# Letters to the Editor

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## BAY OF BENGAL MONSOON

Ramage (1963) has discussed the circulation in a monsoon cyclonic centre of 2 June 1963 and associated rainfall mechanism. He admits that 'quite obviously it would be most dangerous to generalise from a single case' but wants to 'show that the method used in this one case might, with considerable effect, be applied to other cases in order to build up a complete picture of the usual dynamic and thermodynamic distributions associated with a Bay of Bengal monsoon rain situation'. In spite of this caution, he seems to suggest more extensive application of his model for monsoon rains as will be seen from the quotation—"This admittedly crude model may explain the observed distribution of monsoon rain and cloud and the apparent anomaly of variable precipitation falling from what seems to be a uniform layer of nimbostratus. In addition, monsoon rain would appear to be associated with low level divergence whereas the shower type precipitation typical of fair weather regimes within the monsoon may be associated with low level convergence." Also in quoting the case of monsoon depression of July 1947, studied by Desai, Ramage seems to suggest similarity with his model. It is explained below that the model suggested by Ramage has no general validity as far as the most important systems of the southwest monsoon are concerned.

Indian meteorologists have recognised the very important role of the southwest monsoon depressions on the character of the monsoon. These depressions form near the head of the Bay of Bengal and move initially in a westnorthwesterly direction. In Ramage's model for monsoon rains and cyclone, convergence is mainly near 500-mb level, the air rising from there upto about 300 mb. Below 600 mb there is descent of air along with falling rain. On the other hand, there are several reports from aircrafts which have flown across the southwest monsoon depressions that the cloud systems do not extend above 600 to 500 mb, though towering cumulus clouds with very low base may rise above this height here and there through successive cloud systems and that most of the heavy rain occurs from levels below about 600 mb. Further, the very heavy rain that occurs in monsoon depressions over extensive areas is unlikely if the ascent of air commences from about 600 mb. In the case discussed by Ramage the temperature at 600 mb in the rain area is about 3°C and the saturation mixing ratio about 8 gm per kg. This is about the same as is found in the extratropics at the ground level. If the ascent of the air takes place from the 600-mb level and above only, the rainfall should be about the same as in the higher latitudes. There would be no way to explain the much heavier rainfall except by assuming excessive values of vertical velocity.

Ramage's case consists of a cyclonic circulation centre, approximately 50 km in diameter, near 11°N , 95°E identified at 500 mb through aircraft flights at that level. He infers the thermal nature of this system from the drop-sounding data, one made in the rain area about 500 km northnortheast of the centre and the other west of rain area about 900 km northwest of the centre. At the position of the drop-sonde ragarded as typical of the cyclonic circulation, according to his stream line chart for 500 mb (*vide* Fig. 2, Ramage 1963) stream lines are anticyclonically curved. This point is within 100 to 200 km of the nearby col. In view of the distance from the cyclonic centre, character of the stream lines at the point, and greater proximity to the

**TABLE 1**

**Temperatures (°C) of radiosonde at Port Blair and drop-soundings discussed by Ramage**

| Pressure level (mb) | Radiosonde at Port Blair 1 June 1963 | | Drop-soundings of 1 June 1963 discussed by Ramage (1963) | |
|---|---|---|---|---|
| | 00Z | 12Z | In rain area | Outside rain area |
| 1000 | 25°C | 27°C | 24°C | 27°C |
| 950 | 24 | 24 | 22 | 25 |
| 900 | 22 | 22 | 19 | 22 |
| 850 | 20 | 20 | 17 | 18 |
| 800 | 16 | 16 | 14 | 15 |
| 750 | 12 | 13 | 11 | 12 |
| 700 | 7 | 10 | 9 | 10 |
| 650 | 3 | 8 | 6 | 5 |
| 600 | —2 | 6 | 3 | 2 |
| 550 | —4 | 2 | 0 | 0 |
| 500 | —7 | —2 | 2 | —3 |

col, it is doubtful if the drop-sonde at 500 km can be regarded as representative of the cyclonic system. At the position of the drop-sonde 900 km from the centre, the stream lines are cyclonic but this is regarded as representative of the environment of the cyclonic system. Simply because the drop-sonde at 500 mb was in the rain area which extended upto the cyclonic circulation centre, from the similarity of the rain alone it cannot be regarded as typical of the cyclonic centre.

Table 1 shows radiosonde temperatures on 1 June 1963 at Port Blair which was only 300 km from the cyclone centre in comparison with the drop-soundings discussed by Ramage. In both the drop-soundings there are isothermal layers between 500 and 550 mb which Ramage dismisses as due to spurious causes, as per private communication. Hence maximum temperature difference at 500 mb between the two soundings cannot be relied upon. If so, the air in the rain area is warmer by one degree than outside at 600 and 650 mb. To build the argument on the character of the cyclonic circulation and rainfall mechanism on this difference may be risky. Though Port Blair was in the rain area and nearer the cyclone centre, its temperatures show variations of more than one degree between morning and evening. The site of this drop-sounding at 16·3°E and 89·5°N was barely 100 km from the rain area which seems to have extended upto 90° or 91°E. If the stream lines did not change from first to second June as assumed by Ramage, the trajectory of the air in mid-troposphere to this point was from the rain area and it was too close by for the air to have been modified in four hours or so (which may be the time of travel from the rain area to the western drop-sounding) to represent the so-called environment.

On 1 and 2 June monsoon was advancing into southeast and east central Bay of Bengal. Synoptic patterns at the time of advance of monsoon are not typical of the subsequent monsoon period. Even after the monsoon is established, synoptic features in west and north Arabian Sea are not similar to the Bay of Bengal. One should be careful in further studies in assuming features of Arabian Sea monsoon as applicable to the Bay.

The very interesting part of Ramage's paper is the identification of a mid-tropospheric low at the beginning of the monsoon. Similar lows have been noticed by the Indian forecasters during the monsoon season but their role on the activity of monsoon has not been elucidated fully. Due to the strong wind field of the lower troposphere in the monsoon season their reflection at these levels could only be a kink in the isobars or stream lines which is difficult to identify. As the general field is weak in mid-troposphere, it is easier to follow these lows at these levels. This is not to suggest

that the mid-tropospheric lows are not filled up by the time we go to the lower troposphere. But their structure has to be studied with more cogent data.

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*REFERENCE*

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