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Letters to the Editor

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CHANGES IN PRESSURE GRADIENTS AND WIND CIRCULATION IN THE LOWER AND UPPER TROPOSPHERE OVER INDIA DURING TRANSITION FROM THE WINTER TO SUMMER TYPE AND DURING THE SUMMER MONSOON AND IN THE RAINFALL DISTRIBUTION DURING THE LATTER PERIOD

1. From an examination of contour height differences for the standard isobaric levels between Nagpur and Trivandrum and between New Delhi and Nagpur, Ananthakrishnan (1970 a) has reported that the broad picture which emerges about the reversal of pressure gradient from the winter to the summer type across the Peninsula is that it takes place at the surface by middle of March and at the 100-mb level by the end of April; the changes at the surface level progress gradually upwards and at the 100-mb level downwards and the two progressions converge near the mid-troposphere by the beginning of June when the monsoon sets in. The transition is fairly abrupt in the upper troposphere as seen from the steep slope of the contour height difference curves. Further, it is seen that the reversal of pressure gradient is of shortest duration at and near the mid-troposphere and of longer summer regimes at the surface and 100-mb level.

From Ananthakrishnan's curves it is seen that over the Peninsula the 500 mb changes would show them to be a part of the upward progression of the surface changes, while over north India the same would appear to be a part of downward progression of the 100 mb changes; the 500 mb change ends in middle of June over the Peninsula and at the end of June over northern India, the date of setting of monsoon over Kerala and in East Pakistan and West Bengal being at the beginning of June. The mid-tropospheric level 500 mb would thus appear a transition level for circulations building up in the lower and upper troposphere during the transition to the summer monsoon circulation. It has been shown by Rao and Desai (1970) that the westerly monsoon and circulation upto 600 mb and the easterly circulation between 500 and 100 mb can build up independently of each other, there being *no* cause-effect relation between the two, although the changes in the two may take place simultaneously in some years. This would mean that for the short or medium range forecasting during the summer monsoon, 500 mb changes are not the ideal ones and that 700 mb changes might be most suitable for the purpose for judging the lower westerly circulation; the upper tropospheric changes would give an idea to what extent the lower tropospheric circulation is going to be affected by the same from the point of weather although they may not be able to initiate the lower level westerly monsoon circulation itself (Desai 1969).

2. In two other notes Ananthakrishnan (1970 b, c) has discussed the results of pentad analysis of surface pressure and rainfall. The pressure difference between New Delhi and Nagpur reaches a maximum value by the beginning of June and remains practically constant till the middle of August (pentad 46) when it begins to decrease; the rainfall increases in the first pentad of June, reaches a maximum in July-August and then decreases, being minimum in the middle of August (46 pentad) and then increases, becoming maximum in August-September. Ananthakrishnan has stated that the two rainfall maxima on either side of the minimum have to be associated with the northward advance and southward retreat of the circulation features connected with the southwest monsoon, particularly of the trough of low pressure over the Gangetic valley, the minimum rainfall in 46 pentad indicating the northernmost position of the Gangetic valley trough.

Considering the fact that rainfall is little over the plains when the trough is at the foot of the hills and confined only to the surface layers and there is absence of its axis sloping southwards with height and there is presence of southwesterly to westerly winds, their forward boundary sloping northwards with height and more rainfall when it is near about its usual position, one would not be justified in associating minimum rainfall with the northernmost position of the *normal monsoon trough*. Again it would not appear correct to associate the two rainfall maxima with the northward advance and southward retreat of the monsoon circulation as more rain than usual occurs in association with the trough when its axis at

the surface is further south than usual or extends from near south Rajasthan and north Gujarat to near Orissa coast.

Srinivasan and Ramakrishnan (1970) have stated that the monsoon trough shifts from day to day and its location is intimately connected with rainfall distribution. The frequency of trough location in different latitude belts is more important than its monthly or seasonal mean position. They observed that during July and August for the years 1961 to 1969 the trough lay near the mean position only on 30 to 45 per cent of occasions.

3. From the above discussion it will be clear that the circulations below about 600 mb and above 500 mb develop independently during the transition from winter to summer conditions, the changes at the surface being gradually transmitted upwards and at 100-mb level downwards, the lower and upper level changes converging near 500 mb level during the middle of June over the Peninsula and at the end of June over northern India. The level 600 to 500-mb can be considered as a transitional level in the mean. The monsoon circulation upto about 600 mb sets in over Kerala and West Bengal and East Pakistan at the beginning of June and as such, there is *nothing like abrupt changes* in the upper troposphere and setting in of the lower level monsoon circulation and associated rainfall. It would appear that the two rainfall maxima in July-August and August-September with a minimum in 46 pentad — middle of August cannot be interpreted as northward and southward movement of the Gangetic valley trough and the northernmost position of the trough respectively; at the time of the minimum rainfall over the plains, the trough is confined only to the surface layers near the foot of the hills or it may be even absent.

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