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Formation, intensification and unusual movement of the storm of 8 November 1965

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ABSTRACT. The synoptic situations associated with the formation, intensification and unusual movement of the storm of 8 November 1965 are discussed in this paper.

1. Track of the storm

The track of the cyclonic storm of 8 November 1965 from inception as low pressure area over southeast Bay of Bengal on 4th to dissipation in Coromandel coast on 9th is shown in Fig. 1. Further details from photographs of TIROS-10 are given in Table 1.

November storms in the Bay of Bengal generally originate between Lat. 8°N and 13°N. Those that form in southern latitudes generally move in a westnorthwesterly direction, strike the Coromandel coast and dissipate over the Peninsula or emerge into Arabian Sea where they re-intensify also; while those that form in northern latitudes move in a more northwesterly or northerly direction and later recurve towards northeast.

Hence the southwesterly movement of the above storm from 7 to 9 November is unusual. However, during the 70-year period 1891 to 1960, 10 storms showing a southwesterly movement in the Bay of Bengal are also on record (Fig. 2).

2. Formation and initial intensification between 4 and 6 November 1965

According to Dunn and Miller (1960), tropical cyclones are known to originate (1) in easterly waves, (*ii*) in the inter-tropical convergence zone and (*iii*) in the trailing southerly portions of the old Polar troughs.

In the present study also the origin of the storm could be traced to an easterly wave which moved across Victoria Point on 3rd as seen by the pressure fluctuation with lowest pressure on 3rd (Table 2). Subsequently, it moved across Car Nicobar which recorded pressure fluctuation with lowest pressure on 4th and associated abnormal rainfall of 12·8 and 8·5 cm on 4th and 5th respectively (Table 2). According to Dunn (1960), the abnormal rainfall was one of the best indications that the wave was becoming unstable and developing into a vortex where a disturbance was forming. Again widespread rainfall in Bay Islands on 4th and 5th, when Kondul, Mayabandar, Nancowry and Long Island recorded 3 to 4 cm of rain also indicated that upward motion was well organised over a wide area.

Therefore, it was seen that the easterly wave which moved across south Andaman Sea on 3rd, became unstable over southeast Bay of Bengal on 4th where it formed into a low pressure area, the associated upper air circulation extending upto about 10·5 km as seen by the winds over Port Blair (Fig. 3). The system was observed by TIROS-10. Embedded in the deep southeasterly current, it moved northwestwards at 9 kts on 4th and 5th.

Simultaneously, a wave in the westerlies, ahead of a major trough, was moving eastwards at higher latitudes as shown by the drop in the heights of constant pressure levels over Visakhapatnam on 5th from 500 to 150 mb and aloft (Table 3) and by the intense wind fluctuation at 300 mb and aloft from 5th to 7th (Fig. 4). Therefore, as postulated by Riehl (1954), due to interaction between the wave and the low pressure area while moving across the same longitude the latter concentrated into a depression by the morning of 6th, the vortex of which was photographed by TIROS-10. Further, the period of the microseisms at Madras showed abrupt increase from 1200 to 1800 GMT on 5th reaching a maximum at 0300 GMT on 6th (Fig. 5) which also confirmed the formation of the depression.

3. Westerly movement on 6 November 1965

Tannehill (1956) in his account of 'Unusual Hurricane movements' found sea level 'High' to exert profound influence in blocking and deflecting the hurricanes from their normal paths.

Similarly, in the present study, a sea level ridge over central and north Bay of Bengal (Fig. 6) which extended sloping westwards upto 500-mb level over the central and western parts of the country (Fig. 7) effectively blocked the further northwestward movement of the depression. Therefore, under the influence of easterlies, that extended from 500 mb and aloft upto 200-mb

TABLE 1

Details of photographs of TIROS-10 in respect of the storm of 8 November 1965

Date	Time (GMT)	Central Region		Description of cloud system
		Lat. (°N)	Long. (°E)	
4	0443	8·0	91·0	Heavy overcast — 3 deg. in diameter — banding well defined to the north and east
5	0553	10·5	88·5	Disturbed area — banding well defined
6	0524	12·5	85·5	Vortex-eye dimly visible — pronounced outflow NW quadrant
7				No picture
8	0503	12·0	81·0	Eye visible — disturbed area — banding well defined
9	0535	11·0	80·5	Disturbed area — 2½ deg. some banding

TABLE 2

0830 IST mean sea level pressure (mb), rainfall (cm) and 24-hr pressure changes at Victoria Point (1-5 November) and Car Nicobar (2-6 November)

Nov 1965	Victoria Point			Car Nicobar		
	Pressure	24-hr change	Rainfall	Pressure	24-hour change	Rainfall
1	1014·3	—	Nil			
2	1013·7	—0·6	Nil			
3	1012·3	—1·4	Nil	1013·2	0·0	2·1
4	1013·5	+1·2	Nil	1011·1	—2·1	128·4
5	1014·1	+0·6	Nil	1012·1	+1·0	84·6
6				1013·1	+1·0	1·0

TABLE 3

Height (gpm) of constant pressure levels — Visakhapatnam (4 to 6 November 1965)

Pressure level (mb)	4 Nov		5 Nov		6 Nov	
	00 GMT	12 GMT	00 GMT	12 GMT	00 GMT	12 GMT
1000	103	103	112	094	111	104
900	1021	1035	1040	1017	1032	1029
850	1511	1528	1532	1511	1530	1521
800	2029	2045	2045	2031	2054	2037
700	3151	3166	3164	3186	3181	3159
600	4424	4436	4414	4441	4459	4431
500	5890	5910	5840	5890	5930	5890
400	7610	7620	7530	7620	7670	7620
300	9730	9720	9600	9740	9790	9720
200	12500	12460	12300	12530	12580	12510
150	14330	14270	14080	14390	14400	14370
100	16790	16690	16460	16860	—	—
70	18950	—	18580	18980	—	—
50	20970	—	20540	—	—	—

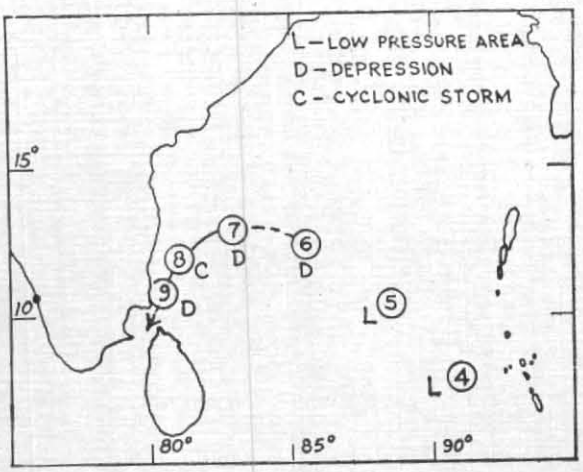

Fig. 1. Track of storm of 8 November 1965

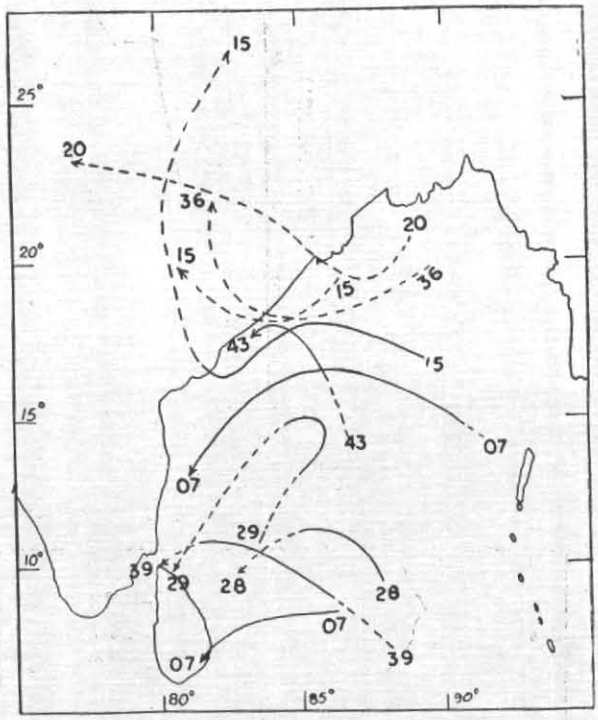

Fig. 2. Storm tracks with a southwesterly movement in Bay of Bengal during 1891–1960

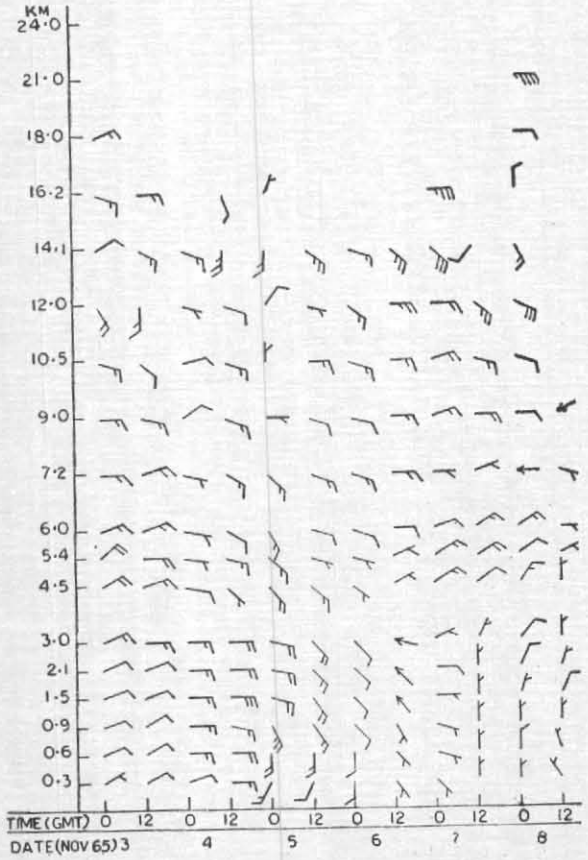

Fig. 3. Vertical time-section of winds at Port Blair 3–8 November 1965

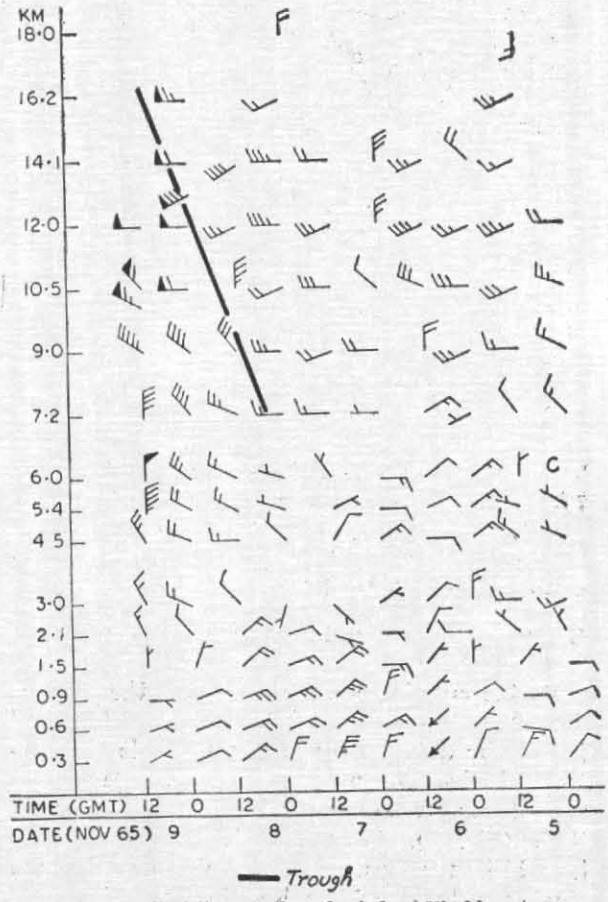

Fig. 4. Vertical time-section of winds at Visakhapatnam 5–9 November 1965

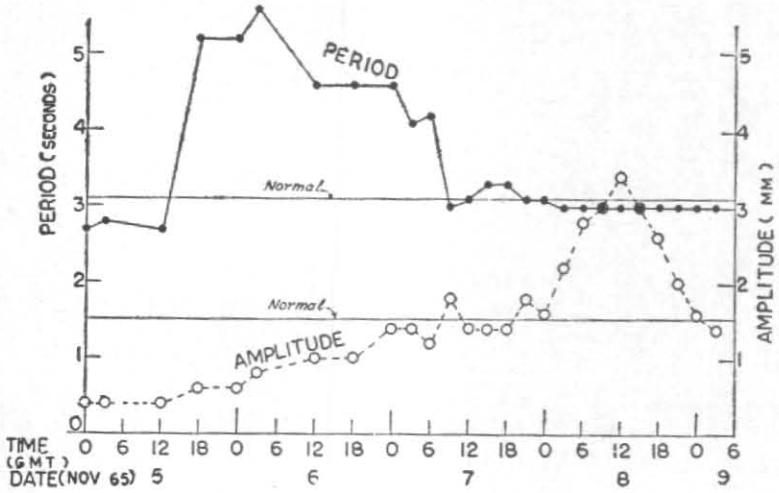

Fig. 5. Microseisms at Madras (5–9 November 1965)

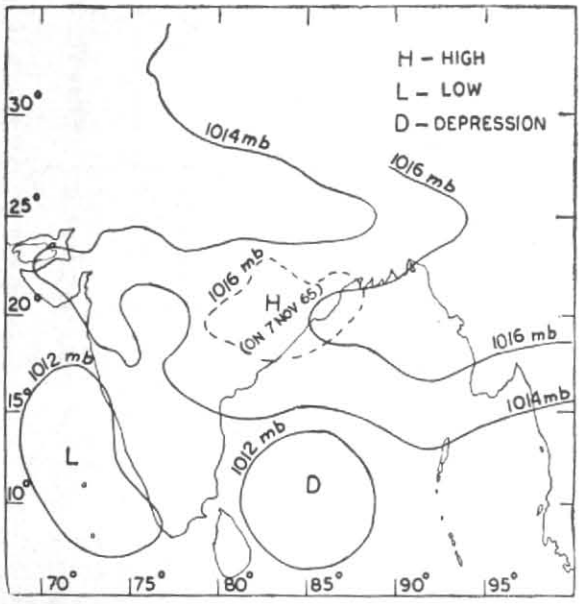

Fig. 6. Mean sea level isobars at 0830 IST 6 November 1965

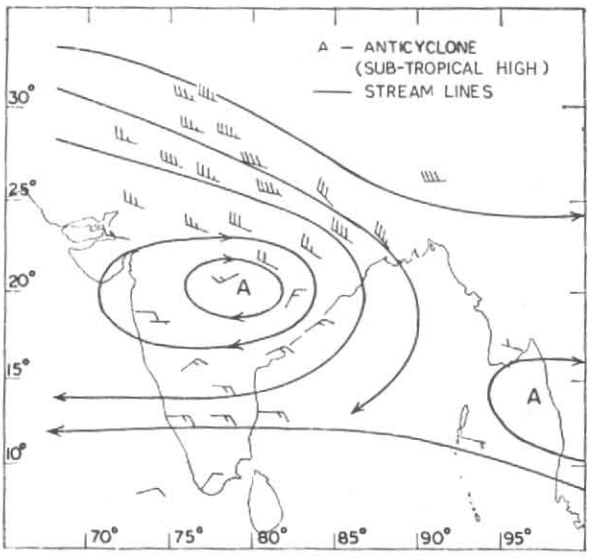

Fig. 7. 500-mb level winds at 00 GMT 6 November 1965

level, it moved slowly in westerly direction at 7 kts and was centred on the morning of 7th near Lat. 13°N and Long. 83°E. The slower movement was an indication of recurvature ahead of an approaching high level trough.

4. Unusual southwestward movement and intensification on 7 November

By the morning of 7th the ridge of the previous day shifted westwards forming a closed 'High' (shown by dotted lines in Fig. 6) while the sub-tropical high pressure cell at 500-mb level also shifted slightly westwards by the evening of 6th itself (Fig. 8). So the basic easterly current in which the system was embedded became northeasterly from 500 mb and aloft. Therefore, the depression taking an anticyclonic curvature, which was unusual, moved slowly southwestwards at 6 kts.

As regards intensification, Riehl has stated that "to further the formation process interaction between low level disturbance and the upper atmosphere must take place" so that the system is better organised and large quantities of air are lifted to high levels and pumped away by the divergent flow aloft. In average hurricanes, he located the surface position of the storm under the divergent flow of a 200-mb high.

Similar situation developed in the present case also by the evening of 7th as shown by the 1200 GMT winds at 850 and 200-mb levels (Figs. 9 and 10 respectively). Further, it may also be assumed that the interaction between the storm

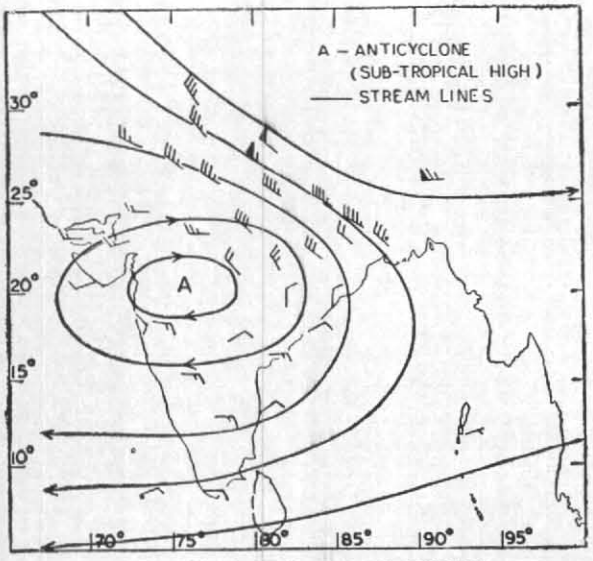

Fig. 8. 500-mb level winds at 1200 GMT 6 November 1965

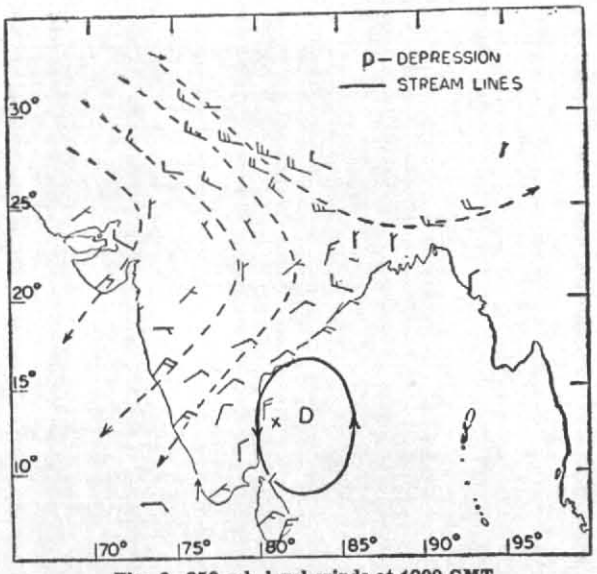

Fig. 9. 850-mb level winds at 1200 GMT 7 November 1965

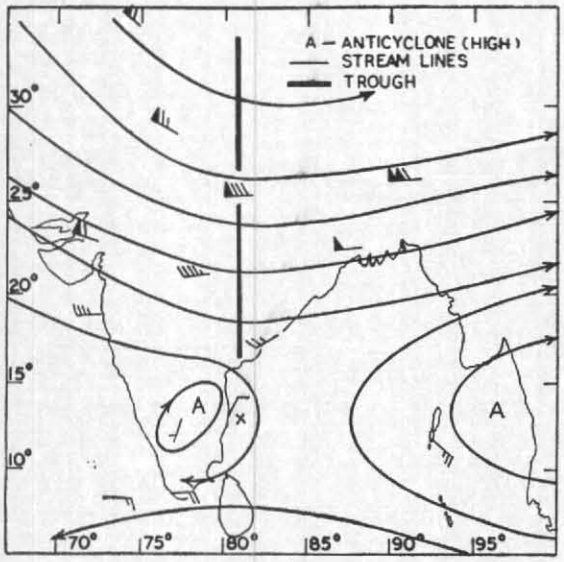

Fig. 10. 200-mb level winds at 1200 GMT 7 November 1965

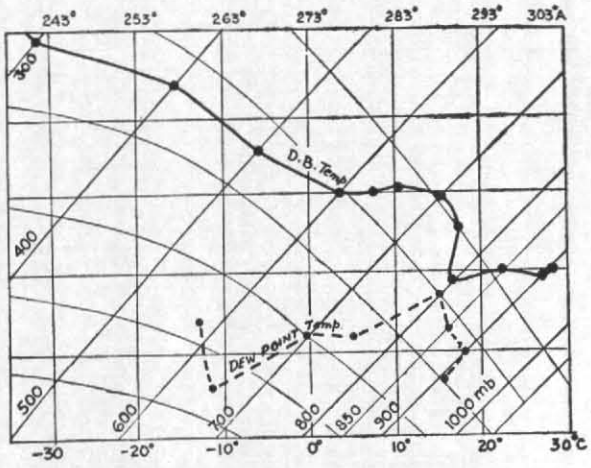

Fig. 11. Tephigram of Bangalore at 1200 GMT 7 November 1965

and the high level trough (Fig. 10) at higher latitudes which was moving across the same longitude over which the centre of the storm was located was an additional factor for intensification.

Therefore, the depression intensified rapidly into a cyclonic storm by the morning of 8th. TIROS–10 observation 'eye visible' supported this view. Further, microseisms at Madras, which showed the approach of the system nearer to Madras by the decrease in period from 0300 GMT of 6th, indicated storm type microseisms from 0000 GMT on 8th with increase of amplitude till 1200 GMT (Fig. 5) which also confirmed the intensification of the system into a storm, as stated by Tannehill (1956) in connection with hurricanes and typhoons in the Atlantic and Pacific Oceans.

During the process of intensification into a cyclonic storm, the lifted air from the centre of the storm was subsiding in the forward portion at Bangalore about 600 km west of the centre (Fig. 11) as seen by the inversion layer between 800 and 750 mb with a layer of dry adiabatic lapse rate below the subsiding column as mentioned by Desai and Rao (1954) under 'Subsidence in Tropical Depressions and Cyclones'.

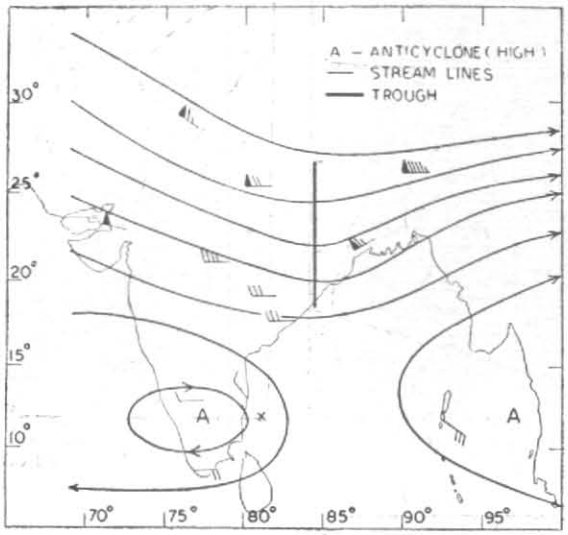

Fig. 12. 200-mb level winds at 00 GMT
8 November 1965

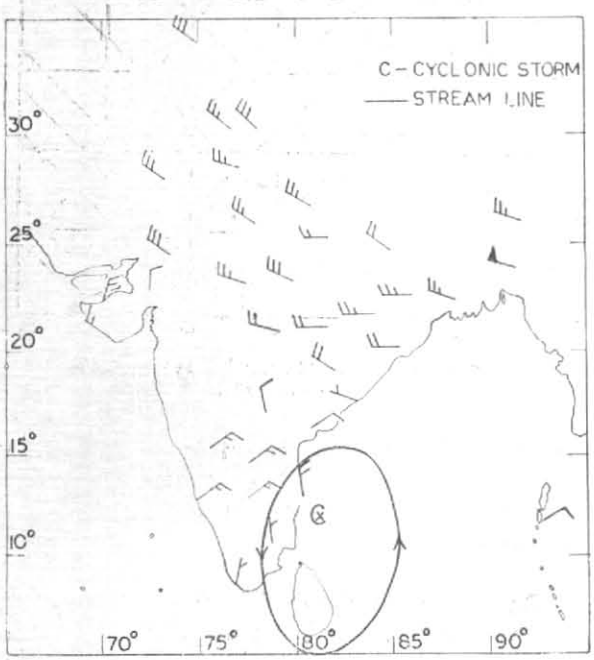

Fig. 13. 500-mb level winds at 00 GMT
8 November 1965

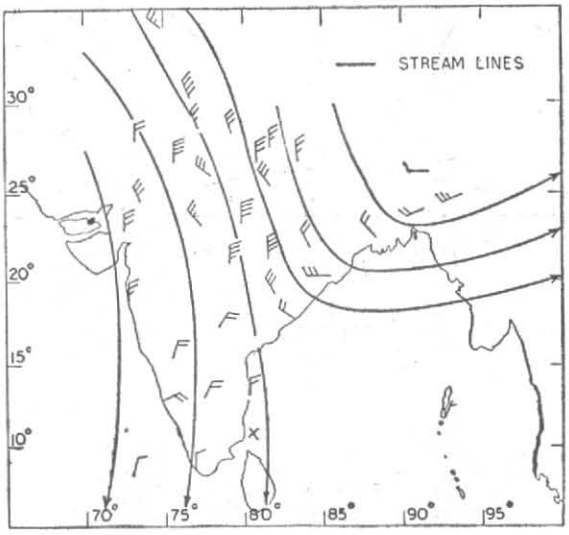

Fig. 14. 500-mb level winds at 00 GMT
9 November 1965

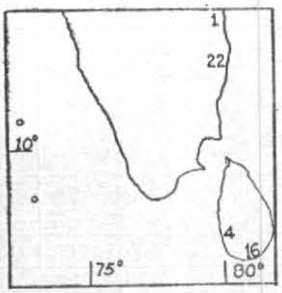

Fig. 15 (8 November 1965)

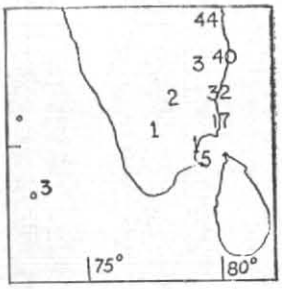

Fig. 16 (9 November 1965)

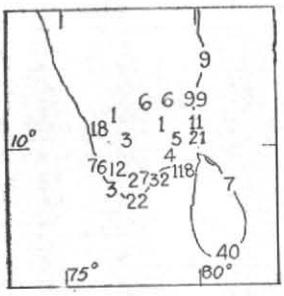

Fig. 17 (10 November 1965)

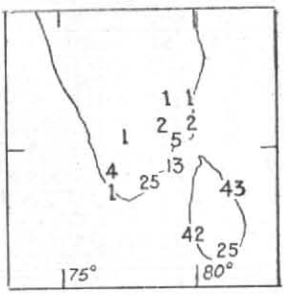

Fig. 18 (11 November 1965)

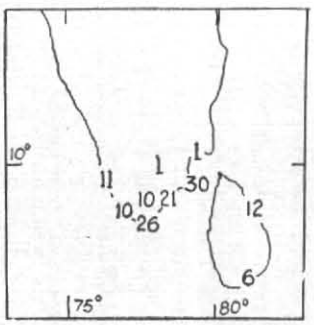

Fig. 19. (12 November 1965)

Figs. 15-19. Rainfall (mm) recorded at 0830 IST

TABLE 4

0830 IST mean sea level pressure of stations along the Coromandel coast for the period 7 to 12 November 1965

November 1965 7	8	9	10	11	12
Madras 14·1	12·0	13·0	12·8	13·1	14·8
Cuddalore 14·1	12·1	11·8	12·6	12·8	14·5
Nagapattinam 13·5	12·4	10·6	12·0	12·1	14·2
Pamban 13·6	11·7	12·4	10·2	10·8	12·3
Palayamkottai 14·0	12·5	12·3	10·7	11·2	13·0

5. Rapid weakening and unusual southward movement

By the morning of 8th the conditions which were favourable for intensification, very rapidly changed, *e.g.*, the superposition of the 200-mb high over the surface position of the storm was disturbed by the rapid southwestward shift of the former (Fig. 12) while the high level trough also moved away eastwards, so that the storm came under the influence of the rear of the trough which was a region of convergence. Further, the sub-tropical high pressure cell at 500-mb level also shifted westwards (Fig. 13) so that the winds from 500 mb and aloft were mainly northerly or northeasterly.

Therefore the storm drifted slowly southwards at 3 kts and rapidly weakened into depression by the morning of 9th when only a disturbed area was observed by TIROS-10. Microseisms at Madras which rapidly decreased in amplitude from 1200 GMT of 8th to 0300 GMT of 9th also confirmed weakening.

By 00 GMT of 9th, northerlies at 500-mb level and aloft strengthened considerably and prevailed

over the whole country (Fig. 14) and so the system continued to move southwards and weakening further became unimportant over Maldives area by 13th.

The unusual southward movement of the storm from 7th to 11th along the Coromandel coast may be inferred from the 0830 IST sea level pressures at coastal stations shown in Table 4, where it may be seen that Madras recorded the lowest pressure on 8th while Cuddalore and Nagapattinam, south of Madras, recorded lowest pressure on 9th and Pamban and Palayamkottai further south recorded lowest pressure on 10th.

The daily rainfall over south Peninsula between 8th and 12th shown in Figs. 15 to 19 also confirmed the southward movement.

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