

CHAPTER 5

INDIVIDUAL TYPHOONS OF 1970

NOTE. See last page of this chapter for definition of units and terms appearing herein.

A. TYPHOON NANCY 19 FEB 2300Z-27 FEB 1100Z*

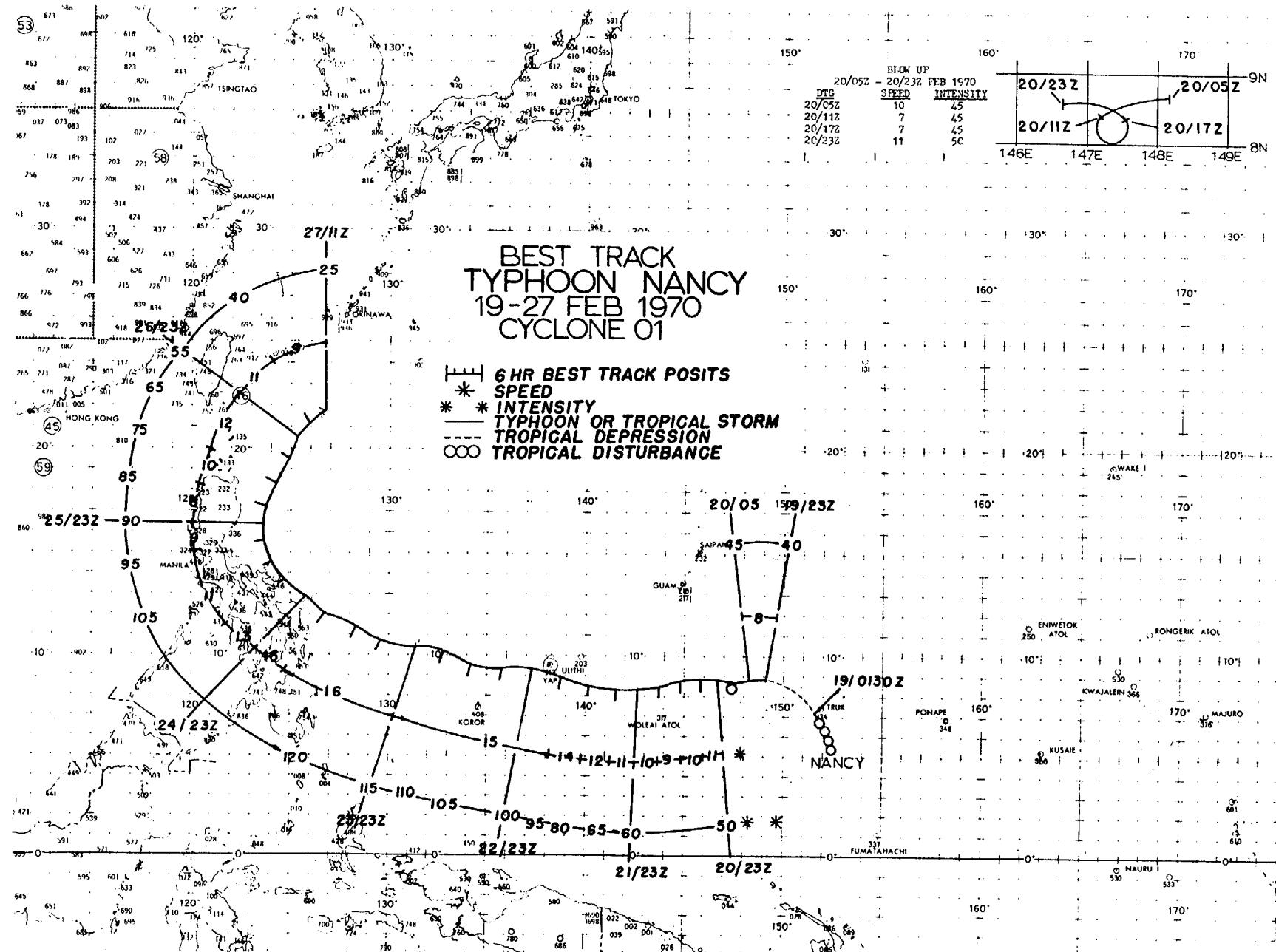
1. STATISTICS

- a. Number of Warnings Issued - 31
- b. Number of Warnings with Typhoon Intensity - 19
- c. Distance Traveled During Warning Period - 2,148 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 949 MBS at 24/0900Z
- b. Minimum Observed 700 MB Height - 2606 M at 24/2100Z
- c. Maximum Surface Wind - 120 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 400 MI

*Time of First and Last Warning Issued (Followed throughout Chapter 5.)



3. TYPHOON NANCY NARRATIVE

On the 18th of February a mass of increased convective activity showing signs of organization was noted south of the Central Carolines by the ESSA-8 Satellite. A recon aircraft was dispatched to the area the following day finding a weak circulation with a 1004 mb central pressure and thus the birth of Nancy was detected just south of Truk Island.

For several days prior to the 18th, satellite pictures had shown active ITCZ cloudiness in the region between the Central Carolines and the equator. During this period a front advanced into the tropics, producing a tightening pressure gradient across the Caroline chain and increasing the horizontal shear. It is believed that this increase provided the impetus for development of a weak perturbation located in the intertropical trough. This situation is similar to events described by Fett (1968) for generation of Typhoon Marie in 1966.

The developing Nancy drifted northwestward and reached tropical storm intensity early on the 20th. Swinging on a westerly track at 10 to 12 knots, it passed through the Caroline chain as it reacted to an east-west oriented ridge line to its north. Typhoon intensity was reached mid-day of the 22nd (Figure 5-1), about 100 miles northwest of Woleai Atoll, as Nancy moved from beneath a weak 200 mb trough which had been an inhibiting feature to outflow aloft from the storm.

Development of typhoon strength is unusual for a tropical storm during February. For the past 25 year period of record only one other storm (Irma, 1953) achieved this mark.

The eye of Nancy passed 35 miles south of Yap early the following morning with the island experiencing winds of 60 knots gusting to 69 knots and a barometer reading of 988.4 mb. Fortunately, the wall cloud region did not cross over Yap, as the storm at that time had reached 95 knots in intensity. A reconnaissance aircraft shortly afterward reported a circular eye 25 miles in diameter and a central pressure of 958 mb.

Damage on Yap was estimated to be \$160,000 with no personal casualties. Major damage was caused by heavy sea action and rains resulting in erosion of roads and causeways and damage to crops and homes.

Upon movement into the Philippine Sea at a rate of 15 to 16 knots, the typhoon approached the southwestern periphery of the subtropical ridge and began to slowly change to a more northwesterly course on the 24th some 330 miles east of Leyte.

5-4

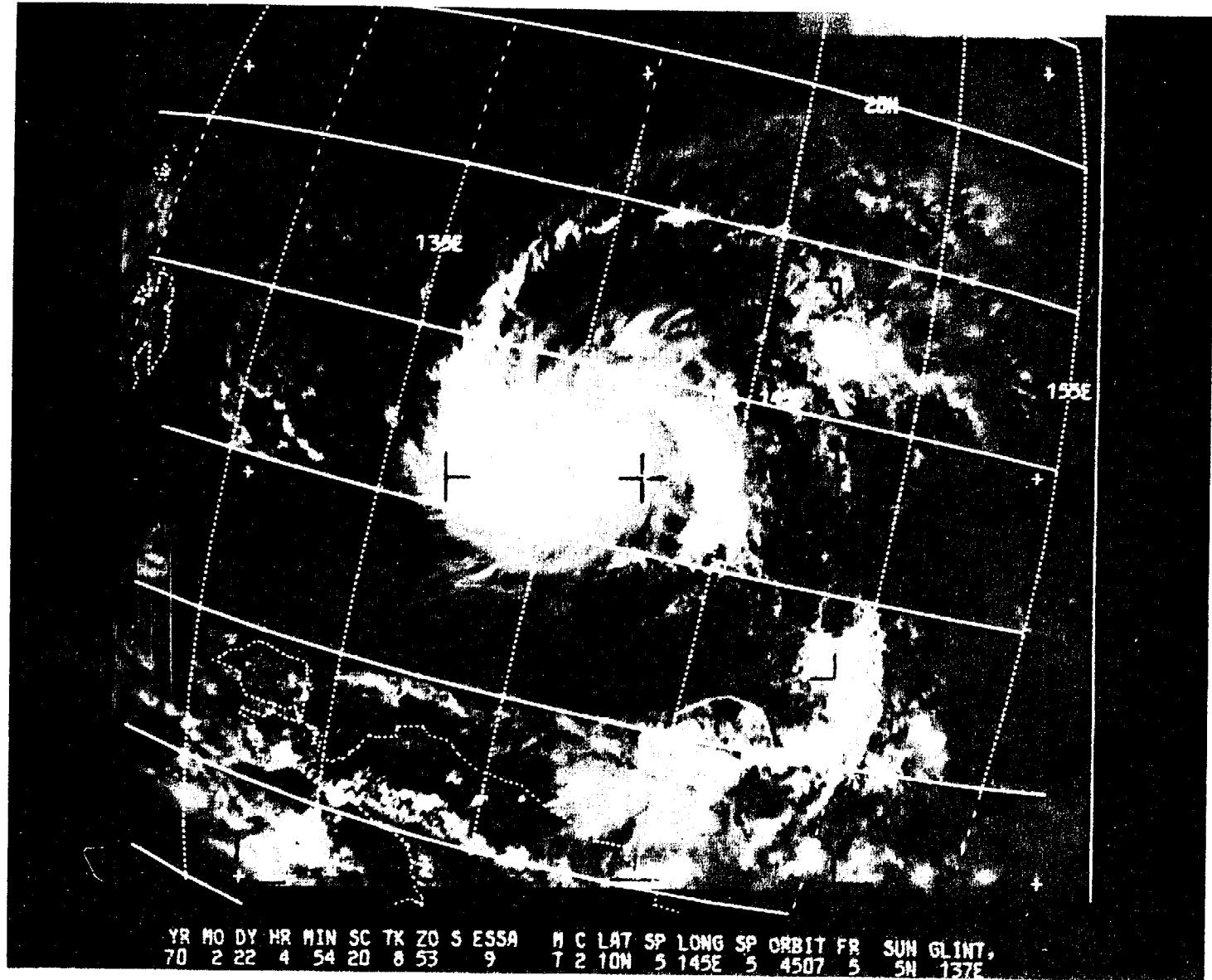


FIGURE 5-1 ESSA 9 VIEW OF NANCY TAKEN ON 22 FEBRUARY SHORTLY AFTER REACHING TYPHOON INTENSITY.

Nancy was near her peak intensity at 120 knots (Figure 5-2) when the American ship Antinous bound from Manila to Guam was caught in her eye shortly before midnight on the 24th about 90 miles east of Samar. The ship's log referred to monstrous confused seas with winds well over 100 knots and wave swell heights over 40 feet. Three large butane tanks on the main deck broke loose and carried away a large portion of the bulwark. A minimum pressure of 953 mb was recorded while in the eye. The barograph track of the Antinous is reproduced in Figure 5-3.

As the typhoon commenced to recurve, her track brought the edge of the eye over Catanduanes Island on the afternoon of the 25th. The U. S. Coast Guard loran station on the island recorded a maximum wind of 120 knots before the wind indicating equipment jammed. A duplicate of the Antinous' minimum pressure of 953 mb was logged by the station's barometer while in the eye.

Paralleling the Luzon coast some 100 miles offshore, Nancy began to slowly weaken as she approached the westerlies. Turning on a northeast course she decreased to tropical storm strength on the 26th. Becoming extratropical she was absorbed into a frontal zone late on the 27th some 240 miles southeast of Okinawa.

Property damage on the Philippine islands of Catanduanes and Samar was estimated near a million dollars (U.S.) with about 5,000 families rendered homeless.

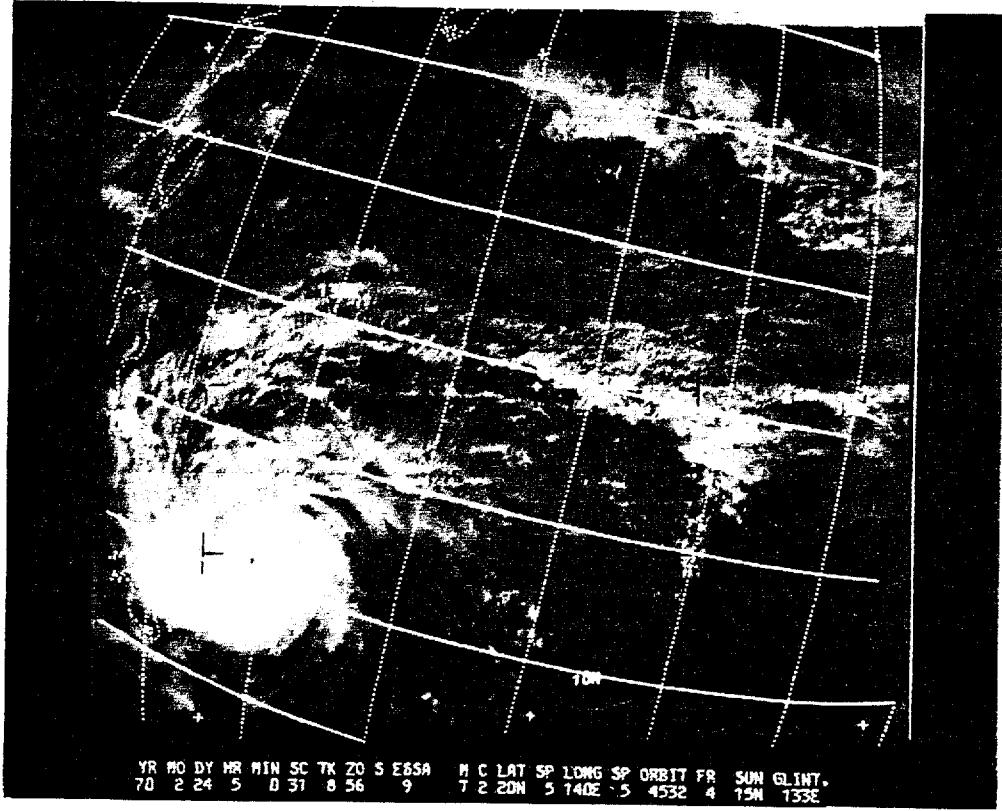


FIGURE 5-2 ESSA 9 PHOTO OF NANCY TAKEN ON 24 FEBRUARY NEAR ITS PEAK STRENGTH 120 KTS

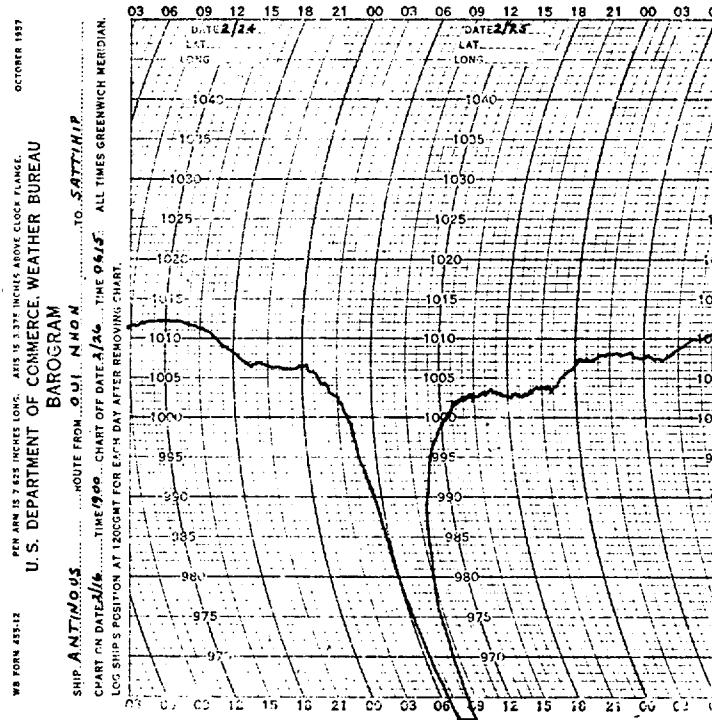


FIGURE 5-3 REPRODUCTION OF BAROGRAPH TRACE FROM THE SS ANTINOUS DURING ENCOUNTER WITH TYPHOON NANCY. TRACE WOULD HAVE BEEN LOWER BUT NEEDLE RESTING ON BASE. SHIP'S BAROMETER REACHED 28.06 IN. (953 MB) WHILE IN NANCY'S EYE.

TYPHOON NANCY

EYE FIXES CYCLONE

FIX NO.	TIME	POSTI	UNIT- METHOD -ACCY	01				MIN 700MB	FLT LVL	EYE	ORIEN- TATION	EYE DIA	CHARACTER WALL CLOUD
				FLT	LVL	SFC WND	0RS SLP						
1	190354Z	09.5N 152.0E	SLTLS	STG B	DIA	--	CAT -						
2	192300Z	08.6N 149.1E	54-P-02---	700MB	060	095	986	3011	18/--	---			
3	200300Z	08.7N 148.6E	54-P-03---	700MB	065	065	986	2996	16/12	---			
4	200452Z	09.0N 147.5E	SLTLS	STG C	DIA	--	CAT -						
5	200900Z	08.6N 147.5E	VW-P-03---	0290M	035	035	990	---	26/25	---			
6	201500Z	08.3N 147.4E	VW-P-03---	700MB	050	045	987	3048	26/26	---			
7	202045Z	08.6N 147.1E	54-P-05---	700MB	070	045	992	3027	13/12	---			
8	210230Z	08.5N 146.0E	54-P-05---	700MB	040	050	989	3005	12/11	---			
9	210356Z	08.0N 145.0E	SLTLS	STG C	DIA	--	CAT -						
10	210851Z	08.6N 145.1E	VW-P-05---	0290M	--	050	984	---	28/23	---			
11	211445Z	08.4N 144.3E	VW-P-05---	700MB	040	--	--	3008	16/13	---			
12	212100Z	08.1N 143.1E	54-P-05---	700MB	047	030	980	2938	16/12	---			
13	220330Z	08.1N 141.8E	54-P-03---	700MB	046	060	978	2890	15/12	---			
14	220454Z	08.5N 141.0E	SLTLS	STG X	DIA	02	CAT 2						
15	220830Z	08.2N 140.5E	VW-P-05---	4500M	--	110	972	---	25/24	CIRC	---	44	---
16	221200Z	08.6N 139.9E	VW-P-04---	4600M	040	--	--	---	25/24	CIRC	---	42	---
17	221514Z	08.7N 139.0E	VW-P-05---	2590M	--	125	967	---	27/26	ELIP	NE-SW	40X--	
18	222045Z	09.1N 137.7E	54-P-05---	700MB	065	--	958	2752	23/12	CIRC	---	25	
19	230225Z	09.2N 136.1E	54-P-08---	700MB	085	100	963	2786	22/12	CIRC	---	40	10NM THK
20	230553Z	09.5N 135.5E	SLTLS	STG X	DIA	03	CAT 4						OPEN NE
21	230851Z	09.2N 135.1E	VW-P-05---	2440M	--	120	959	---	26/24	ELIP	N-S	40X--	
22	231205Z	09.3N 134.6E	VW-P-15---	--	--	--	--	---	26/24	CIRC	---	40	10NM THK, OPEN N
23	231647Z	10.2N 132.7E	VW-P-10---	2380M	--	130	955	---	28/24	ELIP	NW-SE	40X--	
24	232100Z	10.1N 131.8E	54-P-10---	700MB	098	--	950-	2670	22/11	ELIP	NE-SW	38X30	50NM THK-NW
25	240230Z	10.4N 130.1E	54-P-10---	700MB	100	120	953	2707	22/13	CIRC	---	40	---
26	240501Z	10.5N 129.5E	SLTLS	STG X	DIA	03	CAT 4						
27	240900Z	11.2N 128.6E	VW-P-03---	700MB	--	130	949	2758	26/22	CIRC	---	25	---
28	241430Z	11.7N 127.0E	VW-P-02---	700MB	--	--	953	2664	19/13	CIRC	---	22	CLSD, 23NM THK
29	242100Z	12.5N 126.2E	54-P-02---	700MB	--	--	--	2606	18/12	CIRC	---	23	22NM THK
30	250300Z	13.5N 125.2E	54-P-10---	500MB	090	--	952	---	05/7	CIRC	---	30	7NM THK, OPEN E
31	250528Z	13.7N 124.5E	VW-P-03---	700MB	--	--	--	2752	16/14	ELIP	N-S	36X--	CLSD, 15NM THK
32	250559Z	14.0N 124.5E	SLTLS	STG X	DIA	03	CAT 4						
33	250925Z	14.3N 124.1E	VW-P-03---	700MB	--	--	953	2682	18/13	CIRC	---	40	---
34	251445Z	15.0N 123.9E	VW-P-02---	700MB	102	--	970	2679	20/14	CIRC	---	36	14NM THK
35	252100Z	15.8N 123.7E	54-P-02---	500MB	--	--	--	2682	04/52	CIRC	---	62	12NM THK
36	260215Z	16.8N 123.8E	54-P-05---	700MB	--	080	--	2713	18/12	CIRC	---	20	8NM THK, OPEN SE
37	260303Z	17.0N 123.5E	SLTLS	STG X	DIA	03	CAT 4						8NM THK
38	260915Z	18.1N 124.0E	VW-P-05---	--	--	--	--	---	26/23	CIRC	---	36	---
39	261407Z	19.0N 124.6E	VW-P-05---	--	--	--	--	---	26/23	CIRC	---	18	OPEN SW-WSW
40	262100Z	20.3N 125.1E	54-P-10---	700MB	035	--	992	3015	26/23	WK W/C			
41	270000Z	20.5N 125.3E	54-P-02---	700MB	045	--	992	3042	26/23	NEG W/C			
42	270210Z	20.6N 125.2E	54-P-02---	700MB	038	--	000	3045	26/23	NEG W/C			
43	271912Z	21.5N 126.3E	VW-P-10---	0260M	--	025	001	---	26/23	---			

TYPHOON NANCY

TROPICAL CYCLONE 01 -- 2/19/2300Z TO 2/27/1100Z
 POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
01	19/2300Z	8.6N	149.1E	8.6N	149.1E	10.3N	146.2E	346-0102	11.9N	143.3E	008-0228	13.5N	140.3E	035-0312
02	20/0500Z	8.8N	148.4E	8.7N	148.2E	10.6N	145.4E	354-0120	12.3N	142.4E	012-0246	-----	-----	-----
03	20/1100Z	8.9N	147.3E	8.4N	147.2E	9.8N	143.8E	325-0090	10.7N	140.4E	005-0138	11.6N	137.0E	051-0204
04	20/1700Z	8.4N	147.2E	8.4N	147.6E	8.7N	144.5E	057-0042	8.8N	141.8E	090-0180	-----	-----	-----
05	20/2300Z	8.6N	146.8E	8.6N	146.7E	8.8N	144.8E	071-0126	8.9N	142.8E	093-0330	9.0N	140.8E	097-0564
06	21/0500Z	8.5N	145.7E	8.6N	145.7E	8.5N	142.3E	067-0042	8.5N	139.0E	102-0192	-----	-----	-----
07	21/1100Z	8.6N	144.8E	8.5N	144.8E	8.6N	141.0E	076-0048	8.6N	137.0E	106-0168	8.6N	133.0E	119-0324
08	21/1700Z	8.5N	144.0E	8.3N	143.8E	8.5N	140.2E	102-0084	8.5N	136.2E	115-0216	-----	-----	-----
09	21/2300Z	8.1N	142.7E	8.1N	142.7E	7.4N	137.5E	173-0108	7.1N	132.3E	162-0192	7.6N	128.0E	158-0336
10	22/0500Z	8.0N	141.5E	8.2N	141.5E	7.3N	136.4E	162-0114	7.1N	131.2E	156-0228	-----	-----	-----
11	22/1100Z	8.1N	140.0E	8.4N	140.1E	8.1N	134.1E	180-0078	8.1N	128.4E	176-0192	8.8N	123.7E	184-0342
12	22/1700Z	8.8N	138.5E	8.8N	138.7E	9.0N	133.1E	169-0066	9.0N	127.4E	170-0174	-----	-----	-----
13	22/2300Z	9.2N	137.1E	9.2N	137.2E	11.0N	131.3E	008-0048	12.7N	125.9E	134-0006	15.3N	121.8E	244-0120
14	23/0500Z	9.5N	135.4E	9.2N	135.7E	10.9N	129.4E	341-0018	12.6N	124.2E	202-0060	-----	-----	-----
15	23/1100Z	9.3N	134.6E	9.4N	134.2E	9.8N	129.8E	134-0126	11.1N	125.5E	159-0216	13.1N	122.0E	202-0336
16	23/1700Z	10.2N	132.4E	10.1N	132.8E	11.7N	127.1E	134-0012	14.2N	122.7E	220-0090	-----	-----	-----
17	23/2300Z	10.3N	131.3E	10.2N	131.2E	11.5N	126.4E	158-0078	13.7N	122.6E	202-0156	16.8N	120.0E	234-0360
18	24/0500Z	10.6N	129.5E	10.6N	129.6E	12.2N	123.9E	207-0090	15.3N	120.1E	242-0234	-----	-----	-----
19	24/1100Z	11.2N	128.1E	11.3N	128.2E	13.4N	122.9E	226-0090	17.0N	120.1E	252-0246	21.0N	120.5E	-----
20	24/1700Z	11.9N	126.5E	11.9N	126.8E	14.5N	121.7E	246-0126	18.4N	119.9E	258-0282	-----	-----	-----
21	24/2300Z	12.6N	125.7E	12.8N	125.8E	15.5N	121.8E	249-0114	19.4N	120.8E	057-0252	23.8N	123.8E	-----
22	25/0500Z	13.7N	124.7E	13.6N	124.7E	17.7N	122.2E	288-0090	21.4N	122.9E	276-0162	-----	-----	-----
23	25/1100Z	14.5N	123.9E	14.5N	124.1E	18.4N	122.4E	273-0102	22.0N	124.8E	-----	25.2N	130.2E	-----
24	25/1700Z	15.3N	123.5E	15.4N	123.8E	19.1N	122.7E	262-0114	22.9N	126.0E	-----	-----	-----	-----
25	25/2300Z	16.1N	123.4E	16.2N	123.7E	19.3N	123.0E	242-0132	23.0N	126.0E	-----	-----	-----	-----
26	26/0500Z	17.2N	123.7E	17.2N	123.8E	20.9N	124.5E	261-0072	24.2N	129.3E	-----	-----	-----	-----
27	26/1100Z	18.4N	123.9E	18.3N	124.2E	22.9N	127.1E	-----	26.5N	133.8E	-----	-----	-----	-----
28	26/1700Z	19.6N	124.7E	19.4N	124.8E	22.9N	128.9E	-----	26.3N	135.5E	-----	-----	-----	-----
29	26/2300Z	20.6N	125.4E	20.4N	125.2E	23.9N	129.9E	-----	26.7N	137.2E	-----	-----	-----	-----
30	27/0500Z	20.8N	125.4E	21.1N	125.8E	-----	-----	-----	-----	-----	-----	-----	-----	-----
31	27/1100Z	21.7N	126.5E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0085 MI. 95.8
 AVERAGE 48 HOUR ERROR - 0190 MI.
 AVERAGE 72 HOUR ERROR - 0322 MI.

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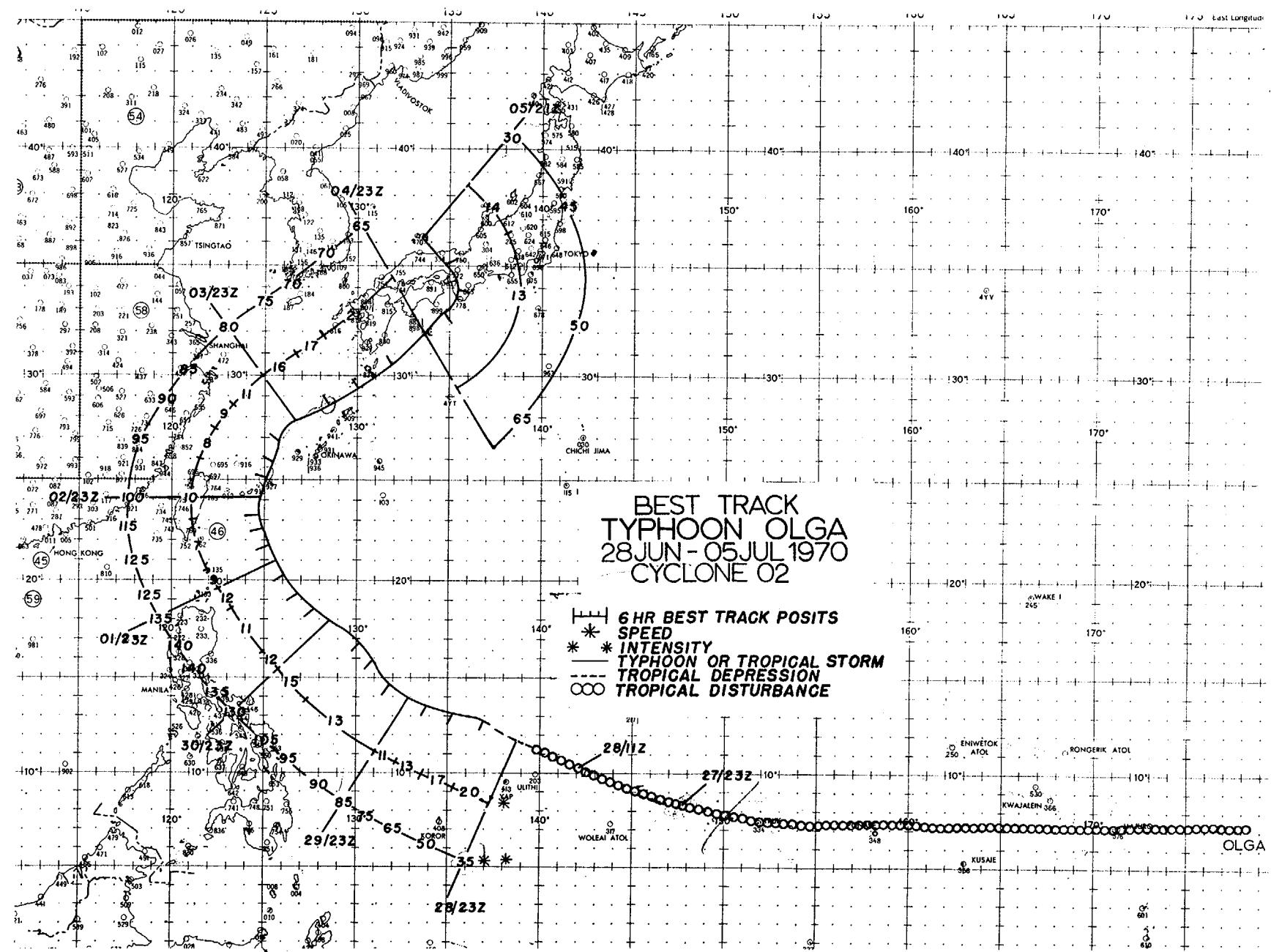
B. TYPHOON OLGA 28 JUN 2300Z-05 JUL 2300Z

1. STATISTICS

- a. Number of Warnings Issued - 29
- b. Number of Warnings with Typhoon Intensity - 22
- c. Distance Traveled During Warning Period - 2,382 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 904 MBS at 01/2118Z
- b. Minimum Observed 700 MB Height - 2268 M at 01/2100Z
- c. Maximum Surface Wind - 140 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 360 MI



3. TYPHOON OLGA NARRATIVE

After a four month lull of tropical cyclone activity, the subtropical ridge began to build in mid-June producing a broad flow of easterlies in the tropics south of 25°N and increasing tropical wave frequency.

The pre-Olga system was first noted by a wave passage at Majuro in the Marshall Island group on the 24th. Signs of a developing disturbance were detected as satellite pictures from ESSA-8 and ITOS-1 on the 26th showed considerable convective activity and evidence of banding as the wave reached the Truk-Ponape vicinity in the Central Carolines.

A tight pressure gradient existed south of the ridge line causing strong easterlies and a westward movement of the pre-Olga system in excess of 20 knots. This rate of forward speed apparently inhibited the establishment of a circulation at the surface until the system was southwest of Guam early on the 29th. Reconnaissance detected a closed center at first light just north of Ulithi Island with maximum winds of 35-40 knots (Figure 5-4).

The newly-developed storm assumed a northwest course upon entrance into the Philippine Sea as weakening occurred along the subtropical ridge line in the vicinity of the Ryukyu Islands. On this track, Olga was in a favorable region for further intensification as she approached difluent flow aloft associated with a 200 mb anticyclone south of the Ryukyu chain. The forward speed of the storm decreased to 13 knots and Olga reached typhoon strength by evening on the 29th and within 36 hours became the season's first super typhoon.

Deepening had occurred at a rapid rate during this period culminating in a 904 mb central pressure on July 1st when Olga was 300 miles due east of the northeastern tip of Luzon. This reduction of pressure represented an explosive deepening of 62 mb in 24 hours. Winds generated under the wall cloud region, surrounding a tight 6 mile diameter eye, were estimated near 140 knots at this point (Figure 5-5). The building of heights and establishment of a high cell in the vicinity of Iwo Jima created a relative weakness in the ridge line near the 125th meridian while Olga was reaching her maximum intensity. The storm reacted to this opened avenue by gradually shifting course northward on the 1st.

A short wave in the westerlies was nearing the Asian coast as the typhoon passed between Taiwan and Okinawa the following day. In response to the approach of the short wave, the typhoon took a sharp turn to the northeast while passing 100 miles abeam of Okinawa, and began to accelerate in forward

speed reaching 21 knots south of Kyushu some 12 hours later. A developing low in the short wave system moving into the Sea of Japan brought its influence on the scene by slowing and deflecting the storm's course to the northwest. The weakening Olga arrived ashore on Honshu's Kii Peninsula south of Osaka on the 5th with winds of tropical storm force.

Highest winds reported during the typhoon's transit through and west of the Ryukyu's occurred at Kume Shima which recorded 90 knots gusting to 110 knots during the early morning hours of the 4th some 50 miles east of the center.

Olga had weakened in strength considerably just before reaching the Ryukyu's early on the 3rd as dry air began to enter the system. The vertical extent of convective activity associated with the storm was markedly shallow during the period it traversed the East China Sea as reconnaissance aircraft were topping the typhoon's cloudiness at 10,000 feet.

Upon crossing Honshu and entering the Sea of Japan, Olga merged with a cold low. Heavy rains attended the system while crossing Japan and later as it drifted over South Korea. The excessive rains (up to 13 inches in Japan) caused landslides and extensive flooding in some areas which was responsible for at least 8 deaths in Japan and 29 deaths in South Korea. Damage was estimated near 10 million dollars in and around Tokyo.

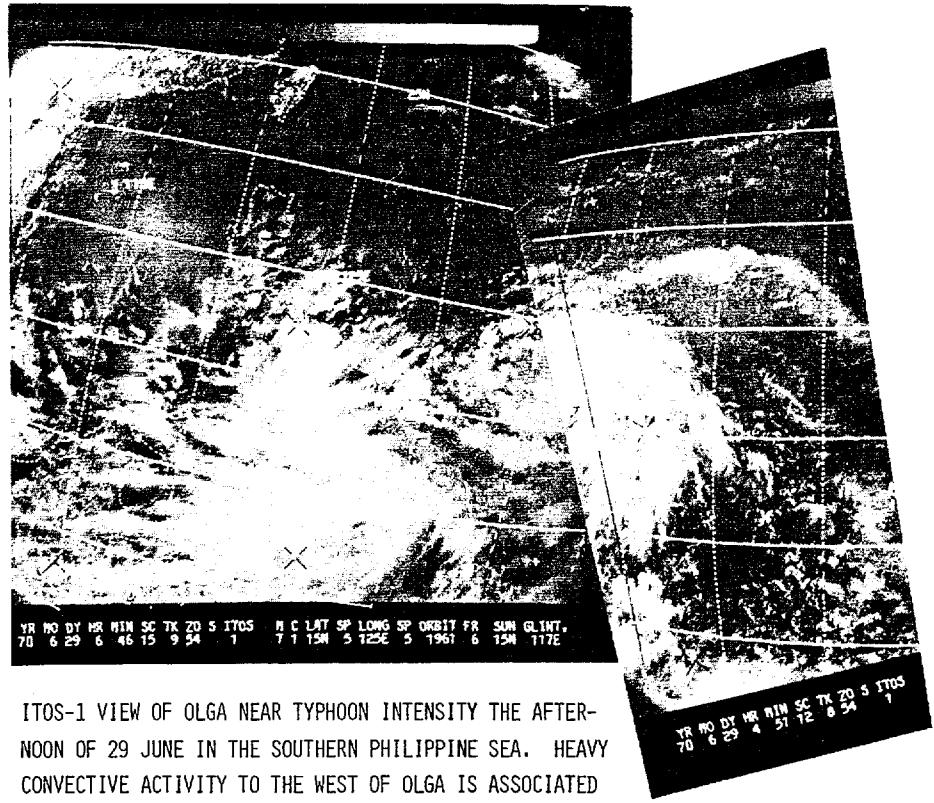


FIGURE 5-4 ITOS-1 VIEW OF OLGA NEAR TYPHOON INTENSITY THE AFTERNOON OF 29 JUNE IN THE SOUTHERN PHILIPPINE SEA. HEAVY CONVECTIVE ACTIVITY TO THE WEST OF OLGA IS ASSOCIATED WITH TROPICAL STORM PAMELA A SHORT DISTANCE EAST OF MINDANAO.

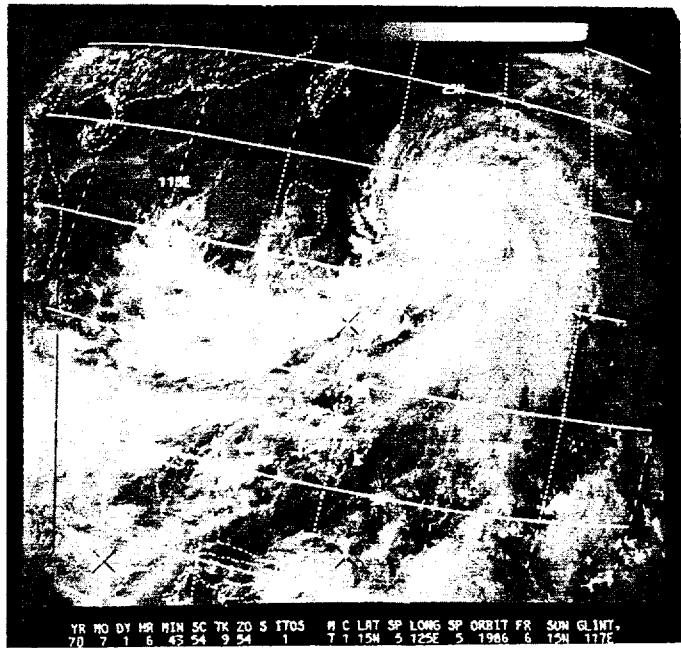


FIGURE 5-5 OLGA ON 1 JULY, OF SUPER TYPHOON INTENSITY LOCATED EAST OF NORTHERN LUZON AS SEEN BY CAMERA'S ABOARD ITOS-1.

TYPHOON OLGA

FIX NO.	TIME	POSII	EYE FIXES CYCLONE												CHARACTER WALL CLOUD
			UN:T- MET:00 -ACCY	FLT LVL	LVL WIND	SFC VNH	OHS SIP	MIN 700MB	FLT LVL	TT/TO	EYE FORM	ORIEN- TATION	EYE DIA		
1	290550Z	10.0N 145.0E	SLTLS	STG S	01A --	CAT -									
2	290225Z	12.5N 137.6E	54--07---	0420M	045	040	993	---	25/23	CIRC	----	18			
3	290646Z	13.0N 137.0E	SLTLS	STG X	01A 02	CAT 2									
4	290646Z	13.0N 137.0E	SLTLS	STG X	01A 02	CAT 2									
5	290945Z	13.0N 135.6E	VW--10---	0400M	--	050	--	--	--/27	CIRC	----	08			
6	291457Z	13.4N 134.3E	VW--10---	0200M	040	--	--	--	--/--	ELIP	NE-SW	16x13			
7	292040Z	13.7N 133.3E	54--15---	700MB	000	100	966	2783	17/11	CIRC	----	12			
8	300200Z	14.3N 132.4E	54-P-15---	700MB	080	110	964	2768	21/11	CIRC	----	12			
9	300548Z	14.5N 131.0E	SLTLS	STG X	01A 03	CAT 2									
10	300929Z	15.0N 131.2E	VW--02---	--	--	--	--	--	24/21						
11	301211Z	16.0N 130.9E	VW-P-03---	700MB	070	045	978	2911	15/09	CIRC	----	12			
12	302100Z	17.5N 129.1E	54-P-03---	700MB	075	110	929	2481	18/10	CIRC	----	08			
13	010000Z	17.9N 128.3E	54-P-03---	700MB	100	150	908	2301	24/11	CIRC	----	07			
14	010218Z	18.2N 128.0E	54-P-03---	700MB	120	110	914	2268	24/12	CIRC	----	06			
15	010644Z	19.0N 127.5E	SLTLS	STG X	01A 04	CAT 4									
16	010909Z	19.0N 127.3E	VW--03---	0300M	--	--	--	--	--/--	CIRC	----	10			
17	011502Z	20.2N 126.5E	VW--03---	0400M	--	--	--	--	--/--	CIRC	----	07			
18	012000Z	20.4N 125.7E	54--02---	700MB	090	--	920	2320	18/10	CIRC	----	04			
19	020015Z	21.0N 125.6E	54-P-02---	700MB	090	130	915	2340	25/13	CIRC	----	06			
20	020300Z	21.4N 125.4E	54-P-02---	700MB	080	130	920	2380	19/15	CIRC	----	15			
21	020550Z	21.2N 124.9E	SLTLS	STG X	01A 05	CAT 4									
22	020600Z	21.9N 125.2E	LND RUR	--	--	--	--	--	--/--						
23	020700Z	22.0N 125.1E	LND RUR	--	--	--	--	--	--/--						
24	020800Z	22.1N 125.0E	LND RUR	--	--	--	--	--	--/--						
25	020855Z	22.5N 125.1E	VW-P-25---	0080M	002	--	--	--	--/--	CIRC	----	09			
26	020900Z	22.1N 125.0E	LND RUR	--	--	--	--	--	--/--						
27	020900Z	22.2N 125.0E	LND RUR	--	--	--	--	--	--/--						
28	021000Z	22.2N 125.0E	LND RUR	--	--	--	--	--	--/--						
29	021100Z	22.4N 125.0E	LND RUR	--	--	--	--	--	--/--						
30	021200Z	22.3N 125.0E	LND RUR	--	--	--	--	--	--/--						
31	021300Z	22.5N 125.0E	LND RUR	--	--	--	--	--	--/--						
32	021400Z	22.8N 125.0E	LND RUR	--	--	--	--	--	--/--						
33	021500Z	23.0N 125.0E	LND RUR	--	--	--	--	--	--/--						
34	021515Z	22.9N 124.7E	VW-P-05---	--	070	080	--	--	--/--	CIRC	----	08	14NM THK, OPEN W		
35	021600Z	23.0N 125.0E	LND RUR	--	--	--	--	--	--/--						
36	021710Z	23.2N 125.0E	LND RUR	--	--	--	--	--	--/--						
37	021800Z	23.3N 124.8E	LND RUR	--	--	--	--	--	--/--						
38	021900Z	23.6N 124.9E	LND RUR	--	--	--	--	--	--/--						
39	022000Z	23.6N 124.9E	LND RUR	--	--	--	--	--	--/--						
40	022045Z	23.6N 124.9E	54-P-00---	700MB	075	075	950	2640	18/12						
41	022100Z	23.9N 125.1E	LND RUR	--	--	--	--	--	--/--						
42	030100Z	24.5N 124.9E	LND RUR	--	--	--	--	--	--/--						
43	030230Z	24.8N 125.0E	54-P-02---	700MB	070	125	960	2728	17/14						
44	030300Z	24.8N 125.0E	LND RUR	--	--	--	--	--	--/--						
45	030646Z	24.0N 125.1E	SLTLS	SIG X	01A 0	CAT 3									
46	030700Z	25.2N 125.3E	LND RUR	--	--	--	--	--	--/--						
47	030830Z	25.8N 125.7E	LND RUR	--	--	--	--	--	--/--						
48	030900Z	25.3N 125.5E	VW-P-03---	700MB	--	--	--	--	--/--	CIRC	----	11			

124 54

5-15

Fix No.	TIME	POSIT	EYE FIXES CYCLONE				02	FLT LVL	OBS SLP	ORS HGT	MIN 700MB	FLT TT/TO	EYE FORM	ORIEN- TATION	EYE DIA	CHARACTER WALL CLOUD										
			UNIT- METHOD -ACCY	FLT LVL	LVL	WND																				
49	031030Z	25.7N 125.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
50	031049Z	25.8N 125.5E	VW--03--	700MB	---	---	963	2777	22/13	CIRC	---	05	CLSD	-----	-----	-----										
51	031110Z	25.7N 125.2E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
52	031230Z	25.7N 125.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
53	031430Z	26.0N 125.9E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
54	031508Z	26.4N 125.7E	VW--02--	700MB	---	---	---	2835	25/14	CIRC	---	12	CLSD	-----	-----	-----										
55	031630Z	25.8N 126.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
56	032055Z	27.3N 126.0E	54--05--	700MB	065	065	948	3088	21/12	CIRC	---	20	WK W/C SE QUAD	-----	-----	-----										
57	040200Z	27.9N 127.8E	54--05--	700MB	060	050	955	2725	22/14	CIRC	---	--	APRNT WK W/C SE-W	-----	-----	-----										
58	040547Z	28.0N 128.0E	SLTLS	STG X	01A 01	CAT 2	---	---	---	---	---	---	---	---	---	---										
59	040922Z	29.0N 129.5E	VW--05--	700MB	004	075	---	2826	21/14	---	---	---	OPEN N	-----	-----	-----										
60	041300Z	29.7N 130.9E	VW--05--	700MB	080	---	967	2896	21/14	---	---	---	DIFF TO LOCATE EYE ON RDR	-----	-----	-----										
61	041430Z	29.9N 131.1E	VW--05--	700MB	080	---	967	2810	21/15	---	---	---	-----	-----	-----	-----										
62	041800Z	30.9N 132.4E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
63	041900Z	30.9N 132.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
64	042000Z	31.3N 133.2E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
65	042100Z	31.4N 133.4E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
66	042104Z	31.6N 133.3E	54--05--	700MB	065	075	959	2740	17/14	ELIP	N-S	30X20	10NM THK, OPEN N	-----	-----	-----										
67	042200Z	31.6N 133.4E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
68	042300Z	31.7N 133.7E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
69	050235Z	32.3N 134.3E	54--05--	---	047	065	953	---	16/14	ELIP	N-S	45X30	6NM THK, OPEN NE	-----	-----	-----										
70	050449Z	32.0N 135.1E	SLTLS	STG X	01A 03	CAT 3	---	---	---	---	---	---	---	---	---	---										
71	050750Z	33.3N 135.1E	VW--03--	---	---	---	---	---	---	---	---	---	---	---	---	---										
72	050800Z	33.2N 135.3E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
73	050900Z	33.2N 135.5E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---										
74	050906Z	33.4N 135.6E	VW--03--	---	---	---	---	---	---	---	---	---	3NM THK, OPEN S&W QUAD	-----	-----	-----										
75	051200Z	34.2N 135.4E	LND RUR	---	---	---	---	---	---	---	---	10	3NM THK, OPEN S&W QUAD	-----	-----	-----										
76	051300Z	34.3N 135.2E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
77	051400Z	34.4N 135.3E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
78	051600Z	34.8N 134.8E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
79	051700Z	35.0N 134.8E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
80	051800Z	35.6N 134.5E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
81	051900Z	35.9N 134.1E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
82	052000Z	35.9N 134.9E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										
83	052100Z	36.1N 133.7E	LND RUR	---	---	---	---	---	---	---	---	---	-----	-----	-----	-----										

TYPHOON OLGA

TROPICAL CYCLONE 02 -- 6/28/2300Z TO 7/5/2300Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST
01	28/2300Z	11.5N	139.3E	11.7N	139.1E	14.0N	132.6E	270-0012	-----	-----	-----	-----	-----	-----	-----	-----	-----
02	29/0500Z	12.9N	136.9E	12.7N	137.0E	15.7N	129.2E	089-0156	18.3N	122.5E	268-0294	-----	-----	-----	-----	-----	-----
03	29/1100Z	13.1N	135.3E	13.1N	135.3E	15.0N	129.0E	249-0126	17.5N	123.7E	239-0204	20.3N	119.2E	247-0348	-----	-----	-----
04	29/1700Z	13.7N	133.7E	13.5N	133.9E	15.7N	127.3E	248-0174	18.3N	122.0E	245-0252	-----	-----	-----	-----	-----	-----
05	29/2300Z	13.9N	132.9E	14.0N	132.9E	15.5N	127.6E	209-0150	17.8N	123.2E	217-0228	20.8N	119.2E	238-0372	-----	-----	-----
06	30/0500Z	14.3N	131.9E	14.8N	131.8E	15.9N	127.2E	189-0156	17.8N	123.0E	208-0270	-----	-----	-----	-----	-----	-----
07	30/1100Z	15.8N	131.0E	15.8N	131.1E	18.7N	127.1E	161-0036	20.5N	122.9E	224-0174	22.7N	118.9E	242-0414	-----	-----	-----
08	30/1700Z	16.9N	130.3E	16.8N	130.2E	19.1N	126.0E	180-0060	21.0N	121.9E	230-0210	-----	-----	-----	-----	-----	-----
09	30/2300Z	18.0N	128.8E	17.7N	128.9E	21.7N	125.1E	327-0054	25.9N	125.3E	007-0102	30.2N	133.0E	066-0342	-----	-----	-----
10	01/0500Z	18.5N	127.5E	18.5N	127.7E	22.2N	124.5E	299-0048	26.9N	126.4E	280-0114	-----	-----	-----	-----	-----	-----
11	01/1100Z	19.2N	126.9E	19.3N	126.8E	22.8N	122.5E	360-0012	26.7N	126.3E	041-0054	30.7N	134.1E	069-0210	-----	-----	-----
12	01/1700Z	20.6N	126.2E	20.1N	126.1E	24.8N	125.5E	019-0090	28.7N	129.6E	061-0216	-----	-----	-----	-----	-----	-----
13	01/2300Z	20.9N	125.7E	20.9N	125.7E	24.7N	125.2E	022-0030	28.4N	128.9E	070-0102	31.5N	137.1E	098-0156	-----	-----	-----
14	02/0500Z	21.7N	125.3E	21.8N	125.3E	25.2N	125.5E	090-0012	29.7N	130.5E	052-0114	-----	-----	-----	-----	-----	-----
15	02/1100Z	22.7N	125.0E	22.6N	125.1E	26.3N	126.3E	064-0036	30.6N	132.2E	054-0120	35.2N	142.5E	077-0342	-----	-----	-----
16	02/1700Z	23.1N	124.9E	23.3N	124.9E	26.3N	126.3E	161-0036	30.6N	132.2E	090-0006	-----	-----	-----	-----	-----	-----
17	02/2300Z	24.1N	125.0E	24.2N	125.0E	27.6N	127.7E	108-0036	31.5N	134.1E	165-0024	36.2N	143.8E	-----	-----	-----	-----
18	03/0500Z	25.1N	125.1E	25.2N	125.3E	28.8N	128.0E	296-0036	32.4N	133.5E	252-0072	-----	-----	-----	-----	-----	-----
19	03/1100Z	25.9N	125.5E	26.0N	125.6E	29.8N	128.8E	287-0078	35.0N	134.4E	317-0084	-----	-----	-----	-----	-----	-----
20	03/1700Z	26.7N	126.0E	26.9N	126.0E	30.3N	129.1E	264-0150	35.5N	134.8E	326-0018	-----	-----	-----	-----	-----	-----
21	03/2300Z	27.6N	126.2E	27.8N	127.0E	31.0N	128.4E	260-0282	34.8N	132.2E	-----	-----	-----	-----	-----	-----	-----
22	04/0500Z	28.5N	128.7E	28.5N	128.7E	33.7N	135.0E	000-0054	39.3N	144.2E	-----	-----	-----	-----	-----	-----	-----
23	04/1100Z	29.5N	130.2E	29.4N	130.3E	34.4N	137.4E	071-0084	37.0N	150.0E	-----	-----	-----	-----	-----	-----	-----
24	04/1700Z	30.3N	131.8E	30.6N	132.1E	34.5N	139.6E	100-0222	35.6N	150.3E	-----	-----	-----	-----	-----	-----	-----
25	04/2300Z	31.9N	134.0E	31.9N	134.0E	35.5N	142.8E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
26	05/0500Z	32.7N	135.0E	32.8N	135.0E	35.7N	142.1E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
27	05/1100Z	33.9N	135.5E	33.9N	135.7E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
28	05/1700Z	35.0N	135.4E	35.2N	135.1E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
29	05/2300Z	36.5N	133.1E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0088 MI.
AVERAGE 48 HOUR ERROR - 0139 MI.
AVERAGE 72 HOUR ERROR - 0312 MI.

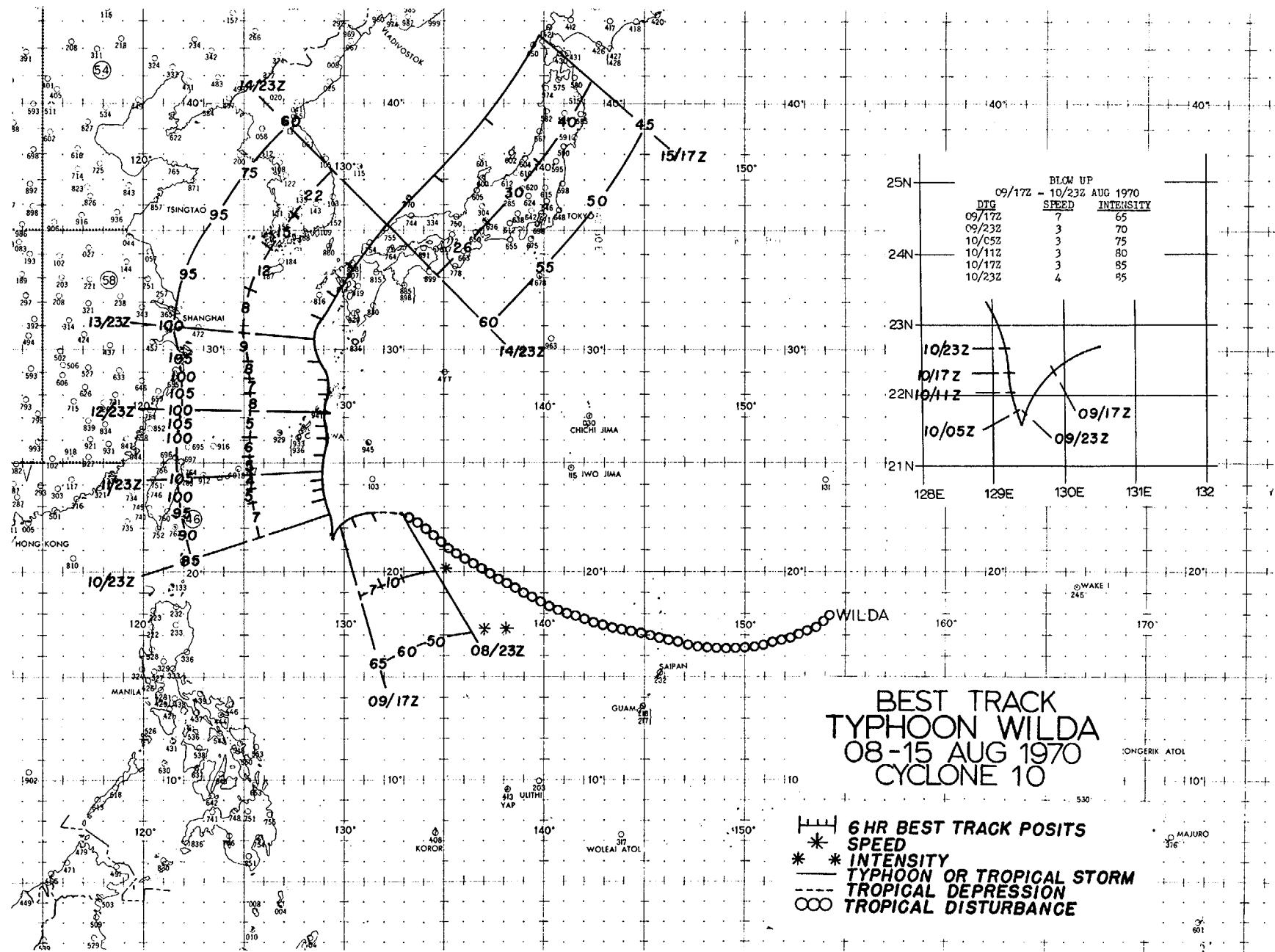
C. TYPHOON WILDA 09 AUG 0500Z-15 AUG 1700Z

1. STATISTICS

- a. Number of Warnings Issued - 27
- b. Number of Warnings with Typhoon Intensity - 19
- c. Distance Traveled During Warning Period - 1,860 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 939 MBS at 11/2100Z
- b. Minimum Observed 700 MB Height - 2585 M at 11/2100Z
- c. Maximum Surface Wind - 105 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 540 MI



3. TYPHOON WILDA NARRATIVE

Wilda developed from a complex system that had its origin in the region south of Marcus Island. The ITOS-1 satellite pass on the 2nd of August indicated considerable convective activity was occurring in an area between Eniwetok and Marcus Island. This was related to a developing circulation in the upper tropospheric Mid-Pacific trough which had been initially evidenced in upper air data the day before.

An induced surface trough from this system drifted west and developed into a broad circulation as it passed through the Northern Marianas chain on the 6th. The presence of a 200 mb shear line to its north prevented any mechanism for sufficient outflow from the area and stifled further development. As the system crossed into the Philippine Sea a complex situation was created as no increase in net mass inflow into the circulation was noted. The depression expanded and covered some 300 miles in radius with two to three smaller surface circulations embedded as evidenced by ship data and satellite pictures. (Figure 5-6)

By the 9th the large circulation approached a more favorable environment as it neared an area of weak anticyclonic shear at 200 mb and less tropospheric vertical wind shear. ESSA-8 displayed a horseshoe cloud band oriented toward the north surrounding most of the depression and open to the south, with maximum convective activity located in the northwest quadrant. It was from this northwest portion that Wilda rapidly developed. A reconnaissance aircraft on an investigative mission in the vicinity detected a partially developed wall cloud with a central pressure of 986 mb.

Steering forces were weak at this point and the newly formed Wilda began a southwestward drift from a position 300 miles southeast of Okinawa. This movement was largely in response to the influence of the circulation around the massive low from which she developed.

During this time frame a mid-tropospheric high cell over the northern East China Sea began to retrograde leaving a weak trough area to the north of Wilda. As the high continued to recede, the typhoon began to drift northward under its own internal forces (Cressman, 1952) at 4 to 6 knots and intensify. The generally weak gradient between the split ridge line favored a slow northward movement for 3 days.

On this track the storm passed 35 miles east of Okinawa during the night of the 12th to the 13th bringing gale force winds to the island. Naha experienced 52 knots gusting to 64 knots with lowest barometer reading at 978 mb. The eye later passed over the western edge of Amami-o-Shima the following

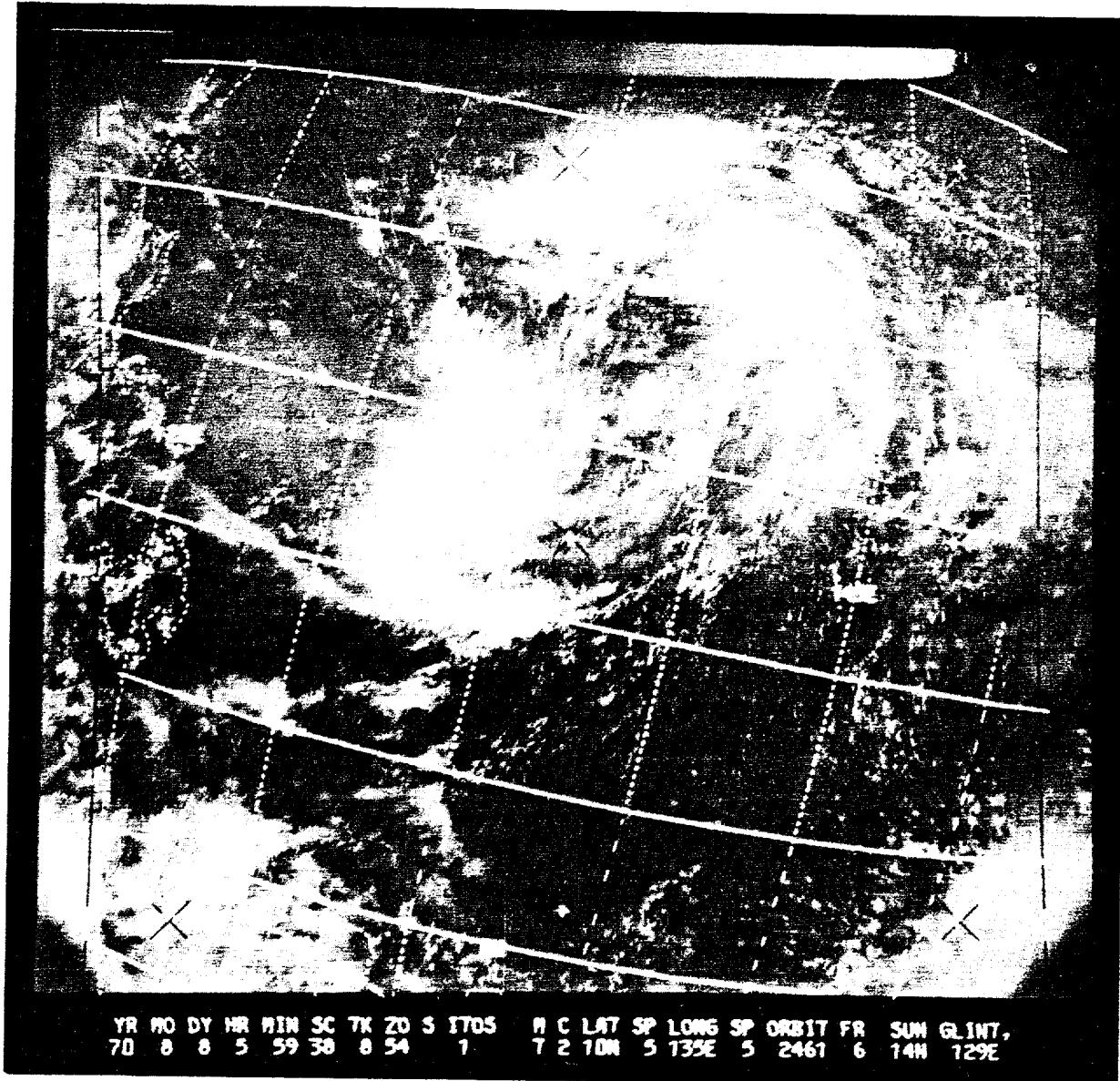


FIGURE 5-6 THE CLOUDINESS ASSOCIATED WITH THE LARGE PRE-WILDA DEPRESSION ON 8 AUGUST APPEARS AS A DISORGANIZED PATTERN TO THE ITOS-1 SATELLITE.

evening with a minimum pressure of 955.8 mb recorded at the island weather station.

In advance of an approaching trough in the westerlies moving off Manchuria, Wilda shifted to a northeast track on the afternoon of the 14th and gradually began to increase in forward speed. This course took the storm with 95 knot winds near the center over Western Kyushu near Nagasaki later that evening (Figure 5-7).

The typhoon was downgraded to a tropical storm as it entered the Sea of Japan with a rate of movement of 22 knots. Wilda started to quickly lose her tropical characteristics as she paralleled the western coast of Honshu some 120 miles offshore. After transforming to extratropical characteristics and skirting western Hokkaido on the 16th the system continued as a well-developed low after passage of the Kamchatka Peninsula on the 17th.

During its lifetime the typhoon reached its maximum strength of 105 knots while east of Okinawa and maintained itself near the 100 knot level until its landfall on the Japanese Coast. Damage reports placed at least 11 persons killed and 326 injured in Japan as the storm brought heavy rain (up to 18 inches) and strong winds to the southern portions of Japan. Over 2,800 houses were reported partially or totally destroyed and 97 vessels of various size sunk or washed away.

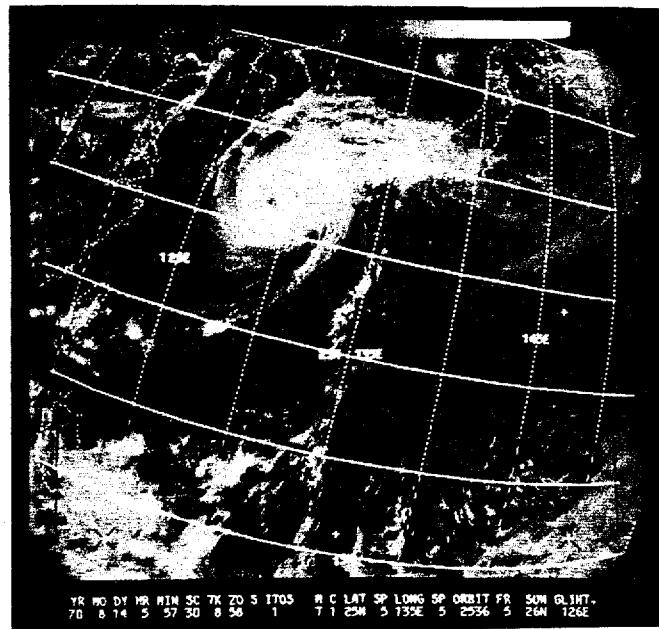


FIGURE 5-7 TYPHOON WILDA SOUTHWEST OF KYUSHU ON 14 AUGUST AS VIEWED BY ITOS-1 IN THE AFTERNOON (TOP) AND NIMBUS IV INFRA-RED (ORBIT 1716) THAT NIGHT (BOTTOM).

TYPHOON WILDA

IX NO.	TIME	POSII	EYE F-XES CYCLONE			10	OBS	OVS	MIN	FLT	LVL	EYE	ORIEN-	EYE	CHARACTER	
			UN/T-	MET-00	-ACCY		FLT	LVL	SFC	MIN	700MB	HGT	TT/TO	FORM	TATION	DIA
1	090656Z	23.0N 130.5E	SLTLS	STG X	01A 02	CAT 2										
2	090700Z	22.8N 131.1E	VW-P-05---	0450M	---	040	986	---	27/23	ELIO	NW-SE	20X15	HLF MOON NNE TO S, 4NM THK			
3	090932Z	22.5N 130.7E	VW-P-05---	700MB	---	045	983	2937	28/24	CIR	---	13	4NM THK, OPEN S-SE			
4	091107Z	22.6N 130.3E	VW-P-----		---	---	---	---	---							
5	100020Z	21.7N 129.3E	54-P-03---	700MB	0/0	080	973	2893	20/16	CIRC	---	15	OPEN SE			
6	100250Z	21.7N 129.3E	54-P-03---	700MB	0/0	110	974	2890	21/11	CIRC	---	10	W/C NW-SE			
7	100602Z	21.0N 129.0E	SLTLS	STG X	01A 03	CAT 2										
8	100903Z	21.9N 129.3E	VW-P-05---		---	---	---	---	---							
9	100910Z	22.0N 129.5E	VW-P-08---		---	065	972	---	27/26	CIRC	---	25	5NM THK, OPEN NE QUAD			
10	101430Z	22.1N 129.3E	VW-P-05---	700MB	---	065	974	2810	27/23	CIRC	---	08	8NM THK, OPEN NNE			
11	102100Z	22.5N 129.1E	54-P-05---	700MB	000	080	970	2795	17/12	CIRC	---	25	OPEN N-NE			
12	110300Z	23.1N 129.1E	54-P-03---	700MB	0/0	090	964	2800	21/13	CIRC	---	20	W/C N QUAD/CLOSING/WK			
13	110400Z	23.5N 128.9E	LND RUR		---	---	---	---	---							
14	110658Z	23.0N 128.0E	SLTLS	STG X	01A 03	CAT 3										
15	110853Z	23.5N 129.1E	VW-P-05---		---	---	---	---	---							
16	110904Z	23.4N 129.0E	VW-P-05---		---	085	957	---	27/25							
17	111210Z	24.0N 129.4E	LND RUR		---	---	---	---	---							
18	111402Z	24.1N 129.0E	LND RUR		---	---	---	---	---							
19	111420Z	24.3N 128.7E	VW-P-03---		---	100	953	2679	27/24	CIRC	---	23	15NM THK, OPEN NW QUAD			
20	111500Z	24.2N 128.9E	LND RUR		---	---	---	---	---							
21	111600Z	24.2N 128.8E	LND RUR		---	---	---	---	---							
22	111700Z	24.3N 128.8E	LND RUR		---	---	---	---	---							
23	111800Z	24.3N 128.8E	LND RUR		---	---	---	---	---							
24	111900Z	24.4N 128.8E	LND RUR		---	---	---	---	---							
25	112000Z	24.5N 128.8E	LND RUR		---	---	---	---	---							
26	112100Z	24.6N 128.7E	54-P-1U---	700MB	095	---	944	2585	17/14	CIRC	---	25	OPEN NW			
27	112200Z	24.6N 128.8E	LND RUR		---	---	---	---	---							
28	120000Z	24.8N 129.0E	LND RUR		---	---	---	---	---							
29	120230Z	25.1N 128.8E	54-P-02---	700MB	005	080	950	2650	20/14	CIRC	---	20	5NM THK, OPEN SW-NW			
30	120559Z	25.2N 129.5E	SLTLS	STG X	01A 0	CAT 4										
31	120700Z	25.4N 128.9E	LND RUR		---	---	---	---	---							
32	120800Z	25.7N 129.0E	LND RUR		---	---	---	---	---							
33	120900Z	25.8N 129.1E	LND RUR		---	---	---	---	---							
34	120925Z	25.8N 129.2E	VW-P-15---		---	---	---	---	---							
35	121000Z	25.9N 129.2E	LND RUR		---	---	---	---	---							
36	121018Z	25.9N 129.1E	VW-P-02---		---	100	950	---	28/23	CIRC	---	22	5NM THK, OPEN W			
37	121100Z	26.0N 129.1E	LND RUR		---	---	---	---	---							
38	121300Z	26.2N 129.0E	LND RUR		---	---	---	---	---							
39	121400Z	26.3N 129.0E	LND RUR		---	---	---	---	---							
40	121445Z	26.3N 129.0E	VW-P-02---		---	---	---	---	---							
41	121500Z	26.4N 129.0E	LND RUR		---	---	---	---	---							
42	121700Z	26.0N 129.0E	LND RUR		---	---	---	---	---							
43	121800Z	26.7N 128.9E	LND RUR		---	---	---	---	---							
44	121900Z	26.8N 128.9E	LND RUR		---	---	---	---	---							
45	122000Z	26.9N 128.9E	LND RUR		---	---	---	---	---							
46	122100Z	26.9N 129.0E	54-P-02---	700MB	085	---	949	2682	17/11	CONC	40-20	OUTER-CLSD, INNER-OPEN W-N				
47	122300Z	27.0N 129.0E	LND RUR		---	---	---	---	---							
48	130030Z	27.2N 129.2E	LND RUR		---	---	---	---	---							

NO.	TIME	POSIT	EYE F-1ES CYCLONE			10 SFC HGT	OBS MNR SFC HGT	MIN 700MB	FLT LVL IT/TO	EYE FORM	ORIEN- TATION	EYE DIA	CHARACTER
			UV	T-	FLT								
			MET	00	LVL								
LACCY	LVL	WIND	-ND	SFC	HGT	IT/TO	FORM	CHARACTER					
49	130300Z	27.5N 129.1E	54--03---	700MB	100	100	941	2594	18/10	CTRC	----	15	OPEN NW-NE
50	130500Z	28.0N 129.1E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
51	130600Z	28.2N 129.0E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
52	130657Z	28.0N 129.2E	SLTLS	STG X	DIA 0	CAT 4	---	---	--/-	----	----	----	-----
53	130700Z	28.3N 129.1E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
54	130924Z	28.4N 129.1E	VW--01---	850UM	---	085	945	2615	19/12	CIRC	----	30	CLSD, 18NM THK
55	131100Z	28.5N 128.8E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
56	131200Z	28.7N 128.8E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
57	131300Z	28.8N 128.9E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
58	131410Z	28.9N 129.1E	VW--01---	850UM	---	---	941	2603	21/12	CIRC	----	30	15NM THK, NW&E QUAD
59	131500Z	29.2N 128.9E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
60	131600Z	29.4N 128.8E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
61	131800Z	29.8N 128.7E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
62	132000Z	30.1N 128.5E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
63	132200Z	30.3N 128.5E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
64	132300Z	30.4N 128.6E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
65	140100Z	30.6N 128.7E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
66	140300Z	30.9N 128.7E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
67	140300Z	30.9N 128.7E	54--02---	700MB	085	085	950	2652	20/-	CIRC	----	35	CLSD, 5NM THK
68	140400Z	31.0N 128.7E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
69	140400Z	31.0N 128.8E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
70	140500Z	31.2N 128.8E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
71	140500Z	31.2N 128.9E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
72	140558Z	31.5N 129.0E	SLTLS	STG X	DIA 0	CAT 4	---	---	---	----	----	----	-----
73	140700Z	31.5N 129.1E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
74	140700Z	31.6N 129.1E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
75	140800Z	31.7N 129.2E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
76	140800Z	31.8N 129.2E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
77	140900Z	31.9N 129.2E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
78	140900Z	31.9N 129.2E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
79	140901Z	31.8N 129.4E	VW--01---	700MB	---	075	941	2615	21/16	CIRC	----	23	4-12NM THK, OPEN SW
80	141000Z	32.1N 129.3E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
81	141000Z	32.1N 129.3E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
82	141100Z	32.2N 129.4E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
83	141100Z	32.2N 129.5E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
84	141200Z	32.4N 129.6E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
85	141200Z	32.5N 129.5E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
86	141200Z	32.7N 129.8E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
87	141300Z	32.6N 129.6E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
88	141400Z	32.9N 130.1E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
89	141400Z	32.8N 129.9E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
90	141405Z	32.6N 130.1E	VW--01---	700MB	---	---	946	2731	18/13	CIRC	----	30	12NM THK, OPEN SW QUAD
91	141500Z	33.1N 130.2E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
92	141500Z	33.0N 130.1E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
93	141600Z	33.2N 130.2E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
94	141600Z	33.3N 130.3E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
95	141700Z	33.4N 130.4E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----
96	141702Z	33.5N 130.6E	LND RUR	---	---	---	---	---	--/-	----	----	----	-----

FIX NO.	TIME	POSII	TYPHOON WILDA				EYE FIXES CYCLONE				CHARACTER	
			UNIT- MET-HD -ACCY	FLT LVL	WIND WND	SFC SLP	MIN 700MB HGT	FLT LVL TT/TO	EYE FORM	ORIEN- TATION		
97	141800Z	33.8N 130.8E	LND	RUR	---	---	---	---	---	---	---	
98	141800Z	33.8N 130.7E	LND	RUR	---	---	---	---	---	---	---	
99	141900Z	33.9N 131.1E	LND	RUR	---	---	---	---	---	---	---	
100	142000Z	34.0N 131.4E	LND	RUR	---	---	---	---	---	---	---	
101	142055Z	34.7N 131.6E	54-/-08---	500MB	051	---	---	---	---	---	---	
102	142100Z	34.5N 131.5E	LND	RUR	---	---	---	---	---	---	---	
103	142200Z	34.7N 131.9E	LND	RUR	---	---	---	---	---	---	---	
104	150000Z	35.3N 132.3E	LND	RUR	---	---	---	---	---	---	---	
105	150245Z	35.7N 131.9E	54-/-02---	700MB	045	---	---	3066	---	---	NEG W/C	
106	150800Z	38.4N 139.8E	LND	RUR	---	---	---	---	---	---	---	
107	151125Z	39.8N 139.8E	VW- -03---	---	030	976	---	25/22	---	---	NEG W/C	
108	151300Z	40.9N 139.1E	LND	RUR	---	---	---	---	---	---	---	
109	151400Z	41.5N 139.4E	LND	RUR	---	---	---	---	---	---	---	

TYPHOON WILDA

TROPICAL CYCLONE 10 -- 8/8/2300Z TO 8/15/1700Z
POSITION AND FORECAST VERIFICATION DATA

<u>WARN NO.</u>	<u>DTG</u>	<u>WARNING POSIT LAT</u>	<u>LONG</u>	<u>BEST TRACK LAT</u>	<u>LONG</u>	<u>24 HR FCST LAT</u>	<u>LONG</u>	<u>24 HR ERROR DEG DIST</u>	<u>48 HR FCST LAT</u>	<u>LONG</u>	<u>48 HR ERROR DEG DIST</u>	<u>72 HR FCST LAT</u>	<u>LONG</u>	<u>72 HR ERROR DEG DIST</u>
01	09/0500Z	22.8N	131.5E	22.8N	131.5E	22.8N	127.9E	310-0102	22.8N	124.4E	264-0252	-----	-----	-----
02	09/1100Z	22.6N	130.3E	22.5N	130.4E	21.9N	124.8E	269-0246	22.2N	118.8E	261-0558	23.0N	113.3E	258-0822
03	09/1700Z	22.3N	129.1E	22.2N	129.9E	21.9N	123.3E	265-0324	22.3N	117.3E	259-0642	-----	-----	-----
04	09/2300Z	21.8N	129.5E	21.7N	129.4E	20.6N	126.6E	228-0186	20.0N	122.4E	232-0456	20.6N	118.3E	237-0708
05	10/0500Z	21.7N	129.3E	21.7N	129.3E	21.7N	128.8E	184-0096	21.9N	127.1E	207-0228	-----	-----	-----
06	10/1100Z	22.0N	129.5E	22.0N	129.3E	22.7N	129.0E	169-0066	27.1N	125.0E	202-0144	25.0N	124.0E	231-0348
07	10/1700Z	22.2N	129.3E	22.4N	129.2E	23.3N	128.0E	211-0078	24.5N	125.0E	240-0246	-----	-----	-----
08	10/2300Z	22.6N	129.0E	22.7N	129.1E	23.7N	127.1E	236-0114	25.2N	123.6E	248-0312	27.1N	120.3E	246-0480
09	11/0500Z	23.3N	129.0E	23.3N	129.0E	25.4N	127.8E	275-0060	28.1N	125.1E	271-0210	-----	-----	-----
10	11/1100Z	23.6N	128.9E	23.8N	128.8E	25.5N	127.7E	211-0030	27.9N	125.4E	256-0192	29.8N	122.4E	248-0390
11	11/1700Z	24.4N	128.6E	24.5N	128.8E	26.6N	127.1E	270-0102	28.7N	124.3E	259-0234	-----	-----	-----
12	11/2300Z	24.8N	128.6E	24.8N	128.9E	26.7N	127.9E	241-0060	29.1N	127.4E	218-0096	31.3N	128.7E	216-0276
13	12/0500Z	25.3N	128.8E	25.3N	129.0E	27.1N	128.6E	204-0054	28.9N	128.3E	170-0138	-----	-----	-----
14	12/1100Z	26.0N	129.3E	26.0N	128.1E	27.6N	132.7E	108-0198	29.4N	137.1E	114-0426	32.8N	145.3E	134-0564
15	12/1700Z	26.6N	129.0E	26.6N	129.0E	28.6N	130.2E	126-0090	30.8N	134.7E	125-0264	-----	-----	-----
16	12/2300Z	27.1N	129.0E	27.2N	129.0E	29.5N	128.9E	167-0054	31.9N	128.9E	218-0246	35.7N	130.1E	-----
17	13/0500Z	28.0N	129.0E	28.0N	129.1E	35.8N	136.0E	053-0450	-----	-----	-----	-----	-----	-----
18	13/1100Z	28.7N	129.0E	28.7N	129.1E	32.9N	129.6E	010-0036	38.0N	133.0E	245-0204	-----	-----	-----
19	13/1700Z	29.4N	129.0E	29.5N	128.8E	33.8N	129.9E	314-0030	38.5N	133.5E	229-0378	-----	-----	-----
20	13/2300Z	30.4N	128.5E	30.4N	128.6E	34.1N	130.2E	235-0102	39.2N	134.2E	-----	-----	-----	-----
21	14/0500Z	31.2N	128.6E	31.2N	128.8E	34.7N	130.8E	230-0234	39.9N	134.6E	-----	-----	-----	-----
22	14/1100Z	32.1N	129.5E	32.3N	129.5E	36.4N	133.1E	226-0258	42.7N	136.7E	-----	-----	-----	-----
23	14/1700Z	33.4N	130.5E	33.4N	130.4E	37.6N	134.0E	221-0402	43.9N	137.0E	-----	-----	-----	-----
24	14/2300Z	34.9N	132.0E	35.1N	132.0E	43.0N	136.8E	-----	-----	-----	-----	-----	-----	-----
25	15/0500Z	37.0N	134.9E	37.3N	134.5E	-----	-----	-----	-----	-----	-----	-----	-----	-----
26	15/1100Z	39.9N	138.0E	39.5N	137.0E	-----	-----	-----	-----	-----	-----	-----	-----	-----
27	15/1700Z	42.9N	140.8E	42.7N	139.7E	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0146 MI. 146.6
AVERAGE 48 HOUR ERROR - 0290 MI.
AVERAGE 72 HOUR ERROR - 0512 MI.

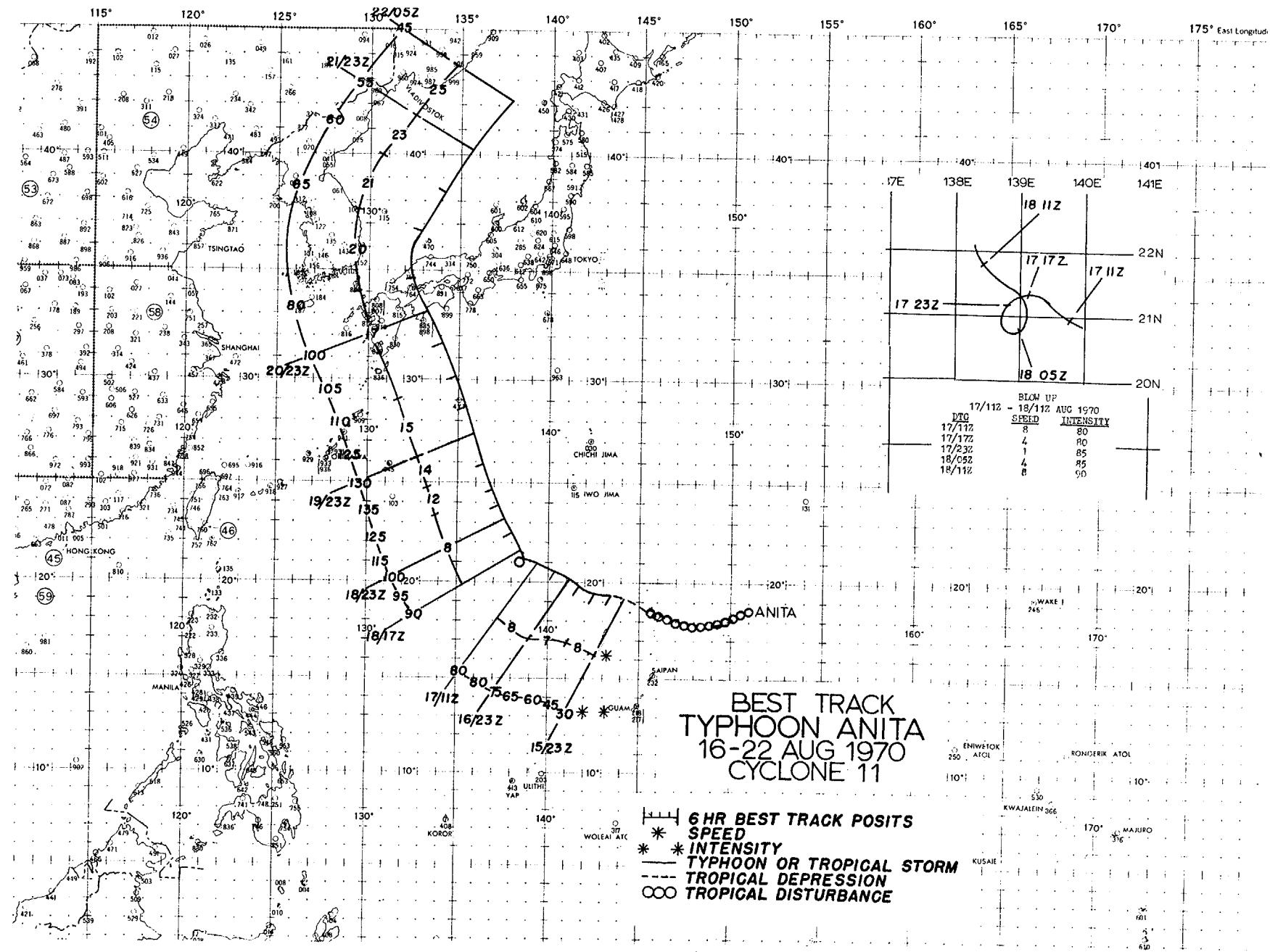
D. TYPHOON ANITA 15 AUG 2300Z-22 AUG 0500Z

1. STATISTICS

- a. Number of Warnings Issued - 26
- b. Number of Warnings with Typhoon Intensity - 19
- c. Distance Traveled During Warning Period - 2,001 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 912 MBS at 19/2055Z
- b. Minimum Observed 700 MB Height - 2325 M at 19/2055Z
- c. Maximum Surface Wind - 135 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 480 MI



3. TYPHOON ANITA NARRATIVE

As early as the 11th upper air reports from Marcus and Wake Islands plus satellite pictures indicated an upper level circulation in existence between the two islands. Two days later an ESSA-8 view disclosed the system to have drifted south of Marcus and enhanced in convective activity. Ship data indicated the low aloft had reflected downward into the surface pressure pattern as an induced wave.

This wave disturbance passed through the Northern Marianas chain during the night of the 15th to 16th with evidence of a developing circulation. A reconnaissance aircraft investigated the system the following afternoon and located a closed center with 995 mb central pressure 140 miles northwest of Pagan Island and Tropical Storm Anita was named.

Anita proceeded west northwest and intensified to typhoon strength within 18 hours while shifting to a more northerly course on the 17th. The ridge line north of the typhoon began to weaken considerably between Okinawa and Iwo Jima as a reflection of a slow moving trough in the westerlies east of Korea. Meanwhile heights began to build east of Japan with the establishment of a strong center of action for the subtropical ridge to the northeast of Anita. This set up steering conditions which resulted in a northwest path towards the Japanese coastline for the next three days.

While southwest of Iwo Jima on the 18th, Anita began to approach a 200 mb trough over the Sea of Japan extending through the Northern Ryukyu's. As this trough provided an efficient evacuation mechanism for the transfer of mass to the westerlies, the central pressure began to respond. In the following 36 hours dropsonde measurements showed a progressive fall of 55 mb. Reconnaissance aircraft radar presentations and infra-red satellite view of the storm during the night of the 19-20th indicated Anita had become highly organized in character (Figure 5-8). The storm reached its peak intensity while attaining super typhoon strength during the morning hours of the 20th as aerial reconnaissance registered a 912 mb surface pressure in the eye some 270 mi northwest of Iwo Jima (Figure 5-9).

At this point Anita started to increase her forward speed to 15 knots and later to 17 knots due to the increased southerly flow created between a strong mid-tropospheric high to the northeast and a cut off low in the East China Sea. The eye of the typhoon crossed the coastline of Western Shikoku about 40 N.M. southwest of Kochi City during the late morning hours of the 21st with an accompanying storm surge of 7.7 feet flooding parts of the city. At this time Anita had filled and wind strength was near 105 knots. Maximum sustained wind



FIGURE 5-8 NIMBUS IV NIGHTTIME INFRA-RED VIEW OF TYPHOON ANITA (ORBIT 1783) 19 AUGUST.
A TROPICAL DISTURBANCE IS DEPICTED NORTHEAST OF THE TYPHOON EAST OF THE
JAPANESE ISLANDS.

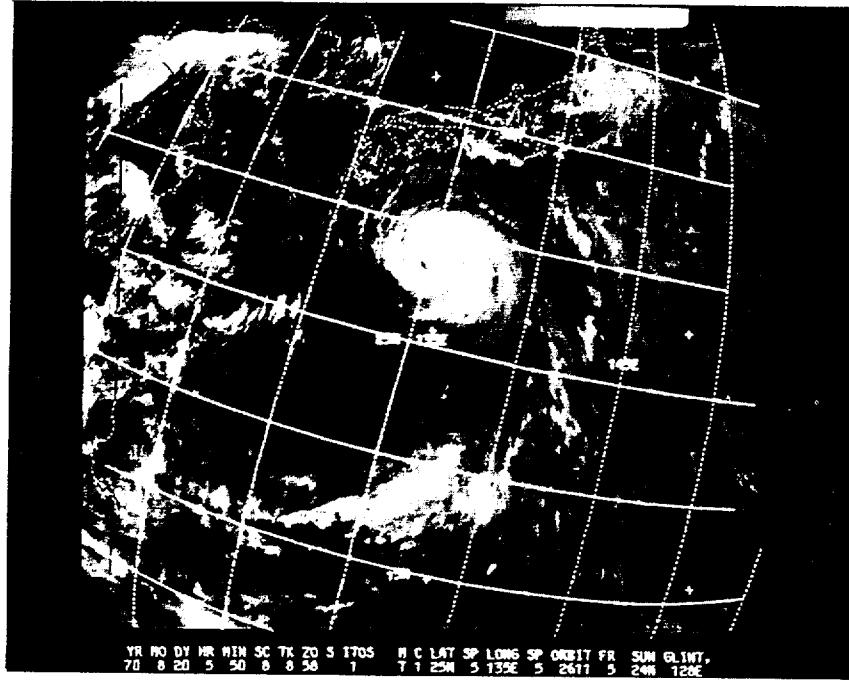


FIGURE 5-9 ANITA SOUTH OF SHIKOKU ISLAND WITH SUPER TYPHOON WINDS AS DISPLAYED TO
ITOS-1 ON THE AFTERNOON OF 20 AUGUST.

report occurred at Murotomisaki Weather Station registering 100 knots and gusts to 124 knots about 60 miles east of the center. Lowest pressure measured in the area was at Cape Ashizuri 15 miles west of the center with 962.3 mb.

At least 31 vessels were reported sunk including the 2,739 ton Japanese ship Koyo Maru along the coast of Japan while heavy rains (up to 15 inches) caused floods and landslides inland. Statistics reveal at least 23 storm-related deaths, 556 injured and over 5,000 houses partially or totally destroyed.

In response to a major trough moving off the China coast, the typhoon recurved sharply after passage over Hiroshima and entrance into the Sea of Japan. On her north-east course, at a rate greater than 20 knots, Anita quickly lost typhoon intensity late on the 21st. She transformed to an extratropical system as she passed west of Hokkaido by the 22nd.

TYPHOON ANITA

FIX NO.	TIME	POSIT	EYE FIXES CYCLONE			11	OBS	OBS	MIN	FLT	LVL	EYE	ORIEN- TATION	EYE DIA	CHARACTER
			UN-T- MET:OU -ACCY	FLT LVL	LVL WND		SFC WND	MN SIP							
1	160222Z	19.3N 143.4E	54--25--			040	045	995	---	26/24	---				NEG WALL
2	160512Z	19.5N 143.0E	SLTLS	STG 8	DIA --	CAT -				--/-					-----
3	160600Z	18.8N 142.3E	ACFT RUR							--/-					-----
4	160903Z	19.2N 142.4E	VW--10--	0160M	050	--	--	--	--/-	CIRC	---	10	OPEN TO NW		
5	161211Z	19.3N 141.9E	VW--105--			--	--	--	--/-	CIRC	---	15	CLSD WALL 4NM THK		
6	161405Z	19.3N 141.7E	VW--10--			--	--	--	--/-	CIRC	---	17	OPEN TO N		
7	162100Z	19.7N 141.4E	54--05--	700MB	055	075	978	2914	16/12	CIRC	---	22	5NM THK, OPEN W QUAD		
8	170300Z	20.3N 140.6E	54--05--	700MB	072	080	976	2920	19/13	CIRC	---	40	NEG W/C		
9	170456Z	19.5N 139.5E	SLTLS	STG X	DIA 0,	CAT 3									-----
10	170900Z	20.8N 139.8E	VW--05--	0200M	--	055	977	--	28/23	CIRC	---	18	NEG W/C		
11	171235Z	21.0N 139.5E	VW--02--	0200M	--	055	977	--	28/24	ELIP	N-S	36X24	8NM THK N SEMICIR		
12	171400Z	21.0N 139.1E	VW--10--		--	--	--	--	--/-	ELIP	N-S	35X25	-----		
13	172100Z	21.1N 139.0E	54--05--	700MB	070	080	960	2810	23/15	---			OPEN NE-NW		
14	180430Z	20.9N 138.9E	54--10--	700MB	060	075	962	2829	16/11	---			CLSD		
15	180533Z	21.5N 138.0E	SLTLS	STG X	DIA 0,	CAT 3									-----
16	180900Z	21.4N 138.5E	VW--05--		057	--	--	--	--/-	ELIP	NE-SW	20X14	CLSD		
17	181340Z	21.9N 138.3E	VW--03--		065	100	965	--	27/23	CIRC	---	20	CLSD		
18	182020Z	22.8N 137.8E	54--07--	700MB	067	070	947	2643	16/12	CIRC	---	20	OPEN SSW-W		
19	190300Z	23.6N 137.4E	54--08--	700MB	110	095	924	2435	20/12	CIRC	---	18	CLSD, 5NM THK		
20	190454Z	23.5N 137.0E	SLTLS	STG X	DIA 0,	CAT 4									-----
21	190925Z	24.5N 137.1E	VW--10--		--	--	--	--	--/-				CLSD, 5NM THK		
22	191005Z	24.5N 137.2E	VW--05--	700MB	--	--	921	2417	--/-	CIRC	---	14	CLSD, 5NM THK		
23	191435Z	25.2N 136.7E	VW--10--		--	--	--	--	--/-				CLSD, 5NM THK		
24	192055Z	26.3N 136.6E	54--05--	700MB	110	130	912	2325	22/15	CIRC	---	18	CLSD		
25	200300Z	28.0N 135.6E	54--30--	700MB	100	110	924	2430	20/14	CIRC	---	20	CLSD		
26	200425Z	27.5N 135.5E	ACFT RUR		--	--	--	--	--/-					-----	
27	200520Z	28.5N 135.0E	SLTLS	STG X	DIA 0	CAT 4									-----
28	200800Z	29.4N 134.9E	LND RUR		--	--	--	--	--/-						-----
29	200857Z	29.5N 135.2E	VW--05--		075	--	--	--	--/-	CIRC	---	11	CLSD, APRD BKN S SEMICIR		
30	200900Z	29.5N 134.9E	LND RUR		--	--	--	--	--/-						-----
31	201425Z	30.7N 134.3E	VW--03--	700MB	075	--	950	2658	16/12	CIRC	---	20	CLSD, 11NM THK		
32	201430Z	30.4N 134.2E	ACFT RUR		--	--	--	--	--/-						-----
33	201600Z	31.2N 133.9E	ACFT RUR		--	--	--	--	--/-						-----
34	201658Z	31.4N 133.7E	ACFT RUR		--	--	--	--	--/-						-----
35	201700Z	31.4N 133.8E	ACFT RUR		--	--	--	--	--/-						-----
36	201800Z	31.5N 133.7E	ACFT RUR		--	--	--	--	--/-						-----
37	201800Z	31.6N 133.6E	ACFT RUR		--	--	--	--	--/-						-----
38	201900Z	31.8N 133.7E	LND RUR		--	--	--	--	--/-						-----
39	202000Z	32.1N 133.5E	LND RUR		--	--	--	928	--/-						-----
40	202100Z	32.0N 134.0E	54--105--	700MB	070	080	950	2725	17/13	CINC				50-20	OUTER-OPEN W-NW, INNER-OPEN SW-W
41	202100Z	32.4N 133.3E	LND RUR		--	--	--	--	--/-						-----
42	202200Z	32.5N 133.3E	LND RUR		--	--	--	--	--/-						-----
43	202230Z	32.7N 133.3E	LND RUR		--	--	--	--	--/-						-----
44	202300Z	33.0N 133.2E	LND RUR		--	--	--	--	--/-						-----
45	210000Z	33.3N 132.9E	LND RUR		--	--	--	--	--/-						-----
46	210200Z	34.2N 132.5E	LND RUR		--	--	--	--	--/-						-----
47	210300Z	34.2N 132.6E	54--06--	500MB	075	--	--	--	--/-						NEG W/C
48	210500Z	34.9N 132.2E	LND RUR		--	--	--	--	--/-						-----

TYPHOON ANITA
EYE FIXES CYCLONE

FIX NO.	TIME	POSII	UNIT- METHOD -ACCUY	FLT		SFC	OBS	MIN	700MB	FLT	EYE	ORIEN- TATION	EYE DIA	CHARACTER WALL CLOUD
				FLT	LVL									
49	Z10700Z	35.7N 132.4E	LND RDR	---	---	---	---	---	---	---	---	---	---	---
50	Z10800Z	35.8N 132.5E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
51	Z11000Z	36.1N 132.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
52	Z11024Z	36.1N 132.3E	VW--03---	700MB	057	---	993	3024	15/09	---	---	---	---	---
53	Z11200Z	36.7N 132.9E	LND RDR	---	---	---	---	---	---	---	---	---	---	---
54	Z11215Z	36.8N 132.8E	VW--04---	700MB	060	---	---	---	---	---	---	---	---	NEG W/C
55	Z11300Z	36.9N 133.1E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
56	Z11400Z	37.5N 133.0E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
57	Z11407Z	37.2N 133.4E	VW--01---	700MB	060	---	991	3051	13/11	---	---	---	---	NEG W/C
58	Z12100Z	39.4N 135.1E	54--10---		065	---	---	---	---	---	CTRC	---	10	---

TYPHOON ANITA

TROPICAL CYCLONE 11 -- 8/15/2300Z TO 8/22/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING LAT	POSIT LONG	BEST TRACK LAT	TRACK LONG	24 HR FCST LAT	FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	FCST LONG	72 HR ERROR DEG DIST
01	15/2300Z	19.4N	143.6E	19.1N	144.4E	21.7N	141.7E	-018-0096-	-----	-----	-----	-----	-----	-----
02	16/0500Z	20.1N	143.2E	19.3N	143.5E	22.2N	141.2E	027-0102	-----	-----	-----	-----	-----	-----
03	16/1100Z	19.2N	142.2E	19.3N	142.5E	19.4N	138.8E	202-0096	20.2N	135.5E	242-0186	21.3N	132.8E	229-0306
04	16/1700Z	19.3N	141.2E	19.6N	141.7E	19.7N	137.5E	227-0120	20.6N	134.2E	244-0240	-----	-----	-----
05	16/2300Z	19.8N	141.1E	20.1N	141.1E	21.2N	138.5E	288-0018	22.7N	135.5E	259-0120	24.3N	132.9E	226-0252
06	17/0500Z	20.5N	140.4E	20.6N	140.3E	22.6N	137.7E	324-0120	24.6N	135.1E	288-0132	-----	-----	-----
07	17/1100Z	21.0N	139.6E	20.9N	139.5E	23.1N	136.8E	313-0120	25.3N	134.3E	283-0150	27.7N	132.7E	217-0180
08	17/1700Z	21.4N	138.9E	21.1N	139.1E	23.4N	136.2E	300-0114	25.7N	133.9E	266-0156	-----	-----	-----
09	17/2300Z	21.2N	138.9E	21.1N	138.9E	21.9N	137.8E	175-0072	23.4N	135.7E	188-0234	25.0N	133.9E	175-0480
10	18/0500Z	20.9N	138.9E	20.9N	139.0E	21.3N	138.7E	155-0168	22.3N	137.2E	167-0390	-----	-----	-----
11	18/1100Z	21.6N	138.4E	21.7N	138.5E	23.2N	136.8E	188-0090	25.8N	134.7E	180-0258	28.3N	133.4E	177-0492
12	18/1700Z	22.1N	138.0E	22.4N	138.1E	24.0N	136.8E	180-0114	26.6N	135.5E	164-0300	-----	-----	-----
13	18/2300Z	23.1N	137.7E	23.1N	137.7E	26.3N	135.9E	197-0060	30.5N	134.5E	156-0162	36.5N	136.2E	197-0228
14	19/0500Z	23.9N	137.2E	23.9N	137.4E	27.6N	135.5E	180-0066	32.6N	134.1E	146-0150	-----	-----	-----
15	19/1100Z	24.7N	136.9E	24.7N	137.1E	28.4N	135.2E	169-0102	33.9N	134.0E	160-0162	41.5N	136.5E	-----
16	19/1700Z	25.4N	136.5E	25.9N	136.8E	29.0N	134.7E	166-0150	33.6N	132.1E	200-0294	-----	-----	-----
17	19/2300Z	26.6N	136.5E	27.3N	136.3E	31.2N	135.2E	134-0144	37.8N	134.8E	197-0150	47.0N	139.5E	-----
18	20/0500Z	28.3N	135.7E	28.7N	135.6E	36.5N	134.1E	036-0132	45.0N	137.5E	003-0162	-----	-----	-----
19	20/1100Z	30.1N	134.9E	30.1N	134.8E	39.2N	134.9E	030-0180	-----	-----	-----	-----	-----	-----
20	20/1700Z	31.5N	134.3E	31.5N	133.9E	38.5N	134.5E	046-0012	-----	-----	-----	-----	-----	-----
21	20/2300Z	32.9N	133.2E	33.0N	133.1E	40.3N	134.6E	277-0048	-----	-----	-----	-----	-----	-----
22	21/0500Z	34.8N	132.7E	34.7N	132.4E	43.7N	136.2E	330-0096	-----	-----	-----	-----	-----	-----
23	21/1100Z	36.3N	132.7E	36.5N	132.9E	41.0N	136.1E	-----	-----	-----	-----	-----	-----	-----
24	21/1700Z	38.0N	133.9E	38.3N	134.2E	43.8N	139.5E	-----	-----	-----	-----	-----	-----	-----
25	21/2300Z	40.1N	135.7E	40.2N	135.7E	-----	-----	-----	-----	-----	-----	-----	-----	-----
26	22/0500Z	42.2N	137.4E	42.3N	137.4E	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0100 MI. } O/.
AVERAGE 48 HOUR ERROR - 0202 MI.
AVERAGE 72 HOUR ERROR - 0323 MI.

E. TYPHOON BILLIE 23 AUG 0500Z-31 AUG 1100Z

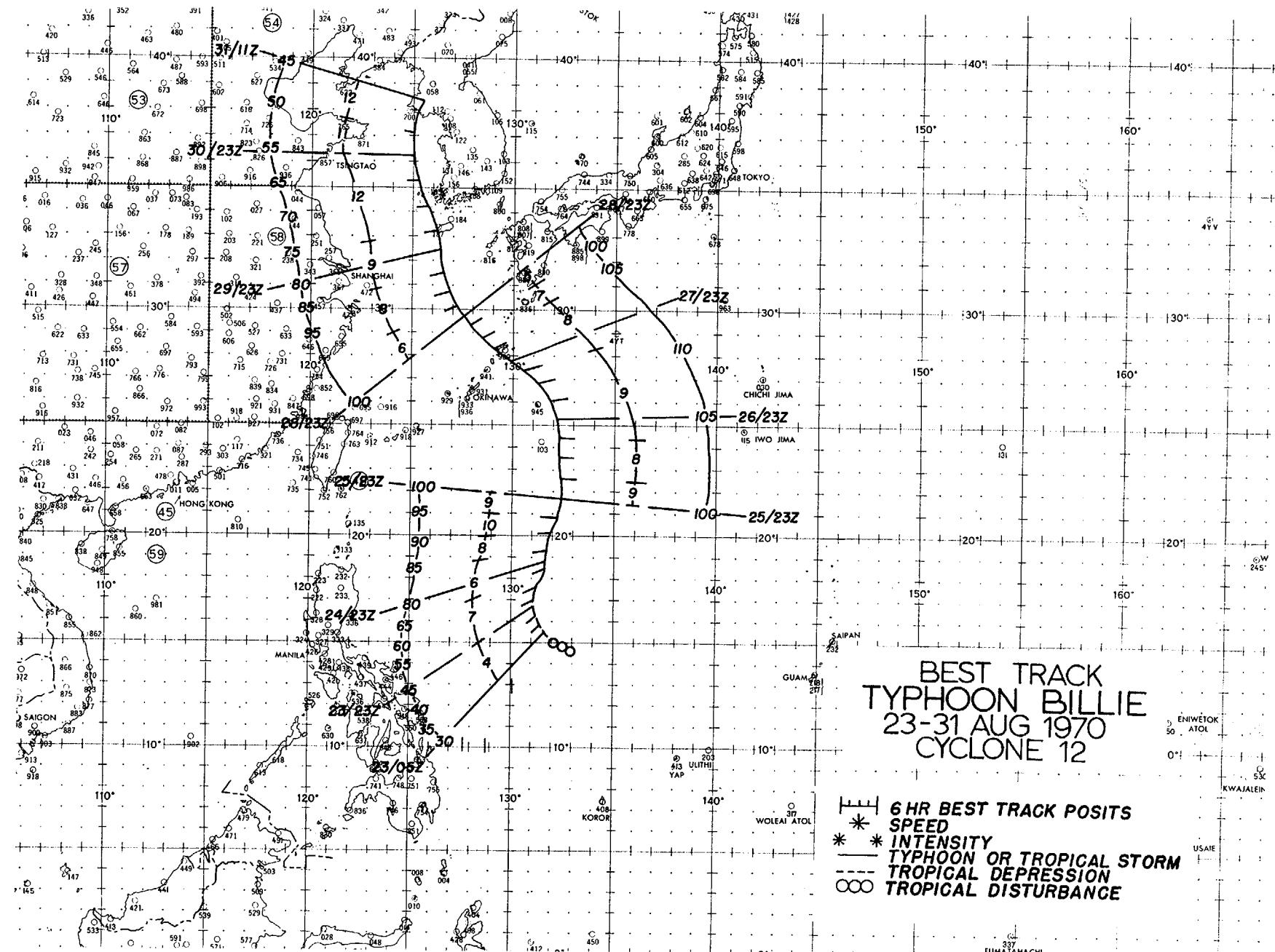
1. STATISTICS

- a. Number of Warnings Issued - 34
- b. Number of Warnings with Typhoon Intensity - 24
- c. Distance Traveled During Warning Period - 1,697 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 945 MBS at 28/0000Z
- b. Minimum Observed 700 MB Height - 2624 M at 28/0000Z
- c. Maximum Surface Wind - 110 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 600 MI

5-36



3. TYPHOON BILLIE NARRATIVE

Billie formed in the Philippine Sea within the zone of the intertropical trough on August 22nd. Prior to this, extensive cloudiness had been depicted by satellite pictures for several days in this area. The enhanced convection appeared to be generated by increased southwest monsoon flow into the region which apparently had been triggered by the presence of Typhoon Anita in the Northern Philippine Sea.

Upon initial detection of a weak depression by reconnaissance aircraft on the 23rd the storm intensified slowly while drifting northward and reached typhoon force early on the 25th. The westerlies were displaced near 40°N during the latter part of August and steering initially was weak. However, a high cell located east of Guam provided some steering and this combined with the storm's internal steering force for a northward movement of 8 to 9 knots through the 27th.

As heights began to build slowly across Japan, Billie swung to a northwesterly course during the afternoon of the 27th which caused the track to cross through the Ryukyu chain just south of Amami-o-Shima. Prior to passage of the island, Billie reached her lowest pressure of 945 mb and maximum strength of 110 knots. (Figure 5-10)

Heights continued to build over the Sea of Japan and the ridge line receded toward a higher latitude. The typhoon began to turn more northward which eventually took the storm just west of Chiejudo Island and into the Yellow Sea where it paralleled the South Korean coastline. As drier air began to enter the typhoon's circulation, Billie was reduced to tropical storm strength early on the 31st. The storm was being approached by a westerly trough which caused the storm's center to arrive on the Korean coastline west of Kaesong. The tropical system rapidly transformed to extratropical character and accelerated into Manchuria. At least 15 persons were reported killed due to flooding and landslides associated with the storm's rainfall over South Korea.

An unusual aspect during Billie's lifetime was that on five occasions a double wall cloud or concentric eye was observed by reconnaissance crews. The first three instances occurred during the 26th with the outer wall cloud 50 miles in diameter and the inner 7 miles. Later on the 29th, as the storm crossed the East China Sea, 2 cases were observed with an outer diameter of 80 and inner of 20 miles.

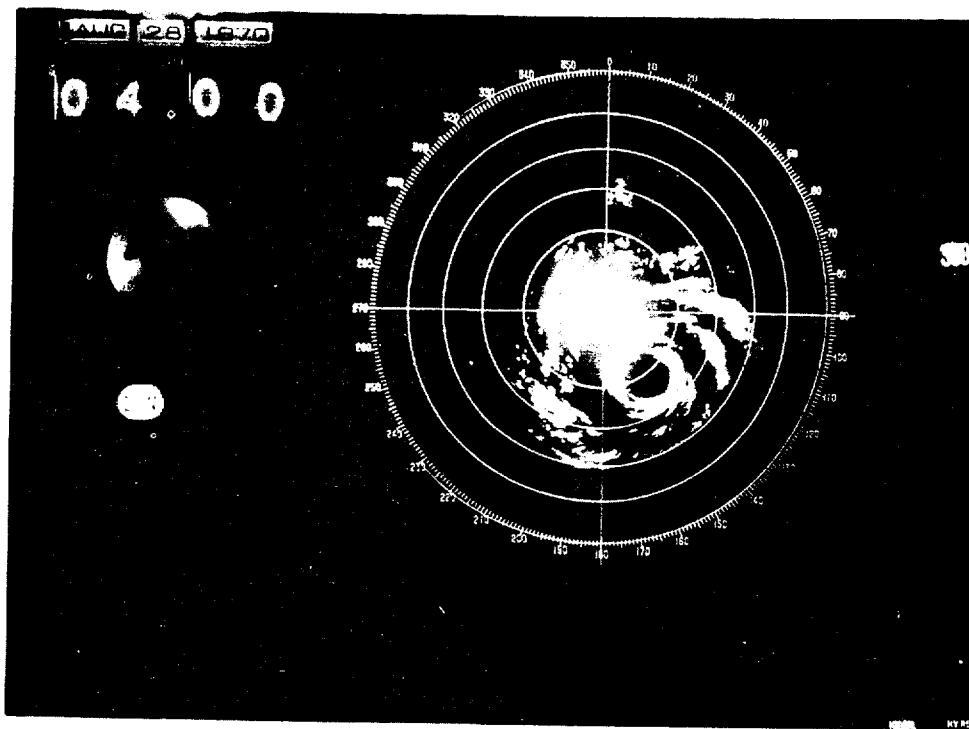
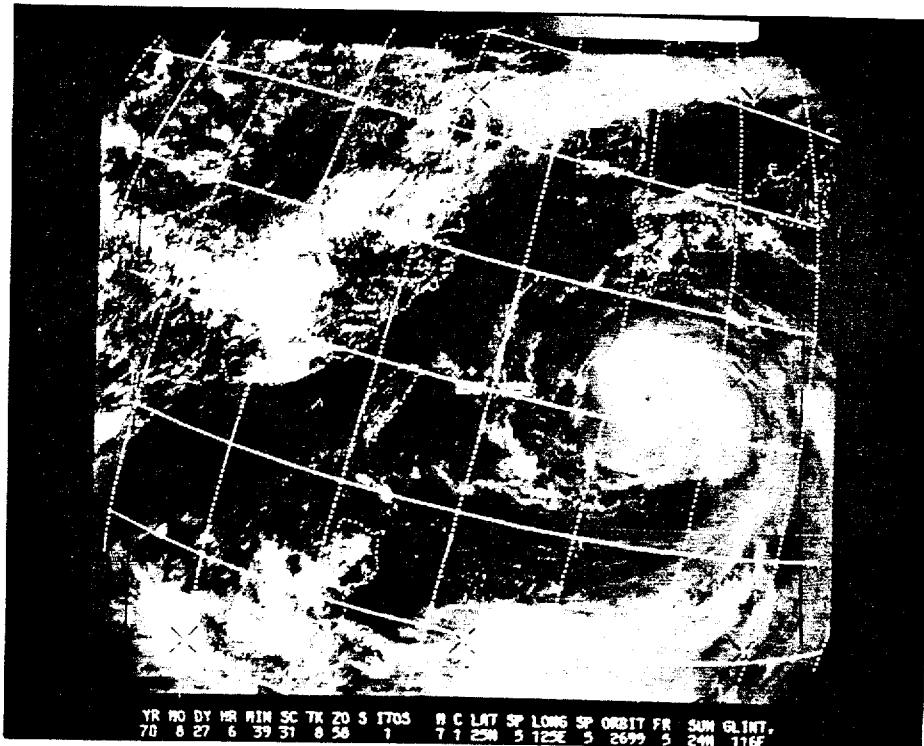


FIGURE 5-10 TOP - TYPHOON BILLIE AS SEEN BY ITOS-1 SATELLITE DURING THE AFTERNOON OF
 27 AUGUST.
 BOTTOM - THE EYE OF BILLIE ON 28 AUGUST 0400 (JST) - 27/1900 GMT AS
 VIEWED BY THE NAZE MITSUBISHI RADAR (10.4 CM) ON AMAMI-O-SHIMA ISLAND
 (COURTESY JAPAN METEOROLOGICAL AGENCY). RANGE MARKS ARE AT 100 KM
 INTERVALS.

5-39

TYPHOON BILLIE

FIX NO.	TIME	POSII	EYE FIXES CYCLONE				12	MIN	FLT	LVL	EYE	ORIEN- TATION	EYE DIA	CHARACTER
			UNIT- MET-00	FLT	LVL	OBS								
-ACCY	LVL	WIND	SFC	MN	700MB	TT/TO	FORM							
1	230215Z	15.6N 131.8E	54-+-05---	028	030	002	3106	26/23	---	---	---	---	---	NEG W/C
2	232110Z	16.3N 131.5E	54-+-08---	700MB	030	---	990	3015	13/10	---	---	25	APRNT W/C FORMG SE QUAD	
3	240300Z	16.8N 131.1E	54-+-08---	700MB	042	040	986	2999	15/11	CIRC	---	25	NEG W/C	
4	241546Z	17.0N 131.0E	SLTIS	STG X	DIA 0+	CAT 2								-----
5	241240Z	17.5N 131.2E	VW-+-20---	---	---	---	---	---	---	---	---			-----
6	241312Z	17.6N 131.1E	VW-+-0/-	---	035	---	---	---	CIRC	---	16	W/C FORMG S SEMICIR		
7	241457Z	18.0N 131.5E	VW-+-04---	0450M	045	980	---	24/21	CIRC	---	24	W/C FORMG S QUAD, 5NM THK		
8	242100Z	18.8N 131.6E	54-+-03---	700MB	055	050	966	2829	18/12	CIRC	---	08	W/C FORMG S QUAD	
9	250300Z	19.0N 131.7E	54-+-05---	700MB	000	080	---	2813	18/13	CIRC	---	06	W/C BLDG N QUAD	
10	250642Z	19.0N 132.5E	SLTIS	STG X	DIA 0+	CAT 3								-----
11	250800Z	19.3N 132.7E	VW-+-0/-	---	---	---	---	---	---	---				-----
12	251845Z	19.9N 131.9E	VW-+-05---	1500M	103	110	963	---	27/24	CIRC	---	35	8NM THK, OPEN SW	
13	251230Z	20.0N 131.6E	VW-+-20---	700MB	095	---	---	---	CIRC	---	40	CLSD, 8-13NM THK		
14	252100Z	21.7N 132.3E	54-+-05---	700MB	070	075	956	2743	18/10	CONC	---	50-7	OUTER-CLSD, INNER-OPEN SW	
15	260000Z	22.1N 132.2E	54-+-05---	700MB	075	080	956	2740	17/10	CONC	---	50-8	OUTER-CLSD, INNER-OPEN SW	
16	260300Z	22.6N 132.3E	54-+-03---	700MB	075	080	945	2740	18/11	CONC	---	50-6	OUTER CLSD, INNER-OPEN SW	
17	260543Z	22.5N 132.0E	SLTIS	STG X	DIA 0+	CAT 4								-----
18	260859Z	23.4N 132.1E	VW-+-05---	130	135	960	---	27/24	CIRC	---	35	CLSD, 10NM THK		
19	261000Z	23.5N 132.1E	VW-+-0/-	---	---	---	---	---	---	---				-----
20	261140Z	23.7N 132.2E	VW-+-05---	700MB	085	---	---	2746	20/12	CIRC	---	25	CLSD	
21	261405Z	23.9N 132.3E	VW-+-05---	700MB	100	---	958	2743	19/13	CIRC	---	30	CLSD	
22	262100Z	25.0N 132.2E	54-+-05---	700MB	075	085	950	2688	20/15	CIRC	---	35	OPEN SW QUAD	
23	270100Z	25.7N 132.1E	LND RUR	---	---	---	---	---	---	---				-----
24	270200Z	26.0N 131.9E	LND RUR	---	---	---	---	---	---	---				-----
25	270300Z	26.0N 131.9E	54-+-05---	700MB	090	100	949	2667	18/14	CIRC	---	40	OPEN S QUAD	
26	270400Z	26.1N 131.8E	LND RUR	---	---	---	---	---	---	---				-----
27	270500Z	26.2N 131.8E	LND RUR	---	---	---	---	---	---	---				-----
28	270640Z	26.0N 132.0E	SLTIS	STG X	DIA 0	CAT 4								-----
29	270900Z	26.9N 131.5E	LND RUR	---	---	---	---	---	---	---				-----
30	270924Z	27.0N 131.2E	VW-+-10---	---	---	---	---	---	---	---				-----
31	271013Z	26.8N 131.3E	VW-+-05---	---	085	947	---	27/23	CIRC	---	30	OPEN S, 8NM THK		
32	271216Z	27.1N 131.2E	VW-+-10---	---	---	---	---	---	---	---				-----
33	271400Z	27.1N 130.9E	VW-+-05---	---	---	---	---	---	CIRC	---	30	OPEN S QUAD, WALL 4NM THK NW-E		
34	271500Z	27.3N 130.5E	LND RUR	---	---	---	---	---	---	---				-----
35	271600Z	27.5N 130.4E	LND RUR	---	---	---	---	---	---	---				-----
36	271700Z	27.4N 130.3E	LND RUR	---	---	---	---	---	---	---				-----
37	271741Z	27.3N 130.4E	54-+-05---	500MB	000	---	---	03/-4	ELIP	NW-SE	45x3	CLSD		-----
38	271800Z	27.2N 130.1E	LND RUR	---	---	---	---	---	---	---				-----
39	271800Z	27.5N 130.2E	LND RUR	---	---	---	---	---	---	---				-----
40	271900Z	27.8N 130.1E	LND RUR	---	---	---	---	---	---	---				-----
41	271900Z	27.6N 130.2E	LND RUR	---	---	---	---	---	---	---				-----
42	272100Z	27.8N 129.9E	54-+-05---	700MB	058	---	946	2637	17/13	CIRC	---	35	CLSD	
43	272230Z	27.9N 129.7E	LND RUR	---	---	---	---	---	---	---				-----
44	272300Z	27.9N 129.6E	LND RUR	---	---	---	---	---	---	---				-----
45	280000Z	27.9N 129.6E	54-+-05---	700MB	005	090	956	2624	17/13	CIRC	---	40	CLSD	
46	280000Z	27.9N 129.5E	LND RUR	---	---	---	---	---	---	---				-----
47	280300Z	28.1N 129.2E	54-+-03---	700MB	075	090	948	2634	18/12	CIRC	---	20	CLSD	
48	280400Z	28.1N 129.1E	LND RUR	---	---	---	---	---	---	---				-----

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FIX NO.	TIME	POSIT	EYE FIXES CYCLONE			12	MIN 700MB	FLT LVL	EYE FORM	ORIENTA- TION	EYE DIA	CHARACTER WALL CLOUD
			UNIT- METHOD	FLT ACCY	FLT LVL		SFC SLP					
49	280500Z	28.2N 129.0E	LND RUR	---	---	---	---	---	---	---	---	-----
50	280514Z	28.5N 128.5E	SLTLS	STG X	DIA 04	CAT 3	---	---	---	---	---	-----
51	280600Z	28.5N 129.0E	LND RUR	---	---	---	---	---	---	---	---	-----
52	280700Z	28.5N 128.9E	LND RUR	---	---	---	---	---	---	---	---	-----
53	280840Z	28.6N 128.7E	54-p-02---	700MB	070	060	947	2630	19/15	CIR	---	28 CLSD, SMALL OPENINGS S
54	280900Z	28.7N 128.7E	LND RUR	---	---	---	---	---	---	---	---	-----
55	280920Z	28.7N 128.6E	VW-p-05---	700MB	---	065	952	---	20/15	CIR	---	27 WK W/C S QUAD
56	281100Z	28.8N 128.4E	LND RUR	---	---	---	---	---	---	---	---	-----
57	281200Z	29.0N 128.1E	VW-p-05---	700MB	070	---	---	2728	19/15	CIR	---	27 -----
58	281200Z	28.8N 128.3E	LND RUR	---	---	---	---	---	---	---	---	-----
59	281400Z	28.9N 128.0E	LND RUR	---	---	---	---	---	---	---	---	-----
60	281500Z	29.0N 128.0E	LND RUR	---	---	---	---	---	---	---	---	-----
61	281500Z	29.2N 127.8E	VW-p-03---	700MB	070	---	948	2749	17/12	ELIP	NW-SE	20x17 6NM THK, OPEN S AND SE
62	281600Z	29.1N 127.9E	LND RUR	---	---	---	---	---	---	---	---	-----
63	281700Z	29.2N 127.8E	LND RUR	---	---	---	---	---	---	---	---	-----
64	281800Z	29.3N 127.7E	LND RUR	---	---	---	---	---	---	---	---	-----
65	281900Z	29.4N 127.5E	LND RUR	---	---	---	---	---	---	---	---	-----
66	282000Z	29.5N 127.4E	LND RUR	---	---	---	---	---	---	---	---	-----
67	282055Z	29.6N 127.6E	54-p-05---	700MB	085	---	949	2670	17/11	CONC	80-20	OUTER-CLSD, INNER-CLSD
68	282100Z	29.5N 127.5E	LND RUR	---	---	---	---	---	---	---	---	-----
69	282200Z	29.6N 127.3E	LND RUR	---	---	---	---	---	---	---	---	-----
70	282300Z	29.7N 127.3E	LND RUR	---	---	---	---	---	---	---	---	-----
71	290000Z	29.8N 127.4E	54-p-05---	700MB	065	065	949	2679	17/13	CONC	80-20	WALL DETERG
72	290200Z	29.9N 127.2E	54-p-05---	700MB	075	080	950	2676	18/13	CIR	20	OPEN W
73	290637Z	30.5N 127.2E	SLTLS	STG X	DIA 0-	CAT 3	---	---	---	---	---	-----
74	290815Z	30.6N 127.0E	VW-p-03---	---	080	951	---	27/25	CIR	---	30	OPEN S SEMICIR, NO SEP WALL
75	291130Z	31.1N 127.2E	LND RUR	---	---	---	---	---	---	---	---	-----
76	291230Z	31.2N 127.0E	LND RUR	---	---	---	---	---	---	---	---	-----
77	291330Z	31.4N 126.8E	LND RUR	---	---	---	---	---	---	---	---	-----
78	291400Z	31.0N 126.0E	VW-p----	---	---	---	---	---	---	CIR	---	25 -----
79	291430Z	31.6N 126.8E	LND RUR	---	---	---	---	---	---	---	---	-----
80	292100Z	32.3N 126.3E	54-p-03---	700MB	065	---	958	2768	17/13	CIR	---	80 OPEN W-NW, RDR PRESENT POOR
81	292100Z	32.4N 126.7E	LND RUR	---	---	---	---	---	---	---	---	-----
82	292155Z	32.3N 126.4E	54-p----	---	---	---	---	---	---	---	---	-----
83	292200Z	32.6N 126.7E	LND RUR	---	---	---	---	---	---	---	---	-----
84	292300Z	32.8N 126.8E	LND RUR	---	---	---	---	---	---	---	---	-----
85	300000Z	32.9N 126.8E	LND RUR	---	---	---	---	---	---	---	---	-----
86	300100Z	33.1N 126.4E	LND RUR	---	---	---	---	---	---	---	---	-----
87	300200Z	33.2N 126.4E	LND RUR	---	---	---	---	---	---	---	---	-----
88	300300Z	32.9N 126.2E	54-p-03---	700MB	002	---	970	2798	16/13	---	---	NEG W/C
89	300300Z	33.4N 126.4E	LND RUR	---	---	---	---	---	---	---	---	-----
90	300543Z	33.0N 126.0E	SLTLS	STG X	DIA 0-	CAT 2	---	---	---	---	---	-----
91	300600Z	33.7N 126.5E	LND RUR	---	---	---	---	---	---	---	---	-----
92	300700Z	33.8N 126.5E	LND RUR	---	---	---	---	---	---	---	---	-----
93	300900Z	34.2N 126.8E	LND RUR	---	---	---	---	---	---	---	---	-----
94	301210Z	34.7N 125.9E	VW-p-25---	3050M	050	---	---	---	---	---	---	NEG W/C
95	302100Z	35.8N 125.0E	54-p-03---	700MB	045	---	977	2887	12/09	CIR	05	NEG W/C

TYPHOON BILLIE

TROPICAL CYCLONE 12 -- 8/23/0500Z TO 8/31/1100Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR LAT	FCST LONG	24 HR DEG DIST	48 HR LAT	FCST LONG	48 HR DEG DIST	72 HR LAT	FCST LONG	72 HR DEG DIST
		LAT	LONG	LAT	LONG									
01	23/0500Z	15.8N	131.5E	15.5N	131.8E	17.3N	129.0E	281-0120	-----	-----	-----	-----	-----	-----
02	23/1100Z	16.2N	130.9E	15.8N	131.4E	17.6N	128.3E	270-0162	-----	-----	-----	-----	-----	-----
03	23/1700Z	16.1N	131.3E	16.1N	131.2E	16.9N	129.8E	229-0126	-----	-----	-----	-----	-----	-----
04	23/2300Z	16.3N	131.5E	16.5N	131.1E	17.7N	130.7E	217-0078	-----	-----	-----	-----	-----	-----
05	24/0500Z	17.1N	131.0E	16.9N	131.1E	19.8N	128.8E	280-0168	22.8N	125.9E	270-0354	-----	-----	-----
06	24/1100Z	17.4N	131.0E	17.6N	131.2E	19.7N	129.6E	237-0150	22.0N	127.3E	252-0282	24.4N	124.3E	250-0402
07	24/1700Z	18.2N	131.4E	18.3N	131.5E	20.5N	130.7E	258-0084	22.7N	128.8E	243-0204	-----	-----	-----
08	24/2300Z	19.0N	131.6E	18.8N	131.6E	22.0N	131.8E	296-0024	24.8N	131.4E	241-0048	27.6N	130.7E	104-0048
09	25/0500Z	19.0N	131.7E	19.3N	131.8E	20.6N	131.9E	189-0126	23.4N	131.7E	180-0156	-----	-----	-----
10	25/1100Z	20.1N	132.0E	21.1N	131.9E	22.4N	132.1E	180-0086	25.9N	131.2E	180-0048	29.4N	130.0E	067-0090
11	25/1700Z	20.6N	131.8E	20.8N	132.2E	23.3N	131.8E	197-0060	26.8N	130.8E	161-0036	-----	-----	-----
12	25/2300Z	21.9N	132.4E	21.8N	132.3E	25.1N	132.6E	108-0018	28.5N	131.3E	062-0084	31.9N	130.0E	044-0186
13	26/0500Z	22.9N	132.3E	22.7N	132.3E	26.5N	131.8E	000-0030	29.9N	130.6E	042-0126	-----	-----	-----
14	26/1100Z	23.7N	132.1E	23.5N	132.2E	27.3N	131.4E	010-0036	30.7N	130.2E	039-0144	35.8N	130.4E	031-0354
15	26/1700Z	24.2N	132.1E	24.3N	132.2E	27.2N	131.4E	104-0048	30.6N	130.3E	059-0144	-----	-----	-----
16	26/2300Z	25.3N	132.2E	25.2N	132.2E	28.5N	132.0E	070-0120	31.6N	132.0E	063-0258	36.5N	132.8E	053-0402
17	27/0500Z	26.3N	132.0E	26.0N	131.8E	29.9N	131.7E	056-0168	33.5N	131.8E	051-0306	-----	-----	-----
18	27/1100Z	27.0N	131.3E	26.7N	131.3E	30.4N	130.2E	044-0126	34.4N	130.0E	037-0270	39.9N	133.1E	047-0486
19	27/1700Z	27.6N	130.3E	27.4N	130.5E	30.5N	128.1E	010-0072	34.4N	128.9E	035-0210	-----	-----	-----
20	27/2300Z	28.0N	129.7E	27.8N	129.8E	31.5N	127.8E	009-0114	36.1N	129.1E	032-0258	41.8N	135.0E	055-0576
21	28/0500Z	28.2N	128.9E	28.3N	129.0E	30.9N	127.4E	016-0042	35.5N	129.5E	052-0210	-----	-----	-----
22	28/1100Z	28.9N	128.4E	28.8N	128.4E	31.7N	127.3E	022-0060	35.3N	127.7E	058-0108	40.6N	131.3E	064-0294
23	28/1700Z	29.4N	127.6E	29.3N	127.8E	32.5N	126.3E	354-0060	36.7N	127.5E	051-0138	-----	-----	-----
24	28/2300Z	29.7N	127.4E	29.6N	127.4E	32.2N	126.3E	180-0012	36.1N	127.2E	093-0102	41.0N	131.8E	-----
25	29/0500Z	30.2N	127.1E	30.2N	127.1E	32.7N	126.2E	170-0036	36.6N	127.5E	106-0120	-----	-----	-----
26	29/1100Z	30.8N	126.8E	30.7N	126.8E	33.9N	126.3E	128-0066	37.7N	127.9E	110-0120	42.1N	130.9E	-----
27	29/1700Z	31.6N	126.7E	31.5N	126.5E	35.0N	126.9E	098-0078	38.6N	128.0E	-----	-----	-----	-----
28	29/2300Z	32.6N	126.4E	32.4N	126.3E	36.8N	128.1E	077-0150	42.3N	130.9E	-----	-----	-----	-----
29	30/0500Z	33.2N	126.3E	33.3N	126.1E	36.9N	127.5E	098-0120	41.5N	130.1E	-----	-----	-----	-----
30	30/1100Z	34.5N	126.0E	34.3N	125.7E	38.9N	127.3E	071-0034	-----	-----	-----	-----	-----	-----
31	30/1700Z	35.7N	126.1E	35.2N	125.3E	40.2N	128.2E	-----	-----	-----	-----	-----	-----	-----
32	30/2300Z	36.2N	125.1E	36.2N	125.0E	-----	-----	-----	-----	-----	-----	-----	-----	-----
33	31/0500Z	37.2N	125.0E	37.2N	125.0E	-----	-----	-----	-----	-----	-----	-----	-----	-----
34	31/1100Z	38.4N	125.6E	38.4N	125.5E	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0085 MI.
AVERAGE 48 HOUR ERROR - 0169 MI.
AVERAGE 72 HOUR ERROR - 0315 MI.

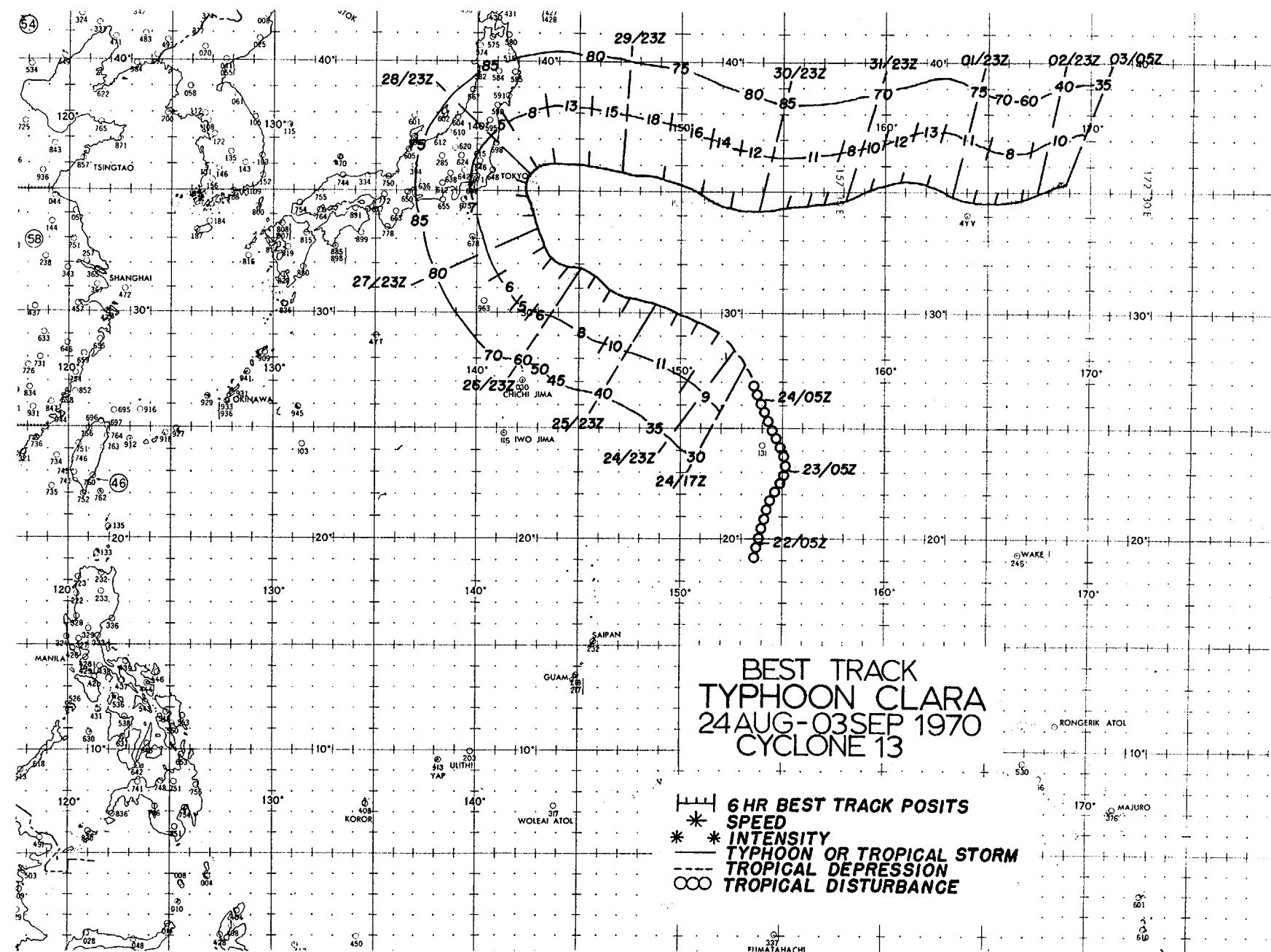
F. TYPHOON CLARA 26 AUG 0500Z-03 SEP 1100Z

1. STATISTICS

- a. Number of Warning Issued - 34
- b. Number of Warnings with Typhoon Intensity - 13
- c. Distance Traveled During Warning Period - 2,449 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 965 MBS at 30/2100Z
- b. Minimum Observed 700 MB Height - 2789 M at 30/2100Z
- c. Maximum Surface Wind - 85 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 420 MI



3. TYPHOON CLARA NARRATIVE

The fourth typhoon of August appeared on the scene in its early stages as Billie was churning the waters of the Philippine Sea east of Okinawa. Clara developed to typhoon force at an unusually high latitude of 32°N. This was the 5th storm on record to reach typhoon intensity north of the 30th parallel since 1945.

The pre-Clara system was first noted by the ITOS-1 satellite on the 21st south of Marcus Island. The disturbance was related to an upper tropospheric circulation which had separated from the Mid-Pacific trough. The system drifted in a generally northward direction for the next two days and gradually attained a warm core.

On passage of Marcus on the 24th, the island's sounding indicated warming greater than one degree at all levels from 850 to 300 mb. After passage of Marcus a weak surface circulation developed.

The depression, not more than a degree and a half in diameter, reacted to a blocking ridge line to its north by commencing a more westerly track at 9-11 knots.

During the period of the 25th to the 26th the Clara circulation passed under a 200 mb shear line which acted as a hostile environment for further development as mass outflow from the system was retarded. Thus Clara barely attained minimum tropical storm strength during this portion of her track.

Later on the 26th, the system moved from beneath the shear line aloft, slowly strengthened and reached typhoon force the following day although its circulation remained small. Clara shifted to a northeast course 300 miles southeast of Tokyo late on the 27th and came under surveillance of the radar atop Mount Fuji (See Figure 5-11).

The typhoon missed connections with a short wave in the westerlies passing to the north. It instead took a sharp turn to the east on the 29th 120 mi abeam of Tokyo (Figure 5-12) as flow to the rear of the trough forced the storm on an abrupt change of course. For the next five days, Clara was effectively cut off from the westerlies and maintained her typhoon intensity along a 1,200 mile sinusoidal path towards Ocean Station Victor.

Late on the 2nd, Clara began to turn to the northeast and weaken along the periphery of the westward extension of the subtropical high system centered near the Hawaiian Islands. As increasing vertical shear was encountered and drier and

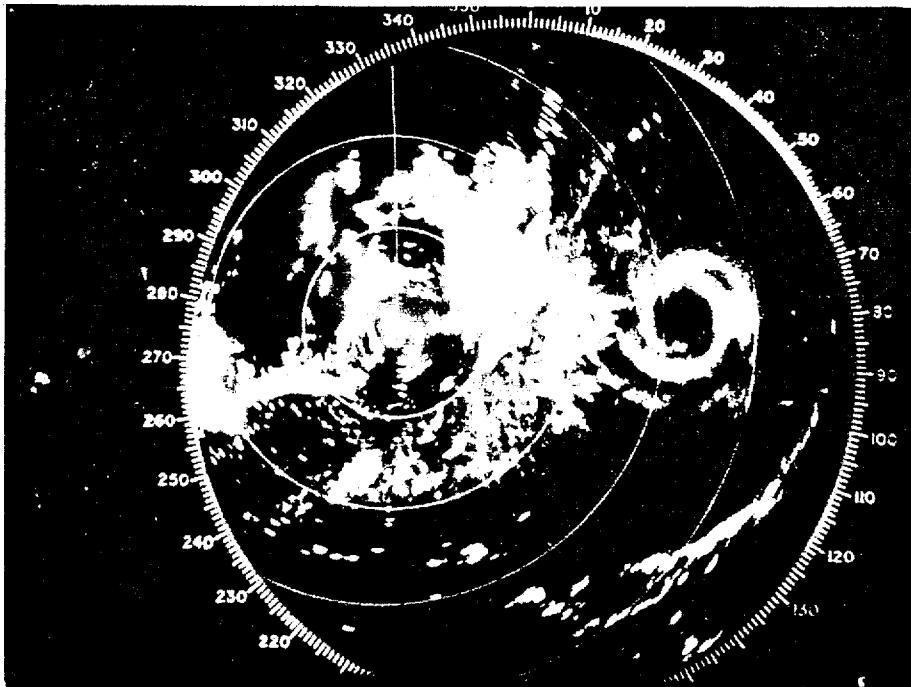


FIGURE 5-11 RADAR SCOPE PHOTOGRAPH OF TYPHOON CLARA AS VIEWED BY MT. FUJI MITSUBISHI RADAR (10.4 CM) ON 29 AUGUST AT 0417 GMT (COURTESY JAPAN METEOROLOGICAL AGENCY, TOKYO DISTRICT OBSERVATORY). RANGE MARKS ARE AT 100 KM INTERVALS. MUCH OF THE ECHO RETURN OUTSIDE THE WALL CLOUD AREA IS DUE TO GROUND CLUTTER AND SEA RETURN.

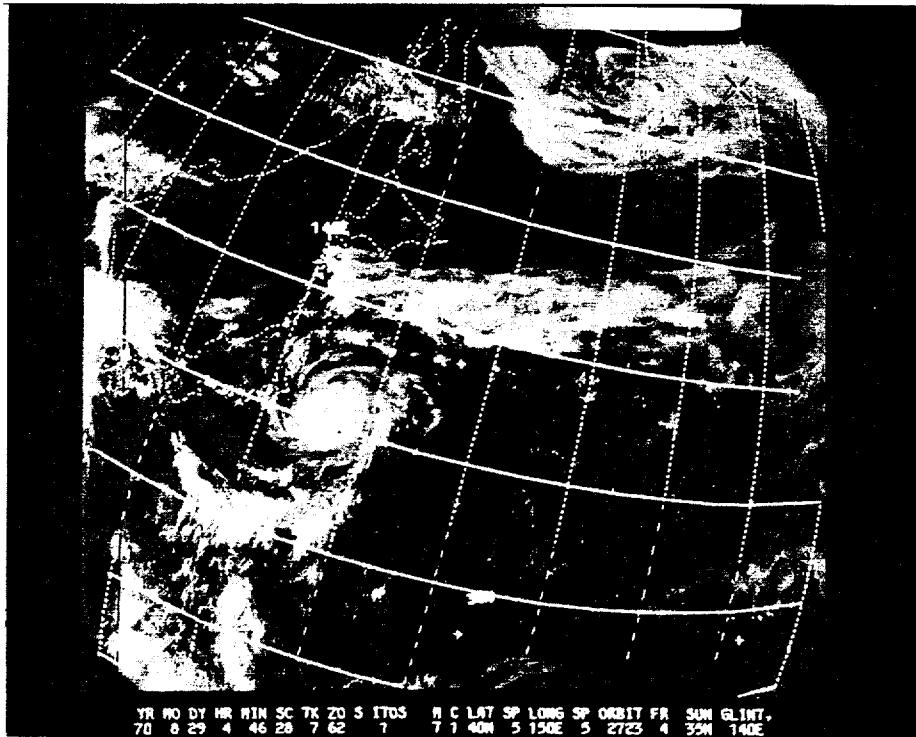


FIGURE 5-12 TYPHOON CLARA AS SEEN BY ITOS-1 ON 29 AUGUST DUE EAST OF TOKYO.

cooler air entrained into the circulation the storm gradually weakened until it was absorbed by a frontal system on the 4th.

During her eastward trek across the West Pacific, Clara affected numerous vessels in the shipping lanes. The Swedish vessel Sonette along with the Netherlands vessel Precent estimated winds of 80 knots on their close encounters with the storm respectively on the 30th of August and the 1st of September.

An interesting sidenote was that Hurricane Dot in the Central Pacific¹ formed on the 1st of September and was recurving close to the International Date Line on the 2nd and 3rd. Reconnaissance planes that were fixing Clara from Wake Island were called upon to position Dot before landing at Midway Island. An unusual accomplishment thus took place on the 3rd of September as reconnaissance aircraft fixed both a typhoon and a hurricane on the same mission.

¹Dot was the forecast responsibility of the Central Pacific Hurricane Center, Honolulu.

NO.	TIME	POSIT	EYE FIXES CYCLONE				13	O-S	MIN	FLT	ORIEN-	EYE	CHARACTER
			UN	T-	FLT	LVS							
			MET	O:	LVL	SFC							
-IX			-ACCY		LVL	WND	>NO	S:P	HGT	RT/TO	FURM	ORIENTA-	DIA
1	230449Z	23.0N 155.5E	SLTLS	STG C	01A	--	CAT	-					
2	240350Z	25.0N 154.5E	SLTLS	STG C	01A	--	CAT	-					
3	250447Z	29.0N 152.0E	SLTLS	STG X	01A	02	CAT	2					
4	260543Z	30.5N 148.0E	SLTLS	STG X	01A	02	CAT	2					
5	262100Z	31.0N 145.0E	54--05--	700MB	055	050	945	2908	12/07	CIRC	---	22	CLSD 12-15NM THK
6	270300Z	31.0N 144.0E	54--05--	700MB	055	070	976	2893	14/07	CIRC	---	15	OPEN NE QUAD
7	271449Z	31.0N 144.0E	SLTLS	STG C	01A	--	CAT	-					
8	270950Z	31.0N 144.5E	VW--120--										
9	271000Z	32.0N 142.0E	LND RUR										
10	271052Z	32.0N 143.0E	VW--110--										CLSD 9-27NM THK
11	271140Z	32.0N 143.0E	VW--005--		045								CLSD
12	271500Z	32.5N 143.0E	LND RUR										
13	271700Z	32.0N 143.0E	LND RUR										
14	271800Z	32.0N 143.0E	LND RUR										
15	271900Z	33.0N 143.0E	LND RUR										
16	272100Z	33.1N 143.2E	54--05--	700MB	055	080	971	2850	15/08	CIRC	---	10	SNM THK, OPEN SE-S
17	272300Z	33.1N 143.2E	LND RUR										
18	280041Z	33.2N 143.0E	54--05--	700MB	055	085	96.9	2853	14/07	CIRC	---	19	OPEN SE-S-W
19	280300Z	33.8N 142.9E	54--05--	700MB	057	085	96.8	2865	17/07	CIRC	---	20	OPEN SE-SW
20	280500Z	33.9N 142.8E	LND RUR										
21	280545Z	33.0N 142.5E	SLTLS	STG C	01A	--	CAT	-					
22	280600Z	34.0N 142.0E	LND RUR										
23	280700Z	34.2N 142.7E	LND RUR										
24	280830Z	34.4N 142.5E	VW--105--										OPEN S
25	280900Z	34.3N 142.7E	LND RUR										
26	281100Z	34.5N 142.5E	LND RUR										
27	281200Z	34.8N 142.5E	LND RUR										
28	281401Z	34.9N 142.5E	VW--110--	700MB	055		978	2975	16/09	CIRC	---	25	OPEN S QUAD
29	281500Z	35.0N 142.2E	LND RUR										
30	281600Z	35.1N 142.2E	LND RUR										
31	281700Z	35.3N 142.3E	LND RUR										
32	281800Z	35.3N 142.1E	LND RUR										
33	282000Z	35.5N 142.2E	LND RUR										
34	282100Z	35.5N 142.2E	54--05--	700MB	075	075	973	2862	15/08	CTRC	---	35	CLSD
35	282100Z	35.7N 142.2E	LND RUR										
36	282100Z	35.5N 142.3E	LND RUR										
37	282200Z	35.6N 142.4E	LND RUR										
38	282300Z	35.6N 142.4E	LND RUR										
39	280000Z	35.6N 142.5E	LND RUR										
40	280100Z	35.6N 142.6E	LND RUR										
41	280200Z	35.6N 142.8E	LND RUR										
42	280300Z	35.9N 142.7E	54--05--	700MB	065	120	975	2841	17/14	CTRC	---	20	OPEN SSW
43	280446Z	35.8N 142.5E	SLTLS	STG X	01A	01	CAT	3					
44	280500Z	36.1N 143.0E	LND RUR										
45	280600Z	35.8N 143.2E	LND RUR										
46	280804Z	36.1N 143.4E	VW--005--			100	977						OPEN W
47	281200Z	35.0N 144.0E	LND RUR										
48	281402Z	35.1N 144.3E	VW--008--			100	945	2990					OPEN W

TYPHOON CLARA

Fix No.	TIME	POS(1)	EYE F/XES CYCLONE 13								MIN	FLT	LVL	EYF	ORIEN-	EYE	CHARACTER	
			UN-I- MET-DU -ACLY	FLT LVL	LVL WND	SFC RHO	MIN SLP	700MB HGT	FLT TR/TU	FORM								
43	292115Z	36.0N 146.7E	54--05---	700MB	0/2	050	975	2883	15/14	ELIP	NW-SE	25X18	CLSD					
50	300000Z	35.0N 147.5E	54--05---	700MB	0/3	080	974	2868	16/12	ELIP	NW-SE	12X--	CLSD, APRS BRKG UP					
51	300215Z	35.0N 148.3E	54--08---	700MB	0/0	000	959	2832	16/11	ELIP	NW-SE	28X22	OPEN NW, BRKG UP					
52	300543Z	34.5N 150.5E	SLTS	STG X	DIA 03	CAT 3								-----				
53	300926Z	35.0N 151.2E	VW--02---	3080M	068	--	943	2929	17/12	ELIP	NW-SE	38X28	OPEN W					
54	301405Z	34.0N 151.9E	VW--10---	3000M	065	--	973	2911	16/10	CIR	----	30	OPEN NE-SW, BRKG UP NE					
55	302100Z	34.0N 153.4E	54--05---	700MB	000	085	945	2789	13/08	CIR	----	30	CLSD					
56	310200Z	34.2N 154.7E	54--05---	700MB	000	090	940	2800	18/07	CIR	----	30	CLSD, ILL DEF S QUAD					
57	310444Z	34.5N 155.0E	SLTS	STG X	DIA 04	CAT 2							-----					
58	310915Z	34.5N 156.1E	VW--05---	3000M	0/0	060	973	2853	13/18	CIR	----	28	CLSD, 15NM THK N SEMICIR					
59	311130Z	34.7N 156.6E	VW--11---	3000M	045	--	--	--	--/--	CIR	----	28	CLSD					
60	010300Z	35.0N 158.0E	54--30---	700MB	000	100	975	2893	17/10	CIR	----	15	NOT WELL DEF, OPEN S					
61	010405Z	35.0N 158.5E	SLTS	STG X	DIA 05	CAT 2							-----					
62	011004Z	35.0N 160.3E	VW--120---	--	--	--	--	--	--/--				-----					
63	011114Z	35.4N 160.9E	VW--05---	700MB	005	--	979	2963	16/12	CIR	----	15	CLSD					
64	011230Z	35.5N 161.3E	VW--120---	--	--	--	--	--	--/--				-----					
65	012056Z	35.1N 163.1E	54--15---	700MB	052	085	943	2935	18/10	CIR	----	30	OPEN SSW-NNE					
66	020300Z	34.8N 163.7E	54--20---	700MB	000	090	979	2941	17/12	CIR	----	15	OPEN NE					
67	020440Z	34.0N 165.0E	SLTS	SIG X	DIA 07	CAT 2							-----					
68	021230Z	34.7N 165.1E	VW--11---	--	--	--	--	--	--/--				W/C S SEMICIR, 6NM THK					
69	021250Z	34.0N 165.4E	VW--05---	--	045	991	--	24/24	--				-----					
70	022015Z	34.9N 166.4E	54--15---	700MB	039	040	992	3021	15/-				NEG W/C					
71	030340Z	34.0N 168.0E	SLTS	SIG C	DIA --	CAT -							-----					
72	030400Z	35.2N 168.4E	54--10---	700MB	035	030	943	3030	11/09	--			NEG W/C					
73	040242Z	34.0N 169.0E	SLTS	SIG C	DIA --	CAT -							-----					

TYPHOON CLARA

TROPICAL CYCLONE 13 -- 8/24/1700Z TO 9/3/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST
01	26/0500Z	30.5N	147.5E	30.6N	147.5E	31.7N	142.1E	264-0108	-----	-----	-----	-----	-----	-----	-----	-----	-----
02	26/1100Z	30.8N	146.3E	31.0N	146.6E	32.0N	140.6E	266-0162	-----	-----	-----	-----	-----	-----	-----	-----	-----
03	26/1700Z	31.0N	145.3E	31.5N	145.9E	32.1N	140.3E	258-0156	-----	-----	-----	-----	-----	-----	-----	-----	-----
04	26/2300Z	32.0N	145.1E	31.9N	145.0E	34.1N	141.6E	298-0072	36.8N	139.6E	296-0144	42.7N	144.6E	345-0432	-----	-----	-----
05	27/0500Z	32.0N	144.3E	31.9N	144.3E	33.8N	138.4E	266-0216	-----	-----	-----	-----	-----	-----	-----	-----	-----
06	27/1100Z	32.0N	143.9E	32.2N	143.8E	33.8N	138.5E	255-0198	-----	-----	-----	-----	-----	-----	-----	-----	-----
07	27/1700Z	32.8N	143.5E	32.7N	143.4E	35.7N	142.0E	338-0030	39.7N	142.4E	327-0252	-----	-----	-----	-----	-----	-----
08	27/2300Z	33.1N	143.1E	33.5N	143.0E	35.8N	141.9E	284-0024	40.0N	145.0E	340-0270	-----	-----	-----	-----	-----	-----
09	28/0500Z	34.0N	142.8E	34.1N	142.7E	36.2N	141.8E	284-0048	-----	-----	-----	-----	-----	-----	-----	-----	-----
10	28/1100Z	34.6N	142.4E	34.7N	142.4E	37.4N	141.8E	306-0120	-----	-----	-----	-----	-----	-----	-----	-----	-----
11	28/1700Z	35.3N	142.3E	35.2N	142.3E	38.1N	142.8E	314-0168	-----	-----	-----	-----	-----	-----	-----	-----	-----
12	28/2300Z	35.8N	142.2E	35.7N	142.4E	38.5N	143.1E	312-0246	-----	-----	-----	-----	-----	-----	-----	-----	-----
13	29/0500Z	36.0N	142.9E	36.0N	142.8E	37.6N	146.6E	314-0174	-----	-----	-----	-----	-----	-----	-----	-----	-----
14	29/1100Z	36.3N	143.8E	36.2N	143.8E	37.4N	147.9E	313-0216	-----	-----	-----	-----	-----	-----	-----	-----	-----
15	29/1700Z	36.3N	144.8E	36.1N	145.4E	36.7N	149.1E	310-0210	37.0N	155.0E	324-0174	-----	-----	-----	-----	-----	-----
16	29/2300Z	35.8N	147.2E	35.7N	147.0E	35.4N	156.1E	060-0126	-----	-----	-----	-----	-----	-----	-----	-----	-----
17	30/0500Z	35.6N	149.4E	35.5N	149.2E	39.4N	157.9E	024-0330	-----	-----	-----	-----	-----	-----	-----	-----	-----
18	30/1100Z	35.6N	151.8E	34.9N	151.1E	36.9N	159.7E	049-0222	-----	-----	-----	-----	-----	-----	-----	-----	-----
19	30/1700Z	34.6N	152.8E	34.4N	152.4E	36.0N	158.4E	036-0102	-----	-----	-----	-----	-----	-----	-----	-----	-----
20	30/2300Z	34.3N	153.9E	34.3N	153.8E	35.7N	159.7E	058-0096	-----	-----	-----	-----	-----	-----	-----	-----	-----
21	31/0500Z	34.2N	155.2E	34.3N	155.1E	34.7N	160.8E	112-0078	-----	-----	-----	-----	-----	-----	-----	-----	-----
22	31/1100Z	36.2N	156.5E	34.4N	156.2E	36.2N	162.3E	059-0090	-----	-----	-----	-----	-----	-----	-----	-----	-----
23	31/1700Z	34.8N	157.9E	34.6N	157.1E	36.7N	163.7E	043-0114	-----	-----	-----	-----	-----	-----	-----	-----	-----
24	31/2300Z	34.9N	157.8E	34.8N	158.0E	35.6N	159.5E	282-0186	37.2N	161.7E	295-0300	-----	-----	-----	-----	-----	-----
25	01/0500Z	35.0N	158.1E	35.2N	159.3E	35.9N	159.9E	288-0222	37.6N	162.2E	293-0352	-----	-----	-----	-----	-----	-----
26	01/1100Z	35.4N	160.7E	35.4N	160.7E	38.6N	165.8E	000-0234	-----	-----	-----	-----	-----	-----	-----	-----	-----
27	01/1700Z	35.9N	161.9E	35.3N	162.0E	39.6N	167.0E	006-0288	-----	-----	-----	-----	-----	-----	-----	-----	-----
28	01/2300Z	35.1N	163.8E	34.9N	163.3E	35.8N	170.5E	072-0150	38.3N	178.2E	-----	-----	-----	-----	-----	-----	-----
29	02/0500Z	34.8N	164.0E	34.7N	164.3E	34.4N	167.8E	222-0075	35.6N	173.4E	-----	-----	-----	-----	-----	-----	-----
30	02/1100Z	34.5N	165.2E	34.7N	165.8E	34.7N	169.6E	-----	36.4N	175.4E	-----	-----	-----	-----	-----	-----	-----
31	02/1700Z	34.8N	166.3E	34.8N	166.3E	36.2N	171.1E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
32	02/2300Z	35.0N	167.3E	35.0N	167.5E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
33	03/0500Z	35.3N	168.5E	35.4N	168.8E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
34	03/1100Z	35.4N	169.8E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROP - 0153 MI.

AVERAGE 48 HOUR ERROR - 0249 MI.

AVERAGE 72 HOUR ERROR - 0432 MI.

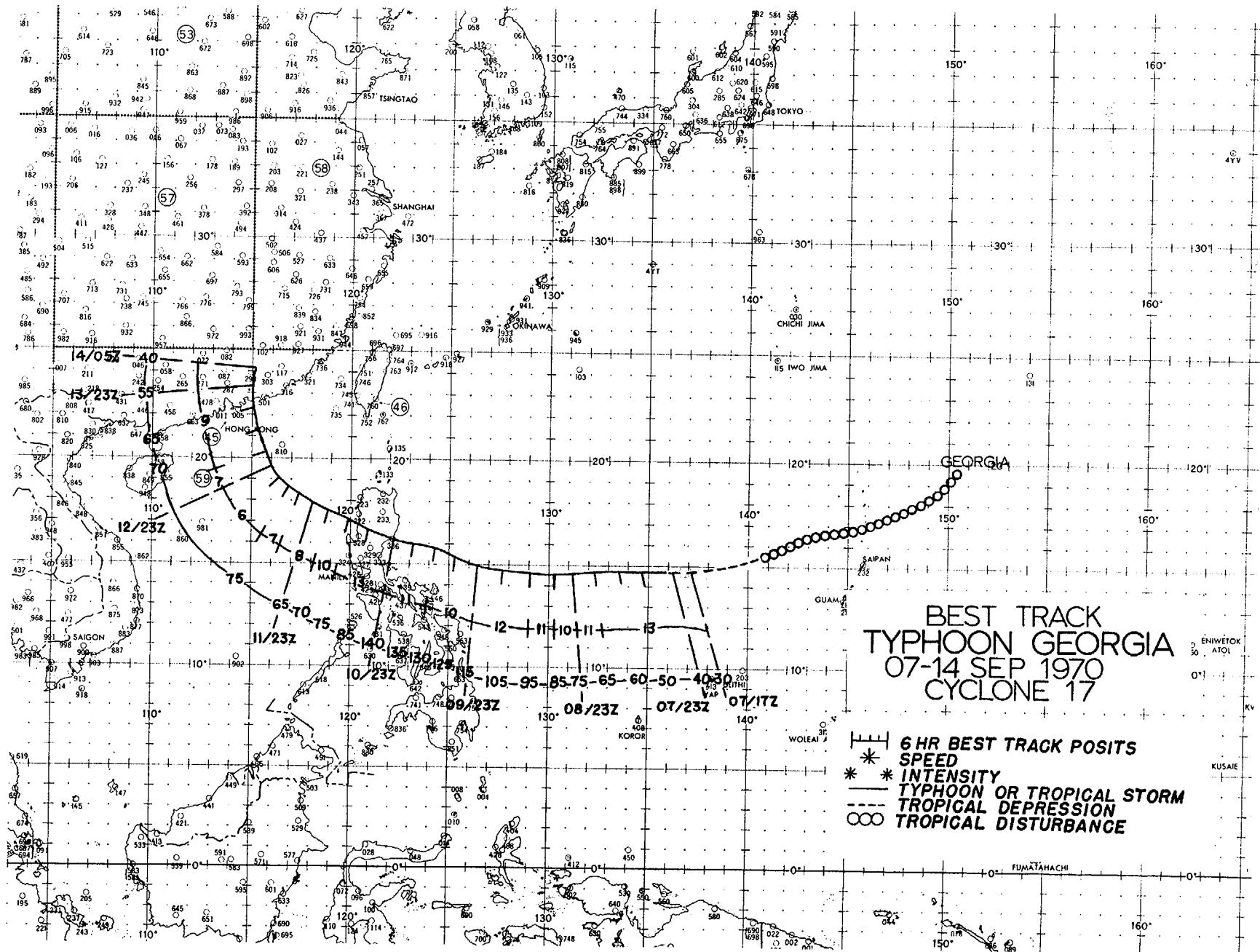
G. TYPHOON GEORGIA 07 SEP 2300Z-14 SEP 2300Z

1. STATISTICS

- a. Number of Warnings Issued - 26
- b. Number of Warnings with Typhoon Intensity - 19
- c. Distance Traveled During Warning Period - 1,718 MI

2. CHARACTERISTICS

- a. Minimum Observed SLP - 904 MBS at 10/2040Z
- b. Minimum Observed 700 MB Height - 2390 M at 10/0600Z
- c. Maximum Surface Wind - 140 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 360 MI



3. TYPHOON GEORGIA NARRATIVE

An ITOS-1 photograph on the 4th indicated that an upper tropospheric circulation in existence west of Marcus Island had developed a significant increase in convective activity along its southern periphery. The disturbance drifted southwestward toward the northern Marianas with an induced trough appearing on the 0000GMT surface chart on September 5th. The system continued on its southwestward track with a small surface circulation forming west of the Marianas a day later. An aerial reconnaissance investigation on the 8th revealed that tropical storm force had been reached and the first warning on Georgia was issued (Figure 5-13).

The storm began a westward march at 11 to 13 knots across the Philippine Sea as guided by the southern boundary of the subtropical ridge. Typhoon force was achieved early the next morning as difluent equatorward flow over the storm, from the 200 mb ridge extension south of Japan, favored further deepening.

Early on the 10th Georgia began to shift to a slightly more west northwest track, and that evening, as she neared the Luzon coastline, maximum winds occurring near the center reached super typhoon force near 140 knots. The ITOS-1 satellite showed a tightly organized ring of convective activity surrounding the storm near this time (Figure 5-14). This was further evidenced in the fact that Casiguran Weather Bureau Station on the Luzon coast, 90 miles from the center, had yet to experience gale force winds although the typhoon was only 6 hours from landfall. A reconnaissance aircraft in the 10 mile diameter eye of Georgia, a few hours before she struck shore, recorded an extremely warm 500 mb temperature of 14.5°C and indicated the deepening trend had reached 904 mb.

The typhoon slammed into North Central Luzon during the early morning hours of the 11th near Cape San Ildefonso. Extensive damage was suffered at Casiguran, which was 15 N.M. north of the center at landfall, and several surrounding small villages along the coastline. Minimum pressure at Casiguran was reported at 977.5 mb with winds estimated at 120 knots. By contrast the storm did not produce excessive torrential rains but was relatively dry with only 5.44 inches recorded during its passage at the weather station. Ninety-five persons were killed during the onslaught and an additional 80 people reported missing. Property damage was fixed near 1.4 million dollars.

The storm continued on a west northwest track across Luzon and emerged into the South China Sea 12 hours later of minimum typhoon strength due to the disrupting mountainous terrain of the island. A weakness in the ridgeline over China

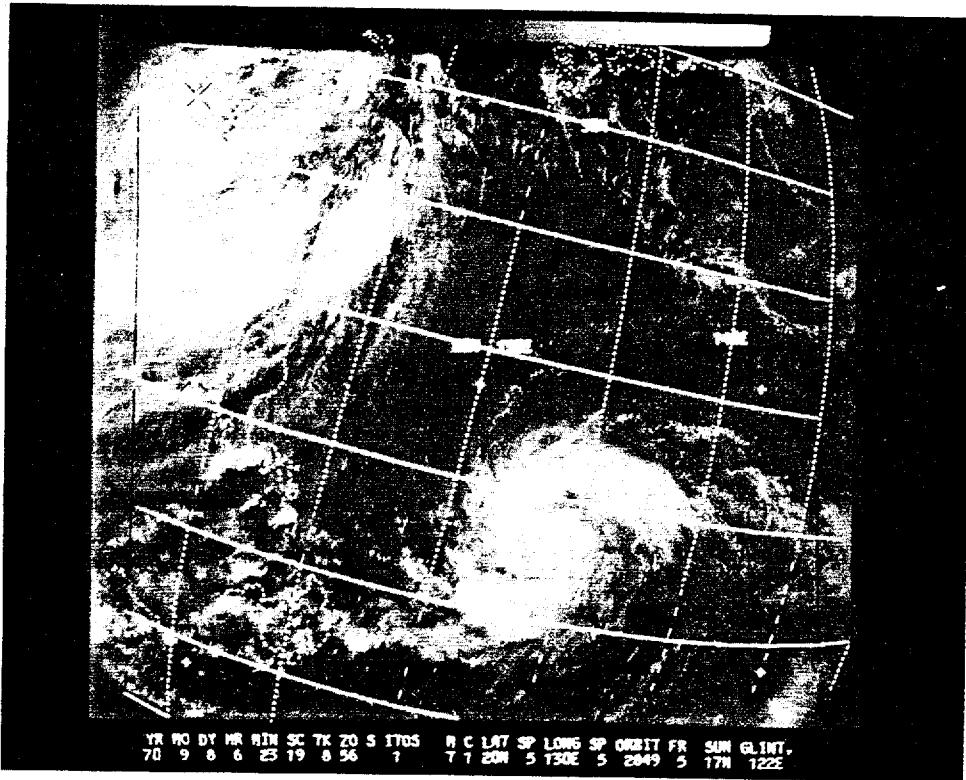


FIGURE 5-13 ITOS-1 PHOTO OF GEORGIA AS A DEVELOPING TROPICAL STORM ON 8 SEPTEMBER.

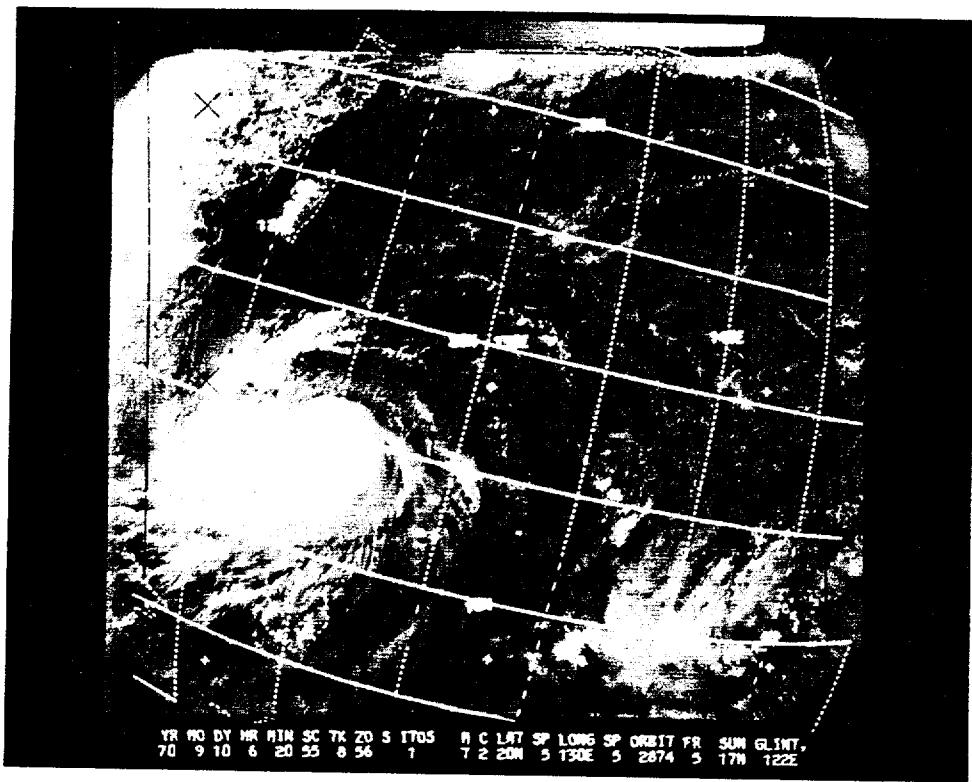


FIGURE 5-14 SUPER TYPHOON GEORGIA AS VIEWED BY ITOS-1 ON 10 SEPTEMBER JUST EAST OF LUZON.

provided a path for Georgia to recurve on a northward course with ultimate landfall occurring some 70 miles east of Hong Kong on the 14th.

The storm's intensity remained near 70 to 75 knots during its trek across the South China Sea while its eye was noted by reconnaissance crews to have expanded to some 70 miles in diameter.

By the 13th the storm came under surveillance of the radar at the Royal Observatory at Hong Kong and was later observed to cross the South China coast the following morning. Maximum gusts of 59 knots occurred at the Hong Kong International Airport while peak gusts of 56 knots were registered at the Royal Observatory. Georgia weakened rapidly after landfall and dissipated over land.

TYPHOON GEORGIA

EYE FIXES CYCLONE 17

FIX NO.	TIME	POSIT	UNIT				SFC SLP	MIN	FLT LVL	FLT LVL	EYE FORM	ORIEN- TATION	EYE DIA	CHARACTER WALL CLOUD
			MET- OD	-ACCY	FLT	LVL								
1	070526Z	14.0N 139.5E	SLTLS	SIG 3	DIA --	CAT -								
2	080130Z	14.7N 135.6E	54--05---		700MB	030	040 000	3057	11/09	CIRC	----	--	W/C N-SE	
3	080330Z	14.6N 135.1E	54--05---		700MB	040	025 995	3057	13/08	CIRC	----	--	W/C N-SE	
4	080623Z	14.5N 135.0E	SLTLS	STG C	DIA --	CAT -								
5	081015Z	14.7N 133.9E	VW--03---		700MB	042	-- 000	3066	14/09	ELIP	N-S	--x--	W/C NW-S	
6	081402Z	14.8N 132.9E	VW--05---		700MB	055	-- 993	3039	16/09	CIRC	----	24	5-7NM THK, OPEN E-W	
7	081700Z	14.7N 131.5E	54--20---		700MB	050	-- 943	2978	14/10	CIRC	----	CLSD, SML BRKS N QUAD		
8	080300Z	14.3N 130.7E	54--10---		700MB	070	090 975	2908	16/09	CIRC	----	14	CLSD 4NM THK	
9	090715Z	14.5N 130.0E	SLTLS	STG X	DIA 03	CAT 2								
10	091335Z	14.0N 128.6E	VW--			--	--	--	--	--				
11	091438Z	14.7N 128.1E	VW--05---			-- 080	--	--	--/24	CIRC	----	19	4NM THK, OPEN NW QUAD	
12	091535Z	14.7N 127.8E	VW--05---		700MB	--	-- 976	2728	21/13	CIRC	----	18	3NM THK, OPEN N QUAD	
13	092100Z	14.8N 126.7E	54--03---		700MB	10	-- 110	937	2554	22/09	CIRC	----	16	CLSD 3NM THK
14	100000Z	15.2N 126.4E	LND RUR		--	--	--	--	--	--				
15	100105Z	14.8N 126.2E	ACFI RDR		300MB	--	--	--	--	CONC	----	40-20	OUTER-CLSD, INNER-CLSD	
16	100300Z	15.2N 125.5E	54--05---		700MB	040	-- 130	927	2451	19/09	CIRC	----	14	CLSD 3NM THK
17	100600Z	15.2N 125.2E	54--05---		700MB	045	-- 130	920	2390	17/11	CIRC	----	12	CLSD 3NM THK
18	100621Z	15.0N 124.5E	SLTLS	STG X	DIA 03	CAT 4								
19	100830Z	15.5N 124.5E	LND RUR		--	--	--	--	--	--				
20	100906Z	15.6N 124.6E	54--05---	400MB	--	--	--	--	--	CIRC	----	15	CLSD 3NM THK	
21	100908Z	15.5N 124.6E	VW--10---		050	085	--	--	--	CIRC	----	12	CLSD 4NM THK	
22	101030Z	15.7N 124.5E	LND RUR		--	--	--	--	--					
23	101110Z	15.6N 124.2E	LND RUR		--	--	--	--	--					
24	101200Z	15.5N 124.3E	VW--10---		045	--	--	--	--	CIRC	----	12	CLSD 4NM THK	
25	101230Z	15.7N 124.2E	LND RUR		--	--	--	--	--					
26	101530Z	15.8N 123.4E	LND RUR		--	--	--	--	--					
27	101600Z	15.8N 123.3E	LND RUR		--	--	--	--	--					
28	101630Z	15.9N 123.3E	VW--02---		--	--	--	--	--	CIRC	----	12	CLSD 4NM THK	
29	101725Z	15.9N 123.1E	VW--03---		--	--	--	--	--	CIRC	----	12	CLSD	
30	101730Z	15.0N 123.0E	LND RUR		--	--	--	--	--					
31	101830Z	15.0N 122.8E	LND RUR		--	--	--	--	--					
32	101900Z	15.0N 122.7E	LND RUR		--	--	--	--	--					
33	102000Z	15.0N 122.6E	LND RUR		--	--	--	--	--					
34	102040Z	15.9N 122.4E	54--03---	500MB	080	--	--	--	15/01	CIRC	----	10	CLSD	
35	110245Z	16.0N 121.3E	54--10---	500MB	--	--	--	--	--	CIRC	----	5	CLSD ON RDR	
36	110717Z	17.5N 119.0E	SLTLS	STG X	DIA 03	CAT 2								
37	110930Z	17.3N 119.9E	VW--25---		-- 055	--	--	--	--				NEG WALL	
38	111400Z	17.6N 119.1E	VW--20---		-- 060	--	--	--	--				ILL DEFINED	
39	112100Z	17.5N 117.8E	54--05---	700MB	055	--	984	2984	15/13	CIRC	----	25	CLSD	
40	120100Z	18.0N 117.4E	54--05---	700MB	065	-- 040	983	2957	15/13				NEG W/C	
41	120619Z	18.0N 116.5E	SLTLS	STG X	DIA 03	CAT 3								
42	120910Z	18.5N 117.1E	VW--03---		-- 080	--	975	--	26/23	CIRC	----	75	NEG W/C	
43	121515Z	19.3N 116.3E	VW--06---		080	--	982	2969	23/18	ELIP	NW-SE	85x70	NEG W/C	
44	122110Z	19.8N 116.1E	54--05---	700MB	065	-- 973	2890	18/13	CIRC	----	45	OPEN S		
45	130010Z	19.6N 116.0E	54--05---	700MB	065	-- 974	2887	17/12	CIRC	----	40	OPEN NE 8NM THK		
46	130240Z	20.0N 115.9E	54--05---	700MB	085	-- 950	974	2987	17/12	CIRC	----	60	CENTER OPEN NE	
47	130715Z	20.5N 115.5E	SLTLS	STG X	DIA 03	CAT 2								
48	130905Z	20.7N 115.5E	VW--15---		05	-- 155	--	--	--	ELIP	NW-SE	99x-8	CENTER OPEN NW	
49	131200Z	21.5N 115.7E	VW--		--	--	--	--	--					

TYPHOON GEORGIA

TROPICAL CYCLONE 17 -- 9/7/1700Z TO 9/14/0500Z
 POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST
01	07/2300Z	14.5N	136.0E	14.6N	136.1E	15.7N	132.9E	054-0120	-----	-----	-----	-----	-----	-----	-----	-----	-----
02	08/0500Z	14.7N	134.9E	14.6N	134.8E	15.8N	131.0E	027-0090	17.5N	128.2E	049-0204	-----	-----	-----	-----	-----	-----
03	08/1100Z	14.7N	133.7E	14.6N	133.6E	14.9N	129.3E	027-0024	16.4N	125.5E	051-0084	18.8N	122.2E	051-0168	-----	-----	-----
04	08/1700Z	14.7N	132.2E	14.7N	132.3E	15.4N	127.6E	360-0042	17.3N	124.0E	026-0096	-----	-----	-----	-----	-----	-----
05	08/2300Z	14.7N	131.1E	14.5N	131.2E	15.2N	126.3E	360-0018	16.8N	122.5E	021-0048	19.2N	119.2E	036-0102	-----	-----	-----
06	09/0500Z	14.4N	130.3E	14.4N	130.2E	14.5N	126.0E	144-0048	15.8N	122.1E	126-0078	-----	-----	-----	-----	-----	-----
07	09/1100Z	14.3N	129.3E	14.5N	129.0E	14.6N	125.4E	131-0078	15.7N	121.8E	124-0138	17.1N	118.3E	138-0126	-----	-----	-----
08	09/1700Z	14.7N	127.6E	14.7N	127.7E	15.2N	123.3E	170-0036	16.4N	119.9E	134-0084	-----	-----	-----	-----	-----	-----
09	09/2300Z	14.8N	126.3E	14.9N	126.4E	15.7N	121.7E	226-0024	17.4N	118.0E	180-0024	20.0N	114.8E	289-0066	-----	-----	-----
10	10/0500Z	15.2N	125.1E	15.2N	125.4E	17.5N	120.9E	000-0054	19.4N	117.3E	000-0066	-----	-----	-----	-----	-----	-----
11	10/1100Z	15.7N	124.3E	15.5N	124.3E	17.6N	120.7E	054-0060	19.6N	117.0E	013-0054	22.2N	113.8E	305-0102	-----	-----	-----
12	10/1700Z	16.2N	123.4E	15.8N	123.2E	18.1N	119.7E	049-0060	20.2N	116.1E	349-0066	-----	-----	-----	-----	-----	-----
13	10/2300Z	16.2N	122.1E	16.0N	122.1E	18.3N	118.3E	022-0030	21.1N	115.2E	334-0096	24.6N	113.3E	309-0132	-----	-----	-----
14	11/0500Z	16.7N	121.0E	16.6N	120.9E	18.7N	117.1E	345-0024	21.2N	113.9E	299-0108	-----	-----	-----	-----	-----	-----
15	11/1100Z	17.3N	119.9E	17.0N	119.8E	19.3N	116.3E	326-0042	22.0N	113.1E	290-0132	-----	-----	-----	-----	-----	-----
16	11/1700Z	17.9N	118.6E	17.4N	118.8E	20.3N	115.0E	312-0102	23.2N	112.0E	289-0180	-----	-----	-----	-----	-----	-----
17	11/2300Z	17.9N	118.1E	17.8N	118.1E	19.4N	114.6E	262-0078	21.5N	111.4E	245-0228	-----	-----	-----	-----	-----	-----
18	12/0500Z	18.2N	117.3E	18.3N	117.3E	19.6N	114.2E	244-0090	21.7N	111.1E	238-0264	-----	-----	-----	-----	-----	-----
19	12/1100Z	18.4N	116.9E	18.7N	116.8E	19.7N	114.2E	217-0108	21.5N	111.4E	-----	-----	-----	-----	-----	-----	-----
20	12/1700Z	19.0N	116.2E	19.1N	116.4E	20.8N	113.4E	229-0126	23.4N	110.8E	-----	-----	-----	-----	-----	-----	-----
21	12/2300Z	19.7N	116.1E	19.6N	116.0E	20.8N	115.5E	175-0144	22.9N	114.4E	-----	-----	-----	-----	-----	-----	-----
22	13/0500Z	20.1N	115.8E	20.3N	115.7E	22.0N	115.1E	180-0126	-----	-----	-----	-----	-----	-----	-----	-----	-----
23	13/1100Z	20.7N	115.5E	21.2N	115.4E	23.1N	114.8E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
24	13/1700Z	21.5N	115.3E	22.2N	115.2E	24.8N	115.0E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
25	13/2300Z	22.9N	115.2E	23.2N	115.2E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
26	14/0500Z	23.6N	115.1E	24.1N	115.2E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0069 MI.
 AVERAGE 48 HOUR ERROR - 0114 MI.
 AVERAGE 72 HOUR ERROR - 0116 MI.

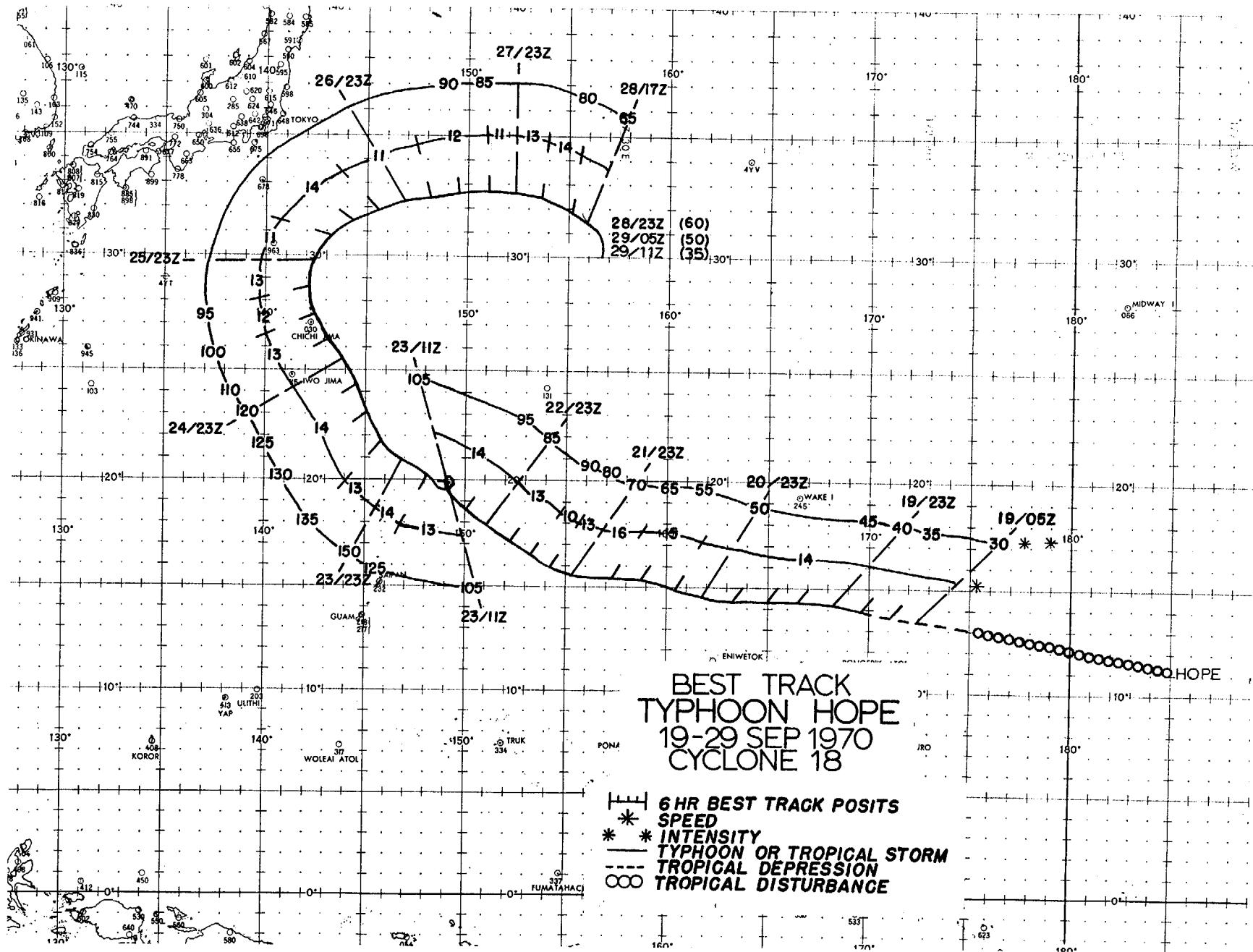
H. TYPHOON HOPE 20 SEP 0500Z-29 SEP 0500Z

1. STATISTICS

- a. Number of Warnings Issued - 37
- b. Number of Warnings with Typhoon Intensity - 27
- c. Distance Traveled During Warning Period - 3,034 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 895 MBS at 23/2100Z
- b. Minimum Observed 700 MB Height - 2219 M at 23/2100Z
- c. Maximum Surface Wind - 150 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 180 MI



3. TYPHOON HOPE NARRATIVE

Hope spent her seven day period of typhoon intensity describing a parabolic track around the September mean position of the subtropical high pressure system in the West Pacific.

Digitized ITOS-1 mosaics indicate that the initial disturbance can be tracked back to the Central Pacific south of Johnston Island as early as the 14th. Successive mosaics showed the system to move westward about 5 degrees of longitude per day with an apparent slowdown on crossing the International Date Line. On the 19th a reconnaissance aircraft was dispatched from Wake Island to the suspect area and located a weak circulation north of the Marshall Islands with a 1007 mb central pressure.

The tropical cyclone progressed on a west northwest course north of the Caroline Islands at 14 to 15 knots for the next two days. Upon reaching typhoon intensity early on the 22nd, Hope changed to a northwestward course as the ridge line weakened in the vicinity of 145-150°E. The storm moved on this heading for two days and continued to deepen reaching super typhoon force during the night of the 23rd to 24th. (See Figure 5-15.)

The 200 mb pattern at this time resembled that described by Miller (1957) as favorable for maximum intensity for hurricanes. An upper tropospheric trough extending from Southern Japan and west of Iwo Jima was stationed to the northwest of the typhoon. This combined with Hope's already large upper level anticyclone, provided considerable evacuation of mass outflow to the westerlies.

Aerial reconnaissance at daybreak on the 24th logged a central pressure of 895 mb, the lowest to occur in the Northern Hemisphere during 1970. When compared with the dropsonde reading 24 hours earlier of 979 mb, this represented a phenomenal drop of some 84 mb². A 14.5°C rise in temperature was noted on penetration at the 700 mb level with 27°C recorded inside the eight mile diameter eye. Maximum winds at this time were estimated to be 150 knots.

The typhoon dropped below super status the following morning as it neared the Volcano Island group on a slightly more northward course. The center passed 30 miles east of Chi Chi Jima the evening of the 25th with the island reporting

⁴A drop of 87 mb in 24 hours was observed in IDA-1958, as the typhoon reached a record low central pressure of 877 mb (see Jordan, 1959).

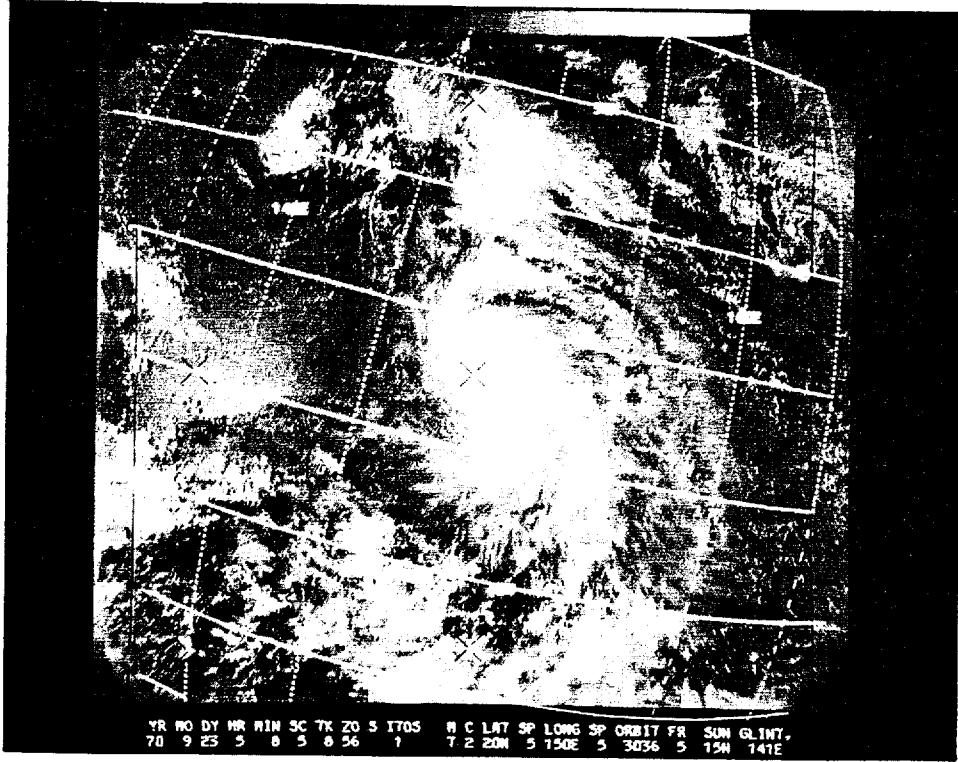


FIGURE 5-15 ITOS-1 VIEW OF SUPER TYPHOON HOPE ON THE AFTERNOON OF 23 SEPTEMBER DURING PERIOD OF MAXIMUM DEEPENING.

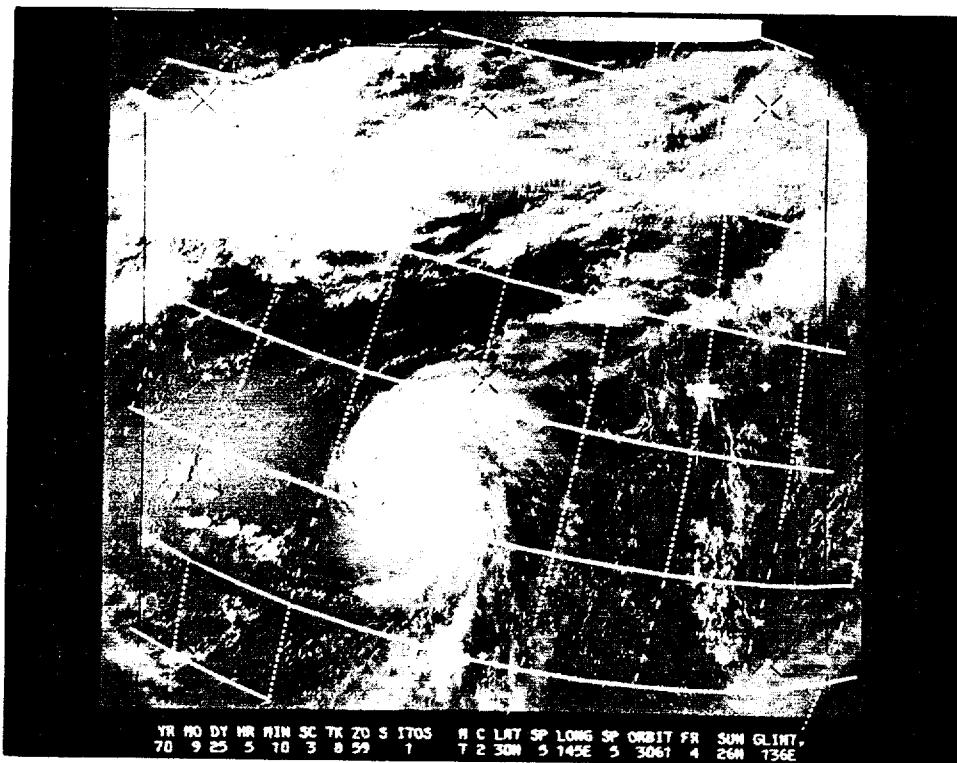


FIGURE 5-16 TYPHOON HOPE AS SEEN BY ITOS-1 ON 25 AUGUST A SHORT DISTANCE FROM CHI JIMA ISLAND.

45 knot sustained and wind gusts to 89 knots with a barometer reading of 972.5 mb (Figure 5-16).

Hope shortly thereafter began to recurve and shift to a northeastward heading on the 26th. Like Clara, the storm was too far south to be accelerated northeast by an approaching short wave in the westerlies. By the next day it was forced on an easterly track by the northerly component behind this trough. However, the steering eventually pushed Hope south of east on the 28th toward the Mid-Pacific 200 mb shear line. This effectively reduced Hope to less than typhoon intensity in a 12 hour period as outflow from the system was impeded. As the storm drifted further south and under the shear aloft, it weakened to depression status and began to describe an anti-cyclonic hook to the west as it slowly dissipated.

The marked demise of a developed typhoon remaining over warm waters is an unusual event in the West Pacific, however, a not too infrequent occurrence in the Atlantic. Similar cases are mentioned by Sugg and Pelisser (1968) in discussion of Hurricane Beulah in the Western Caribbean in 1967 and Simpson, Sugg and Staff (1970) for Hurricane Holly in the Atlantic in 1969.

TYPHOON HOPE

TYphoon HOPE

FLX NO.	TIME	POSIT	EYE FIXES CYCLONE				19	PBS	04S	MIN	FLT	DRIEN- TATION	EYE	CHARACTER
			UNIT- MET-O. -ACCY	FLT LVL	LVL WIND	SFC IND								
49	271530Z	32.5N 150.9E	VW-->10---			0d5	---	---	---	--/-	CIRC	----	42	OPEN 12NM THK, OPEN S-W
50	272100Z	32.7N 151.7E	54-->05---	700mb	007	100	968	2847	23/17	CIRC	----	40	POORLY DEF, OPEN S & W	
51	280409Z	32.5N 153.5E	SLT+S	STG X	01A 0.3	CAT 3								-----
52	280440Z	32.3N 153.5E	54-->03---	700mb	005	120	968	2902	26/23	CIRC	----	40	W/C NE QUAD	
53	280900Z	31.9N 154.8E	VW-->15---			---	---	---	--/-	CIRC	----	70	OPEN S, DISORG	
54	281935Z	32.1N 155.1E	VW-->07---			---	000	977	---	25/21	CIRC	----	OPEN S W/C NE QUAD	
55	281400Z	32.0N 155.6E	VW-->30---			---	---	---	--/-				NEG W/C	
56	290030Z	30.9N 156.6E	54-->30---	700mb	---	060	997	3091	17/14				NEG W/C	
57	290300Z	30.9N 156.5E	54-->20---	450mb	---	060	996	---	24/-				NEG W/C	
58	290505Z	30.3N 156.5E	SLT+S	STG -	01A --	CAT -							-----	

69-5

TYPHOON HOPE

TROPICAL CYCLONE 18 -- 9/19/1700Z TO 9/29/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT	BEST TRACK	24 HR FCST	24 HR ERROR	48 HR FCST	48 HR ERROR	72 HR FCST	72 HR ERROR
		LAT LONG	LAT LONG	LAT LONG	DEG DIST	LAT LONG	DEG DIST	LAT LONG	DEG DIST
01	20/0500Z	14.1N 166.6E	14.2N 166.5E	15.5N 161.4E	057-0060	17.1N 157.2E	066-0180	-----	-----
02	20/1100Z	14.4N 165.3E	14.2N 164.9E	15.8N 160.2E	062-0084	17.6N 156.1E	066-0168	19.0N 152.2E	104-0186
03	20/1700Z	14.7N 164.0E	14.2N 163.3E	16.2N 159.1E	063-0114	18.1N 154.9E	068-0156	-----	-----
04	20/2300Z	14.7N 161.7E	14.3N 161.8E	15.5N 155.3E	----0000	16.7N 149.7E	233-0096	18.1N 144.5E	220-0204
05	21/0500Z	14.1N 160.6E	14.9N 160.4E	14.1N 154.5E	173-0102	15.1N 148.8E	197-0228	-----	-----
06	21/1100Z	15.2N 159.0E	15.1N 158.8E	16.0N 153.5E	153-0024	17.3N 148.7E	185-0150	19.5N 144.8E	187-0216
07	21/1700Z	15.2N 157.3E	15.3N 157.3E	16.2N 151.8E	204-0054	17.8N 147.2E	202-0144	-----	-----
08	21/2300Z	15.5N 155.4E	15.5N 155.3E	16.5N 148.9E	241-0144	18.4N 143.4E	234-0240	20.5N 138.8E	226-0402
09	22/0500Z	15.6N 154.1E	15.8N 154.2E	16.8N 147.8E	227-0174	18.9N 142.3E	230-0264	-----	-----
10	22/1100Z	16.3N 153.4E	16.4N 153.3E	18.2N 149.2E	172-0096	19.8N 144.9E	186-0198	21.9N 141.3E	191-0324
11	22/1700Z	17.1N 152.4E	17.1N 152.3E	18.7N 148.2E	180-0084	20.3N 143.9E	188-0234	-----	-----
12	22/2300Z	17.8N 151.2E	17.7N 151.1E	20.2N 146.9E	180-0036	22.5N 142.9E	200-0174	25.4N 139.8E	209-0288
13	23/0500Z	18.4N 150.2E	18.8N 150.0E	21.1N 146.1E	171-0042	23.7N 142.3E	196-0156	-----	-----
14	23/1100Z	19.8N 149.1E	19.8N 149.0E	25.2N 147.0E	036-0150	28.9N 144.4E	047-0138	33.5N 145.4E	023-0138
15	23/1700Z	20.1N 148.4E	20.1N 148.2E	23.7N 145.6E	116-0066	27.3N 143.8E	132-0114	-----	-----
16	23/2300Z	20.9N 147.1E	20.8N 146.9E	24.2N 143.0E	220-0084	28.0N 140.8E	220-0132	32.9N 143.4E	281-0174
17	24/0500Z	21.4N 146.1E	21.8N 146.0E	24.3N 142.3E	200-0126	27.7N 140.3E	220-0222	-----	-----
18	24/1100Z	22.4N 145.2E	23.1N 145.3E	26.5N 142.0E	201-0048	30.9N 142.1E	259-0114	36.3N 147.3E	334-0246
19	24/1700Z	24.0N 144.4E	24.2N 144.5E	29.6N 143.0E	035-0072	35.0N 146.8E	017-0204	-----	-----
20	24/2300Z	25.2N 144.0E	25.3N 144.0E	30.3N 143.2E	046-0048	36.9N 148.6E	017-0288	-----	-----
21	25/0500Z	26.4N 143.2E	26.3N 143.1E	31.9N 144.0E	029-0084	38.8N 150.3E	016-0402	-----	-----
22	25/1100Z	27.4N 142.5E	27.3N 142.4E	32.7N 144.4E	005-0084	42.0N 152.5E	014-0576	-----	-----
23	25/1700Z	28.4N 142.2E	28.6N 142.2E	33.7N 145.5E	360-0120	-----	-----	-----	-----
24	25/2300Z	29.6N 142.3E	29.7N 142.4E	35.4N 147.7E	011-0186	-----	-----	-----	-----
25	26/0500Z	30.7N 143.0E	30.6N 143.1E	36.2N 150.2E	024-0252	-----	-----	-----	-----
26	26/1100Z	31.2N 144.2E	31.3N 144.3E	37.3N 153.6E	036-0342	-----	-----	-----	-----
27	26/1700Z	31.8N 145.6E	31.7N 145.6E	-----	-----	-----	-----	-----	-----
28	26/2300Z	32.3N 146.8E	32.3N 146.9E	33.9N 152.2E	360-0084	33.7N 159.3E	040-0204	-----	-----
29	27/0500Z	32.3N 147.9E	32.3N 148.1E	32.3N 152.5E	270-0060	31.8N 158.6E	061-0120	-----	-----
30	27/1100Z	32.5N 149.6E	32.6N 149.5E	32.5N 155.5E	019-0036	32.8N 162.1E	-----	-----	-----
31	27/1700Z	32.5N 151.5E	32.6N 151.0E	32.5N 157.8E	058-0108	-----	-----	-----	-----
32	27/2300Z	32.6N 152.2E	32.5N 152.3E	32.6N 157.8E	033-0108	-----	-----	-----	-----
33	28/0500Z	32.4N 153.6E	32.3N 153.7E	32.3N 159.3E	057-0162	-----	-----	-----	-----
34	28/1100Z	32.1N 155.5E	31.9N 155.2E	32.0N 161.4E	-----	-----	-----	-----	-----
35	28/1700Z	32.0N 156.3E	31.5N 155.9E	32.1N 161.8E	-----	-----	-----	-----	-----
36	28/2300Z	31.2N 156.5E	31.0N 156.6E	-----	-----	-----	-----	-----	-----
37	29/0500Z	30.9N 156.5E	30.8N 156.5E	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0101 MI.
 AVERAGE 48 HOUR ERROR - 0204 MI.
 AVERAGE 72 HOUR ERROR - 0242 MI.

I. TYPHOON IRIS 03 OCT 2300Z-08 OCT 0500Z

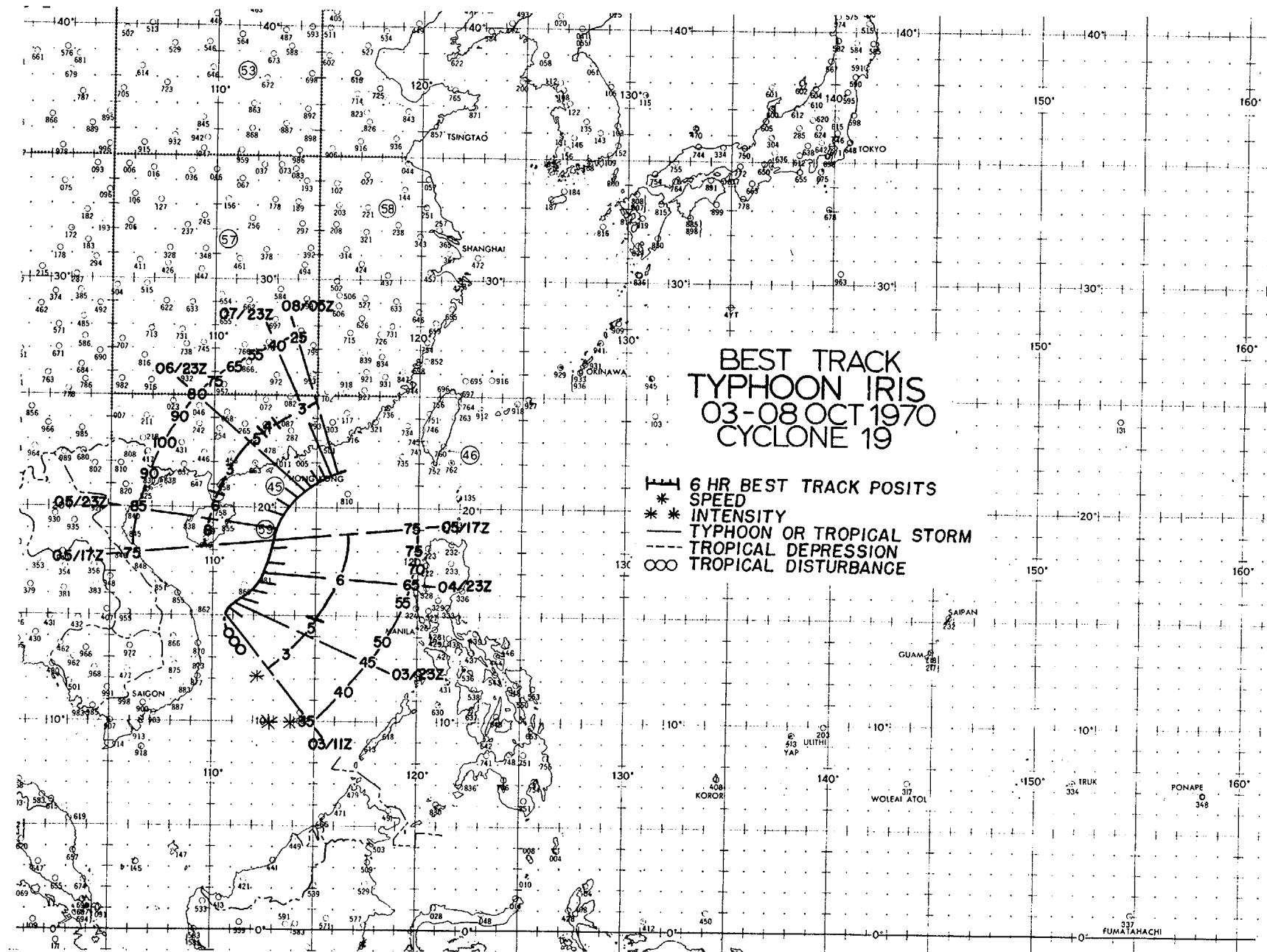
1. STATISTICS

- a. Number of Warnings Issued - 18
- b. Number of Warnings with Typhoon Intensity - 11
- c. Distance Traveled During Warning Period - 492 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 944 MBS at 06/0902Z
- b. Minimum Observed 700 MB Height - 2743 M at 06/0315Z
- c. Maximum Surface Wind - 100 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 180 MI

5-68



3. TYPHOON IRIS NARRATIVE

Iris was the first tropical storm in the waters of the South China Sea to develop to typhoon strength in the month of October since 1957.

A surge in the northeast monsoon late in September created a rather sharp northeast to southwest shear line across the South China Sea by early October. This intensified the lower tropospheric cyclonic shear in the western portion of the area and as the surge began to recede on the 2nd, a small weak circulation remained off the Vietnam Coast.

Evidence of a developing storm became apparent on the 3rd as gradient level winds (3,000 feet) along the central Vietnam Coast ran as high as 46 knots while showing a sharp cyclonic curvature. An aerial reconnaissance investigation on the 4th located Iris 135 miles east of Quang Ngai with maximum winds of 45 knots, a weak wall cloud, and a central pressure of 992 mb.

With the presence of a southern extension of a mid-tropospheric ridge to the east of the storm and a weak trough to the northwest, Iris moved at a rate of 5 to 6 knots towards the northeast. Evidence of further deepening was noted during the morning of the 5th (Figure 5-17) as the USS Chipola passed within 3 miles of the eye recording a barometer drop to 985 mb, while the Chinese weather station in the Parce Island group, 10 miles west of the center, reported winds of 68 knots.

A jet max associated with a 200 mb trough in central China provided the main mechanism for outflow from the system as Iris reached its maximum intensity the afternoon of the 6th about 140 miles south of Hong Kong. Aerial reconnaissance at this time observed a central pressure of 944 mb and winds estimated near 100 knots.

The eye of Iris came under surveillance of the Hong Kong Royal Observatory radar early on the 7th (Figure 5-18) and commenced to slow to a forward speed of 3 knots. The system completely collapsed in less than a 24 hour period as a 200 mb short wave emerging from the Gulf of Tonkin arrived in the vicinity on the 7th. Upon drifting over the storm the confluent pattern aloft inhibited any further outflow from the storm and by the following afternoon the typhoon was reduced to little more than a depression. All traces of Iris had disappeared by the 9th.

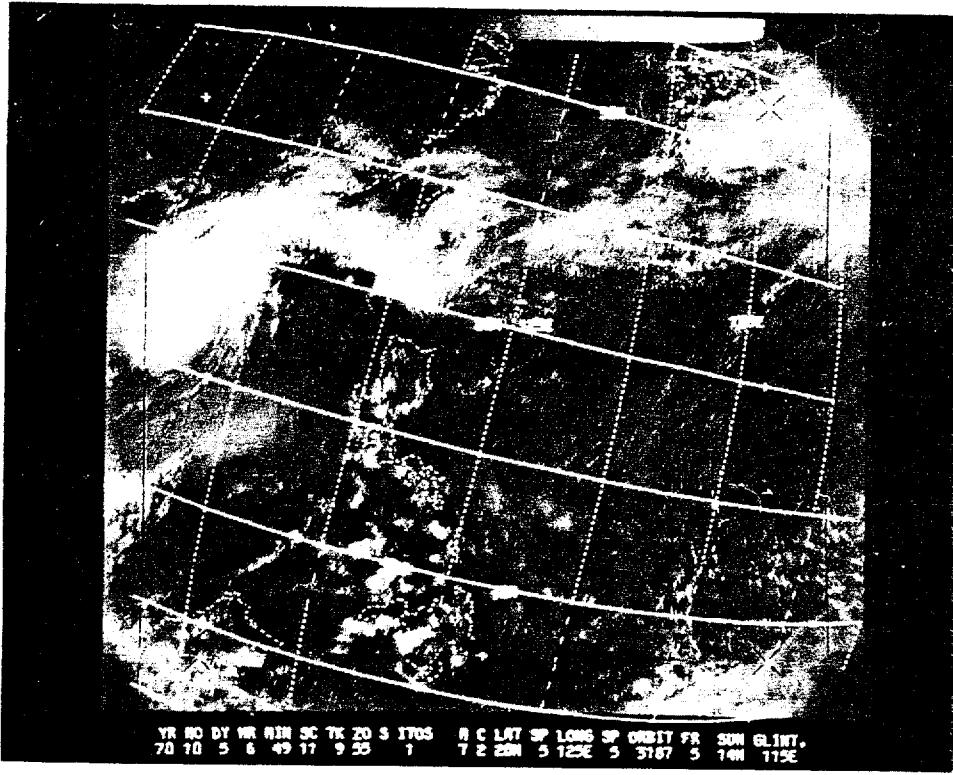


FIGURE 5-17 ITOS-1 PHOTO OF IRIS THE AFTERNOON OF 5 OCTOBER AS A NEWLY DEVELOPED TYPHOON.

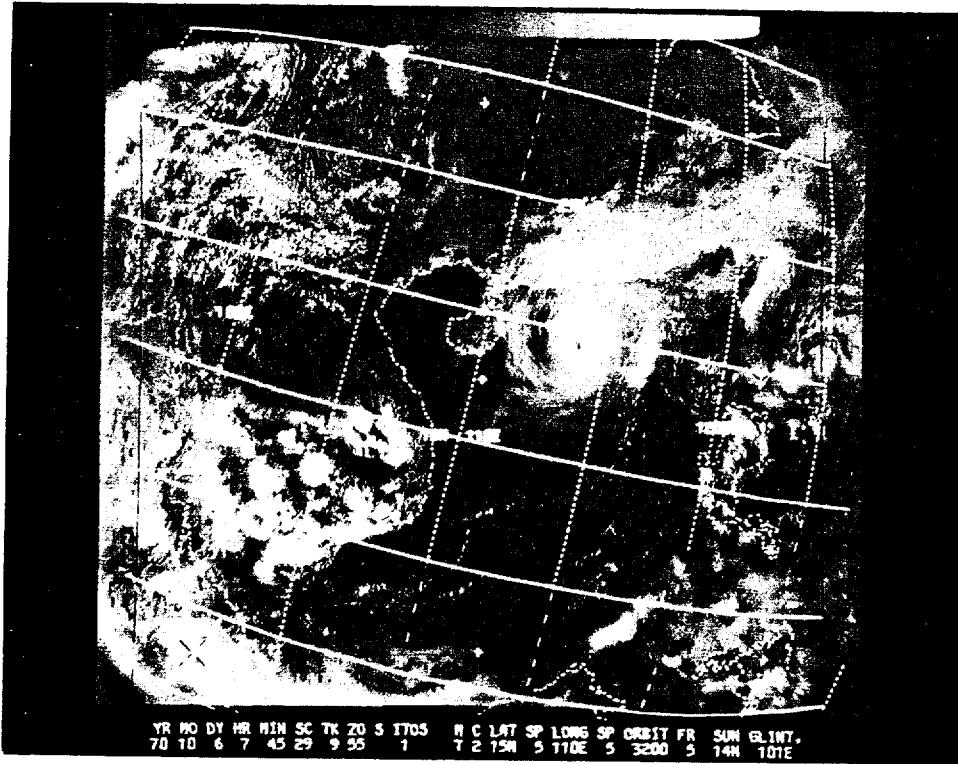


FIGURE 5-18 TYPHOON IRIS LOCATED SOUTH OF HONG KONG ON 7 OCTOBER.

TYPHOON IRIS EYE FIXES CYCLONE 19															
FIX NO.	TIME	POSIT	UNIT- MET- TAC	FLT LVL	LVL WIND	SFC AND	DBS SLP	DHS MIN	MIN 700MB	FLT LVL	TT/T0	EYE FORM	ORIEN- TATION	EYE DIA	CHARACTER WALL CLOUD
1	040012Z	15.5N 111.4E	VW-->10---	---	045	992	---	26/24	CIRC	---	29	WK W/C CLOSED			
2	040200Z	15.9N 111.2E	LND RVR	---	---	---	---	---	---	---	---				
3	040315Z	15.6N 111.3E	VW-->05---	---	050	990	---	26/23	CIRC	---		CLSD 8-15NM THK			
4	040400Z	16.0N 111.3E	LND RVR	---	---	---	---	---	---	---	---				
5	040610Z	15.7N 111.6E	54-->05--- 700MB	045	045	994	3027	15/10	CIRC	---	40	APRNT CLSD W/C			
6	040748Z	15.5N 111.5E	SLTLS STG C	01A	--	CAT -									
7	050130Z	17.4N 112.6E	SHR RVR	---	---	---	---	---	---	---	---				
8	050320Z	17.3N 112.5E	VW-->03---	---	---	---	---	---	---	---	---	CLSD			
9	050649Z	17.5N 112.5E	SLTLS STG X	01A 02	CAT 4										
10	050801Z	17.8N 112.9E	VW-->05--- 700MB	070	075	973	2911	26/23	ELIP	NW-SE	18X--	CLSD ALQUADS 5-7NM THK			
11	051440Z	18.4N 113.0E	VW-->07---	015	---	---	---	---	---	---	---	CLSD			
12	052031Z	19.0N 113.0E	VW-->10---	---	---	---	---	---	---	---	---	CLSD 5-7NM THK			
13	052200Z	19.0N 113.1E	LND RVR	---	---	---	---	---	---	---	---				
14	060100Z	19.4N 113.2E	LND RVR	---	---	---	---	---	---	---	---				
15	060315Z	19.6N 113.4E	54-->07--- 700MB	070	080	960	2743	16/09	CIRC	---	21	CLSD			
16	060535Z	19.8N 113.7E	54-->05--- 700MB	080	090	960	2749	15/09	CIRC	---	18	CLSD			
17	060600Z	19.7N 113.5E	LND RVR	---	---	---	---	---	---	---	---				
18	060746Z	19.5N 113.5E	SLTLS STG X	01A 01	CAT 4										
19	060900Z	19.7N 113.7E	LND RVR	---	---	---	---	---	---	---	---				
20	060902Z	19.9N 113.9E	VW-->10---	100	944	---	24/23	CIRC	---	23	CLSD				
21	061000Z	19.9N 113.7E	LND RVR	---	---	---	---	---	---	---	---				
22	061200Z	20.0N 113.9E	LND RVR	---	---	---	---	---	---	---	---				
23	061400Z	20.3N 114.4E	VW-->20---	---	---	---	---	---	---	ELIP	NW-SE	25X12	12NM THK, OPEN S		
24	061900Z	20.3N 113.9E	LND RVR	---	---	---	---	---	---	---	---				
25	062200Z	20.4N 114.0E	LND RVR	---	---	---	---	---	---	CIRC	---	42			
26	062300Z	20.4N 114.1E	LND RVR	---	---	---	---	---	---	CIRC	---	42			
27	070000Z	20.5N 114.2E	LND RVR	---	---	---	---	---	---	CIRC	---	34			
28	070125Z	20.6N 114.5E	54-->03--- 700MB	090	090	975	2896	18/09	CIRC	---	20	CLSD			
29	070400Z	20.7N 114.6E	LND RVR	---	---	---	---	---	---	CIRC	---	30			
30	070425Z	20.8N 114.7E	54-->03--- 700MB	085	080	980	2920	17/08	CIRC	---	20		W/C DSPTG SE QUAD		
31	070600Z	20.8N 114.7E	LND RVR	---	---	---	---	---	---	CIRC	---	32			
32	070647Z	22.0N 115.5E	SLTLS STG X	01A 01	CAT 3										
33	070800Z	20.8N 114.8E	LND RVR	---	---	---	---	---	---	---	---				
34	071000Z	20.9N 115.2E	LND RVR	---	---	---	---	---	---	---	---				
35	071100Z	20.8N 115.2E	LND RVR	---	---	---	---	---	---	---	---				
36	071400Z	21.1N 115.7E	LND RVR	---	---	---	---	---	---	---	---				

TYPHOON IRIS

TROPICAL CYCLONE 19 -- 10/3/1100Z TO 10/8/0500Z
 POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST
01	03/2300Z	15.5N	111.3E	15.4N	111.0E	15.5N	111.3E	217-0108	15.1N	109.7E	219-0324	-----	-----	-----	-----	-----	-----
02	04/0500Z	15.6N	111.3E	15.6N	111.4E	15.6N	111.3E	215-0138	15.2N	109.7E	221-0360	-----	-----	-----	-----	-----	-----
03	04/1100Z	15.7N	111.6E	16.0N	111.8E	15.7N	111.6E	208-0150	15.3N	109.5E	222-0378	-----	-----	-----	-----	-----	-----
04	04/1700Z	16.2N	112.5E	16.4N	112.2E	17.4N	114.1E	140-0090	-----	-----	-----	-----	-----	-----	-----	-----	-----
05	04/2300Z	17.0N	112.4E	17.0N	112.5E	18.9N	114.3E	113-0054	20.9N	117.1E	084-0150	22.7N	121.0E	075-0306	-----	-----	-----
06	05/0500Z	17.5N	112.8E	17.5N	112.7E	19.4N	114.7E	116-0048	21.1N	116.8E	082-0114	-----	-----	-----	-----	-----	-----
07	05/1100Z	18.0N	113.2E	18.0N	112.9E	20.1N	115.4E	086-0084	22.6N	118.9E	067-0234	-----	-----	-----	-----	-----	-----
08	05/1700Z	18.5N	113.3E	18.6N	113.0E	20.3N	115.5E	090-0078	22.4N	118.7E	068-0198	-----	-----	-----	-----	-----	-----
09	05/2300Z	19.3N	113.1E	19.3N	113.3E	22.1N	113.4E	329-0102	-----	-----	-----	-----	-----	-----	-----	-----	-----
10	06/0500Z	19.8N	113.8E	19.8N	113.8E	22.4N	114.1E	342-0096	-----	-----	-----	-----	-----	-----	-----	-----	-----
11	06/1100Z	20.1N	114.1E	20.0N	113.9E	21.8N	116.2E	054-0078	23.9N	118.0E	-----	-----	-----	-----	-----	-----	-----
12	06/1700Z	20.6N	114.7E	20.3N	114.1E	22.3N	116.7E	048-0102	24.4N	118.4E	-----	-----	-----	-----	-----	-----	-----
13	06/2300Z	20.5N	114.4E	20.6N	114.4E	21.9N	115.1E	326-0042	23.3N	115.6E	-----	-----	-----	-----	-----	-----	-----
14	07/0500Z	20.8N	114.6E	20.8N	114.7E	22.2N	115.3E	-----	23.7N	115.7E	-----	-----	-----	-----	-----	-----	-----
15	07/1100Z	21.1N	114.9E	21.0N	115.0E	22.2N	115.3E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
16	07/1700Z	21.6N	115.0E	21.1N	115.3E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
17	07/2300Z	21.1N	115.5E	21.3N	115.6E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
18	08/0500Z	21.3N	115.8E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0090 MI.
 AVERAGE 48 HOUR ERROR - 0251 MI.
 AVERAGE 72 HOUR ERROR - 0306 MI.

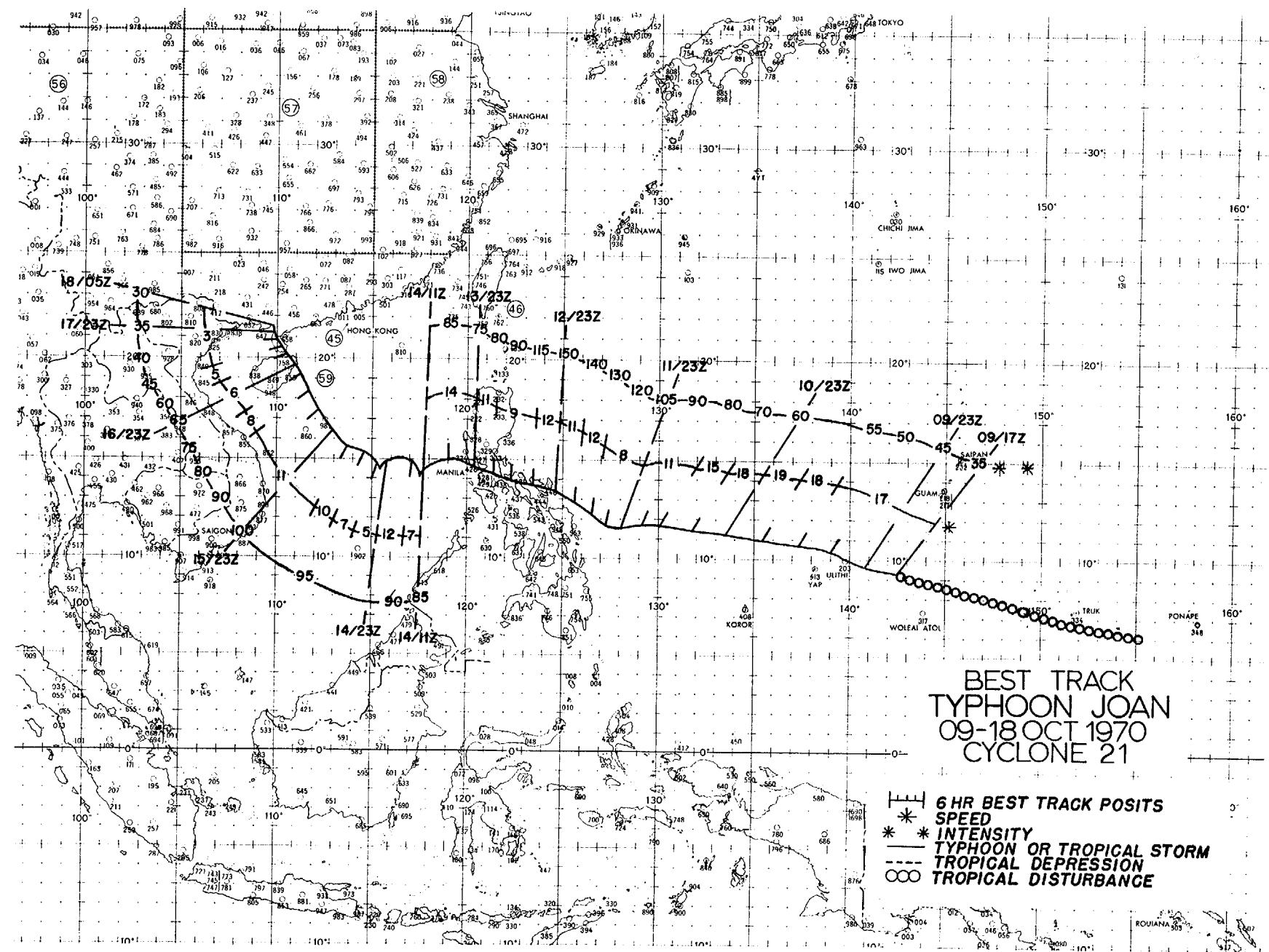
J. TYPHOON JOAN 09 OCT 2300Z-18 OCT 0500Z

1. STATISTICS

- a. Number of Warnings Issued - 34
- b. Number of Warnings with Typhoon Intensity - 25
- c. Distance Traveled During Warning Period - 2,254 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 901 MBS at 12/2100Z
- b. Minimum Observed 700 MB Height - 2332 M at 12/2100Z
- c. Maximum Surface Wind - 150 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 720 MI



3. TYPHOON JOAN NARRATIVE

Joan was the first of two sister super typhoons to strike the Republic of the Philippines within a period of a week.

The disturbance which was to become Joan entered on stage in the Truk-Ponape area of the Caroline Islands on the 8th of October. Upper air data revealed the existence of a 200 mb circulation two days earlier and by the 8th a downward reflection of the system appeared as a wave in the surface pressure pattern. Meanwhile, the subtropical ridge was strengthening, producing a tightening pressure gradient and resulting in favorable relative vorticity pattern for increasing mass inflow into the system. As a consequence of the strong easterly trades the wave disturbance began a westward movement of 17 knots. A surface circulation developed by the morning of the 9th and that afternoon, Joan passed Ulithi Atoll having reached tropical storm force.

Upon achieving typhoon intensity by noon the 11th, the storm's forward speed reduced to 11 knots while it moved within the southern periphery of a 200 mb anticyclone situated 300 miles southeast of Okinawa. In response to the increasing divergence pattern aloft, the central pressure began to drop steadily from 976 to 924 mb by late the following afternoon. As Joan approached super typhoon intensity, she reacted to a weakness in the ridge line and shifted to a more northwesterly component, thus aiming the storm at the southeastern peninsula of Luzon.

The cooler upper tropospheric environment of westerlies surrounding the typhoon's northern periphery served as a marked zone of contrast to the vast quantities of warm air being pumped out from the wall cloud region during this deepening period. The strong thermal wind effect in this area of merging air contributed to the production of an upper jet of westerly winds extending over a considerable distance. Evidence of the extensive outflow in existence on October 12th is depicted by the generation of a long band of cirrus stretching some 1,200 miles from Manila to Guam (see Figure 5-19). The narrow jet along the northern and eastern periphery of Joan was present as far east as Guam which reported at 200 mb west northwesterly winds of 50 knots.

The severity the typhoon had attained was testified to by an aerial reconnaissance crew which entered Joan before daybreak on the 13th. Upon penetration of the wall cloud region, the aircraft encountered severe turbulence accompanied by a "g" load force of 2.5. Once in the eye, the closed wall cloud topping above 35,000 feet gave a stadium bowl effect as revealed

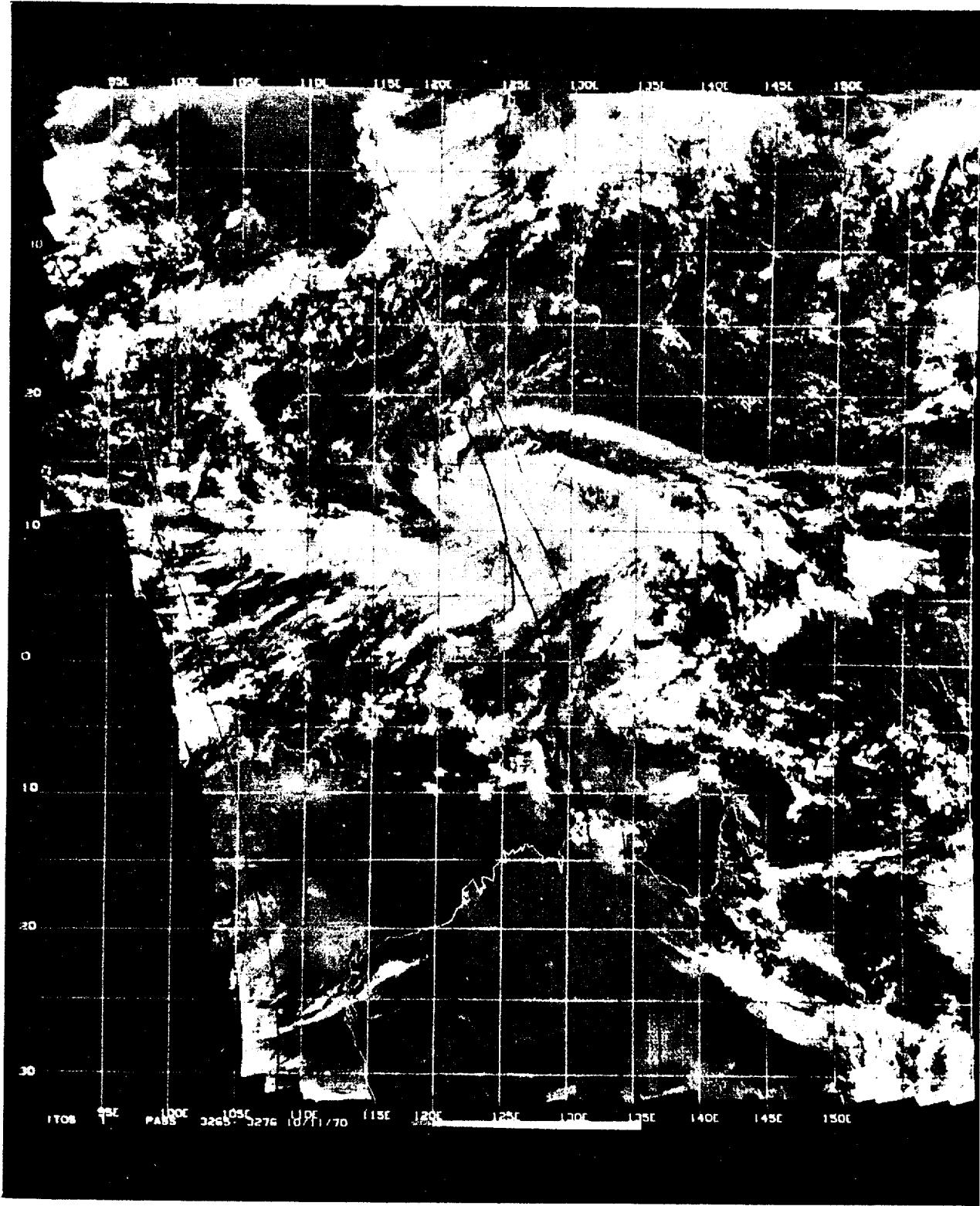


FIGURE 5-19 ITOS-1 MOSAIC ON 12 OCTOBER (LOCAL SUN TIME) DEPICTING EXTENSIVE CIRRUS BAND ON THE PERIPHERY OF TYPHOON JOAN'S OUTFLOW REGION.

by the continuous lightning occurring in all quadrants of the encircling coliseum. A dropsonde reading of 901 mb and max 700 mb temperature of 23.5°C was obtained while orbiting in the 25 mile diameter eye. Maximum surface wind occurring under the wall cloud region was estimated at 150 knots as daylight began. Looking for a weakness in the radar return to avoid further encounters with severe turbulence, the aircraft was forced to climb to 22,000 feet before exit was made. The temperature recorded at 500 mb during this climb was measured at +8.4°C.

Joan made landfall near noon in the Lagonoy Gulf region of southeastern Luzon after skirting the southern coast of Catanduanes Island. The U. S. Coast Guard loran station on the island, 30 miles north of the center, registered winds of 90 knots gusting to 110 knots before the anemometer failed. Lowest barometer reading was 973 mb. On the southern portion of the island the Philippine Weather Bureau station at Virac was heavily damaged but recorded a minimum sea level pressure of 950.7 mb and winds estimated near 150 knots.

The typhoon swept through the southern extent of Luzon moving across Bicol and Tagalog provinces and gradually losing strength. Passing some 20 miles south of Manila on the morning of the 14th, the International airport reported peak gusts of 84 knots and a 976.9 mb pressure reading while the Coast Guard vessel USCGC Blackhawk anchored in Manila Bay sustained gusts of 75 knots.

Upon her entrance in the South China Sea, aircraft fixes traced a cycloidal track during the 14th and 15th. The trajectory over rugged terrain of Luzon had disorganized the vertical structure around the central eye region of Joan. Apparently, the surface center was showing an oscillating behavior while embedded within a more stable upper center describing a uniform westerly track.

During this time frame, the area of gale force winds grew in size to more than 250 miles in radius from the center while the eye diameter expanded to some 80 miles. This area filled almost the entire northern half of the South China Sea ranking Joan as the largest typhoon in size in 1970 (Figure 5-20). The shipping traffic in this region felt its fury as at least one 390-foot vessel was in distress for over 24 hours.

A slow moving trough in the westerlies over Central China began to weaken the ridge line along 105-115°E on the 15th. This provided a path for a more northward component and Joan headed on a course toward the northeastern tip of Hainan on the morning of the 17th. It was of minimal typhoon strength and weakened considerably on passage up the Luichow Peninsula

slowly dissipating further inland over South China.

The typhoon left in its wake some 575 people dead and 1,590 injured, plus an additional 193 missing in the Republic of the Philippines. Damage was estimated near 74 million dollars (U.S.) with at least 80,000 people reported to be homeless and an agricultural crop loss of 92 percent in the region affected. These figures rank the storm high on the list of most destructive to affect that country.

5-79

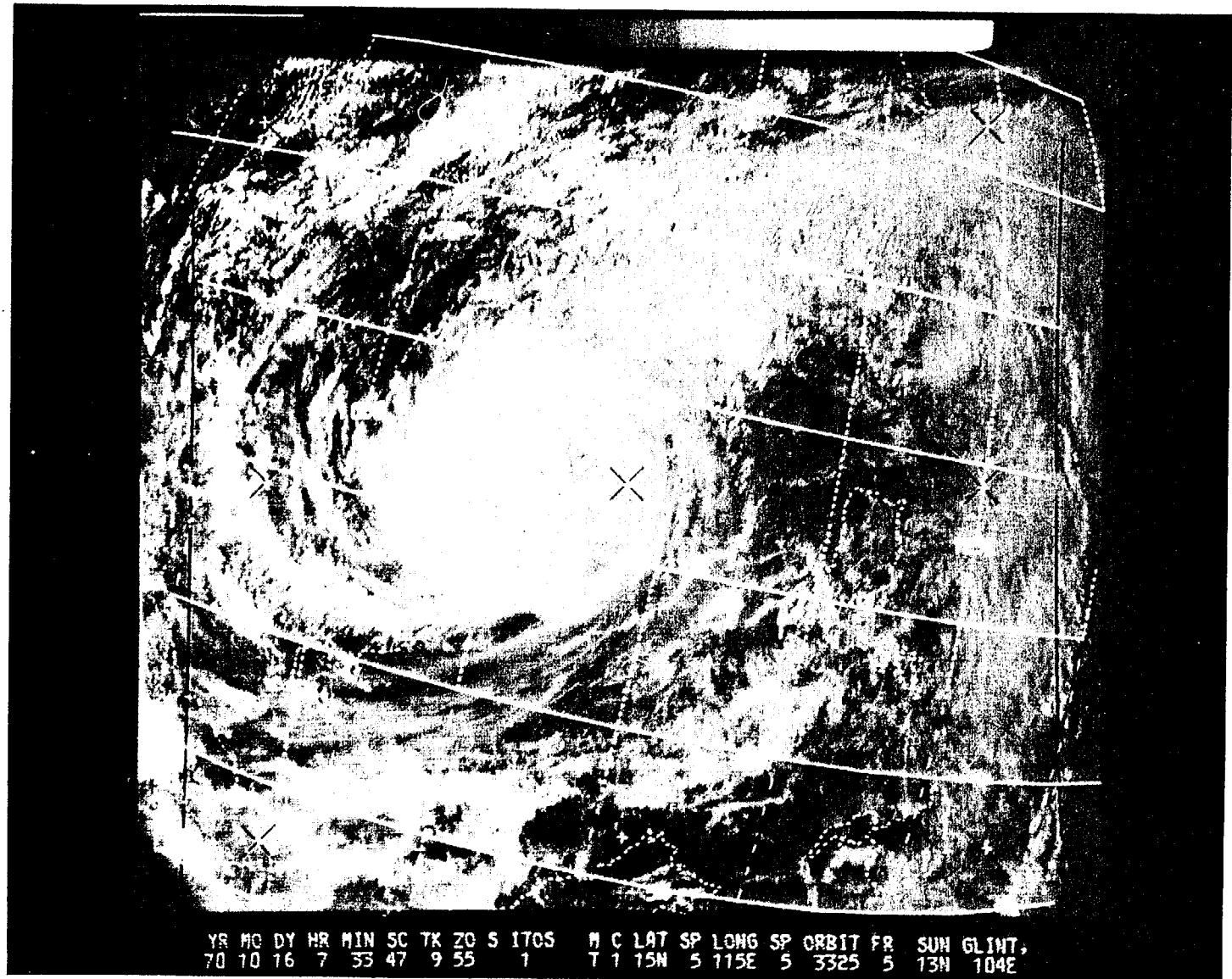


FIGURE 5-20 JOAN THE LARGEST TYPHOON IN SIZE DURING THE 1970 SEASON AS SEEN BY
CAMERA'S ABOARD ITOS-1 ON 16 OCTOBER.

TYPHOON JOAN

EYE FIXES CYCLONE

21

FIX NO.	TIME	POSIT	UNIT- MET- -ACCY	FLT LVL	LBS WIND AND SLP	OHS MIN 700MB HGT	MIN 700MB HT/TO	FLT LVL EYE FORM	ORIEN- TATION	EYE DIA	CHARACTER WALL CLOUD
1	090450Z	09.0N 144.0E	SLTLS	STG B	DIA --	CAT -	---	25/23	----	----	-----
2	092345Z	09.5N 140.4E	54--0-15---	0500M	048	045 997	---	25/23	----	10	W/C NE SEMICIR
3	100300Z	10.0N 139.6E	54--0-01---	700MB	048	035 996	3011	13/11	CIRC	----	-----
4	100546Z	09.5N 137.5E	SLTLS	STG X	DIA 04	CAT 2	2987	13/10	----	25	NO ORG W/C
5	100600Z	10.3N 138.7E	54--0-05---	700MB	050	045 987	2902	15/10	CIRC	----	25
6	100846Z	10.6N 138.0E	VW--0-03---	0320M	---	055 993	---	21/23	CIRC	25	WK W/C 6NM THK, OPEN NNE
7	101447Z	10.8N 136.1E	VW--0-05---	0320M	---	055 990	3030	24/20	CIRC	27	12NM THK, OPEN NNE
8	102100Z	11.0N 134.0E	54--0-05---	700MB	045	060 990	2996	14/08	CIRC	25	OPEN NW-E QUAD
9	110300Z	11.2N 132.3E	54--0-05---	000	070	076	2902	15/10	CIRC	25	OPEN E-SW
10	110642Z	11.0N 132.5E	SLTLS	STG X	DIA 03	CAT 2	-----	-----	-----	-----	-----
11	110910Z	11.6N 130.7E	VW--0-03---	0430M	074	075 978	---	24/20	CIRC	15	3NM THK, WK S-W
12	111100Z	11.6N 130.5E	VW--0-03---	---	---	---	---	---	---	-----	-----
13	111200Z	11.7N 130.0E	VW--0-03---	---	---	---	---	---	CIRC	25	-----
14	111430Z	11.7N 130.1E	VW--0-10---	700MB	100	---	2908	12/07	CIRC	30	CLSD 12NM THK
15	112100Z	11.4N 128.4E	54--0-10---	700MB	092	---	959	2752	22/13	ELIP	SML BRKS IN W/C
16	120300Z	11.4N 127.3E	54--0-10---	700MB	---	110 943	2615	20/11	CIRC	23	OPEN NW
17	120530Z	11.5N 127.1E	54--0-10---	700MB	088	120 938	2570	20/10	CIRC	25	CLSD
18	120544Z	12.0N 127.0E	SLTLS	STG X	DIA 03	CAT 4	-----	-----	-----	-----	-----
19	120915Z	11.9N 127.0E	VW--0-07---	0270M	---	130 924	---	27/23	CIRC	16	CLSD 6NM THK
20	121200Z	12.4N 126.7E	LND RUR	---	---	---	---	---	CIRC	25	-----
21	121400Z	12.4N 126.3E	VW--0-03---	---	---	---	---	---	CIRC	14	CLSD
22	121600Z	12.8N 126.0E	LND RUR	---	---	---	---	---	CIRC	25	-----
23	121800Z	13.0N 125.7E	LND RUR	---	---	---	---	---	CIRC	30	-----
24	121900Z	13.1N 125.5E	LND RUR	---	---	---	---	---	CIRC	55	-----
25	122100Z	12.9N 125.2E	54--0-05---	700MB	110	150 901	2332	24/14	CIRC	25	CLSD 6NM THK
26	122300Z	13.4N 124.6E	LND RUR	---	---	---	---	---	CIRC	30	-----
27	130000Z	13.5N 124.6E	LND RUR	---	---	---	---	---	---	-----	-----
28	130200Z	13.6N 124.0E	LND RUR	---	---	---	---	---	---	-----	-----
29	130300Z	13.6N 123.7E	LND RUR	---	---	---	---	---	---	-----	-----
30	130330Z	13.6N 123.5E	LND RUR	---	---	---	---	---	---	-----	-----
31	130400Z	13.6N 123.6E	LND RUR	---	---	---	---	---	---	-----	-----
32	130500Z	13.6N 123.3E	LND RUR	---	---	---	---	---	---	-----	-----
33	130500Z	13.6N 123.4E	LND RUR	---	---	---	---	---	---	-----	-----
34	130530Z	13.5N 123.3E	LND RUR	---	---	---	---	---	---	-----	-----
35	130630Z	13.7N 123.1E	LND RUR	---	---	---	---	---	---	-----	-----
36	130640Z	14.0N 123.0E	SLTLS	STG X	DIA 04	CAT 4	-----	-----	-----	-----	-----
37	130803Z	13.8N 122.9E	LND RUR	---	---	---	---	---	---	-----	-----
38	130858Z	13.8N 122.8E	VW--0-05---	700MB	050	---	2990	---	CIRC	10	BRKN, POORLY DEF
39	131000Z	13.8N 122.7E	LND RUR	---	---	---	---	---	---	-----	-----
40	131030Z	13.7N 122.7E	LND RUR	---	---	---	---	---	---	-----	-----
41	131100Z	13.8N 122.6E	LND RUR	---	---	---	---	---	---	-----	-----
42	131130Z	13.8N 122.5E	LND RUR	---	---	---	---	---	---	-----	-----
43	131230Z	13.9N 122.4E	LND RUR	---	---	---	---	---	---	-----	-----
44	131300Z	14.0N 122.3E	LND RUR	---	---	---	---	---	---	-----	-----
45	131330Z	14.0N 122.2E	LND RUR	---	---	---	---	---	---	-----	-----
46	131402Z	13.9N 122.2E	VW--0-02---	---	---	---	---	---	CIRC	09	POORLY DEF
47	131500Z	14.1N 122.0E	LND RUR	---	---	---	---	---	---	-----	-----
48	131730Z	14.4N 121.6E	LND RUR	---	---	---	---	---	---	-----	-----

TYPHOON JOAN

EYE FIXES CYCLONE

.014

TYPHOON JOAN

TROPICAL CYCLONE 21 -- 10/9/1700Z TO 10/18/0500Z
POSITION AND FORECAST VERIFICATION DATA

<u>WARN NO.</u>	<u>DTG</u>	<u>WARNING LAT</u>	<u>POSIT LONG</u>	<u>BEST LAT</u>	<u>TRACK LONG</u>	<u>24 HR LAT</u>	<u>FCST LONG</u>	<u>24 HR DEG DIST</u>	<u>48 HR LAT</u>	<u>FCST LONG</u>	<u>48 HR DEG DIST</u>	<u>72 HR LAT</u>	<u>FCST LONG</u>	<u>72 HR DEG DIST</u>
01	09/2300Z	9.4N	140.6E	9.5N	140.7E	11.6N	134.6E	060-0066	13.2N	128.9E	024-0114	15.2N	123.5E	329-0126
02	10/0500Z	10.3N	139.0E	10.2N	139.0E	12.8N	132.8E	036-0102	14.6N	127.0E	358-0186	-----	-----	-----
03	10/1100Z	10.8N	137.3E	10.7N	137.3E	13.0N	131.1E	027-0090	15.0N	125.3E	335-0180	17.1N	119.9E	323-0240
04	10/1700Z	10.9N	135.4E	10.8N	135.4E	12.0N	129.0E	360-0030	13.9N	123.7E	298-0132	-----	-----	-----
05	10/2300Z	11.1N	133.4E	11.0N	133.5E	12.0N	126.4E	291-0096	13.7N	120.3E	275-0240	16.0N	115.2E	286-0312
06	11/0500Z	11.3N	131.7E	11.4N	131.7E	12.3N	125.1E	291-0126	14.2N	119.3E	278-0240	-----	-----	-----
07	11/1100Z	11.5N	130.2E	11.6N	130.3E	12.6N	124.1E	279-0150	14.4N	118.7E	279-0210	16.7N	113.9E	300-0258
08	11/1700Z	11.5N	129.6E	11.5N	129.1E	11.0N	124.8E	207-0120	12.0N	120.0E	214-0150	-----	-----	-----
09	11/2300Z	11.3N	128.0E	11.4N	128.0E	11.4N	122.5E	228-0168	12.7N	117.3E	240-0204	14.5N	112.4E	264-0198
10	12/0500Z	11.5N	127.1E	11.5N	127.2E	11.9N	123.1E	191-0102	12.7N	119.1E	180-0138	-----	-----	-----
11	12/1100Z	12.0N	126.8E	12.2N	126.7E	13.5N	124.0E	101-0090	14.5N	120.0E	090-0126	15.7N	116.0E	072-0072
12	12/1700Z	12.8N	126.1E	12.8N	125.8E	13.9N	122.4E	104-0048	14.9N	118.4E	090-0066	-----	-----	-----
13	12/2300Z	13.0N	125.0E	13.3N	124.7E	14.0N	121.4E	119-0060	15.2N	117.4E	078-0084	16.8N	114.1E	069-0060
14	13/0500Z	13.7N	123.2E	13.6N	123.5E	15.0N	118.8E	270-0012	16.5N	114.9E	345-0096	-----	-----	-----
15	13/1100Z	14.0N	122.3E	13.8N	122.4E	15.3N	117.9E	008-0048	16.6N	114.5E	355-0078	18.2N	111.6E	226-0012
16	13/1700Z	14.2N	121.6E	14.1N	121.5E	15.4N	117.6E	031-0030	16.8N	114.2E	020-0066	-----	-----	-----
17	13/2300Z	14.5N	120.6E	14.5N	120.4E	15.7N	117.0E	046-0066	17.0N	113.8E	050-0054	18.6N	110.9E	180-0066
18	14/0500Z	14.9N	119.2E	15.0N	119.1E	16.4N	115.1E	352-0090	17.9N	112.1E	348-0030	-----	-----	-----
19	14/1100Z	14.4N	117.5E	14.5N	117.8E	16.3N	116.3E	057-0108	17.9N	114.5E	101-0144	19.3N	113.1E	112-0174
20	14/1700Z	14.3N	118.0E	14.9N	117.2E	16.2N	116.5E	080-0162	17.7N	114.7E	114-0204	-----	-----	-----
21	14/2300Z	14.9N	116.0E	14.9N	115.9E	15.5N	112.1E	222-0072	15.5N	108.8E	207-0276	-----	-----	-----
22	15/0500Z	14.5N	115.2E	14.9N	115.4E	14.5N	111.7E	190-0174	14.5N	108.6E	199-0342	-----	-----	-----
23	15/1100Z	15.0N	114.5E	15.3N	114.7E	15.0N	111.0E	194-0204	15.0N	107.9E	202-0342	-----	-----	-----
24	15/1700Z	15.4N	114.0E	15.7N	113.7E	15.4N	110.7E	190-0222	15.8N	107.8E	200-0372	-----	-----	-----
25	15/2300Z	16.1N	113.1E	16.4N	113.0E	18.0N	110.1E	206-0108	20.0N	108.0E	239-0126	-----	-----	-----
26	16/0500Z	17.1N	112.2E	17.4N	112.3E	20.3N	110.4E	360-0018	23.0N	110.0E	-----	-----	-----	-----
27	16/1100Z	18.5N	111.7E	18.4N	111.9E	22.9N	110.8E	012-0150	-----	-----	-----	-----	-----	-----
28	16/1700Z	19.0N	111.8E	19.1N	111.4E	22.2N	112.1E	075-0108	-----	-----	-----	-----	-----	-----
29	16/2300Z	19.7N	111.6E	19.7N	111.0E	21.6N	111.5E	069-0078	-----	-----	-----	-----	-----	-----
30	17/0500Z	19.7N	111.4E	20.0N	110.5E	20.4N	110.2E	-----	-----	-----	-----	-----	-----	-----
31	17/1100Z	19.9N	111.1E	20.4N	110.2E	20.7N	110.2E	-----	-----	-----	-----	-----	-----	-----
32	17/1700Z	20.8N	109.9E	21.7N	110.1E	22.5N	108.8E	-----	-----	-----	-----	-----	-----	-----
33	17/2300Z	21.0N	110.2E	21.1N	110.0E	-----	-----	-----	-----	-----	-----	-----	-----	-----
34	18/0500Z	21.4N	110.1E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0099 MI.
 AVERAGE 48 HOUR ERROR - 0168 MI.
 AVERAGE 72 HOUR ERROR - 0151 MI.

99.8

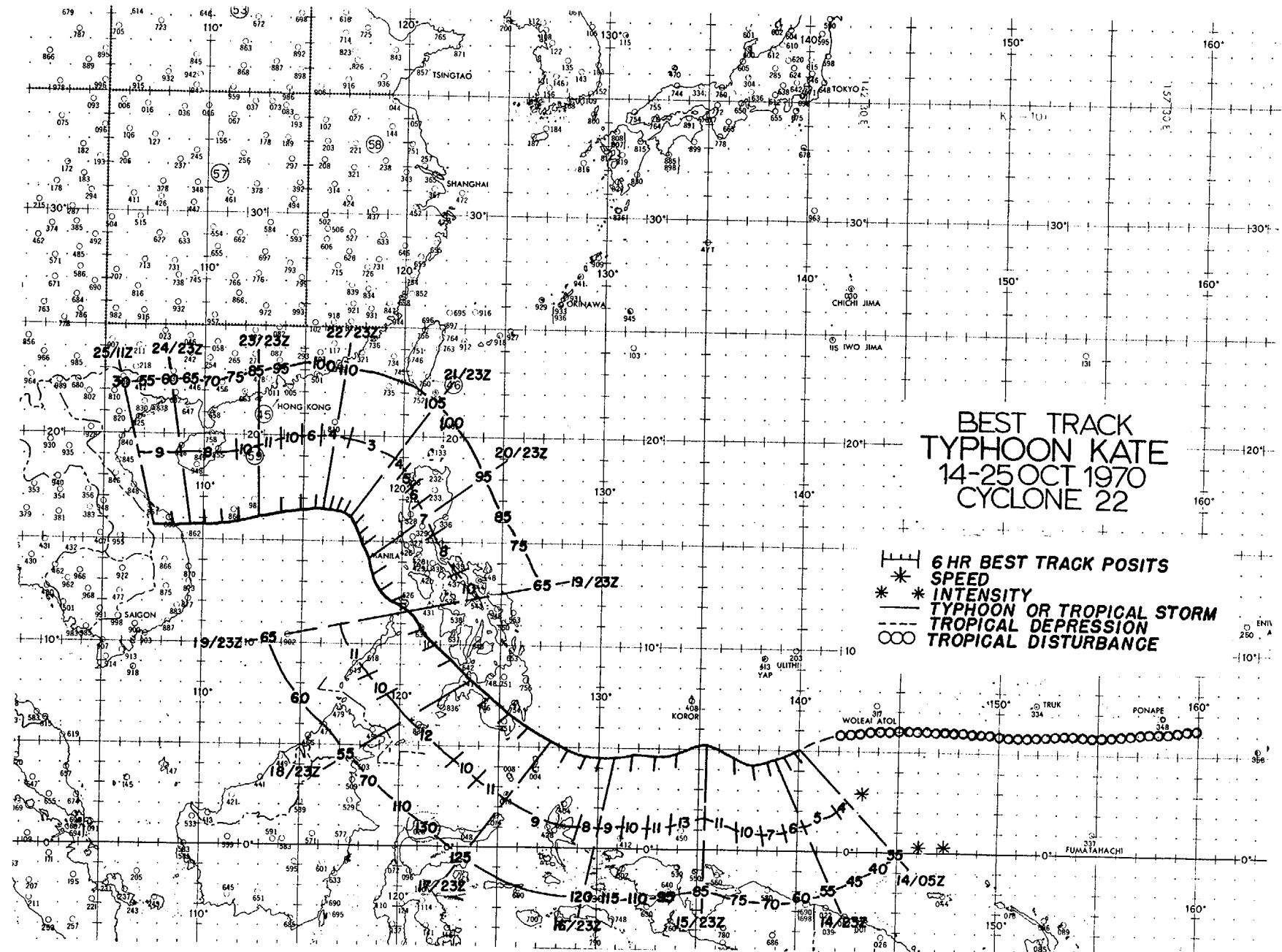
K. TYPHOON KATE 15 OCT 0500Z-25 OCT 1100Z

1. STATISTICS

- a. Number of Warnings Issued - 42
- b. Number of Warnings with Typhoon Intensity - 34
- c. Distance Traveled During Warning Period - 2,317 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 938 MBS at 16/2100Z
- b. Minimum Observed 700 MB Height - 2554 M at 22/2100Z
- c. Maximum Surface Wind - 130 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 540 MI



3. TYPHOON KATE NARRATIVE

While Joan was making headway in the South China Sea, Kate appeared on the scene developing south of Yap and commencing on an unusually low latitude track.

The initial impulse that later became Kate first revealed itself on the Majuro upper air sounding in the Marshalls with winds showing a cyclonic shift in the 700 mb and 500 mb levels on October 7th. The perturbation continued westward but realigned along a lower latitude apparently in response to the building heights to the rear of Joan. The ITOS-1 picture on the 13th showed a marked flare up in convective activity as the system moved under considerable difluent flow generated by equatorward outflow from Typhoon Joan some 1,300 miles to the northeast.

An organized pattern of clouds was apparent 300 miles south of Yap the following day. By the time a reconnaissance aircraft reached the area the afternoon of the 15th, Kate was near typhoon intensity with a wall cloud in process of forming, a central pressure of 986 mb and winds estimated near 60 knots.

During its westward journey in the following 3 days the typhoon remained small but concentrated. Shifting course slightly northwest the afternoon of the 17th (Figure 5-21), the storm aimed for the Davao Gulf of Mindanao reaching super typhoon strength some 24 hours later. The following evening its center arrived ashore 30 miles south of Davao City being the second typhoon to strike the Philippines in 4 days. Evidence of the highly concentrated nature of Kate at this time could be testified to by Davao not reporting a wind **higher** than 25 knots! Over 5,000 houses and other structures were lost in the accompanying storm surge, heavy rains and flooding in Southern Mindanao. Kate proved to be the most costly typhoon of the season as she struck an area unaccustomed to the effects of tropical cyclones and where light housing materials are common. A total of 631 persons perished with an additional 284 still counted as missing. Damage estimates were close to 50 million dollars (U.S.) The death toll counted surpassed all other typhoons on record in the Philippines and ranked Kate as the greatest killer cyclone experienced by that country.

Once over the Sulu Sea the storm was surprisingly intact after passing through the mountainous terrain of Mindanao. Kate slowly regained strength reaching typhoon strength just before passage over Busuanga Island. The Talampolan U. S. Coast Gurad LORAN station on the island reported gusts to 76 knots and a barometer reading of 989.9 mb.

Kate swung to a northward heading paralleling the western Luzon coast and slowing in forward speed as she approached the

ridge line (Figure 5-22). As height rises to the north blocked any further advancement, she slowly turned on a westward course on the 22nd setting sights for the Indochina coastline. Increasing in forward speed to 10 knots, the storm started to weaken on its west southwesterly track. Kate arrived onshore on the 25th just south of DaNang reduced to tropical storm force and bringing gale winds to the coast. The DaNang airfield reported winds 40 knots gusting to 66 knots. The storm lost intensity and later dissipated inland over the plateau region.

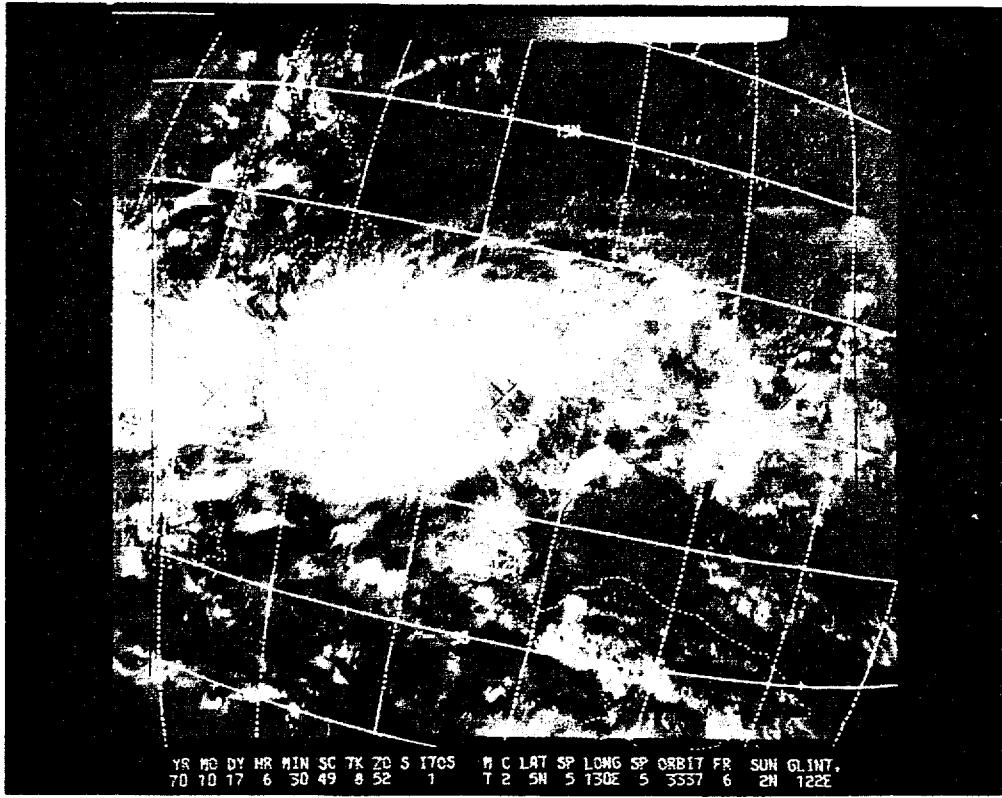


FIGURE 5-21 ITOS-1 DEPICTS TYPHOON KATE ON 17 OCTOBER DURING ITS LOW LATITUDE TRACK TOWARDS MINDANAO.

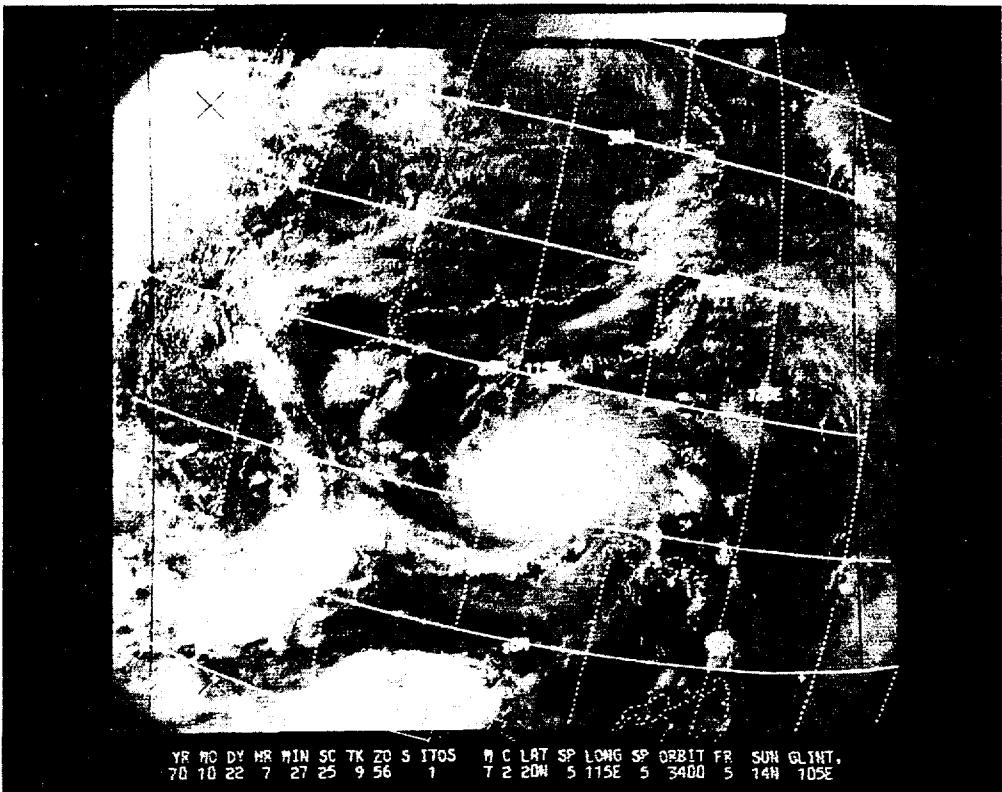


FIGURE 5-22 KATE WEST OF LUZON AS SEEN BY ITOS-1 ON 22 OCTOBER.

5 18

TYPHOON KATE

fix nu.	time	posii	eye fixes cyclone				22		min	fl	eye	orienta	eye dia	character	
			un-t-	met-o	accy	flt	lvl	sfc	obs	700mb	lvl	tt/to	form		
1	140536Z	05.0N 140.0E	SLTLS	STG B	DIA --	CAT -									
2	150555Z	04.5N 138.1E	54-p-06---		700MB	050	055	986	3018	19/14	----				W/C FORMG E-S
3	150633Z	04.0N 137.0E	SLTLS	STG B	DIA --	CAT -									
4	150737Z	04.3N 137.9E	54-p-06---		700MB	070	070	986	2984	16/11	----				
5	151502Z	04.2N 136.8E	VW-p-05---			--	--	--	--	--	--				
6	152100Z	05.2N 135.7E	54-p-05---		700MB	075	075	976	2896	17/08	ELIP	NW-SE	30x17	7-10NM THK	
7	160300Z	05.1N 134.8E	54-p-02---		700MB	075	085	971	2856	17/11	CIRC	----	25	CLSD, 10NM THK	
8	160534Z	04.5N 133.5E	SLTLS	STG X	DIA 04	CAT 3									CLSD, 10NM THK
9	161210Z	04.6N 132.3E	VW-p-05---			110	095	960	---	27/23	CIRC	----	17		
10	161405Z	04.7N 132.0E	VW-p-----		700MB	--	--	959	2746	23/09	ELIP	N-S	15x13	ROTATG RAPIDLY 10-12NM THK	
11	161445Z	04.7N 131.9E	VW-p-----			--	--	--	--	--	--				
12	162100Z	04.5N 131.2E	54-p-05---		700MB	103	120	938	2591	23/13	CIRC	----	10	CLSD, 4NM THK	
13	170300Z	04.4N 130.3E	54-p-10---		700MB	104	100	938	2600	27/11	CIRC	----	10	CLSD, 3-4NM THK	
14	170631Z	04.7N 129.7E	SLTLS	STG X	DIA 03	CAT 4									
15	170830Z	04.8N 129.5E	VW-p-15---		0300M	--	050	--	---	--	--				
16	172100Z	05.3N 127.9E	54-p-06---		700MB	120	--	949	2664	21/09	ELIP	NW-SE	12x10	CLSD, 10-12NM THK	
17	180300Z	05.9N 126.6E	54-p-03---		700MB	075	(130)	(941)	2621	23/11	CIRC	----	20	CLSD, 4-5NM THK	
18	180727Z	06.0N 125.0E	SLTLS	STG X	DIA 07	CAT 3									
19	180900Z	06.4N 125.8E	VW-p-10---		0300M	--	--	--	---	--	--				
20	181200Z	06.8N 125.3E	VW-p-20---			--	--	--	--	--	--			CLSD, BUT BRKG UP	
21	181418Z	07.2N 124.9E	VW-p-20---			--	--	--	--	--	--			BARELY DISCRNBL	
22	182100Z	07.2N 123.6E	54-p-05---		500MB	030	--	--	--	-3/8	CIRC	----	04	APRNT W/C N QUAD	
23	190040Z	11.6N 119.9E	LND RUR			--	--	--	--	--	--			NEG W/C	
24	190140Z	11.9N 119.7E	LND RUR			--	--	--	--	--	--				
25	190300Z	09.1N 123.0E	54-p-10---		500MB	045	--	--	--	-2/-5	CIRC	----	10	NEG W/C	
26	190600Z	09.8N 122.5E	54-p-20---		500MB	045	--	--	--	-4/-6	CIRC	----		NEG W/C	
27	190628Z	10.0N 121.5E	SLTLS	STG X	DIA 01	CAT 2									
28	190851Z	09.7N 122.1E	VW-p-05---		0300M	--	065	992	---	25/22	CIRC	----	14	CLSD	
29	191152Z	10.1N 121.5E	VW-p-05---		0360M	--	065	988	---	25/22	CIRC	----	25	CLSD, WK S QUAD	
31	191515Z	10.4N 121.1E	VW-p-05---		700MB	060	--	--	---	18/12	CIRC	----	20	CLSD	
31	192100Z	11.5N 120.9E	54-p-02---		700MB	040	--	978	2905	18/12	CIRC	----	10	CLSD, 7NM THK	
32	192340Z	11.7N 120.0E	LND RUR			--	--	--	--	--	--				
33	200000Z	11.8N 120.1E	54-p-02---		700MB	070	060	980	2908	16/12	CIRC	----	10	CLSD	
34	200300Z	12.0N 119.5E	54-p-02---		700MB	040	070	976	2877	18/12	CIRC	----	15	CLSD, 5NM THK	
35	200600Z	12.3N 119.2E	54-p-02---		700MB	050	090	972	2853	17/10	CIRC	----	10	CLSD	
36	200721Z	12.5N 119.2E	SLTLS	STG X	DIA 02	CAT 4									
37	200900Z	12.7N 119.3E	VW-p-05---			--	--	--	--	--	--				
38	201200Z	12.9N 119.0E	VW-p-05---			--	--	--	--	--	--			7NM THK, OPEN SW	
39	201447Z	13.2N 118.6E	VW-p-05---			--	--	--	--	--	--			5NM THK, OPEN SW	
40	201500Z	13.2N 118.7E	LND RUR			--	--	--	--	--	--			7NM THK, OPEN SW	
41	201530Z	13.4N 118.9E	LND RUR			--	--	--	--	--	--				
42	202100Z	14.0N 118.4E	54-p-01---		700MB	085	--	958	2755	22/12	CIRC	----	30		
43	210000Z	14.5N 118.2E	LND RUR			--	--	--	--	--	--			8-10NM THK, OPEN S QUAD	
44	210310Z	14.8N 118.0E	54-p-01---		700MB	070	125	958	2737	21/10	CIRC	----	15	5-8NM THK, OPEN SE	
45	210631Z	14.7N 117.5E	SLTLS	STG X	DIA 01	CAT 3									
46	210845Z	15.3N 117.8E	VW-p-05---		0500M	110	115	961	---	27/23	CIRC	----	20	CLSD	
47	211517Z	15.8N 117.5E	VW-p-05---		700MB	077	--	960	2781	18/10	CIRC	----	20	CLSD, WK SE QUAD	
48	212100Z	16.1N 117.5E	54-p-05---		700MB	100	--	952	2698	18/11	ELIP	NW-SE	20x--	CLSD, 6NM THK	

TYPHOON KATE																
FIX NO.	TIME	POSIT	EYE F/XES CYCLONE				22				MIN 700MB	FLT LVL	EYE FORM	ORIENTA- TION	EYE DIA	CHARACTER WALL CLOUD
			UNIT- MET-DO	FLT	LVL	SFC	OHS	MN	SLP	TT/10						
49	220315Z	16.4N 117.1E	54--02--	700MB	090	--	963	2701	16/09	CIRC	----	20	6NM THK, WK SE	-----		
50	220727Z	16.0N 117.0E	SETLS	STG X	01A 04	CAT 4	----	----	----	----	----	----	----	19X17	CLSD, 7NM THK, WK SE	
51	220805Z	16.6N 116.8E	VW--05--	0500M	115	115	947	---	23/20	ELIP	N-S	----	17	CLSD, 7NM THK	-----	
52	221200Z	16.8N 116.4E	VW--12--	----	----	----	----	----	----	CIRC	----	17	CLSD, 7NM THK	-----		
53	221407Z	16.7N 116.5E	VW--14--	----	----	----	----	----	----	CIRC	----	17	CLSD, 7NM THK	-----		
54	222100Z	16.5N 116.2E	54--05--	700MB	105	--	941	2554	17/11	CIRC	----	17	CLSD, 5-7NM THK, WK SE	-----		
55	230315Z	15.7N 115.7E	54--02--	700MB	110	100	956	2707	16/12	CIRC	----	18	CLSD, 4NM THK	-----		
56	230600Z	16.7N 115.4E	54--02--	700MB	110	100	955	2698	16/12	CIRC	----	18	CLSD, 4NM THK	-----		
57	230629Z	16.5N 114.8E	SLTLS	STG X	01A 03	CAT 4	----	----	----	----	----	----	----	----	-----	
58	230910Z	16.5N 115.1E	VW--05--	----	125	125	960	---	22/24	CIRC	----	20	CLSD, 5-18NM THK	-----		
59	231130Z	16.5N 114.6E	VW--05--	700MB	105	--	952	2722	19/10	CIRC	----	20	CLSD, HVY S QUAD	-----		
60	231445Z	16.4N 114.1E	VW--05--	700MB	110	--	955	2777	19/11	CIRC	----	20	CLSD, 10NM THK	-----		
61	232100Z	16.1N 113.0E	54--02--	700MB	080	--	968	2822	13/10	ELIP	NE-SW	24X16	DEGENRTG, OPEN NW	-----		
62	240252Z	16.0N 112.0E	54--02--	700MB	070	065	941	2905	17/10	CIRC	----	30	WK W/C S QUAD	-----		
63	240725Z	16.0N 111.1E	SLTLS	STG X	01A 03	CAT 3	----	----	----	----	----	----	----	----	-----	
64	240855Z	15.9N 111.2E	VW--02--	----	060	--	----	----	----	CIRC	----	24	8NM THK, OPEN NW-NE	-----		
65	240910Z	15.9N 112.0E	LND RUR	----	----	----	----	----	----	----	----	----	----	----	-----	
66	241045Z	15.9N 111.7E	LND RUR	----	----	----	----	----	----	----	----	----	----	----	-----	
67	241157Z	15.6N 110.2E	VW--02--	----	----	----	----	----	----	CIRC	----	25	OPEN NNW-N-E-SE	-----		
68	241527Z	15.9N 110.3E	VW--05--	0500M	070	060	948	---	24/23	----	----	----	----	NEG W/C	-----	
69	241545Z	15.9N 109.6E	LND RUR	----	----	----	----	----	----	----	----	----	----	----	-----	
70	242100Z	15.9N 109.5E	54--05--	700MB	050	--	949	2981	12/12	----	----	----	----	----	-----	
71	250300Z	15.7N 108.4E	54--02--	500MB	055	--	995	---	-17-5	CIRC	----	28	APRNT W/C W-N-SE	-----		

TYPHOON KATE

TROPICAL CYCLONE 22 -- 10/14/0500Z TO 10/25/1100Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
01	15/0500Z	4.4N	138.2E	4.4N	138.1E	5.6N	136.1E	066-0144	7.2N	132.8E	046-0228	-----	-----	-----
02	15/1100Z	4.6N	137.6E	4.3N	137.4E	5.9N	135.3E	064-0174	7.4N	132.0E	044-0228	8.7N	128.2E	054-0198
03	15/1700Z	4.2N	136.6E	4.7N	136.5E	4.9N	133.5E	078-0108	6.5N	130.3E	049-0144	-----	-----	-----
04	15/2300Z	5.4N	135.3E	5.1N	135.2E	8.3N	131.5E	011-0234	10.3N	128.1E	007-0300	12.0N	124.4E	016-0228
05	16/0500Z	5.3N	134.5E	4.6N	133.8E	6.9N	131.1E	023-0156	8.7N	128.0E	031-0186	-----	-----	-----
06	16/1100Z	4.6N	132.5E	4.6N	132.6E	5.6N	127.7E	305-0102	6.5N	123.4E	264-0114	7.5N	119.6E	220-0186
07	16/1700Z	4.7N	131.5E	4.5N	131.6E	5.7N	127.2E	306-0078	6.6N	123.3E	229-0078	-----	-----	-----
08	16/2300Z	4.5N	130.8E	4.4N	130.7E	4.9N	127.5E	165-0024	5.7N	124.8E	151-0174	6.7N	122.2E	160-0318
09	17/0500Z	4.5N	130.0E	4.5N	130.0E	5.0N	126.8E	158-0060	5.9N	124.2E	153-0228	-----	-----	-----
10	17/1100Z	4.8N	129.1E	4.6N	129.2E	5.6N	125.9E	160-0066	6.6N	123.4E	154-0216	7.8N	120.8E	159-0312
11	17/1700Z	5.0N	128.0E	4.9N	128.4E	5.9N	124.9E	165-0096	7.1N	122.4E	160-0234	-----	-----	-----
12	17/2300Z	5.3N	127.7E	5.3N	127.4E	6.2N	124.6E	150-0144	7.3N	121.5E	165-0270	8.8N	118.7E	176-0318
13	18/0500Z	6.0N	126.3E	6.0N	126.3E	7.5N	122.5E	176-0108	9.4N	118.9E	189-0162	-----	-----	-----
14	18/1100Z	6.5N	125.4E	6.7N	125.4E	8.5N	121.4E	189-0084	10.8N	117.7E	211-0126	13.3N	114.3E	238-0234
15	18/1700Z	7.1N	124.3E	7.5N	124.4E	9.3N	120.5E	195-0090	11.7N	117.0E	220-0132	-----	-----	-----
16	18/2300Z	7.6N	123.4E	8.3N	123.3E	9.9N	119.5E	202-0114	12.4N	116.0E	233-0162	15.0N	112.9E	253-0258
17	19/0500Z	9.3N	122.6E	9.3N	122.4E	12.8N	119.2E	351-0042	14.7N	115.6E	268-0132	-----	-----	-----
18	19/1100Z	10.1N	121.8E	9.9N	121.7E	13.5N	118.3E	327-0054	15.8N	114.9E	278-0162	19.1N	113.2E	309-0246
19	19/1700Z	10.8N	120.7E	10.8N	121.0E	13.4N	116.8E	270-0096	16.1N	113.8E	273-0210	-----	-----	-----
20	19/2300Z	11.6N	120.6E	11.7N	120.3E	14.5N	117.5E	299-0048	17.4N	115.3E	300-0126	20.2N	114.8E	344-0216
21	20/0500Z	12.4N	119.5E	12.1N	119.4E	15.1N	116.9E	288-0054	16.7N	115.7E	284-0072	-----	-----	-----
22	20/1100Z	12.9N	119.1E	12.7N	118.9E	15.5N	117.3E	284-0024	17.3N	116.4E	352-0048	19.2N	115.8E	019-0168
23	20/1700Z	13.5N	118.5E	13.4N	118.5E	15.0N	117.0E	256-0024	17.7N	116.2E	360-0066	-----	-----	-----
24	20/2300Z	14.1N	118.1E	14.1N	118.3E	16.6N	116.7E	300-0030	18.5N	116.0E	004-0108	20.5N	115.6E	032-0306
25	21/0500Z	15.0N	117.8E	14.8N	117.9E	17.8N	117.1E	005-0084	19.9N	116.9E	023-0204	-----	-----	-----
26	21/1100Z	15.5N	117.7E	15.4N	117.8E	17.9N	117.1E	016-0084	19.9N	116.9E	031-0234	21.4N	116.8E	046-0468
27	21/1700Z	16.0N	117.5E	15.9N	117.5E	17.9N	117.1E	029-0084	19.5N	116.9E	043-0258	-----	-----	-----
28	21/2300Z	16.2N	117.5E	16.3N	117.3E	17.8N	117.1E	046-0090	19.5N	116.9E	050-0312	21.0N	116.8E	005-0528
29	22/0500Z	16.5N	117.0E	16.4N	117.0E	18.1N	116.4E	030-0096	19.8N	116.2E	048-0336	-----	-----	-----
30	22/1100Z	16.8N	116.7E	16.5N	116.6E	18.1N	115.6E	024-0102	19.6N	115.0E	048-0324	21.1N	114.6E	-----
31	22/1700Z	16.8N	116.3E	16.6N	116.3E	17.8N	115.0E	037-0108	19.2N	114.1E	050-0306	-----	-----	-----
32	22/2300Z	16.5N	116.2E	16.7N	115.9E	16.8N	116.0E	078-0186	17.4N	114.4E	072-0306	18.0N	112.4E	-----
33	23/0500Z	16.8N	115.5E	16.5N	114.8E	17.3N	113.2E	048-0114	18.1N	110.3E	039-0180	-----	-----	-----
34	23/1100Z	16.5N	114.9E	16.3N	113.8E	16.1N	112.3E	082-0084	15.9N	109.0E	-----	-----	-----	-----
35	23/1700Z	16.4N	113.8E	16.1N	112.7E	16.0N	110.2E	064-0012	15.9N	106.2E	-----	-----	-----	-----
36	23/2300Z	16.1N	112.6E	16.0N	111.7E	15.8N	108.1E	270-0060	-----	-----	-----	-----	-----	-----
37	24/0500Z	16.0N	111.6E	16.0N	111.7E	15.8N	107.2E	275-0060	-----	-----	-----	-----	-----	-----
38	24/1100Z	15.9N	110.9E	15.9N	110.8E	15.8N	106.7E	-----	-----	-----	-----	-----	-----	-----
39	24/1700Z	15.9N	110.1E	15.9N	110.0E	15.8N	106.4E	-----	-----	-----	-----	-----	-----	-----
40	24/2300Z	15.9N	109.2E	15.8N	109.2E	-----	-----	-----	-----	-----	-----	-----	-----	-----
41	25/0500Z	15.9N	108.2E	15.7N	108.3E	-----	-----	-----	-----	-----	-----	-----	-----	-----
42	25/1100Z	16.0N	107.3E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0089 MI.

AVERAGE 48 HOUR ERROR - 0192 MI.

AVERAGE 72 HOUR ERROR - 0284 MI.

L. TYPHOON PATSY 14 NOV 0500Z-22 NOV 0500Z

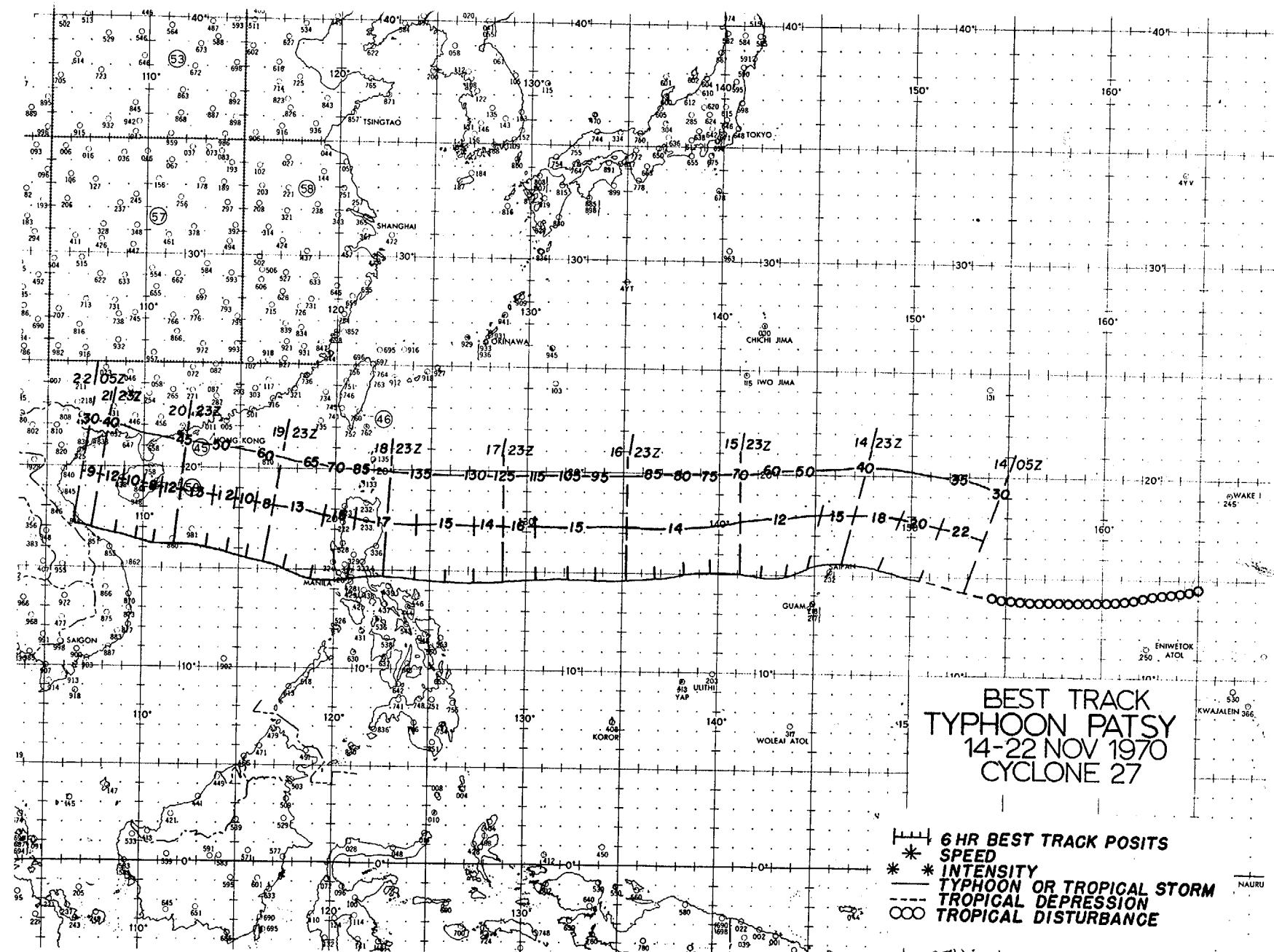
1. STATISTICS

- a. Number of Warnings Issued - 33
- b. Number of Warnings with Typhoon Intensity - 19
- c. Distance Traveled During Warning Period - 2,917 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 918 MBS at 18/2200Z
- b. Minimum Observed 700 MB Height - 2256 M at 18/0957Z
- c. Maximum Surface Wind - 135 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 600 MI

5-92



3. TYPHOON PATSY NARRATIVE

Culminating a light typhoon season, Patsy showed herself in embryonic form as a disturbance southeast of Wake Island on the 10th of November. Associated with an upper level circulation in the Mid-Pacific trough the system tracked slightly south of west for three days gradually reflecting downward to the surface as a wave trough.

By the 13th satellite photographs from the ESSA-8 and ITOS-1 indicated further development was in process as cloudiness was taking on a more organized character. However, reconnaissance aircraft could locate no closed circulation at the surface, as the speed of translation (22 knots) of the system and the presence of a 200 mb shearline to its north apparently inhibited further intensification.

During the early morning hours of the 14th a surface depression formed just east of the Marianas' chain. Patsy was at the threshold of tropical storm strength as she slowed in forward speed to 12 knots and passed just north of Saipan near noon. The U. S. Coast Guard station on the island indicated a barometer dip to 999 mb and gusts to 30 knots in thunderstorms. (See Figure 5-23 for satellite view sequence of Patsy.)

As development was occurring practically in the backyard of the Joint Typhoon Warning Center on Guam, the opportunity presented itself to view by radar the transformations that were taking place. The FPS-81 (5cm) collocated at Fleet Weather Central began to detect spiral band activity in the afternoon and later indications of a developing eye, as the storm started to move out of range. A reconnaissance aircraft confirmed the following morning that Patsy had attained typhoon force 200 miles west northwest of Guam.

For the next four days, a strong ridge line prevented any meridional component to the typhoon's westward movement at 14 to 15 knots. Luzon now became the target of a third typhoon in as many months.

Approaching the southeastern periphery of a 200 mb anticyclone centered near the Luzon straits, Patsy began a steady reduction in central pressure on the morning of the 17th which increased her maximum winds to super typhoon strength by the following afternoon. Near daybreak on the 19th, a reconnaissance aircraft at 500 mb fixed the 20 mile diameter eye in Luzon's Lamon Bay 105 miles east of Manila. The winds were estimated near 135 knots while a dropsonde reading indicated deepening had bottomed out at 918 mb.

A few hours earlier, the center had passed 40 miles north of the U. S. Coast Guard station on Catanduanes Island. Westerly winds of 90 knots with gusts to 100 knots were experienced while the barometer showed a reading of 975.7 mb.

Arriving ashore by mid-morning Patsy showed little slowdown in forward speed as she roared through the metropolitan area of Manila creating considerable havoc. Calms of varying times up to 35 minutes were reported during her high noon passage. Not since Winnie in June of 1964 had a typhoon so seriously affected the city of Manila.

During the siege the President Taft was torn from its anchorage and collided with the Greek vessel Aliakmon in Manila Bay while the coastal freighter PMI Engineer and a passenger ship of the Philippine President Lines were blown aground.

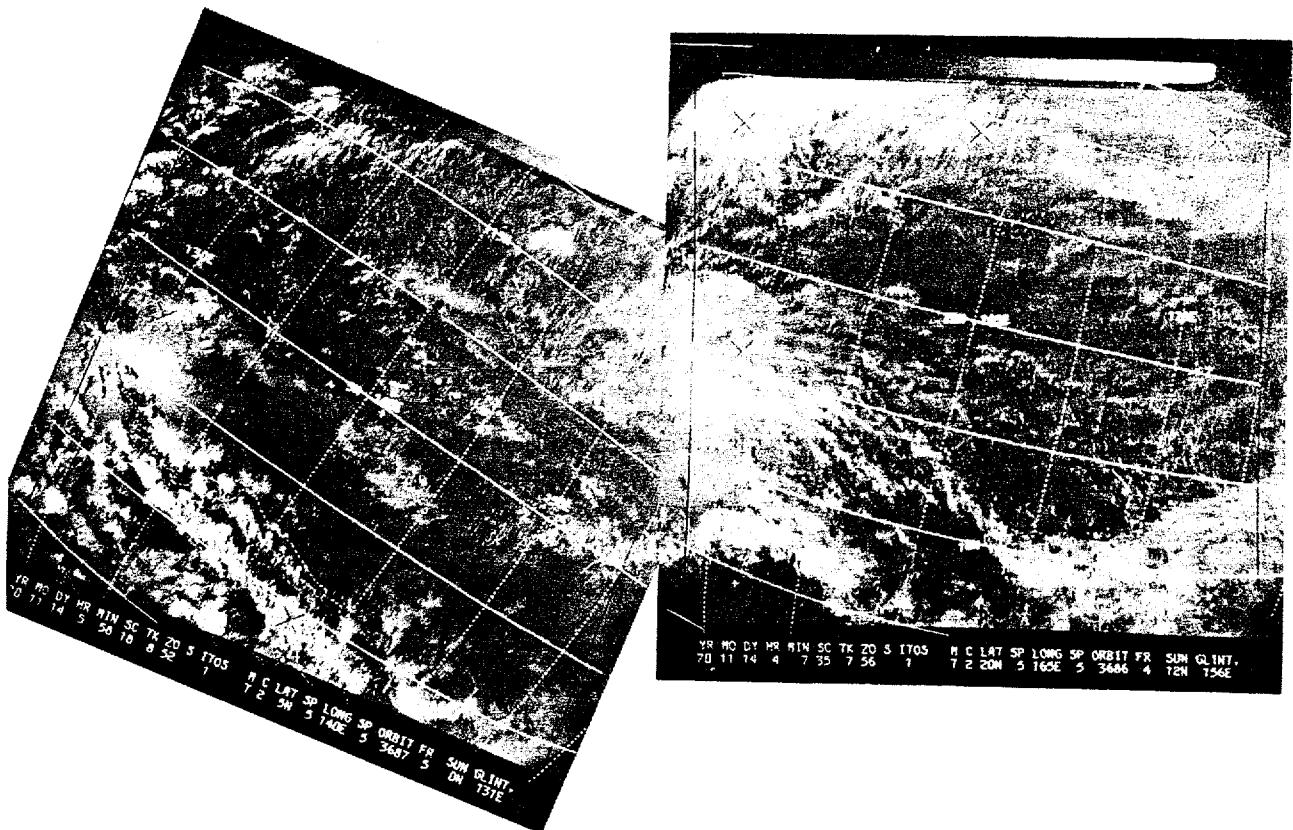
Manila International Airport reported a peak gust to 108 knots with the lowest reported pressure 969.3 mb. Both the Naval Station at Sangley Point on Manila Bay and Naval Air Station at Cubi Point on Subic Bay recorded gusts to 78 knots as Patsy's center passed within 10 miles.

The storm was responsible for 241 deaths and 1,756 injured with an additional 351 reported missing. At least 135 of the deaths occurred at sea. The damage toll incurred was near 80 million dollars (U.S.) as there were an estimated 31,380 refugees in Manila alone whose homes were completely or partially destroyed. Patsy stands on record as the most devastating to strike Manila, since the establishment of the Philippine Weather Bureau in 1865.

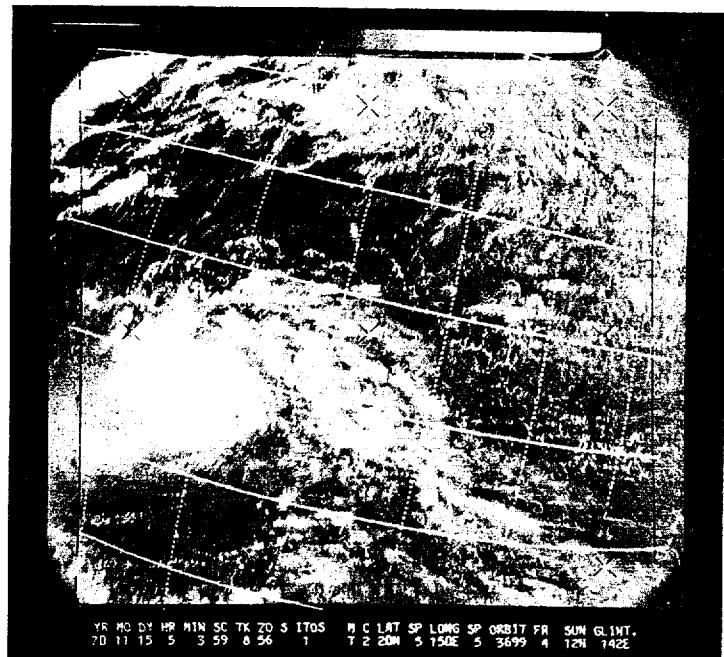
Leaving Luzon, the organized structure of the typhoon had been disrupted by her transit over the rugged islands. Patsy later weakened to tropical storm strength as she moved further into the South China Sea on the 19th. The cooler water and the modifying effect of the northeast monsoon acted as a barrier to any reintensification.

As a small high cell in the Gulf of Tonkin began to give way to a trough in the westerlies, the course of the storm shifted north of west which brought the center inland near the 17th parallel of the Indochina coastline on the 22nd. Quang Tri, just south of where the center struck, reported winds of 35 knots and gusts to 47 knots. Shortly afterwards the circulation broke up and dissipated over the highland region.

FIGURE 5-23 ITOS-1 VIEW SEQUENCE OF TYPHOON PATSY

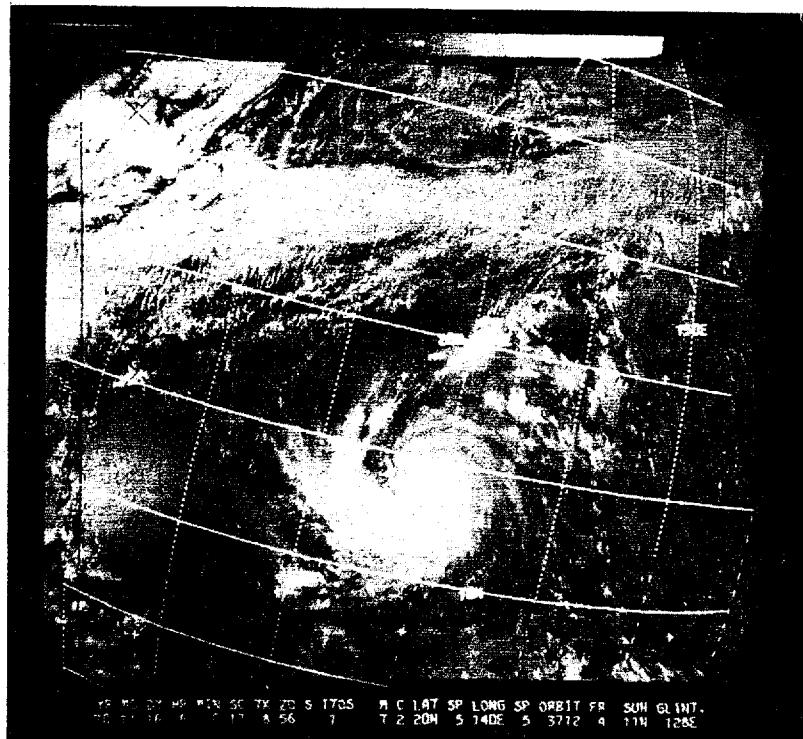


14 NOVEMBER - WAVE STAGE

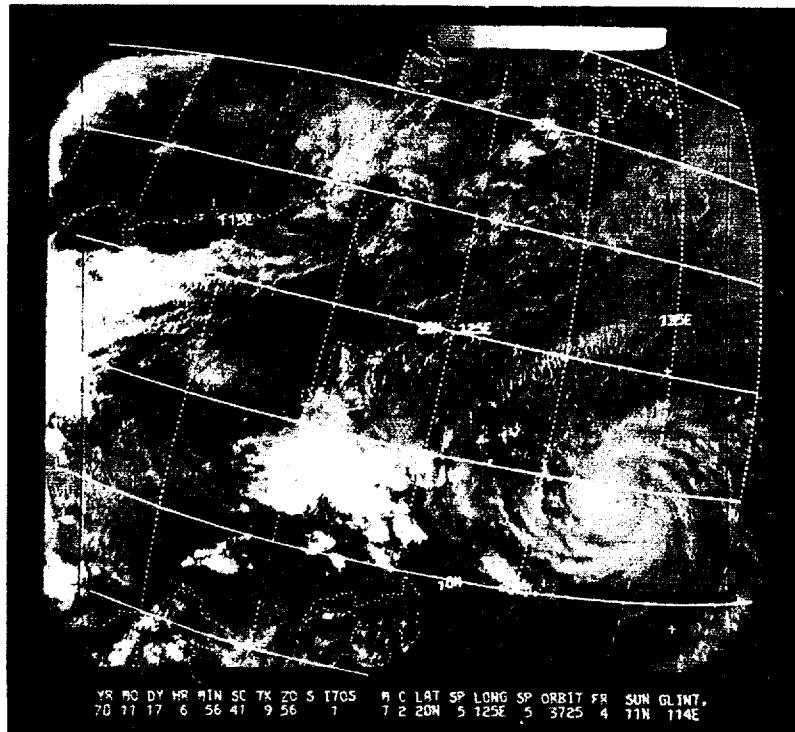


15 NOVEMBER - TROPICAL STORM STAGE

FIGURE 5-23 (CONT.) ITOS-1 VIEW SEQUENCE OF TYPHOON PATSY

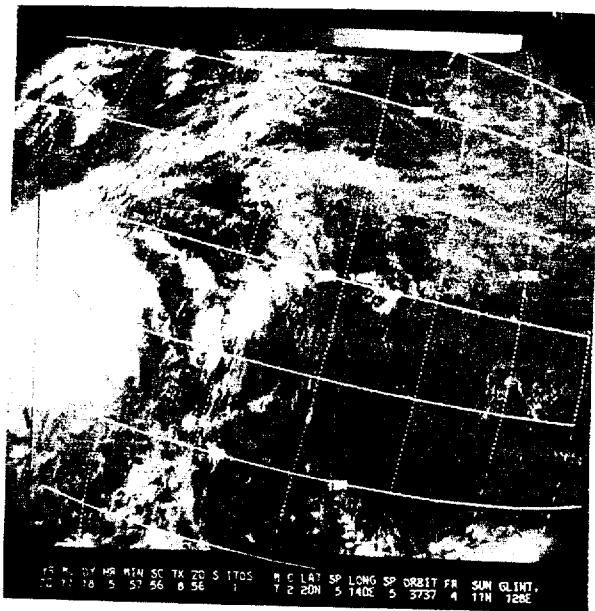


16 NOVEMBER - TYPHOON STRENGTH (75 KT)

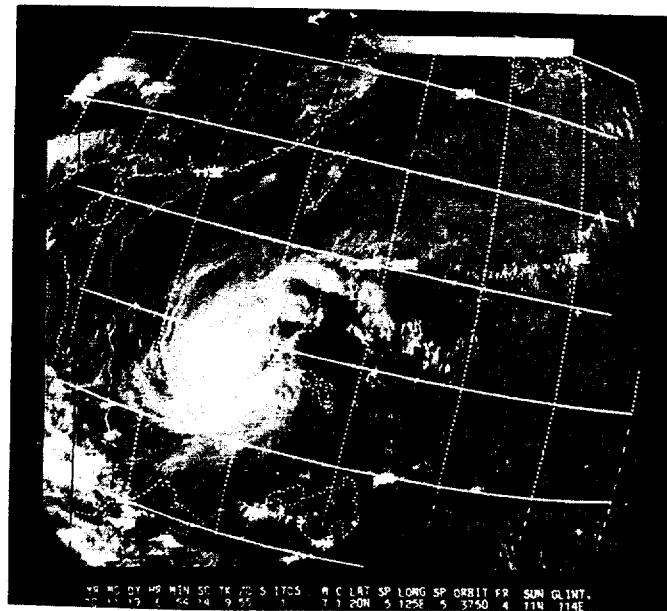


17 NOVEMBER - TYPHOON STRENGTH (95 KT)

FIGURE 5-23 (CONT.) ITOS-1 VIEW SEQUENCE OF TYPHOON PATSY



18 NOVEMBER - SUPER TYPHOON STRENGTH (130 KT)



19 NOVEMBER - TYPHOON STRENGTH (80 KT) - WEAKENED AFTER TRAVERSE OF LUZON.

5
6
8

TYPHOON PATSY

EYE FIXES CYCLONE

27

FIX NO.	TIME	POSIT	UNIT- MET-OD -ACCY	FLT FLT LVL	WDS LVL WHD WnD	DWS SRC MIN SLP	DRS 700MB HGT	MIN 700MB	FLT LVL TT/TO	EYE FORM	ORIEN- TATION	EYE DIA	CHARACTER WALL CLOUD
1	130506Z	13.0N 159.6E	SLTLS	STG 8	DIA --	CAT -							-----
2	140408Z	13.5N 153.0E	SLTLS	STG X	DIA 03	CAT 2							-----
3	141030Z	14.7N 150.4E	VW-P-20---	0500M	--	028	016	---	25/26	---			-----
4	142030Z	15.3N 147.4E	54-P-05--	700MB	035	040	995	3082	12/11	---			NEG W/C
5	140030Z	15.4N 146.0E	54-P-02--	700MB	--	040	998	3088	14/13	---			W/C DEVLPG SE QUAD
6	150315Z	15.3N 145.3E	54-P-05--	700MB	--	040	998	3075	16/14	---			W/C DEVLPG SE QUAD
7	150504Z	14.5N 145.0E	SLTLS	STG X	DIA 05	CAT 3							-----
8	150633Z	15.0N 144.4E	LND RUR	--	--	--	--	--	--/-	---			-----
9	150836Z	15.0N 144.2E	VW-P-06--	--	--	--	--	--	--/-	CIRC	----	17	WK W/C S-W-NW
10	150945Z	15.0N 144.0E	LND RUR	--	--	--	--	--	--/-	---			-----
11	151245Z	14.6N 143.6E	LND RUR	--	--	--	--	--	--/-	---			-----
12	151500Z	14.9N 142.9E	LND RUR	--	--	--	--	--	--/-	---			-----
13	151518Z	14.8N 143.2E	VW-L-10--	--	--	--	--	--	--/-	CIRC	----	20	7NM THK, OPEN W
14	152100Z	15.0N 141.6E	54-P-05--	700MB	040	065	986	3021	16/12	CIRC	----	18	CLSD
15	160000Z	15.1N 140.8E	54-P-05--	700MB	070	080	990	3018	15/11	CIRC	----	15	CLSD
16	160300Z	14.9N 140.0E	54-P-05--	700MB	067	090	989	3008	15/11	CIRC	----	10	CLSD
17	160600Z	14.6N 139.7E	SLTLS	STG X	DIA 03	CAT 3							-----
18	160759Z	15.3N 138.5E	ACFT RUR	--	--	--	--	--	--/-	---			-----
19	161018Z	15.0N 138.3E	VW-P-05--	--	030	--	--	--	--/-	ELIP	NE-SW	36X17	INTENSE SE & W
20	161450Z	14.8N 137.6E	VW-P-10--	700MB	--	--	--	2957	19/11	ELIP	NW-SE	12X10	OPEN NW
21	162100Z	14.6N 135.7E	54-P-07--	700MB	000	070	972	2853	16/12	ELIP	NW-SE	18X09	BRKN NRN HALF
22	170300Z	14.7N 134.5E	54-P-05--	700MB	070	080	961	2755	18/12	ELIP	NW-SE	16X12	CLSD
23	170656Z	14.7N 133.5E	SLTLS	STG X	DIA 01	CAT 3							-----
24	170903Z	~ 14.4N 132.5E	VW-P-15--	--	--	--	--	--	--/-	ELIP	NW-SE	16X08	CLSD
25	171400Z	14.6N 131.5E	VW-P-05--	700MB	--	940	2582	17/12	ELIP	N-S	16X08	CLSD	
26	172100Z	14.3N 129.2E	54-P-05--	700MB	102	--	930	2475	20/13	CONC	30-08	OUTER-CLSD, INNER-CLSD	
27	1H0300Z	14.6N 127.9E	54-P-03--	700MB	080	120	922	2402	22/12	ELIP	NW-SE	25X15	CLSD, 5-8NM THK
28	1H0600Z	14.0N 127.0E	SLTLS	STG X	DIA 05	CAT 4							-----
29	1H0800Z	14.6N 127.1E	LND RUR	--	--	--	--	--	--/-	---			-----
30	- 1H0957Z	14.2N 126.6E	VW-P-05--	700MB	118	--	916	2256	26/11	CIRC	----	18	CLSD, 6-14NM THK
31	181336Z	14.6N 125.7E	LND RUR	--	--	--	--	--	--/-	---			-----
32	181436Z	14.6N 124.9E	LND RUR	--	--	--	--	--	--/-	---			-----
33	181517Z	14.5N 124.8E	VW-P-05--	700MB	080	--	--	--	--/-	CIRC	----	15	CLSD, 6-15NM THK
34	181536Z	14.6N 124.6E	LND RUR	--	--	--	--	--	--/-	---			-----
35	181636Z	14.8N 124.5E	LND RUR	--	--	--	--	--	--/-	---			-----
36	181736Z	14.8N 124.2E	LND RUR	--	--	--	--	--	--/-	---			-----
37	181836Z	14.8N 123.8E	LND RUR	--	--	--	--	--	--/-	---			-----
38	181936Z	14.6N 123.6E	LND RUR	--	--	--	--	--	--/-	---			-----
39	182040Z	14.7N 123.2E	LND RUR	--	--	--	--	--	--/-	---			-----
40	182200Z	14.5N 123.0E	54-P-03--	500MB	070	095	918	---	09/-5	CIRC	----	20	CLSD, 5-10NM THK
41	182210Z	14.7N 122.8E	LND RUR	--	--	--	--	--	--/-	---			-----
42	182340Z	14.7N 122.6E	LND RUR	--	--	--	--	--	--/-	---			-----
43	190110Z	14.6N 122.2E	54-P-01--	500MB	100	100	---	---	10/-6	CIRC	----	16	CLSD, 10NM THK
44	190115Z	14.7N 122.0E	LND RUR	--	--	--	--	--	--/-	---			-----
45	190140Z	14.8N 122.2E	LND RUR	--	--	--	--	--	--/-	---			-----
46	190208Z	14.9N 121.5E	LND RUR	--	--	--	--	--	--/-	---			-----
47	190225Z	14.8N 121.6E	LND RUR	--	--	--	--	--	--/-	---			-----
48	190240Z	14.8N 121.2E	LND RUR	--	--	--	--	--	--/-	---			-----

TYphoon Patsy
EYE FIXES CYCLONE

27

FIX NO.	TIME	POSIT	UNIT-MET- -ACCY	FLT	LVL	WND	SFC WND	DRS SLP	MIN HGT	700MB	FLT TT/TO	LVL FORM	EYE	ORIENTA- TION	EYE DIA	CHARACTER WALL CLOUD
49	190325Z	14.9N 121.7E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	---	---
50	190445Z	14.9N 120.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
51	190505Z	14.9N 120.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
52	190635Z	14.6N 120.5E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
53	190645Z	14.5N 119.8E	SLTLS SIG X	DIA 03	CAT 4	---	---	---	---	---	---	---	---	---	---	---
54	190800Z	15.3N 119.4E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
55	190830Z	15.3N 119.2E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
56	190846Z	14.5N 119.8E	VW-R-1U---	---	---	---	---	---	---	---	---	---	---	---	---	NEG W/C
57	190900Z	15.2N 118.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
58	191000Z	15.2N 118.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
59	191045Z	15.5N 118.4E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
60	191145Z	15.0N 118.2E	LND RUR	---	---	---	---	---	---	---	---	---	---	---	---	---
61	191418Z	14.8N 118.1E	VW-P-02---	0300M	071	065	987	---	---	26/22	---	---	---	---	---	NEG W/C
62	192355Z	15.8N 115.5E	VW-R-02---	---	050	---	---	---	---	---	---	---	---	---	---	NO APRNT W/C
63	200200Z	15.4N 115.6E	VW-R-2U---	---	045	045	---	---	---	---	---	---	---	---	---	FRMG W QUAD, 6NM THK
64	200300Z	15.4N 115.7E	54-R-15---	---	---	---	---	---	---	---	---	---	---	---	---	FORMD S-NW
65	200751Z	15.0N 114.0E	SLTLS SIG X	DIA 04	CAT 3	---	---	---	---	---	---	---	---	---	---	---
66	200917Z	15.5N 114.3E	VW-R-15---	---	---	---	---	---	---	---	---	---	---	---	---	---
67	200936Z	15.7N 115.0E	VW-P-05---	0500M	040	045	989	---	26/24	CIRC	---	---	30	OPEN N SEMICIR	---	
68	201414Z	15.8N 113.9E	VW-P-03---	700MB	030	---	987	3042	19/12	---	---	---	---	---	NEG W/C	
69	210300Z	15.9N 111.0E	54-P-05---	700MB	040	035	998	3037	13/11	CIRC	---	---	14	WK W/C OPEN S	---	
70	210847Z	16.0N 109.5E	SLTLS SIG X	DIA 03	CAT 2	---	---	---	---	---	---	---	---	---	---	---
71	210915Z	16.3N 109.7E	VW-P-05---	0400M	047	050	988	---	28/21	CIRC	---	---	10	NEG W/C	---	
72	211152Z	16.3N 109.5E	VW-P-02---	0400M	043	045	996	---	26/23	CIRC	---	---	10	NEG W/C	---	
73	211453Z	16.7N 108.8E	VW-P-03---	0400M	043	040	998	---	26/21	CIRC	---	---	10	NEG W/C	---	

TYPHOON PATSY

TROPICAL CYCLONE 27 -- 11/14/0500Z TO 11/22/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
01	14/0500Z	13.8N	152.7E	14.3N	152.8E	13.8N	146.0E	143-0108		14.9N	140.0E	108-0018					
02	14/1100Z	13.7N	151.0E	14.8N	148.3E	13.9N	144.9E	129-0090		15.4N	138.4E	027-0024		16.0N	133.3E	041-0102	
03	14/1700Z	13.8N	149.5E	15.2N	148.3E	14.2N	143.0E	144-0048		15.7N	137.1E	019-0054					
04	14/2300Z	15.4N	146.5E	15.4N	146.4E	15.2N	139.5E	277-0090		16.0N	133.3E	305-0132		16.6N	128.3E	351-0126	
05	15/0500Z	15.2N	144.7E	15.3N	144.8E	14.7N	138.2E	258-0078		15.0N	132.9E	293-0042					
06	15/1100Z	14.9N	143.6E	14.9N	143.6E	14.0N	137.9E	186-0060		14.2N	132.8E	129-0042		15.1N	128.3E	077-0150	
07	15/1700Z	14.7N	142.9E	14.9N	142.4E	14.1N	139.2E	106-0150		14.0N	135.1E	097-0264					
08	15/2300Z	15.0N	141.1E	15.0N	141.1E	15.0N	135.3E	019-0018		14.7N	130.8E	085-0120		14.7N	126.7E	090-0246	
09	16/0500Z	14.9N	139.5E	15.0N	139.6E	14.6N	133.8E	134-0006		14.7N	129.3E	084-0114					
10	16/1100Z	15.0N	138.1E	15.0N	138.1E	14.9N	132.8E	072-0036		14.8N	128.6E	084-0168		14.6N	124.5E	090-0318	
11	16/1700Z	14.8N	137.1E	14.8N	136.7E	14.8N	132.2E	083-0096		14.8N	128.0E	087-0216					
12	16/2300Z	14.5N	135.2E	14.7N	135.2E	14.0N	129.5E	125-0048		14.3N	124.6E	100-0126		14.9N	120.5E	095-0240	
13	17/0500Z	14.7N	134.0E	14.7N	133.7E	14.7N	128.4E	079-0060		15.2N	123.0E	075-0132					
14	17/1100Z	14.5N	132.0E	14.7N	132.1E	14.7N	126.0E	046-0012		14.9N	121.1E	082-0120		15.1N	116.9E	104-0144	
15	17/1700Z	14.5N	130.8E	14.6N	130.5E	14.8N	125.0E	075-0042		14.9N	120.1E	090-0144					
16	17/2300Z	14.5N	128.7E	14.5N	129.7E	15.0N	122.5E	019-0018		14.9N	117.6E	108-0072		14.8N	113.5E	104-0096	
17	18/0500Z	14.5N	127.4E	14.5N	127.3E	15.2N	121.3E	040-0042		15.2N	116.2E	119-0048					
18	18/1100Z	14.4N	126.2E	14.5N	125.7E	15.2N	120.3E	064-0078		15.2N	115.4E	119-0060		15.2N	111.3E	126-0120	
19	18/1700Z	14.5N	124.4E	14.6N	124.2E	15.2N	118.5E	070-0048		15.2N	113.5E	046-0012					
20	18/2300Z	14.4N	122.8E	14.7N	122.4E	15.0N	116.8E	126-0030		15.1N	111.9E	134-0006		14.9N	107.8E	169-0126	
21	19/0500Z	14.9N	121.1E	14.6N	120.7E	15.2N	115.1E	207-0024		15.0N	110.2E	189-0078					
22	19/1100Z	14.6N	119.2E	14.6N	119.0E	14.7N	113.4E	222-0078		14.2N	109.4E	183-0132					
23	19/1700Z	14.7N	117.4E	14.9N	117.6E	14.6N	111.7E	255-0084		13.3N	107.3E	200-0216					
24	19/2300Z	14.7N	115.9E	15.3N	116.3E	14.3N	110.1E	241-0108									
25	20/0500Z	15.2N	115.5E	15.6N	115.4E	14.7N	109.8E	201-0102									
26	20/1100Z	15.7N	114.7E	15.7N	114.4E	16.1N	110.2E	120-0030									
27	20/1700Z	15.8N	113.3E	15.0N	113.2E	15.4N	108.4E	185-0078									
28	20/2300Z	15.9N	111.9E	15.2N	111.8E												
29	21/0500Z	15.8N	110.5E	16.3N	110.5E												
30	21/1100Z	16.3N	109.4E	16.4N	109.6E												
31	21/1700Z	16.6N	108.5E	16.7N	108.6E												
32	21/2300Z	16.8N	107.5E	17.0N	107.3E												
33	22/0500Z	17.1N	106.4E														

AVERAGE 24 HOUR ERROR - 0061 MI.
AVERAGE 48 HOUR ERROR - 0101 MI.
AVERAGE 72 HOUR ERROR - 0166 MI.

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DEFINITION OF TERMS AND ABBREVIATIONS IN CHAPTER 5

1. The units used in the tables and figures in this chapter are as follows:

DISTANCE - Nautical Miles/Speed Knots

HEIGHT OF PRESSURE LEVEL - Meters

PRESSURE - Millibars

TEMPERATURE - Degrees Celsius

2. With reference to eye fix data summaries, the following terms and abbreviations are used:

- a. UNIT - Reconnaissance unit that made the fix.

54WRS = 54th Weather Reconnaissance Squadron

VW-1 = Airborne Early Warning Squadron ONE

- b. METHOD

P = Penetration

R = Airborne Radar

SLTLS = Position Based on NESS Satellite Bulletins

LND RDR = Land Radar

ACFT RDR = Aircraft Radar (Commercial or Military) Other than 54 or VW

- c. ACCY - Estimated navigational accuracy of the fix in nautical miles.

- d. FLT LVL TT/TO - Flight level temperature inside/outside the eye or center.

- e. CHARACTER WALL CLOUD - Extent to which the wall cloud encloses the eye and its thickness based on reconnaissance estimate. Remark as to its development may also appear under this heading.

Abbreviations used in CHARACTER WALL CLOUD columns follow:

ALQUADS	All quadrants	FB	Feeder bands
APRNT	Apparent	FORMD	Formed
APRS	Appears	FORMG	Forming
BLDG	Building	HLF	Half
BRKG	Breaking	HVY	Heavy
BRKN	Broken	IRREG	Irregular
BRKS	Breaks	NEG	Negative
CLSD	Closed	ORG	Organized
CONC	Concentric	PRESNT	Presentation
DEF	Defined	QUAD	Quadrant
DEGENRTG	Degenerating	REFORMG	Reforming
DETERG	Deteriorating	RDR	Radar
DEVLPG	Developing	ROTATG	Rotating
DIFF	Difficult	SEMICIR	Semicircle
DISCRNBL	Discernable	SEP	Separate
DISORG	Disorganized	SML	Small
DISIPTG	Dissipating	W/C	Wall cloud
		WK	Weak