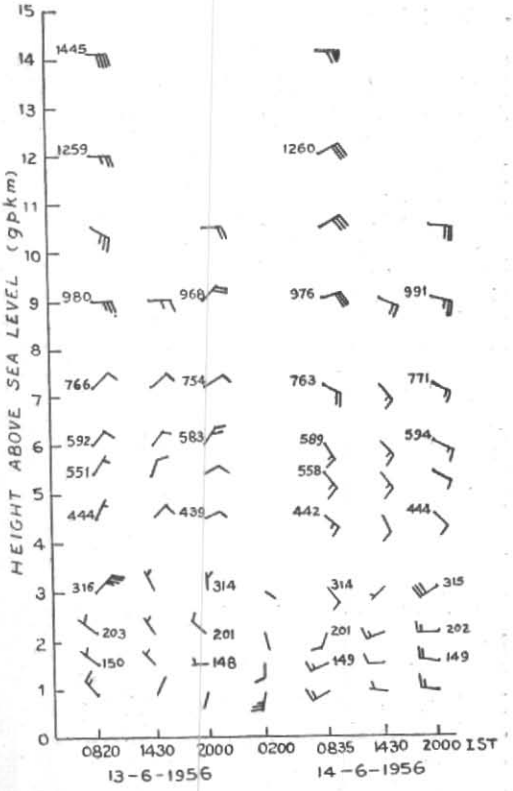

Fig. 2 (a). Time-altitude cross-section of Madras

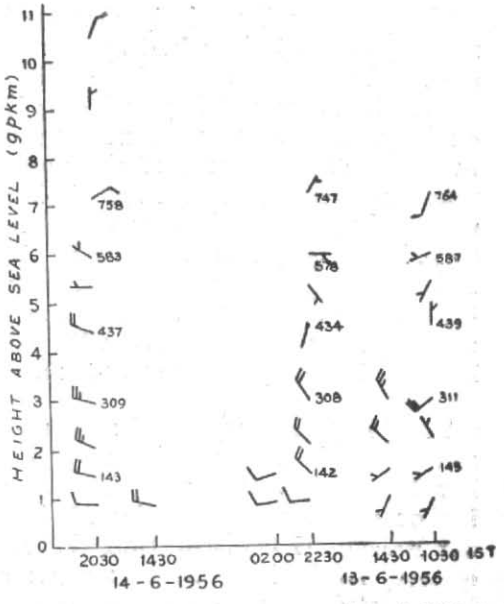

Fig. 2(b). Time-altitude cross-section of Allahabad

(Altitudes in tens of geopotential metres)

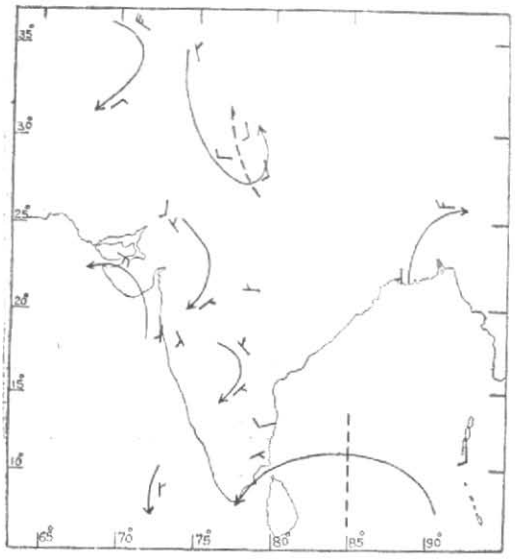

Fig. 3(a)

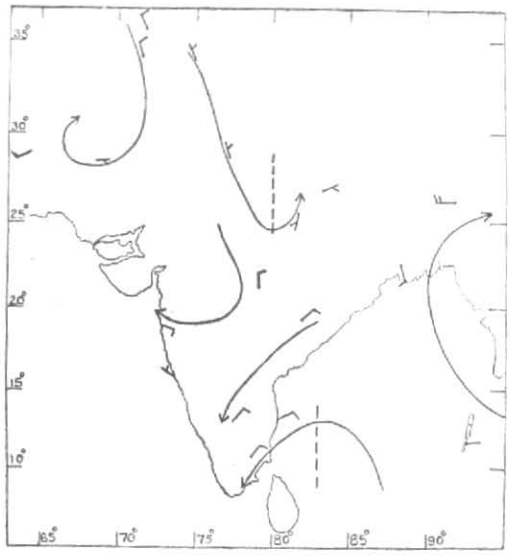

Fig. 3(b)

- - - - - - - - - - - - Trough lines

has given an explanation that the pronounced northerlies may be associated with marked divergence which accounts for the deepening of the tropical perturbations.

The pronounced northerly flow on the morning of the 13th would appear to be associated with the axes of the trough over the south and central Bay and over U.P. coming to near about the same longitude. At that time the axis of the northern trough was perhaps near long. 80°E and that of the southern one near about long. 83°E. Probably by 1500 GMT of the 13th, both the trough lines were along the longitude of 81°E. Figs. 3(a) and 3(b) show the upper air flow pattern at 0200 GMT of the 12th and 13th respectively at 5·4 km.

The in-phase superposition from the morning of the 13th till that night would have been associated with marked divergence in the mid and upper troposphere. Pisharoty and Kulkarni (1956) have shown that zones of heavy rainfall in the monsoon season can be associated with marked divergence in the mid and upper troposphere. In the present case there was already moist air over the Peninsula. The mid and upper tropospheric divergence combined with the day time heating initiated some thunderstorms over the Peninsula by the evening. The upper divergence may have reached its maximum intensity at night and the thunderstorms also multiplied. A thunderstorm is, to a certain extent, self-sustaining and even generates neighbouring thunderstorms provided the upper air conditions are favourable. This seems to have happened in the course of the night and extensive thunderstorm activity developed over the Peninsula. The fact that thunderstorms to the north of about lat. 20°N were very few, inspite of the upper level divergence, seems to be due to the dry air mass prevailing over the area in the lower levels.

It would appear that the movement of the lower latitude trough alone cannot account for all the weather that occurred over the Peninsula on the 13th night. The position of this trough on the 12th relative to the east coast of the Peninsula was about the same as that in relation to the western portions of the Peninsula on the 13th morning.

The 24 hours between the mornings of the 12th and 13th were conspicuous by the absence of any weather either along the Coromandal coast or in the southwest Bay.

The synoptic features on the 13th morning were peculiar enough, for the monsoon season, to be made note of and the divergence in the mid- and upper troposphere due to the in-phase superposition of the troughs is suggested as a plausible explanation for the extensive development of weather.

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