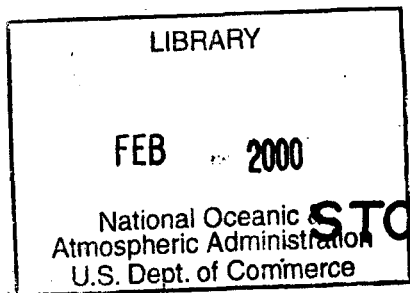


# INDIA WEATHER REVIEW 1970

## ANNUAL SUMMARY

### PART-C



## STORMS & DEPRESSIONS

QC  
990  
.I39  
I52a  
pt. C  
1970

### 1. INTRODUCTION.

Seven cyclonic storms and eight depressions formed in the Bay of Bengal and the Arabian Sea during the year 1970. A depression also developed over the land area (Gangetic West Bengal). Of the seven cyclonic storms, four formed in the Bay of Bengal (three of them severe) and three in the Arabian Sea. The tracks of these storms and depressions are shown in Fig. 1, together with their monthly distribution in Table I.

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

- i. No cyclonic storm struck the coast of Andhra Pradesh, Tamil Nadu or the west coast of India;
- ii. The depressions, which developed in the Bay of Bengal and moved westwards across the central and northern parts of the country during the monsoon, provided good rainfall to many parts of north India.
- iii. Two severe cyclones in the Bay of Bengal recurved and struck Bangla Desh (formerly East Pakistan) during October and November, during a period of one month. The November cyclone caused devastation in Bangla Desh, where a few lakhs of people were killed. A large part of the damage was caused by a storm surge of approximately 4 to 5 metres height.
- iv. While it was not possible to assess the total damage to the country exclusively on account of cyclonic storms, the loss due to floods could be estimated from the following newspaper report :

The Times of India, 10th November 1970 :

" Flood Death Roll This Year - 1100.  
New Delhi : November 9 - Eleven hundred people lost their lives in floods in various States and Union Territories this year, according to a statement laid on the table of the Lok Sabha today. In Gujarat the death roll was 432 and in Uttar Pradesh 344.

In terms of cattle lost, Assam and West Bengal suffered the most. Over 31,300,000 people in the area of 81,90,000 hectares were affected by the floods which destroyed or damaged crops worth over Rs. 268 crores." - PTI.

# **National Oceanic and Atmospheric Administration**

## **Environmental Data Rescue Program**

### **ERRATA NOTICE**

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages

Faded or light ink

Binding intrudes into the text

This document has been imaged through the NOAA Environmental Data Rescue Program. To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or [www.reference@nodc.noaa.gov](mailto:www.reference@nodc.noaa.gov).

Information Manufacturing Corporation  
Imaging Subcontractor  
Rocket Center, West Virginia  
September 14, 1999

INDIA WEATHER REVIEW, 1970

ANNUAL SUMMARY

PART C

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

CONTENTS

1. Introduction	...	...	...	C1
2. History of the Cyclones and Depressions	...		...	C2 - C12

## 2. HISTORY OF THE CYCLONES AND DEPRESSIONS.

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

### BAY OF BENGAL

#### 1. SEVERE CYCLONE, MAY 2-7

A low pressure area which lay over south Andaman Sea on 30th April, moved into southeast Bay on 1st May and concentrated into a depression on the morning of 2nd near 11°N, 88°E. Moving north, it intensified into a cyclonic storm on the 3rd morning with its centre near 15°N, 88°E. The intensification of the depression into a cyclonic storm was assisted by an extended anticyclonic circulation in the upper troposphere (above 500 mb) over the Bay of Bengal. Subsequently, the storm moved in a northeasterly direction and further intensified into a severe cyclonic storm near 18°N, 90°E on the morning of 4th. It crossed the coast of Bangla Desh near Cox's Bazar on the early morning of the 7th and weakened into a low pressure area by the evening over the central parts of Burma.

This system caused fairly widespread rain in the Bay Islands upto 3rd May.

The cyclone was tracked, and its intensity estimated with the help of Weather Satellite pictures. There were not enough Ships' observations in the storm field, but for the following ships' reports on the 5th :-

Date	Time (GMT)	Call Sign	Lat. °N	Long. °E	Wind knots	Pressure (mb)
5/5	0000	VWQF	17.4	89.2	WNW/27	1001.0
5/5	0000	VWYJ	19.2	89.5	N/25	998.8
5/5	0600	ATBA	18.3	90.4	W/35	999.7

Akyab reported a surface wind of 30 knots both at 0300 GMT and 1200 GMT of the 6th. The cloud pictures of ITOS - 1 at about 0800 GMT of 5th (Fig. 2) and ESSA - 8 at about 0400 GMT of the 6th indicated a well defined "eye". The maximum wind speed estimated from the satellite pictures was about 80 knots and the central pressure was approximately 975 mb.

#### 2. DEPRESSION, MAY 23-24.

A depression formed in northeast Bay of Bengal on the morning of 23rd May near 19.5°N, 91.0°E. It moved northeast, crossed the coast south of Cox's Bazar by the same night and weakened into a low pressure area over south Assam and the adjoining parts of Bangla Desh and Burma on the next day.

Associated with this system, the monsoon advanced into most parts of east central Bay by the 25th of May.

The APT cloud picture of ESSA - 8 in the morning and ITOS - 1 in the evening of 23rd suggested the disturbance was in Stage C.

#### 3. CYCLONE, JUNE 7-11.

A low pressure area formed over north Bay of Bengal on 6th June, and concentrated into a depression on the morning of 7th near 21.5°N, 89.5°E. It moved inland, and subsequently, it emerged into the head Bay of Bengal on the 8th. Thereafter, it intensified into a cyclonic storm on the morning of 9th, with its centre near 21.0°N, 88.0°E. Moving

northwestwards, the cyclone crossed north Orissa coast near Balasore on the night of 9th and lay as a deep depression near Rourkela at 0300 GMT of the 10th. Subsequently, it moved west and weakened into a low pressure area over east Vidarbha and adjoining central Madhya Pradesh by the 11th evening.

The system caused scattered heavy to very heavy rain in Gangetic West Bengal and Orissa from the 7th to 10th, and in Vidarbha and south Madhya Pradesh from the 11th to 13th. Local rivers in Vidarbha rose in flood and dislocated road communications. The notable rainfall amounts were :

Date	Station	Rainfall (cm)	Date	Station	Rainfall (cm)
7	Sandheads	24	11	Gondia	14
8	Sandheads	19		Wardha	13
10	Chandbali	15	13	Khandwa	28
	Angul	12		Buldhana	15

Sandheads reported a surface wind of 35 knots at 00 GMT of 9th and 30 knots at 1200 GMT. The lowest pressure recorded was 987 mb (departure -14 mb) at Sandheads at 0300 GMT of the 9th and at Balasore (departure -10 mb) at 1200 GMT of the same day. The central pressure of the storm was estimated to be 982 mb. This system was classified as C + from the NIMBUS/ESSA satellite pictures of 9th morning. There was marked outflow of Cirrus clouds towards the western and southern quadrants of the storm.

#### 4. DEEP DEPRESSION, JUNE 29 - JULY 3.

A low pressure area developed over north Bay of Bengal on the evening of 28th June and concentrated into a depression on the 29th morning with its centre near 20° N, 88° E. It intensified into a deep depression on the 30th morning, and crossed the north Orissa coast the same forenoon. Thereafter, it moved northwestwards, weakened into a depression and was centred on the morning of 2nd July over northeast Madhya Pradesh about 50 km north of Pendra. Continuing to move northwestwards, it gradually weakened into a low pressure area over the central parts of Uttar Pradesh by the 3rd evening.

It caused vigorous monsoon conditions in Orissa, Madhya Pradesh and Vidarbha during this period. According to press reports, some rivers in Orissa were in spate and flooded large areas of paddy fields in Cuttack district. The heavy rain in Madhya Pradesh caused floods in the Wainganga river and in its tributaries. It also dislocated road traffic in parts of Madhya Pradesh and caused damage to crops in Raipur district.

The notable amounts of rainfall associated with this system were :

Date	Station	Rainfall (cm)	Date	Station	Rainfall (cm)
30/6	Paradeep	21	2/7	Durg	17
	Puri	13		Gondia	16
1/7	Bolangir	22		Bhawanipatna	15
	Kanker	21	3/7	Hoshangabad	18
	Angul	17		Bhopal, Raigarh	14
	Durg, Titlagarh	16		Narsinghpur	13
2/7	Raipur	23			

At 0300 GMT of 30th June, Paradeep reported a wind speed of 45 knots and Sandheads 30 knots. On that day the 24 hour pressure change was about -6 mb, and pressure defect 5-6 mb on the Orissa coast. At 0300 GMT of 1st July, Sambalpur recorded a pressure defect of 8 mb.

#### 5. DEEP DEPRESSION, JULY 6-8.

A low pressure area, which moved westwards from Burma into east central Bay of Bengal on the 5th, concentrated into a depression on the 6th evening with its centre near 18.5° N, 91.0° E. Moving northwestwards, it became deep on the next morning, crossed the

C<sub>4</sub>

north Orissa coast near Balasore on the forenoon of the 8th and weakened into a low pressure area on the 9th over west Bihar and neighbourhood. Thereafter, it moved north to east Uttar Pradesh and adjoining Bihar Plains on the 10th. It persisted there till the 12th and later merged with the monsoon trough.

This system caused isolated heavy falls in east Madhya Pradesh, Vidarbha, Orissa, Gangetic West Bengal, Bihar and east Uttar Pradesh. The principal amounts of rainfall were :

<u>Date</u>	<u>Station</u>	<u>Rainfall (cm)</u>	<u>Date</u>	<u>Station</u>	<u>Rainfall (cm)</u>
9	Chandbali	10	11	Jaunpur	10
10	Krishnanagar	13	12	Patna Airport	15

This system was classified as Stage C from the Satellite APT pictures of the 6th evening and the 7th morning. Sandheads, Akyab and Maya Bandar reported pressure defects of 7 mb at 0300 GMT of 7th. On that evening, the pressure defect at Sandheads was about 9 mb. Sandheads recorded a surface wind speed of 30 knots at 00 GMT and 25 knots at 1200 GMT of the 7th. A ship (ZCSN) at 19°6, 91°1 E reported a wind of 20 knots from ESE at 00 GMT of the 7th and a pressure of 991.8 mb.

#### 6. DEPRESSION, AUGUST 17-19.

A low pressure system which lay over Burma on 15th August, moved westwards across the Bay of Bengal on 16th. It accentuated an already existing trough over west central Bay, which became well marked on the 17th morning and concentrated into a depression on the same evening about 100 km southeast of Gopalpur. It crossed the coast near Gopalpur on the 18th morning and weakened into a low pressure area over southwest Madhya Pradesh on the 20th morning.

In association with this system, there was widespread rain with scattered heavy falls in north Peninsular India and the central parts of the country. The heavy rain in Maharashtra State dislocated road traffic in many parts of the State, particularly in Vidarbha and Marathwada. In Andhra Pradesh, the flooded Kunderu river inundated many villages in Nandyal taluk in Kurnool district. The river Godavari inundated many parts of Bhadrachalam town and also many villages in Karimnagar, Nizamabad, Khammam and East and West Godavari districts. The heavy rain in Telangana dislocated road and rail traffic in many parts of Telangana and caused damage to paddy crops.

The principal amounts of very heavy rainfall were :

<u>Date</u>	<u>Station</u>	<u>Rainfall (cm)</u>	<u>Date</u>	<u>Station</u>	<u>Rainfall (cm)</u>
17	Agumbe	18	18	Nizamabad	14
	Mangalore AP	14	19	Harnai, Mahabaleshwar	21
	Betul	13		Bombay (Colaba)	20
18	Mahabaleshwar	20		Bhira	16
	Agumbe	20	20	Wardha, Dahanu, Bhira, Bombay (Santacruz)	12

A ship (SEGL) at 1100 GMT of the 17th reported WSW/30 knots winds near 16°8 N, 84°0 E and a pressure of 993 mb. Stations about 300-400 km to the north and south of the system reported easterly winds of 30 to 40 knots and westerlies of 40-50 knots respectively in the lower troposphere from the 17th to 20th. The maximum pressure defect reported was 10.5 mb at Chandrapur at 03 GMT on the 19th, near the centre of the depression. The APT pictures did not show any special characteristics.

### 7. DEEP LAND DEPRESSION, SEPTEMBER 2-8.

A low pressure area, which lay over Gangetic West Bengal and adjoining Bihar Plateau and north Orissa on 31st August, concentrated into a depression on the morning of 2nd September with its centre about 50 km northwest of Midnapore. It intensified into a deep depression on the morning of 3rd about 50 km east of Ranchi. Moving westwards, it weakened into a depression over north Gujarat State on the morning of 7th with its centre near Ahmedabad. Subsequently, it moved north to southwest Rajasthan by the 8th. Thereafter, moving westsouthwestwards, it emerged into the Arabian Sea on the 9th evening.

In association with this system, widespread rain was recorded in Gangetic West Bengal, Bihar Plateau, Orissa, Madhya Pradesh and Vidarbha from 1st to 7th and in Gujarat State from 6th to 8th. Rainfall was also fairly widespread in east Rajasthan from 6th to 8th. According to press reports, heavy rains in West Bengal, flooded vast areas in the districts of Murshidabad, Midnapore, Birbhum, Burdwan, 24 Parganas, Howrah and Hooghly resulting in some loss of life. Several thousands of people were rendered homeless. The flooded Narmada and Tapti inundated many parts of southwest Madhya Pradesh and Broach and Surat districts of Gujarat. Parts of Mandla, Hoshangabad and Harda towns were also submerged by the Narmada. The heavy rain in Saurashtra caused floods in the local rivers and dislocated road and rail traffic. The floods in Gujarat State took a heavy toll of human lives and caused very heavy damage to crops and other property. In Broach district, some 300 to 400 persons were reported to have been washed away in Tarsali and Titodra villages. Floods in Cuttack, Keonjargarh, Puri and Balasore districts in Orissa damaged standing crops.

The notable amounts of very heavy rainfall were :

<u>Date</u>	<u>Station</u>	<u>Rainfall (cm)</u>	<u>Date</u>	<u>Station</u>	<u>Rainfall (cm)</u>
2	Krishnanagar,	13	5	Pachmarhi	16
3	Sriniketan	14		Contai	15
	Calcutta, Dum Dum,		6	Khargone	18
	Burdwan	13		Bhaunagar	14
4	Burdwan	26	7	Surat, Bhaunagar	26
	Krishnanagar	22		V. Vidyanagar	21
	Bagati.	19		Baroda	20
	Dhanbad	15		Broach	15
	Betul	14			

The pressure defect near the centre of the system was generally about 8 to 10 mb between the 3rd and 7th. The easterlies at about 300 km away to the north of the system were 40-50 knots in the lower troposphere (upto 2.0 km a.s.l.) between the 3rd and the 5th.

An interesting feature of this system was the very heavy rain in Gangetic West Bengal on the 3rd and 4th in the rear of the system and the continuance of this spell of heavy rain on the 5th and 6th, even after the system had moved away westwards to west Madhya Pradesh.

### 8. DEEP DEPRESSION, SEPTEMBER 8-18.

A low pressure area moving across Burma into northeast Bay of Bengal on 8th September, concentrated into a depression on that day. It became deep on the 9th morning with its centre about 150 km southeast of Calcutta. It crossed the West Bengal coast that forenoon and moved northwestwards across Bihar Plateau to east Uttar Pradesh by the 12th. It remained near Lucknow-Kanpur area upto the 14th morning. Then moving eastwards, it weakened into a depression on the 15th, over east Uttar Pradesh and into a low pressure area over north Bihar by the 18th.

This system caused fairly widespread rain in Gangetic West Bengal and Orissa on 9th and 10th, in Bihar State from 9th to 12th and again from 16th to 19th, in Madhya Pradesh from 10th to 15th and in Uttar Pradesh from 10th to 19th. According to press reports, heavy and incessant rains in Uttar Pradesh caused much damage to property and widespread inundation. Some 150 persons lost their lives. In north Bihar, the flooded Ganga inundated some areas of Monghyr district while the Gandak and other rivers flooded many parts of Motihari in Champaran district. The flood situation in south Bengal became worse taking the death toll to 80 and affected about 8 million people. Considerable damage was also caused to crops and houses in south Bengal. The flood waters of the Subarnareka inundated the entire town of Jaleswar in Balasore district.

The principal amounts of very heavy rainfall were :

<u>Date</u>	<u>Station</u>	<u>Rainfall(cm)</u>	<u>Date</u>	<u>Station</u>	<u>Rainfall (cm)</u>
9	Sagar Island	16	15	Allahabad	23
	Burdwan	13		Orai, Banda	16
11	Ranchi	17	16	Kanpur	24
12	Sidhi	20		Fatehpur	21
13	Allahabad	16		Jaunpur	18
14	Fatehpur	21	18	Motihari	17
	Lucknow City	14	19	Chapra	18

The upper winds between 0.3 and 1.5 km within 200 to 300 km of the system were generally 30-35 knots, particularly in the northern and eastern sectors between the 9th and the 14th and 40-45 knots on one or two days. Lucknow reported a surface wind of 20-30 knots on the 13th, and upto midday of the 14th. The pressure defect near the centre of the system was generally 7-11 mb from 9th to 14th. The lowest pressure near the centre was about 990 mb on the 13th.

During most of this period, the APT cloud pictures showed well organised bands suggesting that the system could be classified as X category, Stage 2, equivalent to a cyclone.

The interesting features of this system were :

- i. It intensified over land between the 12th and 13th and could even be classified as a land cyclone of narrow core;
- ii. The system made a loop and persisted over Uttar Pradesh for 4 to 5 days giving very heavy rainfall.

#### 9. DEPRESSION, SEPTEMBER 21-23.

A well marked low pressure area formed over west central Bay on the 20th September. It concentrated into a depression on the morning of 21st about 100 km southeast of Vishakhapatnam. Thereafter, moving northwestwards across Vidarbha, it weakened into a well marked low pressure area over north Gujarat State and adjoining Rajasthan on 23rd.

This system caused widespread rain in north Peninsula from 21st to 23rd and scattered rain in Gujarat State from 23rd to 27th. The heavy rain in Hyderabad, which fell during a short interval of about 4 hours, was reported to have flooded the twin cities of Hyderabad and Secunderabad and caused many houses to collapse. About 775 lives were lost on account of heavy rain.

Bombay (Colaba) recorded 13 cm of rain, Begumpet 12 cm and Dahanu 10 cm on the 22nd.

A ship (PHFN) near 16°8 N, 85°4 E reported surface wind of SSW/20 knots at 0600 GMT of the same day and a surface pressure of 1001.6 mb. The pressure defect near the



centre of the system was about 7 mb on the 21st and 22nd. This system could be classified as Stage B, with the help of APT cloud pictures.

#### 10, SEVERE CYCLONE, OCTOBER 18-24.

A depression formed on the morning of 18th October near 14°5' N, 85°0' E. Moving slowly northnortheastwards, it intensified into a cyclonic storm on the morning of 20th and into a severe cyclonic storm on the morning of 21st, when it was centred near 16°0' N, 86°5' E. Taking a more northerly course on 22nd, it was centred near 21°5' N, 89°0' on the morning of 23rd. An interesting feature of the storm was the absence of any marked change in upper air temperatures of Calcutta between the evening (1200 GMT) ascents of October 22 and 23.

The storm crossed the Sunderbans coast near West Bengal - Bangla Desh border on that forenoon; thereafter, moving across Bangla Desh it weakened into a low pressure area over south Assam and adjoining parts of Bangla Desh on the 24th evening.

In association with this system, there was widespread rain in the Bay Islands from 18th to 23rd, in Tamil Nadu on 18th and 19th, in Gangetic West Bengal on 23rd and 24th and in Assam from the 23rd to 25th. Scattered heavy to very heavy falls were recorded in Gangetic West Bengal on 23rd. Calcutta City recorded a maximum wind speed of 105 km. p.h. in gusts on the 23rd. (Fig. 6). According to press reports, the cyclone disrupted communications and caused damage to houses and crops in the coastal districts of West Bengal. Life in Calcutta city was paralysed on the 23rd by the failure of power supply. The cyclone wrought considerable havoc in Bangla Desh, where 200-300 people were reported to have lost their lives.

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

Contai 15 cm, Sagar Island 13 cm, Bagati 11 cm and Calcutta 9 cm on the 23rd and Shillong 22 cm and Tura 10 cm on the 24th.

The following ships' reports were available in and near the storm field :

Date	Time (GMT)	Call Sign	Lat. °N	Long. °E	Wind (knots)	Pressure (mb)
18/10	0000	Ship	13.5	85.0	SW/15	1003.7
	0600	PCPL	12.6	84.5	SW/30	1003.9
	1200	GVPC	16.6	85.6	ENE/10	1004.0
	1500	GSWE	15.7	86.7	SSW/24	1003.5
20/10	0130	SWQM	14.2	86.3	SW/45	-
	0200	VWVT	15.8	83.4	NNW/30	1000.3
21/10	0000	KRRL	14.8	87.8	SW/30	998.0
	1200	ATAP	14.5	87.2	SW/52	999.5
	1200	VWJN	17.3	88.3	SE/45	994.0
	1800	MSDN	19.0	89.4	S/25	998.7
22/10	0000	GIAY	15.4	86.0	W/44	999.0
	0600	GIAY	16.3	86.6	WNW/50	998.1
	1200	MSDN	16.9	90.1	SW/50	995.5

On the morning of 23rd, when the storm was close to the coast near West Bengal - Bangla Desh border, Calcutta and the ship "Sandheads", which lay close to Diamond Harbour reported a 24 hour pressure change of -9 mb and a departure of -18 mb. On the same evening, Agartala reported a 24 hour pressure change of about -12 mb and a pressure departure of -16 mb.

The APT cloud pictures received showed this system as generally belonging to class X-2 or 3 with a central overcast region of about 3° diameter during the period 20th to 23rd.

The maximum wind estimated from the satellite pictures was about 70 knots and the estimated pressure at the centre of the cyclone 980 mb.

#### 11. SEVERE CYCLONE, NOVEMBER 8-13.

A depression formed in south and adjoining central Bay of Bengal on the morning of 8th November with centre near 12°5 N, 86°5 E. Moving very slowly northwards, it intensified into a cyclonic storm on the morning of 9th, when it was centred near 13°5 N, 86°5 E.. It remained stationary near 14.5 N, 87.0 E from the 9th evening to the 10th morning. Then moving northnortheastwards, it intensified into a severe cyclonic storm, which was centred on the morning of 11th near 16°5 N, 87°5 E. Taking a northeasterly course it crossed the coast of Bangla Desh during the night of 12th. It was centred about 100 km southsoutheast of Agartala on the morning of 13th as a cyclonic storm. Then it rapidly weakened into a low pressure area by the same evening over south Assam.

This system caused widespread rain in the Bay Islands from 8th to 11th, with scattered very heavy falls on the 8th and 9th. There was also fairly widespread rain in Gangetic West Bengal on the 12th and 13th, and in south Assam on the 13th and 14th. According to press reports, this cyclone caused unprecedented havoc on the off-shore islands and the coastal districts of Bangla Desh. There was heavy damage to life and property, largely due to storm surge of approximately 4-5 metres height. The surge apparently reached its maximum height at 00 GMT of November 13 at Chittagong harbour. This cyclone did not affect India seriously. But heavy rain in the Bay Islands during the 8th and 9th resulted in floods in these islands. There was also considerable damage to houses and crops in the Mizo hills district of south Assam. Some damage to houses and crops was also reported from the southern parts of 24 Parganas.

The notable amounts of rainfall associated with this system were :

Date	Station	Rainfall (cm),	Date	Station	Rainfall (cm)
8	Hut Bay	21	9	Maya Bandar	22
	Port Blair	13		Long Island	12

The following ships' reports were available in and near the storm field :

Date	Time (GMT)	Call Sign	Lat. °N	Long. °E	Wind (knots)	Pressure (mb)
8/11	0000	VWSJ	15.3	85.9	NE/23	1008.3
9/11	0000	VQHJ	13.9	83.2	NNE/25	1004.3
	0000	VWPS	12.3	89.3	S/24	1009.3
	0600	VWIM	10.8	84.0	NW/20	1006.2
	1500	GDSJ	14.7	86.8	E/30	994.9
10/11	0000	VWIM	13.8	84.8	NNW/25	1003.7
	0000	GDSJ	14.3	86.8	NNE/40	1001.0
	0400	ULUF	16.1	87.2	ENE/60	-
11/11	0000	VWIM	16.1	85.2	N/30	1001.7
12/11	2200	SS Rajah	Near Chittagong port		SE/52	-
	2300	- do -	- do -		SE/64	993.5
13/11	0000	- do -	- do -		SW/64	982.6

A ship M.V. Mahajagmitra reported at 0530 hrs GMT of 12th near 20°5 N, 89°0 E winds of hurricane force and a pressure of 964 mb. Subsequently, the ship was lost with 50 persons on board.

Some interesting observations from the coastal areas as the storm was moving north towards the head Bay of Bengal are given below :

Date	Time	Station/Location	24 hour prs. change mb	Pressure dep. from normal (mb)	Wind Knots
12/11	0300	Sandheads	-	-	ENE/80 at surface (estimated)

Date	Time GMT	Station/Location	24 hour prs. change mb	Pressure dep. from normal(mb)	Wind Knots
12/11	0300	N.Orissa/West Bengal coast	-7 to -8	-10 to -12	-
	0300	Burma coast	-2	-5	-
	1200	West Bengal coast	-8 to -9	-12	-
		Bangla Desh coast	-7 to -8	-7 to -8	-
	1200	Chittagong and Calcutta	-	-	40/50 from 1.0 to 2.0 km
13/11	0000	Agartala	-	-	NNE/30 at surface. NE/60 at 0.6 km
	0300	Agartala	-9	-12	-

The APT cloud pictures showed this system to be in Stage X, category 2 or 3 on the 9th and 10th and Stage X, Category 3 or 4 on the 11th and 12th. Both the ESSA-8 and the ITOS-1 pictures on the 11th showed a clear "eye". The maximum wind estimated from the satellite pictures was about 100 knots and the central pressure was 966 mb.

## 12. DEEP DEPRESSION, NOVEMBER 19-20.

A low pressure area from south Andaman Sea moved westwards into south Bay by the 18th November and became well marked. It concentrated into a depression on the morning of 19th about 600 km southeast of Madras (near 9°0 N, 84°0 E). It became deep on that evening and moving westnorthwest, crossed the Tamil Nadu coast near Vedaranniyam on the forenoon of 20th. Then it weakened into a low pressure area over Tamil Nadu.

In association with this system, fairly widespread rain occurred in Tamil Nadu from the 19th to the 21st, with heavy to very heavy falls in coastal Tamil Nadu. According to press reports, heavy rain in coastal Tamil Nadu inundated low lying areas from Pondicherry to Atirampattinam. There was some damage to houses and crops in Thanjavur district. Heavy rain in Madras on the 21st paralysed city life, flooding low lying areas and rendering thousands of people houseless. Rameswaram and Pamban experienced squally weather.

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

Date	Station	Rainfall (cm)	Date	Station	Rainfall (cm)
19	Cuddalore	13	20	Vedaranniyam	21
20	Cuddalore	31 (Exceptionally heavy)	21	Atirampattinam	13
	Nagapattinam	21		Madras Airport	19
	Pondicherry	21		Madras City	15

The following ships' observations were available near the depression field.

Date	Time GMT	Call Sign	Lat. °N	Long. °E	Wind (knots)	Pressure (mb)
19/11	1200	VWXC	11.6	82.6	ENE/21	1003.7
	1200	VWRD	10.8	81.6	ENE/18	1002.0

The pressure defect observed was about 4-5 mb.

From the APT picture received at Bombay, the system was classified as Stage X, Category 1 on the 19th and 20th.

ARABIAN SEA

## 1. CYCLONE, MAY 28 - JUNE 2.

A low pressure area formed off the Mysore - Goa coast on 27th May and concentrated into a depression on the 28th evening near 14°5 N, 71°5 E. Moving north, it intensified into a cyclonic storm on 29th evening near 16°5 N, 71°5 E. Thereafter, moving northwest, it weakened into a deep depression on the 31st morning near 19°N, 68°E. Later it moved away westwards and crossed into Saudi Arabia near 20°N on the morning of 3rd June.

In association with this system, the monsoon advanced upto south Konkan by the end of May. Although the depression moved away westwards, the incursion of moist Arabian Sea air continued in Gujarat State, West Madhya Pradesh and Rajasthan during the first three days of June. Moderate rainfall was recorded in these areas upto 4th June.

The following ships reports were available near the storm field.

Date	Time GMT	Call Sign	Lat. °N	Long. °E	Wind (Knots)	Pressure (mb)
29/5	1200	PDIT	16.5	69.2	NW/15	999.9
	1200	JDFU	16.3	69.8	NW/25	1000.0
	1300	VWCC	15.6	70.8	W/20	996.2
	1600	VWCC	16.0	71.1	WNW/25	996.8
30/5	1500	VWCC	17.3	71.6	WSW/30	995.1
31/5	0545	SLWT	20.5	68.0	E/25	-
	0850	SLWT	20.3	68.0	SE/30	-
1/6	1200	SRRN	17.1	61.9	WSW/20	998.0
2/6	0000	PHWJ	20.8	59.3	NNE/20	999.2
	0600	6ZRG	18.0	59.2	SW/15	998.5
	1200	PHWJ	18.5	58.0	W/15	997.7

From the Satellite picture, this system could be classified as Stage X Category 1 on the 29th and Stage X Category 2 on the 30th and 31st. On the 1st and 2nd June, it was Stage B or C. The maximum wind speed estimated from the satellite pictures was about 50 knots and the estimated central pressure was 986 mb.

## 2. CYCLONE, SEPTEMBER 10-13.

A depression which lay over southwest Rajasthan on the 8th, moved westsouthwestwards and emerged into the Arabian Sea on the evening of 9th. It became deep on the 10th morning. It probably intensified into a cyclonic storm that evening with its centre near 23°5 N, 64°0 E. Then moving slowly westwards it weakened into a low pressure area over northwest Arabian Sea and coastal Arabia by the 14th.

This system caused widespread rain in Kutch. Naliya recorded 8 cm of rain on the 9th and 5 cm on the 10th. This system was tracked in north Arabian Sea with the help of Satellite pictures. No ships reports were available near the storm field.

This system could be classified as Stage X Category 2 from the APT satellite pictures on the 10th and Stage X Category 3 on the 11th. An "eye" was visible on the 11th. (Fig. 11). It was Stage C on the 12th. The system was probably a cyclonic storm with a narrow core.

## 3. DEPRESSION, OCTOBER 11-13.

A low pressure area moving westwards from the Bay of Bengal across the Peninsula, emerged into the east central Arabian Sea off Mysore - south Maharashtra coast on the morning of 11th October, and concentrated into a depression with its centre near 14°N,

71° E. Then it moved away westnorthwestwards and weakened into a low pressure area off the Saudi Arabia coast by the 13th evening.

Except for fairly widespread rain in south Maharashtra State and coastal Mysore and scattered rather heavy rain in the Arabian Sea Islands on the 11th, it did not affect the country.

Amini, Androth and Karwar recorded 4 cm of rain each on 11th.

This system was tracked mainly with the help of satellite pictures and could be classified generally as Stage B on the 11th, 12th and 13th.

#### 4. CYCLONE, NOVEMBER 22-29.

A low pressure area which lay over Tamil Nadu on the night of 20th November, emerged into the Laccadive area off the Kerala coast on the 21st and concentrated into a depression on the morning of 22nd near 10°0 N, 71°0 E. Moving westwards, it was centred near 9°5 N, 64°0 E on the 26th morning. Thereafter, moving westsouthwestwards, it intensified further into a cyclonic storm on the morning of 28th near 8°0 N, 57°0 E. Continuing to move westsouthwestwards, it weakened rapidly into a low pressure area off the Somalia coast on the next day.

This system caused fairly widespread rain in the Arabian Sea Islands from the 22nd to 24th. Amini recorded 6 cm of rain on the 23rd. The following ships' reports were available in and near the field of the disturbance.

Date	Time GMT	Call Sign	Lat. °N	Long. °E	Wind Knots	Pressure (mb)
23/11	0900	GJXE	11.8	69.8	ENE/25	1009.7
	1500	GYV	11.6	69.8	SE/20	1008.1
	1800	GYV	12.4	69.2	E/20	1008.0
24/11	0000	GYV	13.5	68.2	ENE/25	1008.0
	0600	VWLG	11.6	69.7	ESE/24	1006.5
	1200	GYQV	9.6	64.4	NNW/20	1007.4
	1200	GJXE	7.3	65.4	WNW/15	1008.2
	1200	VWLG	10.5	70.5	E/20	1006.5
25/11	0000	GYQV	9.1	66.8	NNW/10	1004.8
	1200	GYQV	8.8	69.3	S/15	1007.0
26/11	0600	VWZM	10.5	64.3	ENE/15	1006.7

There were no ships' reports on the subsequent days and the system was tracked with the help of satellite pictures only.

This system could be classified as Stage B or C upto 27th and as Stage X, Category 1 on the 28th. The maximum wind speed estimated from the Satellite picture was about 40 knots on the 28th.

Note :- The Annual Summary - Part C will not be published from 1971 onwards as the account of storms and depressions for 1971 and onwards will be published in the Indian Journal of Meteorology, Hydrology and Geophysics.

TABLE 1  
MONTHLY DISTRIBUTION OF CYCLONES AND DEPRESSIONS IN THE  
BAY OF BENGAL AND ARABIAN SEA - 1970.

C  
12

Month	Jan		Feb		Mar		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	D	C	D	C	
Bay of Bengal	-	-	-	-	-	-	-	-	-	1	1(1)	1	1	1	-	1	-	2	-	-	1(1)	1	1(1)	-	-	7	4(3)
Arabian Sea	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	-	-	1	-	-	-	1	3
Land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
Total	-	-	-	-	-	-	-	-	-	1	2(1)	1	1	1	1	1	-	3	1	1	1(1)	1	2(1)	-	-	9	7(3)

D - Depressions                      C - Cyclones  
 Figures in bracket indicate severe cyclones.

APPENDIX I

LEGEND FOR FIGURES

- Fig. 1 Tracks of Storms and Depressions in the Indian Seas (1970).
- Fig. 2 ITOS-1 view of the severe cyclone in the Bay of Bengal on 5 May 1970 at 0844 GMT. A faint but pin-point eye can be seen.
- Fig. 3 ESSA-8 view of the land depression on 12 September 1970 at 0445 GMT.
- Fig. 4 Dines P.T. Anemograph record of Calcutta on 23 October 1970. The maximum speed reached was 104 kmph at about 1250 IST.
- Fig. 5 ESSA-8 view of the Bay cyclone on 21 October 1970 at 0355 GMT. Storm in the intensifying stage.
- Fig. 6 ITOS-1 view of the same cyclone on 22 October 1970 at 0923 GMT. The storm has become severe.
- Fig. 7 ESSA-8 view of the East Pakistan cyclone at 0350 GMT on 10 November 1970.
- Fig. 8 ITOS-1 view of the East Pakistan severe cyclone at 0859 GMT on 11 November 1970. A well defined eye can be seen. This picture is by the kind courtesy of NESC, Washington.
- Fig. 9 ESSA-8 view of the East Pakistan severe cyclone at 0337 GMT on 12 November 1970.
- Fig.10 Hyetogram of Cuddalore on 20 November 1970. About 11 cm of rain fell between 0400 and 0530 IST.
- Fig.11f ESSA-8 view of the Arabian Sea cyclone on 11 September 1970 at 0609 GMT.
- Fig.12 ESSA-8 view of the Arabian Sea cyclone on 28 November 1970 at 0534 GMT.

# TRACKS OF STORMS AND DEPRESSIONS (IN THE INDIAN SEAS)

1970

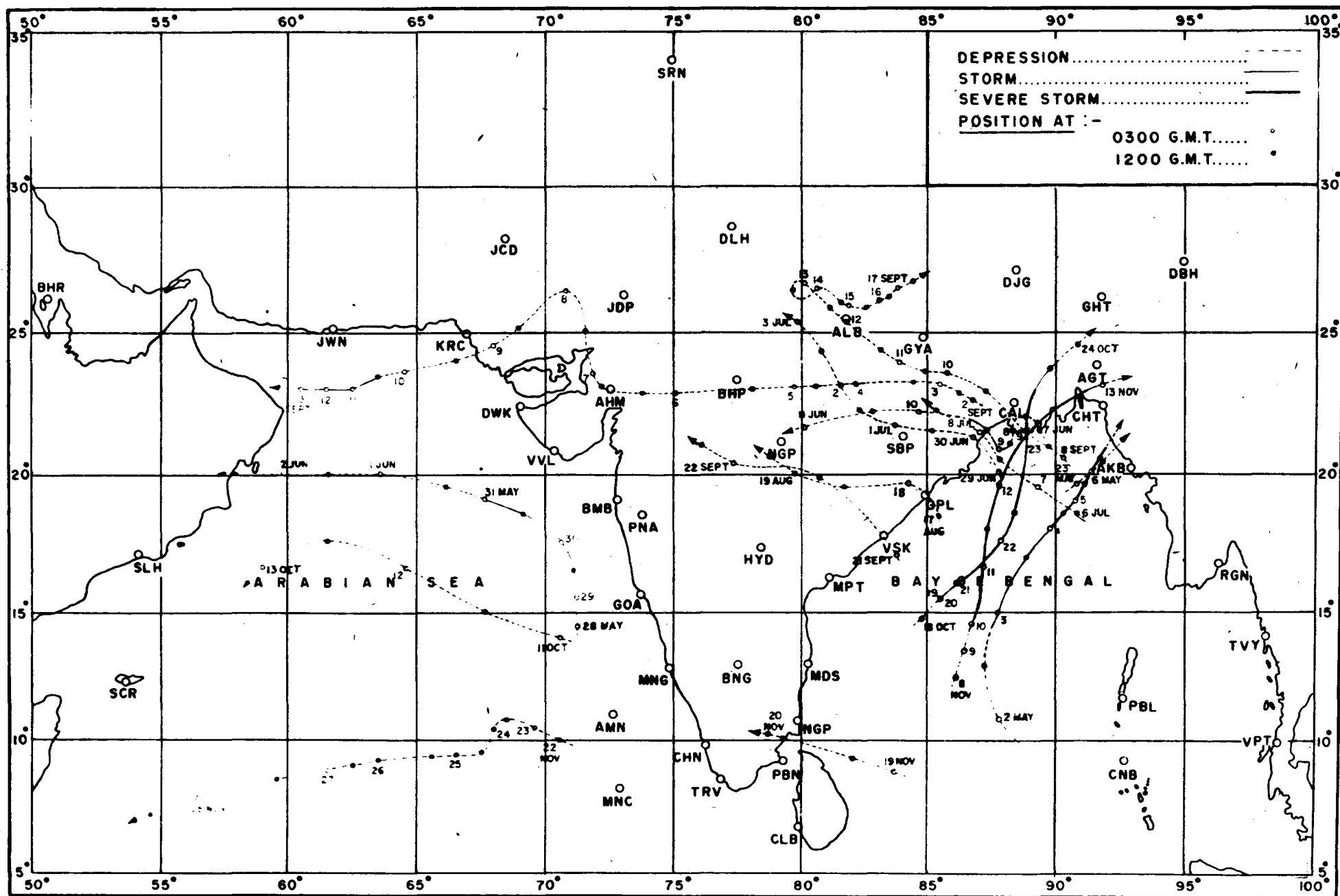


FIG. 1



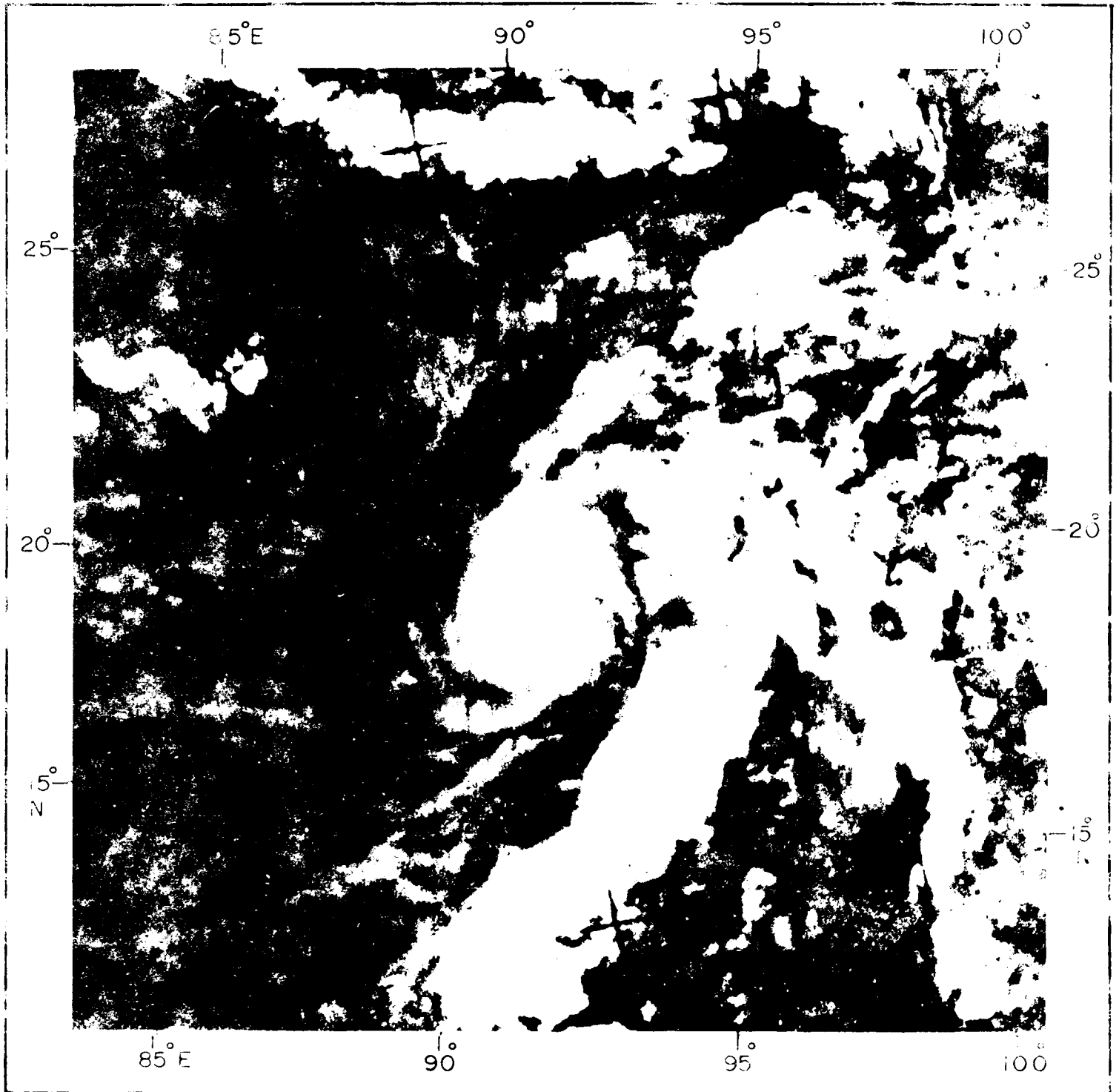


FIG 2 ITOS-1, 5 MAY 1970, 0844 GMT.



FIG 3 ESSA-8, 12 SEPT 1970, 0445 GMT.

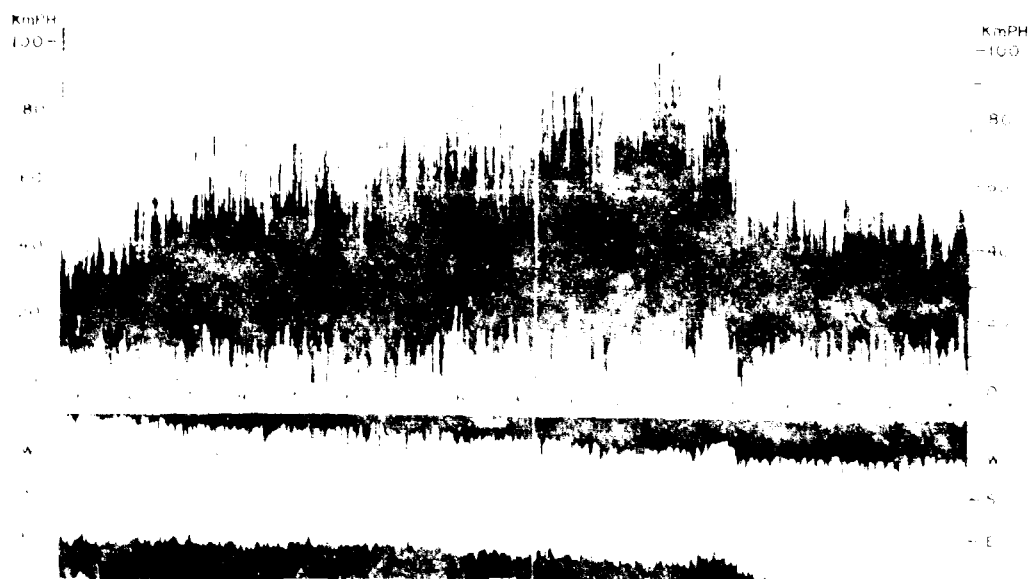


FIG 4 DINES P.T. ANEMOGRAPH, CALCUTTA 23 OCTOBER 1970

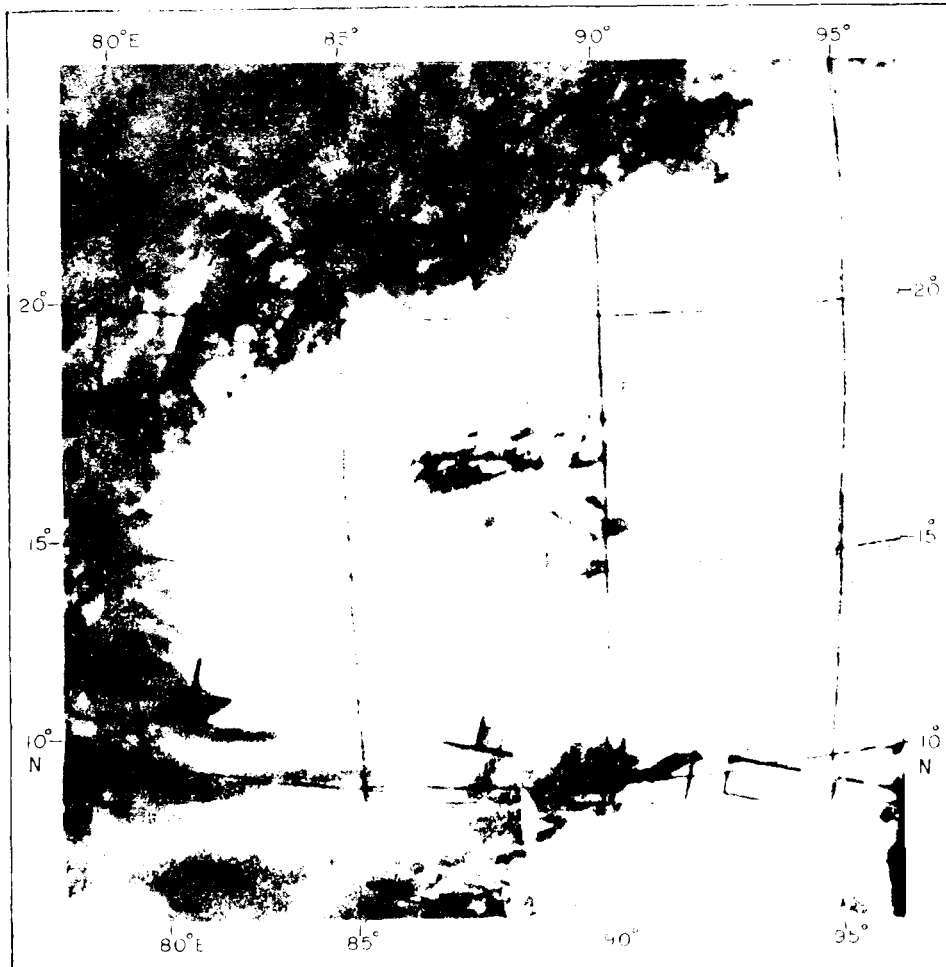


FIG. 5  
 ESSA 9  
 21 OCT 1970  
 0355 GMT.

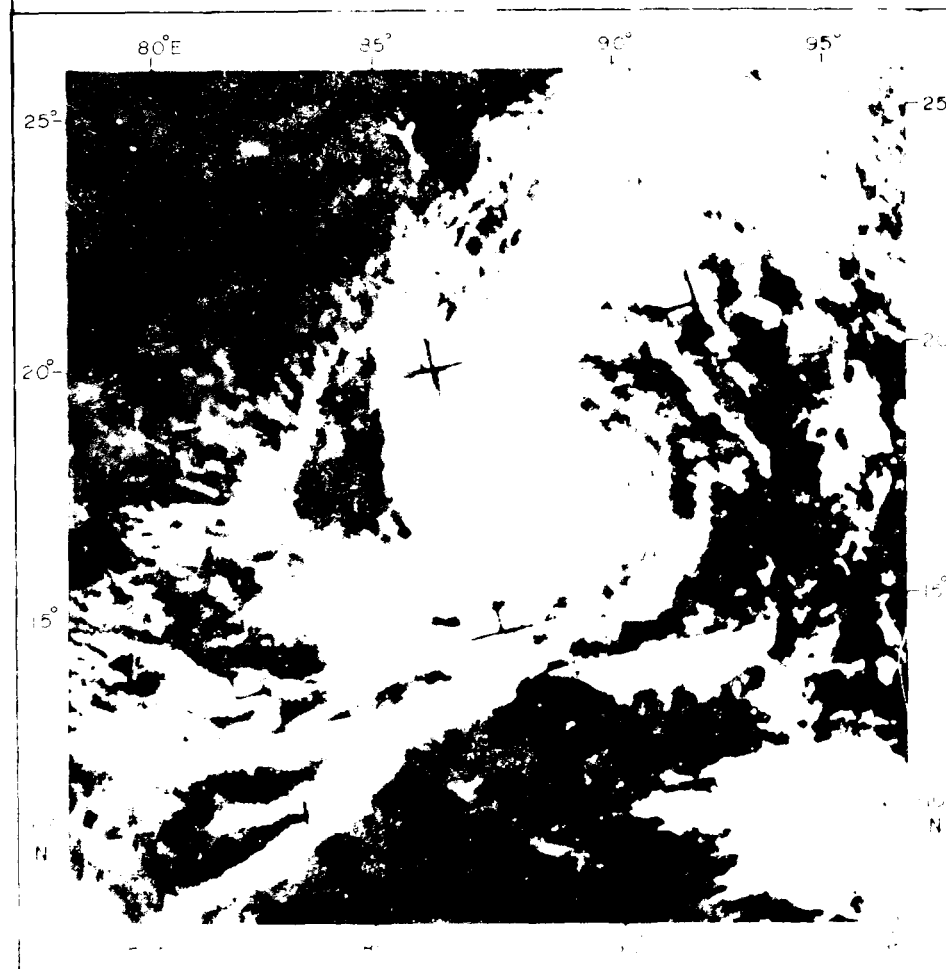


FIG 6  
 ITOS-1,  
 22 OCT 1970  
 0923 GMT.

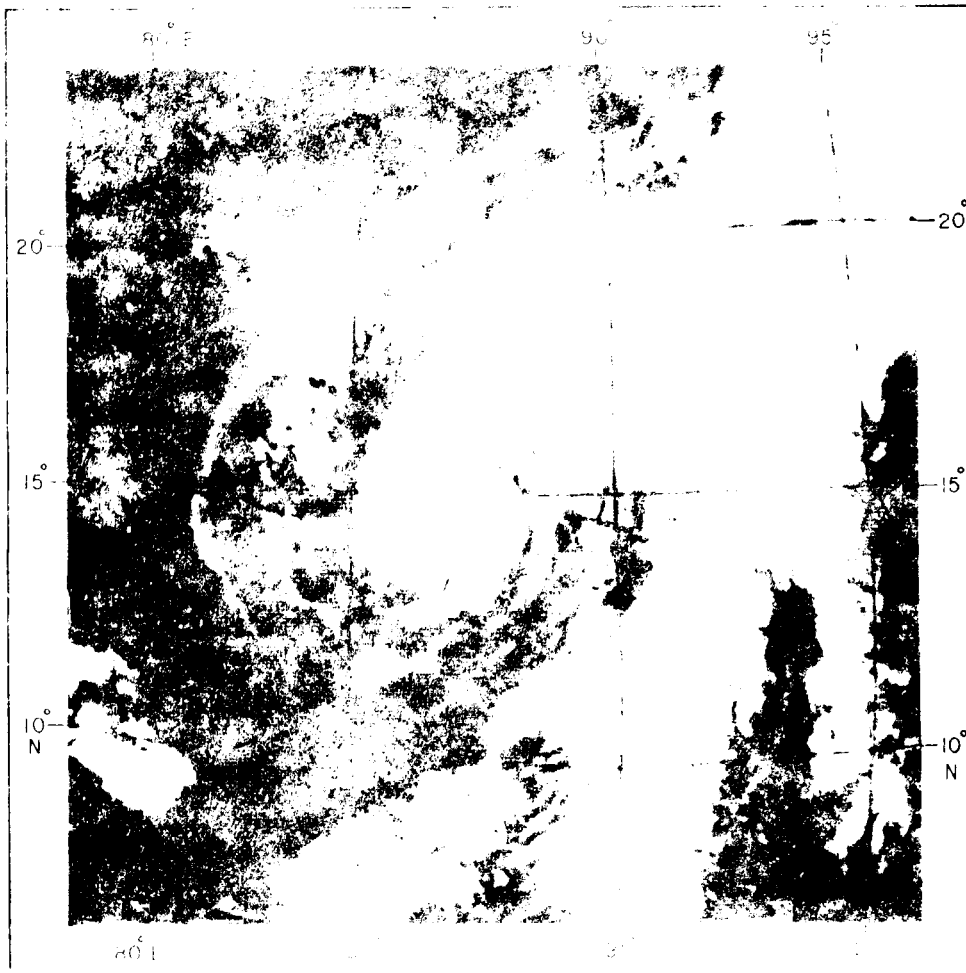


FIG. 7  
 ESSA-8,  
 10 NOV 1970.  
 0350 GMT.

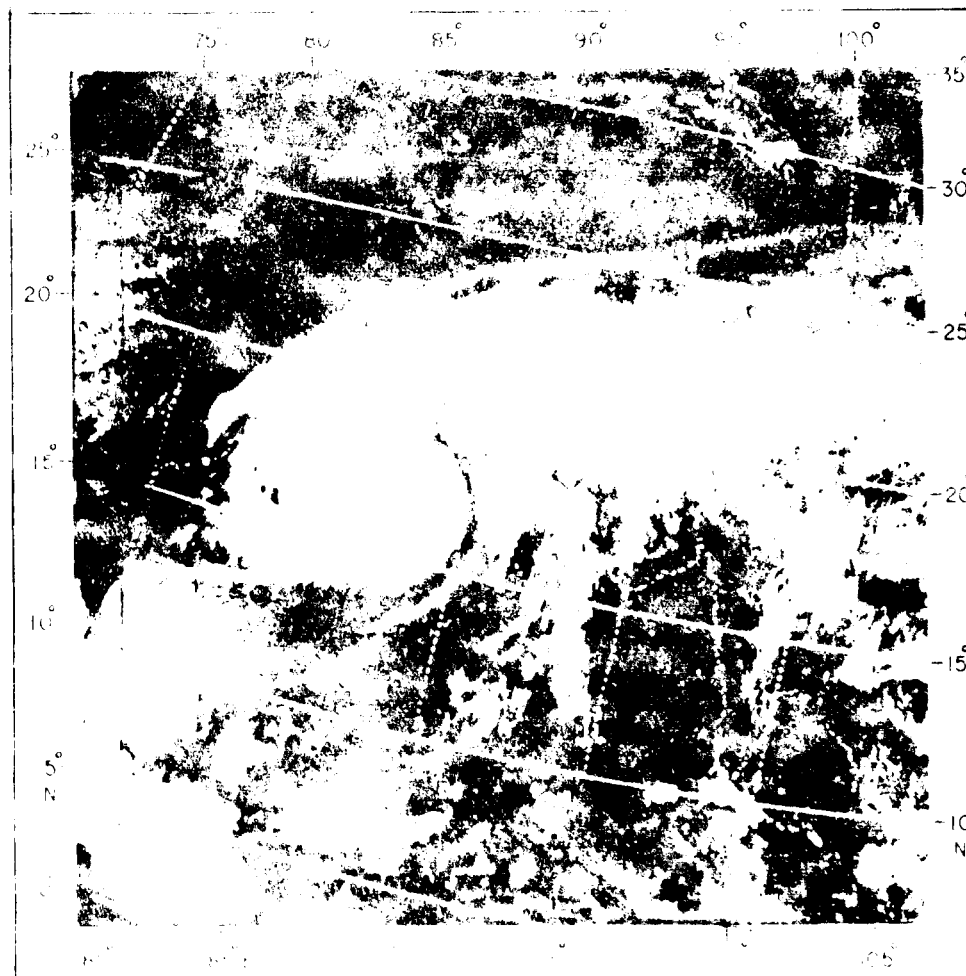


FIG. 8  
 ITOS-1,  
 11 NOV 1970.  
 0859 GMT.

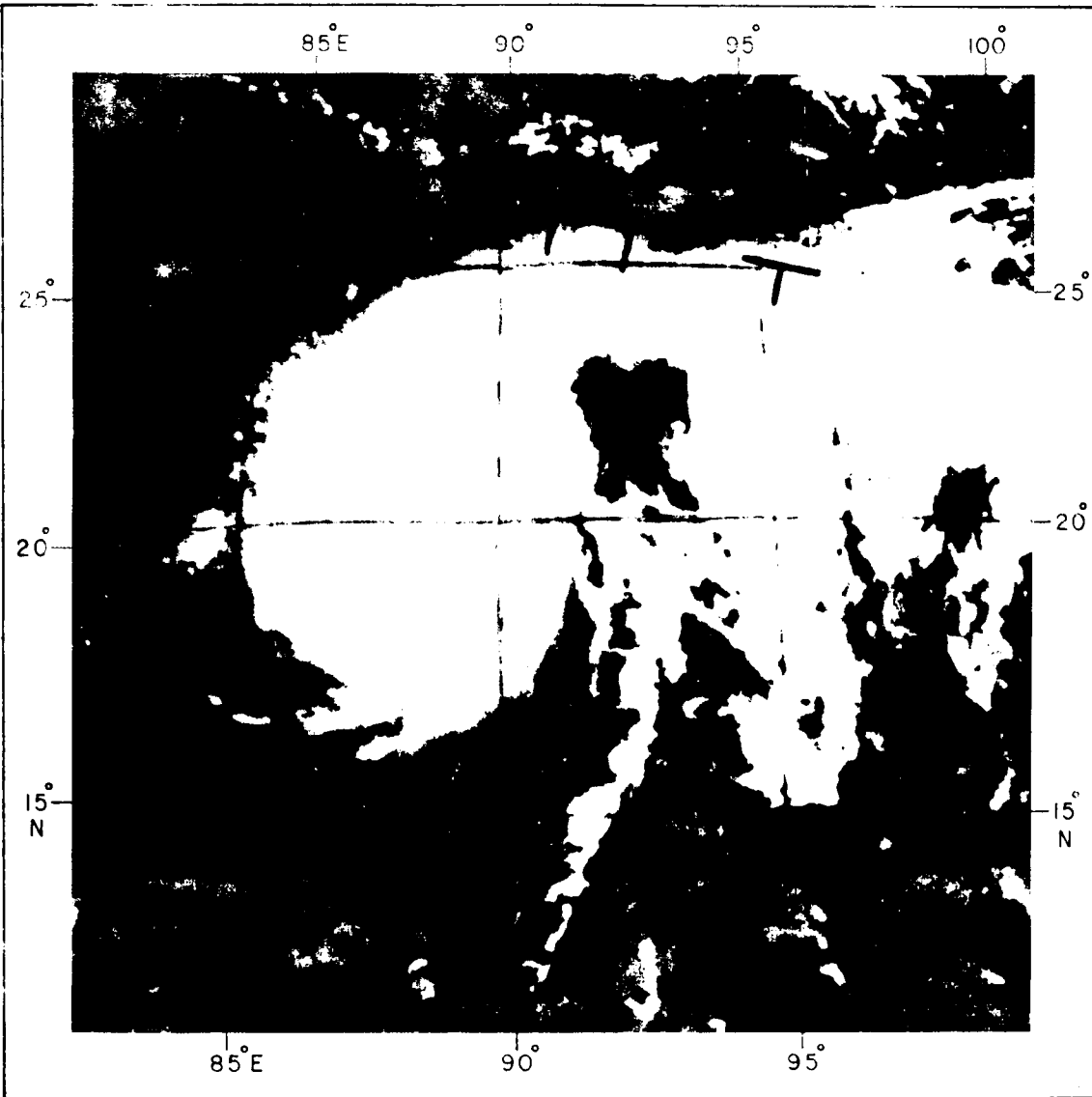


FIG.9 ESSA- 8 ,12 NOVEMBER 1970, 0337 GMT.

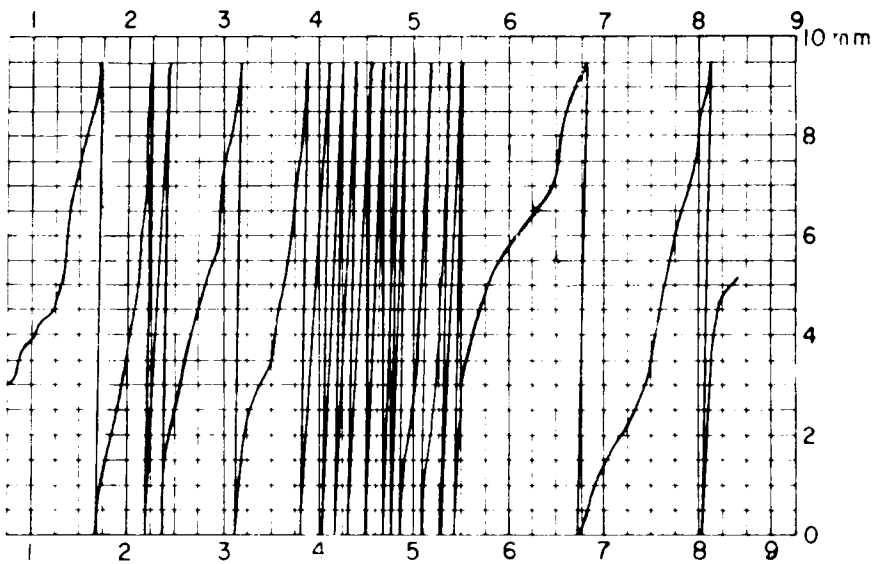


FIG.10 HYETOGAM OF CUDDALORE  
20 NOVEMBER 1970



FIG. II  
 ESSA-8,  
 11 SEPT 1970,  
 0609 GMT.



FIG. 12  
 ESSA-8,  
 28 NOV 1970,  
 0534 GMT.