

## Cyclones and depressions of 1973—Bay of Bengal and Arabian Sea

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### 1. Introduction

Six cyclonic storms and eight depressions formed in the Bay of Bengal and the Arabian Sea during the year 1973. Two depressions also developed over land areas, one over Gangetic West Bengal and the other over Rajasthan. Of the six cyclones, five formed in the Bay of Bengal (three of them of severe intensity) and one over the Arabian Sea. Of the ten depressions, six developed during the southwest monsoon season. The tracks of these cyclonic storms and depressions are shown in Fig. 1, and their monthly distribution is provided in Table 1.

The main feature of this year's cyclonic disturbances were :

(i) No cyclonic storm struck the coast of Andhra Pradesh and Tamil Nadu or the west coast of India.

(ii) All the cyclonic storms in the Bay of Bengal took a northerly course and affected north Orissa, West Bengal and Bangla Desh.

(iii) The cyclonic storm, which hit north Orissa near Chandbali in October, was a rain storm which caused very heavy rain and serious floods in that state resulting in heavy damage to property and some loss of life. The other cyclones did not cause any serious damage to life or property in the country.

(iv) The depressions and other low pressure areas which moved across the plains of north India during the southwest monsoon season caused floods and some damage to life and property in Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh and Vidarbha.

A brief history of the cyclones and depressions, together with the important features associated with them, is given in the following paragraphs.

### 2. Bay of Bengal

#### 2.1. Deep depression of 6-9 July

A well marked low developed over northwest and adjoining west central Bay on the 4th and concentrated into a depression on the morning of 6th with its centre near  $19.5^{\circ}\text{N}$ ,  $86.5^{\circ}\text{E}$ . Moving northwest, it crossed Orissa coast between Puri and Paradeep as a deep depression on the early morning of 7th. Thereafter moving westnorthwest, it gradually weakened into a low over north Madhya Pradesh by the evening of 9th and merged with the monsoon trough on the 10th.

This system caused active monsoon conditions in Orissa on the 5th and 7th, in Telangana on 5th, in east Madhya Pradesh from 5th to 8th and in west Madhya Pradesh from 9th to 11th. Active to vigorous monsoon conditions prevailed in Vidarbha on the 8th and 9th. The notable amounts of rainfall were as follows.

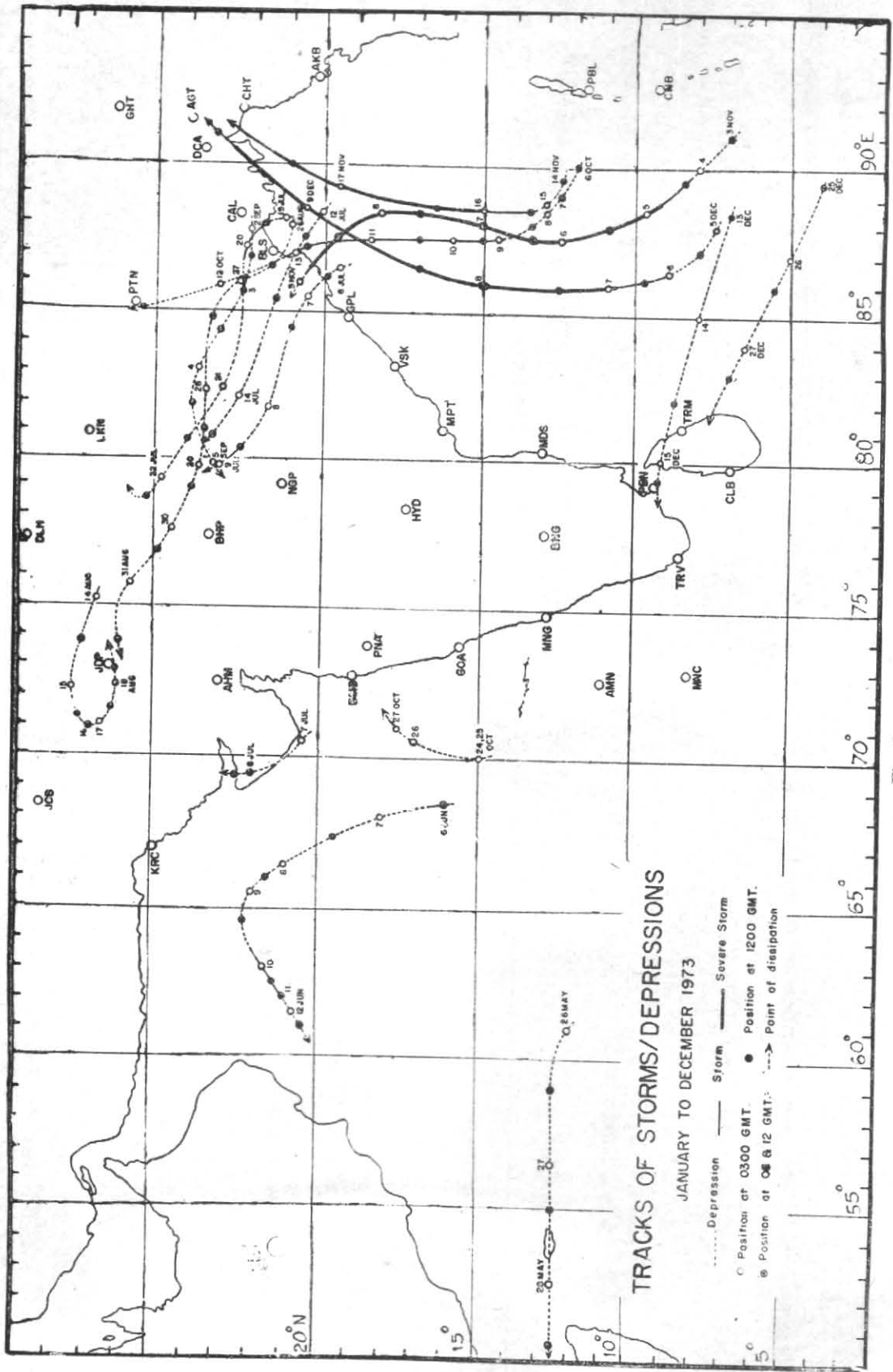


Fig. 1

TABLE 1

Monthly distribution of Cyclones and Depressions in the Bay of Bengal and Arabian Sea during 1973

	Jan-Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
	D C	D C	D C	D C	D C	D C	D C	D C	D C	D C
Bay of Bengal	— —	— —	— —	2 1	1 —	— —	— 1	— 2(2)	2 1(1)	5 5(3)
Arabian Sea	— —	1 —	— 1	1 —	— —	— —	1 —	— —	— —	3 1
Land Depression	— —	— —	— —	— —	1 —	1 —	— —	— —	— —	2 —
Total	— —	1 —	— 1	3 1	2 —	1 —	1 1	— 2(2)	2 1(1)	10 6(3)

D—Depression, C—Cyclonic storm. Figures in bracket indicate the cyclonic storm which had become severe

Date	Station	Rainfall (cm)
Jul 5	Mandla	16
7	Gariaband (M.P.)	23
	Balod (M.P.)	15
	Mahasamund	14
	Jagdalpur	14
	Puri	12
8	Deori (U.P.)	29
	Brahmapuri	21
	Balod (M.P.)	20
	Bhanupratappur (M.P.)	19
	Panni (Vidarbha)	16
	Tirora (Vidarbha)	15
	Titlagarh	15
	Kanker	15
	Nagpur	14
8	Bhandara (Vidarbha)	13
	Katol (Vidarbha)	13
	Durg	13
9	Indore	20
	Igatpuri (Maharsashtra)	17
	Arvi (Vidarbha)	16
	Hinganghat (Vidarbha)	15
	Katol (Vidarbha)	14
	Amraoti	14
	Nagpur	14
	Ratlam	13
	Betul	13
	Ujjain	13
	Brahampuri	13
	Wardha	13

The largest negative pressure departure from normal near the centre of the depression was 13 mb reported at Gondia and Raipur at 0300 GMT on the 8th. The lowest pressure near the centre of the system was reported at Mandla. It was 984.6 mb at 1200 GMT on the 8th. The strength of the easterlies and westerlies about 300 km away from the centre of the depression were 40/50 kt and 50/55 kt respectively between 1 and 3 km a.s.l. on 7th and 8th..

### 2.2. Deep depression of 12-14 July

A feeble low which lay over northwest Bay on 11 July, concentrated into a depression at 0300 GMT of 12th near 20°N, 88.5°E. Moving west-northwest, it was probably deep on the morning of 13th when it lay close to the Orissa coast near Chandbali. It crossed coast near Chandbali that forenoon and continuing to move westnorthwest, it weakened into a low over north Madhya Pradesh on the morning of 15th.

Under the influence of this system, the monsoon was active in Madhya Pradesh from 12th to 15th, in Orissa on 13th and 14th, in Telangana on 14th and in Marathwada and North Interior Mysore on 15th. It was vigorous in Vidarbha on 14th and 15th and in Madhya Maharashtra on 15th. The principal amounts of rainfall were :

Date	Station	Rainfall (cm)
Jul 12	Sidhi	9
	Satna	7
13	Mahasamund (M.P.)	13
	Jabalpur	9
	Vidihsha	9
	Puri	8
	Titlagarh	7
14	Sironcha	23
	Bhopalpatnam	20
	Durg	15
	Raipur	11
	Jagdalpur	9
14	Chnadrapur	9
	Guna	8
	Mahabaleshwar	22
	Bhira	16
	Pachmarhi	15
	Murtizapur	15
	Hoshangabad	12
	Indore	9
	Raisen	9
	Dhar	8
	Jalgaon	8

The westerlies about 500 to 600 km to the south of the depression centre were 45 to 55 kt between 1 and 3 km a.s.l. on 13th and 14th. The largest negative pressure departure from normal near the centre of the depression was 8 to 9 mb on 13th.

### 2.3. Contai cyclone of 19-22 July

A low which lay over north Bay of Bengal on 18th, concentrated into a depression on the morning of 19th with its centre near Sandheads. Moving northnorthwest, it rapidly intensified into a cyclonic storm during the same night, crossed coast near Contai and lay on the morning of 20th near Midnapore. Then moving practically west-northwest, it gradually weakened into a depression on the evening of 22nd near Jhansi. Subsequently, it moved northeastwards as a low across east Uttar Pradesh and broke up over Nepal-Himalayas by the morning of 24th.

This system caused active to vigorous monsoon in Orissa from 19th to 21st, in Madhya Pradesh from 21st to 23rd and in east Rajasthan on 22nd and 23rd. The monsoon was also active in Gangetic West Bengal on 20th and in Bihar Plateau on 21st. Scattered or isolated heavy to very heavy falls occurred in Madhya Pradesh, Orissa, Gangetic West Bengal and east Rajasthan on a few days during the above period.

The notable amounts of rainfall were :

Date	Station	Rainfall (cm)
July 19	Paradeep	16
20	Talcher (Orissa)	26
	Chandbali	25
	Parjang (Orissa)	23
	Chandipur (Orissa)	17
	Rairkhol (Orissa)	17
	Dhankenal (Orissa)	16
	Paradeep	15
	Sagar Island	15
	Sandheads	14
	Balasore	14
	Angul	12
21	Parjang (Orissa)	19
	Karanjie (Orissa)	18
	Binka (Orissa)	13
	Deogarh (Orissa)	12
	Keonjargarh	10
	Sarangarh (M. P.)	10
22	Bhopal	28
	Pachmarhi	27
22	Rajgarh	24
	Jhalrapatan (Rajasthan)	20

July 22	Raisen	19
	Bakani (Rajasthan)	18
	Vidisha	18
	Jhalawar	17
	Khanpur (Rajasthan)	17
	Deeg (Rajasthan)	17
	Pirawa (Rajasthan)	17
	Sironj (Rajasthan)	16
	Sagar	15
	Garoth (M. P.)	15
	Kota	14
	Hoshangabad	14
	Betul	14
23	Rajgarh	30
	Tonk	13
	Sitagarh (M. P.)	13
	Nimach	13
	Kota A. P.	10

Floods in the *Narmada* and other rivulets in Madhya Pradesh were reported to have submerged many parts in that state dislocating vehicular traffic. Many districts in Orissa were also reported to have been affected by serious floods, causing damage to standing crops and other property. Jaipur was the worst hit sub-division. In Bhadrak division, some houses were damaged due to floods and crops over 1 lakh hectares were reported to have been affected. According to the report of an officer who toured the storm affected areas, there were no tidal waves nor was there any serious damage due to winds.

The largest negative pressure departure from normal reported near the centre of this system was 11 mb at 0300 GMT of 20th at Midnapore.

A few important reports from ships and observatories near the storm field are given in Table 2.

### 2.4. Deep depression of 26-31 August

Under the influence of a low pressure wave moving westwards across Burma, a low formed over north Bay on 24th evening. It concentrated into a depression on the morning of 26th near Sandheads and crossed coast close to and south of Balasore on the same afternoon. It became deep on the morning of 27th near Jamshedpur. Moving generally westnorthwest across north Madhya Pradesh, it weakened into a well marked low over south Rajasthan on the morning of 1 September. The low persisted there upto the 3rd morning, and merged with the monsoon trough that evening.

TABLE 2

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg)	Speed (kt)	
19 JULY						
0600	ATGW	20.5	89.1	230	28	999.3
1200	Sagar Island			180	18	988.3
1200	ATGW	20.2	89.3	260	33	999.1
1200	VWPT	20.2	89.1	230	30	993.0
1200	VWPX	20.9	88.8	210	18	991.7
1800	Sandheads			SSW	80	989.4
1800	VWPT	20.8	88.4	240	39	991.9
20 JULY						
0000	Sandheads			230	54	991.8
0000	Calcutta			SE 40-45 (upto 0.9 km)		
0300	Sagar Island			SSE 40		992.8
1200	Gaya			E 45 (at 0.6 & 0.9 km)		—
1200	Bhagalpur			E 45 (at 0.6 & 0.9 km)		—

This system caused active to vigorous monsoon conditions in Orissa and Vidarbha on 26th and 27th, in Gangetic West Bengal on 27th and 28th, in east Madhya Pradesh from 26th to 29th, in west Madhya Pradesh from 26th to 31st and in Rajasthan and Gujarat Region from 29 August to 4 September. The monsoon was active over Bihar Plateau on 28th. Very heavy rain was reported from many places in west Madhya Pradesh and south Rajasthan. Many parts of west Madhya Pradesh, Gujarat Region and south Rajasthan were seriously affected by floods leading to heavy damage to roads, bridges, houses and standing crops and paralysing road and rail communications. The cities of Bhopal, Hoshangabad, Ujjain, Ahmedabad and Broach were inundated by flood waters.

The notable amounts of heavy rainfall associated with this system were :

Date	Station	Rainfall (cm)
Aug 26	Chandbali	13
	Akola	12
	Puri	11
27	Sagar	17
	Sagar Island	16
	Rairkhol (Orissa)	15
	Sandheads	14
	Sambalpur	12
28	Gotitoria (M.P.)	33
	Harrai (M. P.)	22
	Surajpur (M.P.)	19
	Sandheads	19
	Ambikapur	13

Aug 29	Gotitoria (M.P.)	25
	Gadarwada (M.P.)	23
	Vidisha (M.P.)	20
	Jabalpur	20
	Pachmarhi	18
	Rajgarh	17
	Gotegaon (M.P.)	14
	Narsinghpur	12
	30	Bhopal
Pachmarhi		24
Shajapur		21
Kannod		19
Khategaon (M.P.)		19
Dewas (M.P.)		14
Gadarwada (M.P.)		14
Abu		14
Raipur (Rajasthan)		13
Raisen (M.P.)		13
Ujjain	13	
Aug 31	Abu	27
	Ratlam	26
	Deeg (Rajasthan)	23
	Ujjain	22
	Dhar	20
	Dewas (M.P.)	18
	Kotra (Rajasthan)	18
	Indore	16
	Dhryawad (Rajasthan)	16
	Rajpur	15
	Deesa	15
	Dohad	14
	Kumbhalgarh (Rajasthan)	14
	Abu Road (Rajasthan)	14
	Galiakot (Rajasthan)	14
	Dhambala (Rajasthan)	13
	Jhabua (M. P.)	13
Sep 1	Pindwara (Rajasthan)	64
	Abu	56
	Abu Road	30
	Jharol (Rajasthan)	28
	Sirohi (Rajasthan)	26
	Erinapura (Rajasthan)	25
	Kotra (Rajasthan)	25
	Reoder (Rajasthan)	25
	Lunavada (Gujarat)	16
	Kunba (Rajasthan)	15
	Sardha (Rajasthan)	15
	Khirwara (Rajasthan)	15
	Jaswantpura (Rajasthan)	14
	Dungarpur	12
2	Abu	42
	Erinapura	36

The largest negative pressure departure from normal near the centre of the system was 12 mb reported by Jabalpur at 0300 GMT of 29th. The lowest pressure of 987.8 mb was reported by Jabalpur at 0000 GMT of 29th near the centre of the depression. The easterlies in the lower troposphere about 300 to 400 km from the centre of the depression were 30 to 40 kt on many days.

### 2.5. Chandbali cyclone of 6-12 October

A low moved westwards across Tennasserim coast into Andaman Sea on 4th and became well marked on 5th. It moved to southeast Bay on 5th and concentrated into a depression on that evening near 12°N, 90°E. Subsequently moving

northwest, it intensified into a cyclonic storm on the morning of 9th near  $14.5^{\circ}$  N,  $87.5^{\circ}$  E. Thereafter, moving practically northwards, it crossed north Orissa coast near Chandbali around midnight of 11th and weakened into a trough over north Bihar on the morning of 13th.

This system caused generally widespread rain with scattered heavy to very heavy falls in Orissa, West Bengal and Bihar State between the 11th and 13th. Fairly widespread rain also occurred over the Bay Islands from 4th to 10th, and in Assam and adjacent states on the 11th and 12th. This was a rainstorm which caused very heavy rain and floods in Orissa. Chandbali recorded 44 cm of rain on 12th, which was a record for that station for the month of October. A few more stations in Orissa reported more than 40 cm of rain on that day. About 1.5 million people were affected by floods in Orissa. More than 60,000 houses were reported to have been damaged in north Orissa. Road, rail and telecommunication links, were disrupted and a number of bridges were damaged. Floods due to heavy rain and saline water inundation caused by mild tidal waves in the coastal areas, affected large areas of agricultural land in Orissa. According to the report of the officer who visited the storm affected areas of Orissa, there was no tidal wave during the passage of the storm, although the sea was very high and rough. Saline inundation caused much damage in the Basudeopur area. Less than a hundred persons were reported to have lost their lives in Orissa, while the toll of cattle was reported to be heavy. Heavy rain in Bihar was reported to have damaged the flowering paddy crops over some areas in that state. The coastal areas of West Bengal were reported to have been affected by saline water inundation and floods in rivulets. In Midnapore district, 5000 houses were damaged and the damage to property and crops was estimated to be about Rs. 10 lakhs. No damage due to strong winds was reported in any of these states. The principal amounts of heavy rainfall associated with this system were:

Date	Station	Rainfall (cm)
Oct 9	Car Nicobar	12
10	Suliapada (Orissa)	59
	Korapi (Orissa)	22
11	Spro (Orissa)	40
	Nilagiri (Orissa)	35
	Oupada (Orissa)	33
	Dhamnagar (Orissa)	30
	Simulia (Orissa)	30
	Basudevpur (Orissa)	30
	Agarpara (Orissa)	29
	Belanga (Orissa)	29

Oct 11	Bouth (Orissa)	26
	Balia (Orissa)	25
	Bhandaripokhari (Orissa)	20
	Baliapal (Orissa)	15
	Baliaula (Orissa)	15
12	Baripada	47
	Chandbali	44
	Rajkanika (Orissa)	42
	Bhadrak (Orissa)	41
	Shamakunti (Orissa)	39
	Kaptipada (Orissa)	31
12	Khunla (Orissa)	27
	Balasore	26
	Tihidi (Orissa)	25
	Kuliara (Orissa)	25
	Betmati (Orissa)	22
	Ranchi	18
	Dharapana (Orissa)	15
	Rairangpur (Orissa)	14
	Hazaribagh	14
	Dhanabad	14
	Monghyr	12
	Jamui	12
	Paradeep	12
13	Cooch Behar	25
	Raxaul	23
	Chapra	21
	Darjeeling	21
	Patna AP	21
	Jalpaiguri	16
	Jahanabad (Bihar)	16
	Purnea	14
	Kalimpong	13

Chandbali reported a negative pressure departure from normal of 12 mb at 1200 GMT of 11th when the centre of the storm was about 75 km from that station. Jamshedpur reported the largest pressure defect of 14 mb, and a 24-hr pressure fall of 10mb at 0300 GMT of 12th, when this system lay as a deep depression with its centre close to Jamshedpur. A few important observations reported by ships near the storm field by coastal stations are given in Table 3.

Based on satellite picture, National Oceanic and Atmospheric Administration (NOAA), Washington had estimated the maximum wind speed in association with this system to be 25 kt. The classification on Dvorak's scale (1973) was T 1.5/1.5 from the 8th to 11th. The Fleet Weather Central at Guam had estimated the maximum wind to be 45 kt based on satellite data. Assuming the maximum wind to be 45 kt, because some ships had reported 40 kt, the pressure at the centre of the system was estimated to be 994 mb on the basis of Fletcher's formula ( $V_m = 16\sqrt{P_c - P_0}$ ). This was in good agreement with the lowest pressure of 996.2 reported by ship GZDG on 9th and 996.4 reported by Chandbali on 11th. For this storm, the direction of movement (northerly) between 9th and 11th was towards the area of the largest 24-hour pressure fall, that is, the Orissa coast. A westerly

TABLE 3

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg)	Speed (kt)	
7 OCTOBER						
1200	VWBL	12.6	89.1	Var	06	1001.5
1200	Port Blair			SW	30	
				(at 0.6 & 0.9 km)		
8 OCTOBER						
0000	Port Blair			SW	30	
				(at 0.9 km)		
0300	ATAE	15.3	86.1	050	22	1006.4
0900	ATAE	14.5	87.0	020	27	998.5
1200	ATAE	14.2	87.4	040	22	996.8
1200	VWDG	16.8	90.9	130	20	1004.2
1800	ATAE	13.5	88.6	190	30	998.7
2100	ATAE	13.0	88.7	220	42	996.4
9 OCTOBER						
0000	GZDG	15.8	85.4	010	25	1001.4
0000	ATAE	12.6	89.3	220	33	1001.0
0600	ATAE	11.8	90.1	210	33	1001.3
1200	LEGY	12.5	83.5	WNW	30	1004.0
1800	GZDG	12.7	88.8	250	41	996.2
10 OCTOBER						
0000	GZDG	12.9	89.6	230	37	1001.3
11 OCTOBER						
0000	PTGY	19.3	91.3	140	24	998.7
0000	Paradeep			N	25	1000.5
0300	Sandheads			NE	25	1001.6
0000	Bhubaneshwar					
				360	40	
				(at 0.3 km)		
0600	Sandheads			090	38	1000.7
0600	Bhubaneshwar					
				360	24	998.3
1200	Sandheads			140	35	997.7
1200	Candbali			340	12	996.4
1200	Paradeep			320	31	997.3
1200	Calcutta			E	40	
				(at 0.6 km)		
1600	Paradeep			290	35	997.6
1800	Sandheads			140	42	996.7
12 OCTOBER						
0000	Calcutta			SE	45-50	
				(at 0.6 & 0.9 Km)		
0000	Sandheads			S	40	1000.3

trough in the middle troposphere which lay along 80°E could also have influenced the movement of the storm towards the north.

### 2.6. Paradeep cyclone of 3-9 November

Under the influence of a low pressure wave moving westwards across Tennasserim, a low formed over south Andaman Sea on 1 November. Moving westwards, it concentrated into a depression over southeast Bay on the evening of 3rd near 7°N, 91°E. Subsequently, moving northwest, it intensified into a severe cyclone on the morning of 5th with its centre near 9.5°N, 88.5°E. Moving in a northerly direction upto 8th morning and later north-westwards, it crossed Orissa coast close to and north

of Paradeep on the early morning of 9th. It weakened rapidly after crossing coast and lay as a trough over Orissa by the same evening.

This system caused widespread rain with isolated heavy falls in the Bay Islands from 4th to 6th and scattered to fairly widespread rain in many parts of northeast India from 8th to 10th. This cyclone was reported to have caused some damage to standing crops in the coastal districts of Orissa between Paradeep and Chandbali. No information was available about tidal waves. At Balasore, the sea was reported to be generally calm. However, saline water inundation was reported from Basudevapur area affecting 655 acres of land and from Bahanaga Block of Sadar sub-division affecting 1415 acres of land (covering 20 villages). No saline water inundation took place at Chadbali. Saline water inundation was reported at Uttar Sumiti and Jambo area of Mahakalpara Block but the saline water receded quickly. The sea was reported to be very rough off Paradeep with waves of height 3 to 4.5 m. No heavy rain was reported from Orissa in association with this cyclone and there was no damage to life or other property worth mentioning.

Paradeep reported the strongest surface wind of 54 kt from northnorthwest at 1900 GMT of 8th, while Chandbali reported the strongest surface wind of 54 kt from southeast at 0000 GMT of 9th. The strongest surface wind reported by Balasore was only 13 kt, while Gopalpur reported winds of 10 kt or less on 8th and 9th. This suggests that this cyclone had strong winds confined to within half to one degree from its centre, particularly when it approached the coast. The hourly observations of wind and pressure at Paradeep on 8th and 9th are given in Fig. 2. The lowest pressure recorded by Paradeep was 989.7 mb at 2300 GMT of 8th and the negative pressure departure from normal at that hour was 23 mb. Over the sea area, the strongest wind of 74 kt from westsouthwest and the lowest pressure of 980.0 mb was reported by ship JMHN at 0630 GMT of 5th near 10°N, 88°E. Important ships' reports in the storm field are given in Table 4.

This cyclone was tracked by the 10 cm radar at Paradeep from 0200 GMT of 8th to 0400 GMT of 9th. The smooth track of this cyclone as determined by radar observations is given in Fig. 3. The radar photograph of the storm at 1842 GMT of 8 November is reproduced in Fig. 4.

The maximum wind estimated from the satellite cloud pictures of this storm by the Satellite Centre at Washington was about 50 kt (the classification being T 3.5/3.5 on Dvorak's scale (whereas the

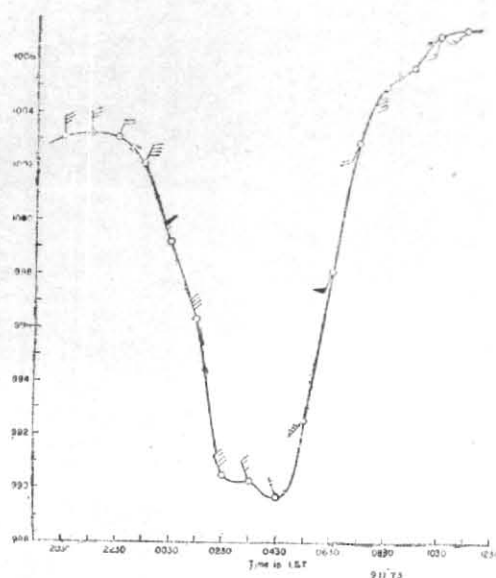


Fig. 2

Hourly observations of wind and pressure at Paradeep Port

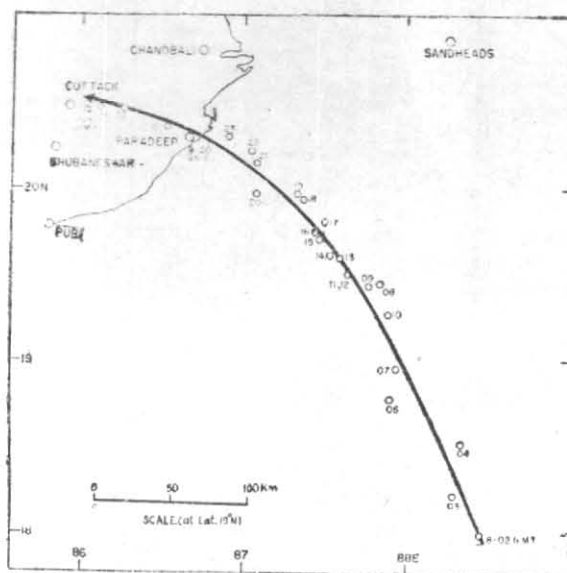


Fig. 3

Track of Paradeep Cyclone of 3-9 November 1973

TABLE 4

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	
3 NOVEMBER						
1800	ATJJ	10.4	89.2	080	35	1004.5
4 NOVEMBER						
0600	ATAE	9.6	92.6	130	24	1004.1
0600	JMHN	8.2	91.0	S	30	1001.1
0600	ATLA	10.7	88.2	050	22	1004.6
1000	JMHN	8.7	90.5	S	30	998.5
1200	ATLA	10.5	89.6	050	30	999.8
1200	ATAE	10.4	91.7	130	18	1002.6
5 NOVEMBER						
0000	ATLA	9.8	91.2	120	30	1001.4
0000	GOSM	5.5	89.0	250	25	1005.9
0100	JMHN	10.0	88.1	050	55	988.0
0300	ATAE	12.6	89.1	090	33	1003.2
0600	JMHN	10.0	88.2	240	74	982.5
1200	JMHN	9.8	88.2	WSW BF 11	(55)	992.0
1200	ATAE	14.2	87.4	060	33	1002.5
1800	JMHN	10.0	89.5	S	30	1002.5
6 NOVEMBER						
0200	Bangla Doot	10.0	82.5	330	35	1003.7
0300	ATAE	16.2	85.2	010	34	1003.5
0900	GMHAN	15.0	84.8	360	25	1001.1
8 NOVEMBER						
0000	VWDG	18.9	86.1	350	24	1002.1

Fleet Weather Central (FWC) at Guam estimated the maximum wind to be 75 kt on the basis of satellite data. Assuming the maximum wind to be 75 kt, as ship JMHN had reported 74 kt, the lowest pressure at the centre of the storm works out to be 984 mb, which agreed well with the pressure reported by JMHN (982 mb). Satellite picture of this cyclone is given in Fig. 5.

Although the storm moved practically northwards between 5th and 8th, its ultimate landfall was over Orissa, where the maximum 24-hour pressure fall and negative pressure departure from normal occurred from 7th morning to 8th evening. This change in track from north to northwest could also be conceived as being a case of missed recurvature, as the westerly trough which was steering the storm northwards upto 7th, moved away eastwards a little too early. This brought the storm under the influence of the easterlies south of the anticyclone in the rear of the trough.

#### 2.7. Hatia cyclone of 14-18 November

A low pressure area moved westwards across Tenasserim on 12th and became well marked over Andaman Sea on the 13th. It concentrated into a depression on the morning of 14th over southeast Bay near 12.5°N, 89.5°E. Moving slowly west-northwestwards initially and later northwards, it intensified into a severe cyclonic storm on the morning of 16th with its centre near 15°N, 88.5°E. Subsequently, it recurved northeastwards, weakened into a cyclonic storm by 1800 GMT of 17th and





Fig. 4  
Radar view of Paradeep  
Cyclone at 1842 GMT of  
8 Nov 1973

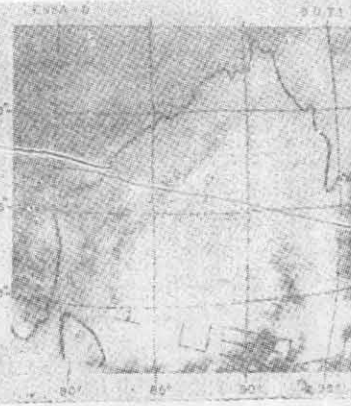


Fig. 5  
ESSA-8 view of Paradeep  
Cyclone on the morning of  
5 Nov 1973



Fig. 6  
Satellite view of Hatia Cyclone at  
0159 GMT on 16 Nov showing 'eye'  
of the storm. (Courtesy : FWC/  
JTWC, Guam)

crossed Bangla Desh coast near Hatia as a depression on the early morning of 18th and weakened *in situ* on 19th.

This system caused fairly widespread rain over the Bay Islands from the 12th to 17th, with isolated heavy falls on 14th. Fairly widespread rain or thundershowers occurred in Assam and the adjacent states on 18th and 19th, with isolated heavy falls on the 18th. No damage was reported due to this cyclone.

Coco Island reported a surface wind of 25 kt from eastsoutheast at 0300 GMT on the 14th, while Port Blair reported S/25 kt at 0.6 and 0.9 km a.s.l. at 0600 GMT on the same day. A few ships which were close to the storm centre on 16th and 17th reported lowest pressures of 997 to 998 mb. Ship ELYL at 0000 GMT of 16th reported maximum speed in gusts at 45 kt near the storm centre. Important ships' reports and observations from coastal stations are listed in Table 5.

A trough in the middle tropospheric westerlies lay north of 20°N with its axis between 80 and 85°E from the 16th to 18th. This appears to have influenced the recurvature of the storm northeastwards. The largest 24-hr pressure fall and pressure deficiency occurred over Orissa coast at 1200 GMT of 16th, over West Bengal coast at 0300 GMT of 17th and over Bangla Desh coast at 1200 GMT of 17th. The northeastward shift of the area of maximum 24-hr pressure fall along the coast was suggestive of the recurvature of the storm. Except for its landfall, the reason for weakening of the storm as it approached Bangla Desh coast on 18th is obscure in the light of the fact that the upper westerly trough had not overtaken the storm, and

the sea surface temperature reported by a ship near the storm field at 1800 GMT of 17th was about 29°C, compared to an air temperature of 26°C.

Washington classified this system as T 3.5/3.5 on 16th morning and T 4.0/4.0 on 17th morning based on satellite pictures. This provides a maximum wind of 50 kt on 16th and 60 kt on 17th. The FWC at Guam estimated the maximum wind to be 55 kt on 16th and 17th. But the ships in the storm field generally reported winds of less than 40 kt, the highest being 45 kt in gusts. However, the satellite picture of this cyclone reproduced from the Annual Typhoon Report 1973, published by the FWC, Guam shows an eye at 0159 GMT on 16 November (Fig. 6). Consequently this system could be classified as a severe cyclone on the 16th and 17th. Assuming the maximum wind in association with this cyclone to be 55 kt, the pressure at the centre of the system was estimated to be 994 mb. Ships close to the storm centre had reported the lowest pressure of 997 mb on the 17th.

#### 2.8. Barisal cyclone of 5-9 December

A low which developed over south Bay on 3rd concentrated into a depression on the morning of 5th near 7.5°N, 88°E. Moving northwestwards, it intensified into a cyclonic storm on the morning of 6th when it was centred near 9°N, 86.5°E. Thereafter moving northwards it became severe on the morning of 7th near 11°N, 86°E. It continued to move northwards upto the 8th morning. Subsequently, it recurved northeastwards and crossed the Bangla Desh coast near Barisal on the afternoon of 9th and weakened into a low over northeast Bangla Desh and adjoining parts of Assam on 10th. Later it moved away eastwards.

TABLE 5

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	
15 NOVEMBER						
1200	ELYL	12.4	89.8	190	24	1006.5
1200	GMHR	15.3	86.0	030	24	1007.9
16 NOVEMBER						
0000	ELYL	14.7	87.9	310	21	998.0
1200	ELYL	16.6	85.7	360	24	1006.5
1200	VWDG	17.1	90.9	150	21	1004.5
2030	VWDB	18.5	90.0	E by S BF 7(30)		998.5
2200	VWDG	18.6	89.7	ENE BF 5(18)		998.0
17 NOVEMBER						
0300	GBMH	20.9	90.1	E	25	1003.0
0300	Sandheads	at Sagar		050	28	1007.6
0600	Sandheads	at Sagar		090	31	1006.9
0600	Sagar Island			NNE	25	1005.1
0600	VWDG	19.5	89.0	320	15	1002.2
0600	ATGE	21.0	89.0	060	30	1003.5
1200	GBMH	29.9	90.2	S	25	997.1
1200	Sandheads			050	31	1006.4
1200	Cox's Bazar			120	30	1003.5
1200	Calcutta			NE	35	(at 0.6 & 0.9 km)
1200	Agartala			NE	50	(at 0.6 & 0.9 km)
1800	Chittagong			SSE	85	(at 0.9 km)
1800	Cox's Bazar			S	45	(at 0.9 km)

This system caused fairly widespread rain over the Bay Islands from 3rd to 9th, with isolated heavy falls from 4th to 6th. Fairly widespread rain also occurred in Orissa and Gangetic West Bengal on 9th and in Assam and adjacent states from 9th to 11th with isolated heavy falls in Orissa and Gangetic West Bengal on 9th and in Assam and adjacent states on 10th. According to press reports, *M.V. Sonavali* was caught in the cyclone and sank about 250 km southeast of Visakhapatnam. About 10 members of the crew were reported to have lost their lives. Heavy rain in Gangetic West Bengal caused some damage to crops in the coastal districts, particularly Midnapore district, and in Sagar Island. A tidal wave of about 4.5 m was reported to have affected the coastal areas of Bangla Desh, with considerable damage to cattle

TABLE 6

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	
5 DECEMBER						
0000	ATLA	11.4	86.2	040	25	1008.8
1200	VWDD	7.6	83.2	010	20	1008.4
2100	VWVK	12.5	82.8	030	30	1004.5
6 DECEMBER						
0000	ATLA	11.0	89.3	100	25	1005.6
1200	VWDD	11.6	82.8	020	24	1005.6
7 DECEMBER						
0000	VWDD	13.8	83.1	020	30	1005.7
0000	ATEI	6.9	87.1	220	28	—
0600	GMHR	12.0	85.2	050	11	1003.0
1200	PGOZ	13.4	85.0	020	40	998.0
1200	ATDB	8.9	86.4	260	33	1004.0
1200	GMHR	10.8	84.5	320	20	1003.6
1330	Ship	13.5	83.0	NE BF 8(37)		1003.0*
1800	PGOZ	12.9	84.9	340	35	—
8 DECEMBER						
0000	PGOZ	12.4	84.9	300	35	1002.1
0000	ATGE	17.2	88.2	100	30	1003.1
0300	GHZT	13.5	89.5	150	24	1008.3
0600	ATGE	16.4	87.6	120	35	1003.0
1200	ATGE	16.8	87.0	160	55	991.0
1400	ATGE	16.6	86.9	220	45	994.2
1800	ATGE	16.1	86.3	320	45	1004.0
9 DECEMBER						
0000	ATAF	20.0	87.5	360	60	999.5
0000	Sandheads	at Sagar		N	50	1003.2
0000	Calcutta			NE	55	(at 0.6 & 0.9 km)
0300	Sandheads			NNE	50	1002.4
0300	Hatia			above	30	1007.5
0600	Cox's Bazar			SE	60-80	(at 0.3 & 0.6 km)
0600	Sandheads			NNW	45	1003.3
0900	Chittagong			SSE	45	1000.6
0930	Dacca			NNE	40	999.0
1200	Agartala			E	10	998.9
1200	Dacca			NNE	35	998.0
1200	Hatia			SW	30	1004.3
1300	Dacca			N	25	999.0
1300	Sandwip			SW	50	1001.3
1300	Hatia			SW	45	1002.8

\*Uncorrected

life and property. The principal amounts of rainfall associated with this system were :

Date	Station	Rainfall (cm)
Dec 4	Hut Bay	10
5	Port Blair	12
6	Car Nicobar AP	10
	Long Island	7
7	Coco Island	8
9	Paradeep	11
	Sagar Island	10
	Contai	9
	Puri	8
	Uluberia	7
10	Haflong	14
	Cherrapunji	11
	Ziro	11
	Silchar	8
	Shillong	7

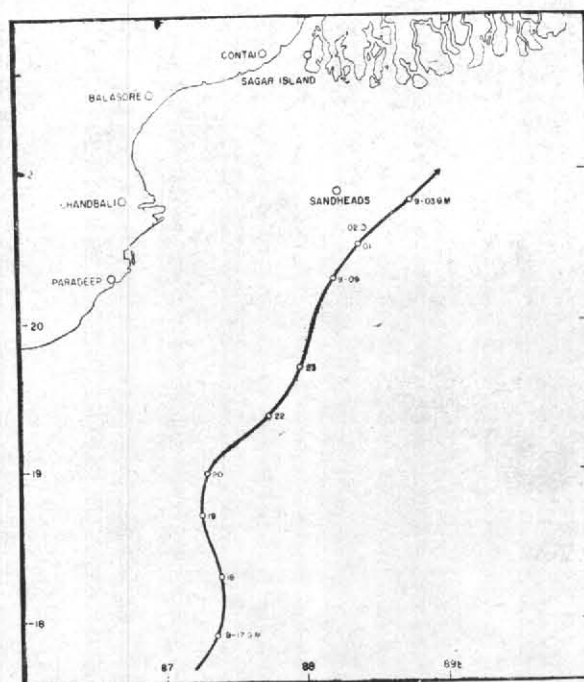


Fig. 7

Radar track of Severe Cyclonic Storm of 8-9 December 1973

Important reports from ships and observatories near the storm field are given in Table 6. Ship ATGE reported the lowest pressure of 989.5 at 1030 GMT of 8th close to the storm centre. It reported a maximum surface wind of 55 kt from south-southeast at 1200 GMT of 8th near 16.8°N 87°E. Ship ATAF reported a maximum wind of 60 kt from the north near 20°N, 87.5°E at 0000 GMT of 9th. Ship VWG reported the lowest pressure of 991 mb at 0300 GMT of 9th near 19.6°N, 89.7°E and a southerly wind of 10 to 11 B.F. Sandheads recorded a pressure defect of 14 mb at 0300 GMT of 9th. Agartala also reported a pressure defect of 14 mb at 1200 GMT of 9th.

The maximum 24-hour pressure fall was seen over Andhra coast on 7th. It shifted along the east coast to Gangetic West Bengal by the 9th morning, as the storm recurved northeastwards.

The cyclone came within the range of the Paradeep radar on 8th night and was tracked by the radar from 1700 GMT of 8th to 0300 GMT of 9th. The track of the cyclone as provided by radar fixes is depicted in Fig. 7.

Washington classified this system as T 4/4 and T 3.5/4 on 7th and 8th respectively based on satellite pictures. This gives a maximum wind of 60 kt. Guam also estimated the maximum wind associated with this cyclone to be 60 kt on 7th

and 8th on the basis of satellite pictures. Both Washington and Guam indicated a possible "eye" on 7th. The APT cloud pictures received at Bombay showed that this system was in stage X, category 2 (*vide* code 373, Manual on codes, WMO Publication No. 306) with the diameter of the central overcast being 4 degrees on 7th and 8th. This provides an estimated maximum wind of 60 kt. With a maximum wind of 60 kt, the pressure estimated at the centre of the storm was 992 mb, which agreed fairly well with the lowest pressure of about 990 mb reported by ships. Satellite pictures of the cyclone on 7th and 8th are reproduced in Figs. 8 and 9.

#### 2.9. Deep depression of 13-15 December

A low pressure area formed over extreme south-east Bay on 10th and became well marked on the 11th and 12th. It concentrated into a depression at 1200 GMT of 13th near 7°N, 88.5°E. Moving westnorthwest, it became deep on the morning of 14th with its centre near 8°N, 85°E. Continuing to move westnorthwest, it crossed south Tamil Nadu coast near Pamban on 15th night and emerged into Lakshadweep-Maldives area on 16th as a low.

In association with this system, fairly widespread rain with isolated heavy falls occurred in Tamil Nadu from 15th to 17th. The principal amounts of rainfall (in cm) were: Pondicherry, Tiruppondi

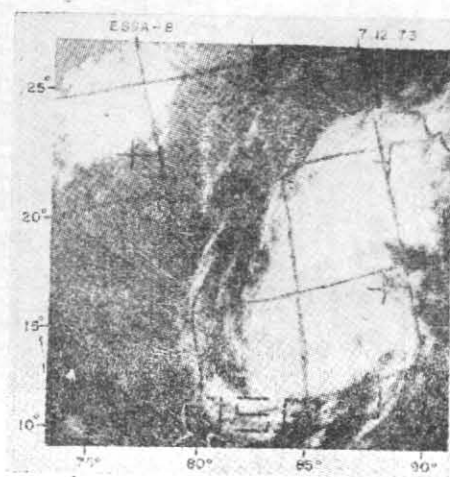


Fig. 8. 7 December 1973

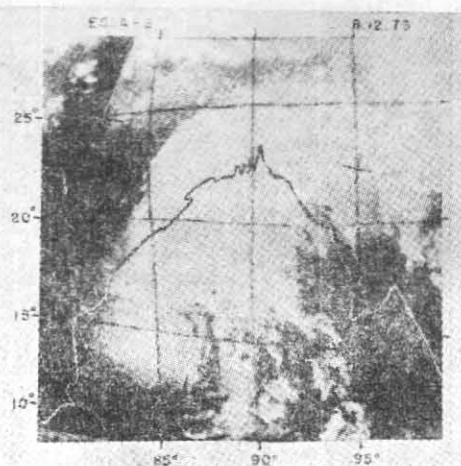


Fig. 9. 8 December 1973

Satellite view of Barisal Cyclone on the mornings of 7 and 8 December 1973

TABLE 7

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg)	Speed (kt)	
13 DECEMBER						
0600	VWBL	9.8	87.4	040	24	1010.8
14 DECEMBER						
0000	ATGX	8.6	82.8	N	20	1007.6
1200	ATGX	10.0	83.4	090	20	1006.5
1200	ATGU	8.3	81.9	270	30	1002.5
15 DECEMBER						
0000	Trincomalee			SW	25	1005.6
0000	Jaffna			NNE	20	1009.8
0130	VWVT	10.3	81.9	SE	15-20	—
0300	Pamban			340	23	1008.2

TABLE 8

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	
25 DECEMBER 1974						
0000	V. Point			E	40	
				(at 0.6 km)		
0000	Ship	4.1	89.0	Var.	Light	1005.8
0600	JMLS	5.8	86.3	NNE	20	1010.0
0900	JMLS	5.6	87.1	N	25	1006.1
26 DECEMBER 1973						
1800	ATJJ	10.7	88.8	070	28	1012.2
27 DECEMBER 1973						
0000	Colombo			NNE	30-35	
				(at 0.3 & 0.6 km)		
1200	VWXB	8.9	82.2	E	25	1006.0
1200	Baticoloa			NNE	20	1006.4

9 each on 15th, Kanchipuram 10, Madras 9, Kodai-kanal 8, Mayuram, Kulithalai 7 each on 16th.

A few important reports from ships and land stations near the depression field are given in Table 7.

#### 2.10. Depression of 25-27 December

A low moved from the east into south Andaman Sea on 22nd. It moved into extreme southeast Bay on 24th and concentrated into a depression on 25th morning with its centre near 4°N, 89.5°E. Then moving westnorthwest, it became probably deep on 27th, crossed Sri Lanka coast close to and south of Batticoloa on the same night, and lay as a well

marked low over Comorin and adjoining Sri Lanka on the 28th morning.

This system caused widespread rain in Tamil Nadu on 28th and 29th with scattered or isolated heavy falls. Rainfall was also fairly widespread in Sri Lanka from 25th to 28th. Scattered rain occurred in the Bay Islands from 22nd to 26th with isolated heavy falls on 23rd and 26th. The principal amounts of rainfall associated with this system were:

Date	Station	Rainfall (cm)
Dec 23	Car Nicobar	14
26	Kondul	11

Dec 28	Vedaranniyam	14
	Thathaingarpet (T.N.)	14
28	Arantangi (T.N.)	9
	Karur	8
	Pudukottai (T.N.)	8
	Thanjavur (T.N.)	8
	Mannarguli (T.N.)	7
	Kodaikanal	7
29	Kadaikanal	9

T.N.—Tamil Nadu

Colombo reported northnortheast winds of 30-35 kt at 0.3 and 0.6 km on the 27th morning. Some reports from ships in the depression field are given in Table 8.

### 3. Arabian Sea

#### 3.1. Deep depression of 26-28 May

Under the influence of a cyclonic circulation in the lower and middle troposphere, which moved into the Laccadive area on 23rd, the trough off Kerala-Mysore coasts developed into a well marked low by the evening of 24th. Moving westwards, the low concentrated into a depression on the morning of 26th near 12°N, 61°E. It became deep on the 27th morning when it was centred near 12.5°N, 56.5°E. Continuing to move westwards at a rapid rate, it weakened into a depression on 28th evening and into a low over the Gulf of Aden on the 29th morning.

This depression did not cause any rain over India.

Ship KHHW near 9°N, 62°E reported a surface wind of 20 kt from westsouthwest at 1200 GMT of 26th. Ship JFLJ near 14.5°N, 56°E reported a surface wind of 25 kt from east at 0600 GMT of 27th. This system was classified as stage B (*vide* code 373, Manual on codes, W.M.O. Publication No. 306) from satellite pictures by Washington.

#### 3.2. Cyclonic storm of 7-12 June

A low pressure area developed off Kerala coast on 2 June. Moving northwestwards, it concentrated into a depression on the evening of 6th near 16°N, 68.5°E. It became deep on the evening of 7th. Continuing to move northwest upto the 9th, and later southwestwards, it intensified into a cyclonic storm on the morning of 10th. It weakened into a depression by 12th, and dissipated off the Oman coast by 13th.

Under the influence of this system, the southwest monsoon revived over Kerala on 4 June and advanced upto Konkan and upto about 20°N over the Arabian Sea by the 8th. The monsoon was active in Kerala on 6th and 7th and in coastal Mysore on 8th and 9th. Isolated heavy rain

TABLE 9

Time (GMT)	Ship/Station	Location		Wind		Pressure (mb)
		Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	
7 JUNE						
0600	GTGE	17.2	71.4	170	33	1003.0
1200	Veraval			SE	15	1000.0
8 JUNE						
0300	Porbandar			SE	15	999.2
1200	Dwarka			160	27	995.2
1200	Porbandar			160	19	995.7
9 JUNE						
0300	GCKS	22.3	66.9	130	10	994.4
1200	GCKS	21.0	67.7	190	24	993.9
1800	Ship	21.4	65.5	200	20	994.8
10 JUNE						
0000	PIWA	21.3	63.0	320	13	992.4
0600	PIWA	20.5	64.1	200	30	995.5
1800	XHGJ	21.5	63.0	040	30	992.0
11 JUNE						
0600	PDII	20.3	63.6	190	29	996.7
0600	XHGJ	19.8	65.3	SSW	30	995.5
1200	PDII	21.6	62.3	Var	28	992.0
1800	PDII	22.6	60.8	030	18	998.0
12 JUNE						
0000	JQSD	20.8	64.3	SSW	25	997.6
0600	JQSD	21.7	63.3	150	24	998.0
1200	JQSD	22.4	61.2	060	21	996.1

occurred over these areas during this period. No other reports of severe weather over the country were received in association with this system.

Some important reports from observatories in Gujarat coast and from ships in the depression field are given in Table 9.

This system was classified as T 2/2 on the morning of 10th by Washington on the basis of satellite cloud pictures. This classification gives a maximum wind of 30 kt. As some ships had reported winds of 33 kt. away from the centre, assuming the maximum wind to be 35 kt, the estimated pressure at the centre of the storm works out to be 991 mb which agrees well with the lowest pressure of 992 mb reported by a ship near the centre. Satellite pictures of this storm are given in Figs. 10 and 11.

#### 3.3. Depression of 7-8 July

In the trough of low that lay off north Maharashtra-south Gujarat coasts, a low developed over south Gujarat coast and adjoining east central Arabian Sea on the 6th. It concentrated

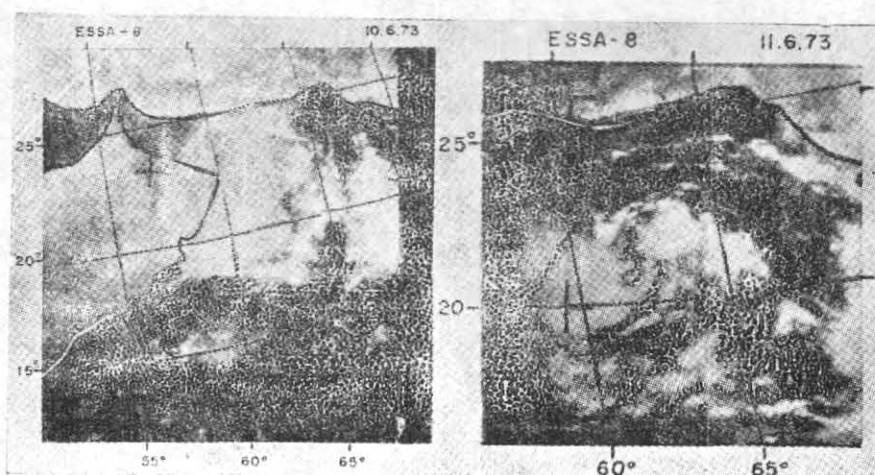


Fig. 10. 10 June

Fig. 11. 11 June 1973  
(Storm shows sign of weakening)

ESSA-8 view of the Arabian Sea Cyclone on the forenoons of 10 and 11 June 1973

into a depression on the morning of 7th near  $20.5^{\circ}\text{N}$ ,  $70.5^{\circ}\text{E}$ . Moving northwest, it weakened into a low over Kutch on the morning of 9th and subsequently merged with the seasonal low over Pakistan on the 11th.

This system caused active monsoon conditions in Konkan on 7th and 8th and in Gujarat State from 9th to 12th. The monsoon was vigorous in Saurashtra and Kutch on the 10th. The principal amounts of rainfall were :

Date	Station	Rainfall (cm)
Jul 7	Mahabaleshwar	32
	Bhiara	20
	Hagnai	20
	Ratnagiri	12
8	Bhira	33
	Mahabaleshwar	30
	Bombay (Colaba)	15
	Dahanu	9
9	Porbandar	15
	Mahuva	9
10	Okha	28
	Porbandar	25
	Veraval	15
	Surat	10

Porbandar town was cut off from the rest of the state for a few days due to very heavy rain and flooding.

The pressure departure from normal over Saurashtra in general was  $-10$  to  $-12$  mb. The highest pressure departure of  $-14$  mb was recorded at Porbandar at 1200 GMT of 8th.

Bhuj reported an easterly 25 kt wind at 0.6 and 0.9 km a.s.l. at 1200 GMT of 7th. Veraval re-

ported a surface wind of 30 to 40 kt from W/SW on 8th. On the same day at 1200 GMT, Jamnagar reported a surface wind of 20/25 kt from ESE.

#### 3.4. Depression of 24-27 October

A low which lay off the Kerala-Mysore coast on 22nd, concentrated into a depression on the morning of 24th near  $15^{\circ}\text{N}$ ,  $70^{\circ}\text{E}$ . Moving slowly northwards, it weakened into a low off Maharashtra coast by 27th evening.

This system caused fairly widespread rain in Mysore and Maharashtra States, during the above period.

#### 4. Land Depressions

##### 4.1. Deep depression of 14-18 August

In the monsoon trough, a cyclonic circulation in the lower troposphere moved from central Uttar Pradesh to southwest - Uttar Pradesh and adjoining east Rajasthan on the 12th and a low developed there on the morning of 13th. The low moved westwards to east Rajasthan and concentrated into a depression on the morning of 14th with its centre near Jaipur. Continuing to move in a westerly direction, it became deep on the morning of 16th with its centre close to Jaisalmer. It was practically stationary near Jaisalmer till 17th morning and subsequently moved eastwards to Jodhpur by the evening of 18th. It weakened into a low over east Rajasthan on 19th and merged with the monsoon trough on 20th.

This system caused fairly widespread rain in Uttar Pradesh, west Madhya Pradesh, Gujarat Region and the plains of northwest India on some

days during the above period, with heavy to very heavy falls in west Madhya Pradesh, Gujarat Region and Rajasthan. The monsoon was active in Uttar Pradesh and west Madhya Pradesh between 12th and 14th, in Haryana on 12th and 13th, in east Rajasthan from 12th to 15th and again on 19th, in west Rajasthan from 15th to 18th and in Punjab on 16th. It was vigorous in Gujarat Region on 16th. Jaisalmer had a record rainfall of 20 cm on 16th, while Barmer reported an exceptionally heavy fall of 23 cm on 18th. Very heavy rain in Rajasthan was reported to have caused serious floods in the southern districts of Rajasthan leading to dislocation of road and rail communications. About 20 persons lost their lives, 20,000 houses were damaged and about 2 lakhs people and some 400 villages were affected by the floods.

The principal amounts of heavy rainfall associated with this system were :

Date	Station	Rainfall (cm)
Aug 12	Allahabad	14
13	Sagar	12
	Shivpuri	11
	Sheepur	11
	Guna	10
	Gwalior	10
14	Tonk	24
	Kanpur IAF	13
15	Erinpura Road	17
	Abu	14
	Jalore	11
16	Jaisalmer	20
	Abu	14
17	Sam (Rajasthan)	54
18	Barmer	23
	Abu	17
	Sam (Rajasthan)	14
	Jaswantpura (Rajasthan)	13
19	Jalore	17
	Abu	15
	Schoganj (Rajasthan)	15
	Erinpura Road	13
	Ahore (Rajasthan)	12

At 0000 GMT on the 14th, Delhi reported an eastsoutheast wind of 35 kt and Bikaner north-northeast 30 kt at 0.6 km a.s.l. At 1200 GMT same day, Jodhpur reported southwesterly winds of 25 kt at 0.3 km and Jaipur a southerly of 25 kt at 0.9 km. The wind at Jodhpur at 0.9 km at 0000 GMT of 16th and 18th were south/25 kt and south/35 kt respectively. Jodhpur also reported a surface wind of south/20 kt at 0300 GMT of 17th and south/25 kt at 0300 GMT of 18th. The highest negative pressure departure from normal near the centre of this system was about 10 mb at Jaisalmer at 1200 GMT of 16th and 10 mb at Jodhpur at 0300 GMT of 18th. Jaisalmer reported the lowest pressure of 986.8 mb at 1200 GMT of 16th.

One of the factors responsible for the intensification of this system into a deep depression was the in-phase super position of troughs in the upper tropospheric westerlies and easterlies over the area of the depression. The subsequent eastward movement of the depression appears to have been due to the influence of the westerly trough. The system weakened after being overtaken by the westerly trough.

#### 4.2. Depression of 2-5 September

Under the influence of a low pressure wave moving westwards across Burma, a well marked low formed over north Bay on 30 August. It moved northwards to Gangetic West Bengal and adjoining Bangla Desh by 1 September. Subsequently, it moved westsouthwestwards to coastal West Bengal and concentrated into a depression with its centre close to and north of Con'ai on the morning of 2nd. Later, moving generally west-northwest, it weakened into a well marked low over north Madhya Pradesh on 6th.

In association with this system, the monsoon was vigorous in Gangetic West Bengal on 1st and 2nd, in Orissa on 3rd, in Bihar Plateau on 1st and 3rd, in Gujarat Region on 5th and 7th and in west Madhya Pradesh on 6th and 7th. It was active in Orissa and Bihar Plateau on 2nd, in Bihar Plains on 3rd, in east Madhya Pradesh from 3rd to 5th and in west Madhya Pradesh and Vidarbha on 5th. Floods were reported from Bankura and Midnapore districts of West Bengal and Mayurbhanj district of Orissa, resulting in damage to crops. Heavy to very heavy rain in west Madhya Pradesh and Gujarat Region was reported to have worsened the flood situation which prevailed in to those areas towards the end of August.

The notable amounts of heavy rainfall associated with this system were :

Date	Station	Rainfall (cm)
Sep 1	Dumka	13
	Sriniketan	12
	Asansol	10
2	Braipada	17
	Bankura	10
3	Sambalpur	27
	Jharsuguda	19
	Surajpur (M.P.)	16
	Binka (Orissa)	13
	Chaibasa	12
	Keonjhar	11
	Rourkela	10
4	Pendra	15
	Champa	11
	Bilaspur (M.P.)	11

Sep 5	Narsinhpur	13
	Sagar	11
	Sarangpur (M.P.)	11
6	Sitamau (M.P.)	18
	Rajgarh	17
	Byawara (M.P.)	17
	Sardarpur (M.P.)	17
	Kachroad (M.P.)	15
	Dewas (M.P.)	15
	Ujjain	14
7	Survar (M.P.)	14
	Indore	13
	Jhandla (M.P.)	22
	Jahabua (M.P.)	20
	Ratlam	18

Sep 7	Dohad	15
	Indore	15
	Dhar (M.P.)	15
	Jobar (M.P.)	13

The highest pressure defect near the centre of the depression was 6 mb. At 0.9 km a.s.l., Bhubaneshwar reported a surface wind of west/35 kt and Calcutta east/15 kt at 0000 GMT of 2nd. At 0000 GMT of 3rd, Calcutta reported south/30 kt, Ranchi east/30 kt, Asansol eastsoutheast/25 kt and Bhubaneshwar west/25 kt at 0.9 km a.s.l.

#### REFERENCE

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