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# Zones of rainfall ahead of a tropical depression

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ABSTRACT. The paper presents the results of a study of the nature and distribution of precipitation in the forward quadrant of a monsoon depression on the basis of hourly rainfall data from 18 self-recording raingauge stations set up over an area of 12,600 sq. km in Gangetic West Bengal. The precipitation was mostly convectional and was often restricted at a time to very narrow columns of the atmosphere, less than 10 km in diameter. Ahead of the depression there were annular bands of wet and dry zones. The outermost limit of the wet zone was at a distance of about 300 km from the centre of the depression. Between 300 and 150 km from the centre of the depression, the wet and dry zones were at nearly steady and predictable distances from the depression. The wet zones were about 30 to 50 km wide and the dry zones about 50 to 80 km. The zones situated within a distance of about 150 km from the depression were, however, unsteady with occasional variations in the distribution of rainfall. Consequently the wet zone observed initially at and around the centre of the depression turned dry during the course of the movement of the depression.

## 1. Introduction

On the rainfall associated with tropical storms (depressions and cyclones), studies so far made in India refer to the total amount of rainfall in 24 hours. For shorter durations, rainfall data were scanty. In recent years, however, a large number of stations equipped with self-recording syphon raingauges was set up at and near the Damodar Catchment. In 1960 there were 18 such stations with satisfactory records (Fig. 1). With the help of these, the distribution and character of rainfall in the forward quadrant of a depression on 24 August 1960 were studied. The results are discussed in this paper.

## 2. Peculiarities of rainfall distribution

From 03 GMT on the 24th to 12 GMT on the 25th weather was mainly cloudy and thundery over the region. Examination of the total hourly rainfall showed that the amount of rainfall usually varied significantly within short distances. Between 9 and 10 GMT of the 24th, Panchet Hill received as much as 22·8 mm of rainfall, while Asansol about 18 km away remained dry. Konar and Bokaro are only 10 km apart but there were several occasions when only one of them experienced rainfall suggesting that precipitation was mostly convectional and was often restricted to very narrow columns of the atmosphere less than 10 km in diameter.

## 3. Zones of rainfall

During the period 3 to 12 GMT of the 24th all the stations in the region had received appreciable amount of rainfall. Such integrated amounts of rainfall as are available for routine synoptic analysis do not give us a complete idea of the distribution of rainfall in time and space. Even with the available network of 18 self-recording raingauge stations, it is not possible to study this aspect very satisfactorily. However, some of the hourly rainfall distribution charts reveal some interesting facts.

From Fig. 2 it is seen that between 11 and 12 GMT none of the four stations situated at a distance of about 210 to 270 km from the depression had any rainfall. All the three stations between 102 and 162 km from the depression also remained dry. To the east and west of these dry zones there were areas which experienced significant amounts of rainfall. This suggests that the distribution of rainfall ahead of the depression was not uniform but discontinuous up to an appreciable distance.

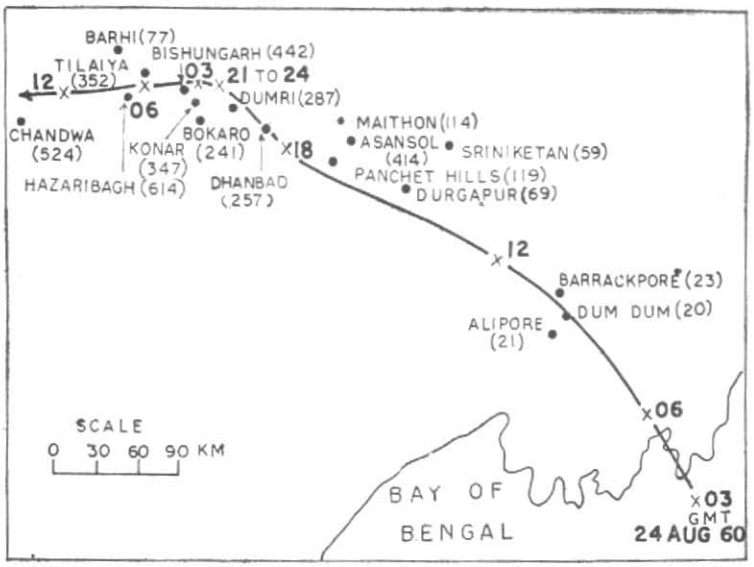


**Fig. 1. Locations of recording raingauge stations (with their heights in metres a.s.l.)**
(Track of depression ×—× with its centre at sea level at synoptic hours)

To confirm this important feature, a detailed study was made of the rainfall in three selected areas almost equidistant from each other. Area A comprised Alipore, Dum Dum and Barrackpore, area B Maithon, Asansol and Panchet Hill and area C Barhi, Talaiya and Hazaribagh. Distance between the areas A and B is 210 km and between B and C 180 km. For these areas mean rainfalls were worked out for every hour from 3 GMT of the 24th till the centre of the depression crossed a particular area. These are plotted against the distance of the depression centre at the corresponding hour and given in Fig. 3. The location of the centre of the depression for non-synoptic hours was interpolated from those determined from synoptic charts at 00, 03, 06, 12, 18 and 21 GMT.

If the depression had distinct dry and wet zones, as suggested by Fig. 2, one should expect the rainfalls in each of the areas A, B and C to decrease and increase with the passage of dry and wet zones respectively. But a decrease or increase of rainfall alone is no reason to believe that it is associated with the passage of dry or wet zone. Because, an increase of rainfall may be due to the intensification of the depression itself.

If the depression intensifies temporarily and causes an increase of rainfall, it would be reflected in the rainfalls of all the areas A, B and C more or less at the same time. The distances of the depression at that time from each area would vary.

On the contrary, if there is a wet zone ahead of a depression and it causes an increase of rainfall when it passes over the area A, the other two areas B and C will not experience it at the same time. They will experience it only after a lapse of time when the depression moves further and carries it over to the area B and then to the area C. So an increase or decrease of rainfall over an area when associated with the passage of a wet or dry zone would depend upon the distance of the depression from the area.

Fig. 3 shows in the first instance that none of the areas A, B and C had experienced a steady increase of rainfall in association with the advancing depression. On the other hand rainfall increased and decreased alternately in all these areas. Decrease of rainfall almost always culminated in a perfectly dry spell. In our discussion here we shall, therefore, refer the decreasing

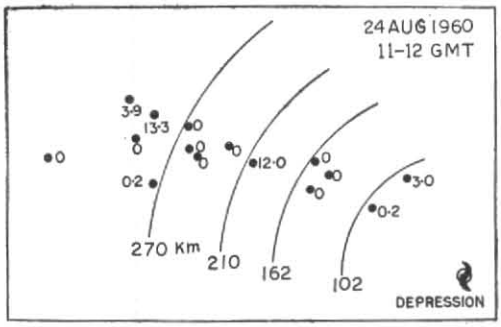


Fig. 2. Distribution of rainfall (mm) at different distances ahead of the depression

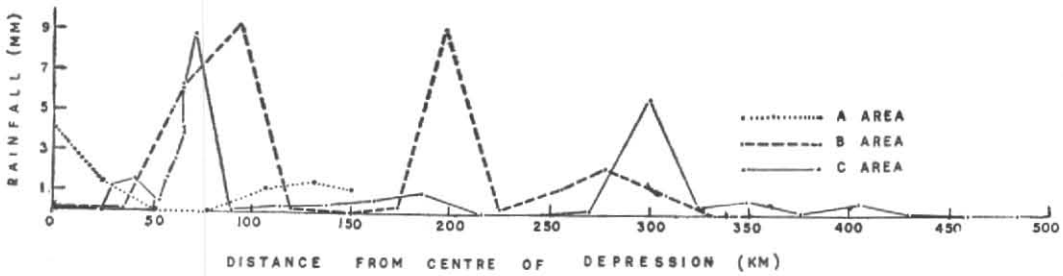


Fig. 3. Variation of rainfall ahead of the depression

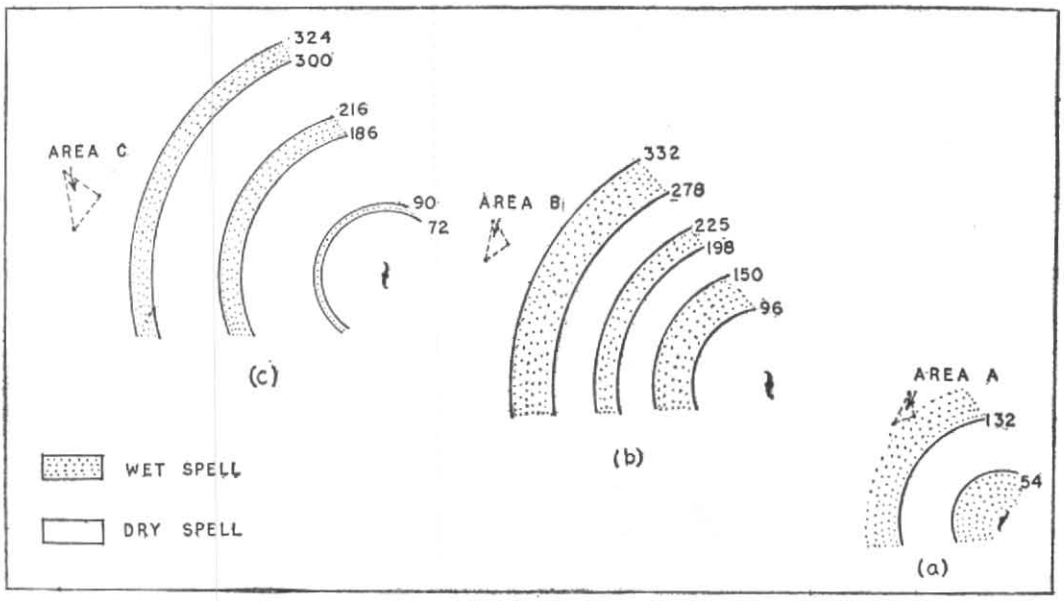


Fig. 4. Distance of the depression when each area experienced the wet and dry spells

phase of rainfall as a dry spell and the increasing phase of rainfall as a wet spell.

Based on the observations plotted in Fig. 3, the distance of the depression when each area (A, B and C) experienced the wet and dry spells is shown diagrammatically in Figs. 4(a) to 4(c) for the convenience of discussion. An examination of the Figs. 4(b) and 4(c) shows that both the areas B and C experienced 4 dry spells and 3 wet spells before the centre of the depression moved off these areas. These spells occurred alternately, beginning first with a dry spell. Over the area B the wet spell prevailed after the depression reached within a distance of 332 km. When the depression reached practically at the same distance (324 km) from the area C, it brought in a wet spell over that area also. A dry spell followed the wet spell in the area B after the depression reached 278 km away. Over the area C the dry spell set in when the depression came within a distance of 300 km.

The second wet spell started over the area B when the depression was 225 km away. It gave way to a dry spell after the depression reached a distance of 198 km. Similar sequence of wet and dry spells occurred over the area C when the depression was almost at the same distance from it. As the depression traversed the last 198 km towards the area B, it caused in the area B first a dry spell, then a wet spell and finally again a dry spell. Exactly the same sequence of rainfall was experienced in the area C as the depression travelled the last 186 km towards it. The wet spell set in the area B when the depression reached within a distance of 150 km. At this distance from the depression, the area A also had experienced a wet spell. But in the area C the wet spell set only after the depression reached less than 90 km away. Probably the wet zone situated at about 150 km from the centre of the depression had shrunk after crossing the area B.

Following the wet spell, a dry spell started over the areas A, B and C when the depression crossed the following distances — Area A=132 km, area B=96 km, area C=72 km. In the areas B and C the dry spell mentioned above continued till the depression passed away. In other words the centre of the depression was a dry zone when it reached these areas. In the area A, on the contrary, a wet spell set in when the depression reached about 54 km away and it continued till the depression passed away (Fig. 4a). From an altogether different sequence of wet and dry spells in the area A and the difference in the locations of the last wet zone experienced in the areas B and C it appears that the inner region of the depression upto about 150 km from its centre was rather a loose system with occasional variations in the distribution of rainfall.

## 4. Conclusion

The present study indicates that ahead of the depression there were annular bands of wet and dry zones. The outermost limit of the wet zone was at a distance of about 300 km from the centre of the depression. Between 300 and 150 km from the centre of the depression, the wet and dry zones were at nearly steady and predictable distances from the depression. The wet zones were about 30 to 50 km wide and the dry zones about 50 to 80 km. The zones situated within a distance of about 150 km from the depression were, however, unsteady with occasional variations in the distribution of rainfall. Consequently the wet zone observed initially at and around the centre of the depression turned dry during the course of the movement of the depression. The precipitation was mostly convectional and was often restricted at a time to very narrow columns of the atmosphere, less than 10 km in diameter.

## 5. Acknowledgement

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