

ROYAL OBSERVATORY, HONG KONG

METEOROLOGICAL RESULTS
1977

PART III—TROPICAL CYCLONE SUMMARIES

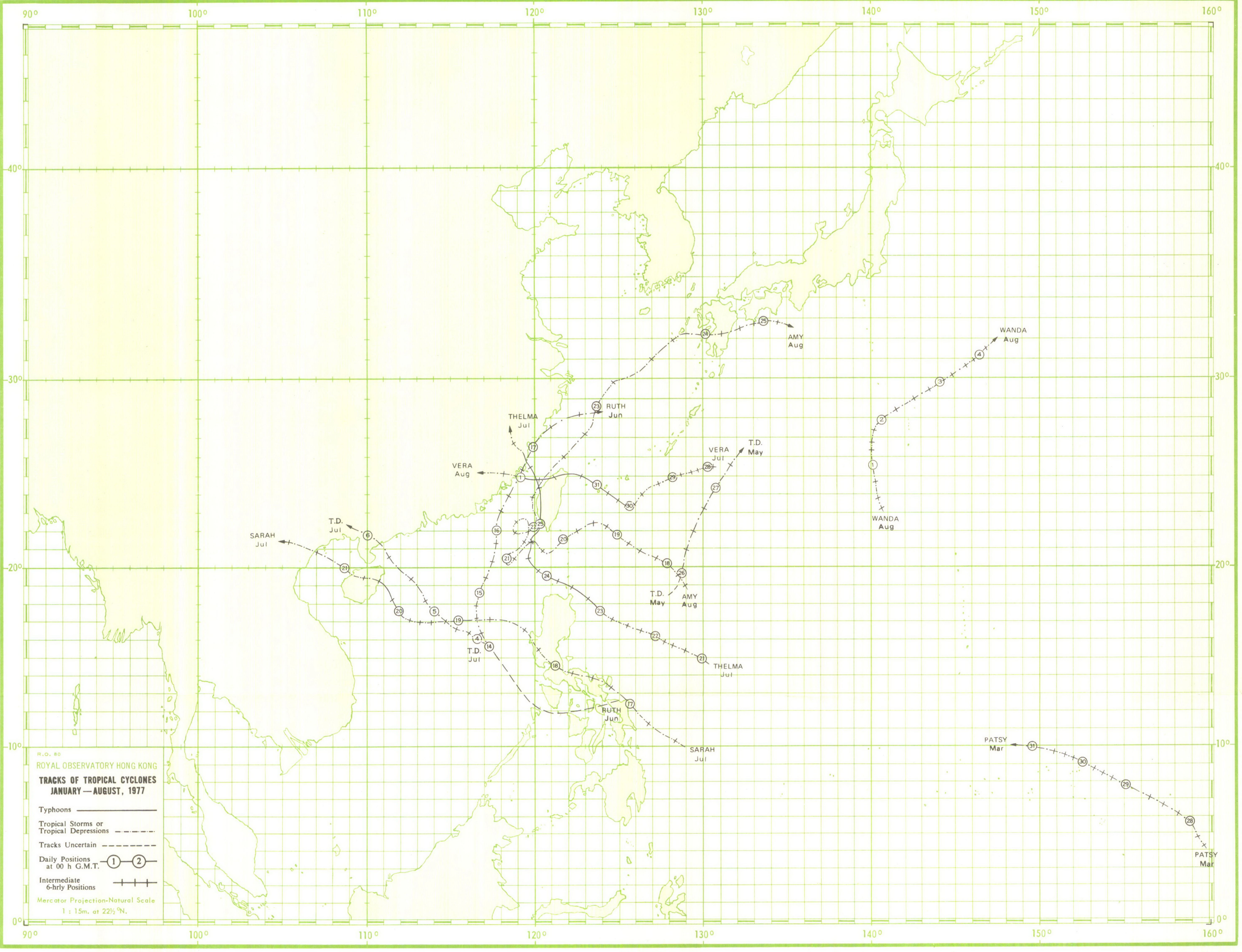


ERRATA TO HONG KONG METEOROLOGICAL RESULTS 1977

PART III – TROPICAL CYCLONE SUMMARIES

Page 42, table 9. (CONT'D)

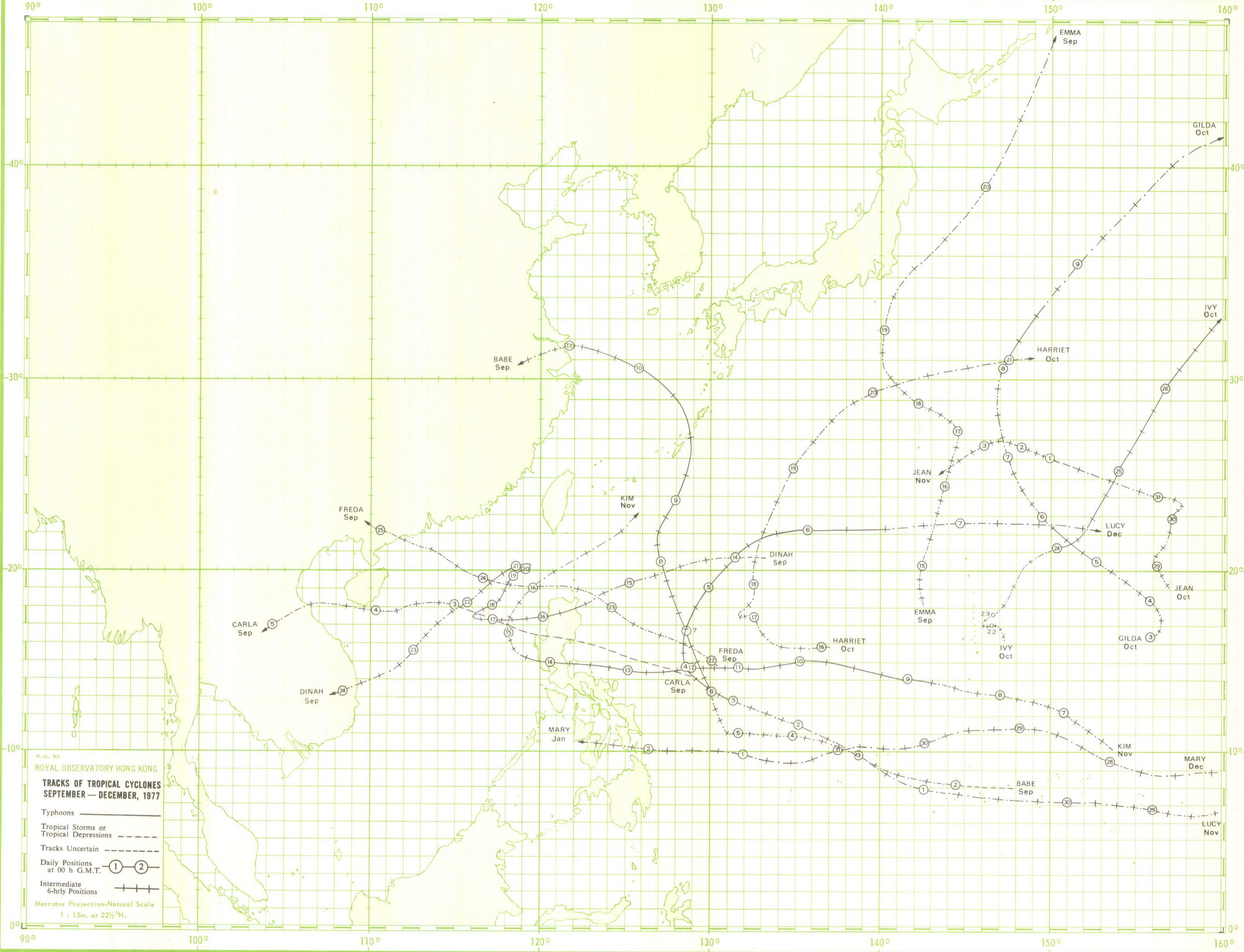
Name of tropical cyclone	Month	Rainfall at the Royal Observatory (mm)				
		(i)	(ii)	(iii)	(iv)	(i) + (iv)
		300 n. mile	24 hours	48 hours	72 hours	
T. Thelma	Jul	-	2.2	2.3	2.8	2.8



R.O. 80
 ROYAL OBSERVATORY HONG KONG
TRACKS OF TROPICAL CYCLONES
JANUARY—AUGUST, 1977

- Typhoons ————
- Tropical Storms or Tropical Depressions - - - - -
- Tracks Uncertain ······
- Daily Positions at 00 h G.M.T. (1) (2)
- Intermediate 6-hrly Positions + + + + +

Mercator Projection-Natural Scale
 1 : 15m. at 22½°N.



R.O. 80
ROYAL OBSERVATORY HONG KONG

**TRACKS OF TROPICAL CYCLONES
SEPTEMBER — DECEMBER, 1977**

- Typhoons —————
- Tropical Storms or
Tropical Depressions - - - - -
- Tracks Uncertain - - - - -
- Daily Positions
at 00 h G.M.T. ① ②
- Intermediate
6-hrly Positions + + + + +

Mercator Projection-Natural Scale
1 : 15m. at 22½°N.

METEOROLOGICAL RESULTS

1977

PART III—TROPICAL CYCLONE SUMMARIES

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INTRODUCTION

Apart from a short break 1940–1946, surface observations of meteorological elements since 1884 have been summarized and published in the Royal Observatory's Meteorological Results. Upper-air observations were begun in 1947 and from then onwards the annual volumes were divided into two parts, namely Part I—Surface Observations and Part II—Upper-air Observations.

During the period 1884–1939, reports on destructive typhoons were occasionally prepared and were included as Appendices to the Meteorological Results. However, after 1947, this practice was extended and an account of all tropical cyclones which caused gales in Hong Kong was included in the Annual Departmental Reports. The first issue of a new series—'Meteorological Results, Part III—Tropical Cyclone Summaries' was introduced in 1971. It contained information about all tropical cyclones over the western North Pacific and the South China Sea (i.e. the area bounded by the Equator, 45°N, 100°E and 160°E) that occurred in the year 1968.

Tracks of tropical cyclones in the western North Pacific and the South China Sea were published in Meteorological Results, Part I up to 1967. During the period 1884–1960, the tracks were plotted with day circle positions only. The time of the day circle varied to some extent but remained fixed at 0000 G.M.T. after 1944. The day circle times used for earlier tropical cyclones are given in the Royal Observatory Technical Memoir No. 11, Volume 1. From 1961 onwards, 6-hourly positions were shown on the tracks of all tropical cyclones.

Provisional reports on individual tropical cyclones affecting Hong Kong have been prepared since 1960; this was done in order to meet the immediate needs of the press, shipping companies and others. These reports were cyclostyled and were supplied on request. Initially, reports were only written on those tropical cyclones for which gales or storm signals had been hoisted in Hong Kong, but by 1968 it had become necessary to produce a report on every tropical cyclone during which any tropical cyclone warning signal was raised.

In this publication, tropical cyclones are classified into the following four categories according to the maximum sustained winds within their circulations:

A TROPICAL DEPRESSION (T.D.) has maximum sustained winds of less than 34 knots and at this stage the centre is often not very clearly defined and cannot always be fixed precisely.

A TROPICAL STORM (T.S.) has maximum sustained winds in the range 34–47 knots.

A SEVERE TROPICAL STORM (S.T.S.) has maximum sustained winds in the range 48–63 knots.

A TYPHOON (T.) has maximum sustained winds of 64 knots or more.

The Royal Observatory has a network of anemographs to record surface winds in Hong Kong. The instruments used are all Dines pressure-tube anemographs or M.O. Mark IV cup generator type anemographs manufactured by R. W. Munro Ltd. Quick-run mechanisms are also fitted to the anemographs at the Hong Kong Airport (Southeast), Waglan Island, Tate's Cairn and Cheung Chau for recording the fine structure of the wind flow in typhoons for research purposes. Details of these stations are given below.

Station	Position		Elevation of barometer above M.S.L.	Elevation of ground above M.S.L.	Head of anemometer above M.S.L.	Type of anemometer
	Latitude N	Longitude E				
Royal Observatory	22° 18'	114° 10'	(m)	(m)	(m)	Dines, Cup
Hong Kong Airport (Southeast)	22° 20'	114° 11'	33	32	61	Dines, Cup
Hong Kong Airport (Northwest)	22° 20'	114° 11'	24	4	16	Dines, Cup
Waglan Island	22° 11'	114° 18'	24	4	14	Dines, Cup
Tate's Cairn	22° 22'	114° 13'	62	55	75	Dines, Cup
Cheung Chau	22° 12'	114° 01'	*	575†	588	Dines
King's Park	22° 19'	114° 10'	79	72	92	Dines
Star Ferry	22° 18'	114° 10'	66	65	78	Cup
Green Island	22° 17'	114° 07'	*	3	17	Cup
Tsim Bei Tsui	22° 29'	114° 00'	*	76	90	Cup
Tai O	22° 15'	113° 51'	*	26	44	Dines
Castle Peak	22° 23'	113° 58'	*	76	90	Cup
				11	24	Dines

* No barometer.

† Level of the ground floor of the building compound of the Radar Station.

Wind measurements are also made by China Light & Power Co. Ltd. at Hok Un and Tsing Yi Island, by Cable & Wireless Ltd. at Stanley, by the R.A.F. at Tai Mo Shan and by the Chinese University at Ma Liu Shui. Wind speed measurements have not been corrected for the reduced density of the air but in most cases this would increase the figures in the tables by less than 5 per cent.

The reports in Section 5 present a general description of the life history of each tropical cyclone affecting Hong Kong from formation to dissipation including:

- (a) how the tropical cyclone affected Hong Kong;
- (b) the sequence of display of tropical cyclone warning signals;
- (c) the maximum gust peak speeds and maximum winds recorded at various stations in Hong Kong;

- (d) the lowest barometric pressure recorded in Hong Kong;
- (e) the daily amount of rainfall recorded at the Royal Observatory; and
- (f) the times and heights of the highest tides and maximum storm surges recorded in Hong Kong.

Whenever practical, radar photographs and pictures received from weather satellites are included together with information and data* obtained from reconnaissance aircraft.

In this publication different times have been in use in different contexts. The reference times of tropical cyclone warnings for shipping are given in G.M.T. Records of meteorological observations were in Standard Time (G.M.T. +8 hours) and Local Time could be either Standard Time or Summer Time (G.M.T. +9 hours) until 18 March 1977 when the terms Standard Time and Summer Time were dropped and 'Hong Kong Time' which is 8 hours ahead of the G.M.T. was adopted as a unitary time system. The result is that G.M.T. +8 hours was in use for all general purposes throughout the year.

The following convention is used in this publication:

- (a) Unlabelled times given in hours and minutes (e.g. 1454) on a 24-hour clock, or times expressed as a.m. or p.m. are 8 hours ahead of G.M.T. (in Standard Time or Hong Kong Time);
- (b) Times labelled 'G.M.T.' are in Greenwich Mean Time.

Distances are generally given in international nautical miles (n mile), 1 international nautical mile being 1852 metres exactly. In order to shorten the text, the words 'international' and 'nautical' are usually omitted. The unit of speed is one international knot (kn), which is equal to 1.852 km/h or about 0.514 m/s.

* The data from reconnaissance aircraft were taken directly from eye-fix messages received operationally at the Royal Observatory, Hong Kong. No attempt has been made to convert the wind speeds into equivalent '10-minute mean winds' to make them comparable with reports from surface stations.

DESCRIPTION OF TABLES

Table 1 is a list of tropical cyclones in 1977 in the western North Pacific and the South China Sea (i.e. in the area bounded by the Equator, 45°N, 100°E and 160°E). The names of these tropical cyclones are those used by the U.S. Fleet Weather Central/Joint Typhoon Warning Center, Guam. The dates cited cover the period during which the track of each tropical cyclone lay within the above-stated region and may not necessarily represent its full life-span. This limitation applies to all other elements in the table.

Table 2 gives the number of tropical cyclone warnings for shipping issued by the Royal Observatory, Hong Kong in 1977, the duration of these warnings and the time of validity of the first and last warnings for all tropical cyclones in Hong Kong's area of responsibility (i.e., the area bounded by 10°N, 30°N, 105°E and 125°E). Times are given in hours G.M.T.

Table 3 presents a summary of the occasions on which the tropical cyclone warning signals were hoisted during 1977. The sequence of the signals displayed and the number of tropical cyclone warning bulletins issued for each tropical cyclone are also given. Times are given in hours and minutes in Hong Kong Time which is 8 hours ahead of G.M.T.

Table 4 presents a summary of the occasions on which the tropical cyclone warning signals were hoisted between 1946 and 1977. The Strong Wind Signal, No 3, was not introduced until 1956 and the Gale or Storm Signals 5, 6, 7 and 8 were renumbered as 8 NW, 8 SW, 8 NE and 8 SE respectively with effect from 1 January 1973.

Table 5 gives the annual number of tropical cyclones in Hong Kong's area of responsibility between 1946 and 1977. The annual number of tropical cyclones which caused tropical cyclone warning signals to be raised in Hong Kong is also included.

Table 6 shows the maximum, mean and minimum duration of display of each tropical cyclone warning signal during the period 1946-1977.

Table 7 presents the casualties and damage figures associated with tropical cyclones in Hong Kong for the period 1937-1977. The information is compiled from local newspapers and from the Marine Department's records.

Table 8 contains the particulars of ships sunk, damaged, grounded, etc., by various tropical cyclones during the period 1974-1977. The information is compiled from local newspapers and from the Marine Department's records.

Table 9 presents the maximum storm surge (the excess, in metres, of the actual water level over that predicted in the Tide Tables) for each tropical cyclone affecting Hong Kong in 1977. Data on the nearest approach, the maximum winds at the Royal Observatory and Waglan Island, the minimum sea-level pressure and the total rainfall recorded at the Royal Observatory are also included together with an estimate of the minimum central pressure of each tropical cyclone during its closest approach.

Table 10 presents some meteorological information for those typhoons which required the hoisting of the Hurricane Signal, No. 10 in Hong Kong since 1946. The information presented includes the distances and bearings of nearest approach, the minimum sea-level pressures recorded at the Royal Observatory and the maximum 60-minute mean winds and maximum gusts recorded at some selected stations in Hong Kong.

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TROPICAL CYCLONE SUMMARIES FOR 1977

In 1977 there were only twenty-one tropical cyclones over the western North Pacific and the South China Sea compared with an annual average of thirty-one over the period 1947–1976. Of these twenty-one tropical cyclones only eleven attained typhoon intensity. Six tropical cyclones crossed the coast of China while two passed directly over Taiwan. Three crossed the Philippines and another three affected Vietnam. Only one tropical cyclone struck Japan and none affected Korea. The monthly distribution of these tropical cyclones is shown in Figure 1 and a brief summary of their tracks is contained in Table 1. Six-hourly positions of these tropical cyclones are also tabulated in the appendix. The monthly mean frequency of occurrence of tropical cyclones during the years 1947–1976 is given in Figure 2 for comparison.

During the year there were ten tropical cyclones in Hong Kong's area of responsibility for tropical cyclone warnings for shipping (i.e. the area bounded by 10°N, 30°N, 105°E and 125°E) compared with an average figure of seventeen in the past thirty years. Seven tropical cyclones entered this area while three developed within it. Altogether 294 warnings for shipping were issued by the Royal Observatory in connection with these ten tropical cyclones and tropical cyclone warning signals were displayed in Hong Kong to give warning about eight of them.

The total tropical cyclone rainfall during the year amounted to 597.9 mm which was slightly above the annual average value of 566.9 mm and represented about 36 per cent of the year's total rainfall of 1680.0 mm. The wettest tropical cyclone was Tropical Storm Carla in September while the driest was Severe Tropical Storm Ruth in June. The rainfall associated with Carla was 268.4 mm and with Ruth was only 2.2 mm.

The first tropical cyclone of the year was Tropical Storm Patsy which formed to the east of the Caroline Islands on 27 March. It moved northwestwards and dissipated about 400 miles southeast of Guam on 31 March.

No tropical cyclones were observed in April. A tropical depression developed on 26 May over the western North Pacific to the east of Luzon. It moved northeastwards and dissipated to the east of the Ryukyu Islands the next day.

Severe Tropical Storm Ruth was the first tropical cyclone of the year for which signals were displayed in Hong Kong. Ruth developed over the South China Sea to the west of the southern Philippines on 14 June. It passed about 200 miles to the east of Hong Kong on 16 June and dissipated over the East China Sea 36 hours later.

Five tropical cyclones formed in July and three of them affected Hong Kong. Typhoons Thelma and Vera crossed Taiwan within one week and caused widespread damage, particularly to the new container port at Kaohsiung. Signals were displayed for Tropical Storm Amy, the only tropical cyclone that formed in August. Amy originated about 500 miles northeast of Manila on 17 August. It entered the South China Sea on 20 August and remained quasi-stationary to the southwest of Taiwan for about two days. It then turned northeastwards through the Taiwan Strait and became extratropical on 25 August to the southeast of Shikoku.

Five tropical cyclones were observed in September and local signals were hoisted for three of them. Typhoon Dinah crossed north Luzon on the evening of 15 September causing severe casualties and damage. It stayed over the northeastern part of the South China Sea for an exceptionally long time and the Stand By Signal remained hoisted in Hong Kong for a record 124 hours and 40 minutes. Severe Tropical Storm Freda passed about 80 miles to the south-southwest of Hong Kong and was the only tropical cyclone for which Gale or Storm Signals were hoisted during the year.

There were four tropical cyclones in October. They all formed north of 15°N well to the east of the Philippines and dissipated over the Ocean without encountering land.

Two typhoons developed in November. Typhoon Kim was one of the most intense typhoons in recent years. It crossed the Philippines on 14 November and left behind a trail of death and heavy damage. Typhoon Lucy formed on 28 November to the east of the Caroline Islands. At first, it moved westwards but began to turn to the northeast on 4 December and finally dissipated to the west of the Mariana Islands three days later. Typhoon Mary originated well to east of the Caroline Islands on 20 December and by the end of the year it was centred about 850 miles east-southeast of Manila.

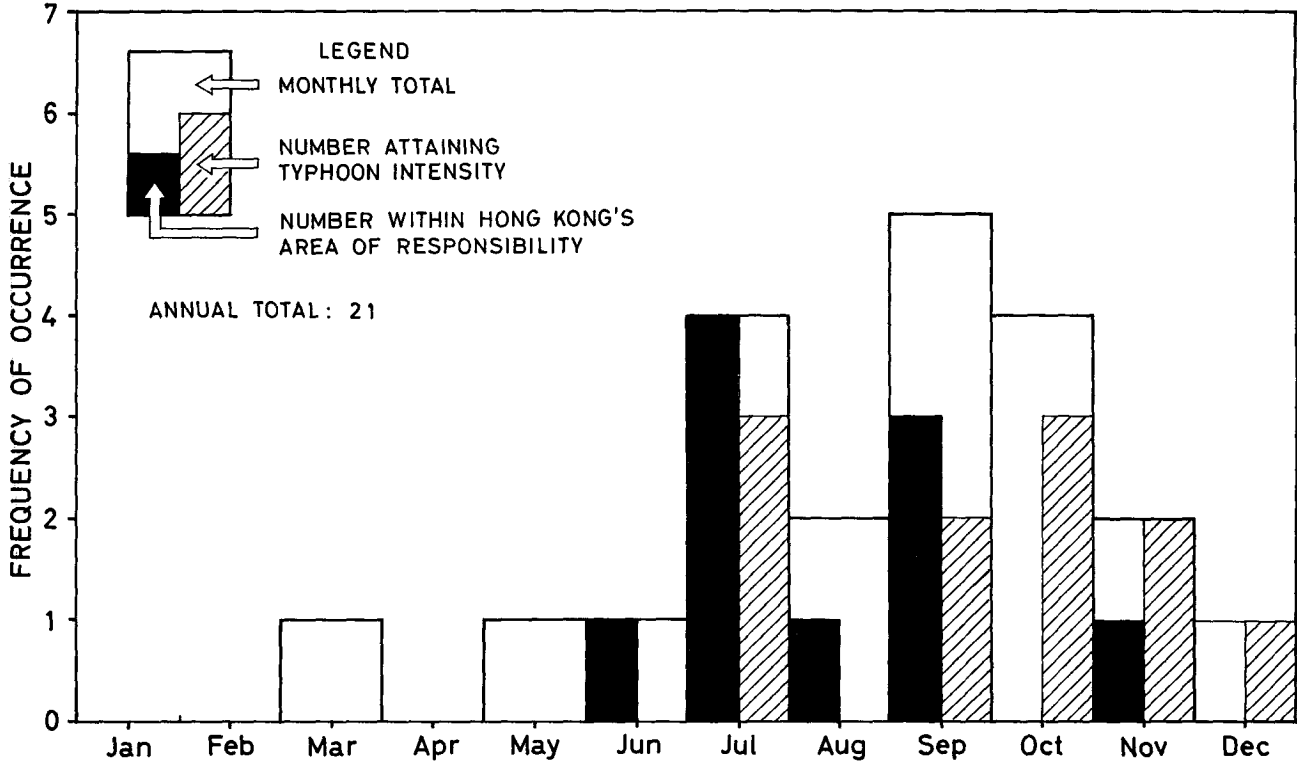


Figure 1. Monthly distribution of the frequency of occurrence of tropical cyclones and typhoons in the western North Pacific and the South China Sea in 1977. (classified in accordance with the month of the first day circle of each track)

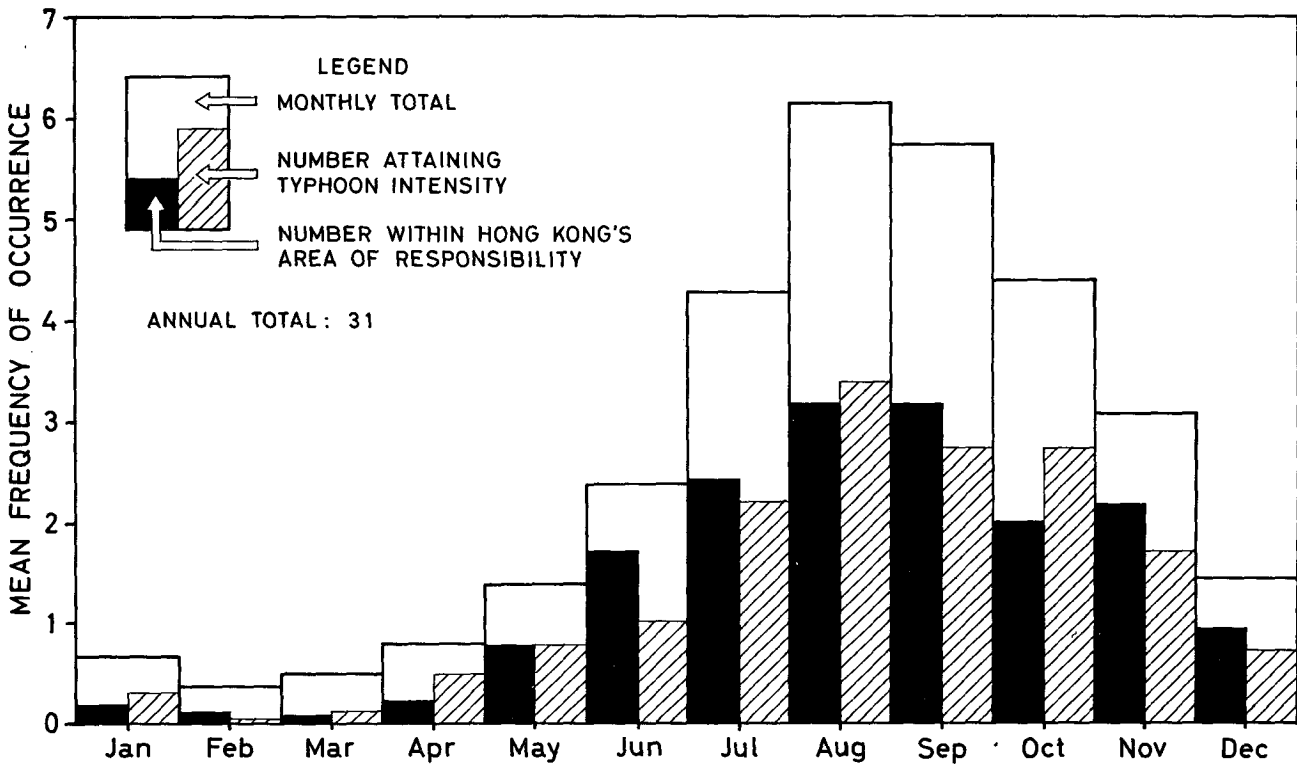


Figure 2. Monthly distribution of the mean frequency of occurrence of tropical cyclones and typhoons in the western North Pacific and the South China Sea, 1947-1976, (classified in accordance with the month of the first day circle of each track)

REPORTS ON TROPICAL CYCLONES AFFECTING HONG KONG IN 1977

SEVERE TROPICAL STORM RUTH

14-17 June 1977

The track of this severe tropical storm is shown in Figure 3

A low pressure area with disturbed weather developed over the Pacific to the east of the southern Philippines on 10 June 1977. It became more organized as it crossed the southern Philippines and entered the South China Sea on the morning of 13 June. The Royal Observatory's estimates of the maximum wind speeds in the disturbance from satellite photographs were 25 knots on both 12 and 13 June.

The low pressure area began to intensify while it was moving northwestwards at 10 knots over the warm waters of the South China Sea where sea surface temperatures around 30°C were reported. During the early hours of 14 June, it developed into a tropical depression and became a tropical storm on the same morning. Satellite photographs showed that the tropical storm, named Ruth, had a small central core of clouds with a diameter of around 120-150 nautical miles (Figure 4). There was more development in the southeast quadrant where ship reports consistently showed wind strengths of near-gale or gale force. Throughout its existence, Ruth remained a fairly small but intense storm, being most active in the southeast quadrant.

Throughout 14 June it continued to move northwestwards at a slightly reduced speed of 8 knots. At 8.00 a.m., a ship (the Johan U) about 25 miles east of the centre of Ruth reported a southerly wind of 48 knots and a pressure of 991.0 millibars. In Hong Kong, the Stand By Signal, No. 1, was hoisted at 10.30 p.m. when Tropical Storm Ruth was about 320 miles to the south-southeast and was beginning to move northwards at around eight knots.

On the morning of 15 June, a reconnaissance aircraft reported a minimum central pressure of 976 millibars and maximum surface winds of 75 knots near the centre of Ruth. The satellite photograph that morning also gave an estimated maximum surface wind of 55 knots (Figure 5). Both reports indicated that Ruth had reached severe tropical storm intensity. Later in the day another reconnaissance aircraft also reported similar conditions (minimum central pressure of 978 millibars and maximum surface winds of 80 knots).

During the next 48 hours, Ruth moved northwards or north-northeastwards at an average speed of about nine knots. Pratas Island reported a heavy hail storm in the spiral rainband in advance of Ruth which was centred about 175 miles to the south at the time. Pratas later experienced heavy rain and near-gale force winds as Ruth passed about 35 miles to its east. The closest approach of Ruth to Hong Kong was about 200 miles to the east around 8.00 a.m. on 16 June when the central pressure of the storm was estimated to be 985 millibars. Three hours later the 'Nedlloyd Karakorum' reported winds of 53 knots and a pressure of 995.5 millibars when it was 30 miles south of Ruth.

Ruth continued to move around the Pacific anticyclone as it headed northwards. It was soon evident that the threat to Hong Kong had diminished and the Stand By Signal was lowered at 10.00 a.m. on 16 June when Ruth was about 200 miles to the east. Ruth moved north-northeastwards when it entered the Taiwan Strait. There the sea surface temperatures were generally less than 28°C and together with the effects of the land, Ruth gradually began to weaken. The tropical cyclone skirted the coast of southeast China during the early hours of 17 June and then curved east-northeastwards at around 15 knots. Ruth weakened into a tropical depression by the same evening and later degenerated into an area of low pressure over the East China Sea.

The weather in Hong Kong was relatively unaffected by Severe Tropical Storm Ruth. Winds were generally light to moderate from the south on 14 June and from the east on 15 June. However, winds became moderate to fresh southwesterly during the next two days. Apart from some cloudy intervals and a few isolated showers, the weather in Hong Kong was generally fine, sunny and hot. Temperatures were highest on 16 June when a maximum of 32.8°C was recorded at the Royal Observatory. At 5.00 p.m. on 16 June the Royal Observatory recorded a minimum sea-level pressure of 1003.7 millibars. Ruth was then centred about 240 miles to the east-northeast of Hong Kong.

The following amounts of rainfall were recorded at the Royal Observatory:

14 June	15.5 mm
15 June	Trace
16 June	Nil

Total: 15.5 mm

There were no reports of damage to property in Hong Kong. The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the period when the Stand By Signal was on display were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.1	16 Jun	8.15 a.m.	0.2	16 Jun	6.15 a.m.
Tai Po Kau	2.0	16 Jun	7.00 a.m.	0.3	16 Jun	12.30 p.m.
Chi Ma Wan (Lantau Island)	2.3	16 Jun	8.45 a.m.	0.3	16 Jun	7.00 a.m.

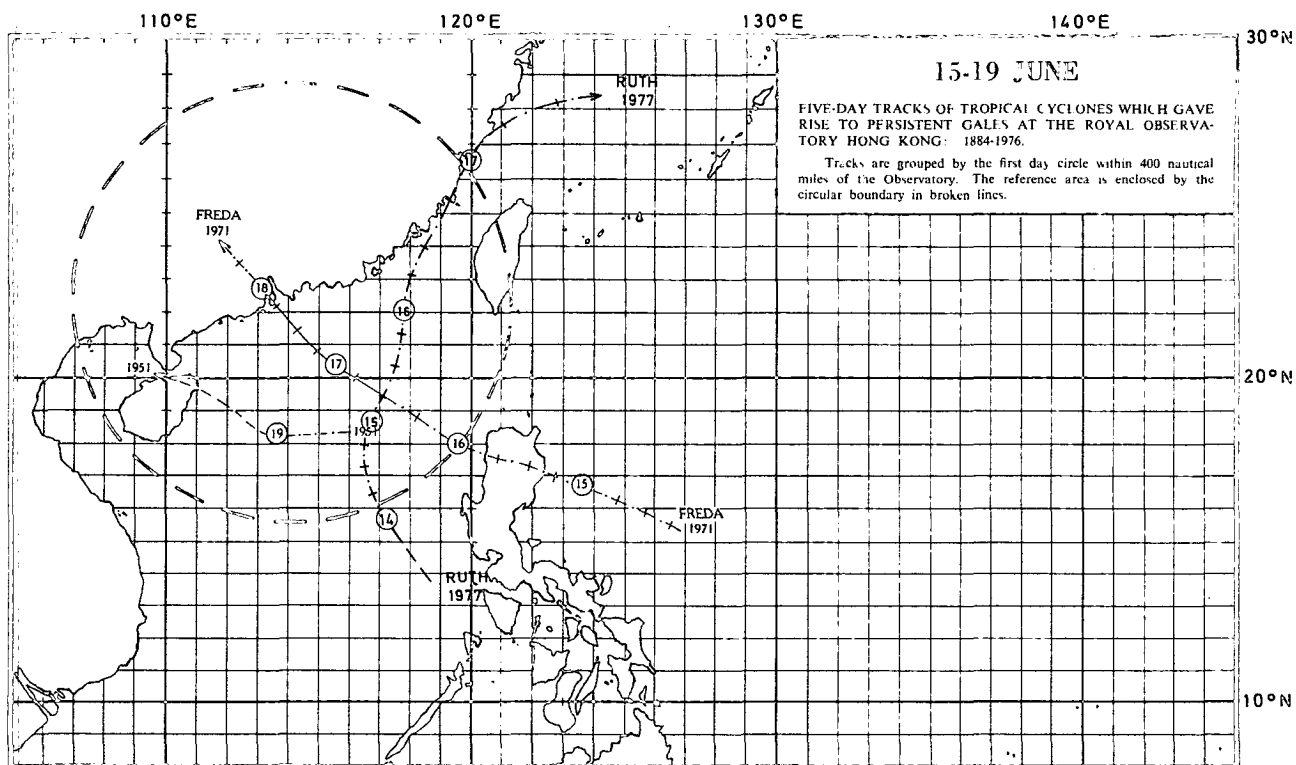


Figure 3. Track of Severe Tropical Storm Ruth: 14-17 June 1977.

90°E 95°E 100°E 105°E 110°E 115°E 120°E 125°E

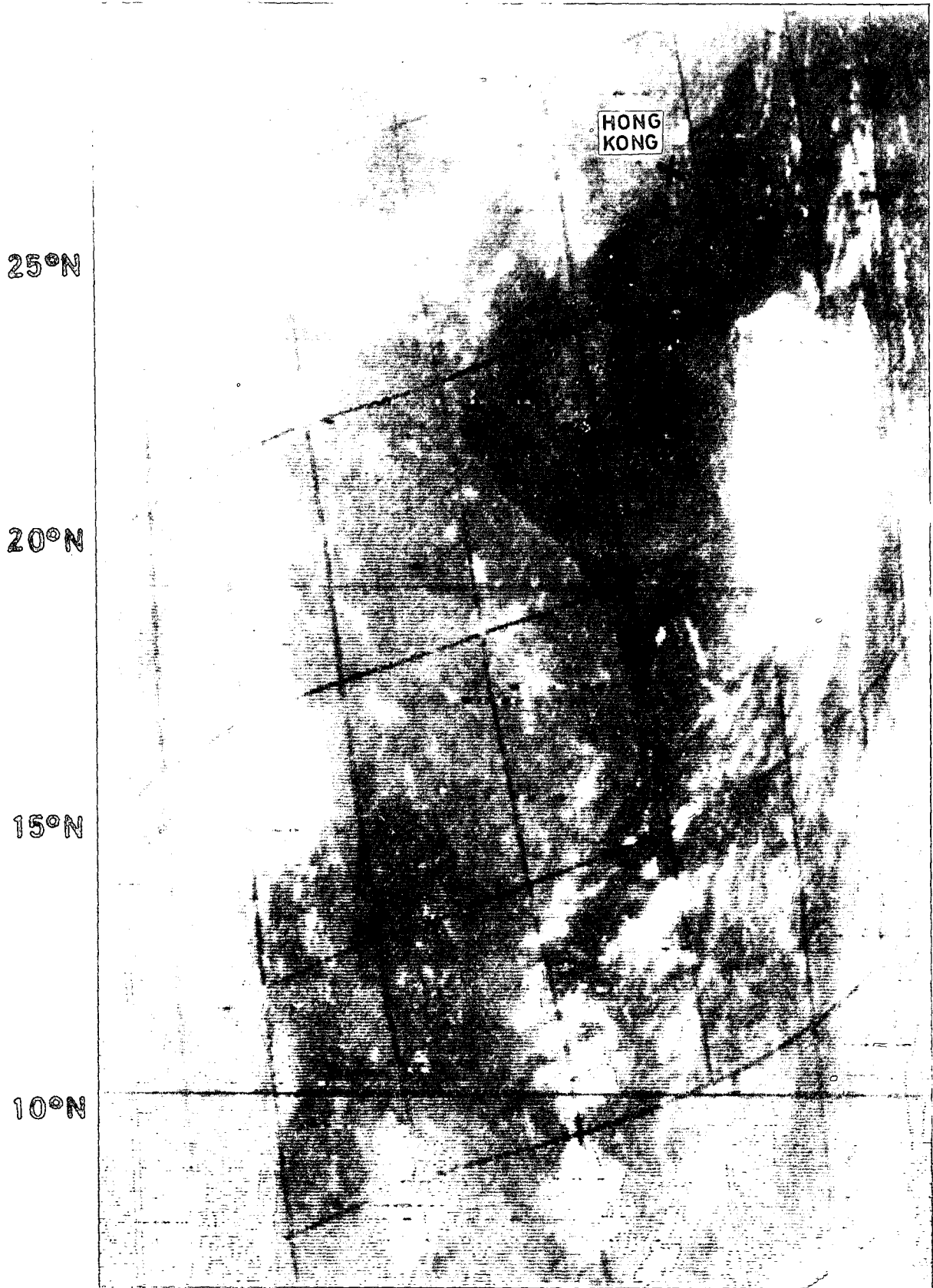


Figure 4. NOAA-5 APT picture of Severe Tropical Storm Ruth taken from 9.43 a.m. to 9.51 a.m. on 14 June 1977.

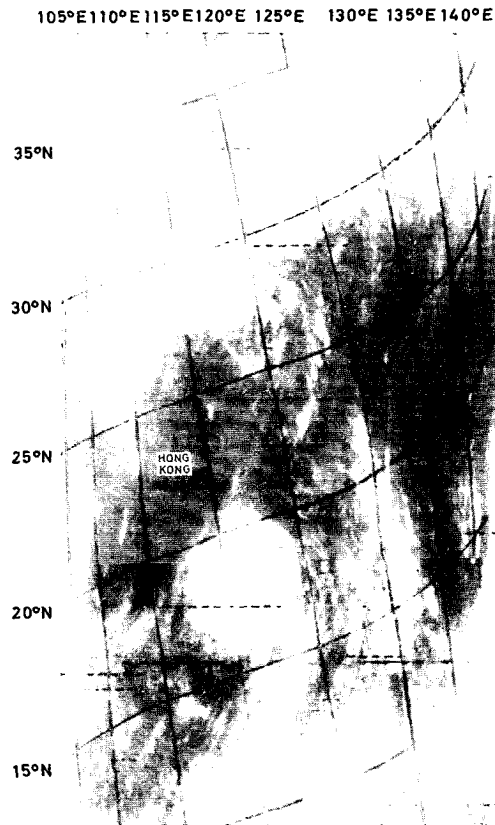


Figure 5. NOAA-5 APT picture of Severe Tropical Storm Ruth taken from 8.54 a.m. to 9.02 a.m. on 15 June 1977.

TROPICAL DEPRESSION

4-6 July 1977

The track of this tropical depression is shown in Figure 6

On the morning of 4 July 1977, a tropical depression developed over the South China Sea about 400 miles south-southeast of Hong Kong and moved west-northwestwards at six knots. Satellite pictures received at the Royal Observatory showed that the tropical cyclone was not well organized and the maximum surface winds were only about 25 knots.

In Hong Kong the Stand By Signal, No. 1, was hoisted at 10.35 p.m. on the same day when the tropical depression was about 350 miles south of Hong Kong and had begun to move northwestwards at five knots.

At 6.00 a.m. on 5 July, a ship about 210 miles east of the centre of the depression reported a surface wind of 37 knots, but at 6.22 a.m. the maximum surface winds near the centre of the tropical cyclone were reported by a reconnaissance aircraft at just 25 knots and the minimum sea-level pressure was estimated to be 991 millibars.

Satellite photographs on that day indicated that the centre of the depression was still ill defined (Figure 7). However, as winds over Hong Kong gradually freshened from the east, the Strong Wind Signal, No. 3, replaced the Stand By Signal at midday when the tropical depression was centred about 240 miles to the south.

During the afternoon, the tropical depression accelerated and moved northwestwards at 15 knots. The closest approach was about 190 miles southwest of Hong Kong around 2.00 a.m. on 6 July. The minimum sea-level pressure near the centre at this moment was estimated to be about 990 millibars while the lowest pressure at the Royal Observatory was 1001.1 millibars recorded at 6.00 p.m. on 5 July when the tropical depression was about 210 miles to the south-southwest.

The tropical depression entered the west coast of Kwangtung near the Luichow Peninsula around 5 a.m. on 6 July and gradually weakened overland. All signals were lowered at 11.10 a.m. by which time the depression had degenerated into an area of low pressure over the western part of Kwangtung Province.

In Hong Kong, winds were generally moderate to fresh easterly on 4 July. They became strong the next day and

continued strong until the morning of 6 July. The maximum winds and maximum gusts recorded at various locations were as follows:

Location	Maximum mean hourly wind in points and knots		Maximum gust in points and knots	
	Royal Observatory	E	16	E
Hong Kong Airport (SE)	E	24	E	49
Hong Kong Airport (NW)	E	20	E	45
Waglan Island	ESE	25	E	43
Tate's Cairn	E	32	E	55
Cheung Chau	ESE	27	ESE	46
King's Park	ESE	23	ESE	46
Star Ferry	E	28	SE	46
Green Island	E	26	E	43
Tsim Bei Tsui	E	22	ESE	32
Tai O	ESE	28	ESE	56
Castle Peak	SSE	28	SSE	46

The weather in Hong Kong on 4 July was mainly cloudy with isolated showers which became more frequent and squally during the next two days. The following rainfall amounts (mm) were recorded:

	Royal Observatory	Tai Mei Tuk	Shek Pik	Tai Lam Chung	Jubilee
Observations for the 24-hour period ending at	midnight	9 a.m.	9 a.m.	3 p.m.	3 p.m.
4 July	0.4	Nil	Nil	Nil	Trace
5 July	24.1	2.5	40.0	8.8	18.5
6 July	39.4	13.9	20.0	27.6	41.6
7 July	11.1	49.2	81.5	3.8	12.6
Total	75.0	65.6	141.5	40.2	72.7

There were no reports of damage to property in Hong Kong. The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of tropical cyclone warning signals were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.3	5 Jul	11.30 a.m.	0.4	5 Jul	4.45 p.m.
Tai Po Kau	2.3	5 Jul	2.00 p.m.	0.8	5 Jul	2.30 p.m.
Chi Ma Wan (Lantau Island)	2.5	5 Jul	10.00 a.m.	0.5	5 Jul	10.45 p.m.

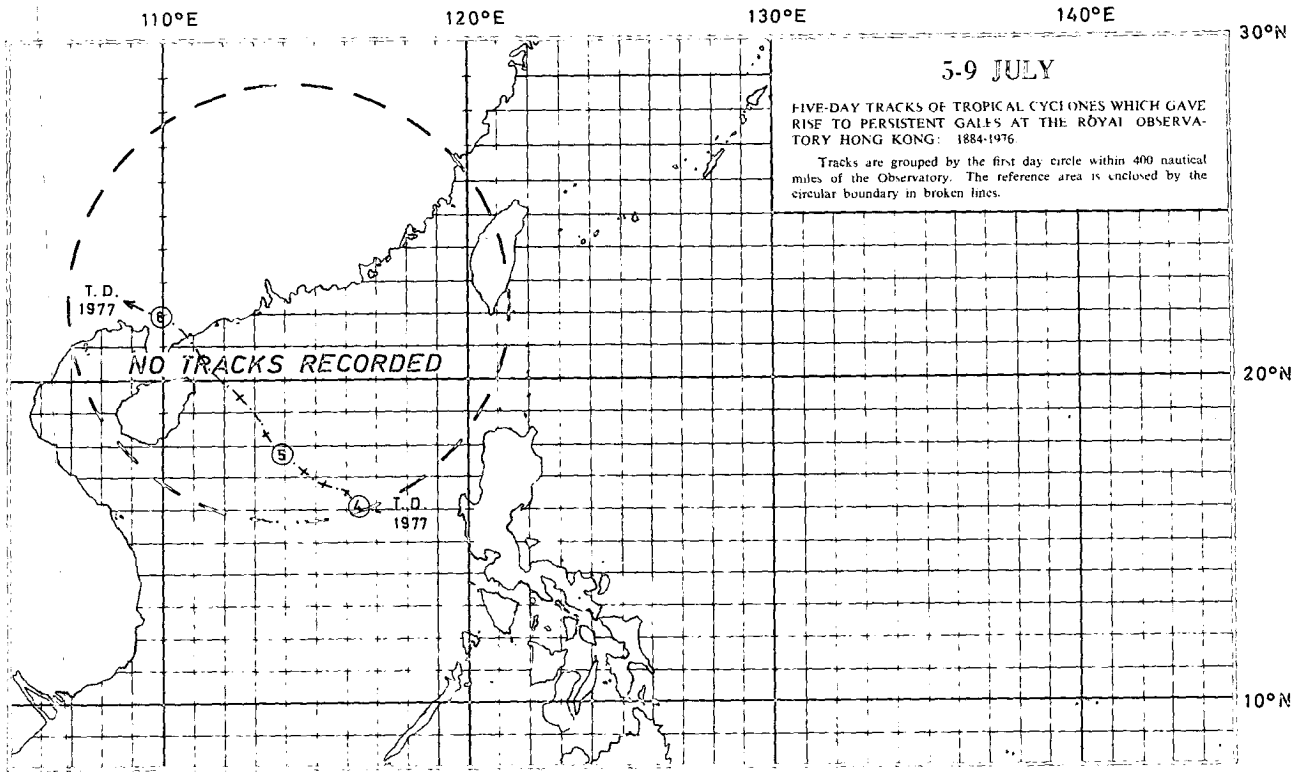


Figure 6. Track of the Tropical Depression: 4-6 July 1977.

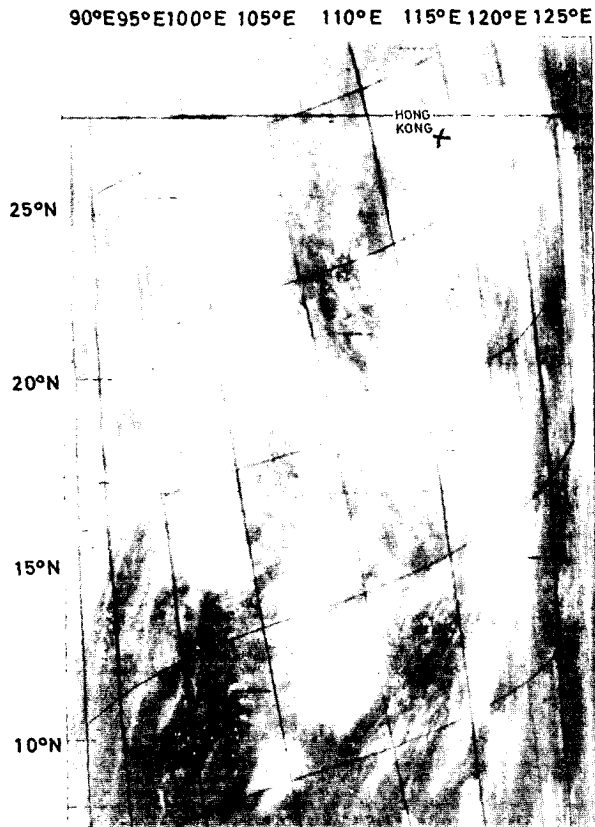


Figure 7. NOAA-5 APT picture of the Tropical Depression taken from 9.51 a.m. to 9.59 a.m. on 5 July 1977.

TYPHOON SARAH

16-21 July 1977

The track of this typhoon is shown in Figure 8

On 16 July, Sarah formed as a tropical depression over the western North Pacific about 520 miles east-southeast of Manila and moved northwestwards at 17 knots. During the next morning, it intensified into a tropical storm and satellite pictures received by the Royal Observatory showed that its circulation was well-organized with maximum surface winds estimated to be around 35 knots (Figure 9). Sarah slowed down to 12 knots as it crossed the Philippines and passed about 10 miles to the northeast of Manila on the morning of 18 July.

Sarah entered the South China Sea during the afternoon of 18 July and began to move westwards towards the Paracel Islands accelerating to about 18 knots. At 5.30 a.m. on 19 July, a reconnaissance aircraft reported maximum surface winds of around 50 knots with the minimum central pressure of 992 millibars.

In Hong Kong, the Stand By Signal, No. 1, was hoisted at 7.30 a.m. on 19 July when Sarah was about 320 miles to the south-southeast. Satellite photographs received on that morning indicated that Sarah was still well organized with maximum surface winds estimated to be around 50 knots (Figure 10). As winds in Hong Kong gradually freshened from the east, the Stand By Signal was replaced by the Strong Wind Signal, No. 3, at 11.15 a.m. By that time, Sarah had become a severe tropical storm.

At 12.32 p.m. on the same day, a report from a reconnaissance aircraft indicated that the central pressure of Sarah had dropped to 985 millibars and the maximum winds had reached about 70 knots. During that afternoon, Sarah slowed down to seven knots. At 3.00 a.m. the next morning, Sarah passed about 30 miles north-northwest of the Paracel Islands where a minimum sea-level pressure of 977.5 millibars and a surface wind of 60 knots were reported. A total rainfall amount of 604 millimetres was recorded at the Paracel Islands during the 24 hours from 8.00 a.m. on 19 July to 8.00 a.m. on 20 July.

Early on 20 July, Sarah turned northwestwards and further intensified into a typhoon. The maximum surface winds near the centre were then estimated to be about 65 knots from satellite pictures received in the morning (Figure 11). The typhoon was closest to Hong Kong around 6 p.m. on the same day when it was centred about 260 miles to the southwest. The minimum central pressure of Sarah at this time was estimated to be about 960 millibars. The typhoon then changed to a westerly course again and moved across Hainan Island during the early morning of 21 July.

In Hong Kong, all signals were lowered at 6.30 a.m. on 21 July when Sarah was centred over the Gulf of Tonkin after it had weakened into a severe tropical storm while crossing Hainan Island. Sarah continued to weaken over northern Vietnam and subsequently degenerated into an area of low pressure.

Winds in Hong Kong were generally light to moderate easterlies on 17 and 18 July. They gradually became strong during the afternoon of 19 July and continued until the evening of 20 July. All the maximum winds and maximum gusts recorded at various locations occurred on 20 July were as follows:

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Royal Observatory	E	19	E	40
Hong Kong Airport (SE)	E	25	E	47
Hong Kong Airport (NW)	ENE	19	SE	42
Waglan Island	E	30	E	54
Tate's Cairn	ENE	32	E	62
Cheung Chau	ESE	27	E	50
King's Park	ESE	21	ESE	43
Star Ferry	E	28	E	47
Green Island	ENE	30	ENE	44
Tsim Bei Tsui	ESE	16	E	34
Tai O	E	24	E	46
Castle Peak	S	18	SE	34

The weather was fine, sunny and hot on 17 and 18 July and temperatures were highest on 18 July when a maximum of 33.7°C was recorded at the Royal Observatory. During the morning of 19 July conditions gradually became cloudy with scattered showers which became more persistent and heavy until the afternoon of 21 July. The minimum sea-level pressure at the Royal Observatory was 1000.5 millibars recorded at 4.00 a.m. on 20 July when Sarah was about 320 miles to the south-southwest.

The following amounts of rainfall (mm) were recorded:

	Royal Observatory	Tai Mei Tuk	Shek Pik	Tai Lam Chung	Jubilee
Observations for the 24-hour period ending at	midnight	9 a.m.	9 a.m.	3 p.m.	3 p.m.
19 July	45.4	Nil	Nil	4.0	4.2
20 July	69.2	98.0	74.0	80.7	114.7
21 July	13.4	32.1	23.5	7.9	24.8
22 July	Trace	17.4	1.6	0.2	6.7
Total	128.0	147.5	99.1	92.8	150.4

There were no reports of damage to property in Hong Kong. The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of tropical cyclone warning signals were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.4	20 Jul	10.30 a.m.	0.5	19 Jul	3.30 p.m.
Tai Po Kau	2.4	20 Jul	9.00 a.m.	0.9	19 Jul	8.00 p.m.
Chi Ma Wan (Lantau Island)	2.6	20 Jul	10.45 a.m.	0.9	19 Jul	9.00 p.m.

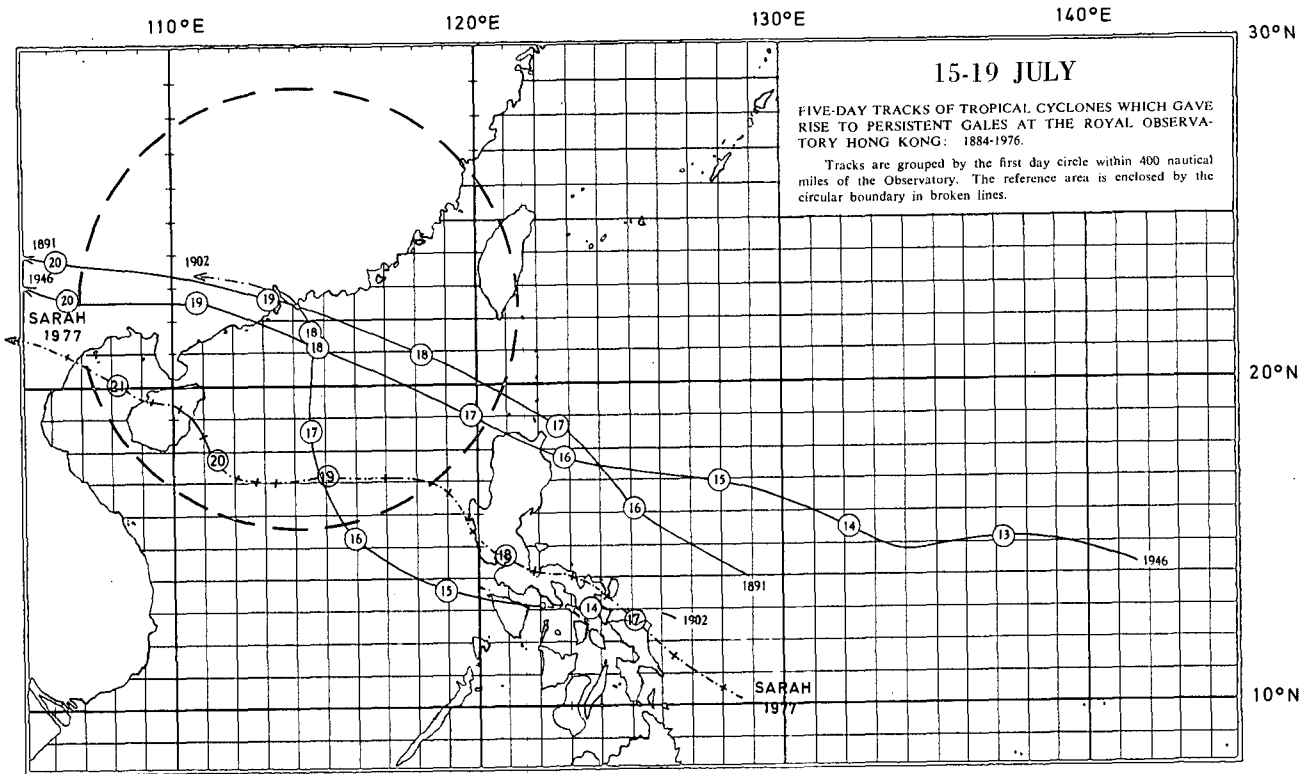


Figure 8. Track of Typhoon Sarah: 16-21 July 1977.

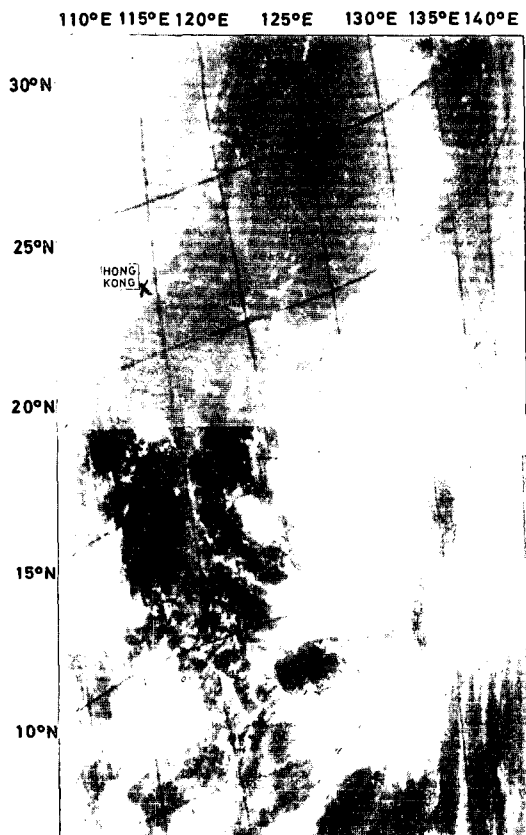


Figure 9. NOAA-5 APT picture of Typhoon Sarah taken from 8.43 a.m. to 8.51 a.m. on 17 July 1977.

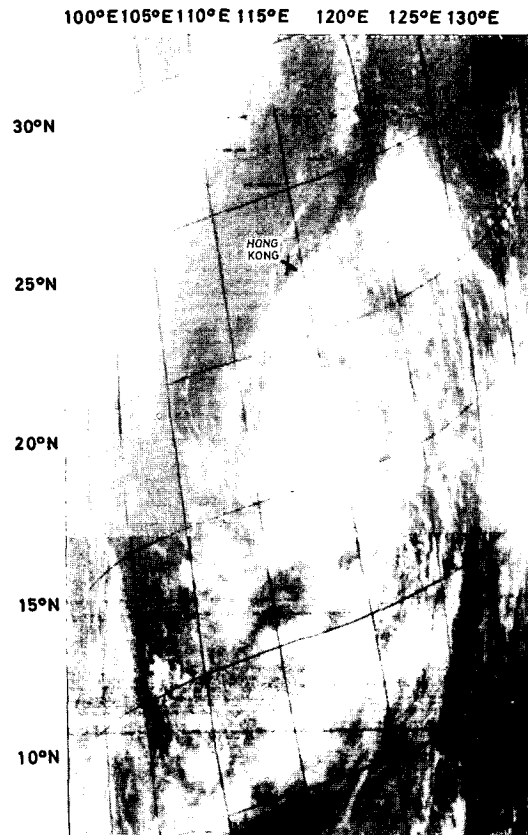


Figure 10. NOAA-5 APT picture of Typhoon Sarah taken from 9.13 a.m. to 9.21 a.m. on 19 July 1977.

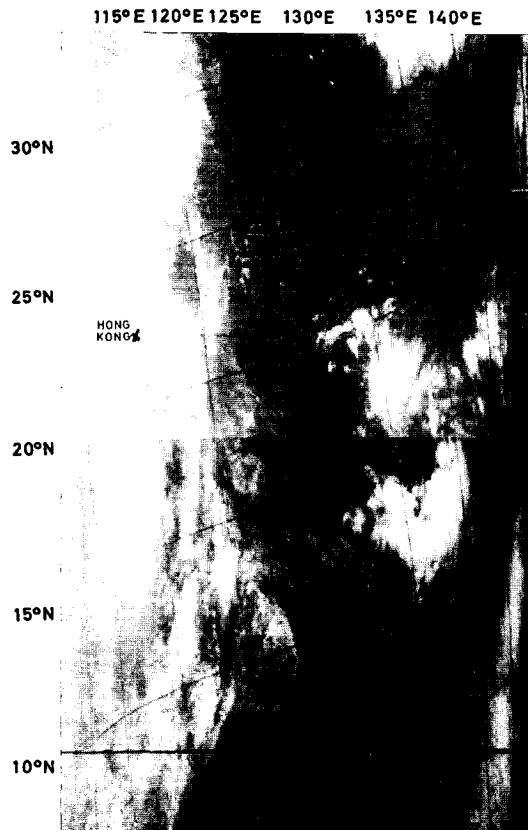


Figure 11. NOAA-5 APT picture of Typhoon Sarah taken from 8.27 a.m. to 8.35 a.m. on 20 July 1977.

TYPHOON THELMA

21-25 July 1977

The track of this typhoon is shown in Figure 12

Thelma first developed as a tropical depression early on 21 July about 520 miles east of Manila. It moved north-westwards at 11 knots and rapidly intensified into a tropical storm during the afternoon. At 5.18 p.m. on the same day, a reconnaissance aircraft reported that the minimum central pressure was about 992 millibars and the maximum surface winds were around 55 knots.

The tropical storm reached severe tropical storm strength on the afternoon of 22 July. Satellite pictures received at the Royal Observatory that day indicated that Thelma was well organized and maximum surface winds of about 60 knots were estimated near its centre (Figure 13). Thelma became a typhoon early on 23 July when it was about 90 miles east of the northern tip of Luzon. Later, at 11.22 a.m., a reconnaissance aircraft reported that the minimum central pressure had dropped to 945 millibars and the maximum surface winds had reached 100 knots.

While crossing the Balintang Channel overnight, Thelma slowed down to eight knots and weakened slightly. At 5.35 a.m. on 24 July a reconnaissance aircraft reported a minimum central pressure of 962 millibars and maximum surface winds of 75 knots near the centre of the typhoon.

In Hong Kong, the Stand By Signal, No. 1, was hoisted at 9.00 a.m. on 24 July when the typhoon was centred about 390 miles to the east-southeast. A reconnaissance aircraft report made at 5.42 p.m. on 24 July indicated that the minimum central pressure was about 957 millibars and the maximum surface winds were around 80 knots. The typhoon turned northwards during the evening and moved at about 10 knots in the general direction of the Taiwan Strait.

Thelma came closest to Hong Kong at around 4.00 a.m. on 25 July when it was centred about 310 miles to the east. Its minimum central pressure at this time was estimated to be about 960 millibars. The typhoon then moved northeastwards towards the southern tip of Taiwan. When it came to a position about 50 miles south of Kaohsiung, it turned northwards directly towards Kaohsiung. At 8.00 a.m. on the same day, a ship (President McKinley) about 35 miles south-southeast of the centre of Thelma reported a surface wind of 70 knots.

Thelma passed over Kaohsiung and skirted the western coast of Taiwan on 25 July. It entered the Taiwan Strait later in the afternoon and left behind widespread damage in Taiwan. According to press reports, 28 people were killed and nearly 2000 houses were destroyed. Seventeen vessels and nine fishing boats sank in the typhoon while another 50 vessels broke loose and drifted in the harbour of Kaohsiung. Satellite pictures taken on three consecutive mornings before Thelma struck Kaohsiung are shown in Figures 14-16.

In Hong Kong, all signals were lowered at 2.15 p.m. on 25 July when Thelma was about 360 miles to the east-northeast over the Taiwan Strait. The typhoon then crossed the China coast near Foochow during the evening and rapidly weakened into a tropical storm. It subsequently degenerated into an area of low pressure over Fukien Province on the morning of 26 July.

Thelma had little effect on the weather in Hong Kong. Winds were generally light to moderate from the west on 24 July and became fresh southwesterlies the next day. Conditions were fine, sunny and hot during 24 to 25 July with a maximum temperature of 33.8°C recorded at the Royal Observatory on 25 July. The lowest pressure at the Royal Observatory was 998.1 millibars recorded at 5.00 p.m. on 25 July. The centre of Thelma was then about 370 miles to the east-northeast of Hong Kong.

During the period when the Stand By Signal was displayed, no rainfall was recorded at the Royal Observatory and there were no reports of any damage to property in Hong Kong.

The highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of the Stand By Signal were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.0	25 Jul	4.00 a.m.	0.3	24 Jul	11.30 p.m.
Tai Po Kau	2.0	25 Jul	5.30 a.m.	0.4	24/25 Jul	midnight
Chi Ma Wan (Lantau Island)	2.2	25 Jul	4.15 a.m.	0.4	25 Jul	1.00 a.m.

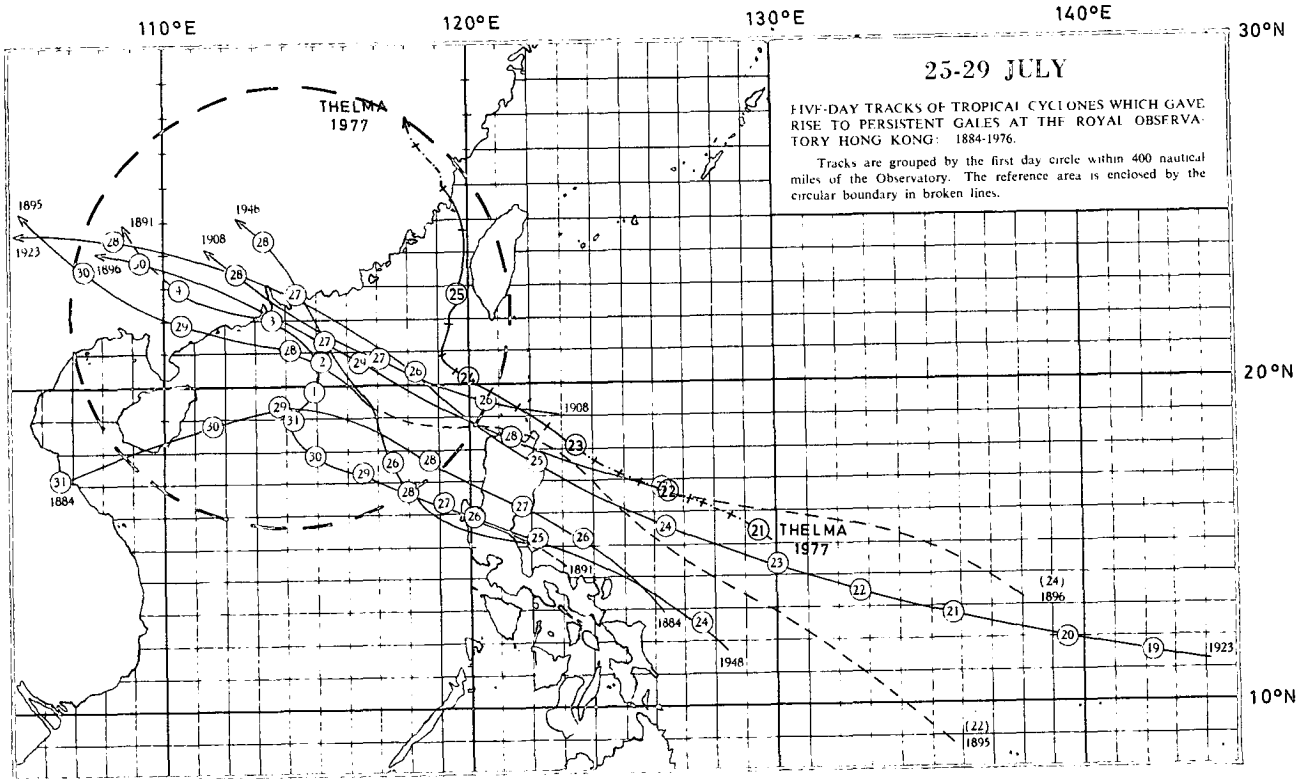


Figure 12. Track of Typhoon Thelma: 21-25 July 1977.

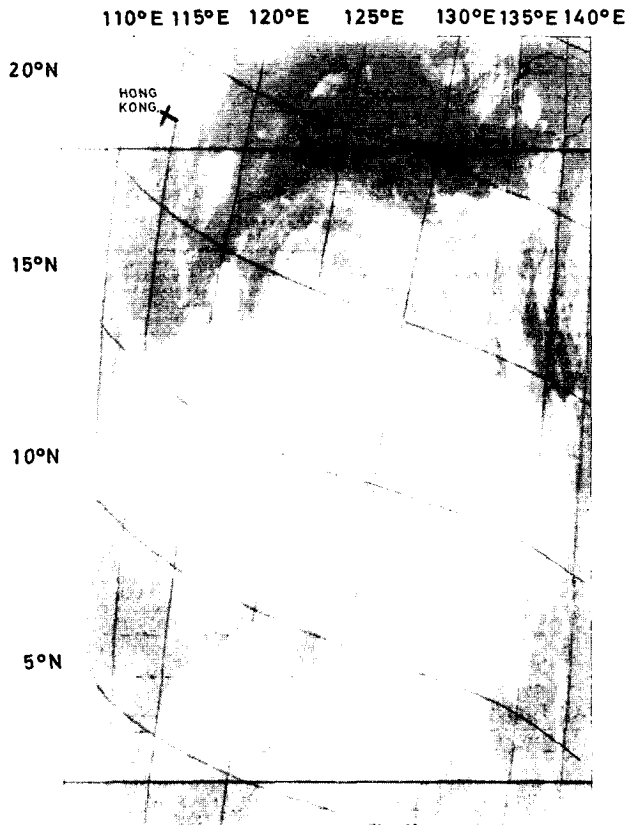


Figure 13. NOAA-5 APT picture of Typhoon Thelma taken from 7.51 p.m. to 7.59 p.m. on 22 July 1977.

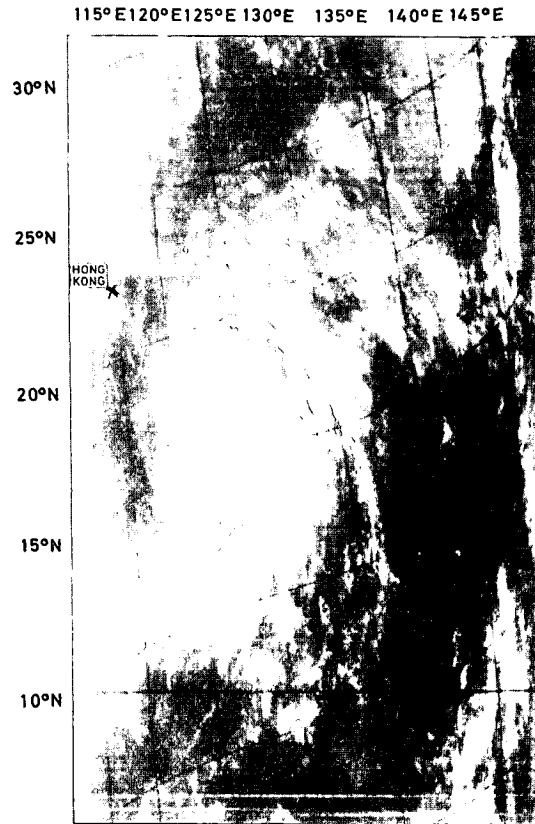


Figure 14. NOAA-5 APT picture of Typhoon Thelma taken from 8.11 a.m. to 8.19 a.m. on 23 July 1977.

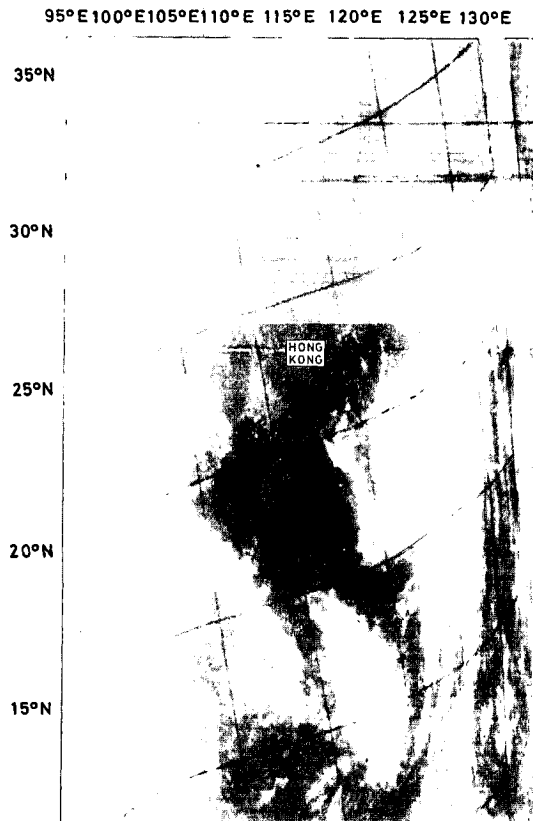


Figure 15. NOAA-5 APT picture of Typhoon Thelma taken from 9.23 a.m. to 9.31 a.m. on 24 July 1977.

110°E 115°E 120°E 125°E 130°E 135°E 140°E

30°N

25°N

HONG
KONG

20°N

15°N

10°N



Figure 16. NOAA-5 APT picture of Typhoon Thelma taken from 8.41 a.m. to 8.49 a.m. on 25 July 1977.

TROPICAL STORM AMY

17-25 August 1977

The track of this tropical cyclone is shown in Figure 17

Amy first developed as a tropical depression on the evening of 17 August about 520 miles east-northeast of Manila and moved northwestwards at eight knots. At 4.00 a.m. the next day, a reconnaissance aircraft reported a minimum sea-level pressure of 996 millibars and a maximum surface wind of 30 knots.

Amy intensified into a tropical storm on the morning of 19 August. During the evening, it turned southwestwards at nine knots towards the Bashi Channel. An infrared satellite picture received at the Royal Observatory that evening indicated that the circulation of Amy had become well organized and the maximum surface winds were about 45 knots (Figure 18).

In Hong Kong, the Stand By Signal, No. 1, was hoisted at 10.00 a.m. on 20 August when Amy was centred about 400 miles to the east.

During the day of 20 August, the tropical storm moved on a meandering course through the Bashi Channel into the South China Sea. At 6.30 p.m., a reconnaissance aircraft gave an estimate of the minimum central pressure at 986 millibars and a maximum surface wind of 35 knots. At 8.00 a.m. the next morning, a ship near the northern tip of Luzon about 150 miles east of the centre of Amy reported a surface wind of 50 knots.

When Amy was centred about 90 miles east-southeast of Pratas Island on the morning of 21 August, it started to recurve slowly and turned northeastwards towards the southern tip of Taiwan. Later on the same day, Amy made a loop in an anticlockwise direction over the South China Sea just to the west of southern Taiwan and then moved eastwards towards Kaohsiung. When the centre was about 30 miles southwest of Kaohsiung early on 22 August, it turned abruptly northwards and skirted around Taiwan through the Taiwan Strait into the East China Sea. However, possibly due to topographical effects, a secondary centre was also observed on that morning over Taiwan just to the west of Hualien. This secondary centre then drifted slowly southeastwards into the Pacific Ocean and then northeastwards to join the primary centre on the early morning of 23 August.

Amy was at its nearest approach to Hong Kong around 11.00 p.m. on 21 August when it was making a loop about 250 miles to the east. The minimum sea-level pressure near the centre of Amy at this time was estimated to be about 985 millibars. In Hong Kong, the Stand By Signal was lowered at noon on 22 August when Amy was centred about 320 miles to the east and was moving northwards at sixteen knots through the Taiwan Strait.

The tropical storm continued northeastwards at sixteen knots across the East China Sea. It crossed Kyushu early on 24 August and subsequently became extratropical over the Pacific Ocean on the morning of 25 August just to the southeast of Shikoku.

During the period from 20 August to 22 August when the Stand By Signal was displayed in Hong Kong, winds were light to moderate from the west and conditions were cloudy with a few isolated showers. A total of 5.1 mm of rain was recorded on 21 August at the Royal Observatory. The lowest pressure was 996.8 millibars recorded at the Royal Observatory at 4.00 p.m. on 21 August when the centre of Amy was about 300 miles to the east. There were no reports of damage to property in Hong Kong. The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of the Stand By Signal were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.3	22 Aug	2.30 a.m.	0.4	21 Aug	2.45 a.m.
Tai Po Kau	2.3	22 Aug	2.30 a.m.	0.5	21 Aug	2.00 p.m.
Chi Ma Wan (Lantau Island)	2.4	22 Aug	2.00 a.m.	0.5	21 Aug	2.15 p.m.

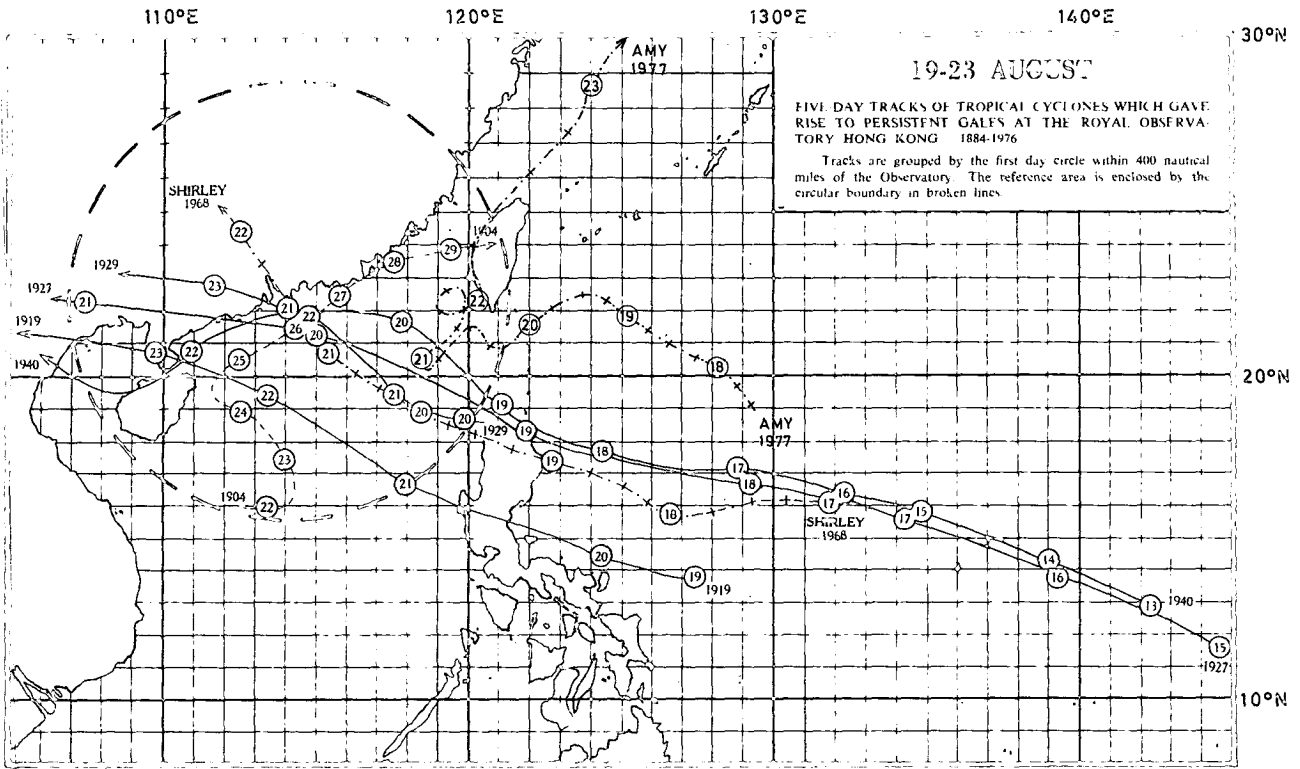


Figure 17. Track of Tropical Storm Amy: 17-25 August 1977.

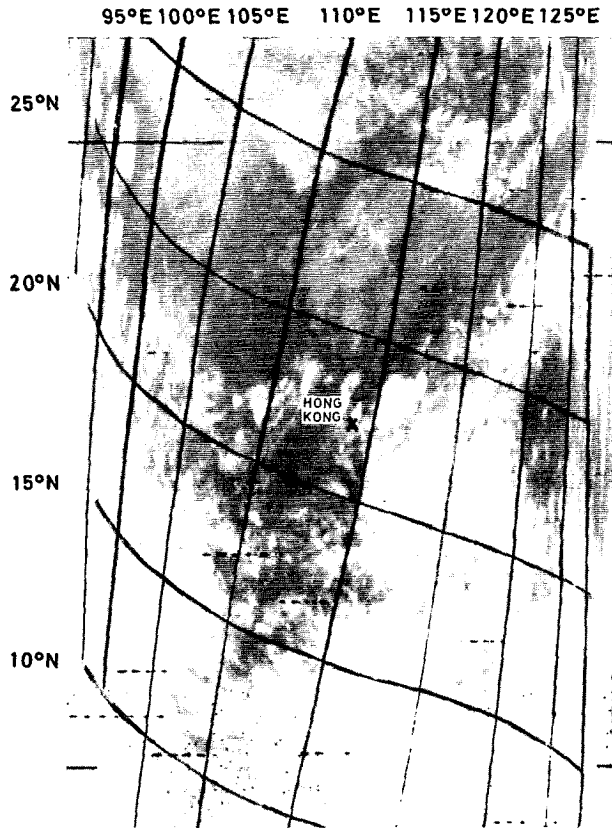


Figure 18. NOAA-5 APT picture of Tropical Storm Amy taken from 8.42 p.m. to 8.50 p.m. on 19 August 1977.

TROPICAL STORM CARLA

3-5 September 1977

The track of this tropical storm is shown in Figure 19

Carla developed from an area of low pressure which from 31 August to 3 September moved steadily west-northwestwards from a position east of the southern Philippines across Luzon into the South China Sea. Early on 3 September, this low pressure area intensified into a tropical depression when it was about 260 miles south of Hong Kong. From that time, it moved in a westerly direction at twelve knots towards southern Hainan. At 8.45 a.m. on the same morning, a reconnaissance aircraft reported a minimum central pressure of 992 millibars and a maximum surface wind of 45 knots.

In Hong Kong, the Stand By Signal, No. 1, was hoisted at 10.15 a.m. on 3 September when the tropical depression was about 250 miles to the south. Carla continued to intensify and became a tropical storm around noon. The storm was nearest to Hong Kong two hours later when it was about 240 miles to the south. The minimum central pressure at this time was estimated to be about 990 millibars. At 6.00 p.m. the Royal Observatory recorded a minimum sea-level pressure of 1002.2 millibars when Carla was centred about 250 miles to the south-southwest of Hong Kong.

Local winds gradually freshened from the east and the Stand By Signal was replaced by the Strong Wind Signal, No. 3, at 4.45 p.m. on the same day when Carla was centred about 250 miles to the south-southwest. At 5.00 p.m., a station in the Paracel Islands reported a surface wind of 42 knots and a sea-level pressure of 994.0 millibars when the centre of the tropical storm was about 100 miles north-northeast of the station.

Early the next day, Carla slowed down to seven knots but continued moving westwards, passing close to the southern coast of Hainan. All signals were lowered in Hong Kong at 12.50 p.m. on 4 September when Carla was close to Yulin about 370 miles southwest of Hong Kong. At 2.00 p.m., Yulin gave a report of its sea-level pressure at 988.5 millibars and the surface wind at 36 knots when the centre of Carla was about 25 miles to the south-southeast.

During the evening of 4 September, Carla accelerated to eighteen knots across the Gulf of Tonkin and crossed the coast of north Vietnam early on 5 September. It then weakened into a tropical depression and turned west-southwestwards across Vietnam and Laos into the northeastern part of Thailand where it subsequently degenerated into an area of low pressure.

In Hong Kong, winds were moderate to fresh from the east early on 3 September and became strong during the evening until the next afternoon. The maximum winds and maximum gusts recorded at various locations were as follows:

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Royal Observatory	E	20	E	45
Hong Kong Airport (SE)	E	25	E	60
Hong Kong Airport (NW)	E	21	ESE	46
Waglan Island	E	34	ESE	48
Tate's Cairn	E	33	E	68
Cheung Chau	ESE	28	E	55
King's Park	ESE	22	ESE	49
Star Ferry	E	27	E	45
Green Island	ENE	38	ENE	57
Tsim Bei Tsui	ENE	22	ENE	34
Tai O	E	27	E	60
Castle Peak	E	17	E	43

The weather in Hong Kong was cloudy with scattered light showers on 3 September and in the afternoon temperatures rose to a maximum of 30.8°C. Overnight, the showers became squally, heavy and more frequent as an outer rainband in association with the circulation of Carla was approaching from the south (Figure 20). This active rainband stayed near Hong Kong for two days and rain in Hong Kong was heaviest on 5 September although the centre of Carla had already moved over Indo-China. The weather improved during

the morning of 6 September and the following amounts of rainfall (mm) were recorded:

	Royal Observatory	Tai Mei Tuk	Shek Pik	Tai Lam Chung	Jubilee
Observations for the 24-hour period ending at	midnight	9 a.m.	9 a.m.	3 p.m.	3 p.m.
3 September	0.8	3.0	Nil	2.0	2.5
4 September	80.6	97.0	6.2	16.5	22.7
5 September	119.7	75.1	69.0	142.7	112.4
6 September	67.3	43.5	35.5	99.4	43.8
7 September	Nil	63.0	14.5	0.2	3.9
Total	268.4	281.6	125.2	260.8	185.3

On the evening of 4 September, a freighter, the S.S. Eastern Mercury, in the harbour drifted from its mooring and collided with five other vessels. That same day, sixty-eight picnickers were stranded on Ping Chau when the ferry service was suspended. In Kowloon, an old man was injured by a falling plank from a wooden hut which was crushed by a big rolling stone. Because of the torrential rain, part of a road surface in Hong Kong Island was washed away and many roads and streets were flooded.

The times and heights of the highest tides and maximum storm surges recorded at various locations in Hong Kong during the display of tropical cyclone warning signals were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.1	4 Sep	11.15 p.m.	0.3	4 Sep	10.00 p.m.
Tai Po Kau	2.2	4 Sep	2.30 a.m.	0.6	4 Sep	2.30 p.m.
Chi Ma Wan (Lantau Island)	2.7	4 Sep	1.45 a.m.	0.8	3 Sep	3.15 p.m.

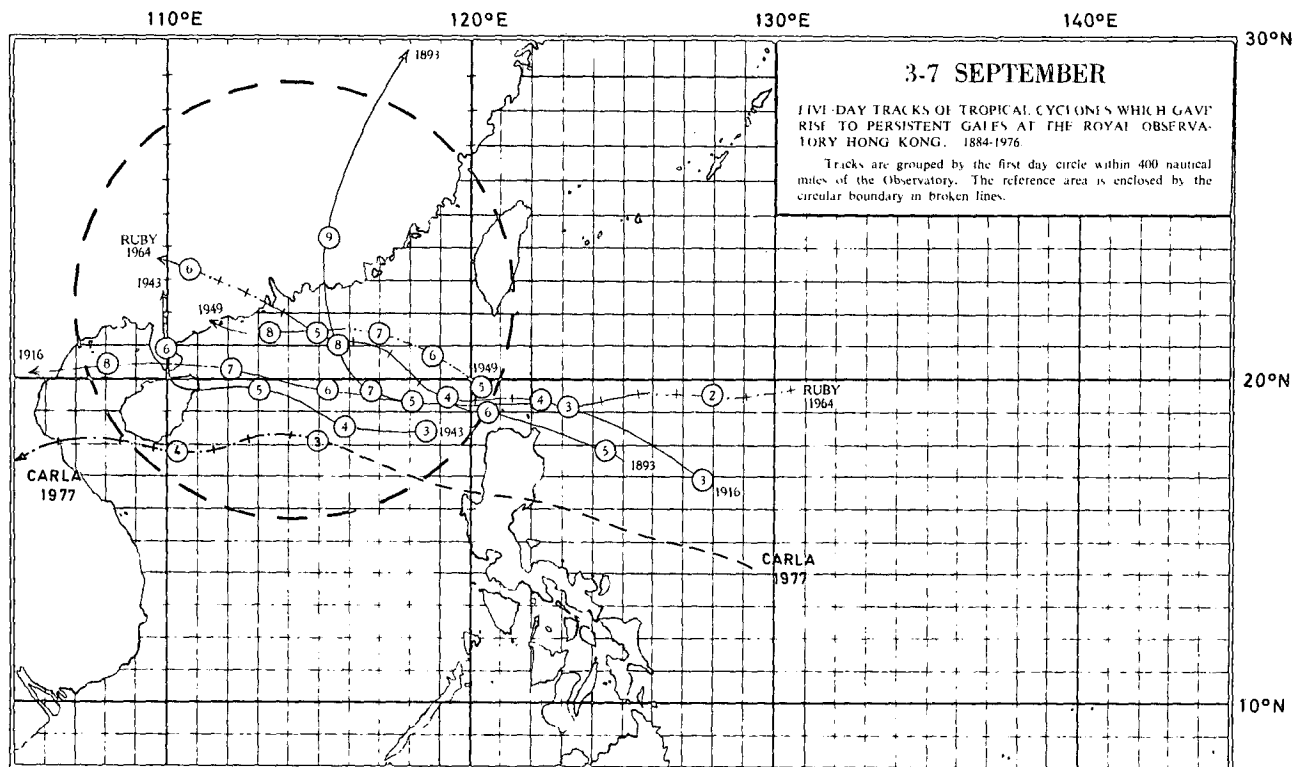


Figure 19. Track of Tropical Storm Carla: 3-5 September 1977.

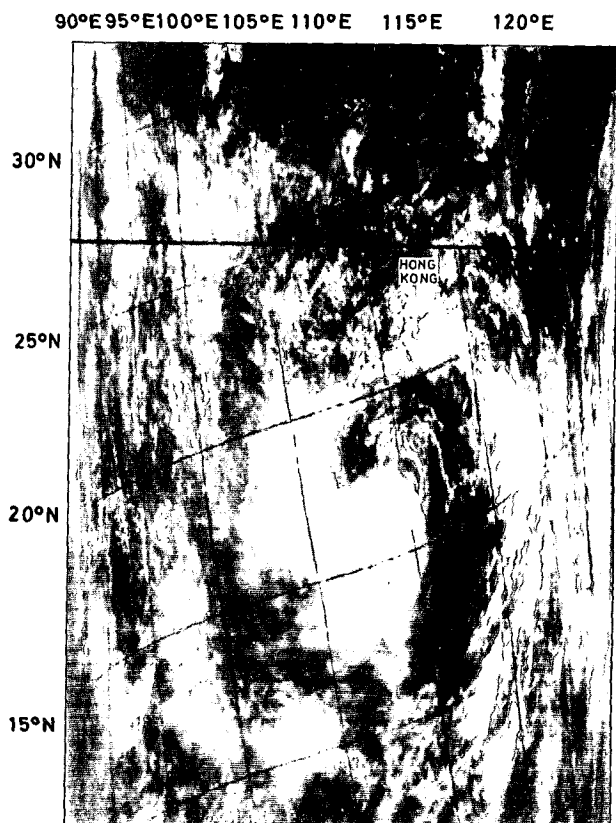


Figure 20. NOAA-5 APT picture of Tropical Storm Carla taken from 9.43 a.m. to 9.53 a.m. on 4 September 1977.

TYPHOON DINAH

14-24 September 1977

The track of this typhoon is shown in Figure 21

Although Typhoon Dinah passed about 230 miles to the southeast and caused no damage in Hong Kong, it stayed over the northeastern part of the South China Sea for an exceptionally long time and the Stand By Signal, No. 1 was displayed for a record 124 hours and 40 minutes. The last similar occasion was Typhoon Tilda in 1964 when the Stand By Signal was displayed for 102 hours and 10 minutes.

Dinah first developed as a tropical depression on the morning of 14 September about 390 miles southeast of Okinawa and moved west-southwestwards at 15 knots towards north Luzon (Figure 22). It intensified into a typhoon the next day and reconnaissance aircraft reported that the central pressure had dropped to 964 millibars and the maximum surface winds were 75 knots. The typhoon crossed north Luzon on the evening of 15 September and caused severe casualties and damage. At 11.00 p.m. Dinah passed within a few miles of Tuguegarao, a station in northeast Luzon, where winds of 96 knots and a mean sea-level pressure of 977.0 millibars were reported.

Typhoon Dinah entered the South China Sea on 16 September and moved westwards at about 8 knots. In Hong Kong the Stand By Signal, No. 1, was hoisted at 4.30 p.m. when the typhoon was centred about 400 miles to the southeast. At first the typhoon moved westwards across the South China Sea but gradually slowed down and became almost stationary. During the afternoon of 17 September, when Dinah was centred about 320 miles south-southeast of Hong Kong, it turned and began to drift slowly northeastwards towards the Bashi Channel. However, on the early afternoon of 20 September when Dinah was about 160 miles to the east of Pratas Island, it changed course again and moved west-southwestwards at about 5 knots. Satellite pictures received at the Royal Observatory the next morning indicated that Dinah was still very intense and well organized and the maximum surface winds near its centre were about 95 knots (Figure 23).

On 21 September strong to gale force winds were reported by ships just off the coast of southeast China and winds in Hong Kong began to freshen from the north. The Stand By Signal was replaced by the Strong Wind Signal, No. 3, at 9.10 p.m. in the evening when the typhoon was centred about 230 miles to the southeast of Hong Kong.

Overnight on 21 September, Dinah established a steady southwesterly course and moved at about 10 knots towards south Vietnam where it degenerated into an area of low pressure early on 24 September.

Dinah was nearest to Hong Kong around 9.00 p.m. on 21 September when it was about 230 miles away. The minimum sea-level pressure near the centre of Dinah at that time was about 980 millibars. In Hong Kong, all signals were lowered at 11.40 a.m. on 22 September when Dinah was 260 miles to the south-southeast.

Dinah had little effect on the weather in Hong Kong. Winds were generally light to moderate from 16 to 20 September but began to freshen from the north on 21 September and strong winds were experienced in exposed places and on hill-tops during that night. The maximum winds and maximum gusts recorded at various locations were as follows:

Location	Maximum mean hourly wind in points and knots		Maximum gust in points and knots	
	Direction	Speed	Direction	Speed
Royal Observatory	NNE	13	N	32
Hong Kong Airport (SE)	N	20	N	35
Hong Kong Airport (NW)	NNE	20	NNE	37
Waglan Island	N	26	E	38
Tate's Cairn	NNE	38	NNE	52
Cheung Chau	NNE	27	NNE	42
King's Park	N	20	NNE	41
Star Ferry	E	15	E	28
Green Island	NNE	32	NNE	43
Tsim Bei Tsui	NNE	18	NNE	29
Tai O	N	26	N	40
Castle Peak	N	23	N	42

The weather was mainly fine and hot from 16 to 20 September apart from some scattered showers on 19 September. Temperatures were highest on 19 September when a maximum of 33.8°C was recorded at the Royal Observatory. The minimum sea-level pressure at the Royal Observatory was 1001.9 millibars recorded at 4.00 p.m. on 17 September when Dinah was about 320 miles to the south-southeast of Hong Kong. Conditions became cloudy and much cooler on 21 and 22 September. The daily rainfall amounts recorded at the Royal Observatory during the period 16-23 September were as follows:

September 16

Nil

September 17	Nil
September 18	0.1 mm
September 19	7.2 mm
September 20	Nil
September 21	Nil
September 22	0.7 mm
September 23	Nil
Total	8.0 mm

There were no reports of any damage to property in Hong Kong during the period when the tropical cyclone warning signals were displayed. The times and heights of the highest tides and maximum storm surges recorded at various locations during this same period were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	3.0	22 Sep	4.15 a.m.	0.8	22 Sep	5.30 a.m.
Tai Po Kau	3.0	22 Sep	5.00 a.m.	1.0	22 Sep	6.00 a.m.
Chi Ma Wan (Lantau Island)	3.4	22 Sep	4.30 a.m.	1.2	22 Sep	4.30 a.m.

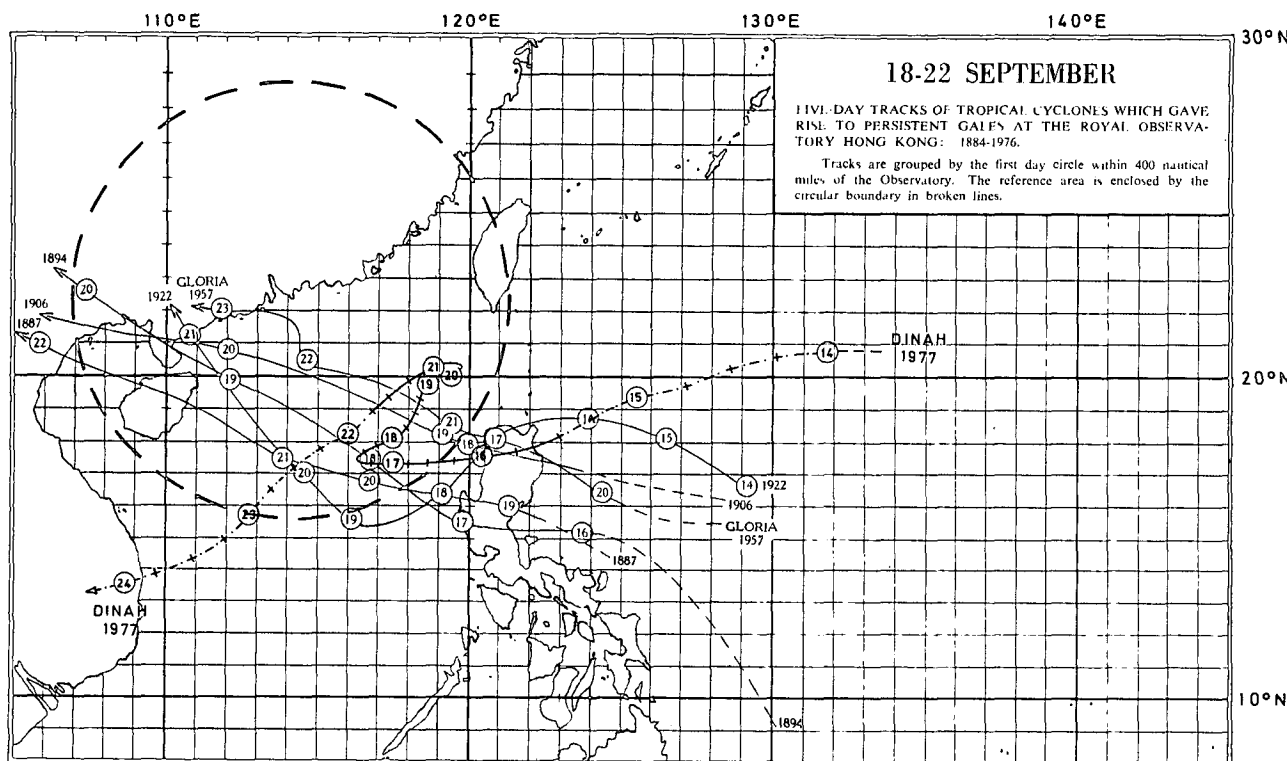


Figure 21. Track of Typhoon Dinah: 14-24 September 1977.

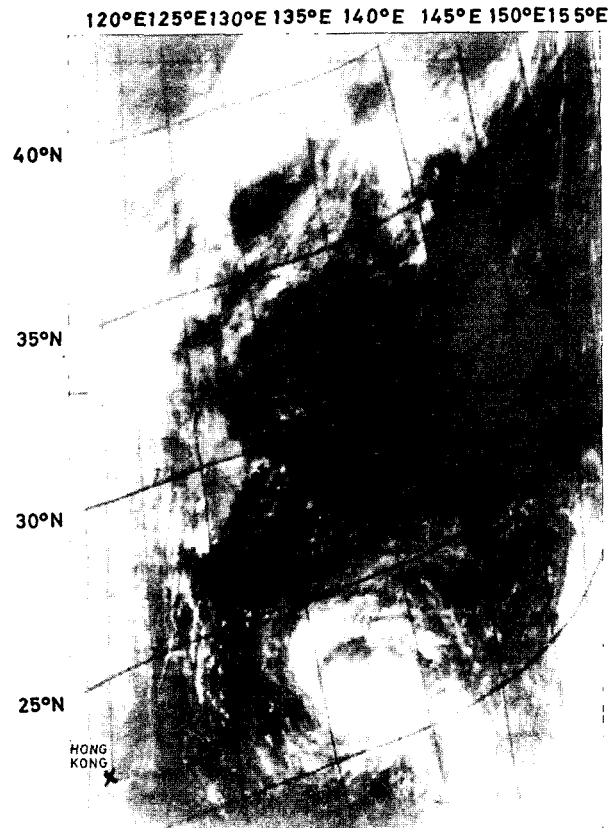


Figure 22. NOAA-5 APT picture of Typhoon Dinah taken from 8.08 a.m. to 8.16 a.m. on 14 September 1977.

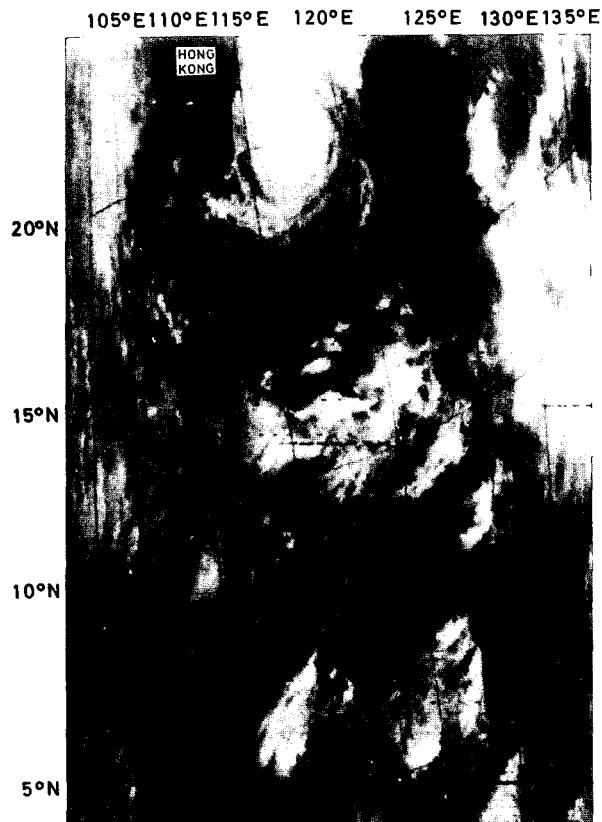


Figure 23. NOAA-5 APT picture of Typhoon Dinah taken from 8.56 a.m. to 9.04 a.m. on 21 September 1977.

SEVERE TROPICAL STORM FREDA

22-25 September 1977

The track of this severe tropical storm is shown in Figure 24

Freda first developed as a tropical depression early on 22 September about 540 miles east of Manila and moved at the abnormally high speed of 16 knots towards the Bashi Channel. It entered the South China Sea the next evening and intensified to a severe tropical storm. Satellite pictures received at the Royal Observatory indicated that the cloud mass of Freda covered an area about 300 miles in diameter and maximum winds were estimated to be about 60 knots (Figure 25). At 10.45 p.m. a reconnaissance aircraft reported a minimum sea-level pressure of 986 millibars near the centre of Freda.

In Hong Kong the Stand By Signal, No. 1, was hoisted at 10.05 p.m. on 23 September when Freda was centred about 350 miles to the east-southeast. Freda continued moving rapidly in the general direction of south China and the Strong Wind Signal, No. 3, was hoisted at 5.20 a.m. the next morning when the severe tropical storm was 250 miles to the southeast. Winds locally were then generally fresh from the north. At 8.00 a.m. on 24 September, Freda passed about 70 miles south of Pratas Island where winds of 38 knots were reported. Severe Tropical Storm Freda continued to move west-northwestwards at about 16 knots. The Strong Wind Signal was replaced by the No. 8 Northeast Gale or Storm Signal at 3.05 p.m. when Freda was 130 miles to the south-southeast. Radar observations at the Royal Observatory during the afternoon indicated that Freda was not a well-organized tropical cyclone and its eye was ill defined (Figure 26). Satellite pictures received at the Royal Observatory later in the evening also revealed that the circulation of Freda was very diffuse and the spiral cloud bands associated with it were weak (Figure 27).

Freda was closest to Hong Kong around 8.00 p.m. on 24 September when it was about 80 miles to the south-southwest. The minimum sea-level pressure near the centre of Freda at this time was estimated to be about 985 millibars. As Freda moved away from Hong Kong, winds locally decreased in strength and the No. 8 Northeast Gale or Storm Signal was replaced by the Strong Wind Signal at 11.15 p.m. when Freda was 100 miles away to the southwest. At this time, Freda was passing about 30 miles to the south of Shangchuan Dao where a surface wind of 48 knots and a minimum sea-level pressure of 997.4 millibars were reported. Freda crossed the south China coast near Yangjiang about 140 miles west-southwest of Hong Kong shortly after 2.00 a.m. on 25 September and degenerated into an area of low pressure to the north of the Luichow Peninsula within the next few hours. All signals were lowered at 5.10 a.m. on 25 September when Freda was 170 miles west-southwest of Hong Kong.

Freda was a fast-moving tropical cyclone and showed little changes in speed from the time it formed until it dissipated overland. This severe tropical storm contrasted sharply with Typhoon Dinah which throughout the previous week moved slowly and erratically in the South China Sea and had just begun dissipating over the South China Sea when Freda was developing.

Local winds were moderate to fresh northerly on 23 September but gradually increased in strength overnight and became generally strong by the next morning. The winds changed to easterly during the day and gale force winds were reported in many locations late in the afternoon and early in the evening. As Freda was moving rapidly away from Hong Kong, the gales subsided after 10.00 p.m. and by the next morning winds were moderate to fresh from the southeast. The maximum winds and maximum gusts recorded at various locations were as follows:

<i>Location</i>	<i>Maximum mean hourly wind in points and knots</i>		<i>Maximum gust in points and knots</i>	
Royal Observatory	ENE	30	ENE	55
Hong Kong Airport (SE)	E	36	E	65
Hong Kong Airport (NW)	E	26	ENE	66
Waglan Island	E	45	ENE	63
Tate's Cairn	ENE	42	ESE	72
Cheung Chau	ESE	40	ESE	62
King's Park	ESE	29	NE	60
Star Ferry	E	39	E	57
Green Island	ENE	48	NE	77
Tsim Bei Tsui	SE	26	SE	44
Tai O	E	38	E	64
Castle Peak	NNE	25	SE	41

The weather was generally fine on 23 September but became cloudy with occasional showers for the next three days. Temperatures were highest on 23 September when a maximum of 29.2°C was recorded at the Royal

Observatory. The minimum sea-level pressure at the Royal Observatory was 1000.5 millibars recorded at about 4.30 p.m. on 24 September when Freda was about 105 miles to the south. The daily rainfall amounts recorded at the Royal Observatory during the period 23–26 September were as follows:

September 23	Nil
September 24	25.2 mm
September 25	50.7 mm
September 26	12.8 mm
Total	88.7 mm

The times and heights of the highest tides and maximum storm surges recorded at various locations during the display of tropical cyclone warning signals were as follows:

Location	Highest Tide Above Chart Datum			Maximum Storm Surge Above Predicted Level		
	Height (m)	Date	Time	Height (m)	Date	Time
North Point	2.6	24 Sep	7.15 a.m.	0.7	24 Sep	10.00 p.m.
Tai Po Kau	2.7	24 Sep	8.00 p.m.	1.2	24 Sep	8.00 p.m.
Chi Ma Wan (Lantau Island)	3.0	24 Sep	8.15 p.m.	1.4	24 Sep	8.15 p.m.

No significant damage was reported during the passage of Freda. However, 37 people were injured by falling or flying objects and 11 of them were hospitalized. There were no reports of people being made homeless but 71 people sought refuge in typhoon shelters. Some minor flooding and landslips were reported in the New Territories. Several cases of scaffolding collapses were reported resulting in partial closure of some roads.

All public transport services were seriously disrupted on the afternoon of 24 September and many were suspended. Air traffic was drastically affected with 9 diversions and many flights cancelled or delayed. Two cargo ships broke their anchor chains but later moved safely to other moorings.

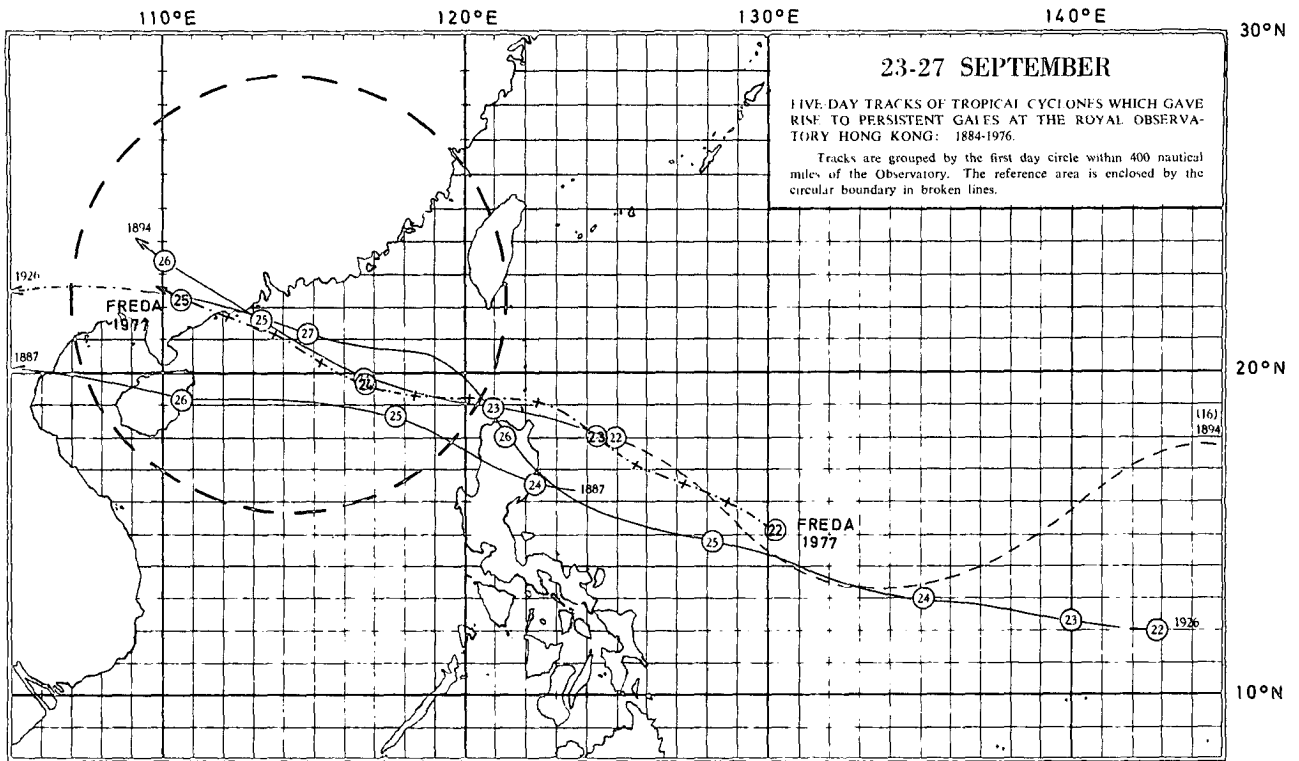


Figure 24. Track of Severe Tropical Storm Freda: 22-25 September 1977.

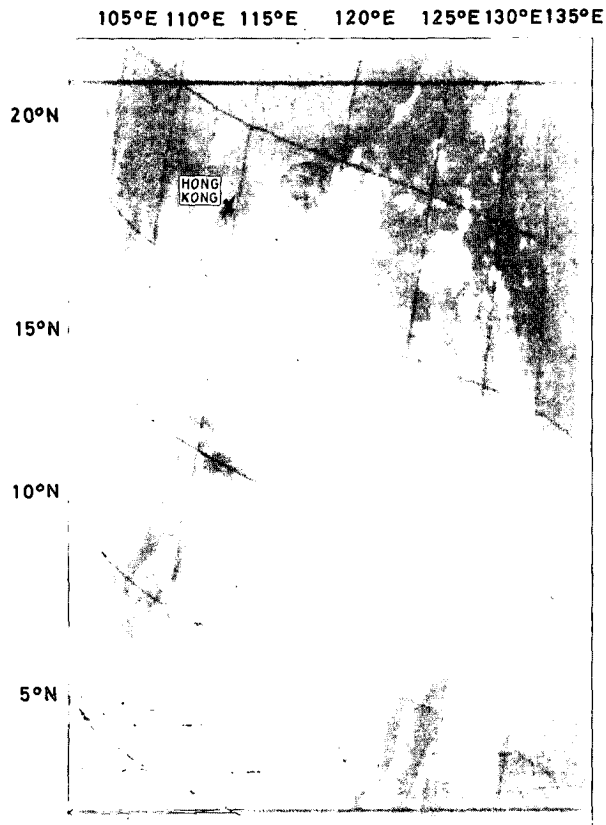


Figure 25. NOAA-5 APT picture of Severe Tropical Storm Freda taken from 8.13 p.m. to 8.21 p.m. on 23 September 1977.

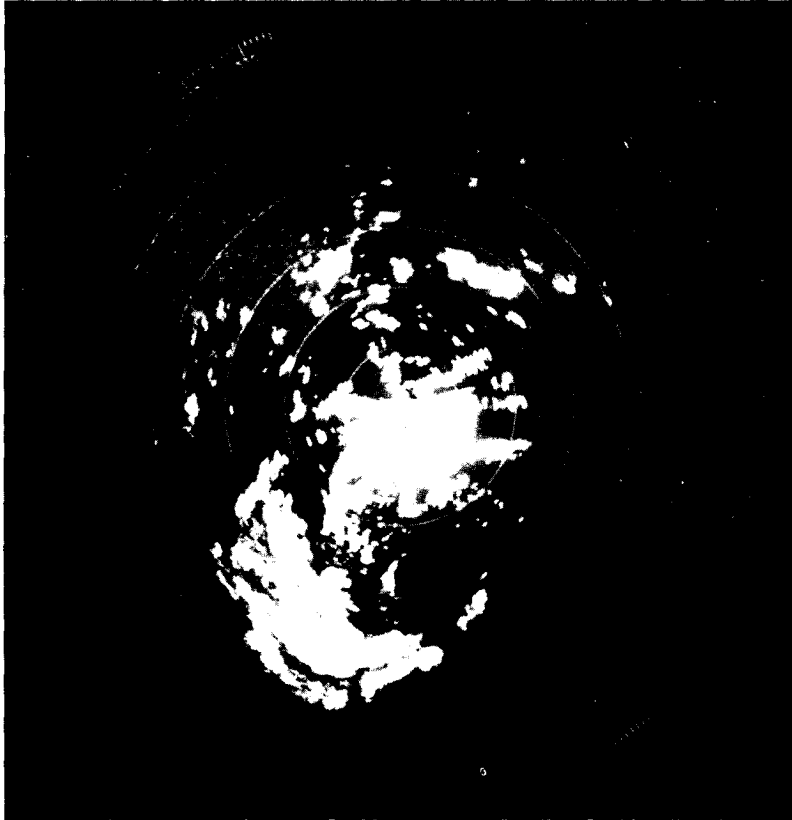


Figure 26. Radar picture of Severe Tropical Storm Freda taken at 3.00 p.m. on 24 September 1977. (Range markers at 40-mile intervals)

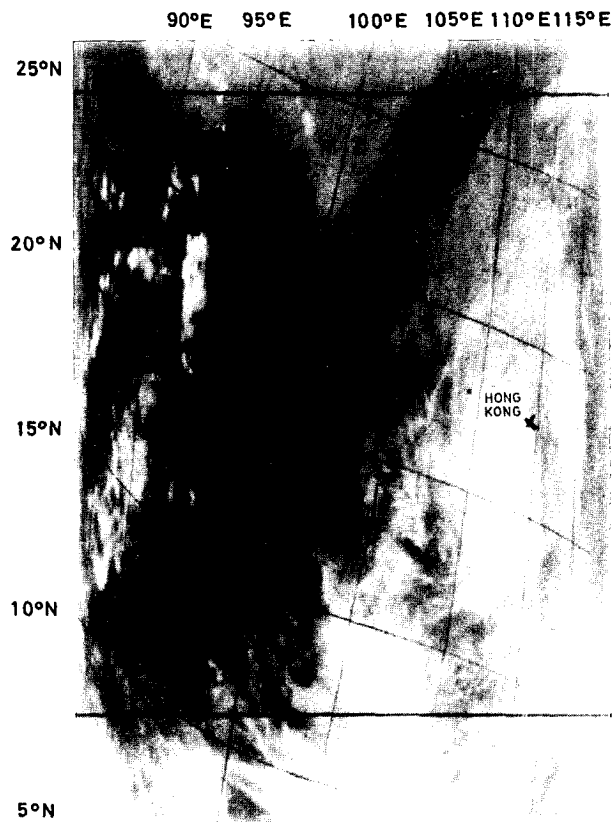


Figure 27. NOAA-5 APT picture of Severe Tropical Storm Freda taken from 9.27 p.m. to 9.35 p.m. on 24 September 1977.

TABLE 1. LIST OF TROPICAL CYCLONES IN THE WESTERN NORTH PACIFIC AND THE SOUTH CHINA SEA IN 1977

Name of Tropical Cyclone	Beginning of Track					First day circle	Last day circle	Ending of Track				
	Date	Time G.M.T.	Position		Date			Time G.M.T.	Position			
			°N	°E					°N	°E		
1 Tropical Storm Patsy*	27	Mar	1200	4.3	159.9	28	31	31	Mar	0000	10.0	149.7
2 Tropical Depression	26	May	0000	19.7	128.8	26	27	27	May	0600	25.6	131.7
3 Severe Tropical Storm Ruth	14	Jun	0000	15.7	117.3	14	17	17	Jun	1200	28.2	122.7
4 Tropical Depression	4	Jul	0000	16.0	116.5	4	6	6	Jul	0000	21.8	110.0
5 Typhoon Sarah	16	Jul	1200	10.4	128.4	17	21	21	Jul	1200	21.5	105.4
6 Typhoon Thelma	21	Jul	0000	14.9	130.0	21	25	25	Jul	1800	26.7	118.8
7 Typhoon Vera	27	Jul	1800	25.4	130.6	28	1	1	Aug	0600	25.1	118.1
8 Tropical Storm Wanda	31	Jul	0600	23.3	140.7	1	4	4	Aug	0600	31.6	146.9
9 Tropical Storm Amy	17	Aug	1200	19.0	129.0	18	25	25	Aug	0600	32.7	134.5
10 Typhoon Babe	2	Sep	0000	8.2	144.6	2	11	11	Sep	1800	30.9	119.3
11 Tropical Storm Carla	3	Sep	0000	18.2	114.9	3	5	5	Sep	0000	17.0	104.2
12 Typhoon Dinah	14	Sep	0000	20.6	131.5	14	24	24	Sep	0000	13.3	108.4
13 Severe Tropical Storm Emma	14	Sep	0600	18.5	142.5	15	20	20	Sep	0600	42.0	148.2
14 Severe Tropical Storm Freda	22	Sep	0000	15.0	130.2	22	25	25	Sep	0000	22.1	110.5
15 Typhoon Gilda	3	Oct	0000	16.5	156.0	3	9	9	Oct	1800	40.0	157.0
16 Severe Tropical Storm Harriet	16	Oct	0000	15.7	136.7	16	21	21	Oct	0000	30.9	147.6
17 Typhoon Ivy	21	Oct	0600	16.4	147.4	22	26	26	Oct	1800	32.5	159.4
18 Typhoon Jean	28	Oct	1200	19.3	156.9	29	3	3	Nov	1200	20.9	144.7
19 Typhoon Kim	6	Nov	0600	10.6	153.1	7	16	16	Nov	1800	22.0	124.8
20 Typhoon Lucy	28	Nov	0600	6.6	159.8	29	7	7	Dec	1800	22.3	152.0
21 Typhoon Mary*	27	Dec	0600	8.9	159.6	28	2	2	Jan	1800	10.4	123.4

N.B. * originated east of 160°E

TABLE 2. TROPICAL CYCLONE WARNINGS FOR SHIPPING ISSUED IN 1977

Tropical Cyclone	No. of Warnings Issued	Date and Time ⁺ of Issue of						Duration of Warnings (hours)
		First Warning			Last Warning			
Severe Tropical Storm Ruth*	30	14	Jun	0000	17	Jun	1800	90
Tropical Depression*	18	4	Jul	0000	6	Jul	0300	51
Typhoon Sarah*	36	17	Jul	0000	21	Jul	0600	102
Typhoon Thelma*	27	22	Jul	1800	26	Jul	0000	78
Typhoon Vera	15	30	Jul	1200	1	Aug	0900	45
Tropical Storm Amy*	35	19	Aug	0000	23	Aug	0600	102
Tropical Storm Carla*	15	3	Sep	0000	5	Sep	0000	48
Typhoon Dinah*	71	15	Sep	0600	24	Sep	0000	210
Severe Tropical Storm Freda*	17	23	Sep	0000	24	Sep	2100	45
Typhoon Kim	30	13	Nov	0300	16	Nov	1200	81
Total	294							852

* Tropical cyclone for which tropical cyclone warning signals were hoisted in Hong Kong

⁺ Times are given in hours G.M.T.

TABLE 3. TROPICAL CYCLONE WARNING SIGNALS HOISTED IN HONG KONG AND NUMBER OF WARNING BULLETINS ISSUED IN 1977

SUMMARY

Signal	No. of Occasions	Total Duration	
1	8	270 h	20 min
3	6	116	40
8 NORTHWEST	-	-	-
8 SOUTHWEST	-	-	-
8 NORTHEAST	1	8	10
8 SOUTHEAST	-	-	-
9	-	-	-
10	-	-	-
Total	15	395	10

DETAILS

Tropical cyclone	No. of Warning Bulletins Issued	Signal	Hoisted			Lowered		
			Date	Time*		Date	Time*	
Severe Tropical Storm Ruth	14	1	14	Jun	2230	16	Jun	1000
Tropical Depression	17	1	4	Jul	2235	5	Jul	1200
		3	5	Jul	1200	6	Jul	1110
Typhoon Sarah	21	1	19	Jul	0730	19	Jul	1115
		3	19	Jul	1115	21	Jul	0630
Typhoon Thelma	14	1	24	Jul	0900	25	Jul	1415
Tropical Storm Amy	23	1	20	Aug	1000	22	Aug	1200
Tropical Storm Carla	14	1	3	Sep	1015	3	Sep	1645
		3	3	Sep	1645	4	Sep	1250
Typhoon Dinah	66	1	16	Sep	1630	21	Sep	2110
		3	21	Sep	2110	22	Sep	1140
Severe Tropical Storm Freda	20	1	23	Sep	2205	24	Sep	0520
		3	24	Sep	0520	24	Sep	1505
		8 NE	24	Sep	1505	24	Sep	2315
		3	24	Sep	2315	25	Sep	0510

* Hong Kong Time

TABLE 4. FREQUENCY AND TOTAL DURATION OF DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS : 1946-1977

Year	Signals	1	3*	8 NW†	8 SW†	8 NE†	8 SE†	9	10	Total	Total Duration (hours)
1946		7	-	1	0	1	2	1	1	13	154
1947		6	-	1	0	1	0	0	0	8	124
1948		5	-	1	1	3	2	0	0	12	112
1949		4	-	0	0	1	1	1	0	7	67
1950		2	-	0	0	1	1	1	0	5	102
1951		4	-	0	0	2	3	1	0	10	133
1952		2	-	0	0	1	1	0	0	4	74
1953		2	-	1	1	2	1	1	0	8	116
1954		5	-	0	0	3	2	2	0	12	133
1955		0	-	0	0	0	0	0	0	0	0
1956		5	4	0	0	0	0	0	0	9	191
1957		4	9	1	1	2	2	0	1	20	296
1958		4	5	0	0	1	0	0	0	10	214
1959		1	1	0	0	0	0	0	0	2	37
1960		11	7	0	2	2	2	1	1	26	433
1961		6	7	1	2	1	0	1	1	19	193
1962		4	3	0	1	1	0	1	1	11	158
1963		4	5	0	0	1	0	0	0	10	176
1964		11	14	1	3	5	3	3	2	42	570
1965		7	6	0	0	1	1	0	0	15	240
1966		6	5	0	0	2	2	0	0	15	285
1967		8	6	0	0	2	1	0	0	17	339
1968		7	7	0	1	1	0	1	1	18	290
1969		4	2	0	0	0	0	0	0	6	110
1970		6	8	2	1	2	0	0	0	19	287
1971		9	10	1	3	2	2	1	1	29	323
1972		8	6	0	0	1	1	0	0	16	288
1973		8	6	1	1	1	0	1	0	18	417
1974		12	10	0	0	2	1	1	0	26	525
1975		8	6	1	0	0	1	1	1	18	292
1976		6	6	0	0	1	2	0	0	15	352
1977		8	6	0	0	1	0	0	0	15	395
Total		184	139	12	17	44	31	18	10	455	7426
Mean		5.8	6.3	0.4	0.5	1.4	1.0	0.6	0.3	14.2	232.1

* The Strong Wind Signal, No. 3, was introduced in 1956

† Gale or Storm Signals, 5, 6, 7 and 8 were renumbered as 8 NW, 8 SW, 8 NE, 8 SE respectively with effect from 1 January 1973

TABLE 5. NUMBER OF TROPICAL CYCLONES IN HONG KONG'S AREA OF RESPONSIBILITY AND THE NUMBER THAT NECESSITATED THE DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS IN HONG KONG : 1946-1977

YEAR	Number in Hong Kong's Area of Responsibility	Number Necessitating the Display of Signals in Hong Kong
1946	9	6
1947	21	6
1948	15	4
1949	16	4
1950	13	5
1951	12	7
1952	22	9
1953	19	6
1954	17	7
1955	14	3
1956	23	5
1957	12	6
1958	14	5
1959	19	2
1960	20	9
1961	22	6
1962	16	4
1963	13	4
1964	25	4
1965	16	10
1966	16	6
1967	16	6
1968	16	8
1969	12	6
1970	11	4
1971	21	6
1972	17	9
1973	14	5
1974	17	9
1975	21	11
1976	12	7
1977	10	5
1977	10	8
Total	515	198
Mean	16.1	6.2

TABLE 6. DURATION OF DISPLAY OF TROPICAL CYCLONE WARNING SIGNALS IN HONG KONG : 1946-1977

Signal	Duration for each occasion			Duration per year		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
1	19 h 00 min	124 h 40 min	1 h 20 min	109 h 18 min	273 h 15 min	0 h 0 min
3*	20 45	71 45	1 00	131 8	267 45	23 55
8 NW†	7 26	13 00	1 30	2 47	13 00	0
8 SW†	5 30	11 10	2 30	2 55	16 10	0
8 NE†	11 25	35 35	2 15	15 42	61 45	0
8 SE†	7 21	17 20	0 20	7 07	28 52	0
8	8 47	35 35	0 20	28 31	82 25	0
9	3 49	6 30	1 10	2 09	11 00	0
10	6 05	9 10	2 30	1 54	12 10	0

* 1956 - 1977

† Gale or Storm Signals, 5, 6, 7 and 8 were renumbered as 8NW, 8SW, 8NE and 8SE respectively with effect from 1 January 1973

TABLE 7. CASUALTIES AND DAMAGE CAUSED BY TROPICAL CYCLONES IN HONG KONG : 1937-1977

Year	Date	Name of Tropical Cyclone	Ocean-going Vessels in Trouble	Junks Sunk or Wrecked	Junks Damaged	Persons Dead	Persons Missing	Persons Injured
1937	1 - 2 Sep	Typhoon	28	545	1 255	11 000	*	*
1957	20 - 23 Sep	T. Gloria	5	2	Several	8	*	111
1960	4 - 12 Jun	T. Mary	6	352	462	11	11	127
1961	17 - 21 May	T. Alice	*	*	*	4	0	20
1962	28 Aug - 2 Sep	T. Wanda	36	1 297	756	130	53	*
1964	26 - 28 May	T. Viola	5	18	18	0	0	41
	2 - 9 Aug	T. Ida	3	7	60	5	4	56
	2 - 6 Sep	T. Ruby	20	32	282	38	6	300
	4 - 10 Sep	T. Sally	0	0	0	9	0	24
	7 - 13 Oct	T. Dot	2	31	59	26	10	85
1966	12 - 14 Jul	S.T.S. Lola	0	*	6	1	0	6
1968	17 - 22 Aug	T. Shirley	1	*	3	0	0	4
1970	1 - 3 Aug	T.D.	0	0	0	2 ⁺	0	0
	8 - 14 Sep	T. Georgia	2	0	*	0	0	0
1971	15 - 18 Jun	T. Freda	8	0	0	2	0	30
	16 - 22 Jul	T. Lucy	10	0	0	0	0	38
	10 - 17 Aug	T. Rose	33**	303	*	110	15	286
1972	4 - 9 Nov	T. Pamela	3	0	0	1	0	8
1973	14 - 20 Jul	T. Dot	14	*	*	1	0	38
1974	7 - 14 Jun	T. Dinah	1	*	*	0	0	0
	18 - 22 Jul	T. Ivy	2	*	*	0	0	0
	15 - 19 Oct	T. Carmen	4	*	*	1	0	0
	21 - 27 Oct	T. Della	1	*	*	0	0	0
1975	10 - 14 Aug	T.D.	2	1	*	2	1	0
	9 - 14 Oct	T. Elsie	5	3	*	0	0	46
	16 - 23 Oct	S.T.S. Flossie	1	*	*	0	0	0
1976	22 Jun - 4 Jul	T. Ruby	0	0	0	3	2	2
	21 - 26 Jul	S.T.S. Violet	0	0	0	2	1	1
	5 - 6 Aug	S.T.S. Clara	0	0	0	0	0	4
	21 - 24 Aug	P.S. Ellen	0	4	7	27	3	65
	15 - 21 Sep	T. Iris	5	0	1	0	0	27
1977	4 - 6 Jul	T.D.	0	0	0	0	0	2
	3 - 5 Sep	T.S. Carla	1	0	0	0	0	1
	22 - 25 Sep	S.T.S. Freda	2	0	0	1	0	37

N.B. Information compiled from Hong Kong newspapers and from the Marine Department's records

* Data unavailable

+ Struck by lightning

**Note: Number of Ocean-going vessels in trouble is revised on 30 Jul 2021.

TABLE 8. SHIPS SUNK, DAMAGED, GROUNDED, ETC., BY TROPICAL CYCLONES IN HONG KONG : 1974-1977

Year	Date	Name of Tropical Cyclone	Name of Ship	Location of Grounding, etc.	Nature of Incident	Remarks
1974	7-14 Jun	T. Dinah	S.S. Silver Shelton	Victoria Harbour	Adrift	Slight damage to both vessels
	18-22 Jul	T. Ivy	S.S. Asmari S.S. Hwalung	East of Tsing Yi Kellett Bank	Adrift Dragging Anchor	
	15-19 Oct	T. Carmen	S.S. Terryusan Maru S.S. Uniparagon S.S. Oriental Hero	Off Po Toi Island South of Stonecutters Island Southwest of Stonecutters Island	Dragging Anchor Adrift Adrift and in collision with S.S. Bright Sea Dragging Anchor	
	21-27 Oct	T. Della	S.S. Pearl Star S.S. Lela	Western Anchorage South of Stonecutters Island	Collision with S.S. Taolin	
1975	10-14 Aug	T.D.	S.S. Wuxi S.S. Hong Kong Truth	Hung Hom Ferry Pier Northwest of Stonecutters Island	Aground Adrift and in Collision with S.S. Dehua	Slight damage to S.S. Dehua .
	9-14 Oct	T. Elsie	S.S. Man Wah S.S. Sea Concord	Kowloon Bay Western Anchorage	Adrift Dragging anchor and in collision with S.S. Caribbean Sea	
			S.S. Yu Heng S.S. Teresa	North of West Point North of Lantau	Adrift Dragging anchor and in collision with S.S. Olympic Sky	
			S.S. Slidre	Northwest of Green Island	Adrift	
16-23 Oct	S.T.S. Flossie	S.S. Shinpoku Maru	Off Stonecutters Island	Aground		
1976	15-21 Sep	T. Iris	S.S. Olympic Dale S.S. United Glory S.S. Oriental Ruler S.S. Nantao S.S. Oceanic Constitution	Junk Bay Victoria Harbour Western Anchorage Western Anchorage	Aground Dragging Anchor Dragging Anchor Dragging Anchor Dragging Anchor and in collision with S.S. Oriental Empress	Causing damage to a fish breeding farm
1977	3-5 Sep	T.S. Carla	S.S. Eastern Mercury	Kowloon City Ferry Pier	Adrift	Collided with five other vessels
	22-25 Sep	S.T.S. Freda	S.S. Padma S.S. Lamboos Tsagliotis	Western Anchorage Western Anchorage	Dragging anchor Dragging anchor	

N.B. Information compiled from Hong Kong newspapers and from the Marine Department's records

TABLE 9. A SUMMARY OF METEOROLOGICAL OBSERVATIONS RECORDED IN HONG KONG DURING THE PASSAGES OF TROPICAL CYCLONES IN 1977

Name of tropical cyclone	Month	Nearest approach to Hong Kong							Minimum hourly M.S.L. pressure at the Royal Observatory			Maximum storm surge				
		Day	Time	Direction	Distance	Movement		Estimated minimum central pressure	Day	Time	Pressure	North Point	Tai Po Kau	Chi Ma Wan		
S.T.S. Ruth	Jun	16	0800	E	200	points	n miles	points	knots	mbar	Day	Time	mbar	m	m	m
Tropical Depression	Jul	06	0200	SW	190			N	10	985	16	1700	1003.7	0.2	0.3	0.3
T. Sarah	Jul	20	1830	SW	260			NW	17	990	05	1800	1001.1	0.4	0.8	0.5
T. Thelma	Jul	25	0400	E	310			WNW	11	960	20	0400	1000.5	0.5	0.9	0.9
T.S. Amy	Aug	21	2300	E	250			NE	10	960	25	1700	998.1	0.3	0.4	0.4
T.S. Carla	Sep	3	1400	S	240			SE	6	985	21	1600	996.8	0.4	0.5	0.5
T. Dinah	Sep	21	2100	SE	230			W	13	990	3	1800	1002.2	0.3	0.6	0.8
S.T.S. Freda	Sep	24	2000	SSW	80			SW	9	980	17	1600	1001.9	0.8	1.0	1.2
								WNW	16	985	24	1700	1001.1	0.7	1.2	1.4

TABLE 9. (CONT'D)

Name of tropical cyclone	Month	Maximum 60-min mean wind in points and knots		Maximum 10-min mean wind in points and knots		Maximum gust peak speed in points and knots		Rainfall at the Royal Observatory (mm)				
		Royal Observatory	Waglan Island	Royal Observatory	Waglan Island	Royal Observatory	Waglan Island	(i) 300 n mile	(ii) 24 hours	(iii) 48 hours	(iv) 72 hours	(1) + (iv)
S.T.S. Ruth	Jun	E 7	SSE 11	E 8	SSE 13	E 19	W 18	Trace	0.2	1.3	2.2	2.2
T.D.	Jul	E 18	E 27	E 20	E 29	E 41	E 43	32.4	41.2	48.8	48.8	81.2
T. Sarah	Jul	E 19	E 30	E 21	E 32	E 40	E 54	19.4	13.4	13.4	24.7	44.1
T. Thelma	Jul	WSW 15	W 18	WSW 16	W 20	SW 31	WSW 26	-	57.2	99.7	100.2	100.2
T.S. Amy	Aug	E 11	ESE 22	E 13	ESE 23	E 24	ESE 31	5.1	-	-	-	5.1
T.S. Carla	Sep	E 22	E 35	E 24	E 37	E 45	ESE 48	0.8	92.0	206.8	267.6	268.4
T. Dinah	Sep	N 15	N 26	N 16	N 27	N 32	E 38	8.0	-	-*	-	8.0
S.T.S. Freda	Sep	ENE 30	ENE 46	ENE 30	ENE 49	ENE 55	ENE 63	61.1	23.1	27.6	27.6	88.7

- N.B. (i) during the period when the tropical cyclone was centred within 300 n miles of Hong Kong
(ii) during the 24-hour period after the tropical cyclone moved outside (or dissipated within) the 300-n mile radius
(iii) during the 48-hour period after the tropical cyclone moved outside (or dissipated within) the 300-n mile radius
(iv) during the 72-hour period after the tropical cyclone moved outside (or dissipated within) the 300-n mile radius

* up to 0100 24 Sep 1977

All data, other than the rainfall, refer to the period when tropical cyclone warning signals were hoisted. Times are given in Hong Kong Time.

TABLE 10. TYPHOONS WHICH REQUIRED THE HOISTING OF THE HURRICANE SIGNAL NO. 10 DURING THE PERIOD 1946-1977

Name of typhoon	Date	Nearest approach to Royal Observatory in miles	Minimum M.S.L. pressure		Maximum 60-min mean winds in points and knots								Maximum gust in points and knots								
			Hourly	Inst.	Royal Observatory	Hong Kong Airport	Waglan Island	Cheung Chau	Tate's Cairn	Cape Collinson	Green Island	Castle Peak	Royal Observatory	Hong Kong Airport	Waglan Island	Cheung Chau	Tate's Cairn	Cape Collinson	Green Island	Castle Peak	
-	18 Jul 1946	S 37	985.7	-	NE -	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Gloria	22 Sep 1957	SW 30	986.2	984.3	ESE 62	ESE 39	E 61	-	-	-	-	-	E 101	ENE 86	ENE 100	-	-	-	-		
Mary	9 Jun 1950	WNW 5	974.3	973.8	SSE 52	SSE 50	SSW 60	-	-	-	-	-	SSE 103	SE 88	SSW 105	-	-	-	-		
Alice	19 May 1961	0	981.6	981.1	EWE 45	E 38	ESE 49	ENE 41	-	-	-	-	E 89	ENE 75	SW 69	ENE 73	-	-	-		
Wanda	1 Sep 1962	SSW 10	955.1	953.2	N 72	N 58	NW 80	NW 64	SE 102	-	-	-	N 140	N 123	NW 117	NW 125	ESE 154	-	-		
Riby	5 Sep 1964	SW 17	971.0	968.2	E 59	N 64	ENE 80	NE 61	ESE 90	SSE 83	-	-	NNE 122	NW 110	E 124	NNE 117	E 145	S 120	-		
Dot	13 Oct 1964	E 18	978.9	977.3	NNW 48	N 36	N 63	NNW 52	NNE 85	N 54	-	-	N 94	N 107	N 99	WNW 111	NE 119	NNE 101	-		
Shirley	21 Aug 1968	0	968.7	968.6	N 37	N 40	NNE 67	SSW 49	NNE 68	SSW 46	-	-	N 72	N 82	NE 113	SSW 90	NNE 110	N 93	-		
Rose	17 Aug 1971	WSW 11	984.5	982.8	SE 55	SE 66	ESE 76	SE 71	S 80	SSW 74	-	-	ESE 121	ESE 114	ESE 102	SE 105	S 120	S 103	-		
Elsie	14 Oct 1975	S 27	996.4	996.2	ENE 31	NNW 36	NNE 64	N 57	NE 70	-	-	NNW 64	N 35	NE 76	N 76	ENE 95	NE 86	NNE 97	-	NE 90	N 65

APPENDIX (1) SIX-HOURLY POSITIONS OF TROPICAL STORM PATSY

<i>Month</i>	<i>Day</i>	<i>Time</i> <i>G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Mar	27	1200	T.D.	4.3	159.9
		1800	T.D.	4.9	159.5
	28	0000	T.S.	5.8	159.0
		0600	T.S.	6.3	158.3
		1200	T.S.	6.8	157.5
		1800	T.S.	7.2	156.6
		0000	T.S.	7.9	155.2
29		0600	T.D.	8.3	154.4
		1200	T.D.	8.5	153.9
		1800	T.D.	8.8	153.3
		0000	T.D.	9.2	152.6
30		0600	T.D.	9.4	152.1
		1200	T.D.	9.6	151.6
		1800	T.D.	9.8	151.0
		0000	T.D.	10.0	149.7
31					

APPENDIX (2) SIX-HOURLY POSITIONS OF TROPICAL DEPRESSION (26-27 MAY)

<i>Month</i>	<i>Day</i>	<i>Time</i> <i>G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
May	26	0000	T.D.	19.7	128.8
		0600	T.D.	20.9	129.1
		1200	T.D.	22.0	129.5
		1800	T.D.	23.2	130.1
27		0000	T.D.	24.3	130.8
		0600	T.D.	25.6	131.7

APPENDIX (3) SIX-HOURLY POSITIONS OF SEVERE TROPICAL STORM RUTH

<i>Month</i>	<i>Day</i>	<i>Time</i> <i>G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>	
Jun	14	0000	T.S.	15.7	117.3	
		0600	T.S.	16.4	116.8	
		1200	T.S.	17.2	116.5	
		1800	T.S.	17.9	116.5	
	15		0000	S.T.S.	18.7	116.7
			0600	S.T.S.	19.4	117.1
			1200	S.T.S.	20.3	117.5
			1800	S.T.S.	21.2	117.7
	16		0000	S.T.S.	22.1	117.7
			0600	S.T.S.	23.1	118.0
			1200	T.S.	23.9	118.5
			1800	T.S.	25.3	119.3
17		0000	T.S.	26.5	119.9	
		0600	T.S.	27.6	121.0	
		1200	T.D.	28.2	122.7	

APPENDIX (4) SIX-HOURLY POSITIONS OF TROPICAL DEPRESSION (4-6 JULY)

<i>Month</i>	<i>Day</i>	<i>Time</i>		<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
		<i>G.M.T.</i>				
Jul	4	0000		T.D.	16.0	116.5
		0600		T.D.	16.4	116.1
		1200		T.D.	16.6	115.3
		1800		T.D.	17.0	114.7
	5	0000		T.D.	17.6	114.0
		0600		T.D.	18.2	113.5
		1200		T.D.	19.4	112.6
		1800		T.D.	20.6	111.3
	6	0000		T.D.	21.8	110.0

APPENDIX (5) SIX-HOURLY POSITIONS OF TYPHOON/SARAH

<i>Month</i>	<i>Day</i>	<i>Time</i>		<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
		<i>G.M.T.</i>				
Jul	16	1200		T.D.	10.4	128.4
		1800		T.D.	11.3	126.8
	17	0000		T.D.	12.4	125.6
		0600		T.D.	13.4	124.5
		1200		T.D.	13.9	123.4
		1800		T.S.	14.2	122.2
	18	0000		T.S.	14.6	121.2
		0600		T.S.	15.5	120.2
		1200		T.S.	16.6	119.4
		1800		T.S.	17.1	117.3
	19	0000		T.S.	17.1	115.3
		0600		S.T.S.	17.0	113.8
		1200		S.T.S.	17.0	113.1
		1800		S.T.S.	17.1	112.5
	20	0000		T.	17.6	111.9
		0600		T.	18.3	111.5
		1200		T.	19.3	110.7
		1800		S.T.S.	19.5	109.7
	21	0000		S.T.S.	20.0	108.6
		0600		S.T.S.	20.8	107.0
		1200		T.S.	21.5	105.4

APPENDIX (6) SIX-HOURLY POSITIONS OF TYPHOON THELMA

<i>Month</i>	<i>Day</i>	<i>Time</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
		<i>G.M.T.</i>			
Jul	21	0000	T.D.	14.9	130.0
		0600	T.D.	15.4	129.0
		1200	T.S.	15.7	128.2
		1800	T.S.	15.9	127.7
	22	0000	T.S.	16.2	127.2
		0600	T.S.	16.5	126.3
		1200	S.T.S.	16.8	125.5
		1800	S.T.S.	17.1	124.6
	23	0000	T.	17.6	123.9
		0600	T.	18.3	123.1
		1200	T.	18.9	122.2
		1800	T.	19.2	121.3
	24	0000	T.	19.5	120.7
		0600	T.	19.9	120.2
		1200	T.	20.5	119.6
		1800	T.	21.4	119.8
	25	0000	T.	22.3	120.3
		0600	T.	24.3	120.3
		1200	T.	25.2	119.7
		1800	T.S.	26.7	118.7

APPENDIX (7) SIX-HOURLY POSITIONS OF TYPHOON VERA

<i>Month</i>	<i>Day</i>	<i>Time</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
		<i>G.M.T.</i>			
Jul	27	1800	T.D.	25.4	130.6
		0000	T.D.	25.4	130.3
	28	0600	T.S.	25.3	129.8
		1200	T.S.	25.2	129.3
		1800	T.S.	25.1	128.7
		0000	S.T.S.	24.9	128.2
		0600	S.T.S.	24.6	127.4
		1200	S.T.S.	24.0	126.4
	29	1800	T.	23.4	126.0
		0000	T.	23.3	125.7
		0600	T.	23.4	125.4
		1200	T.	23.7	125.0
	30	1800	T.	24.0	124.3
		0000	T.	24.4	123.8
		0600	T.	25.0	122.8
		1200	T.	24.9	121.3
		1800	T.	24.8	120.2
	31	0000	T.	24.9	119.2
		0600	T.S.	25.1	118.1
0600		T.S.	25.1	118.1	
Aug	1	0000	T.	24.9	119.2
		0600	T.S.	25.1	118.1

APPENDIX (8) SIX-HOURLY POSITIONS OF TROPICAL STORM WANDA

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Jul	31	0600	T.D.	23.3	140.7
		1200	T.D.	23.8	140.5
		1800	T.D.	24.7	140.3
Aug	1	0000	T.S.	25.6	140.2
		0600	T.S.	26.3	140.1
		1200	T.S.	26.7	140.1
	2	1800	T.S.	27.4	140.2
		0000	T.S.	27.8	140.7
		0600	T.D.	28.4	141.5
	3	1200	T.D.	29.0	142.7
		1800	T.D.	29.4	143.6
		0000	T.D.	29.7	144.1
	4	0600	T.D.	30.2	144.9
		1200	T.D.	30.6	145.7
		1800	T.D.	31.0	146.2
		0000	T.D.	31.3	146.5
		0600	T.D.	31.6	146.9

APPENDIX (9) SIX-HOURLY POSITIONS OF TROPICAL STORM AMY

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Aug	17	1200	T.D.	19.0	129.0
		1800	T.D.	19.6	128.6
	18	0000	T.D.	20.1	127.9
		0600	T.D.	20.5	127.2
		1200	T.D.	20.9	126.3
	19	1800	T.D.	21.3	125.6
		0000	T.D.	21.7	124.9
		0600	T.S.	22.2	124.2
	20	1200	T.S.	22.3	123.4
		1800	T.S.	22.0	122.5
		0000	T.S.	21.5	121.8
	21	0600	T.S.	20.9	120.5
		1200	T.S.	21.4	119.8
		1800	T.S.	20.4	118.8
	22	0000	T.S.	20.4	118.3
		0600	T.S.	21.4	119.4
		1200	T.S.	22.5	119.0
	23	1800	T.S.	21.9	118.9
		0000	T.S.	22.2	120.0
		0600	T.S.	23.9	119.9
	24	1200	T.S.	26.0	121.8
		1800	T.S.	27.2	123.0
		0000	T.S.	28.6	123.7
	25	0600	T.S.	29.8	124.7
		1200	T.S.	31.0	127.0
		1800	T.S.	31.9	128.2
			0000	T.S.	32.2
0600			T.S.	32.2	131.1
1200			T.S.	32.5	132.2
		1800	T.S.	32.7	133.1
		0000	T.D.	32.8	133.7
		0600	T.D.	32.7	134.5

APPENDIX (10) SIX-HOURLY POSITIONS OF TYPHOON BABE

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Sep	2	0000	T.D.	8.2	144.6
		0600	T.S.	8.4	142.8
		1200	T.S.	8.7	141.2
		1800	T.S.	9.3	139.8
	3	0000	T.S.	9.7	138.8
		0600	T.S.	10.3	137.7
		1200	T.S.	10.6	136.7
		1800	T.S.	10.7	135.7
	4	0000	T.S.	10.8	134.8
		0600	S.T.S.	10.8	134.0
		1200	S.T.S.	10.9	133.2
		1800	S.T.S.	10.9	132.4
	5	0000	S.T.S.	11.0	131.6
		0600	S.T.S.	11.0	131.0
		1200	S.T.S.	11.7	130.6
		1800	S.T.S.	12.3	130.3
	6	0000	T.	13.2	130.0
		0600	T.	14.1	129.7
		1200	T.	15.0	129.3
		1800	T.	15.7	128.9
	7	0000	T.	16.6	128.6
		0600	T.	17.7	128.2
		1200	T.	18.5	127.8
		1800	T.	19.4	127.4
	8	0000	T.	20.4	127.1
		0600	T.	21.3	126.8
		1200	T.	22.1	127.0
		1800	T.	22.7	127.4
	9	0000	T.	23.7	128.0
		0600	T.	25.1	128.6
		1200	T.	27.0	128.9
		1800	T.	29.1	127.9
	10	0000	T.	30.5	125.7
		0600	T.	31.0	124.4
		1200	T.	31.4	123.4
		1800	T.	31.5	122.5
11	0000	S.T.S.	31.6	121.7	
	0600	T.S.	31.4	120.9	
	1200	T.S.	31.2	120.0	
	1800	T.D.	30.9	119.3	

APPENDIX (11) SIX-HOURLY POSITIONS OF TROPICAL STORM CARLA

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Sep	3	0000	T.D.	18.2	114.9
		0600	T.S.	18.3	114.0
		1200	T.S.	18.2	112.7
		1800	T.S.	17.8	111.5
	4	0000	T.S.	17.8	110.3
		0600	T.S.	17.9	109.6
		1200	T.S.	18.1	108.6
		1800	T.S.	18.2	106.5
	5	0000	T.D.	17.0	104.2

APPENDIX (12) SIX-HOURLY POSITIONS OF TYPHOON DINAH

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Sep	14	0000	T.D.	20.6	131.5
		0600	T.D.	20.5	129.8
		1200	T.D.	20.2	128.2
		1800	T.D.	19.7	126.8
	15	0000	T.S.	19.3	125.3
		0600	S.T.S.	18.8	123.7
		1200	T.	18.2	122.6
		1800	T.	17.7	121.2
	16	0000	T.	17.4	120.1
		0600	T.	17.3	119.2
		1200	T.	17.2	118.3
		1800	T.	17.3	117.7
	17	0000	T.	17.3	117.2
		0600	T.	17.3	116.5
		1200	T.	17.7	116.1
		1800	T.	17.9	116.6
	18	0000	T.	18.0	117.2
		0600	T.	18.4	117.6
		1200	T.	18.9	117.9
		1800	T.	19.3	118.1
	19	0000	T.	19.7	118.3
		0600	T.	19.8	118.6
		1200	T.	19.9	118.8
		1800	T.	20.0	119.0
	20	0000	T.	20.1	119.2
		0600	T.	20.2	119.4
		1200	T.	20.2	119.2
		1800	T.	20.1	118.9
	21	0000	T.	20.1	118.6
		0600	T.	19.8	117.8
		1200	T.	19.4	117.0
		1800	T.	18.8	116.5
	22	0000	S.T.S.	18.2	115.7
		0600	S.T.S.	17.8	114.8
		1200	S.T.S.	17.1	113.9
		1800	S.T.S.	16.4	113.3
	23	0000	S.T.S.	15.6	112.5
		0600	S.T.S.	14.8	111.7
		1200	T.S.	14.2	110.5
		1800	T.D.	13.8	109.5
	24	0000	T.D.	13.3	108.4

APPENDIX (13) SIX-HOURLY POSITIONS OF SEVERE TROPICAL STORM EMMA

<i>Month</i>	<i>Day</i>	<i>Time</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
		<i>G.M.T.</i>			
Sep	14	0600	T.D.	18.5	142.5
		1200	T.D.	19.0	142.4
		1800	T.D.	19.5	142.4
	15	0000	T.S.	20.2	142.5
		0600	T.S.	21.7	143.1
		1200	S.T.S.	23.1	143.5
	16	1800	S.T.S.	23.7	143.7
		0000	S.T.S.	24.5	143.9
		0600	S.T.S.	25.3	144.1
	17	1200	S.T.S.	25.8	144.3
		1800	S.T.S.	26.5	144.5
		0000	S.T.S.	27.4	144.5
	18	0600	S.T.S.	27.8	144.1
		1200	S.T.S.	28.3	143.6
		1800	S.T.S.	28.4	143.0
	19	0000	S.T.S.	28.7	142.3
		0600	S.T.S.	29.3	141.5
		1200	S.T.S.	30.0	140.6
	20	1800	S.T.S.	31.3	140.2
		0000	S.T.S.	32.4	140.3
		0600	S.T.S.	34.0	140.8
	20	1200	S.T.S.	35.3	142.0
		1800	S.T.S.	36.7	143.8
		0000	T.S.	39.1	146.2
		0600	T.S.	42.0	148.2

APPENDIX (14) SIX-HOURLY POSITIONS OF SEVERE TROPICAL STORM FREDA

<i>Month</i>	<i>Day</i>	<i>Time</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
		<i>G.M.T.</i>			
Sep	22	0000	T.D.	15.0	130.2
		0600	T.D.	15.9	128.6
		1200	T.D.	16.4	127.1
		1800	T.D.	17.0	125.5
	23	0000	T.S.	17.9	124.2
		0600	T.S.	18.9	122.2
		1200	S.T.S.	19.1	120.0
	24	1800	S.T.S.	19.2	118.2
		0000	S.T.S.	19.5	116.6
		0600	S.T.S.	20.2	115.1
	25	1200	S.T.S.	21.1	113.6
		1800	T.S.	21.6	112.0
		0000	T.D.	22.1	110.5

APPENDIX (15) SIX-HOURLY POSITIONS OF TYPHOON GILDA

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Oct	3	0000	T.D.	16.5	156.0
		0600	T.D.	16.7	156.4
		1200	T.D.	17.3	156.5
		1800	T.D.	18.0	156.3
	4	0000	T.D.	18.4	155.9
		0600	T.S.	18.8	155.3
		1200	T.S.	19.4	154.5
		1800	T.S.	20.0	153.6
	5	0000	S.T.S.	20.4	152.8
		0600	T.	21.0	152.0
		1200	T.	21.6	151.0
		1800	T.	22.3	150.2
	6	0000	S.T.S.	22.9	149.6
		0600	S.T.S.	23.6	149.0
		1200	S.T.S.	24.3	148.4
		1800	S.T.S.	25.2	147.9
	7	0000	S.T.S.	26.0	147.6
		0600	S.T.S.	27.1	147.2
		1200	S.T.S.	28.2	147.0
		1800	S.T.S.	29.5	146.9
	8	0000	T.	30.6	147.3
		0600	T.	31.9	148.2
		1200	T.	33.2	149.2
		1800	S.T.S.	34.4	150.4
	9	0000	S.T.S.	35.5	151.6
		0600	S.T.S.	36.8	153.0
		1200	S.T.S.	38.3	154.9
		1800	T.S.	40.0	157.0

APPENDIX (16) SIX-HOURLY POSITIONS OF SEVERE TROPICAL STORM HARRIET

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Oct	16	0000	T.D.	15.7	136.7
		0600	T.D.	15.7	135.3
		1200	T.D.	15.8	134.2
		1800	T.D.	16.5	133.1
	17	0000	T.S.	17.4	132.6
		0600	T.S.	17.4	132.1
		1200	T.S.	17.4	131.8
		1800	T.S.	18.1	132.3
	18	0000	T.S.	19.2	132.6
		0600	S.T.S.	20.4	132.6
		1200	S.T.S.	22.0	133.2
		1800	S.T.S.	23.7	133.9
	19	0000	S.T.S.	25.4	134.8
		0600	S.T.S.	26.8	136.0
		1200	S.T.S.	27.9	137.2
		1800	S.T.S.	28.8	138.5
	20	0000	S.T.S.	29.3	139.6
		0600	T.S.	29.7	141.0
		1200	T.S.	30.1	142.8
		1800	T.S.	30.5	145.2
	21	0000	T.S.	30.9	147.6

APPENDIX (17) SIX-HOURLY POSITIONS OF TYPHOON IVY

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Oct	21	0600	T.D.	16.4	147.4
		1200	T.D.	16.8	147.2
		1800	T.D.	17.0	146.8
	22	0000	T.D.	17.0	146.6
		0600	T.S.	16.9	146.4
		1200	T.S.	16.9	146.2
	23	1800	T.S.	17.3	146.3
		0000	T.S.	17.7	146.8
		0600	T.S.	18.1	147.3
	24	1200	S.T.S.	19.2	147.9
		1800	S.T.S.	20.5	148.9
		0000	T.	21.2	150.3
	25	0600	T.	21.7	151.7
		1200	T.	22.9	152.4
		1800	T.	24.1	153.2
	26	0000	T.	25.4	154.0
		0600	T.	26.4	154.7
		1200	T.	27.4	155.4
	26	1800	T.	28.5	156.1
		0000	T.	29.5	156.8
		0600	T.	30.5	157.5
	26	1200	T.	31.5	158.5
		1800	T.	32.5	159.4

APPENDIX (18) SIX-HOURLY POSITIONS OF TYPHOON JEAN

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>
Oct	28	1200	T.D.	19.3	156.9
		1800	T.D.	19.7	156.5
	29	0000	T.S.	20.3	156.2
		0600	S.T.S.	20.7	156.2
		1200	S.T.S.	21.3	156.6
	30	1800	T.	22.1	157.0
		0000	T.	22.8	157.1
		0600	T.	23.3	157.5
	31	1200	S.T.S.	23.5	157.8
		1800	T.S.	23.8	157.3
		0000	T.S.	24.0	156.3
	31	0600	T.S.	24.3	155.2
		1200	T.D.	24.9	153.5
		1800	T.D.	25.5	151.7
	Nov	1	0000	T.D.	26.0
0600			T.D.	26.1	149.7
1200			T.D.	26.3	149.2
2		1800	T.D.	26.4	148.8
		0000	T.D.	26.6	148.3
		0600	T.D.	26.8	147.7
3		1200	T.D.	26.9	147.0
		1800	T.D.	26.8	146.6
		0000	T.D.	26.6	146.1
3		0600	T.D.	26.3	145.5
		1200	T.D.	20.9	144.7

APPENDIX (19) SIX-HOURLY POSITIONS OF TYPHOON KIM

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>	
Nov	6	0600	T.D.	10.6	153.1	
		1200	T.D.	11.2	152.3	
		1800	T.D.	11.7	151.5	
	7	0000	T.D.	12.2	150.8	
		0600	T.D.	12.5	150.0	
		1200	T.D.	12.8	149.1	
	8	1800	T.S.	13.0	148.1	
		0000	T.S.	13.1	147.1	
		0600	S.T.S.	13.3	145.8	
	9	1200	S.T.S.	13.5	144.4	
		1800	T.	13.9	143.1	
		0000	T.	14.0	141.7	
	10	0600	T.	14.2	140.1	
		1200	T.	14.6	138.5	
		1800	T.	15.0	137.0	
	11	0000	T.	15.0	135.3	
		0600	T.	14.8	134.1	
		1200	T.	14.6	133.2	
	12	1800	T.	14.6	132.3	
		0000	T.	14.6	131.6	
		0600	T.	14.6	130.9	
	13	1200	T.	14.6	130.2	
		1800	T.	14.6	129.6	
		0000	T.	14.6	128.9	
	14	0600	T.	14.5	128.1	
		1200	T.	14.4	127.3	
		1800	T.	14.3	126.3	
	15	0000	T.	14.5	125.2	
		0600	T.	14.7	124.1	
		1200	T.	14.8	123.0	
	16	1800	T.	14.8	121.8	
		0000	T.	15.0	120.5	
		0600	T.	15.2	119.2	
	17	1200	S.T.S.	15.6	118.5	
		1800	S.T.S.	16.1	118.3	
		0000	T.S.	16.5	118.2	
	18	0600	T.S.	17.0	118.1	
		1200	T.S.	17.4	118.2	
		1800	T.S.	18.2	118.8	
	19	0000	T.S.	19.0	119.5	
		0600	T.D.	19.8	120.8	
		1200	T.D.	20.8	122.7	
			1800	T.D.	22.0	124.8

APPENDIX (20) SIX-HOURLY POSITIONS OF TYPHOON LUCY

<i>Month</i>	<i>Day</i>	<i>Time G.M.T.</i>	<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>	
Nov	28	0600	T.D.	6.6	159.8	
		1200	T.D.	6.4	158.3	
		1800	T.D.	6.6	157.0	
	29	0000	T.D.	6.7	156.0	
		0600	T.D.	6.9	155.0	
		1200	T.D.	7.0	154.0	
	30	1800	T.D.	7.1	152.7	
		0000	T.D.	7.1	151.1	
		0600	T.D.	7.2	149.3	
	Dec	1	1200	T.D.	7.3	147.0
			1800	T.D.	7.6	144.7
			0000	T.D.	7.8	142.6
2		0600	T.S.	8.7	140.4	
		1200	T.S.	9.8	138.7	
		1800	T.S.	10.7	137.0	
3		0000	T.S.	11.4	135.3	
		0600	S.T.S.	11.7	134.3	
		1200	S.T.S.	12.1	133.3	
4		1800	S.T.S.	12.4	132.4	
		0000	T.	12.8	131.4	
		0600	T.	13.1	130.5	
5		1200	T.	13.5	129.9	
		1800	T.	14.0	129.3	
		0000	T.	14.6	128.7	
6		0600	T.	15.4	128.5	
		1200	T.	16.7	128.7	
		1800	T.	17.9	129.2	
7		0000	T.	19.0	130.0	
		0600	T.	20.1	131.0	
		1200	T.	21.3	132.2	
8		1800	T.	22.0	133.9	
		0000	T.	22.1	135.8	
		0600	T.	22.2	138.1	
9	1200	T.	22.3	140.3		
	1800	S.T.S.	22.4	142.6		
	0000	S.T.S.	22.5	144.8		
10	0600	T.S.	22.5	147.0		
	1200	T.S.	22.5	149.4		
	1800	T.D.	22.3	152.0		

APPENDIX (21) SIX-HOURLY POSITIONS OF TYPHOON MARY

<i>Month</i>	<i>Day</i>	<i>Time</i>		<i>Intensity</i>	<i>Lat. °N</i>	<i>Long. °E</i>	
		<i>G.M.T.</i>					
Dec	27	0600		T.S.	8.9	159.6	
		1200		T.S.	8.7	157.4	
		1800		T.S.	8.9	155.4	
	28	0000		T.S.	9.4	153.7	
		0600		T.S.	10.2	152.0	
		1200		T.S.	11.0	150.5	
	29	1800		T.S.	11.2	149.2	
		0000		T.S.	11.2	148.3	
		0600		T.S.	11.2	146.8	
	30	1200		T.S.	11.1	145.4	
		1800		T.S.	10.9	144.0	
		0000		T.S.	10.4	142.7	
	31	0600		T.S.	10.1	141.6	
		1200		T.S.	10.1	140.4	
		1800		T.S.	10.2	139.0	
	Jan (1978)	1	0000		T.S.	10.0	137.5
			0600		T.S.	9.5	136.1
			1200		T.S.	9.4	134.8
2		1800		T.S.	9.5	133.4	
		0000		T.S.	9.8	132.0	
		0600		T.S.	10.0	130.5	
		1200		T.S.	10.0	129.0	
		1800		T.D.	10.0	127.6	
		0000		T.D.	10.1	126.4	
	0600		T.D.	10.2	125.5		
	1200		T.D.	10.3	124.3		
	1800		T.D.	10.4	123.4		

N.B. Typhoon Mary originated east of 160°E.