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T O R M S A N D D E P R E S S I O N S

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INDIA WEATHER REVIEW, 1960

ANNUAL SUMMARY

PART-C

STORMS & DEPRESSIONS

I. DEPRESSIONS AND CYCLONIC STORMS

During the year three cyclonic storms and eight depressions formed in the Bay of Bengal and two cyclonic storms and two depressions in the Arabian Sea. The dates of activities of the storms and the greatest barometric depths observed near their centres are given in the following table:

Table I

| Locality | Month | Date | Greatest observed Barometric depth |
|---------------|----------|-----------------|------------------------------------|
| Arabian Sea | May | 12th - 19th | 37 mb (estimated) |
| | November | 17th - 22nd | 20 mb (estimated) |
| Bay of Bengal | October | 8th - 11th | 22 mb (estimated) |
| | October | 28th - 1st Nov. | 24 mb (estimated) |
| | November | 18th - 20th | 17 mb (estimated) |

The detailed description of the storms and depressions are followed by a list of western disturbances of the year, more important local storms during the year and the locations in which wind force of 9 B.F. or more unconnected with cyclonic storms were experienced by ships in the Indian seas.

1 Severe cyclonic storm in the Arabian Sea— —12th to 19th May—

On the morning of 11th May, a well marked low pressure area lay in the southeast and adjoining east central Arabian Sea. By the evening of 12th, it had concentrated into a depression which was centred within one degree of 12°N, 67°E. On 13th, ships observations in the area were scanty but the depression appeared to have moved northwestwards and was centred in the evening within one degree of 13°N and 66°E.

Moving in a westnorthwesterly direction, the depression became deep on the morning of 14th with centre within one degree of 14°N and 64.0°E. S.S. Kampala at 1130 hrs IST of 14th near 14.8°N and 63°E reported surface wind north-northwesterly 30 knots. By 1430 hrs IST of the same day, S.S. Kampala near 14°N and 62.6°E reported westerly surface wind of 30 knots and rough seas and the

deep depression could be located at about this time within one degree of 14.5°N and 63.5°E . The depression was now moving the west and on the morning of 15th with only a lone ship in the area, the deep depression could be located within one degree of 14.5°N and 62.5°E . On the evening of 15th the position was practically the same as in the morning. On the morning of 16th, it was centred near 14.5°N and 61.5°E . On this day ships reported westsouthwesterly surface winds of 30/33 knots in the southern sector of the deep depression. S.S.Cairnforth at 1730 hrs IST reported rough seas, squall and waves of height 14 feet or more.

By the evening of the 16th, the deep depression intensified into a cyclonic storm centred within half-a-degree of 14.5°N and 61°E . At 1730 hrs IST of this day S.S.Mohammedi which was about 150 kms to the westnorthwest of the storm reported surface wind northerly 37 knots with squall and rough seas. By the night of 16th, the cyclonic storm became severe when it was centred at 2330 hrs IST within half-a-degree of 14.5°N and 60.5°E . At this time S.S.Mohammedi which was about one degree to the northwest of the severe cyclonic storm reported surface wind eastnortheasterly/50 knots and rough seas. The severe cyclonic storm moved westwards and on the morning of 17th was centred within half-a-degree of 14.5°N and 60°E . I.N.S.Trishul at 0730 hrs IST of 17th near 15.4°N and 58.9°E reported northeasterly surface wind of 35 knots. S.S.Mohammedi, at 1130 hrs IST of 17th, reported southerly surface wind of 35 knots near 14.7°N and 60.8°E . The latter ship had passed practically through the centre of the storm as shown by the veering of its surface winds from northerly to eastnortheasterly on 16th and to southerly on 17th. The following information was obtained directly through interview with the master of S.S.Mohammedi, captain H.J.Palmer.

"The ship passed practically through the centre of the storm. The lowest pressure recorded being 973.7 mbs at 0250 hours ship's time on 17th May. The ship did not pass through a 'calm centre' - presumably there was none. Maximum wind force was 9 B.F. on the night of 16th and early morning of 17th and the height of the waves was 30 feet or more and the sea was rough to very rough. There was comparatively very little rain and no heavy rain. The visibility was reduced to practically nil due to flying spray."

On 17th, ships in the southern sector continued to report westsouthwesterly surface winds between 30-40 knots. Ship Cairnforth at 0530 hrs IST on 17th reported southwesterly surface wind of 40 knots with squall. The same ship at 1130 hrs IST of the same day reported southwesterly surface wind of 35 knots rough seas and height of waves 14 ft or more. Ship Orange at 1130 hrs IST of 17th reported westsouthwesterly surface wind of 30 knots and waves of height 14 feet or more. S.S.Leicestershire, between 1800 to 2330 hrs IST, reported wind velocity between 8 to 9 B.F. from westsouthwesterly direction. The pressure defect corresponding to the lowest central pressure of 974 mb reported by S.S.Mohammedi would be 37 mb.

The severe cyclonic storm moved in a westerly direction and was centred on the evening of 17th within half-a-degree of 14.5°N and 58.5°E . At 1830 hrs IST ship Indian Tradition near 15.4°N and 57.1°E reported surface wind northeasterly 51 knots (050/51 knots).

The severe storm later moved in a westnorthwesterly direction and was centred on the morning of 18th within one degree of 15°N and 56°E . On this day S.S.Saudi near 15.8°N and 54.0°E reported northnortheasterly surface wind of 37 knots at 0730 hrs IST. At 0930 hrs IST of the same day S.S.Saudi near 15.8°N and 54.2°E reported northerly surface wind of 60 knots and pressure 982.2. mbs. This was the maximum surface wind reported by any ship in the storm field. The following information was obtained directly through interview with the Third Officer of S.S.Saudi.

"The ship's course which was originally northnortheasterly was changed after midnight of 17th to southeasterly to avoid running into the storm. At 0200 GMT of 18th, the ship was kept in hove. The barometer was falling and the lowest pressure of 978.7 mbs was recorded at 0500 GMT of 18th and the surface wind force reached 12 B.F. There was moderate rain throughout, the sea was very rough with very heavy swell and spray. The vessel experienced heavy rolling. The transmitter failed during the early hours of 18th."

The following is an extract from the log maintained on the bridge of S.S.Exchequer on 18th when it was near 15.5°N and 53.20°E at 0500 GMT.

At 0500 GMT: "Sky overcast, visibility good. Rough and eastnortheasterly sea and moderate northeasterly swells. Running at reduced speed to avoid pounding and taking heavy spray over foredeck. Passing moderate rain squalls. Rough eastnortheasterly sea and short high eastnortheasterly swell. Vessel rolling and pitching moderate to deeply at times. Visibility good to fair. At 0530: "Master on bridge. Wind force 9-12, northerly/northeasterly sea. Southeast swells 30-40 feet increasing. Various courses and speeds to east." At 0900 GMT: "Hurricane wind shifts to eastsoutheast. Easterly sea and swells 50 feet high. Visibility poor, vessel labouring."

At 1300 GMT: "Various speeds and courses. Vessel hove to in hurricane. Running at reduced speed to avoid taking heavy seas over bow and weather deck. Vessel pitching heavily and rolling moderately in very rough southeasterly sea and high heavy southeasterly swells."

At 1700 GMT: "Overcast, very rough southeasterly sea and heavy southeasterly swells moderating at end of watch. Vessel pitching and rolling, moderately to heavy at times, visibility good."

At 2100 GMT: "Fine and clear. Moderate southeasterly sea and swells. Vessel rolling moderately, visibility good."

Towards the evening of 18th from scanty ships' observations it would appear that the severe cyclonic storm was rapidly weakening into a depression. S.S.Saudi near 16°N and 54.9°E at 1730 hrs IST reported southerly wind of 5 knots. The position of the ship was very near to its morning position. The following is an extract from the interview with the 3rd officer of S.S.Saudi.

"At 0500 GMT the wind shifted from a northerly direction to southeasterly and the barometer started rising so rapidly that the mercury could be seen shooting up. By the evening of 18th, the wind force decreased." According to the ship's log it resumed its journey at about 1230 hrs. Ship's time on 18th.

The depression continued to move westnorthwestwards and on the morning of 19th lay off Hadrumaut coast. By the evening of 19th it had further weakened into a low pressure area without any appreciable movement.

In association with the formation and movement of the above pressure system, the southwest monsoon advanced into Comorin-Maldives area and Kerala between 14th and 16th. The following were the important amounts of rainfall recorded on the morning of the concerned dates:

| | | |
|----------|-------|---------|
| Alleppey | 5 cm | on 14th |
| Colombo | 14 cm | on 15th |
| Minicoy | 5 cm | on 16th |

On the morning of 17th, the monsoon became vigorous over Kerala. When Cochin recorded 19 cm and Alleppey 15 cm of rainfall; widespread thundershowers had also been recorded along Kanara-south Konkan coast, the important amounts of rainfall being Hanovar 13 cm, Karwar 5 cm and Vengurla 4 cm.

2 Deep depression in the Bay of Bengal—
—27th to 29th May—

On the morning of 25th May, an upper air cyclonic circulation developed over north Bay and adjoining central Bay between 1.5 km and 3.0 km a.s.l. By 26th morning a well marked low pressure area also formed over north Bay and associated upper air cyclonic circulation extending upto 4.5 km a.s.l. During past 24 hours pressure fell there by 3 to 4 mbs and the negative pressure departure was of the order of 4 to 6 mb. By the next morning the well marked low pressure area concentrated into a depression over the north Bay centred at 0830 hrs IST of 27th near 20°N and 88.5°E. The depression moved in a northerly direction and became deep by 2130 hrs IST when it was centred near 21°N and 88.5°E.

The deep depression crossed Sundarbans coast during the late night of 27th/28th. The following observations are relevant in this connection:

| Date | Time of Obsn. IST | Name of ship/ Station | Position | | Wind | | Pressure (mb) | Weather |
|------|-------------------|-----------------------|------------------------------|---------|------|-------------|---------------|----------|
| | | | Lat. °N | Long °E | Dir. | Speed Knots | | |
| 27.5 | 2330 | Saugor Island | - | - | 030° | 25 | 991.7 | Rain |
| 28.5 | 0530 | Saugor Island | - | - | 300° | 30 | 991.7 | Overcast |
| 28.5 | 0530 | Sandheads | Stationed near Saugor Island | | 300° | 40 | 991.3 | Drizzle |
| 28.5 | 0530 | S.S.State of Orissa | 27 | 89.5 | 250° | 25 | 991.5 | Cloudy |

After crossing the Sunderbans coast the deep depression lay over Gangetic West Bengal centred at 0830 hrs IST of 28th about 20 km to the north of Calcutta. It moved northnortheastwards and lay at 1730 hrs IST of 28th May about 40 km to the north of Krishnagar. Moving in a northnortheasterly direction, the deep depression was centred at 0830 hrs IST of 29th near Bogra. Later it weakened, moved northeastwards and broke up over the Assam hills on 30th May. The lowest central pressure and the corresponding departure from the normal during the entire life of the storm was estimated to be 988.0 mbs and -12 mbs respectively at 2330 hrs IST of 27th May.

Under the influence of the storm, the Bay branch of the southwest monsoon temporarily advanced into Gangetic West Bengal on the 28th and into Assam on the 29th. Fairly widespread rain with some heavy to very heavy falls occurred in coastal West Bengal on the 28th and in Assam on 29th and 30th. Contai reported 30 cm on 28th and Cherrapunji 31 cm on the 30th and 23 cm on 31st. Other noteworthy amounts were: Tura 7 cm, Saugor Island and Sandheads 9 cm each, Murhigunj (Saharsa, Bihar) 14 cm on 28th, Cooch Behar 10 cm, Agartala 8 cm, Manihari (Purnea) 11 cm, Kadwa (Purnea) 12 cm, Sahibgunj 13 cm, Gidpur (Monghyr) 10 cm on the 29th, Dhubri 9 cm, Gauhati 8 cm on 30th.

The following statement gives the district averages and noteworthy amounts of rainfall in the eastern districts of Bihar, associated with the cyclonic storm.

| State and district | District averages on | | | Particularly heavy falls |
|--------------------|----------------------|------|------|---|
| | 28th | 29th | 30th | |
| BIHAR | | | | |
| Monghyr | 3 cm | | | Gidhaur 10 cm on 28th |
| Bhagalpur | | | | Colgong 10 cm on 28th |
| Purnear | 4 cm | 5 cm | | Kadwa 12 cm on 28th, Motihari 11 cm on 28th, Kathiar (North) 13 cm, Khoskibag 11 cm, Barsee 10 cm on 29th. |
| Santal Parganas | | 5 cm | | On 29th - Amrapara 16, Barharwa 15, Barie 15, Mahespur 13. Rajmahal 11, Hiranpur 11, Talhajari 10. On 30th Barie 10 cm. |

Rainfall figures for state raingauge stations of Assam and West Bengal are not available.

3 Depression in the Bay of Bengal— —30th June to 4th July—

At 0830 hours IST of 29th June, the seasonal trough of low pressure on the sea level chart extended into the northwest Bay of Bengal with associated upper air cyclonic circulation extending upto 3 km a.s.l. During the next 24 hours, there was a fall of pressure by 2 to 5 mbs over the north Bay and a depression formed there with centre at 0830 hours IST of 30th near 20°N and 88.5°E. It moved westwards and was centred at 0830 hrs IST of 1st July near 20°N and 87°E. By the morning of 2nd, the depression became deep and was centred at 0830 hrs IST of 2nd close to Orissa coast near 20°N and 86.5°E. Negative pressure departure of 8 to 12 mb was noticed over Orissa coast.

In the course of the day, the deep depression crossed Orissa coast, moved northwest and was centred at 1730 hours IST of 2nd near Angul. Moving in a northwesterly direction, the deep depression weakened and lay over northeast Madhya Pradesh as a depression centred at 0830 hours IST of 3rd near Pendra. Continuing to move in the same direction, the depression weakened further and by the morning of 4th, it merged with the seasonal trough of low pressure.

In association with the deep depression, fairly widespread rain fall in Orissa, Gangetic West Bengal and Madhya Pradesh on three days and in Bihar for two days. Some noteworthy amounts of rainfall recorded are: Saugor Island 26 cm on 4th, Cuttack 8 cm on 30th June, Vishakhapatnam 30 cm, Puri 15 cm and Cuttack 7 cm on the 1st July, Gopalpur 8 cm on 2nd, Sagar 10 cm and Nagpur 9 cm on 3rd, Bhopal 7 cm, Guna 8 cm and Nimach 10 cm on 4th.

Rainfall figures for State raingauge stations of Madhya Pradesh and Orissa are not available.

4 Depression in the Arabian Sea— —2nd to 5th July—

A trough of low developed over Gujarat State on 26th June, and gradually intensified in the subsequent few days. It intensified into a shallow land depression by 1730 hours IST of 2nd July, with centre about 80 km north of Veraval. By this time, Dwarka reported northnorthwesterly surface wind of 25 knots and Veraval reported westsouthwesterly surface wind of 25 knots. Very heavy falls of rain of 22 cm and 18 cm were recorded at this time by Porbandar and Veraval respectively.

By 0530 hours IST of 3rd July, Veraval surface wind backed and strengthened to southwesterly 35 knots. The depression moved in a westerly direction and was centred at 0830 hours IST close to Kathiawar coast between Veraval and Porbandar. The depression moved westwards and was centred at 1730 hours IST near 21°N and 69°E. It remained practically stationary at this position on the morning of next day. By the evening of 4th July, however, lowest pressure of 990.8 mb and southsoutheasterly wind of 10 knots were reported by Dwarka. The depression thus appeared to move northwestwards and was centred at 1730 hours IST of this day near 22°N and 68°E. Porbandar reported southsouthwesterly wind of 20 knots, while Veraval continued to report southwesterly wind of 30 knots. Later at 0530 hours IST of 5th, Veraval wind strengthened to southwesterly 40 knots as a result of the northwards advance of the strong monsoon current over northeast and east central Arabian Sea as the depression moved northwestwards. It is noteworthy that at 1130 hours IST of 4th July, S.S.Egidia near 21.5°N in northeast Arabian Sea reported westerly 40 knots and S.S.Nadir near 19°N in east central Arabian Sea reported southwesterly 40 knots.

By the morning of 5th July, the depression moved further northwestwards and weakened into a low pressure area.

Under the influence of this depression over Saurashtra and the Bay depression, monsoon became vigorous over Saurashtra and over northeast and east central Arabian Sea. The noteworthy amounts of rainfall were: Porbandar 9 cm, Veraval 8 cm on 2nd July, Porbandar 22 cm, Veraval 28 cm on 3rd July. The heavy rainfall resulted in severe floods in Saurashtra. According to press reports 35 people lost their lives and 6,000 people were rendered homeless. Considerable dislocation in communications was also caused by the floods.

5 Depression in the Bay of Bengal— —9th to 10th August—

On the morning of 6th August, a low pressure wave from east was noticed moving westwards across central Burma. By the next morning the low pressure wave moved into the north Bay where a low pressure area formed with associated upper air cyclonic circulation extending upto 3 km a.s.l. By the morning of 8th, the low pressure area over north Bay became well-marked with negative pressure departure of 4 to 6 mbs over coastal stations of north Bay. On the next morning, the upper air cyclonic circulation extended upto 6 km a.s.l. and the well marked low pressure area over north Bay concentrated into a depression over Head Bay centred at 0830 hours IST of 9th near 21°N and 88°E.

The following observations are relevant in this connection on 9th:

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | Wind | | Pressure (mb) | Weather |
|-----------------------|----------|---------|-------------------|------|-------------|---------------|----------|
| | Lat. °N | Long °E | | Dir. | Speed Knots | | |
| S.S. Jalaprakash | 19.2 | 86.6 | 0530 | 270° | 5 | 997.1 | Overcast |
| S.S. Jalausha | 19.3 | 87.5 | 0530 | 270° | 5 | 997.9 | Overcast |
| Balasore | - | - | 0830 | 360° | Light | 996.1 | Overcast |
| Chandbali | - | - | 0830 | 270° | 15 | 996.3 | Shower |

In the course of the night of 9th/10th August, the depression moved westnorthwest, crossed north Orissa coast near Balasore, weakened and lay at 0830 hours IST of 10th as a low pressure area over Bihar Plateau and adjoining Madhya Pradesh. Afterwards, the low pressure area moved northwest and merged with the seasonal trough of low pressure over west Uttar Pradesh on the morning of 12th.

In association with the depression, rainfall was fairly widespread in coastal West Bengal, Orissa and Bihar Plateau on the 8th, 9th and 10th August while there was a spell of heavy to very heavy rainfall in northwest Madhya Pradesh and southeast Uttar Pradesh between 11th and 14th August. Balasore reported 10 cm of rain on 8th, Chandbali 19 cm on 9th, Sagar 18 cm on 11th, Orai 24 cm and Jhansi ^{14cms} on 14th. According to press reports, these heavy rains caused large scale floods in the river Ganga and forty villages situated along the river have been inundated near Fatehgarh.

The following statement gives the district averages in Bihar Plateau and noteworthy amounts of rainfall associated with the depression.

| State and district | District averages | | | Particularly heavy falls |
|--------------------|-------------------|------|------|--|
| | 8th | 9th | 10th | |
| BIHAR | | | | |
| Ranchi | | | 3 cm | |
| Singbhum | 4 cm | 4 cm | 3 cm | On 8th - Manoharpur 14 cm, Ghatsila 12 cm. On 9th - Manoharpur 14 cm. |

Rainfall figures for state rain gauge stations in Madhya Pradesh and Uttar Pradesh are not available.

6 Deep depression in the Bay of Bengal— —12th to 18th August—

A closed surface isobar over north Bay together with an upper air cyclonic circulation extending upto 6,0 km a.s.l. indicated that a well marked low pressure area had developed over north Bay on the morning of 12th August. By the evening of the same day the low pressure area concentrated into a depression centred at 1730 hours IST of 12th near 19.5°N and 90°E. The depression moved north-westwards and was centred at 0830 hours IST of 13th near 20°N and 89.5°E and at 0830 hours IST of 14th near 21°N and 89°E when Sandheads reported northwesterly 25 kts and Saugor Island northnortheasterly wind of 20 kts. By the evening of 14th, the depression became deep and was centred at 1730 hours IST close to Sunderbans coast near 88°E. The deep depression crossed Sunderbans coast near 88°E during the night and was centred at 0830 hours IST of 15th, 20 km north of Balasore. It moved in a westnorthwesterly direction and was centred 0830 hours IST of 16th between Chaibasa and Jharsuguda and at 1730 hours IST of 17th near Sidhi. It then weakened into a depression which was centred at 0830 hours IST of 18th near Nowgong. Thereafter it weakened further into a low pressure area over south-east Rajasthan and neighbourhood.

Under the influence of the depression fairly widespread rain with a few heavy to very heavy falls occurred in Orissa on 14th and 15th and in Madhya Pradesh from 15th to 17th. Balasore reported 26 cm and Contai 17 cm on the morning of 15th and Raigarh 19 cm on 17th. Unprecedented floods and devastation in Orissa were reported in the press following the heavy rains in Orissa and east Madhya Pradesh.

The following statement gives the district averages in Bihar Plateau and noteworthy amounts of rainfall associated with the depression.

| State and district | District averages | | Particularly heavy falls |
|--------------------|-------------------|------|-----------------------------|
| | 15th | 16th | |
| BIHAR | | | |
| Singbhum | 5 cm | | Majgaon 20 cm on 15th. |
| Ranchi | | 3 cm | Jagannathpur 17 cm on 15th. |

Rainfall figures for state rain gauge station in Madhya Pradesh and Uttar Pradesh are not available.

7 Depression in the Bay of Bengal—
—24th to 25th August—

Concentrated negative pressure departures over central Burma and associated upper air cyclonic circulation extending upto 4.5 km a.s.l. indicated that a low pressure wave over central Burma was approaching Arakan-Chittagong coast on the evening of 20th August. The low pressure wave moved westwards and under its influence a low pressure area developed over north Bay on the morning of 22nd. This low pressure area persisted and associated upper air cyclonic circulation extended upto 6.0 km a.s.l. on the 23rd. On the morning of 24th, the low pressure area concentrated into a depression centred at 0830 hours IST near 21°N and 89.5°E. It moved in a northwesterly direction crossed Sunderbans coast near 89°E in the afternoon of 24th and was centred at 1730 hours IST of the same day near Burdwan. It was centred at 0830 hours IST of 25th near Hazaribagh. The depression then moved in a northwesterly direction, weakened and lay as a low pressure area over west Uttar Pradesh and adjoining areas of northeast Rajasthan and of the Punjab on 28th. It thereafter merged with the seasonal low.

In association with the depression, fairly widespread rain with a few heavy to very heavy falls occurred in Bihar Plateau on 25th, in east Madhya Pradesh on 25th and 26th, in west Uttar Pradesh on 27th and 28th and in the Punjab (I) on 28th. A few noteworthy amounts of rainfall reported were: Ambikapur 14 cm and Ranchi 8 cm on 25th, Varanasi 14 cm and Sultanpur 10 cm on 26th and Agra 10 cm on 27th and 11 cm on 28th. The heavy rains are reported to have led to flooding of the rivers Jamuna, Sutlej and Beas with considerable damage to crops and property in several districts of Punjab. The flood waters of Ganga were also reported to have inundated large areas of land in Uttar Pradesh.

The following statement gives the district averages in Bihar and noteworthy amounts of rainfall associated with the depression.

| State and district | District averages | | Particularly heavy falls |
|--------------------|-------------------|--|--|
| | on 25th | | |
| BIHAR | | | |
| Ranchi | 4 cm | | On 25th - Ghatsila 19 cm, Palandu 13 cm, and Islampur 18 cm. |
| Palamau | 4 cm | | |
| Singbhum | 5 cm | | |
| Hazaribagh | 4 cm | | Charibariarpur 14 cm on 26th. |

Rainfall figures for State rain gauge stations in Madhya Pradesh and Uttar Pradesh are not available.

8 Deep depression in the Bay of Bengal—
—24th to 27th September—

A low pressure area was located over the north Andaman Sea near the Gulf of Martaban on the morning of 22nd September. It shifted northwestwards into east central Bay and by the morning of 24th concentrated into a depression, centred at 0830 hours IST near 18°N and 90°E. It became deep by the evening of the same day and was centred at 1730 hours IST near 19.5°N and 88.5°E. At 1730 hours IST on 24th, the surface wind at Sandheads was 30 kts from an easterly direction and the pressure departure was -10 mbs. It crossed north Orissa coast on the 25th morning between Balasore and Chandbali, weakened and lay as a depression over north Orissa centred at 0830 hours IST near Keonjhar. It was centred at 0830 hours IST on 26th near Ambikapur. It then moved northeastwards and was centred near Patna at 0830 hours IST of 27th. Moving northwards, it broke up over Nepal-Himalayas on 28th.

Under the influence of the depression rain or thundershowers had been fairly widespread in Orissa and Gangetic West Bengal on 25th, 26th and in Bihar on 26th and 27th. On 28th, rain or thundershowers were widespread in Sub-Himalayan West Bengal and fairly widespread in Bihar Plains. Locally heavy to very heavy falls occurred in Orissa on 25th and 26th, Sub-Himalayan West Bengal and Bihar on 27th and 28th. Some of the noteworthy amounts of rainfall were: Keonjhar 14 cm and Angul 9 cm on 25th, Jamui 18 cm, Darbhanga 17 cm, Patna 16 cm, Darjeeling 12 cm and Gaya 8 cm on 27th and Forbesganj 22 cm, Dhubri 20 cm, Jalpaiguri and Darjeeling 17 cm each, Siliguri 13 cm, Kalimpong 12 cm and Malda 9 cm on 28th.

The following statement gives the district averages in Bihar and noteworthy amounts of rainfall associated with the depression:

| State and district | District averages on | | | Particularly heavy falls |
|--------------------|----------------------|------|------|---|
| | 26th | 27th | 28th | |
| BIHAR | | | | |
| Patna | | 9 cm | | On 26th - Islampur 25. On 27th - Badalpur (Khagole) and Phulwarisari (Block) 18 each, Biharsarif (Block) 17, Dinapur 16, Bikram and Ekan-ger Sarai (Block) 15 cm each. |
| Gaya | | 6 cm | | On 26th - Jhanabad 17 cm. On 27th - Sherghati 12 cm. |
| Shahabad | | 3 cm | | On 27th - Agoan 17 cm. |
| Saran | | 5 cm | | On 27th - Marhaura 19, Mas-rakh 15. |
| Champaran | | 3 cm | | On 27th - Kesriah 20 cm. |
| Muzaffarpur | | 5 cm | | On 27th - Sahibganj 16, Lal-ganj 12. |
| Darbhanga | | 6 cm | | |
| Monghyr | | 9 cm | | On 27th - Gidhapur 20, Chakai Bamda 17, Jamalpur 14, Monghyr Muffasil (Block) and Shekhpura 12 cm each. |
| Bhagalpur | | 5 cm | | On 27th - Sultanganj 14 cm. |
| Saharsa | 5 cm | 9 cm | | On 26th - Bhaptiahi 19, On 27th - Pratapganj 21, Medhapura 14 cm. |

| State and district | District averages on | | | Particularly heavy falls |
|--------------------|----------------------|------|------|--|
| | 26th | 27th | 28th | |
| Purnea | | 3 cm | 9 cm | On 27th - Bahadurganj 27 cm |
| Dhanbad | 3 cm | | | |
| Santal Parganas | | 4 cm | | |
| Palamau | 3 cm | | | |
| Ranchi | 6 cm | 4 cm | | On 26th - Palkot 17, Bishnupur 16 and Gumla 15. |
| Singbhum | 3 cm | 3 cm | | |
| Hazaribagh | 3 cm | 5 cm | | On 27th - Dumri(H) 17, Tuladhir 16 cm and Jamua(B) 14 cm |

Rainfall figures for state rain gauge stations in Madhya Pradesh and Uttar Pradesh are not available.

9 Severe cyclonic storm in the Bay of Bengal—
—8th to 11th October—

On the morning of 6th October, a low pressure wave from the east was moving into a north Andaman Sea across north Tenasserim. Under its influence, a low pressure area formed over north Andaman Sea and adjoining east central Bay by the morning of 7th. Moving northwestwards, the low pressure area became well-marked and lay over east central Bay and adjoining northeast Bay off Arakan-coast on the morning of 8th when upper winds observations of Rangoon and Akyab available upto 1.5 km a.s.l. showed Rangoon about southerly 20 kts and Akyab about easterly 20/25 kts. At 2330 hours IST on the same day, S.S.Glenpark (20.3°N and 92.1°E) recorded surface winds eastsoutheast/25 kts, indicating that the low pressure area had concentrated into a depression by that time with centre within half-a-degree of 19.5°N and 91.5°E.

It remained practically stationary and concentrated into a cyclonic storm of small extent by 0530 hours IST of 9th when S.S.Glenpark (19.6°N and 92.4°E) reported barometric pressure 997 mbs departure from normal being of the order of -11 mb and surface wind southeasterly 35 kts. Without any appreciable movement, the cyclonic storm was centred at 0830 hours IST of 9th near 19.5°N and 91.5°E. The following observations from S.S.Glenpark of 9th are relevant in this connection.

| Position | | Time of Obsn. IST | Wind | | Weather |
|----------|---------|-------------------|-------------|-------------|-----------------------|
| Lat. °N | Long °E | | Dirac-tion. | Speed Knots | |
| 19.5 | 92.4 | 0730 | SSE | 35 | Continuous heavy rain |
| 19.2 | 92.6 | 1130 | S | 40 | -do- |

Moving northwest, the cyclonic storm was centred at 1730 hours IST on 9th near 20°N and 91°E. At 2030 hours IST of 9th S.S.Nardana (21.2°N and 91.2°E) reported surface wind easterly 45 kts. At 2115 hours IST on the same day, S.S. Jalavijaya (21.2°N and 91.4°E) reported surface wind eastsoutheasterly 45 kts.

The cyclonic storm became severe by 0130 hours IST of 10th and was centred near 20.5°N and 90.5°E. At 0150 hours IST of 10th S.S.Jalavijaya (21.0°N and 91.8°E) reported surface wind eastsoutheast/60 kts. Moving in a northerly

direction, it was centred at 0830 hours IST of 10th near 21.5°N and 90.5°E and at 1730 hours IST near 22.0°N and 90.5°E . Barisal reported surface wind east/40 kts Comilla northeast/50 kts at 1730 hours IST of 10th. Moving in a northeasterly direction, the severe cyclonic storm crossed East Pakistan coast between Barisal and Naokhali by 0530 hours IST of 11th, weakened and lay at 0830 hours IST as a depression with centre close to Agartala. Thereafter, it broke up against the Assam hills by 12th morning. The lowest minimum pressure estimated at the centre of the storm was 986 mbs. the corresponding departure from normal being -22 mb.

The severe cyclonic storm was responsible for unprecedented havoc in East Pakistan. According to press reports, with a velocity reaching upto 70 miles per hour it lashed the coastal districts of East Pakistan. It was followed by a huge tidal bore of 19 feet high waves sweeping over the three islands Hatia, Sandwip and Kutubdia in Chittagong district. Official estimate of the death roll was nearly 6,000 in the East Pakistan coastal belt and off shore Islands including Naokhali, Chittagong and Barisal districts. About 100,000 people were rendered homeless. Heavy to very heavy rain occurred in East Pakistan. Cox's Bazar reported 18 cm of rain on 10th and Comilla 8 cm on 11th.

10 Severe cyclonic storm in the Bay of Bengal—
—28th October to 1st November—

In the morning of 26th October, the strengthening of upper winds of Port Blair, pronounced fall of pressure in the south Bay Islands and widespread rain over the Bay Islands indicated that a low pressure wave from the east was moving westwards into the southeast Bay across the south Andaman Sea. On the morning of next day, widespread rain continued over the Bay Islands, Nancowrie reporting 16 cm of rain. Pressure over Burma coast and south Bay Islands rose while that over north Bay Islands fell slightly. From the above facts, together with isobaric pattern it could be inferred that the low pressure wave had moved westwards and accentuated the seasonal trough of low pressure over the southeast Bay. At 0530 hours IST S.S.Andamans (10.0°N and 90.3°E) reported easterly wind of 20 kts and rain/squall, S.S.Neptunia (6.0°N and 85.8°E) westerly winds of 10 kts and S.S. Columbia Trader (8.4°N and 94.3°E) southeasterly wind of 15 kts. The well-marked trough of low pressure over the southeast Bay developed into a depression by the morning of 28th and was centred at 0830 hours IST near 10.5°N and 90°E . Ship Columbia Trader (near 11.5°N and 89.5°E) reported easterly wind of 25 kts at 1130 hours IST and near 11.8°N and 89.8°E at 1730 hours IST on 28th. The depression moved northwestwards and intensified. It lay as a deep depression with its centre at 1730 hours IST of 29th near 12.5°N and 87°E . The following ships' observations on 29th are significant in this connection:

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | Wind | | Weather |
|-----------------------|-------------------------|-------------------------|-------------------|-------------|-------|---------|
| | Lat. $^{\circ}\text{N}$ | Long $^{\circ}\text{E}$ | | Direc- | Speed | |
| | | | | tion. Knots | | |
| S.S.Columbia Trader | 14.7 | 86.2 | 1730 | NE | 30 | Rain |
| S.S.Meliskirk | 13.9 | 85.5 | 1730 | N | 30 | Shower |

Moving northnorthwest during the night, the deep depression was centred at 0830 hours IST of 30th near 15.0°N and 86.0°E . The following ships' observations of 30th indicated that the deep depression then recurved and intensified into a cyclonic storm centred at 1730 hours IST near 16.5°N and 86.5°E .

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | Wind | | Weather |
|--------------------------|----------|----------|-------------------|--------------|-------------|---------|
| | Lat. °N | Long. °E | | Dirac- tion. | Speed (Kts) | |
| S.S. Pakistan Prosperity | 14.0 | 87.0 | 1730 | WSW | 30 | Shower |
| S.S. Meliskirk | 13.5 | 89.1 | 1730 | S | 35 | Shower |
| S.S. Padua | 11.5 | 88.2 | 1730 | SW | 20 | Rain |
| S.S. Columbia Trader | 17.6 | 83.6 | 1730 | NNE | 20 | Rain |

During the course of the night the cyclonic storm moved in a northeasterly direction intensifying at the same time into a severe cyclonic storm which was at 0830 hours IST on 31st near 19.5°N and 89.5°E. The following ships' observations on 31st are significant in this connection:

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | Wind | | Weather |
|------------------------|----------|----------|-------------------|-------|-------------|---------------|
| | Lat. °N | Long. °E | | Dirn. | Speed (Kts) | |
| S.S. Kenia | 19.3 | 88.3 | 0430 | N | 60 | Heavy rain |
| S.S. Kenia | 19.2 | 88.4 | 0630 | NW | 60 | Heavy rain |
| S.S. British Navigator | 20.5 | 88.8 | 0530 | NNE | 50 | Moderate rain |
| S.S. British Navigator | 20.5 | 88.4 | 0600 | NNE | 50 | Moderate rain |

Continuing to move in a northeasterly direction, the severe cyclonic storm having a core of hurricane winds was centred at 1730 hours IST of 31st near 21.5°N and 90.5°E. At 1430 hours IST S.S. Alstentor (21.0°N and 91.7°E) reported southerly wind of 60 kts and very high seas and at 1830 hours IST S.S. Indian Trust (20.5°N and 91.1°E) southwesterly wind of 30 kts and equally winds. At 1730 hours IST Barisal reported northeasterly wind of 70 kts and thundershowers and Mazdia (Noakhali) eastnortheasterly wind of 45 kts and heavy thundershower. According to press reports wind speed exceeded 80 kts at several places; the anemometer on the Swedish ship S.S. Bali which was anchored at Chittagong Port recorded a maximum wind speed of 130 miles per hour.

The severe cyclonic storm passed inland by about midnight of 31st across East Pakistan coast near Noakhali. Thereafter it weakened rapidly and broke up over the Lushai hills on 1st November.

The lowest pressure observed or inferred at the centre of the storm was 988 mbs and the corresponding departure from normal was -24 mbs. In the formation stage this disturbance caused widespread thundershowers in the Bay Islands from 27th to 29th October. It also caused fairly widespread rain in Assam on 1st November. Some of the noteworthy amounts of rainfall were: Nancowrie 16 cm on 27th and 7 cm on 29th, Car Nicobar 8 cm on 28th, 7 cm on 29th, Port Blair 11 cm on 29th, Barisal 7 cm on 31st and Haflong 10 cm, Akyab and Sandoway 7 cm each on 1st November.

The cyclone was of very great severity and affected coastal areas of East Pakistan from Khulna to Cox's Bazar - Chittagong being worst hit. According to reports of eye witness published in newspapers, the cyclone caused very severe devastation over the coastal areas of Barisal, Noakhali and Chittagong

districts and over the off-shore islands - Hatya and Sandwip - off Chittagong coast. The damages caused by the cyclone were mainly of two types (a) those due to the hurricane and (b) those due to storm wave. A huge storm wave which rose to a height of 20 feet according to eye witness is reported to have swept the Chittagong coast in the wake of the cyclone and inundated areas upto a distance of about 10 miles inland. The Patenga Aerodrome (Chittagong) which is about ten miles from Chittagong town was submerged under ten feet of water. Chittagong Port presented a scene of destruction. The Port's Shed, fencing and one of the jetties were badly battered and nine newly installed cranes were smashed. Sixteen out of the seventeen ocean going vessels in the Chittagong port broke their moorings and ran aground by the tidal bore. Some of them were tossed upto a distance of ten miles over the beach and "CHAR" land adjoining the port. S.S. Southern Venture, S.S. American Mail, S.S. Mohanda, S.S. Bali, S.S. Jahangirbad, S.S. Clan Alpine, S.S. Faquirji Cowasjee and S.S. Marshal were amongst those set adrift. A pucca walled wireless centre belonging to the East Pakistan Rifles at Chittagong was ripped apart and its pieces scattered far and wide by the gale.

A railway goods train derailed at Baralund about 20 miles on the Dacca-Chittagong rail line. Men and cattle died in thousands and became homeless in lacs. Hundreds of dead bodies lay scattered on river banks. Standing crops were destroyed and all vegetations had been "burnt" by the extraordinary force of the wind. The exact extent of havoc caused by this cyclone alone cannot be estimated as another cyclone of similar severity struck the same coast only three weeks back/ and this cyclone aggravated the devastation caused by the earlier one. According to East Pakistan official estimates about 15,000 to 20,000 people lost their lives and more than 200,000 were rendered homeless by the two cyclones.

11 Shallow depression in the Bay of Bengal— —10th to 11th November—

On the morning of the 7th November, a low pressure area was over south Bay of Bengal. It was over southwest Bay on the 8th and off Ceylon and Coromandel coast on the 9th.

By the next morning (10th) the low pressure area concentrated into a shallow depression with centre at 0830 hours IST near 10°N and 81°E.

The shallow depression remained practically stationary without intensification till early hours of next day after which it weakened and lay as a low pressure area over the southwest Bay off Coromandel coast and finally became unimportant by 12th.

In association with this shallow depression the northeast monsoon was active along the coastal Madras State from 8th to 11th causing fairly widespread rain with some heavy to very heavy falls there. A few noteworthy amounts of rainfall were: Nagapattinam 24 cm on 9th and 13 cm on 10th, Coonoor 10 cm on 10th, Madras 18 cm and Nellore 20 cm on 11th.

According to press reports, the heavy rains seriously disrupted road and rail traffic in Madras State and rendered homeless more than 10,000 inhabitants of Madurai town. Further, the incessant rain and the consequent flooding is reported to have caused the death of five persons and rendered 1,50,000 homeless in Madras City.

12 Depression in the Arabian Sea— —7th to 10th November—

A low pressure area that persisted over the Laccadives areas till 5th

November moved westwards over southeast Arabian Sea by 6th morning. It concentrated into a depression on the morning of 7th near 10.5°N and 69.5°E . The depression progressively moved in a northwesterly direction till the morning of 10th November when it was centred near 15°N and 66°E . Later it weakened into a low pressure area and became unimportant.

During the formative stage of the depression, a well marked low pressure area also existed over southwest Bay of Bengal off Ceylon. Under the combined influence of both these lows, fairly widespread rainfall occurred over Arabian Sea Islands, Kerala and Madras State with heavy to very heavy falls in Madras State from 5th to 10th November.

13 Cyclonic storm in the Bay of Bengal— —18th to 20th November—

The low pressure area in the southwest Bay of Bengal and neighbourhood became well marked on the 17th November. It concentrated into a depression on the morning of the 18th with centre near 10.5°N and 85.0°E .

During the course of the night the depression moved in a northwesterly direction and was centred at 0830 hours IST of 19th near 11.5°N and 83°E . It is noteworthy that upper winds upto 0.9 km over Madras strengthened to 30/33 kts by 1730 hours IST of 19th. The depression was intensifying. Moving northwestwards, it was centred as a deep depression at 0830 hours IST of 20th near 12.5°N , 82.0°E . At 1130 hours IST of 20th, S.S. Jalamudra (13.5°N , 80.5°E) reported northeasterly winds of 27 kts and drizzle. The deep depression was centred at 1130 hours IST of 20th near 13°N , 81°E . Thereafter, it moved westwards and intensifying into a cyclonic storm of small extent struck the coast near Madras in the afternoon. Winds at Madras (Meenambakkam) were at a mean speed of more than 30 kts for about two hours from 1340 hours IST with corresponding maximum gust speeds ranging from 43 to 73 kts. The higher mean speed of 40 kts and maximum gust speed of 73 kts occurred at the station at about 1510 hours IST. The lowest pressure of 995.7 mb was recorded at 1530 hours IST at Tambaram which was about 5 miles southwest of Meenambakkam. The corresponding departure from normal would be about -17 mb. After crossing coast, the storm of small extent weakened rapidly and lay on the morning of 21st as a low pressure area over south Mysore State, Kerala and adjoining east Arabian Sea.

Under the influence of this storm of small extent, fairly widespread rain occurred in Rayalaseema, north Madras State and adjoining south coastal Andhra Pradesh on 21st, in south Interior Mysore on 21st and 22nd and in Kerala on 22nd. The chief amounts of heavy rainfall reported were: Punalur 11 cm, Nellore 10 cm, Cuddapah 9 cm on 21st; Madras City experienced the fury of the storm with heavy rain and winds of gale force for a few hours on 20th afternoon. According to press reports, many big trees were uprooted dislocating communication and transport. Many huts were damaged by the heavy rain and gales rendering numerous poor people homeless.

14 Cyclonic storm in the Arabian Sea— —17th to 22nd November—

By the evening of 14th November a low pressure area formed in southeast Arabian Sea to the west of Laccadives. Moving slowly westward it concentrated into a depression centred within one degree of 12.0°N , 66.5°E by the 17th morning.

Later, moving westnorthwestwards the depression intensified into a cyclonic storm on the morning of 19th and could be centred within one degree of 13°N

63°E. Ship Torguay at 0830 hours IST near 10.8°N, 63.3°E reported surface winds of 220/29 kts. At 1130 hours IST of 19th ship Achilles near 10°N, 62.4°E reported surface wind of 250/30 kts and ship Jaladhir near 10.2°N, 61.8°E reported southwesterly surface wind of 30 kts. The storm moved westwards and could be centred at 1730 hours IST of 19th within half-a-degree of 13°N, 61.5°E. Ship Torguay reported a pressure of 994.5 mbs. By 0530 hours IST of 20th S.S.Torguay's reported wind speed of 30 kts and gusting to 45 kts in rain squalls and S.S.Achilles near 10.8°N, 58°E reported westerly surface winds 280/30 kts and S.S.Buenosairumaruru near 10.2°N, 61.6°E westsouthwesterly 30 kts. On the morning of 20th, the storm could be centred near 13°N, 60°E.

There were no ship's observations close to the storm centre. Hence winds of gale force in the inner storm area, if any, could only be inferred to be confined to a rather small area of about 2 degrees square around the centre of the cyclone, as evidenced from the following ships' observations which were outside this area. At 1730 hours IST of 20th Achilles near 11.2°N, 54.9°E reported northwesterly surface wind of 20 kts and Buenosairumaruru at 2030 hours IST near 10.9°N, 56.6°E reported surface wind of 300/20 kts. Ship Mohammedi at 2330 hours IST near 15.2°N, 57.0°E reported surface wind of 040/21 kts.

Continuing to move westwards, the storm was centred on the morning of 21st near 13°N, 57°E. Moving westwards, the storm was centred near 13°N, 54°E on the morning of 22nd. Remaining stationary, it weakened into a depression by 1130 hours IST of the same day. It weakened further into a low pressure area over Gulf of Aden by the morning of 23rd November.

On the 20th November, the lowest central pressure could be inferred as 994 mb which corresponded to a pressure defect of -20 mb.

15 Depression in the Bay of Bengal—
—26th November to 3rd December—

On the morning of 24th November, the seasonal trough of low pressure over the southeast Bay and adjoining southwest Bay became well marked. At 0530 hours IST of that day S.S.Rajula (10.2°N, 87.1°E) reported northeasterly winds of 30 kts and rain within sight and S.S.Cardigenshire (5.8°N, 87.8°E) westerly winds of 15 kts. During the next 48 hours the well marked low pressure are persisted over the area. With the approach of a low pressure wave from the east on the morning of 26th, the well marked low pressure area showed signs of concentrating into a depression with the central region near 9°N, 88°E. The following ships' observations on 26th November are significant in this connection:

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | Wind | | Weather |
|-----------------------|----------|---------|-------------------|-------|-------------|---------|
| | Lat. °N | Long °E | | Dirn. | Speed (Kts) | |
| S.S.Andamans | 11.4 | 85.7 | 0530 | NNE | 20 | |
| S.S.Mustansir | 10.5 | 83.6 | 0530 | NNW | 15 | |
| S.S.Nadir | 7.8 | 83.8 | 0530 | NW | 20 | Rain |

By the evening of the same day a depression had formed with centre at 1730 hours IST near 9.5°N, 88.0°E, as could be seen from the following observations of 26th:

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | W i n d | | W e a t h e r |
|-----------------------|----------|---------|-------------------|---------|-------------|---------------|
| | Lat. °N | Long °E | | Dir. | Speed (Kts) | |
| S.S. Andamans | 12.1 | 85.5 | 1730 | N | 15 | - |
| S.S. Caltex | 5.9 | 85.1 | 1730 | WNW | 20 | Shower |
| S.S. Aoska Maru | 4.0 | 88.1 | 1730 | W | 20 | - |
| Fort Blair | - | - | 1730 | E | 10 | - |

During the course of the night the depression moved slowly in a northerly direction and was centred at 0830 hours IST of 27th near 10°N, 88°E. The depression persisted over the area without appreciable movement till the morning of 30th.

From the following ships' observations it could be inferred that the disturbance lay still as a depression in the southeast Bay on the evening of 30th with its centre at 1730 hours IST near 12°N, 88°E.

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | W i n d | | W e a t h e r |
|-----------------------|----------|---------|-------------------|---------|-------------|-------------------|
| | Lat. °N | Long °E | | Dir. | Speed (Kts) | |
| S.S. Bahadur | 15.7 | 85.7 | 1730 | NNE | 20 | - |
| S.S. Jalamohan | 13.1 | 84.4 | 1730 | N | 25 | - |
| S.S. Mastand | 10.2 | 83.5 | 1730 | N | 15 | Rain within sight |
| S.S. Fukuzan Maru | 5.7 | 86.4 | 1730 | WSW | 20 | - |
| S.S. Rajula | 7.6 | 91.9 | 1730 | S | 15 | - |

During the night, the depression moved slowly in a westnorthwesterly direction and was centred at 0830 hours IST of 1st December near 12.5°N, 87.0°E.

The depression then curved to the left and moved slowly westwards and was centred at 1730 hours IST near 12.5°N, 86.0°E. The following observations of 1st December are significant in this connection:

| Name of the Ship/Stn. | Position | | Time of Obsn. IST | W i n d | | W e a t h e r |
|-----------------------|----------|---------|-------------------|---------|-------------|--------------------------------|
| | Lat. °N | Long °E | | Dir. | Speed (Kts) | |
| S.S. Alphacket | 13.0 | 86.5 | 1730 | E | 20 | Shower |
| S.S. Martant | 14.4 | 85.4 | 1730 | NE | 20 | Rain within sight |
| S.S. Caltex London | 14.0 | 83.0 | 1730 | NNE | 25 | - |
| S.S. Wey Leank | 13.1 | 82.4 | 1730 | NNE | 25 | Drizzle. Rough northeast Seas. |
| S.S. Johore Bahru | 11.7 | 82.9 | 1730 | NNW | 20 | Rain |
| S.S. Rajula | 9.5 | 86.9 | 1730 | SW | 15 | Rain within sight. |

Continuing to move slowly in a northwesterly direction, the depression was centred at 0830 hours IST of 2nd near 13.0°N, 85.0°E and near 13.0°N, 84.0°E at 1730 hours IST of the same day.

Thereafter the depression commenced weakening and by the morning of 3rd it weakened into a low pressure area which lay over southwest Bay and adjoining west central Bay. The low pressure area passed inland across Circars coast as a low pressure wave by the morning of 4th.

As the disturbance became unimportant before entering land area, it did not cause much weather over land. It caused local rain from 24th to 27th November and fairly widespread rain from 28th to 30th over the Bay Island and local rain in coastal Andhra Pradesh on 3rd and 4th December and in Telengana on 4th; Kondul reported 14 cm of rain on 28th November.

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II. ACCOUNT OF WESTERN DISTURBANCES DURING 1960

Nearly complete absence of active western disturbances outside the period January-February and March-April, a cessation of western disturbance activity caused by the onset of southwest monsoon over extreme northwest of the country in July and a comparatively large number of weak western disturbances moving across the extreme north of the country were the chief features of the year. During January and February the rainfall over entire northern India was deficient or scanty, but a number of fairly active disturbances moved across northwest India in March and April causing good rainfall over the plains of northern India. As most of the western disturbances moving across Jammu and Kashmir were weak ones the rainfall in these areas was deficient throughout the year. A list of the 71 western disturbances that affected the country, classified according to the nature of precipitation caused by them, is given in the table below. Description in detail of an important western disturbances is also added.

| Nature of pre- cipitation | No. of western disturbances | | | | | | | | | | | |
|-----------------------------------|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Fairly widespread | 3 | 1 | 5 | 3 | 1 | 1 | - | 1 | - | - | - | 2 |
| Local | 1 | - | 2 | 3 | 2 | - | 1 | 2 | 2 | - | 1 | - |
| Scattered or no rain | 5 | 7 | - | 3 | 2 | 4 | - | 3 | 2 | 6 | 3 | 5 |
| No. of disturbances each month | 9 | 8 | 7 | 9 | 5 | 5 | 1 | 6 | 4 | 6 | 4 | 7 |

1 Western disturbance of the period— —20th to 23rd March—

A western disturbance was lying over Iran on 19th, moving eastwards it lay over southeast Iran and adjoining parts of north Baluchistan and Afghanistan on 20th morning. By the evening of 20th it shifted over northeast Baluchistan and adjoining Punjab (P). By 21st morning the western disturbance intensified into a depression and lay over the Punjab (P) and adjoining northwest Rajasthan. The associated upper air trough extended upto 6 km a.s.l. The depression moved eastwards and on 21st evening it was over the Punjab (I) and the associated upper air trough extended from Himachal Pradesh to northeast Rajasthan. On 22nd morning it was lying over the hills of the Punjab and of west Uttar Pradesh and by the evening it weakened into a low pressure area. It moved away eastwards across western Himalayas on 23rd.

In association with this western disturbance widespread rain or snow with a few rather heavy falls occurred in Himachal Pradesh and Punjab. Kumaon hills and fairly widespread rain or snow occurred in Kashmir on 22nd. Fairly widespread rain or thundershowers occurred in the plains of Uttar Pradesh and scattered on the plains of the Punjab and northwest Rajasthan. The chief amounts of rainfall were Dalhousie 4 cm, Joshimath 3 cm, Gorakhpur, Faizabad, Banda, Nainital, Dharamsala and Lucknow 2 cm each.

On 23rd rain or snow was fairly widespread in Himachal Pradesh and Punjab and Punjab-Kumaon hills with some rather heavy falls in Kumaon hills and local in Kashmir. Scattered thundershowers occurred in northeast Uttar Pradesh. Chief amounts were Joshimath and Nainital 4 cm each, Srinagar and Gorakhpur 1cm each.

Earlier also in its eastward passage from Baluchistan and neighbourhood it caused heavy rain over northeast Baluchistan, Chaman recording 8 cm and Hindubagh 5 cm.

In the rear of the western disturbance there was a marked fall in temperatures, which were markedly below normal over most parts of northern India on 23rd and 24th. Coming late in March, the cold spell was conspicuous for the reason.

According to press reports, a large number of places in Jammu and Kashmir, Himachal Pradesh and the hills of the Punjab and of Uttar Pradesh experienced heavy snowfall. Some places in the Punjab and west Uttar Pradesh had hailstorm causing considerable damage to life and property. In some areas in the Punjab the hailstorm was described as unprecedented and standing crops in hundreds of sq. miles suffered total damage.

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III. LOCAL STORMS 1960

| Sr. No. | Place | Date & Time | Classification of storm | Loss of human life | Remarks |
|---------|-----------------------------|-----------------------------|-------------------------|--------------------|--|
| 1 | East Khandesh (Maharashtra) | i) 2nd Jan. ii) 6th Jan. | Hailstorm " | 3 | Standing rabi crops valued at about Rs.40 lakhs are estimated to have been destroyed in the East Khandesh district of Maharashtra. 37 villages in the Erandol Taluka and 48 villages in the Amalner Taluka were affected, where the standing crops in over 12000 acres of land have been completely destroyed. 6 villages in the Raver taluka were also affected. The crops affected were Wheat, Jowar, Chillies, Pulses, Bananas and Cotton. The first hailstorm hit the district on Jan.2 and the second on Jan.6. |
| 2 | Muzaffarnagar | 21st Jan.- night | Severe hailstorm | - | A severe hailstorm accompanied by heavy rains lashed the town and resulted in disruption of telegraphic and telephonic connections in the town. |

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|--------------------------|----------------------|------------------|---|--|
| 3 | Rudhauri (Uttar Pradesh) | 6th Mar. | Severe hailstorm | 4 | 4 persons and 150 heads of cattle were killed in areas around Rudhauri in the neighbouring Basti district in a severe hailstorm. The hailstones as big as tennis balls had caused severe damage to standing rabi crops. |
| 4 | Patna | 7th Mar.- Night | Severe Gale | - | Heavy rains and severe gale swept Patna, Gaya and Shahabad districts on Monday night for over 3 hours, uprooting hundreds of trees and blowing away roof tops and damaging standing Rabi and the mango crops. |
| 5 | Simla | 7th Mar. | Snowstorm | - | A 40 mph gale hit Simla on Monday. Nearly 11 inches of snow has been reported from some parts of the Panji valley of Chamba district in Himachal Pradesh. |
| 6 | New Delhi | 7th Mar.- Evening | Dust storm | 2 | A 98 mph duststorm which hit the Capital on 7th evening dislocated air, rail and road traffic disrupted telephone and telegraph services and brought life to a standstill. The storm, one of the worst in recent years uprooted trees, blew off temporary hutments, tented police stations and caused widespread damage to the refugee colonies. Damage was also done to pavilions at World Agricultural Fair. The storm also disrupted the railway control telephone lines, making contact between stations impossible. It blew off an empty rail wagon near Shakarbasti and another in Delhi goods shed. |
| 7 | Patiala | 14th Mar. | Severe Hailstorm | - | Hailstorms each weighing as much as over half a pound fell over an area of 90 sq. miles in Patiala district on March 14. According to statement of a legislator, crops had been completely destroyed in the area of nearly 100 sq. miles. Birds on their wings perished in the storm and trees became bare of their leaves. Goats and horses caught in the open fields also died in large numbers. The fodder in the area had become poisonous and cattle diseases had broken out in an epidemic form. Hailstones weighing about half a pound each fell for a considerable period and the entire area was under a four feet thick blanket of hailstorms. |

| 1 | 2 | 3 | 4 | 5 | 6 |
|----|------------------------------|------------------------------|-----------|---|---|
| 8 | Hissar | 18th Mar. | Hailstorm | - | Several cattle perished in a hailstorm which hit village of Lilwas, 12 miles from Hissar. Hailstones of unusually large size fell for more than 10 minutes. Hundreds of birds were killed and standing crops were damaged. |
| 9 | Karnal | 26th Mar. | Hailstorm | - | The rabi crop in 20 villages of Guhla, Sub-Tehsil in Karnal district has been badly damaged. According to official estimates, crops worth Rs.30 lakhs in an area of about 50,000 acres have been affected. |
| 10 | Almora | 26th Mar. | Hailstorm | - | The hailstorm damaged orchards and standing crops in rural areas of Almora district and paralysed telegraph and telephone communications between Almora and rest of the country. |
| 11 | Moga | 26th Mar. | Hailstorm | - | Heavy damages have been caused to Rabi crop in Moga villages which were lashed by hailstorm. |
| 12 | Bhatinda | 27th Mar. | Hailstorm | 3 | 3 peasants taking shelter under a tree during a hailstorm were killed in villages of both 15 miles from Bhatinda. The hailstorm also caused heavy damage to crops in the district. |
| 13 | Simla | 29th Mar. | Hailstorm | - | Hailstones of unusually large size weighing nearly $\frac{1}{2}$ a pound each fell in part of Chopal Tehsil in Himachal Pradesh. The entire wheat and barley crops in the Tehsil were damaged. |
| 14 | Dum Dum | 14th Jun.- early morning. | Gale | - | A 91 mph gale swept over Dum Dum airport area early this morning damaging a number of stationary aircraft and dislocating normal schedule of flights. The squall lasting nearly $\frac{1}{2}$ an hour from 3 A.M. swept away portions of the roof of passengers' lounge at the airport. A part of old staff quarters was also damaged. An international plane was hit by a gangway, its tail damaged. |
| 15 | Raipur | 14th Jun. | Gale | - | A 70 mph storm blew over Bilaspur district damaging property worth Rs.2 lakhs in various villages of the district. One person was injured by a flying tin sheet blown off the roof of a house by the storm. Over 200 families were rendered shelterless. |
| 16 | Simla | 15th Jun. | Gale | - | A 60 mph storm, followed by heavy rains swept over Simla and its suburbs. The apple crop at Kotgarh in Himachal Pradesh have been considerably damaged. |
| 16 | Kachla (Uttar Pradesh) | 26th Aug. | Lightning | 3 | 3 persons were killed and 40 others injured by lightning at Kachla 17 miles from Badaun. It is stated that they were all huddled up under "Machan" for protection against rains when lightning struck them. |

IV. WINDS OF FORCE NINE OR MORE IN THE INDIAN SEAS

Excluding dates of storms and depressions, a description of which has been given above, the following reports of winds of force 9 or more by ships in the Indian Seas were received during 1960.

| Date | Name of the ship | Approximate Position | |
|-----------|------------------------|----------------------|-------------|
| | | Lat. °N | Long. °E |
| 12th June | Mataram | 11.4 | 57.9 |
| 26th June | Villedede Deigosauarez | 15.2 | 66.0 |
| 28th June | Villedede Deigosuarez | 15.0 | 61.5 |
| 28th June | Villedede Deigosuarez | 14.8 | 61.0 |
| 28th June | Fansta | 16.5 | 71.9 |
| 29th June | Villedede Deigosuarez | 14.5 | 58.4 |
| 29th June | Fansta | 19.7 | 69.9 |
| 29th June | Villedede Deigosuarez | 14.6 | 58.9 |
| 29th June | Villedede Deigosuarez | 14.5 | 58.4 |
| 29th June | Fansta | 19.3 | 70.2 |
| 29th June | Villedede Deigosuarez | 14.6 | 59.5 |
| 29th June | Villedede Deigosuarez | 14.6 | 58.6 |
| 30th June | Leicestershire | 12.9 | 53.2 |
| 30th June | Villedede Deigosuarez | 14.5 | 56.6 |
| 30th June | Fansta | 22.6 | 67.4 |
| 4th July | Nadir | 19.0 | 71.4 |
| 5th July | Nadir | 19.2 | 70.0 |
| 20th July | Clan Alpine | 10.0 | 52.8 |
| 20th July | Clan Alpine | 10.0 | 53.4 |
| 27th July | Mohammedi | 13.8 | 63.5 |
| 23rd July | St. John | 13.3 | 49.3 |
| 30th July | Cuyamavalley | 22.7 | 61.2 |

No ship in the Bay of Bengal reported wind force of 9 BF or more unconnected with cyclonic storms during the year 1960.

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TRACKS OF STORMS AND DEPRESSIONS (IN THE INDIAN SEAS)

1960

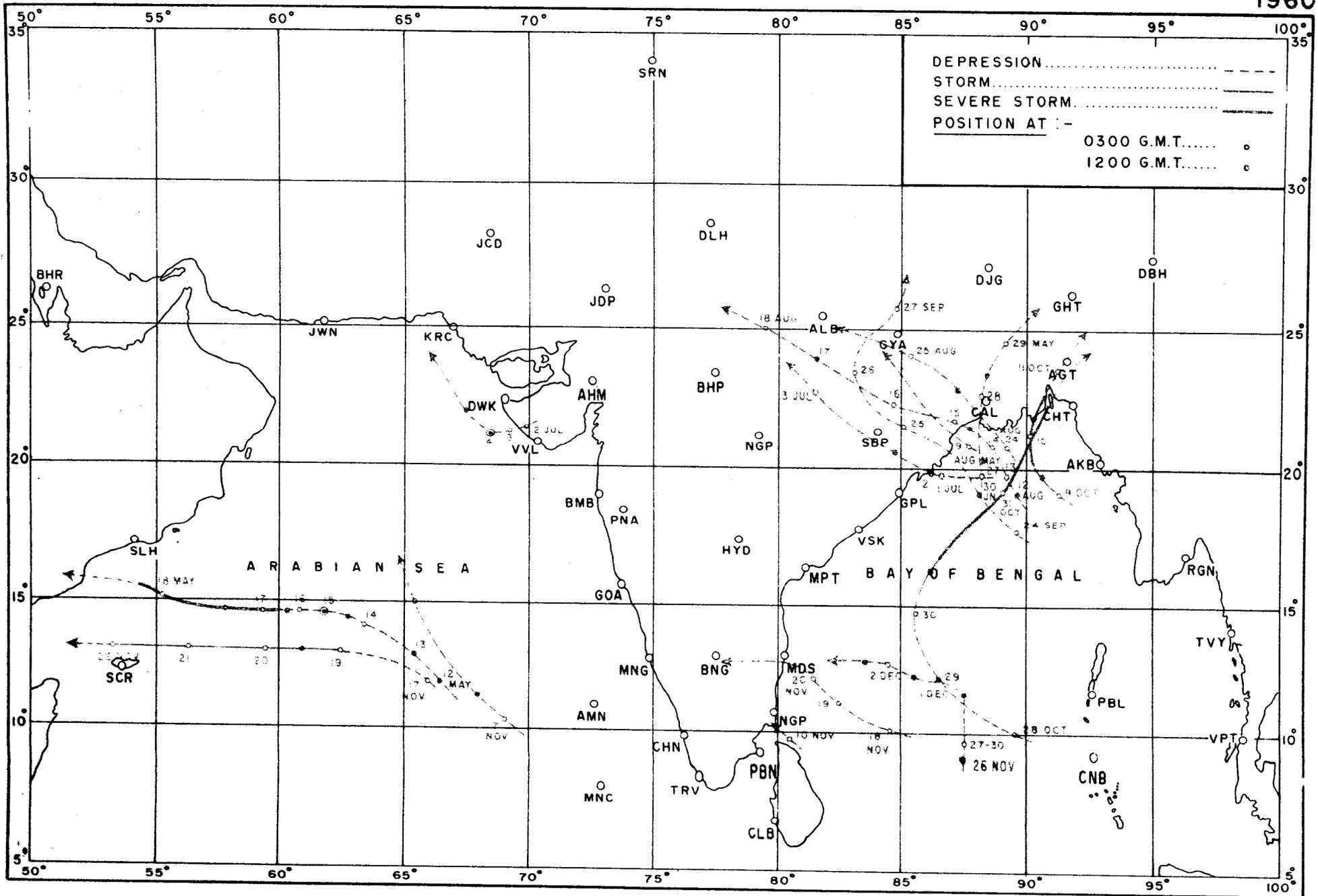


FIG. 1