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Cyclones and depressions of 1975 — Bay of Bengal and Arabian Sea

GEORGE ALEXANDER, V. SRINIVASAN and R. JAMBUNATHAN

Meteorological Office, Poona

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1. Introduction

Seven cyclonic storms and eleven depressions formed in the Bay of Bengal and Arabian Sea during 1975. Of the seven cyclonic storms five formed in the Bay of Bengal (two of them of severe intensity) and two in the Arabian Sea (both of them of severe intensity). Of the eleven depressions, eight formed in the Bay of Bengal and three in the Arabian Sea. Two depressions also developed over land. Out of the total of 20 cyclonic disturbances, 1 developed during winter, 3 during the pre-monsoon period (March to May), 9 during the southwest monsoon (June to September) and 7 during the post-monsoon season (October to December). The tracks of these cyclonic storms and depressions are shown in Fig. 1 and their monthly distribution in Table 1(a).

The main features of the 1975 cyclonic disturbances were :

(*i*) No cyclonic storm struck the east coast of India.

(*ii*) A severe cyclonic storm with an inner core of hurricane winds which developed in the Arabian Sea in the last week of October hit Gujarat coast near Porbandar on 22 October and caused considerable damage to property and some loss of human life in Junagadh, Jamnagar and Rajkot districts of Gujarat State. The storm retained its severe intensity for a considerable distance inland (about 400 km) after crossing coast.

(*iii*) Of the Bay cyclones, one hit Arakan coast in May and another hit Bangla Desh coast in June. The other cyclonic storms in the Bay and Arabian Sea weakened over the sea itself.

A brief history of the cyclonic storms and depressions together with important features associated with them is given in the following paragraphs. Maximum wind and lowest mean sea level pressure associated with the cyclonic storms are given in Table 1(b).

A. Bay of Bengal

1. *Deep Depression of 6-10 January*

Under the influence of an upper air cyclonic circulation moving westwards across Malaysia on 5th, a low pressure area developed over south Andaman Sea and adjoining southeast Bay on the morning of 6th. It concentrated into a depression on the same evening with its centre near 7·5°N, 92·5°E. It became deep the next day. Moving north northeastwards, it was centred near 12°N, 94°E (150 km eastnortheast of Port Blair) on 9th morning and crossed deltaic Burma between Rangoon and Bassein on the night of 10th and weakened on 11th.

This system caused generally widespread rain with scattered heavy to very heavy falls in Bay Islands from 5th to 10th. Car Nicobar recorded 13 cm of rain on 7th; Maya Bandar 11 cm, Long Island 10 cm and Port Blair 9 cm on 9th; Long Island 16 cm, Maya Bandar and Coco Island 11 cm each on 10th.

Maya Bandar showed the highest negative pressure departure of 10 mb from the normal within a degree from the centre of the depression at 1200 GMT of 9th. A few important observations from Bay Islands near the depression field are given in Table 2.

A satellite cloud picture of this depression is reproduced in Fig. 2.

2. *Severe cyclonic storm of 4-8 May*

A low lay over Andaman Sea from 1st to 3rd. It concentrated into a depression on the evening of 4th with its centre near 12·5°N, 96°E. Moving northwestwards, it intensified into a cyclonic storm on the evening of 5th when it was centred near

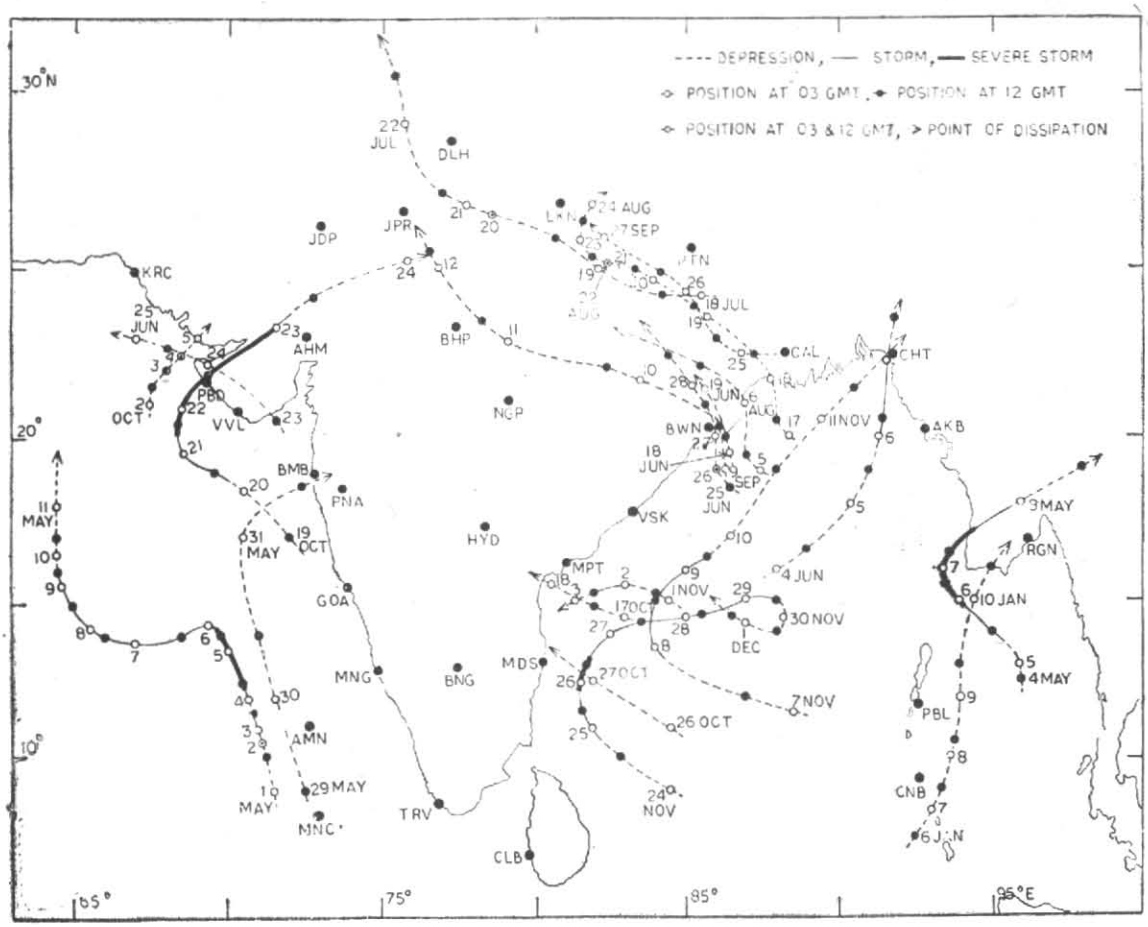

Fig. 1. Tracks of storms/depressions (January—December 1975)

TABLE 1(a)

Monthly distribution of cyclones and depressions in the Bay of Bengal and Arabian Sea, 1975

Jan		Feb-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	D	C
BAY OF BENGAL																					
1	—	—	—	—	1(1)	2	1	—	—	2	—	1	—	2	—	—	3(1)	—	—	8	5(2)
ARABIAN SEA																					
—	—	—	—	1	1(1)	1	—	—	—	—	—	—	—	1	1(1)	—	—	—	—	3	2(
OVER LAND																					
—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	2	—
TOTAL																					
1	—	—	—	1	2(2)	3	1	1	—	2	—	2	—	3	1(1)	—	3(1)	—	—	13	7(4

D=Depression C=Cyclonic Storm Figures in brackets indicate the cyclonic storms which had become severe

14°N, 95°E. Continuing to move northwest it became severe on the morning of 6th with its centre at 0300 GMT near 15°N, 94°E where the satellite picture showed an 'eye'. Then moving slowly northwestwards and later northwards, the storm was centred near 16°N, 93·5°E on 7th when the satellite picture showed a well defined eye. Later it recurved northeastwards and crossed Burma coast between Bassein and Gwalion the night of 7th and weakened into a depression over deltaic Burma by the evening of 8th.

Under the influence of this system generally widespread rain occurred in Bay Islands from 2nd to 8th with isolated heavy falls on 3rd, 4th, 6th and 7th. Long Island reported 11 cm of rain on 4th and 9 cm of 6th and Maya Bandar 11cm on 7th. According to press reports, this cyclone caused some loss of life and damage to sailing vessels in south Arakan coast.

TABLE 1(b)

Cyclonic disturbance	Wind (kt)		Pressure (mb)	
	Max. estimated from satellite pictures	Max. wind reported from nearest observation	Estimated lowest m.s.l. pressure at the centre	Lowest m.s.l. pressure reported from nearest observation
Severe cyclonic storm (6-7 May)	85	—	976·0	—
Cyclonic storm (6-7 June)	—	45 (At Chittagong close to centre)	—	990·2 (at Chittagong)
Cyclonic storm (2 November)	—	32 (Ship ATKU about 150 km from centre)	—	1003·5 (Ship ATKU)
Cyclonic storm (8-9 November)	40	32 (Ship ATFW about 200 km from centre)	998·0	1000·7 (Ship ATML)
Severe cyclonic storm (26 November)	60	55 (at 0·9 km a.s.l. at Madras)	992·0	—
Severe cyclonic storm (4-5 May)	80	34 (Ship VWWS about 100 km from centre)	979·0	998·3 (Ship VWWS)
Severe cyclonic storm (21-23 October)	90	97 (in gusts) at Jamnagar	967·0	972·0 at Porbandar

No ships' reports were available from the storm field. The track of this storm has been finalised mainly with the help of satellite pictures. A few observations from land stations near the storm field are given in Table 3.

The satellite view of this cyclone on 6th and 7th is reproduced in Figs. 3 and 4. The maximum wind speed associated with the cyclone, as estimated from the satellite pictures was about 65 kt on 6th and increased to about 85 kt on 7th. The maximum wind of 85 kt would give the pressure at the centre of the storm as 976 mb.

3. *Chittagong cyclone of 4-8 June*

A low pressure area which lay over the central Bay on 3rd, concentrated into a deep depression on the morning of 4th with its centre near 16°N, 88°E, under the influence of a low pressure wave moving westwards from Burma across north Andaman Sea. This depression moved northeastwards and intensified into a cyclonic storm with a narrow core on the morning of 6th with its centre near 20°N, 91·5°E. It crossed Bangla Desh coast near Chittagong on the forenoon of 7th and weakened into a low over Tripura on that night.

Fairly widespread rain or thundershowers occurred under the influence of this system in Bay Islands from 4th to 6th, in Gangetic West Bengal on 7th and in Assam and adjacent States on 7th and 8th. Maya Bandar and Coco Island recorded 8 cm of rain on 5th; Hut Bay 13 cm on 6th; Cherrapunji 17 cm and Agartala 15 cm on 8th. This

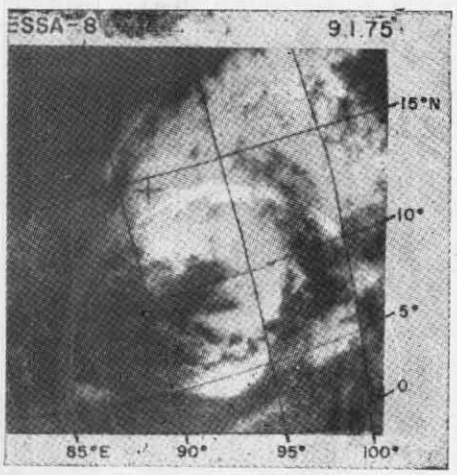

Fig. 2. ESSA-8 view of the deep depression at about 0400 GMT on 9 Jan 1975

system was reported to have caused damage to houses and crops in Bangla Desh. About 50 fishermen were reported missing off Bangla Desh coast. Floods in Tripura due to heavy rain inundated low lying areas and standing crops in that State.

Akyab reported the largest negative pressure departure of 9 mb from normal at 1200 GMT of 6th and Chittagong about 14 mb at 0300 GMT of 7th. Some important observations in the field of this system are given in Table 4. The centre of this storm was estimated from the pictures taken by the cyclone warning radar at Calcutta near 20·7°N, 91.5°E at 0300 GMT of 6th and near 21.4°N, 91.5°E at 1800 GMT of that day The satellite pictures did

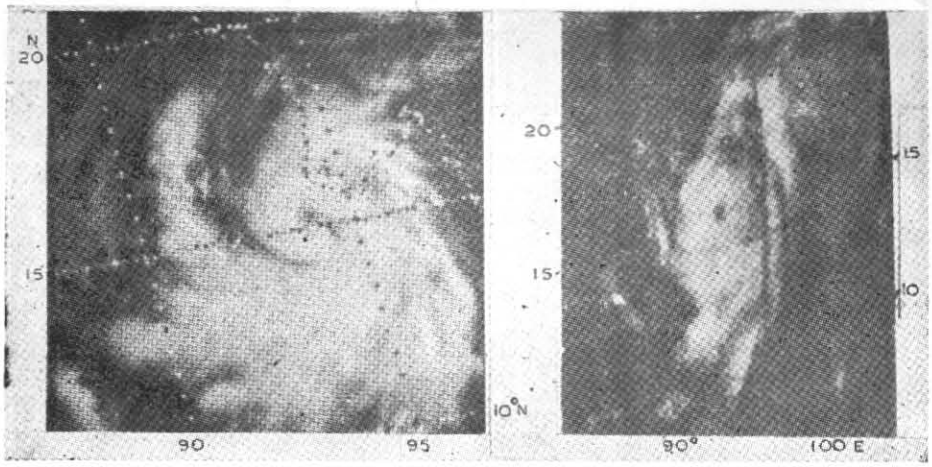

Fig. 3. Satellite view of the severe cyclone on the morning of 6 May 1975 showing the 'eye' of the cyclone

Fig 4. NOAA-3 view of the severe cyclone at about 0300 GMT on 7 May 1975 showing the eye of the cyclone

TABLE 2

Date (1975)	Time (GMT)	Station	Wind Dir. (Deg.)	Wind Speed (kt)	Pressure (mb)
6 Jan	1200	Port Blair	E/ESE (at 0·6 & 0·9 km)	35	
8 Jan	0300	Hut Bay	NE	20	
9 Jan	0000	Port Blair	N (at 0·6 km)	30	
	1200	Maya Bandar	NE	10	1001·7

TABLE 3

Date (1975)	Time (GMT)	Sation	Wind Dir. (Deg.)	Wind Speed (kt)	Pressure (mb)
5 may	0600	Port Blair	W (at 0·6 km)	30	995·2
7 May	1200	Rangoon	SE	25	999·7
8 May	0300	Rangoon	SW	35	1003·2

TABLE 4

Date (1975)	Time (GMT)	Ship/Station	Location Lat. (°N)	Location Long. (°E)	Wind Dir. (Deg.)	Wind Speed (kt)	Pressure (mb)
4 Jun	0600	Port Blair			SW (at 0·6 & 0·9 km)	40·45	
6 Jun	0000	VWDG	18·9	89·6	220	20	995·2
	1200	Akyab			S	20	993.7
7 Jun	0000	Hatia (41,946)			N	45	991.4
	0300	Chittagong (41,940)			SE	40	990.2

TABLE 5

Date (1975)	Time (GMT)	Station	Wind Dir. (Deg.)	Wind Speed (kt)	Pressure (mb)
25 Jun	1200	Bhubaneswar	NE (at 0·9 km)	30	
	1200	Visakhapatnam	W (at 0·6 & 0·9 km)	30	
26 Jun	0000	Gopalpur	NE (at 0·6 km)	30	
	0300	Paradip	ENE	20	994·4
	0600	Calcutta	E (at 0·3 to 0·9 km)	30-35	
	1200	Gopalpur	NNE	15	989·5
27 Jun	0000	Bhubaneswar	NE (at 0·6 & 0·9 km)	30-35	
	0000	Visakhaptanam	W (at 0·6 & 0·9 km)	40 45	
	0000	Bhubaneswar	020	20	990·8

TABLE 6

Date (1975)	Time (GMT)	Station	Wind (Dir. (Deg.)	Wind Speed (kt)
5 Aug	0300	Sandheads	E	20
	1200	Sandheads	SE	20
	1200	Bhubaneswar	NE (at 0·3 to 0·9 km)	25
6 Aug	0000	Bhubeaneswar	NW (at 0·9 km)	25
	0300	Sandheads	S	30
	1200	Puri	SW	20
	1200	Paradip	SW	20
	1200	Calcutta	SE (at 0·9 km)	30

not show this storm clearly as the system occupied a small area and the clouds associated with the storm circulation were masked by the general monsoon cloudiness. Assuming the maximum wind associated with this cyclone as 45 kt (as reported by Chittagong on 7th morning), the central pressure of the storm works out to be 986 mb. The storm was one of small areal extent and when it was over northeast Bay off Arakan-Chittagong coast, the surface and low level winds along Orissa and West Bengal coast were hardly affected.

4. *Depression of 18-19 June*

A well marked low pressure area developed on 16th over northwest and adjoining west central Bay off Orissa coast at the northern limit of the monsoon current, as the monsoon westerlies to the south strengthened. It concentrated into a depression on the morning of 18th with its centre near 19·5°N, 86·5°E. Moving northnorthwest, it crossed Orissa cost near Paradip that night and lay on the morning of 19th with its centre close to Keonjargarh. It weakened into a low the same afternoon over northeast Madhya Pradesh and adjoining parts of Orissa and Bihar.

This system caused the advance of the monsoon into Orissa, Gangetic West Bengal, Bihar State, Madhya Pradesh, east Uttar Pradesh and Vidarbha. Fairly widespread rain occurred in coastal Andhra Pradesh, Marathwada and Vidarbha from 17th to 19th, in Madhya Pradesh, Orissa and West Bengal from 18th to 20th, in Bihar on 19th and in east Uttar Pradesh on 20th. Isolated heavy falls occurred in Vidarbha on 17th, in Orissa on 18th and 19th, in Madhya Pradesh on 19th and in Gangetic West Bengal on 19th and 20th. Akola AP recorded 10 cm of rain on 17th, Berhampore (Orissa) 11cm on 18th, Panposh (Orissa) 11cm, Bilaspur (Madhya Pradesh) 10 cm on 19th.

The largest pressure departure from normal near the centre of the depression was *minus* 7mb on the morning of 18th at Puri. Strong easterly/southeasterly winds speed 30 kt extended from Gangetic West Bengal to plains of Uttar Pradesh on 18th and 19th.

5. *Deep depression of 25-28 June*

A low pressure area formed over northwest and adjoining west central Bay on 24th, from an upper air cyclonic circulation over the west central Bay and neighbourhood which was gradually building downwards during the course of the previous 2 days. Simultaneously the pressure gradient over the Arabian Sea, the Peninsula and the Bay of Bengal also increased and it became 3 mb more than the normal. The low concentrated into a depression on the evening of 25th with its centre near 18·5°N, 86·5°E. It became deep on 26th morning when it was centred near 19°N, 86°E. Moving slowly northwards, it crossed south Orissa coast near Puri on the morning of 27th. Later it moved in a northwesterly direction and weakened gradually into a low by 29th morning over northeast Madhya Pradesh.

In association with this system the monsoon was active to vigorous in coastal Andhra Pradesh on 26th and 27th, in Telangana on 27th and 28th and in Vidarbha from 27th to 29th and active in Orissa on 27th and 28th, in east Madhya Pradesh from 28th to 30th and in west Madhya Pradesh on 29th. The principal amounts of very heavy rainfall (in cm) were : Waltair 16, Kalingapatam 13, Anakapalle, Chintapalli 10 each on 27th; Sironcha 28, Brahmapuri 20, Bhubaneswar 13, Chandrapur 12, Kanker 10 on 28th; Gondia 21, Waraseoni 16, Brahmapuri 15 on 29th. The *Godavari* rose in spate and flooded Bhadrachalam town.

The largest pressure departure from normal near the centre of the depression was about *minus* 9mb on 26th and 27th. Some of the important observations from land stations in the depression field are given in Table 5.

6. *Depression of 5-7 August*

A low which lay over west central and adjoining northwest Bay from 2nd to 4th, concentrated into a depression on the morning of 5th with its centre near 19°N, 87·5°E. Moving in a northerly direction, it crossed north Orissa coast near Chandbali on the forenoon of 6th. Subsequently moving northwestwards, it weakened into a low on the morning of 7th over northeast Madhya Pradesh and neighbourhood and merged with the monsoon trough on 8th.

This system caused generally widespread rainfall in Gangetic West Bengal, Orissa, Vidarbha and Telangana from 5th to 7tn, in coastal Andhra Pradesh on 5th and 7th and in Madhya Pradesh on 6th and 7th. The principal amounts of rainfall (in cm) were : Khammam, Sonepurraj 7 each; Koraput 6 on 5th; Kondapur (Madhya Pradesh) 10, Datia, Indore, Chhatrapur 7 each; Sonepurraj 6 on 6th; Dhamtari (Madhya Pradesh), Akola 9 each, Mandla, Balodabazar (Madhya Pradesh), Bhadrak (Orissa), Jharsuguda 7 each, Contai, Chindwara 6 each on 7th.

Some important observations reported by observatories in the depression field are given in Table 6. The estimated pressure departure from normal at the centre of the depression was about *minus* 9 mb on 5th.

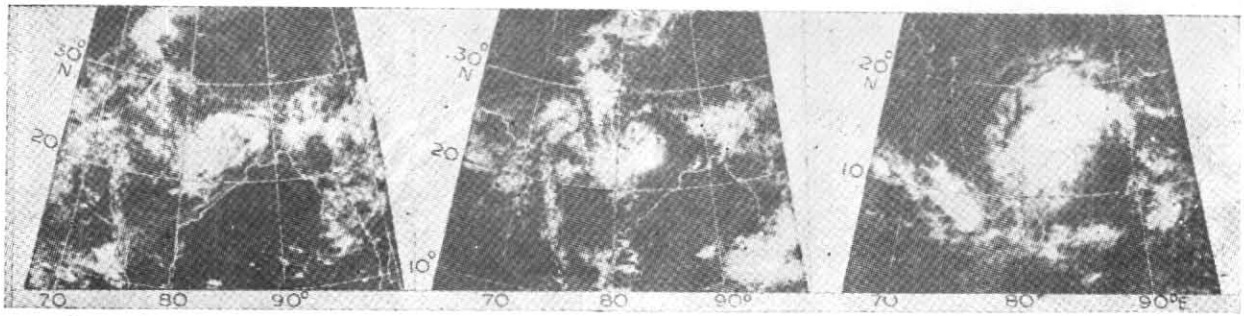

Fig. 5. Deep depression over Bihar on 20 August

Fig. 6. Deep depression over east UP on 22 August

Fig. 7. Cyclonic storm on 8 Nov (Infra-red picture)

Figs. 5-7. NOAA-4 view of the deep depression/cyclonic storm in 1975 at about 0400 GMT

7. *Deep depression of 17-24 August*

The seasonal monsoon trough was well marked extending from northwest Rajasthan to north Bay and a low developed on 16th over north Bay. The satellite picture on that area also showed a heavy mass of cloud. The low concentrated into a depression on the morning of 17th with its centre near 20°N, 88 5°E. Moving in a northerly direction, it became deep on the morning of 18th when it was centred close to Sagar Island. Later it moved northwestwards and reached western Bihar Plateau by 20th morning. During the next three days its movement slowed down considerably and on 23rd morning it lay over southeast Uttar Pradesh. It weakened over northern parts of east Uttar Pradesh by 24th evening.

This system caused fairly widespread rain in coastal Andhra Pradesh on 17th and 18th, in Orissa and Gangetic West Bengal from 17th to 20th, in Bihar and east Madhya Pradesh on many days between 17th and 25th, in east Uttar Pradesh from 21st to 25th and in west Madhya Pradesh and the plains of west Uttar Pradesh from 22nd to 24th with isolated or scattered heavy/very heavy falls in east Madhya Pradesh from 18th to 23rd and in Orissa, Gangetic West Bengal, Bihar State, east Uttar Pradesh and west Madhya Pradesh on a few days. The slow movement and the long life of the depression contributed to the very heavy rains leading to floods. The principal amounts of heavy rainfall (in cm) were : Palsora (Orissa) 12 on 17th; Kendrapara (Orissa) 13, Chandbali 12, Paradip 11, Cuttack, Keonjargarh 10 each on 18th Deogarh (Orissa) 40, Baripada 27, Bhadrak (Orissa) 24, Balasore 22, Swampatna (Orissa) 15, Beohari (Madhya Pradesh) 12, Bharatpur (Madhya Pradesh) 11 on 19th; Bharatpur (Madhya Pradesh) 29, Jharsuguda 26, Beohari (Madhya Pradesh) 25, Katgora (Madhya Pradesh) 18, Deosar (Madhya Pradesh), Ghargoda (Madhya Pradesh) 15 each, Jamshedpur AP 13, Raigarh 12 on 20th; Kothi (Madhya Pradesh) 26, Baikunthpur (Madhya Pradesh) 21, Umaria 16, Bandhogarh (Madhya Pradesh) 15 on 21st; Bandhogarh (Madhya Pradesh) 31, Umaria 26, Beohari (Madhya Pradesh) 25, Surajpur, Kothi (Madhya Pradesh) 23 each, Baikunthpur (Madhya Pradesh) 21, Pawai (Madhya Pradesh) 15 on 22nd; Pawai (Madhya Pradesh) 13, Varanasi, Jaunpur, Umaria 10 each on 23rd; Utraula (Uttar Pradesh) 18, Nautanwa 17, Gonda 15, Basti, Nanpara (Uttar Pradesh) 13 each, Bahraich 11 on 24th; Gorakhpur 18, Bareilly, Mawana 10 each on 25th.

It has been reported tnat the very heavy rain in Madhya Pradesh caused floods in many parts of that State dislocating road and rail communications. The flood waters of the *Ganga* and the *Sone* inundated vast areas in and around Patna city and all communications with Patna were cut off. About 3 lakhs people were trapped in 1 to 3 metres depth of water. Barauni industrial complex in Bihar was also flooded. Many rivers in Orissa also rose in spate and caused floods in the northern districts of the State. The floods affected an area of 9 lakhs hectares and a population of 10 lakhs in 5000 villages. Floods in the *Subarnarekha* affected some parts of Midnapore district.

Some of the important observations from observatories near the depression field are given in Table 7. The pressure departure from normal near the centre of the depression was about *minus* 8 mb on 18th. Satellite views of this depression on 20th and 22nd morning are given in Figs. 5 & 6.

8. *Depression of 9-12 September*

A low pressure area moving westnorthwestwards across Deltaic Burma, reached west central and adjoining northwest Bay off south coastal Orissa on 8th. It concentrated into a depression on the morning of 9th with centre about 100 km southeast of Puri. The depression crossed Orissa coast between Paradip and Puri that evening and was

centred at 1200 GMT between Paradip and Bhubaneswar. Moving westnorthwestwards across Madhya Pradesh upto 11th and later in a northwesterly direction to east Rajasthan, it weakened into a low over east Rajasthan by the morning of 13th.

This system caused generally widespread rain in Telangana and coastal Andhra Pradesh from 8th to 10th, in Gangetic West Bengal, Orissa and Vidarbha from 8th to 11th, in Madhya Pradesh from 8th to 12th, in east Rajasthan and Gujarat region on 12th and 13th, with isolated heavy or very heavy falls over these areas, particularly over Madhya Pradesh and Gujarat on some days. The principal amounts of heavy rainfall (cm) were : Berhampur (Orissa) 12, Pottangi (Orissa) 11, Gopalpur, Chatrapur 10 each on 8th; Hyderabad AP 15, Gopalpur 14, Nalgonda, Sangareddy, Bhaisdehi (Madhya Pradesh) 13 each on 9th; Sehore (Madhya Pradesh) 11, Hanamkonda, Husanabad (Telangana), Novipet (Telangana) 10 each on 10th; Sehore (Madhya Pradesh) 28, Ashta (Madhya Pradesh) 16, Mohindpur (Madhya Pradesh) 15, Sohagpur (Madhya Pradesh) 13, Gondia 11 on 11th Kahnnod 28, Tarana (Madhya Pradesh) 25, Dewas (Madhya Pradesh) 19, Shajapur, Patan (Gujarat), Lunavada (Gujarat) 16 each, Bhopal 14, Indore, Banswara 12 each, Dungarpur 11 on 12th; Gandhinagar 31, Ahmadabad 20, Patan 16, Idar 11, Chittorgarh, Banswara 9 each on 13th.

The pressure departure near the centre of the depression was *minus* 8 to 9 mb on 9th and 10th. The easterlies about 300 to 400 km to the north of the depression centre were about 30 kt strong from 9th to 11th at 0·6 and 0·9 km. Paradip reported E/25 kt wind at 0300 GMT and S/25 kt at 1200 GMT on 9th.

According to press reports, Bhopal and Indore divisions and some districts of north Gujarat were affected by floods leading to disruption of road and rail communications and some damage to crops and houses in those areas.

9. *Depression of 17-18 October*

As a low pressure area moved westwards across the Andaman Sea, the seasonal low over west central Bay, became well marked on 15th and a depression formed on the morning of 17th with its centre near 14·5°N, 83·0°E. Moving westnorthwest, it crossed Andhra coast near Ongole on the afternoon of 18th and weakened into a low over interior Andhra Pradesh the same evening.

This system caused generally widespread rain in Andhra Pradesh and south Orissa from 17th to 19th with isolated heavy falls in Andhra Pradesh on 18th and 19th. The principal amounts of heavy rainfall (in cm) were : Kakinada, Cuddapah, Kosigi and Adoni 7 each on 18th; Kosigi 10, Yammiganur 8, Nellore, Tiruvur, Kowthalam 7 each on 19th. It is reported that the heavy rains adversely affected crops ready for harvest in Rayalaseema.

The pressure departure from normal reported near the centre of the depression was *minus* 7 mb on 18th morning.

10. *Depression of 26-27 October*

The westerlies in the extreme south Bay and in the near equatorial region strengthened from 23 October and showers and rain were reported by a number of ships. The satellite pictures also showed increasing convective activity in this area which was spreading north wards. Following this, the seasonal low over southwest and adjoining west central Bay became more marked by 25th and a depression formed on the evening of 26th with its centre near 11°N, 84·5°E. It moved in a northwesterly direction and weakened into a low off north Tamil Nadu, south Andhra coasts by 27th evening. The low subsequently moved across the south Peninsula into east Arabian Sea.

This system caused generally widespread train in Tamil Nadu from 26th to 28th and in Andhra Pradesh on 27th and 28th with some very heavy falls in Tamil Nadu on 27th and in coastal Andhra Pradesh on 27th and 28th. The principal amounts of heavy rainfall (in cm) were : Madras Airport 21, Nellore 20, Pakala (Prakasam district) 19, Sriperumbudur 17, Maduranthakam 16, Kanchipuram 15, Madras city 14, Venkatagiri (Andhra Pradesh 12, Udayagiri (Andhra Pradesh) 11 on 27th; Kalingapatam 14, Tirupathi, Pakala (Prakasam district) 13 each, Sriperumbudur (Tamil Nadu) 11 on 28th. The rainfall in Madras on 27th was exceptionally heavy and it paralysed the city life by flooding low lying areas.

The pressure departure from normal was about *minus* 6 mb near the centre of the depression. Ship *ATDO* near 10°N, 82°E reported NW/14kt and ship *GYMT* near 12°N, 85°E reported ENE/18 kt at 0600 GMT of 26th and E/20 kt at 1200 GMT of 26th near 13·5°N, 85·5°E. Ship *GHRN* reported SE/14 kt near 12·5N, 84·5°E at 0000 GMT on 27th and SE/20 kt at 0300 GMT of 27th near 135·°N, 84·5°E.

11. *Cyclonic storm of 1-3 November*

A low pressure area from the east moving westwards across the Andaman Sea reached the central parts of the Bay of Bengal on 30 October and became well marked on 31st with central region near 13.5°N, 87°E. It concentrated into depression on the morning of 1 November with its centre near 15°N, 84·5°E. Moving westwards, it intensified

TABLE 7

Date (1975)	Time (GMT)	Station	Wind Dir. (Deg.)	Wind Speed (kt)	Pressure (mb)
18 Aug	0300	Sagar Island	S	40	993·7
	0300	Sandheads	SW	35	997·3
	1200	Sagar Island	SW	35	995·6
	1200	Calcutta	S	30 (at 0·9 km)	
	1200	Bhubaneswar	W	35 (at 0·9 km)	
19 Aug	0000	Panagarh	SE	25	
20 Aug	0000	Gorakhpur	E	35-45 (at 0·6 & 0·9 km)	
	0000	Jabalpur	W	40-45 (at 0·6 & 0·9 km)	
21 Aug	0000	Allahabad	NNE	40 (at 0·6 & 0·9 km)	
	0000	Gorakhpur	E	35-45 (at 0·6 & 0·9 km)	
	1200	Gaya	SE	25-30 (at 0·3 & 0·6 km)	
22 Aug	0000	Allahabad	NE	40 (at 0·9 km)	
	0000	Gaya	SE/S	25 (at 0·3 & 0·6 km)	
	1200	Gorakhpur	SE	40-45 (at 0·6 & 0·9km)	

into a cyclonic storm on the morning of 2nd when it was centred near 15·5°N, 83°E. Continuing to move westwards, it weakened into a deep depression on 3rd morning and into a low off south Andhra coast by the same evening. Subsequently the low moved westwards into east Arabian Sea across the Peninsula.

This system caused fairly widespread rainfall in coastal Andhra Pradesh and north coastal Tamil Nadu from 1st to 3rd and in Rayalaseema from 2nd to 4th. The principal amounts of heavy rainfall (in cm) were : Nellore 7 on 1st, Pidigur (Nellore district) 10, Gudur (Nellore district) 9, Adavipalam (Guntur district) 8, Suvepalli (Nellore district), Edurumandri (Krishna district) 7 each on 2nd; Venkatagiri (Nellore district) 12, Tiruvallur (Chingleput district) 8, Gudur (Nellore district) 7 on 3rd.

Some important observations from ships and land stations near the storm field are given in Table 8. The highest pressure departure from normal reported by the observatories in south coastal Andhra Pradesh was *minus* 4 to 5 mb on 2nd and *minus* 5 to 6 mb on 3rd morning. Assuming the maximum wind speed associated with this system as 40 kt, the estimated pressure at the centre of this storm is about 1000 mb.

The disturbance was classified as a cyclonic storm on the basis of the low level winds over Madras on 2nd (06 and 12 GMT). The satellite pictures did not show features of a tropical storm.

12. *Cyclonic storm of 7-11 November*

A low pressure area from the east which moved into south Andaman Sea on 3rd, persisted in that neighbourhood for the next two days. It moved into southeast Bay on 6th when it became well marked as could be judged from the satellite pictures and concentrated into a depression on the morning of 7th with its centre near 11·5°N, 88·5°E. Moving northwest and intensifying, it lay as a cyclonic storm on the morning of 8th with its centre near about 13·5°N, 84·0°E. Then moving in a northerly direction and later recurving northeastwards, it weakened into a deep depression by the morning of 10th when its centre could be fixed near 17°N, 86·5°E with the help of two ships' reports. Continuing to move northeastwards and accelerating it crossed Bangla Desh coast on 11th night near Chittagong. Thereafter it weakened into a low and moved away across Assam and adjacent States by 13th.

In association with this system, Bay Islands had fairly widespread rain from 3rd to 8th with isolated heavy falls on 5th. Scattered to fairly widespread rain also occurred in Tamil Nadu on 7th and 8th, in coastal Andhra Pradesh on 9th, in Orissa and Gangetic West Bengal from 9th to 11th and in Nagaland, Manipur, Mizoram and Tripura on 11th and 12th with isolated heavy falls in Tamil Nadu on 7th, in Orissa on 10th and in Gangetic West Bengal on 10th and 11th. Some important reports from ships and land stations are given in Table 9.

From the satellite pictures, the maximum wind speed associated with this storm could be estimated as only about 40 kt. This would give the pressure at the centre of the storm as 998 mb and its departure from normal as about minus 12 mb. The satellite view of this storm on the morning of 8th is reproduced in Fig. 7.

13. *Severe cyclonic storm of 24 November-1 December*

A low which was located over southeast Bay on 23rd morning, moved to southwest Bay and concentrated into a depression, probably deep on the morning of 24th with its centre near 9°N, 84·5°E. The satellite pictures showed considerable organisation by the same evening. The system intensified into a cyclonic storm on the morning of 25th with its centre near 11°N, 82°E. Moving northnorthwest, it became severe by the morning of 26th with its centre near 12·5°N, 81·5°E as indicated by the radar picture taken from the cyclone warning radar

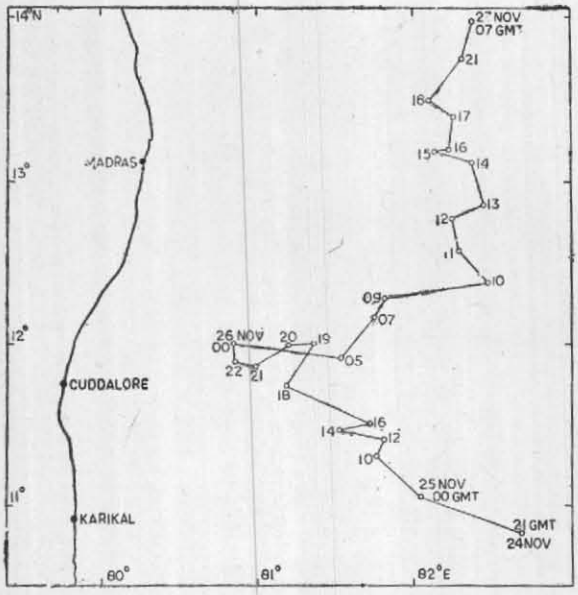

Fig. 8. Radar track of cyclonic storm, 25-27 Nov 1975

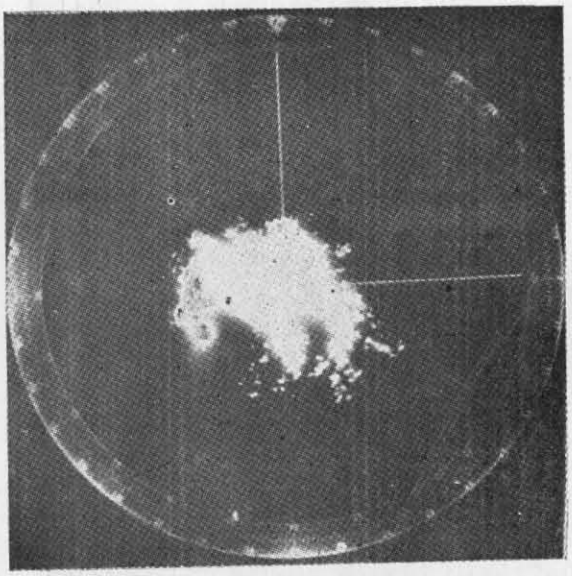

Fig. 9. Picture of the severe cyclonic storm at 0211 IST of 26 Nov 1975 (2041 GMT of 25th) taken by Cyclone Warning Radar at Madras

at Madras. The winds over Madras reached 55 kt at 0·9 km at this time. Then it recurved northeastwards, and weakened into a cyclonic storm on the morning of 27th when it was centred near 14°N, 82·5°E. Later it moved in an easterly direction upto 29th evening. Subsequently, it weakened into a depression and made a loop in its track before weakening further into a low pressure area on 2 December over the central Bay. Due to paucity of ships' observations, the disturbance had to be tracked mainly on the basis of satellite pictures after 29th. The satellite picture on 1 December suggested a temporary reintensification of the system.

In association with this system there was fairly widespread rain in Bay Islands on 24th, in Tamil Nadu from 24th to 27th and in adjoining south coastal Andhra Pradesh from 25th to 27th with some heavy to very heavy falls in coastal Tamil Nadu and adjoining coastal Andhra Pradesh. The principal amounts of rainfall (in cm) were: Mayuram (Thanjavur district) 14, Pondicherry 13 on 24th; Sriperumbudur (Chingleput district) 13, Sulurpet 11 on 25th; Nellore 21, Red Hills 16, Sulurpet 14, Madras, Chembarampakkam, Pondicherry 12 each, Cuddalore, Maduranthakam, Cholavaram 11 each on 26th; Madras, Sriperumbudur 14 each, Maduranthakam, Tiruvallur, Poondi 12 each, Sulurpet 10 on 27th. Continuous heavy rain in Madras city and neighbouring areas for 3 to 4 days paralysed the city life. According to press reports, low lying areas in the city were flooded rendering many thousands of slum dwellers homeless and damaging about a thousand huts. A few deaths were also reported in and around the city due to house collapses. The Chembarambakkam tank near Madras, one of the biggest tanks in the State, was reported to be full for the first time in seven years. The Maduranthakam tank, the biggest in Chingleput district, started overflowing and rivers *Vegavathi* and *Palar* near Kanchipuram were in floods. The Red Hills, Poondi and Cholavaram lakes, the main sources of supplying of protected water to the city, started overflowing during this period.

Some important reports from ships and land stations on the east coast near the storm field are given in Table 10. This storm was tracked by the cyclone warning radar at Madras from 2000 GMT of 24th to 0700 GMT of 27th. The radar track of this storm is shown in Fig. 8. The radar picture of this storm at 0211 IST of 26th (2041 GMT of 25th) is reproduced in Fig. 9. From the satellite pictures, the maximum wind speed associated with this storm could be estimated as 60 kt. This maximum wind gives the pressure at the centre of the storm as 992 mb. The estimated pressure departure from normal at the centre of the storm is about *minus* 19 mb. Satellite pictures of this system as a severe cyclone on 26 November and as a depression on 1 December are reproduced in Figs. 10 and 11.

B. Arabian Sea

1. *Severe cyclonic storm of 1-11 May*

From 24 April, the satellite pictures showed heavy clouding in the extreme southeast Arabian Sea which gradually extended northwards reaching the extreme south Peninsula by 28th. Heavy thundershower activity occurred over Sri Lanka, south Peninsula and Lakshadweep for the next two days

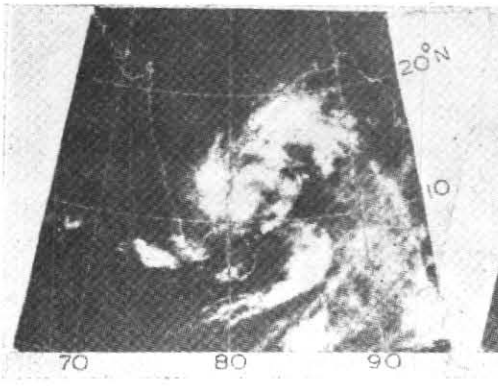

Fig. 10. NOAA-4 view of the severe cyclone at about 0400 GMT on 26 Nov 1975

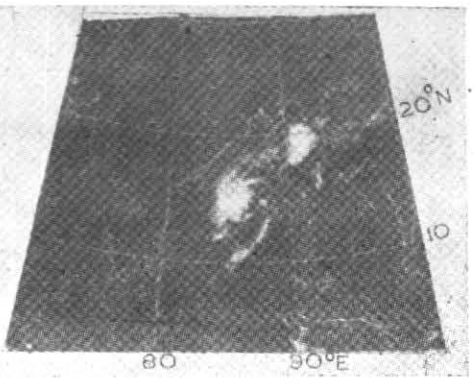

Fig. 11. NOAA-4 view of the depression in the Bay at about 0300 GMT of 1 Dec 1975

TABLE 8

Date (1975)	Time (GMT)	Ship/Station	Location		Wind		Pressure
			Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	(mb)
1 Nov	0300	DEDL	14·7	86·1	160	13	1007·3
	1200	ATKU	16·1	82·9	360	22	1004·6
	1400	ATKU	16·6	83·1	010	26	1005·0
2 Nov	0000	ATKU	16·5	82·5	040	32	1003·5
	0600	VWXW	13·1	82·7	280	25	1008·1
	0600	Visakhapatnam			NE (at 0·6 & 0·9 km)	40-45	
	0600	Madras			WNW (at 0·9 km)	40	
	1200	ATKU	17·3	82·9	050	27	1005·2
	1200	Madras			W (at 0·6 & 0·9 km)	35	
	1200	Gannavaram			NE (at 0·9 km)	30	
	1200	Visakhapatnam			NE (at 0·9 km)	35	
3 Nov	0000	Madras			W (at 0·9 km)	35	
	0000	Gannavaram			ENE (at 0·9 km)	30	
	0000	Visakhapatnam			ENE (at 0·9 km)	30	

and a well marked low pressure area formed at the leading edge of the advancing cloud mass over Lakshadweep area on 30 April. The well marked low concentrated into a deep depression on the morning of 1 May with its centre near 9°N, 71·5°E. Moving northnorthwest it intensified into a cyclonic storm on the morning of 2nd when it was centred near 10·5°N, 71°E. and becames severe by 4th evening. Continuing to move northnorthwest it retained its severe intensity upto 5th evening. Satellite pictures showed the eye on 5th morning and evening. It weakened into a cyclonic storm on the morning of 6th when it was centred near 14·5°N, 69·5°E. Then it took a westerly course up to 8th morning and subsequently a northerly course and weakened into a depression by 10th morning with its centre near 16·5°N, 64·5°E. Weakening further it lay as a low over central and adjoining north Arabian Sea by 11th evening. Satellite pictures suggested an increase in the intensity of the system on 9th.

This system caused generally widespread rain in Lakshadweep from 1st to 5th with scattered or isolated heavy to very heavy falls from 2nd to 4th. Rain or thundershowers were fairly widespread in Kerala and scattered in Karnataka from 1st to 3rd. Androth recorded 7 cm of rain on 2nd; Agathi 16 cm, Andr th 15 cm, Amini 14 cm on 3rd; Androth 10 cm, Amini and Agathi 7 cm each on 4th.

Due to lack of ships' observations, the centre and intensity of the system were estimated mainly

TABLE 9

Date (1975)	Time (GMT)	Ship/Station	Location		Wind		Pressure
			Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	(mb)
7 Nov	0000	ATKU	15·1	85·7	040	22	1008·0
	0000	ATBG	11·9	87·9	010	07	1003·6
	0600	ATBG	11·8	88·7	210	07	1005·6
	1200	ATKU	14·5	87·1	070	24	1004·2
8 Nov	0000	ATKU	13·1	88·6	S	20	1005·4
	0300	ATFW	15·3	82·5	010	30	1003·7
	0300	ATKU	13·0	88·8	SSE	20	1006·8
	0900	ATML	16·2	83·4	050	31	1000·7
	1000	KEHL	13·5	81·1	340	25	1004·6
	1200	ATFW	16·7	83·8	050	32	1002·8
	1200	DEDL	15·0	87·3	140	18	1004·9
	1200	KEHL	13·0	81·2	320	18	1005·1
	1200	ATJR	14·2	81·6	340	25	1005·8
	1200	Visakhapatnam			ENE/NE (at 0·3 to 0·9 km)	35-45	
	1500	DEDL	14·3	86·8	140	27	1004·9
9 Nov	0000	Visakhapatnam			NNE/NE (at 0·3 to 0·9 km)	30-40	
	0000	DEDL	12·0	85·5	220	19	1005·5
	0600	GHKM	18·3	85·5	090	15	1004·8
	0600	ATGD	12·2	83·6	290	20	1005·3
	0600	VWDG	16·8	91·0	180	25	1008·0
	1200	GHKM	17·3	84·6	020	20	1004·6
	1200	ATJR	14·1	83·5	340	14	
10 Nov	0000	ATGD	15·8	86·8	190	05	1003·0
	0300	ATGD	16·5	87·6	190	25	1004·7
	0300	ATJR	17·0	85·5	360	25	
	1200	ATJR	19·2	87·0	360	25	
	1200	ATGD	18·5	89·3	180	23	1003·4
11 Nov	0000	ATGD	21·0	91·6	160	24	1007·4
	0100	ATJR	21·0	88·2	360	13	
	0300	ATGD	21·7	91·7	160	24	1009·4
	1200	Chittagong			SE/SSE (at 0·6 & 0·9 km)	20	
	1800	Chittagong			SSE (at 0·6 & 0·9 km)	25-30	

from satellite pictures particularly after 3rd. The strong winds were confined to a small area around the centre, and on 5th (when the satellite picture showed an 'eye'), a ship 150 km to the northwest of the centre reported only 30 kt. The satellite pictures of this cyclone are given in Figs. 12 and 13. Some important observations from ships and Lakshadweep near the storm field are given in Table 11.

Aircraft SQ 772A, estimated the centre of the cyclone as 13°N, 70°E at 0400 GMT on 5th. Aircraft SQ 732 A, reported the storm centre as 14°N, 65°E on the morning of 8th. Another aircraft flying from Gan to Bahrein reported the storm centre as 13.7°N, 64·2°E at 1140 GMT on 8th.

The maximum wind speed associated with this cyclone has been estimated as 80 kt from the satellite pictures. For this wind speed, the lowest pressure estimated at the centre of the storm is 979 mb.

2. *Deep depression of 29-31 May*

A well marked low developed over Maldive area on 28th evening. Moving northnorthwest, it concentrated into a depression on the evening of 29th with its centre near 9°N, 72·5°E. It became deep the next morning and continuing to move northnorthwest upto 31st morning and recurving northeast later, it crossed Maharashtra coast near Alibag on 31st late evening and weakened inland.

The depression served to usher in the southwest monsoon into Kerala on 31st. Generally widespread rainfall occurred in Lakshadweep on 29th and 30th, in Kerala on 30th, in coastal Karnataka and south Konkan on 31st and in Maharashtra State on 1 June with some heavy falls in Konkan on 1st. Santacruz recorded 11 cm of rain, Alibag 10 cm and Harnai 9 cm on 1 June. Some important observations from ships and observatories are given in Table 12.

TABLE 10

Date 1(975)	Time (GMT)	Ship/Station	Location		Wind		Pressure
			Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	(mb)
24 Nov	0200	APEU	11·0	84·5	E	30	1009·0
	0300	ATKT	10·8	83·7	050	17	1008·7
	0600	UUCX	11·8	84·6	ESE	30	1012·2
	1200	UUCX	12·1	83·5	080	28	1009·9
	1200	Karaikal			NE/ENE (at 0·3 & 0·6 km)	25-30	
25 Nov	0000	ATKT	10·2	82·6	190	35	1005·0
	0000	UJCK	12·8	81·3	070	30	1008·7
	0000	Madras			NNE (at 0·6 & 0·9 km)	35-40	
	0000	Karaikal			NNW (at 0·3 km)	30	
	0600	Madras			NNE (at 0·9 km)	45	
	0600	Karaikal			N (at 0·9 km)	35	
	0900	SHIP	13·5	80·9	050	35	1005·2
	1200	Madras			NE/NNE (at 0·3 to 0·9 km)	30-40	
	1200	Karaikal			NNW/NW (at 0·3 to 0·9 km)	35-45	
26 Nov	0000	Madras			NNE (at 0·6 & 0·9 km)	45-55	
	0300	ATDW	14·0	81·3	060	24	1007·4
	0600	Madras			NNE (at 0·9 km)	50	
	0600	Karaikal			NW (at 0·9 km)	45	
	1200	ATME	13·7	81·1	040	28	1004·5
	1200	Madras			NNW (at 0·3 & 0·6 km)	25	
					NNE (at 0·9 km)	30	
	1200	Visakhapatnam			NE (at 0·9 km)	35-40	
	1200	Gannavaram			NE (at 0·9 km)	35-40	
27 Nov	0300	VWWM	11·8	83·3	230	27	1006·5
	0600	Madras			NW (at 0·9 km)	35	
	0900	VWCC	12·0	82·5	240	24	1005·0
	1200	VWWM	12·6	81·8	W	30	1003·3
	1200	ATAE	12·2	81·9	270	28	1003·1
	1200	Madras			NW (at 0·6 & 0·9 km)	35-40	
28 Nov	0000	ATAF	15·5	85·2	NE	15	
	0300	ATBG	12·4	85·2	220	20	1003·0
	0300	ATEI	17·3	83·6	020	30	1006·5
	0900	ATAF	15·1	86·5	120	15	1000·0
	0900	ATBG	12·5	84·6	240	37	1000·0
	1500	ATBG	12·9	83·7	280	30	1003·0
29 Nov	1030	ATNG	16·7	87·0	NE	30	1004·5
	1200	ATNG	15·4	84·9	NW	24	1005·1
1 Dec	0600	SPTD	12·8	84·5	NW	25	1009·9

According to press reports, road and rail communications were disrupted in coastal Maharashtra due to heavy rain and landslides. Coastal steamer services along Konkan coast were also dislocated.

3. *Depression of 23-25 June*

In the well marked trough that lay off Maharashtra and south Gujarat coasts on 22nd and 23rd, a depression formed at 12 GMT of 23rd with

TABLE 11

Date (1975)	Time (GMT)	Ship/ Station	Location		Wind		Pressure
			Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	(mb)
1 May	0000	Minicoy			SW (at 0·6 & 0·9 km)	35	
	1200	Amini			SE (at 0·6 & 0·9 km)	25	
	1800	Amini			E (at 0·3 km)	40	
					ESE (at 0·6 & 0·9 km)	35	
	1800	Minicoy			W (at 0·6 km)	30	
2 May	0000	Minicoy			WSW (at 0·3 to 0·9 km)	30	
	1200	Minicoy			WSW (at 0·6 km)	30	
					WSW (at 0·9 km)	40	
3 May	0600	Minicoy			SW (at 0·3, 0·6 & 0·9 km)	30, 35 & 50	
	0600	ATJX	9·6	71·3	220	24	1004·0
	1200	ATJX	9·6	70·0	280	28	1003·7
4 May	0000	Amini			S (at 0·6 & 0·9 km)	35	
	1200	Amini			S (at 0·3 km)	30	
5 May	0000	Amini			S (at 0·3 km)	30	
					SSW (at 0·6 & 0·9 km)	35	
	0600	VWWS	16·1	70·1	050	18	1004·8
	1200	VWWS	15·2	69·2	030	30	998·3
	1800	VWWS	14·3	68·5	020	34	1003·0
6 May	0600	UYBW	15·2	70·6	090	16	
8 May	0000	Strathdevon	16·8	66·3	090	15	1005·9
	0600	GUDA	16·5	67·5	SE	25	1007·0
	1200	LFAL	13·4	63·4	290	16	
9 May	0000	LFAL	15·3	67·0	SSE	15	1008·0

its centre near 20·5°N, 71·5°E. Moving in a northwesterly direction across Saurashtra, it weakened into a low over north Arabian Sea by 25th evening. The development of the system was preceded by the movement of a low pressure system between 850 and 500 mb (best seen at 700 mb level) moving westwards across Madhya Pradesh to Gujarat.

This system caused generally widespread rain with isolated heavy falls in Konkan from 23rd to 25th and in Saurashtra & Kutch on 23rd and 24th. Ratnagiri reported 11cm of rain on 23rd, Veraval 9 cm and Jamnagar 8 cm on 24th. The largest pressure departure from normal near the centre of the depression was *minus* 7 to *minus* 8 mb on 23rd evening and on 24th morning. Surat reported S/25 to 35 kt wind at 0·3 to 0·9 km a.s.l. at 1200 GMT of 23rd and 24th and Jamnagar SW/ 30 to 40 kt at 0·6 and 0·9 km a.s.l. at 0000 GMT of 25th. Veraval reported northwesterly 20 kt at 1200 GMT of 23rd at 0·3 and 0·6 km a.s.l.

4. *Depression of 2-5 October*

A low which lay off Maharashtra coast on 30 September moved to off Saurashtra coast on 1 October and concentrated into a depression on the morning of 2nd with its centre near 21°N, 67·5°E. The depression moved northeastwards and weakened into a low over Kutch and neighbourhood by 5th evening.

In association with this system, there was fairly widespread rainfall in Gujarat State and Konkan on 1st and 2nd and scattered or isolated rainfall from 3rd to 5th. Rainfall was fairly widespread

TABLE 12

Date (1975)	Time (GMT)	Ship/ Station	Location		Wind		Pressure (mb)
			Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt)	
29 May	1200	Amini			ESE (at 0·9 km)	20	
30 May	0000	Amini			S (at 0·6 & 0·9 km)	30	
	0000	Mangalore			S/SSE (at 0·6 & 0·9 km)	30-35	
	0300	Amini			SW	25	1006·7
	0600	LJDS	13·7	73·3	140	30	1008·0
	0600	JEHT	14·5	71·9	090	15	1007·5
	0600	Mangalore			SSE (at 0·6 & 0·9 km)	30 & 35	
	1200	Goa			S (at 0·3 & 0·6 km)	30	
31 May	0000	Goa			SSW (at 0·3 km)	25	
					SSW (at 0·6 & 0·9 km)	30	
	0600	Tasman Sea Horse	19·2	71·5	130	25-30	
	1200	Santacruz			SE (at 0·3 km)	35	
					SE (at 0·6 & 0·9 km)	25	
	1200	Alibag			ESE	20	

TABLE 13

Date (1975)	Time (GMT)	Ship/ Station	Location		Wind		Pressure (mb)
			Lat. (°N)	Long. (°E)	Dir. (Deg.)	Speed (kt.)	
20 Oct	0600	Sagar Samrat	19·5	71·3	140	32-35	1004·0
	0600	VWBY	19·9	69·1	360	20	1005·3
	0900	ATFW	18·3	70·3	350	15	1000·9
	1200	Sagar Samrat	19·5	71·3	155	25-30	1002·0
	1200	VWBY	19·8	69·9	080	34	1001·8
	1100	Lokapalaka	20·4	69·6	060	25	996·0
	1200	Veraval			E (at 0·6 & 0·9 km)	30	
	1200	Bombay			S (at 0·9 km)	30	
	1400	VWZT	20·1	71·1	130	6-8 BF (35)	
	2100	Veraval			SE	30	1003·2
21 Oct	0000	Sagar Samrat	19·5	71·3	160	22-25	1004·5
	0130	Haakon Magnus	19·4	71·4	SW	25-30	1005·0
22 Oct	0300	Veraval			SSE	40	1002·8
	0600	WGNF	21·1	69·4	090	45	990·0
	0800	Veraval			S	44	1002·5
	1200	Okha			NE	54	999·9
	1700	Rajkot			SE	48	—
23 Oct	0000	Ahmadabad			S (at 0·9 km)	50	
	0000	Bhuj			NNE (at 0·9 km)	45	

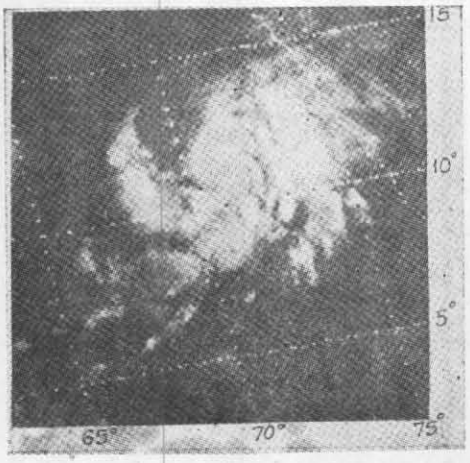

Fig. 12. Satellite view of the cyclone in Arabian Sea on the morning of 3 May 1974

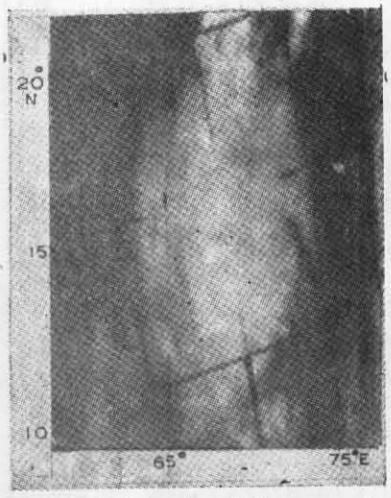

Fig. 13. NOAA-3 view of the severe Arabian Sea cyclone at about 0400 GMT on 5 May 1975 showing a faint eye

in Saurashtra & Kutch on 6th. Isolated heavy falls occurred in Saurashtra on 1st and 2nd. Porbandar recorded 10 cm of rain, Jamnagar 9 cm, Rajkot 8 cm on 1st and Jamnagar 7 cm on 2nd.

Veraval reported surface wind S/20 kt at 0300 GMT of 2nd. The upper winds over Saurashtra & Kutch at 0·6 and 0·9 km a.s.l. were generally S/SE about 20 kt from 2nd to 5th. The pressure departure from normal was about *minus* 8 mb. near the centre of the depression on 3rd and 4th.

5. *Severe cyclonic storm of 19-24 October*

A low which lay over east central Arabian Sea off south Maharashtra and adjoining Karnataka coast on 18th, concentrated into a depression on 19th evening with its centre near 17°N,72°E, under the influence of another low (the remnant of the depression which crossed the south Andhra coast on 18th) which moved westwards across the north Peninsula and emerged into east central Arabian Sea. The depression moved northwestwards and intensified into a cyclonic storm by 20th midday and into a severe cyclonic storm with a core of hurricane winds by 21st evening when it was centred near 20·5°N, 68·5°E as judged from the satellite pictures which showed the formation of an eye for the first time. Satellite pictures also showed a further intensification between 21st evening and 22nd morning. Then recurving northeastwards, it crossed Saurashtra coast near Porbandar (about 15 km to the north) on the afternoon of 22nd. The storm maintained its severe intensity inland upto Jamnagar–Rajkot area. Slightly weakening thereafter, it lay with its centre near Radhanpur on 23rd morning when it was still a severe cyclonic storm as indicated by the upper winds of Bhuj and Ahmadabad in the lower levels. Continuing to move northeast and weakening rapidly it lay as a low over NW Madhya Pradesh and adjoining NE Rajstean and SW Uttar Pradesh by 24th evening.

This system caused generally widespread rain in coastal Karnataka from 18tn to 20th; in Konkan, Goa and Madhya Maharashtra on 19th and 20th; in Saurashtra & Kutch on 22nd and 23rd; in east Rajasthan on 24th and in Haryana on 25th with isolated heavy or very heavy falls in Konkan, Goa and Madhya Maharashtra on 19th; in Saurashtra & Kutch on 22nd and 23rd and in east Rajasthan on 24th. The principal amounts of rainfall (in cm) were : Sangli 11, Ratnagiri, Goa (Panjim) 10 each on 19th; Rupar (Kutch) 14, Amrari (Jamnagar district) 13, Porbandar 10 on 22nd; Jamnagar 25, New Kandla 15 on 23rd. According to press reports and the report of the touring officer this cyclone caused considerable damage to buildings, crops and other property (estimated to be about Rs. 75 crores) in the districts of Junagadh, Jamnagar and Rajkot, the damage being mainly due to strong winds. The loss of human lives has been reported to be about 85. Several thousands of houses were damaged. This cyclone which had an inner core of hurricane winds, uprooted many trees and electric and telephone poles and blew off roof tops in these areas. A train was also blown off its rails near Jam-Kambhalia. Photographs showing damage are given in Figs. 14-16.

Jamnagar recorded the highest wind speed of the order of 160 to 180 kmph on 22nd. The highest wind speed reported by Porbandar was 110 kmph on that day. The hourly values of pressure and wind recorded at Porbandar and Jamnagar on 22nd are depicted in Figs. 17 and 18. The DPT Anemograph record of Jamnagar is reproduced in Fig. 19. Swells of 4 to 6 metres were reported at Porbandar and Okha along Saurashtra coast in association with this cyclone. Some important observations reported by ships and observatories in the storm field are given in Table 13.

Fig. 14. Iron poles bent due to strong E/NE winds in Jamnagar

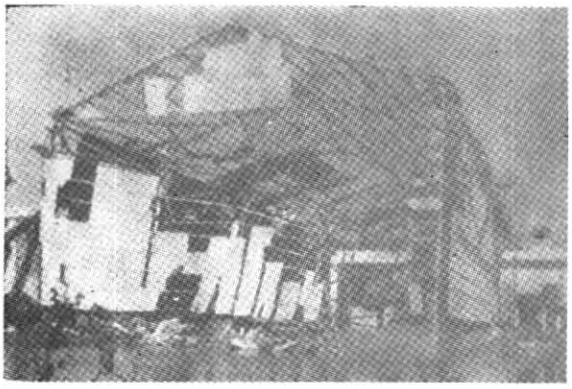

Fig. 15. Roof of a factory building blown off in Porbandar

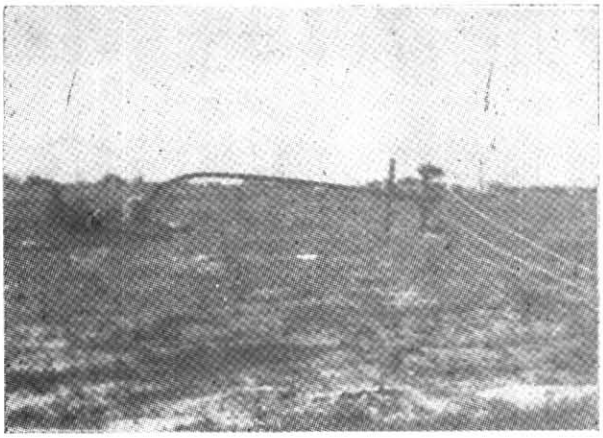

Fig. 16. Electric pole bent towards north in Porbandar by strong southerly winds

The highest pressure departure from normal near the storm centre was *minus* 36 mb at 1000 GMT of 22nd at Porbandar when the storm was closest to the station. The pressure departure from normal was *minus* 17mb at Porbandar at 12GMT of 22nd, *minus* 30 mb at Jamnagar at 1500 GMT of 22nd and *minus* 15 mb at Radhanpur at 0300 GMT of 23rd.

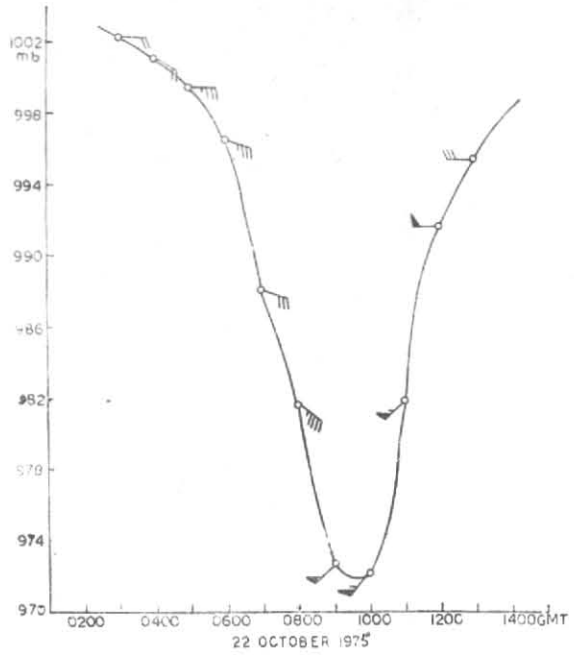

Fig. 17. Observations of wind (kt) and pressure (mb) at Porbandar

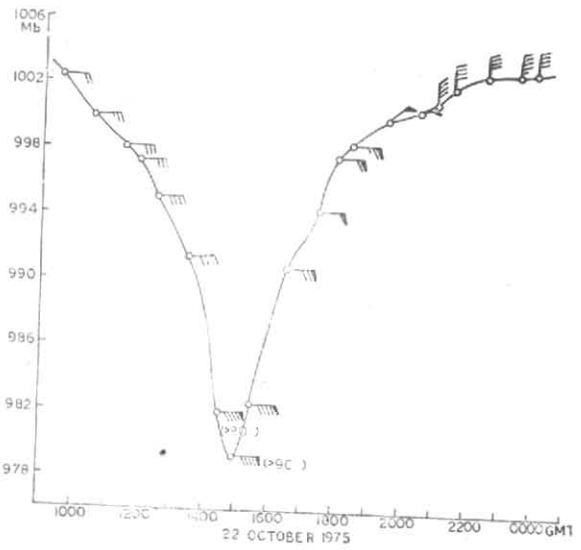

Fig. 18. Observations of wind (kt) and pressure (mb) at Jamnagar AP

The satellite pictures of this storm showing the eye of the storm on the evening of 21st and morning of 22nd are reproduced in Figs. 20 and 21. From the satellite pictures, the maximum wind speed associated with this cyclone could be estimated as about 90 kt. Jamnagar experienced wind speed more than 90 kt in gusts at about 1500 GMT

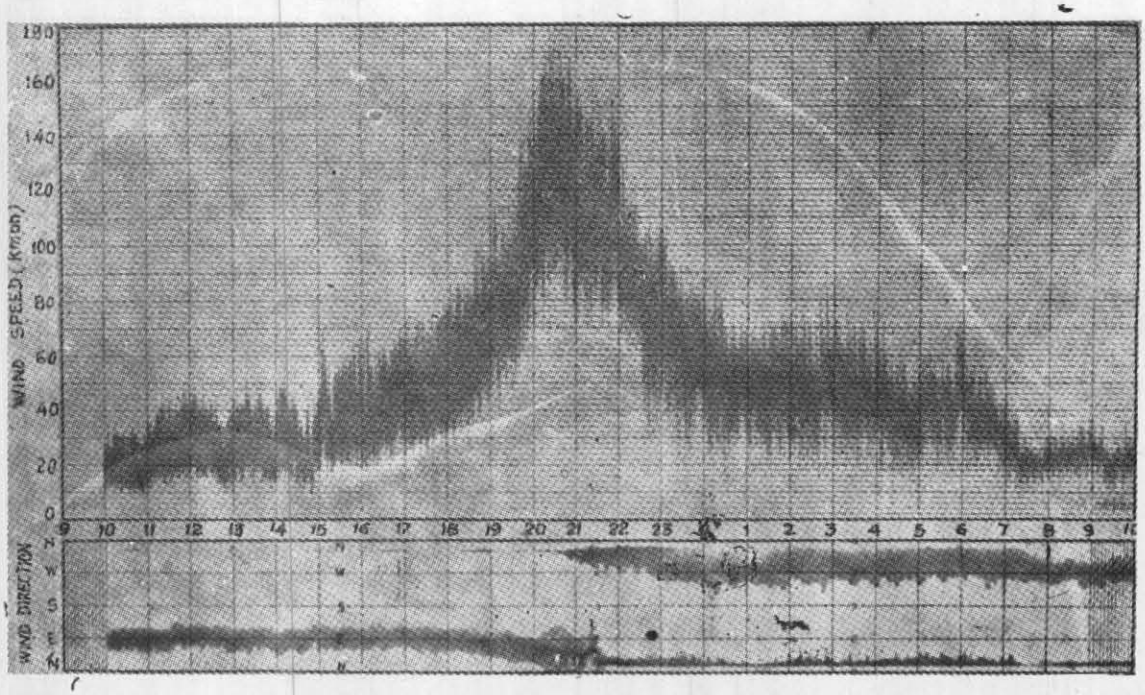

Fig. 19. D. P. T. Anemograph record of Jamnagar IAF station showing wind speed reaching 180 kmph in gusts between 2000 and 2100 IST on 22 October 1975 in association with Porbandar cyclone

of 22nd. Assuming the maximum speed as 100 kt), the central pressure of the cyclone works out to be 967 mb. Porbandar reported the lowest pressure of 972 mb close to the storm centre at 1000 GMT of 22nd. The central pressure of 967 mb would give the pressure departure from normal as about *minus* 43 mb at the storm centre. Based on the average speed of the storm on the 22nd and the rate of fall of pressure at Porbandar and Jamnagar, the pressure gradient at the inner core of the cyclone works out to be about 1 mb per 2·5 km.

From the satellite picture, the diameter of the eye of storm could be estimated to be about 50 km. An aircraft flying at 29000 feet reported the diameter of the eye as 30 miles on 22nd. Aircraft SQ 722A, reported the storm centre as 21°N,68°E, at 0405 GMT on 22nd. Some aircrafts reported extensive *Cb* clouds with moderate to severe turbulence from 150 to 300 miles to the west of Bombay, the cloud tops reaching more than 40,000 feet on the early morning of 21st.

C. Land Depressions

1. *Deep depression of 18-22 July*

A low pressure area developed over Bihar Plateau and adjoining Gangetic West Bengal in the seasonal trough on 15 July and persisted *in situ* for the next 2 days and pressure continued falling over the area. It concentrated rapidly into a deep depression on the morning of 18th with its centre about 50 km northeast of Hazaribagh. Moving west-northwest up to east Rajasthan by 21st and later in a northerly direction, it weakened into a depression on the evening of 22nd over Punjab and into a low over northern parts of Punjab and neighbourhood by the morning of 23rd. The rapid change in the track of the depression northwards after 21st appears to have been under the influence of a westerly trough moving across the extreme north of the country.

This system caused generally widespread rain in northeast India and Madhya Pradesh between 17th and 20th, in northwest India between 20th and 24th and in Uttar Pradesh between 18th and 23rd with some heavy or very heavy falls in Uttar Pradesh and Madhya Pradesh on 3 or 4 days and in Gangetic West Bengal, Bihar State, east Rajasthan, Punjab and Haryana on one or two days. Some of the principal amounts of heavy rainfall (in cm) were : Panna 12, Ranchi 10 on 18th; Shahjahanpur 23, Sidhi 17, Rewa, Ambikapur 12 each, Guna, Ballia 10 each on 19th; Satna 13, Khajuraho 12, Nagaur, Jhunjhunu 10 each on 20th; Shivpuri 10 on 21st; Meerut 19, Khurja, Sardhana 10 each on 22nd; Gurdaspur 20, Mawana, Jullundar 17 each, Sardhana 16, Raya 14, Dasuya 13, Phillaur, 12, Tarantaran 11, Roorkee, Ambala 10 each on 23rd.

According to press reports, floods affected Morena district in Madhya Pradesh. In Orissa rivers *Brahmani* and *Subarnarekha* were in floods. Serious floods affected Amritsar, Gurdaspur, Sangrur and Jullundar districts in Punjab causing damage to crops and other property, Heavy rain and flood dislocated road and rail communications and

Fig. 20. NOAA-4 view of Porbandar cyclone at 1550 GMT on 21 Oct 1975 showing a clear eye

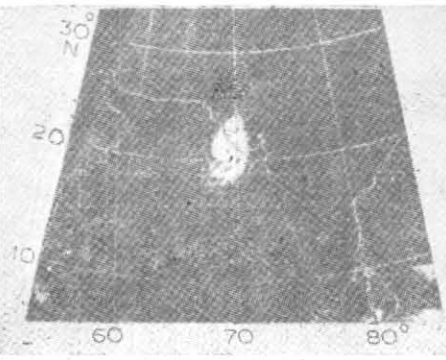

Fig. 21. NOAA-4 iew of Porbandar cyclone at about 0400 GMT on 22 Oct '75 showing a clear circular eye

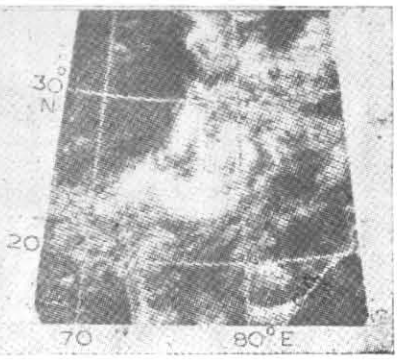

Fig. 22. NOAA-4 view of deep depressio over NW M.P. and adjoining SW U.P. on the morning of 20 July showing bandings in all sectors

NOTE —(i) Figs. 3 and 12 have been reproduced from NOAA Mariners Weather Log, September 1975, Vol. 19, No. 5.

(ii) Figs. 5, 6, 7, 10, 11, 21 and 22 have been reproduced from NOAA Environmental Satellite Imagery (KMRD No. 5·4)

TABLE 14

Date (1975)	Time (GMT)	Station	Wind Dir.	Wind Speed (kt)	Pressure mb)
18 Jul	1200	Bhagalpur	SE (at 0·9 km)	55	
	1200	Calcutta	SSW (at 0·9 km)	45	
	1200	Gorakhpur	E (at 0·9 km)	45	
19 Jul	0000	Varanasi	E	25	992·2
	0300	Varanasi	ESE	28	994·6
	0000	Gorakhpur	ESE (at 0·9 km)	35	
	0300	Varanasi	110	28	994·6
	0300	Allahabad	N	15	992·9
	1200	Lucknow	NE (at 0·3 km)	30	
			NE (at 0·6 km)	40	
			NE (at 0·9 km)	50	
20 Jul	0000	Lucknow	SE (at 0·6& 0·9km)	40-50	
21 Jul	0000	Gwalior	S (at 0·9 km)	35	
	1200	Gwalior	SSW (at 0·9 km)	35	
	1200	Delhi	E (at 0·6 & 0·9km)	25	
	1200	Bareilly	E (at 0·6 & 0·9km)	35-45	
22 Jul	0000	Delhi	S (at 0·6 & 0·9km)	40	

caused many house collapses in some parts of Rajasthan. The easterlies about 300 to 400 km from the centre of the depression were 40 to 50 kt at 0·9 km a.s.l. on 18th and 19th. The maximum negative pressure departure from normal near the centre of the depression was about 6 mb. Some important observations in the depression field are given in Table 14. A satellite cloud picture of this deep depression on 20 July 1975 is given in Fig. 22.

2. *Deep depression 25-27 September*

The remnant of the typhoon Alice could be traced moving westwards across Thailand and Burma and it reached east central Bay and adjoining northeast Bay on 23rd morning as a low pressure area. Travelling northwestwards along Arakan-Chittagong coast, the low lay over Head Bay on 24th morning and moved further northwards into Gangetic West Bengal where it concentrated into a deep depression by 0000 GMT of 25th with its centre about 50 km west of Calcutta. Moving westwards, it weakened into a depression the same evening with its centre near Jamshedpur. Then it moved northwestwards to east Uttar Pradesh by the morning of 27th and weakened subsequently.

This system caused generally widespread rain in Gangetic West Bengal, Orissa and Bihar State from 25th to 28th aid in east Uttar Pradesh and east Madhya Pradesh on 27th and 28th with neavy to very heavy falls in Gangetic West Bengal and Orissa on 25th and 26th and in Bihar on 27th and 28th. The principal amounts of rainfall (cm) were: Kendrapara (Orissa) 7, Sandheads, Uluberia 6 each on 25th; Purulia 17, Midnapore 13, Sandheads 12, Burdwan, Sambalpur 10 each, Bankura, Contai 8 each of 26th; Dholi (Bihar) 31, Minapur (Bihar) 30, Patna, Chapra 18 each, Muzaffarpur, Supaul 17 each, Motihari 15, Darbhanga 12, Dhanbad 11, Pendra 7 on 27th; Patna 16 on 28th.

According to press reports very heavy rain in Patna inundated low lying areas and paralysed the city life. Floods also affected some of the northern districts of Bihar.

Calcutta reported upper wind S/30-40 kt between 0·3 and 0·9 km a.s.l. and Gaya and Bhagalpur E/25 kt at 0·9 km a.s.l. at 0000 GMT of 25th. Gaya reported surface wind NE/20 kt at 0300 GMT of 26th. The pressure departure from normal was *minus* 6 to 7 mb near the centre of the depression on 25th and 26th.